The Changing Size and Shape of Australian Women.

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This thesis was undertaken within the Department of Anatomical Sciences at The University of Adelaide in fulfilment of the requirement of the degree of Master of Medical Science.

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Candidate's Declaration.

Thesis Title: **The Changing Size and Shape of Australian Women.**

Candidate's name: **Kathleen M Berry.**

I declare that this thesis is the result of my own research and that it does not incorporate without acknowledgement material submitted for a degree or diploma in any University and that it does not contain any material previously published, written or produced by another person except where due reference is made in the text.

Signed.

Date. 13th NOV 2001

Name: K M Berry **Course: Master of Medical Science**

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"Some have likened this task to moving mountains, parting the seas and other unnatural acts of God. Who would be adventurous enough to tackle the task of updating anthropometric data bases?"

Stokes 1997: p 22.

Abstract

This study investigates body size and shape of present-day Australian women. The need for such investigations results from the fact that secular trends in body size and shape change these characteristics every few decades. As body size and shape change, there is a need to update metric data used for clothing design. Morphometric photographs and measurements of 38 anthropometric characteristics were taken of 163 women aged from 18 to 82 years coming from various socio-economic circumstances. Their average body height and weight matched Australian Bureau of Statistics data for South Australian women. The anthropometric characteristics were selected for their usefulness in the clothing industry. In comparison with earlier studies of adult Australian women, especially the one conducted in 1926-28 by Berlei, the participants of the present study were only slightly taller (about 11 mm), but much heavier (about 6 kg); this produced an average Body Mass Index of 24.7. Participants also differed from British and American women. These findings indicate a need for an anthropometric survey of Australian women to provide current data for industrial purposes. As a pilot study to this end averages and standard deviations of all 36 anthropometric dimensions and weight were tabulated. Furthermore, based on standard morphometric photographs of anterior, posterior and the lateral aspect of standing women, five body types were identified. They resemble the letters of the alphabet I, A, H, X and XH. For each figure type basic anthropometric dimensions were tabulated. This study can be considered a pilot study for a larger, fully representative anthropometric survey but its results already show an occurrence of a significant trend towards overweight.

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To my late mother, father and sisters; I feel that you have travelled this journey with me thank you.

To all who have assisted in my spiritual growth, without your guidance this thesis would not have been written.

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Chapter 1: Introduction.

Biological characteristics of the human body.

Biological characteristics of the human body size and shape have, over the centuries undergone a number of clearly visible changes. Studies in relation to changes in biological characteristics of human beings are important as they provide a valuable source of data in the areas of: medicine, biology, industrial design and ergonomics, work place management and national clothing size standards for the civilian population and the armed forces. Studies associated with biological changes in relation to human size and shape have over the centuries played a major role in the improvement of human health and welfare. Numerous studies have shown an increase in height and weight of some populations over the last century. Improvements in health, welfare, nutrition, and lifestyle may have contributed to these changes.

At the present time there is a scarcity of data on the current size and shape of Australian women. Various studies indicate that there has been some increase in height and much increase in weight of Australian women over the past few decades (Australian Bureau of Statistics 1995 (A.B.S.), National Health and Medical Research (N.H.M.R.C.) 1997, Australian Institute of Health and Welfare (A.I.H.W.) 1998).

Some researchers believe that improved living conditions and nutrition may have contributed to the overall increase in height, however, there is an alarming increase in overweight and obesity both in Australia and in overseas countries (W.H.O. 1998). The World Health Organisation (W.H.O.1995) provides a grading system to express various degrees of overweight. This grading system is used as a diagnostic tool in the assessment of health, particularly in relation to weight and various degrees of overweight and obesity. Changes in body composition and fat distribution appear to be an indicator of health problems and disease. Body Mass Index (B.M.I) is an indicator of morbidity (Boyd 1980). Another indicator of morbidity is Conicity Index (C.I.), which acts as an indicator of overweight and obesity, particularly in the abdominal region (Valdez 1991).

As well as overweight and obesity becoming a major health concern, various studies now show that there is an alarming increase in the occurrence of bulimia and anorexia nervosa

among young women (Cross 1997). Numerous studies now show that young people are reducing food intake at an age that may affect their growth and development (Buist 2000). The changes in body size and shape may over time have serious health implications for the population. As well as health implications, body size and shape play a major role in the design and production of clothing.

Mass-produced garments are made to fit the majority of people and are produced in graded series of sizes. Since human body dimensions change allometrically, various "sizes" of a garment must differ in shape. Most developed nations conducted large anthropometric surveys collecting data relevant for garment sizing. These data were then used to provide numerical descriptions of clothing "sizes" which are variously labelled, for the use of retailers and consumers. In Australia "size" labels are numerical, starting from size 8 and ending with size 26 with the most common adult sizes being 10, 12, 14. These sizes, however, are not based on a survey of the Australian population.

At the present time no scientific study has been conducted on changes of body size and shape in the Australian population. Furthermore, no scientific study has been conducted in Australia suitable for clothing size standards. The Australian Clothing Size Standard developed in 1959 was derived from data of American women taken in the 1940s. These data, with minor adjustments, are still being used today as a guide for the manufacture and production of Australian garments (Australian Standards 1997). Up to the present time most surveys that have been conducted in Australia have been mainly concerned with health issues. To ascertain the present size and shape of Australian women as required for garment construction and to determine if any secular trends have occurred, this study uses anthropometry, together with the study of typology, on a small sample of adult women. This should be treated as a pilot study for a future full anthropometric survey.

Objectives of the thesis.

The thesis aims firstly to identify the changing size and shape of Australian women by comparing previous studies on changes in human biological characteristics in relation to size and shape of the human body with new data obtained by measuring Australian women. The second aim is to assess the implications of these findings for current data used in the clothing design and production industry.

These aims were investigated by exploring four key questions:

1 What changes in human biological characteristics in relation to body size and shape have taken place in Australia during the past century?

2 What are the differences if any, in the size and shape of present day Australian women compared with women from some overseas countries?

3 In what way do the changes in biological characteristics impact on currently used standards for the design of women's clothing?

4 What are the implications of human biological changes for the clothing design and production industry of women's ready-made clothing?

Presentation of the thesis.

The remainder of the thesis is presented using the following chapter headings:

Chapter 2 Literature Review: an analysis of the current knowledge of the topic.

Chapter 3 Materials and Methods used for the Research.

Chapter 4 Results of this Research.

Chapter 5 Discussion and Comparison of this Research with other Studies.

Chapter 6 Conclusion and Implications.

The literature review (Chapter 2) follows the objectives as outlined above. Literature relevant to changes in biological characteristics of size and shape of the human body, morphology, typology, anthropometry, secular trends, clothing size standards and clothing surveys is reviewed. The literature review provides a focus for a theoretical and practical framework for the thesis.

Chapter 2: Literature Review.

Introduction.

This literature review demonstrates various changes in human biological characteristics, in particular size and shape, that have taken place over the past century. The analysis of the literature in relation to these changes highlights concerns about health and welfare issues, as well as concerns regarding the present day data used in the clothing design and production industry which constitute, however, the main purpose of this study.

Anthropometry.

Anthropometry as a science provides the quantitative tool for the description of the size and shape of the human body. The term anthropometry dates back to the times of Alberti in the 14th century and Elsholtz in the 16th century. According to Tanner (1981) Elsholtz was the first medical person to place importance on measuring the human body. Other disciplines such as biology, psychology, health and fitness, also use anthropometry as a tool to measure physiological responses or psychological characteristics. Some of these are mobility and strength (Hertzberg 1963), psychological characteristics (Sheldon 1970), and body composition, and percentages of various tissues (such as muscle and adipose tissue) and characteristics such as intelligence (Norgan 1994). Although Norgan states that anthropometry may be associated with physiological traits, he puts forward the view that anthropometry is associated with a more comparative study of body size and proportion as well as the description of external shape. Lasker (1994) on the other hand, applies a broader concept to the use of anthropometry. He believes that anthropometry is suitable for and adaptable to scientific and applied problems of human biology, which include; growth and evolution, cultural factors such as design, clothing, equipment, forensic identification, physical fitness, genetic and environmental aspects associated with physique.

Another application of anthropometry is the assessment of health, physical fitness, and human engineering for the civilian population and for military personnel. The armed forces use anthropometry for factors such as recruiting, accession, retention, and occupation training for personnel, protective clothing and equipment and other military hardware (Gordon and Friedl 1994).

Another point of view on the emergence of anthropometry is that anthropometry was not born from the fields of medicine and science but from the artistic field influenced by the Pythagorean philosophy (Tanner 1981). Tanner expressed the view that artists, painters and sculptors required knowledge about the proportions of the human body for the purpose of creating life-like human images.

It appears that anthropometry is used in a wide variety of studies and disciplines. This study, however, uses anthropometry as a scientific tool in the study of the changing size and shape of Australian women-hence it is essential that scientific theories and practice be applied.

As anthropometry is a branch of science, it seems appropriate that at this point a brief discussion in relation to scientific theories and practice is inserted. According to Delbridge *et al.* (1999) the term science comes from the Latin word *scientia,* which means knowledge that is associated with a particular branch of knowledge that provides reproducible observations and measurements of events. Sherwood (1949) defines science as knowledge that is obtained by making accurate observations, which are definable, relevant, and verifiable. Sherwood puts forward the view that, traditionally, the field of science was seen as two separate entities, pure science that was performed in universities to teach and promote knowledge and applied science used for industrial application to produce goods or for assistance in particular problems in independent laboratories.

At the present time, the delineation between pure and applied science is not so great, due to advances in technology, and a more collaborative approach between universities, health authorities, industries and society. According to Latour (1998) scientific developments in the past 150 years have been enormous due to dramatic changes which he refers to as a new culture emerging from the transition from science to the culture of research. He puts forward the view that science and societies are dependent on the same foundation and are inseparable. Berlei, a manufacturer of women's corsetry became a part of these new developments by combining science with research. During 1926 and 1927 Berlei set up a research branch and worked collaboratively with scientists and anthropologists from the University of Sydney. A national Australian census was undertaken to ascertain scientific data, which they believed would benefit society in general, from the medical profession, and for the manufacturing industry for the production of Australian women's corsetry. According to Burley (1926) no such survey on such a large scale had been conducted previously overseas or in Australia.

This present study uses a scientific approach for the collection and collation of information in relation to the current size and shape of present day Australian women that can be used in the clothing industry.

As stated previously, science requires observation that is accurate, definable, relevant and verifiable. In anthropometry it is important that researchers ensure that the measurements taken are accurate and reliable. Norton and Olds (1996) expressed the view that technical variability in taking measurements must be minimised and that anthropometrists should aim to achieve a high level of precision, reliability, accuracy and validity. Lasker (1994) states that historically, anthropometric studies were more concerned with standardisation of method than with the best way to obtain reliability. He believes that anthropometric dimensions to a scientific mind have two important components, first their usefulness and secondly that the measurements can be repeated with little difference due to technical error.

The anthropometric body dimensions used in this survey are useful, reliable, accurate and repeatable. With training, experience and care, the anthropometric measurements can be repeated to minimise technical error that may occur due to human elements associated with taking measurements. The body dimensions have been chosen specifically for the purpose of clothing design and manufacture and wherever possible are consistent with the body dimensions prescribed in the reference document prepared by the International Organisation for Standardisation (I.S.O. 1989). This study also incorporates observations that are used in the study of the typology of body shape.

Morphology.

Morphology is a science of biological form and structure. Studies in human morphology date back many centuries; some of these include the Byzantine era, Greek and Arabic astrology, art and sculpture in the times of great artists such as Leonardo da Vinci. Boyd (1980) cites Cennini (1400) in relation to the ideal body proportions of the human male body. Cennini expressed the view that face-height was the unit of measurement to obtain *"...The proportions which a perfectly formed man's body should possess..."*. It is interesting to note that the units of body measurements used by Cennini are used specifically to ascertain the male body proportions only. Cennini disregarded the female figure proportions and expressed the view that *"...a woman does not have any set proportion"*. Savonarola, in the fifteenth century, used a distance from the hairline to the chin as a measure of the head (testa) arguing that the full height of a man contains nine heads (Boyd). According to Boyd (1980), Leonardo on the other hand experimented with the Greek concept of head height multiples and emphasised variation in human physique rather than an ideal human form. Head height principles are used today in the field of fashion design and illustration. Ireland (1971) recommends that for fashion illustration 8 to 8½ head heights are used in drawing the length of a human body in comparison to 7½ head heights for life drawing.

In human biology, morphology is studied through observation. Sheldon *et al.* (1970) set the path in a morphological description of human beings in relation to aspects associated with personality and clinical concerns. In their studies they identified variable components for the classification and description of the human physique. According to Lasker (1994) the objective way to evaluate and compare morphology is by the use of measurements. He adds that using terms such as big or small to determine size is inappropriate. Various studies have been conducted in relation to individual variations in physique, which describes human morphology and composition (Sheldon *et al.* 1970, Honeyman-Heath and Lindsay Carter 1967). Included in morphological studies is the study of typology, which is the classification of body shapes into types. Such classification, though only approximate, is useful when continuous variation needs to be described in terms of just several discrete units that can be used in industrial practice.

Typology.

The term typology has been used over the centuries to classify body type, body shape, and physique. Kretschmer (1936) expressed the view that studies related to the build of the body belonged essentially in the realm of medical science. He defined three physical body types: *asthenic* (lean body with narrow shoulders), *athletic* strong skeletal muscular with broad shoulders) and *pyknic* (pronounced abdominal area). Sheldon *et al.* (1970) cite body classifications used by Hippocrates and Viola for the medical assessment of body types. Hippocrates defined two physical types: *phthisis habitus* (long thin body) and *apoplectic habitus* (short thick body). Viola on the other hand used different terminology in defining body types: *microsplanchanic* (small trunk and long limbs), and *macrosplanchanic* (large heavy body with short limbs). The most widely accepted terminology in relation to typology at the present time is the one used by Sheldon *et al* in the 1940's called somatotyping.

Somatotyping.

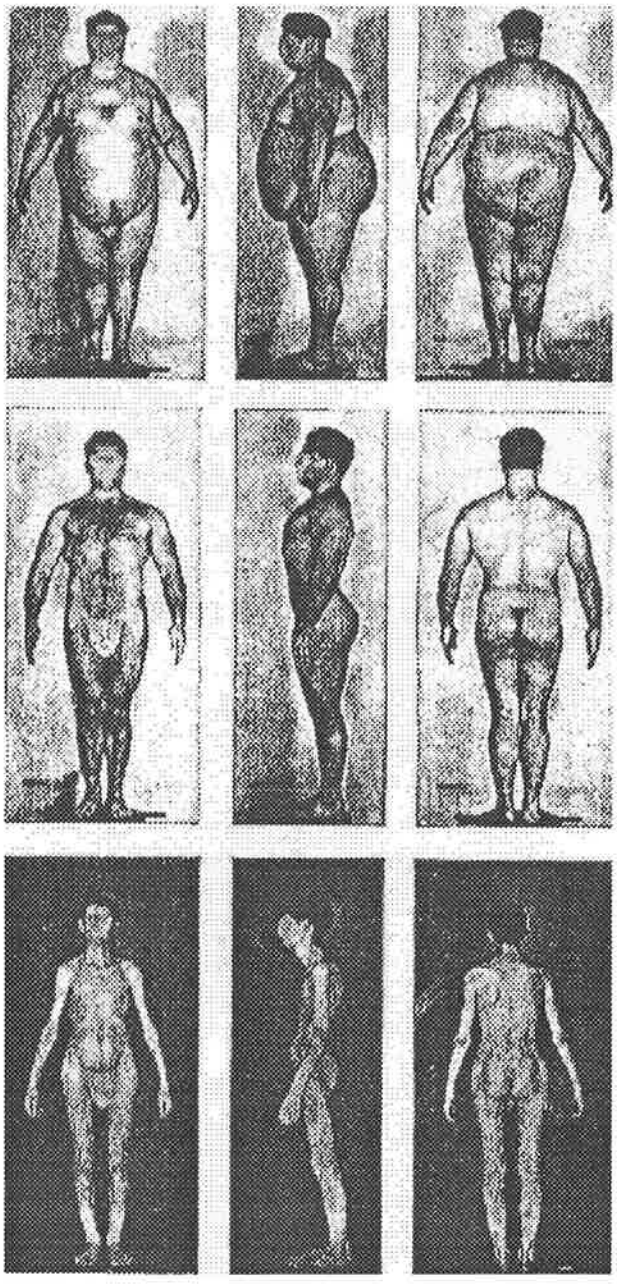
The term somatotype defined by Sheldon *et al* (1940) as a certain quantity of basic components that determine morphological aspects of an individual. These components were first used, for the identification and classification of body types and physique. The classificatory system identified three extreme varieties of human types: endomorph, mesomorph, and ectomorph. Three numeral ratings are used for each component consisting of sequential numbers, which are always recorded in the same way. These numerals represent the individual variation of the morphological composition of human physique. Figure 1 shows the three extreme varieties of human physique used by Sheldon *et al.* (1970).

Figure 1. The Three Extreme Varieties of Human Physique (Sheldon *et al.* 1970).

Endomorph.
(roundness, softness and short limbs).

Mesomorph.
(squareness, large bones and muscular).

Ectomorph.
(short, delicate, fragile thin).



The numerical scale assigned by Sheldon to each body component was a rating from 1 to 7 describing the strength of its expression in a given individual. The data used to arrive at the numerical scale were derived from photographs of 4,000 male university students taken in three standing views the anterior aspect, posterior aspect, and lateral aspect. The extreme variations from the average male body shape were used to arrive at Sheldon's body types now referred to by many as "somatotype". An extreme endomorph was classified 711

meaning the strongest expression of the endomorphic component and a very weak expression of mesomorphic and ectomorphic components. An individual with balanced proportions of all three components would be described as 444.

Honeyman-Heath and Lindsay-Carter (1967) define somatotype as a description of present morphological conformation. They express the view that the terms: somatotype, endomorph, mesomorph, and ectomorph are generally accepted and project similar meanings to those that use them. They argue, however, that various studies indicate modifications and adaptations to Sheldon's methods are necessary to overcome limitations of Sheldon's original somatotype method. Norton and Olds (1996) cite a modified system of Sheldon's somatotyping introduced by Parnell in 1958, and Heath and Carter (1967) as an objective system of somatotyping based on anthropometric dimensions. Norton and Olds (1996) express the view that Sheldon's system of somatotyping although a useful and descriptive tool in the identification of body types, does not, however, relate to body dimensions, and is best used in studies of the psychological aspects of typology. The term somatotyping is not only used in the fields of medicine, biology, and anthropology; it is also used in studies that deal with topics such as: psychology, temperament, perception and body image (Wells and Siegel 1961, Yates and Taylor 1978, Spillman and Everington 1989, Cateland Metzner 1993).

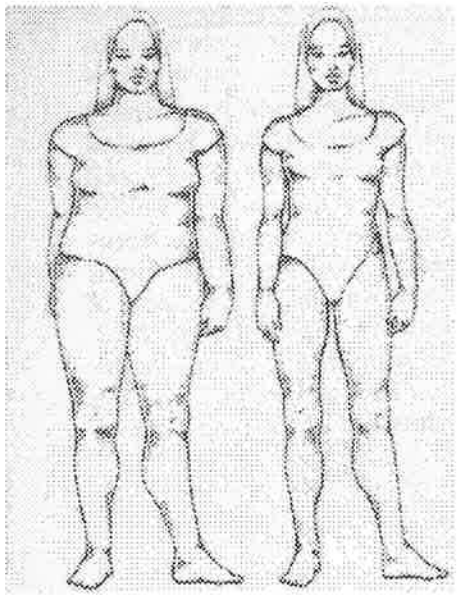
Female Somatotyping.

It is interesting to note that studies in relation to somatotyping have been mainly conducted using male subjects and very few studies in fact have been conducted using female subjects or children. A recent study, however, conducted by Cabot (1997) defines a system for the classification of female figure types. Cabot uses these figure types to identify nutritional and hormonal deficiencies. The four figure types are: android, gynaeoid, lymphatic and thyroid. The android shape has a thick set skeletal frame, large shoulders and is muscular. The gynaeoid shape resembles a pear shape, it has a small waist with width increasing towards the hip and thighs. The lymphatic shape has generalised thickening and puffiness, thick arms and legs, small to average shoulders and a protruding abdomen. The thyroid shape has a lean body and long limbs (Figure 2). Cabot believes that the gynaenoid figure type is in fact the most predominant figure type of all the female figure shapes. The female somatotypes defined by Cabot (1997) are shown in Figure 2.

Figure 2. Female Figure Types and Shapes (Cabot 1997).

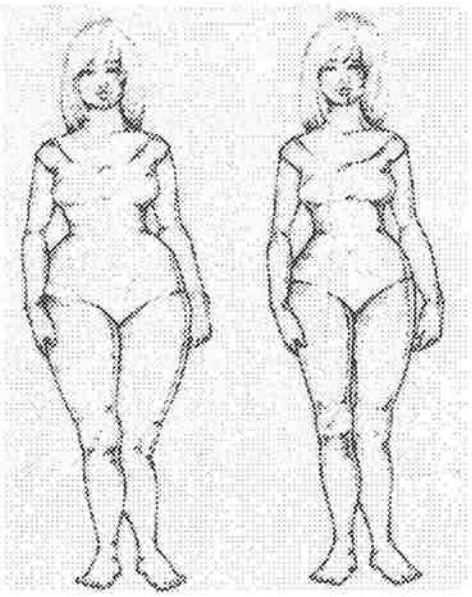
Android figure type.

Overweight Ideal weight



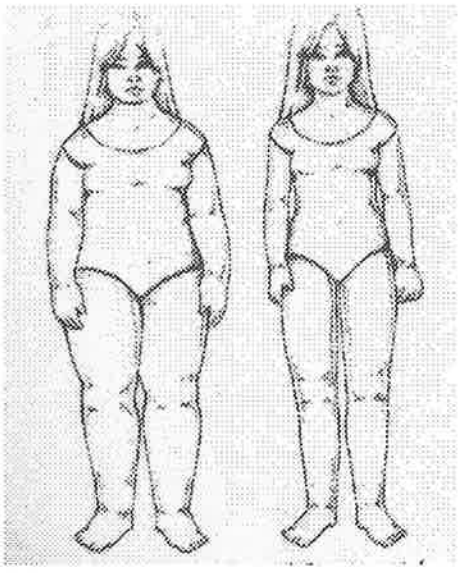
Gynaecoid figure type.

Overweight Ideal weight



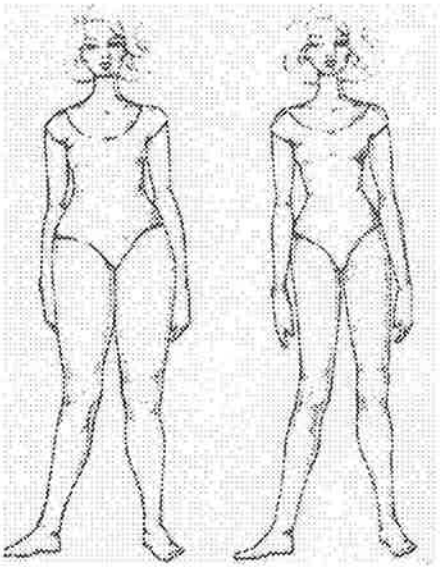
Lymphatic figure type.

Overweight Ideal weight



Thyroid figure type.

Overweight Ideal weight



Secular trends.

One of the key aims of this thesis is to investigate possible changes in human body size and shape, that is, in the biological characteristic of a population. Changes in human biological characteristics are often referred to as secular trends. The term secular is derived from the Latin noun saeculum. Simpson (1971) defines saeculum as a generation, the spirit of the age, the times, a hundred years, a century, an age. Human biologists use the term "secular trends" to refer to alterations in human beings over decades and changes to the human body are referred to as secular shifts and may in fact last less than or more than a century (Roche 1979). According to Van Wieringen (1986) secular trends, changes or shifts in human biological characteristics, do not occur uninterruptedly in any one direction and are not exclusively related to the last hundred years. Tobias (1992) puts forward the view that secular change is understood to mean a change that is going on slowly but persistently. Henneberg (1997) states that secular trends can be viewed as directional changes in human biological characteristics that occur in just a few generations, in evolutionary terms a short period. The literature on secular trends is quite extensive, therefore, only a brief review will be undertaken which will include some historical aspects and current secular trends.

Historical perspective of secular trends.

The growth spurt that has occurred over the past few decades is not new according to Lewin (1995). He says that, although this trend appears to have happened recently the reality is that humans have become smaller in the past 200,000 years. The shrinking process he believes started 200,000 years ago and gathered pace at the end of the Ice Age 10, 000 years ago, then slowed to a halt a few thousand years ago. The recent changes, he says, are the results of better nutrition rather than genetic changes and that these changes are starting to slow down, particularly in Japan. Mosk (1996) states that Japan's young adult population is now taller and heavier so much so that compared to its forebears they consist of giants. Mosk supports Lewin's point of view that the secular trend of the present day Japanese population is due to better public health and nutrition and adds that it is also due to a shift from a labour intensive workforce, to advanced technology and higher productivity on a per capita basis.

Causes of secular trends in height.

Malina (1979) and Meredith (1976) put forward the view that the literature on secular trends is more speculation than confirmed hypotheses and believe that no particular reason for the changes in secular trends has been found. Meredith (1976) says that no one really knows what causes the changes in secular trends. He expressed the opinion that on several continents the human population has increased in stature during late childhood and early adolescence at a faster rate than a century ago, and suggests that the pituitary growth hormone may have contributed to producing the results. Other researchers suggest that secular trends may be due to socio-economic factors. Van Cott *et al.* (1972) expressed the view that secular trends and increases in anthropometric data have occurred in populations that have experienced a pronounced rise in per capita income. Knight (1984) supports the view that socio-economic and class distinction also plays a role in secular trends, this, however, is contradicted by Henneberg (2001).

It appears that secular trends are not universal, and may occur at different rates in different populations and within populations. Some studies also indicate secular trends may run in opposite directions in various populations (Malina 1978, Tobias 1992). Henneberg and Van Den Berg (1990) found that socio-economic factors were not always the reason for the secular trends and that an increase in height of both black and white South Africans was parallel despite apartheid.

Over the past century there is evidence of positive secular trends of stature in some countries. The rise in stature, however, appears to have levelled off. There is however, an alarming increase in the prevalence of overweight and obesity throughout the world which is referred to by the World Health Organisation as a global epidemic (W.H.O 1998).

Secular trends in overweight and obesity.

Hippocrates believed that there was an association between obesity and morbidity and defined obesity as the result of "...when more food than is proper has been taken, it occasions disease." (cited by Rimm *et al* 1998). Truswell and Walqvist (1985) and Bray (1985) draw a distinction between overweight and obesity and refer to overweight as being an increase in body weight over some pre-determined standard in relation to height, and

obesity, on the other hand as an abnormally high proportion of body fat. The World Health Organisation (1998) refers to obesity, as occurring when the intake of energy (food) exceeds expenditure of energy (exercise) and the excess is stored in the body in the form of triglycerides, in adipose tissue.

Many researchers and health authorities now see obesity as a major global public health problem. According to recent studies the prevalence of overweight and obesity is increasing at an alarming rate and is rising to epidemic proportions throughout the world (National Heart Foundation of Australia 1989, Carpenter and Bartley 1994, Foreyt and Goodrick 1995, Rexrode *et al.* 1997, NHMRC 1997, Caterson 1998, Mokdad *et al* 2000, Vanselow 2000, Baur and Allen 2000). Obesity is not a new phenomenon and can be traced back to pre-historic times. In some countries overweight and obesity was and is still perceived to be a sign of wealth and prosperity. At the present time, however, health authorities see obesity as being a major health crisis worldwide. According to W.H.O. (1998) the escalating rise in obesity is fast reaching epidemic proportions that have never been experienced before and is affecting both adults and children. They also add that obesity is now seen to be a major contributing and key factor in chronic and non-communicable disease.

The prevalence of overweight and obesity in developed and developing countries has become a major global problem. The number of adults who are moderately and severely overweight is estimated to be over 200 million, of these 58 million are from developing countries. By the year 2025 it is predicted that 300 million adults will be severely overweight (W.H.O. 1998). Foreyt and Goodrick (1995) predict that by the year 2030, 100 % of adults in the United States will be overweight based on a B.M.I of more than 27. In the United States the prevalence of overweight among American adults increased approximately 5 % between 1987 and 1993 Galuska *et al.* (1996). In Australia 7.4 million adults (56 %) were overweight in 1995. Approximately 2.5 million adults (19 %) were obese. On the average men and women weighed more in 1995 than their counterparts in 1980. In 1995 men weighed 3.6 kg and women weighed 4.8 kg more than in 1980 (AIHW 1999).

Attitudes of health practitioners and health professionals in relation to obesity.

Various studies now perceive obesity to be a disease. Some researchers are concerned that many health practitioners and health professionals are not taking obesity and the associated problems seriously enough. They believe that those dealing with people with obesity problems may need to become more in tune with new developments and major changes that are taking place in the understanding and development of obesity (W.H.O.1998, Caterson 1998 and Vanselow 2000). Caterson (1998) puts forward the view that obesity is a serious medical problem and that prevention and individual therapy are essential. A major goal of NHMRC (1997) in setting up the strategic plan "Acting on Australia's Weight" was the prevention of further weight increase in adults and to reduce the number of adults that are overweight or obese. Vanselow (2000) expresses concern that three years have passed since the publication of the NHMRC's report and that dissemination and implementation strategies for social change have been minimal. This author believes that urgent public health measures with a large diversion of funds, energy and imagination are required. Vanslow claims that Australians are becoming more depressed, overweight and are more likely to suffer from diseases such as diabetes and cancer. Society's attitude and opinion of those who are obese and overweight is that they are lazy and incompetent. Social exclusion has set up a fear in many of becoming overweight. Those people put their lives at risk and resort to other extremes of health risks, which in some cases lead to anorexia nervosa or bulimia nervosa, adding yet another crisis to the public health system.

According to Brown *et al.* (1998), the average weight of women living in Australia during 1980 to 1989 increased 3.1 kg. The NHMRC (1997) using data from the National Heart Foundation (1989) and the Australian Institute of Health and Welfare (1998) reports that 34.3 % of Australian females were overweight or obese. The Australian Bureau of Statistics (1995) using data from the National Health Survey and National Nutrition Survey reported that 64 % of males and 47 % of females were overweight and obese.

Self reported data: issues of concern.

Research using self-reporting methods of collecting data may need to be reviewed with caution (ABS 1995 WHO 1998, Flood *et al.* 2000). The Australian Bureau of Statistics (1995) states that self reported data compared with measured data showed inconsistencies.

Shorter people tended to overestimate their height more than tall people do. Among males with a measured height of 1500 to 1600 mm, 36 % overestimated their height by 50 mm or more, compared with 13 % with a measured height of 1700 to 1800 mm and 5 % with a measured height of 1800 to 1900 mm.

Among females with a measured height of less than 1500 mm, 32 % overestimated their height by more than 50 mm compared with 5 % who measured 1700 mm to 1800 mm. Self-reporting surveys on weight also showed inaccuracies in the reporting of correct weight. The Australian Bureau of Statistics (1995) report showed that only 22 % of males and females estimated their weight to be within 1 kg of their true weight. On the other hand 60 % reported their weight to be within 3 kg. In the 45-64 age group similar results for males and females were recorded with an underestimation of their correct weight of 2.4 kg for males and by 2.7 kg for females. In the light of these findings, the report suggests that the use of self-reported height and weight data brings into question the reliability of such surveys, particularly when using height and weight to obtain B.M.I ratio for the identification of overweight and obesity.

The W.H.O (1998) report also expresses concern that self-reported height and weight are unreliable specifically in relation to obesity. Flood *et al.* (2000) also found that self reported data do not produce reliable results because participants are more likely to underestimate their weight particularly if they are overweight. The true prevalence of overweight and obesity is therefore not obtained.

Increase of obesity in childhood and adolescence.

Various studies indicate that obesity in childhood and adolescence is also increasing at an alarming rate around the world. A study conducted by Gordon-Larsen *et al.* (1997) reported an increase in obesity of American children and adolescents over the past few decades. Adolescents measured in the 1990's were heavier than those measured in the 1960's and much fatter than those measured in the 1970's. The United States Department of Health and Human Services (1997) stated that the number of overweight children is increasing at an alarming rate and that this increase in weight will possibly increase the chances of health problems as they become older. Moon *et al.* (1998) cite a report from the NHMRC 1997 (NHMRC 1997a) which shows that in 1985, 4 % of boys and 6 % of girls were classified as

overweight with 11 % of boys and 9 % of girls being at risk of overweight. The figures showed that the number of overweight children between the ages of 9 to 15 years had doubled by 1994. WHO (1998) estimates that 22 million children under 5 years are overweight.

According to Baur and Allen (2000) obesity in children and adolescents appears to be the second most prevalent chronic disease in Australia. In addition children and adolescents that are obese may be subjected to significant psychological and medical morbidity and the risk of remaining obese during adulthood is also high. Proimos and Sawyer (2000) express the view that the prevalence of obesity in childhood and adolescence is increasing. They believe that proper diagnosis and management of obesity is lacking, and given the long and short-term health implications the management of obesity requires urgent attention at both a public health and at an individual level.

Causes of overweight and obesity.

A general view considered by many is that overweight and obesity are caused by sloth and gluttony, however, NHMRC (1997), Caterson (1998) Baur and Allen (2000) do not support this view. They believe that overweight and obesity is inherited, however, the tendency towards obesity becomes prevalent when certain life-style factors occur, including a high-energy (food) intake together with a diet high in fat accompanied by insufficient energy expenditure. According to the NHMRC (1997) it is not only excess weight that is associated with an elevated morbidity and mortality but that the excess amount of adipose tissue in the body together with its distribution and location are important factors.

An article by Vogel (1999) refers to a court case in which an employee who weighed 400 pounds and was dismissed from his work was awarded $1.000.000 on evidence put forward by a medical witness who claimed that the individual's weight was controlled by genetics. The witness claimed that the obesity of the employee was 80 % due to genetic factors and 20 % to his environment. Vogel adds that every month new gene and genes related to obesity are being discovered with the count at present, 130 and rising. Vogel also cites Atkinson, a researcher from the University of Wisconsin, who states that all the combinations and permutations of the newly discovered genes could lead to many kinds of obesity.

Mokdad *et al.* (2000) do not believe the reason for the epidemic of obesity in the United States is gene related. They state the gene pool did not change dramatically between 1991 and 1999. During this time, however, the prevalence of obesity increased significantly, as did the increase in diabetes. In their study, they found weight increased dramatically in several states, and, that in 1991, four of the 45 participating states had an obesity rate of 15 % or greater. In 1999, 39 states had rates of obesity 15 % or greater. Out of the 45 states none had obesity rates 20 % or higher by 1998, however, obesity rates of 20 % or higher were identified in 7 states compared to 1999 in which the number of states rose to 16. From 1990 to 1998 the increase in diabetes was diagnosed at 33 %, which correlated highly with obesity. Mokdad and colleagues do not give a reason for the increase in obesity, but emphasise that intervention strategies which include: advice on nutrition, physical activities and the study of behavioural and environmental factors are urgently required to control and prevent obesity.

Various studies indicate that obesity is the product of a combination of environmental and genetic factors. A recent study adds yet another dimension to the obesity debate. Dhurandhar *et al* (2000) put forward the view that a virus may contribute to human obesity. They conducted a study using two different animal models and found that the mice and chickens that had been injected with a human adenovirus (AD 36) had increased visceral fat, total fat and or body weight compared to the control group. They suggest that future studies and research on the causes of obesity should also give serious consideration to the possibility that a human virus may be responsible for human obesity.

Sedentary lifestyles, fatty convenience foods and lack of exercise are all other reasons put forward by various researchers in relation to the epidemic of obesity. Mason (2000) states that a sedentary lifestyle and less reliance on "active transport" that is walking, cycling and use of public transport has increased the impact on public health and that more physical activity may provide preventative measures against a vast number of health conditions including obesity. According to Guthrie *et al.* (2000) weight gain in women is a natural part of the ageing process and can be related to menopause. Accompanying the increase in weight, change in body shape occurs particularly around the waist and abdominal areas, referred to as central adiposity. This occurs with ovarian hormonal changes and appears to be associated with the increasing risk of cardiovascular disease at menopause.

Obesity and morbidity.

The study of the link between morphology of the body and disease, is referred to as constitutional medicine (Norton and Olds 1996). The term constitution used by Sheldon *et al.* (1940) refers to the underlying aspects of how these factors go together. They refer to it in their study as the combination of morphology and behavioural characteristics to ascertain an individual's personality. More recent studies imply that certain morphological body shapes are associated with obesity and chronic diseases of the body such as diabetes, hypertension, and atherosclerosis (Valdez 1991, Rimm *et al.* 1988). The body shapes causing major concern are those that appear to have a large proportion of regional adiposity or fatness around the abdominal region. Pi-Sunyer (1991) puts forward the point of view that abdominal obesity creates a more serious health problem than gluteal-femoral obesity due to the amount of intra-abdominal fat, which increases the risk of morbidity such as cardiovascular disease, stroke, hypertension, and diabetes. The Australian Institute of Health and Welfare (1999) expressed the concern that in Australia cardiovascular complications caused by obesity cost $223 million during 1993-1994.

Various methods of assessment are used to estimate body fatness. These include surface anthropometry such as skinfold ratios and the anthropometric measurement of the waist circumference and hip circumference. These methods can assess surface areas only. Measures of deeper fat deposits require equipment such as computed tomography (C.T) or magnetic resonance (M.R.I), which are costly and out of the reach of many clinical practitioners (Norton and Olds 1996).

The most recognised and often used method used in the measurement of fatness is Body Mass Index (B.M.I) which was developed as a consequence of Quetelet's work in the study of body growth and in particular weight and height changes (Boyd 1980). Quetelets B.M.I is used extensively by researchers throughout the world as a means of assessing the measurement of body fatness. B.M.I is calculated by dividing weight in kilograms by the square of height in metres. Table 1 shows the categorisation of B.M.I and the co-morbidity risk factor used by NHMRC (1997) and The WHO Expert Committee (1998).

Table 1 B.M.I: Classifications of Overweight, Obesity and Risk of Co- Morbidity NHMRC (1997) WHO (1998).

Classification	NHMRC B.M.I	WHO B.M.I	Risk of Co- Morbidity
Underweight	< 20	<18.5	low *
Acceptable	≥ 20-≤ 25		
Normal		18.5-24.9	average
Overweight	< 25-≤ 30	≤ 25	
Pre-obese		25-29.5	increased
Obese	<30		
Obese class 1		30.9-34.9	moderate
Obese class 11		35.0-39-9	severe
Obese class 111		≤ 40.0	very severe

Note * low risk of co- morbidity, however, increased risk of other clinical problems such as anorexia nervosa and bulimia nervosa.

A study on healthy weight for middle aged women conducted by Brown *et al.* (1998) found that the optimal range of B.M.I was approximately 19-24. They concluded that from a public health perspective a B.M.I of 20-25 is an acceptable range for the attainment of healthy weight for middle aged women. It is in the acceptable range category recommended by NHMRC and WHO as shown above.

As well as B.M.I being used to assess the degree of fatness it is now recognised that the waist measurement is important in the measure of visceral fat particularly for clinical purposes (Caterson 1998). This view is also supported by Folsom *et al.* (2000) who also add that the waist hip/ratio is important in the assessment of adiposity and may provide extra prognostic information in addition to the use of B.M.I and waist circumference.

Conicity Index.

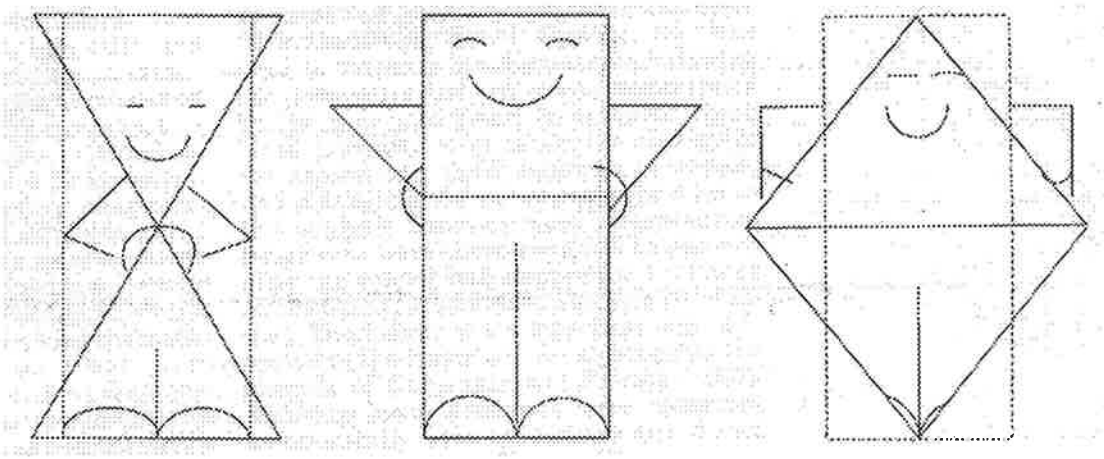
According to Valdez (1991) the traditional method of assessing B.M.I does not, however, isolate the area within which fat accumulates. He puts forward the view that a simple model

based on abdominal obesity, which he refers to as conicity index (C.I), is justified. The conicity index proposed by Valdez is one where conicity acts as an indicator of overweight and obesity, particularly in the abdominal area. He believes that as fat accumulates around the waist, the shape of the body changes (Figure 3) from that of a cylinder to a double cone effect.

Figure 3. Models of Conicity Index (Mueller *et al.* 1996).

Ratings for conicity:

Biconcave <1.0 **Cylindrical 1.0** **Biconical > 1.0**



Mueller *et al.* (1996) describe the value of conicity as varying between 1.0 for a perfect cylinder shape and 1.73 for a perfect biconical shape and add that the more central a person is in fat distribution the higher the value of conicity. The conicity index is calculated by using the following formula:

$$\textbf{Conicity Index} = \frac{Girth\ (mm)}{0.109\sqrt{\frac{Wt\ (kg)}{Ht\ (m)}}}$$

Desirable weights for women.

Very few data are available in Australia on the desirable healthy weight of Australian women. Some researchers express concern that data compiled in one country and used in another country as a diagnostic tool may be unsuitable for that population (Woodhill 1952, Aldoori 1995). Willett *et al* (1995) express concerns that the U.S. desirable weight guidelines of 1990 for women 35 years and over set up a false sense of reassurance. Willett *et al.* found that their study showed women who were within the current guidelines had an increased risk of cardiovascular disease due to excess weight. Aldoori (1995) supports the view expressed by Willett *et al* and adds two other concerns in relation to the U.S.A desirable weight guidelines. The first is that although the weight guidelines developed in the U.S.A are meant primarily for U.S.A women, the guidelines may be used blindly in other countries, particularly in developing countries. Secondly there is concern that guidelines recommended for the U.S. population might be taken for granted by other countries. They may then be considered to be the "truth" or "gold standard" but may not, however, be relevant for use by other populations.

According to Mitchell (1993) the most often and most widely used weight guidelines are those based on Metropolitan Life Insurance Company (M.L.I.C) tables which are based on a minimum number of deaths of insured adults. It appears also that the 1985 M.L.I.C desirable weight guidelines, which had a B.M.I of 19 to 24, were increased to correspond to body mass index of 21 to 27 by 1990. This increased the upper limits of the desirable weight guidelines. Mitchell also states that in the 1983 Metropolitan Life Insurance Company tables, the body frame sizes were obtained from the elbow breadth measurements. He believes body frame size as well as weight and height is important in the assessment of body fatness.

In the absence of appropriate data of body height and body weight in Australia, Fogarty (no reference given) cited by Bray (1985), modified the Metropolitan Life Insurance Company data to provide height and weight standards as a means of identifying the desirable healthy weight of Australian women (Table 2).

Table 2: A Table of Desirable Weights for Women: Metropolitan Life Insurance Company (data modified by Fogarty cited by Bray 1985).

Height (mm)	Average weight (kg)	Acceptable weight range (kg)
1450	46.0	42-53
1480	46.5	42-54
1500	47.0	43-55
1520	48.5	44-57
1540	49.5	44-58
1560	50.4	45-58
1580	51.3	46-59
1600	52.6	48-61
1620	54.0	49-62
1640	55.4	50-64
1660	56.8	51-65
1680	58.1	52-66
1700	60.0	53-67
1720	61.3	55-69
1740	62.6	56-70
1760	64.0	58-72
1780	65.33	59-74

Ideal female body shape.

Fashion designers, modelling agencies, the weight loss, fitness, and beauty industries, advertising agencies and the media, depict the ideal figure to be tall, and slim. Price (1992) found in his study that the print media were a contributory factor that encouraged women in the desire to be as slim as contemporary fashion models. The models appearing in print all over the media during the past 35 years had become thinner and less curvaceous. Tebbel (2000) supports this point of view and claims that model agencies and the media have always preferred attractive women, however, the requirement that they had to be 'stick thin' did not eventuate until the mid sixties with the appearance of the very thin fashion model "Twiggy". Tebbel also adds that the appearance of the stick thin model altered the course of physical anthropology. As large breasts, hips, and bottoms went out of favour the womanly figure with large breasts and bottoms was seen as dowdy and unacceptable.

The current Australian female fashion body-ideal is far from reality and is perceived by many to be unrealistic. During the past several decades body sizes have increased

substantially in most countries, Australia is no exception. In some cases these increases were accompanied by changing body proportions. To date, no scientific study of this phenomenon of secular change of female body size has been conducted in Australia (Berry and Henneberg 1997). According to Buist (2000) the ideal female figure shape has over time undergone many changes. These changes include the Rubenesque, to the curvaceous Marilyn Monroe to the present 'waif' and 'heroin chic' physique.

In contrast with today's thin body ideal the famous Greek statue of Venus of Milo (130 B.C) known as the Greek goddess of female beauty with broad hips and well-developed bust by today's standards may possibly be termed overweight (The World Book Encyclopedia 1992). Venus of Milo's measurements according to Tebbel (2000) were estimated to be bust 1090 mm, waist 790 mm and hips 1020 mm, which she believes to be similar to many women today. According to Dolly Magazine (August 1997) Marilyn Monroe's figure was far from thin with her voluptuous bust and curvaceous hips with measurements that closely approximated an Australian Standard size 14 while she was considered to be by many people the sexiest woman in the world.

According to O'Brien (1982) the female figure type of the mid 1930's was quite matronly. This was reinforced with the standard free dressmaking pattern produced by The Australian Women's Weekly magazine based on a 900 mm bust, which by today's standard is equivalent to an Australian Standard Average woman Size 14. O'Brien also cites measurements from a hospital chart dated July 1934 in which ideal weights were recorded for the average female body frame of 1670 mm (Table 3). The weight for a 19-year-old was recorded at 58.5 kg, which equates to the weight of Australian Standard Average Woman Size 14, which is 59 kg. The height used across all age groups was 1670 mm. This measurement is between the present day Australian Standard Average Woman Size 18 at 1660 mm and Size 20 at 1680 mm in height.

Table 3: Ideal Weight and Height of Female's Measurements Recorded on a Hospital Chart July 1934 cited by O'Brien (1982).

Age in years	Weight in kg	Height in mm
19	58.5	1670
21	59.4	1670
25	61.2	1670
35	62.5	1670
45	65.7	1670

The measurements of ideal weight taken from the hospital chart in 1934 would indicate that average women in those days were in fact much heavier compared to the present day image projected by the fashion and media industries, and to the Australian Standard Size Coding Scheme for Women (1997).

The ideal slim body-image is not only confined to adolescents and young women but appears to be also affecting young children according to Williamson and Delin (1997). They found in their study that girls in South Australia aged between 5 and 10 years expressed greater dissatisfaction with their body shape than did boys of the same age. Girls preferred the thinner ideal to their actual fuller body shape. The results of this study showed that the thin ideal was also apparent in both British and American children. It would appear that this trend is followed through to adolescence and early womanhood.

Buist (2000) believes that the present fashion body-ideal is unachievable and is creating serious health problems particularly for adolescents and young women. As the media continue to present the ideal female model as young and dangerously underweight, there is growing concern that the number of females with eating disorders, anorexia nervosa and bulimia nervosa is steadily increasing.

Many researchers believe that these increases are due to the negative body image that women of all ages and socio-economic groups have of themselves. The Australian Youth Medical Forum in 1995 (Cross 1997) reported that there was a difference between actual weight and perceived ideal weight. They found that fashion models are 14 % lighter now compared to the 1960's and that between 1980 and 1989 the weight of the average woman

increased approximately 3 kilograms. This present study has found that the average woman in 1999 is approximately 6 kilograms heavier than six decades ago. This increase in weight makes the task of attaining the present fashion ideal even more difficult.

The ideal body image, which appears to be unattainable for many females, seems to be creating a population that is striving to copy an impossible image. Whilst the media continue to promote thinness as the ideal, community health costs are rising, as well as the health risks associated with anorexia nervosa and bulimia nervosa. As no national anthropometric survey has been conducted on the Australian population since 1926-1928 no current data exist to indicate what constitutes the average or ideal healthy figure type. Until such a survey is conducted the advertising agencies and media continue to set criteria of the ideal body image as very slim.

Anthropometric surveys.

Anthropometric surveys where the population is physically measured require time, expertise and money therefore very few studies have been conducted on the civilian population. Most large-scale anthropometric studies have been conducted by the armed forces. These studies, however, have been mainly conducted on men therefore data for women are very limited (International Organisation for Standardisation (1989).

Anthropometric health surveys.

Studies related to the health and welfare of the nation have been conducted mainly to assess specific factors such as types of morbidity, mortality rates, nutrition and fitness. Some of these include studies conducted by The National Heart Foundation (1980, 1989), Australian Institute of Health and Welfare (1998) and Australian Bureau of Statistics (1995). Health studies consist mainly of data derived from the collection of a limited number of body dimensions. Measurements used in these studies usually include height, weight, blood pressure and blood chemistry. These surveys although extremely important, provide anthropometric data, which are of limited use for studies of ergonomics, industrial design, or clothing design and production. Data of height and weight, however, are useful and are used in this study for comparison with other data.

The National Heart Foundation of Australia (1980, 1983 and 1989) reported the mean height of Australian women as being 1620 mm. The mean weight, however, was the same for 1980 and 1983 (64 kg). However, weight in the 1989 study was 65.4 kg, which indicated an increase of 1.5 kg for the average Australian woman from 1983 to 1989.

Self reported data of height and weight of the Australian population were also obtained in The National Health Survey. These were then compared with measured data from the National Nutrition Survey. As stated previously self reported data may need to be treated with caution, therefore for the purpose of this study only data from the measured study will be used. The National Nutrition Survey reported the mean measured height for females to be 1614 mm. The mean measured weight for females was 67.0 kg (Australian Bureau of Statistic 1995).

The average height of women in the National Nutrition Survey is 1614 mm (Australian Bureau of Statistic 1995) is slightly smaller than the Heart Foundation (1989), which is 1620 mm. The weight of National Nutrition Survey is 67 kg (Australian Bureau of Statistic 1995) is on average higher than the National Heart Foundation (Table 30).

The Fitness of Australians Report found that 50 % of men and 38 % of women were overweight or obese (Department of the Arts Sports the Environment and Territories (1992). The Bureau of Statistics (1995) found that 64 % of Australian males and 47 % of Australian females were overweight or obese. Australia's Health (1998) states that through the 1980s and in the first half of 1990s, there was a significant increase in the proportion of men and women who were overweight or obese. They cite data from the Australian Bureau of Statistics (1995) and the National Heart Foundation (1980) that show the proportion of obese men rose dramatically from 7.8 % in 1980 to 17.6 % in 1995. The proportion of obese women rose from 6.9 % in 1980 to 16.1 % in 1995. Studies conducted by Namasivayam and Salagaris (1998) also found that the mean weight of Australian women had increased by about 3 kg per decade over the past six decades. They, however, did express caution that the outlying data points may have influenced the strong positive trend in weight. All these studies indicate that the size and shape of the Australian population is changing.

Anthropometric clothing surveys.

The second aim of this thesis is to assess the implications of findings on current data used in the design and production industry. Literature relevant to the clothing industry will now be reviewed. It is interesting to note that, at this point in time, no scientific anthropometric survey has ever been conducted in Australia for clothing size standards. From the literature reviewed it appears that Dr Lancaster from the School of Public Health and Tropical Medicine in New South Wales played a major role in the analysis of available data in the late 1950's that may have contributed to the first Australian Standard Size Coding Scheme for Women's Clothing. The following studies were compared by Dr Lancaster: Australian Study by Berlei 1926-1928 (Lancaster1957), American study conducted by O'Brien and Shelton in 1940 (O'Brien and Shelton 1941), British study conducted by Kemsley 1943 (Kemsley 1950) and Australian women's survey conducted by Woodhill in 1951 (Woodhill 1952). These studies are reviewed below together with some more recent studies.

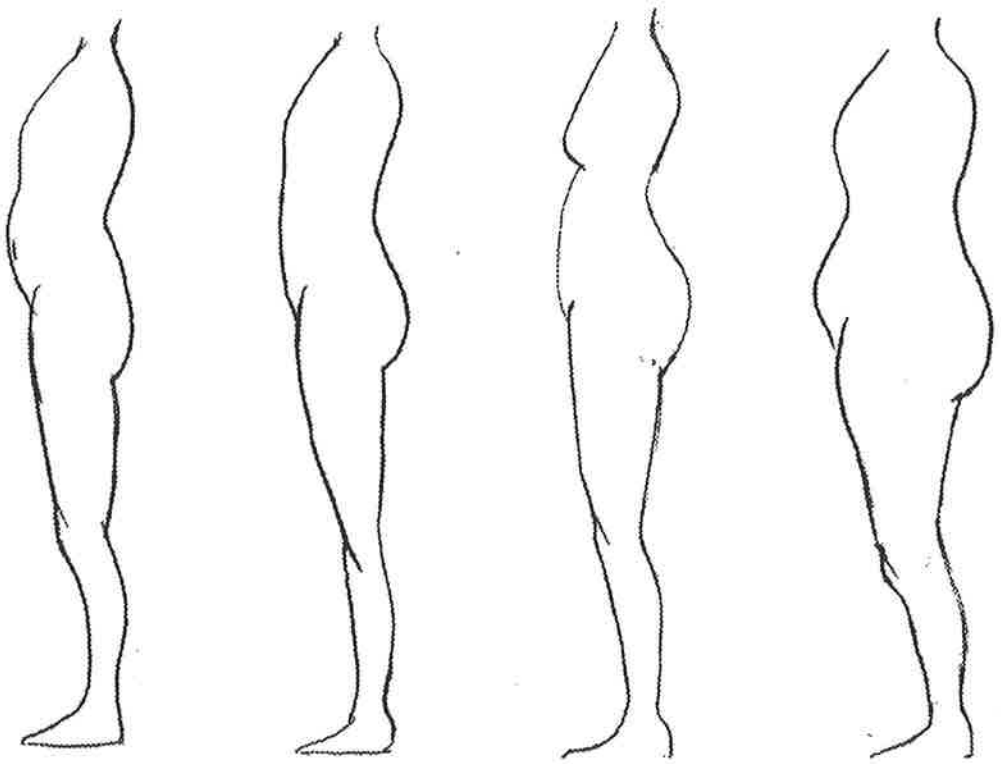
As there were very little published data of Australian women in the late 50's and Berlei had received several requests for their measurements, they requested Dr Lancaster to prepare them for publication. Dr Lancaster found where comparison of measurements could be made that they were reasonably close to the American survey of O'Brien and Shelton (1941). He also found in the final sample that although attempts were made to ensure a representative sample of women, more younger women between the age of 15 and 24 years were represented (Lancaster 1957). Approximately 5,250 women were measured and twenty six body dimensions were taken in the Berlei study compared to 10,042 women and 58 body dimensions in the American study of O'Brien and Shelton. A comparison of body dimensions and the location of where each body dimension is taken are shown in Appendix 2.

Australian anthropometric survey: Berlei 1926-1928.

Berlei conducted a large anthropometric survey of Australian women between 1926 and 1928. This study appears to be the only large-scale survey of Australian women. Berlei, a large manufacturing company producing brassieres and corsetry required scientific data in relation to the shape and form of Australian women in the mid to late 1920's. The purpose of the survey was to ascertain the distribution of figure types of Australian women so that women could obtain a fit that closely approximated their body type (Burley 1926, Lancaster 1957). It appears from media articles and reports at that time that the intention was to survey 20,000 Australian women between the ages of 15 and 65 years (The Sunday Sun 1926, Burley 1926, Beedee 1926). The final survey, however, consisted of 6,038 (this figure differs slightly from the Lancaster report of 1957) women aged between 15 and 65 years. The States and numbers of participants represented in the survey comprised of: New South Wales 4,748, Victoria 580, Queensland 468 and South Australia 242. The largest number of participants was from New South Wales, with 2,597 being in the 15 to 24 year age group. Western Australia and Northern Territory were not represented. Tasmania was surveyed, however, the sample was too small to classify (Berlei 1927). Although not all measurements from the Berlei survey are available there are, however, numerous media articles and reports that provide some information and data relevant to that study which will allow some comparisons to be made with present day data of Australian women.

As a result of the Berlei survey a classification of four figure types was identified with the waist circumference measurement being the major dimension for each of the figure type classifications. Figure 3a shows the four figure types, which are: sway back, big hip, average, and big abdomen (Berlei 1928). It is of particular interest that the figure type classification was based on the waist circumference measurement. It appears this measurement may have been the control dimension (I.S.O.1989). It should also be borne in mind that the Berlei survey of 1926-1927 was commissioned by a company manufacturing women's underwear only.

Figure 3a. Classifications of Figure Types (Berlei Research Department Report 1928).



Sway Back Average Big Hip Big Abdomen

Table 4 shows the four-figure type classifications together with averages for waist circumference, weight, height, bust circumference, abdominal circumference and hip circumference.

Table 4: Classification of Figure Types and Averages within each Classification (Berlei Research Department Report 1928).

Averages	Sway back	Big hips	Average	Big abdomen
Number of participants	2937	224	943	1895
Height (mm)	1598	1645	1623	1622
Weight (kg)	**51.32**	**61.43**	**62.66**	**69.17**
Bust (mm)	**813**	**865**	**876**	**1102**
Waist (mm)	651	721	726	927
Abdominal circumference (mm)	818	907	889	1158
Hip circumference (mm)	929	1001	976	1173

It is interesting to note that there was an increase in height with weight, of the sway back and big hip figure types, whereas with the average and big abdomen figure types there was no increase in height with weight. The bust, abdomen and hip circumference however all increased with a rise in waist circumference. In all figure types, weight increased with waist increase. It is also of interest to note that the height of the sway back figure type is shorter than the big hip, average, and big abdomen figure types. It appears that the sway back group consisted of a younger age group. This may have indicated that the stature of the younger generation was smaller than the older generation at that point in time (Berlei Research Department Report 1928).

American anthropometric survey.

The American survey conducted between 1939 and 1940 was funded by the Federal Project Grant Work Projects Administration and conducted by O'Brien and Shelton (1941) from the Bureau of Home Economics. The purpose of the survey was to obtain body dimensions that could be used in the production of ready-made garments and to improve the fit of those garments. Up to this time no scientific survey had been conducted to obtain body measurements of American women. The measurements used in the American clothing industry for the production of women's garments were derived by trial and error. The survey consisted of 58 body dimensions taken on each of 14,698 participants who consisted of white American women from eight states of America. The age range of the participants

was 18 years and older (O'Brien and Shelton 1941). It appears that this survey formed the basis for the original Standard Table of Body Measurements for the Sizing of Women's Garments in America Sizes 2-20 (American Society For Testing and Materials 1995a).

The present American Standard for Adult Female Misses Figure Type is still based on the original data of O'Brien and Shelton 1941. The current body measurements were upgraded using information supplied by retailers, manufacturers and anthropometric surveys conducted by the armed forces and not from any recent nationwide anthropometric research (American Society for Testing and Materials 1995a). The International Standard Organisation (I.S.O) (1991) expresses the view that data from military surveys are insufficiently representative of a civilian population to enable their direct application to the population. The I.S.O also believes that manufacturers and designers use their own specific measurements or measurements from fashion houses to size their garments. They believe that this creates confusion for the customer and express the view that the only real way to obtain reliable data is from a scientifically conducted anthropometric survey, which they believe, should be updated every 10 years.

British anthropometric survey.

Two British studies that are important for this study are, firstly, the study of height and weight of the British population in 1943 (Kemsley 1950) which Lancaster (1957) cites in his analysis of the Berlei data. The second study is that published by the Board of Trade (1957) and was conducted to provide the British Clothing Industry with data for use in the clothing industry. The Kemsley report (1950) outlines a survey conducted in Great Britain in 1943 by the Ministry of Food on the height and weight of males and female, 14 years and over in the civilian population. The subjects consisted of 27,000 males and 33,500 female workers employed in large and small industrial firms, miners and housewives not gainfully employed. The large firms had welfare facilities and departments. Staff from these departments undertook the weighing and recording of the subjects, which ensured the same procedures, were used throughout the survey. The data collection for the small firms, however, was much more difficult as facilities were not the same as they were in the larger firms. To overcome this difficulty the selection of participants and method of collection of the data and fieldwork for the small firms were undertaken by Social Services Limited. Due to the number of participants and the widespread location of the small firms and housewives

this sample of subjects posed a more difficult task than did the larger firms who had their own facilities. Measurements were taken with the subjects wearing ordinary working clothes, and shoes or boots. Allowances were made to the measurements for the clothing and footwear that was worn.

The second British Survey was conducted by The British Clothing Industry Development Council who undertook to provide the clothing manufacturing industry in Britain with reliable data for the production of ready-made garments. Before the research was completed The Development Council went into dissolution. The Joint Clothing Council Limited assumed responsibility and completed the project. The Board of Trade arranged publication of the report. The survey was conducted in the absence of other reliable data between 1950 and 1951. Thirty-seven body dimensions were taken on approximately 5,000 women between the ages of 18 and 70 years with 2,366 participants in the 18-29 age group, 1,554 in the 30-44 age group and 1,075 in 45-64 age group. The measurements were taken over foundation garments because it was felt that measurements taken in this way were more relevant to the garment manufacturer. Participants consisted of women from business, employees and various women's groups. The British Study found that the main increase in weight and girth circumferences occurred between the ages of 35 and 55 years and that maximum height was reached in the early 20's and decreased steadily from then on (Board of Trade 1957).

Study of Australian Auxiliary Women's Services and Australian Mutual Provident Society.

A study of height, weight and age of Australian women was conducted in Australia by Woodhill (1952) in which medical records of the Women's Australian Auxiliary Air Force, the Australian Women's Army services and summaries of Australian Mutual Provident Society were used. Woodhill expressed the view that data from overseas are often used to determine the standard in a given situation. These data are then often used in Australia as a guide for the norm of the Australian population. Although the overseas data may in the absence of other available data be of some value they may not necessarily be applicable to the Australian population. Woodhill expresses the view that some overseas data may be unsatisfactory for the Australian population due to the Australian climatic environment as a high percentage of sunshine hours per year provide a plentiful supply of vitamin D, which is

an important nutrient for good skeletal development. Therefore as stature and physical measurements are an essential characteristic of the Australian population the overseas data may be irrelevant for the Australian population.

Berlei revisited 2000.

As a follow up from the original Berlei study in 1926-1928 Berlei Pty Ltd (parent company of Hestia Pty Ltd) in 1999 commissioned The University of Newcastle (New South Wales) to undertake a survey. The purpose of the survey was to measure a representative sample of Australian women and compare their heights, weights, and body shape with Australian women from the 1920's. The project was co-ordinated by The Research Institute of Gender and Health. The participants were from New South Wales (Newcastle and Hunter Valley Regions), Queensland (Brisbane areas) and Victoria (Melbourne areas). The sample consisted of a total of 450 participants, with 150 participants from each state. The ages of the participants were 25 to 39 years and were recruited from community and workplace groups. The body dimensions taken by trained personnel included: height (sitting and standing), weight, waist, hip, overbust and underbust. The participant measurements were taken over light clothing without a bra and were comparable to the original Berlei study where participants wore bathing costumes which comprised of a singlet top without bust support. A questionnaire in relation to issues such as: health, fitness, body image, clothes, shopping, lingerie, values and breast cancer was also undertaken. The data obtained from the questionnaire were compared with data from the 18-23, and 45-50 years age cohorts of the Australian longitudinal Study of Women's Health. Average values of the measurements were compared with the averages from the original data of 1926, and from the National Nutrition survey 1995. Three particular aspects of the new Berlei study are of particular interest to the present study: bra sizes, body dimensions of bust, waist, and hip equating to a size 12 garment and the fit of clothes (Patterson and Brown 2000)

The question in relation to "What size bra do you now wear" showed the following self reported results. Size 12B with 16.6 % was the most popular size, with size 12C the next at 15 %, followed by size 12D rated 4.4 %. For the size 14 category, 14B rated 9.1 % and 14C rated 7.7 % (Patterson and Brown 2000). Woman's Day (1980) cite data from Berlei's advertising manager that bras sizes had changed. In the 1960's the most popular bra sizes were size 32A and 34B. In the 80's, however, the bra sizes had increased to 34B and 36B.

A small market research study was conducted in a lingerie retail outlet in which customers were fitted for bras in Queensland between October 2000 and January 2001. The study showed the following sales percentages in bra sizes: size 12C at 19.7 %, size 12B at 17.6 %, size 14C at 11.97 %, size 14B at 11.2 %, size 12D at 8.4 %, size 10C at 5.6 %, and sizes 10B, 14DD, 16D at 2.8 %. It appears from the above information that the cup sizes of bras are increasing and that the female bust in the 21st century is fuller than the 1950's. A comparison of international bra sizes by Lingerie Company of Australia (2001) can be seen in Appendix 1.

The second point of interest in the new Berlei study is the equating of body dimensions to clothing garment size. The measurement of waist at 765 mm, hip measurement 1016 mm and bust 9350 mm is equated to a garment of size 12. The Australian Standard uses body dimensions in conjunction with standard size codes (Australian Standard 1997). The size code for the Australian Standards average women's bust size 14 is 900 mm and 950 mm for size 16. The hip measurement for Australian Standard average women's size 14 is 950 mm and size 16 is 1000 mm. The waist measurement for size 14 is 700 mm and size 16 waist is 750 mm. Therefore in using the New Australian Women data and comparing them with the Australian Standard size coding scheme the garment size would possibly be closer to a size 16 than a size 12. The use of a smaller size code to larger body dimensions appears to be a trend that is used by many manufacturers. This trend is a concern for Australian Standards (Australian Standard 1997).

Responses to the question "How often do you experience difficulty buying clothes" presented some interesting answers, in relation to the fit of women's clothes. Some of these included: bust-16.6 % said "too tight" with 7.5 % "too loose", waist-20.9 % "too loose" 11.6 % "too tight", hips-33.8 % were "too tight" compared to 5.7 % "too loose", thighs-24.9 % "too tight" compared to 2.7 % "too loose". These results appear to indicate that either consumers are trying on garments that are too small for them or that the clothing sizing system is not catering for the increase in size and shape of the Australian woman. Or it may be that, as stated previously, the body dimensions used by designers and manufacturers may be those devised by themselves or fashion houses and used with the Australian Standard Size Coding Scheme.

Variation of terminology and location of body dimensions from anthropometric surveys.

There are 82 body dimensions that have been used in the various studies compared, however, only thirty six body dimensions were used in this study. Terminology, location and procedure of taking body dimensions vary between studies both in Australia and overseas. A list of the terminology and the location of taking body dimensions for the garment industry is outlined in Appendix 2, which compares studies from Australia, America, and Great Britain. There were no inconsistencies in the reviewed literature of the methods of a number of body dimensions measured. These include; shoulder length, shoulder to shoulder length, centre front length, front shoulder point to waistline, centre back length, across back length, side length, armhole circumference, upper arm girth, thigh, upper hip circumference, height and weight.

Bust circumference.

The bust girth measurement is one of the most important measurements used in the sizing of women's garments. Together with the weight measurement it is said to be the most appropriate measurement on which to base a sizing system (O'Brien and Shelton 1941). The I.S.O (1989) refers to the bust girth also as the control measurement used to build a sizing system in which an appropriate size is assigned to a garment. For these reasons it is appropriate that consideration be given to the method and techniques used to measure the bust girth.

Two major aspects are associated with taking the bust measurement. Firstly the terminology and secondly the method and the procedure. Patterson and Brown (2000), and Hickory Seminar Booklet (no date given) use the term "Over Bust" as the bust girth circumference. Pheasant (1987) in Ergonomics- Standards and Guidelines for Designers uses the terms chest (bust) girth. It may be assumed that Pheasant refers to the male figure for chest and bust for females although, however, this is not clear. The procedure of taking the bust measurement by Patterson and Brown (2000), however, is quite clear and precise-that is with the tape placed horizontally around the body at the level of the nipple. The terms, over bust and chest, may in some cases be seen as being synonymous. The studies conducted by O' Brien and Shelton (1941), Board of Trade (1957) and A.S.T.M (1995 b), all use the same method of

taking the chest girth and the bust measurement (Appendix 2). For the chest measurement the tape measure is passed over the shoulder blade, under the armpit and over the top of the bust or upper chest with the tape measure held in a horizontal plane. The bust girth on the other hand is taken with the tape measure placed horizontally around the fullest or maximum level of the bust parallel to the floor. The Board of Trade (1957), however, suggests that it is not always possible to keep the tape in a horizontal plane particularly if the bust prominence was low. If that was the case the tape measure was then repositioned and held in place at the lower end of the scapulae.

The descriptions used for taking the bust girth measurement by I.S.O (1989) and the Australian Standard (1997) are the same (Appendix 2). They both state that the tape measure is passed horizontally over the scapulae under the armpits then across the nipple. Taking the bust girth measurement in this way would assume that the tape measure in many circumstances would not be parallel to the floor, unless the subject's fullest bust projection was very high and almost in line with the axilla. As a part of earlier work the author found that taking the bust measurement as described in the Australian Standards 1975 and 1997 resulted in a measurement that was approximately 40 mm smaller than that obtained from the method described in the 1959 and 1972 Australian Standards.

Waist girth circumference.

As can be seen in Appendix 2, varying methods were also used to identify the natural waistline position. These included: the natural waistline position as being the maximum indentation of the lumbar part of the spine (Lancaster1957), between the top of the iliac crest and the lower ribs (I.S.O 1989), between the lowest rib and hip found by bending the body to the side (A.S.T.M 1995b).

Neck Girth Circumference.

The American studies and the I.S.O (1989) used a chainette to obtain the neck girth circumference. The chainette was then measured along an anthropometer to obtain the neck measurement. The Board of Trade (1967) study did not use a chainette to determine neck measurement. They used a tape measure, starting at the cervicale and followed the neck base to the suprasternale (Appendix 2). Although these methods differed it would be

expected that the end result would be comparable as both the chainette and tape measure were in the same position.

Front to Back crotch.

The method of taking the front to back crotch measurement was consistent in all studies except O'Brien and Shelton (1941). The difference in the O'Brien and Shelton (1941) study was that the participant placed their left leg on a chair whilst the measurement was taken instead of standing in an upright position.

Inleg.

There were several variations in the terminology used e.g crotch height. The main difference was that in most studies, participants were measured with the body in an upright position. This measurement in particular requires special consideration, as it is a sensitive one. In this study the participant held the tape measure at the ischial tuberosity to avoid embarrassment (Appendix 2).

Waist to floor.

The method of taking the waist to floor length was similar among the various studies except O'Brien and Shelton (1941) and Lancaster (1957). They both referred to this measurement as waist height. In taking this measurement O' Brien and Shelton took the measurement from the floor to the back waist which, they defined as being in line with the forth lumbar vertebra. Lancaster on the other hand measured from the floor to the lowest rib cage (Appendix 2).

Clothing standards/historical perspective.

As stated previously, there has been no anthropometric survey conducted in Australia for clothing size standards. In 1957, the Apparel Manufacturers Association, with strong support from manufacturers, retailers and women's groups requested Australian Standards to prepare a draft document for the classification of body measurements as well as a size-coding scheme for women's clothing. The Australian Standards Committee on Women's Wear was set up and comprised of: The Apparel Manufacturers Association of N.S.W, The

Victorian Chamber of Manufacturers, The Retailer Traders Association, The Chambers of Commerce, The New South Wales Wholesale Softgoods Association. As a result, the Australian Standard Size Coding scheme for Women's Clothing L9 1959 was prepared and size codes of numerals such as 10, 12, 14, were adopted.

The Standard, however, was based primarily on the classification of body dimensions and the sizing system developed by the United States Department of Commerce and published as Commercial Standards CS 252-58. American standards were therefore used as a basis for the Australian Standards. The standards were adopted after they were compared by Dr Lancaster with the Australian body measurements supplied by Berlei. They showed distinct similarities and required few minor adjustments to the American standard which provided sets of body dimensions appropriate for Australian women. It is of particular interest that some members on the Standards Women's Wear Committee expressed the view that an Australian comprehensive anthropometric survey of the Australian population was required. Other members, however, were concerned that such a survey would be costly and time consuming and believed that existing information was sufficient to justify the implementation of the 1959 Australian Standard (Australian Standard 1959).

The purpose of the Australian Standard was to provide a basis for the sizing of women's clothing in Australia. The standard was prepared in such a way that consumers could identify their body type by comparing height and weight, with body measurements of bust, waist and hip in the various size categories and then be able to choose a size to which they closely resembled. The size ranges and body types consisted of seven main classifications and two minority classifications. The measurements in the nine size classifications have been converted from imperial to metric and rounded off to the nearest millimetre for comparison with other data for this review. Listed below are firstly the definitions of each classification, and secondly, the body dimension and size code for each classification.

Definitions, classifications and size codes of the 1959 Australian Standard.

Misses AS 8 to AS 20 (average woman).
regular height of 1600 mm to 1676 mm weight 45.36 kg, average hip.

Misses Plus AS 10 to (average height full hip).
regular height of 1612 mm to 1651mm large hip girth 101 mm to 127mm larger than bust (average height with fuller hip).

Women's AS 30 to AS 42 (average hip fuller waist).
1612mm to 1689 mm fuller waist average hip (fuller figure).

Women's Plus AS 34 to AS 40 (fuller hip type figure).
short to regular height 1549mm to 1625mm full hip (short with full hip (approximately 254 mm larger than average figure).

Women's Half Size AS 10 ½ to AS 24 ½ (short slim hip).
short height 1524 mm to 1600 mm (smaller hip approximately 254 mm smaller than bust.

Tall Size AS 12 T to AS 20 T (tall figure type).
height tall 1701 mm and above.

Juniors' AS 9 to AS 17 (stick figure).
short to regular height 1511 mm to 1676 mm, small waist, bust and hip approximately the same.

Two minority size categories:

Larger Women's (tall fuller figure).
height 1689 mm, weight over 90.72 kg as well as bust larger than hip (approximately 50 mm larger than hip).

Women's Slender (average height small hip)
height regular 1638 mm to 1676 mm, weight 64.4 kg to 86.1 kg and hip 50 mm smaller than bust.

The classification and approximate percentages in each classification listed in Table 5 are based on American data and listed in Australian Standard (1959) as Appendix C. Height weight and body dimensions of bust, waist and hip have been extracted from the data for each body type from the 1959 Australian Standard (Tables 6 to 14).

Table 5: Approximate Percentages for Each Size Classification Based on American Data (Australian Standard 1959).

Nomenclature	%
Misses Sizes (average height and hip).	21 %
Misses' Full Hip Sizes (average height full hip).	8 %
Women's Sizes (average height fuller waist average hip).	9 %
Women's Full Hip Sizes (short and average height, full hip).	7 %
Women's Half Sizes (short height, average hip).	9 %
Tall Sizes (above average height, average hip).	12 %
Juniors' Sizes (short to average height, small waist, with hip and bust almost the same).	11 %
Larger Women's Sizes (tall height, weight over 90.72, with bust being 50mm larger than hip).	2 %
Women's Slender Hip Sizes (average height with hips approximately 50mm smaller than hip).	4 %

The seven main classifications and the two minor classifications are listed together with the size code, height, weight, bust, waist and hip measurements for each classification (Tables 6 to 15). The measurements in the 1959 categories have been converted to metric and rounded off to the nearest millimetre. The conversions were performed so that comparisons can be made with more current data. The classifications are listed in the order of highest to lowest group population percentage rating as listed in Table 5.

The Misses classification is shown first as this represented the largest grouping of 21 %. From the group population percentage rating it may be assumed that the Misses sizes represented the average woman. The height ranged from 1600 mm to 1676 mm (Table 6).

Table 6: Misses Sizes (Australian Standard 1959).

Size	AS 8	AS 10	AS 12	AS 14	AS 16	AS 18	AS 20
Height (mm)	1600	1612	1625	1638	1651	1663	1676
Weight (kg)	45.36	48.98	53.52	58.96	65.31	72.50	79.8
Bust (mm)	787	825	863	901	939	990	1041
Waist (mm)	596	622	647	685	723	762	812
Hip (mm)	863	889	914	965	1016	1066	2838

The tall women classification is next with a group population rating of 12 %. There are five sizes in this range starting from size 12 to size 20. The height in this range starts at 1701 mm to 1752 mm (Table 7).

Table 7: Tall Women Sizes (Australian Standard 1959).

Size	AS 12 T	AS 14 T	AS 16 T	AS 18 T	AS 20 T
Height (mm)	1701	1714	1727	1739	1752
Weight (kg)	53.52	59.87	65.77	73.48	80.74
Bust (mm)	838	889	939	990	1041
Waist (mm)	635	673	711	762	812
Hip (mm)	914	952	990	1041	1092

The group population rating of the Junior sizes was 11 %. The numbers of sizes in the range consisted of five and were recorded in odd numerals from 9 to 17. The height commenced at 1511 mm (the shortest in the classifications) up to the Average height of 1676 mm (Table 8).

Table 8: Juniors' Sizes (Australian Standard 1959).

Size	AS 9	AS 11	AS 13	AS 15	AS 17
Height (mm)	1511	1549	1587	1638	1676
Weight (kg)	43.54	48.98	54.88	61.23	68
Bust (mm)	800	838	889	939	990
Waist (mm)	584	622	660	698	736
Hip (mm)	850	889	927	965	1003

The next classification was the Women's Sizes with a group population rating of 9 %. The size code in this classification differed from the other classification with numerals starting at 30 to size 42 (Table 9).

Table 9: Women's Sizes (Australian Standard 1959).

Size	AS 30	AS 32	AS 34	AS 36	AS 38	AS 40	AS 42
Height (mm)	1612	1625	1638	1651	1663	1676	1689
Weight (kg)	51.71	56.70	62.14	68.94	72.20	83.46	90.72
Bust (mm	838	889	939	990	1041	1092	1143
Waist (mm)	635	685	736	787	838	901	965
Hip (mm)	889	927	965	1016	1066	1117	1168

The Women's Half Sizes also had a group population rating of 9 % the same as the Women's Sizes. The size codes in this classification were recorded as ½ sizes starting from size 10 ½ to 24 ½. The height was smaller than the Women's Sizes starting at 1524 mm to 1600 mm (Table 10).

Table 10: Women's Half Sizes (Australian Standard 1959).

Size	**AS 10 ½**	**AS 12 ½**	**AS 14 ½**	**AS 16 ½**	**AS 18 ½**	**AS 20 ½**	**AS 22 ½**	**AS 24 ½**
Height(mm)	1524	1536	1549	1562	1574	1587	1600	1600
Weight (kg)	48.08	53.50	58.96	65.31	72.50	79.80	87.09	92.53
Bust (mm)	838	889	939	990	1041	1092	1143	1193
Waist (mm)	647	698	749	800	850	914	977	1041
Hip (mm)	889	927	965	1016	1066	1117	1168	1219

The next classification is the Misses full hip. The group population rating for this classification was 8 %. The height of this figure type is average with the hips being approximately 100 mm larger than the bust measurement. It is interesting to note that there are only four sizes in this range (Table 11).

Table 11: Misses Full Hip Sizes (Australian Standard 1959).

Size	**AS 10**	**AS 12**	**AS 14**	**AS 16**
Height (mm)	1612	1625	1638	1651
Weight (kg)	51.71	56.24	61.68	68.04
Bust (mm)	812	863	901	939
Waist (mm)	622	647	685	723
Hip (mm)	914	965	1016	1066

The group population rating for the Women's Full Hip was 7 %. The size classification also has only four sizes in the range the same as the Misses full hip size. The height is short starting from 1549 mm to 1625 mm (Table 12).

Table 12: Women's Full Hip Size (Australian Standard 1959).

Size	AS 34	AS 36	AS 38	AS 40
Height (mm)	1549	1574	1600	1625
Weight (kg	60.78	67.13	73.48	80.74
Bust (mm)	939	990	1041	1092
Waist (mm)	736	787	838	901
Hip (mm)	1016	1066	1117	1168

The Women's Slender Hip Size is one of the minority classifications which only had 4 % population group rating. The height ranges from 1638 mm to 1676 mm. The hips, however, are approximately 50 mm less than the bust measurement (Table 13).

Table 13: Women's Slender Hip Size (Australian Standard 1959).

Size	AS 36	AS 38	AS 40	AS 42
Height (mm)	1638	1633	1663	1676
Weight (kg)	64.41	71.66	78.92	86.18
Bust (mm)	990	1041	1092	1143
Waist (mm)	774	825	889	952
Hip (mm)	939	990	1041	1092

The final classification is the Larger Women's Sizes, it also has a very small group population rating which is only 2 %. It is interesting to note the height and weight is the same across all the five sizes. The hip measurement is slightly smaller than the bust of approximately 25 mm. The size code has double numerals starting from size 44 to 52 (Table 14).

Table 14: Larger Women's Sizes Australian Standard (1959).

Size	AS 44	AS 46	AS 48	AS 50	AS 52
Height (mm)	1689	1689	1689	1689	1689
Weight (kg)	*90.72 +	*	*	*	*
Bust (mm)	1193	1244	1295	1346	1397
Waist (mm)	1016	1079	1143	11206	1397
Hip (mm)	1219	1270	1320	1371	1422

Australian Standard (1975).

Revisions of the 1959 standard have been conducted since 1970 and included a change to metrication in which bust, waist, and hip measurements of Australian women were converted from imperial to metric and rounded off to the nearest centimetre. The Standards Association of Australia conducted a survey with the assistance of the Australian Women's Weekly during 1969. This survey consisted of a self reporting questionnaire to which 11,455 women responded and supplied information in relation to bust, waist, hip, and height measurements and their age (1975). As a result of this survey the Australian Standard L 9 was up-dated in the form of a size coding scheme based on bust, waist and hip measurements. It appears that detailed body measurements were retained from the 1959 standard. The latest addition of the Australian Standard (1997) states that the 1997 edition "... confirms the data in the previous edition, due to the absence of more up-to-date survey". It is of particular interest that the revised standards show the number of size categories charts reduced to five instead of nine as in the previous standard. The size codes to fit bust, waist and hip are all consistent with the use of numerals such as 8, 10, and 12, up to size 26 (Table 15). The tables differ vastly from the 1959 standards in that there is a consistent 50 mm interval between bust, waist and hip in each classification. The five

classifications in the 1997 Australian Standard include; Average Woman, Slim Hips and Full Hips, Short Woman and Tall Woman and are listed below in each classification.

The height in the average women's classification ranges from 1600 mm to 1690 mm. The hip measurements in all sizes are 50 mm larger than the bust, which appears to be the accepted norm (Table 15).

Table 15: Average Women (Australian Standard 1997).

Size	8	10	12	14	16	18	20	22	24	26
Height (mm)	1600	1610	1630	1640	1650	1666	1680	1680	1690	1690
Weight (kg)	45	49	54	59	65	73	80	84	91	-
Bust (mm)	750	800	850	900	950	1000	1050	1100	1150	1200
Waist (mm)	550	600	650	700	750	800	850	900	950	1000
Hip (mm)	800	850	900	950	1000	1050	1100	1150	1200	1250

The Variable fittings consist of 4 sizes in each classification and range from size 10 to size 16 (Table 16). No waist measurement is given for either of these classifications. It may be assumed that the waist measurements used in the average women's size chart are to be used. As the variable hip sizes are together in the one chart the full hip measurements are in bold text for ease of comparison. The slim hip category shows the bust and hip are the same measurement. The full hip measurement is 100 mm larger than the bust measurement. As can be seen from the variable chart, the slim and full hip categories only have four sizes in each range. It is of interest that this is the only classification in the Australian Standard (1997) that caters for the full hip figure.

Table 16: Variable Fittings- Slim Hips and Full Hips (Australian Standard 1997).

Size	10 Slim hip	**10 Full hip**	12 Slim hip	**12 Full hip**	14 Slim hip	**14 Full hip**	16 Slim hip	**16 Full hip**
Height	1510	1610	1550	1630	1590	1640	1640	1650
Weight	44	52	49	56	55	62	61	68
Bust	800	800	850	850	900	900	950	950
Waist	-	-	-	-	-	-	-	-
Hip	800	900	850	950	900	1000	950	1050

The short women's classification has the same number of sizes in the range as the average women's classification. The bust, waist, and hip measurements are the same in both short women's and average women's chart (Table 17).

Table 17: Short Women (Australian Standard 1997).

Size	8	10	12	14	16	18	20	22	24	26
Height (mm)	1500	1520	1520	1540	1550	1560	1570	1590	1600	1600
Weight (kg)	43	46	48	54	59	65	73	80	87	93
Bust (mm)	750	800	850	900	950	1000	1050	1100	1150	1200
Waist (mm)	550	600	650	700	750	800	850	900	950	1000
Hip (mm)	800	850	900	950	1000	1050	1100	1150	1200	1250

The tall women's classification has five sizes ranging from size 12 to size 20. The height of women in this classification ranges from 1700 mm starting at size 12 to 1750 at size 20. The increase in height is quite substantial of about 60 to 70 mm from the average women

sizes, which appears to be reasonable. The weight, however, for the tall women and average women is the same for size 12 in both classifications and only 1kg more in the other sizes in the taller classification than the average classification (Table 18).

Table 18: Tall Women (Australian Standard 1997).

Size	12	14	16	18	20
Height (mm)	1700	1710	1730	1740	1750
Weight (kg)	54	60	66	74	81
Bust (mm)	850	900	950	1000	1050
Waist (mm)	650	700	750	800	850
Hip (mm)	900	950	1000	1050	1100

Size 14 Australian Standard (1997), average women, slim hip, full hip, short women and tall women compared.

The following Table 19 consists of height, weight, bust, waist, and hip measurements of Size 14 from each of the Australian Standard (1997) classifications. It is interesting to see that the bust is the same across all classifications. The other point of interest here is that no waist measurement has been recorded for the Slim Hip and Full Hip classification and that the hip measurement is the same for the Average Figure, Short Women and Tall Women.

Table 19: Size 14 Average Woman, Slim Hip, Full Hip Women, Short Women Tall Women Compared (Australian Standard 1997).

Size14	**Height**	**Weight**	**Bust**	**Waist**	**Hip**
Average Women	1640	59	900	700	950
Slim hip	1590	55	900	-	900
Full hip	1640	62	900	-	1000
Short Women	1540	54	900	700	950
Tall Women	1710	60	900	700	950

American Standard for adult female misses figure type sizes 2-20 (American Society for Testing and Materials 1995a).(A.S.T.M. 5585-95).

The measurements in this Standard were derived primarily from the anthropometric survey conducted by O'Brien and Shelton (1941) and updated not from a new anthropometric survey but from designer experience, and from market observations which were cross-checked with other databases (A.S.T.M 5585-95). No weight has been recorded for any size. The size codes for the bust, waist and hip of the American Adult Female Misses Figure Type appear to have no correlation with the size codes outlined in the 1959 or 1997 Australian Standard. The numerals used in the American Misses Sizes are different and much smaller than those used for previously discussed standards. The first size starts at size 2 with a bust measurement of 813 mm (Table 20) which equates to the Australian Standards size 10 that has a bust measurement of 800 mm. The height, waist and hip of the American Standard size 2 also equates to the size 10 of the Australian Standard (1997) (Table 15). The size intervals between bust, waist and hip in all sizes up to size 18 in the American Standard are approximately 25 mm to 38 mm compared to Australian Standard of 50 mm across all sizes (Table 20).

Table 20: Standard Table of Body Dimensions for Adult Female Misses Figure Type Sizes 2-20 (A.S.T.M.-D 5585 1995a).

Size	2	4	6	8	10	12	14	16	18	20
Height (mm)	1610	1626	1638	1651	1664	1676	1690	1702	1715	1727
Weight (kg)	-	-	-	-	-	-	-	-	-	-
Bust (mm)	813	838	864	890	914	952	991	1029	1079	1130
Waist (mm)	610	635	660	685	711	749	787	826	876	927
Hip (mm)	864	902	927	952	978	1016	1054	1092	1143	1194

American Standard for women 55 years and older. (American Society for Testing and Materials 1995b).(A.S.T.M. 5586-95).

Although no anthropometric survey was conducted for the entire population of American women, an anthropometric survey was, however, conducted by Reich and Goldberry from the University of Arizona during 1993 for American Women 55 years and over. A representative sample of 6,786 women from 38 states took part in the survey. The number of body dimensions in total was 58 which included 45 dimensions based on research conducted by O' Brien and Shelton (1941) which were published by U.S. Department of Commerce as P.S. 42-70. The extra 13 body dimensions illustrate physiological changes that occur in the older women which are not represented in the P.S. 42-70 data that continue to be used for all adult females (A.S.T.M. 5586-95). As a result of the 1993 survey for Women 55+, six classifications of female figure types have been identified. Body dimensions are recorded for each classification with the code and letters of each classification type. The five figure types and the codes in brackets are listed below:

Women 55 + of Junior Figure Type (J).
Women 55+ of Junior Petite Figure Type (JP).
Women 55+ of Miss Petite Figure Type (MP).
Women 55+ of Misses Figure Type (M).
Women 55+ of Misses Tall Figure Type (MT).
Women 55+ of Women's Figure Type (W).

The classifications and body dimensions of height, weight, bust, waist, and hip are listed in Tables 21 to26.

The letter J precedes the size code for the American Woman of Junior Figure Type. Uneven numerals starting from 3 to 17 are used for this classification. The height is short to average ranging from 1549 mm to 1647 mm (Table 21).

Table 21: American Women 55 and Over of Junior Figure Type (A.S.T.M. 1995b).

Size	J3	J5	J7	J9	J11	J13	J15	J17
Height (mm)	1549	1568	1575	1587	1599	1610	1621	1647
Weight (kg)	43.09	46.92	50.87	52.47	57.21	61.64	66.20	75.35
Bust (mm)	757	798	825	853	889	928	947	989
Waist (mm)	665	692	716	743	773	814	836	879
Hip (mm)	868	893	924	935	969	995	1028	1047

The letters JP precede the size code for The Junior Petite Figure Type. The numerals used are odd and start from 3 to 15. The height is much shorter than the Women 55+ of Junior Figure Type (Table 21) and ranges from 1441 mm to 1537 mm (Table 22).

Table 22: American Women 55 and Over of Junior Petite Figure Type (A.S.T.M. 1995b).

Size	JP3	JP5	JP7	JP9	JP 11	JP13	JP15
Height (mm)	1441	1451	1473	1481	1501	1511	1537
Weight (kg)	48.86	48.43	49.20	53.56	55.43	60.74	63.67
Bust (mm)	852	844	859	899	912	956	947
Waist (mm)	752	749	752	794	802	850	843
Hip (mm)	915	914	916	952	962	1003	1029

The letters MP precede the size code for the Women 55+ of Miss Petite Figure Type and the numerals are even numbers. The height is short and ranges from 1514 mm to 1589 mm (Table 23).

Table 23: American Women 55 and Over of Miss Petite Figure Type (A.S.T.M. 1995b).

Size	MP8	MP10	MP12	MP14	MP16	MP18
Height (mm)	1514	1534	1549	1561	1575	1589
Weight (kg)	45.28	49.46	53.20	57.70	62.82	69.40
Bust (mm)	798	832	872	907	954	1004
Waist (mm)	697	730	759	792	837	893
Hip (mm)	885	914	949	976	1008	1055

The letter M precedes the size code for the Women 55+ of Misses Figure Type and the numerals are even. The sizes start at size 6 and range up to size 22. Height ranges from 1592 mm to 1703 mm, which is from average height to the beginning of the tall height (Table 24).

Table 24: American Women 55 and Over of Misses Figure Type (A.S.T.M. 1995b).

Size	M6	M8	M10	M12	M14	M16	M18	M20	M22
Height (mm)	1592	1610	1625	1636	1650	1665	1678	1687	1703
Weight (kg)	46.90	48.66	52.21	57.02	61.11	65.61	73.33	78.99	86.04
Bust (mm)	778	798	828	868	906	945	993	1041	1098
Waist (mm)	676	691	721	757	788	827	875	939	998
Hip (mm)	906	901	924	960	988	1016	1057	1103	1138

The letters MT precede the size code of the Women 55+ of Tall Figure Type and the numerals are even. The height ranges from 1693 mm to 1773 mm (Table 25).

Table 25: American Women 55 and Over of Misses Tall Figure Type (A.S.T.M. 1995b).

Size	MT 10	MT12	MT14	MT16	MT18	MT20	MT22
Height (mm)	1693	1708	1718	1734	1753	1769	1773
Weight (kg)	56.38	62.06	66.82	72.18	77.49	85.07	98.89
Bust (mm)	843	901	937	969	1014	1064	1139
Waist (mm)	723	778	820	857	899	960	1045
Hip (mm)	950	987	1018	1053	1081	1122	1195

The letter W precedes the size code for the Women 55+ of Women's Figure Type. The numerals are even and start at 34 to 52. The height is in the average range (Table 26).

Table 26: American Women 55 and Over of Women's Figure Type (A.S.T.M.1995b).

Size	W34	W36	W38	W40	W42	W44	W46	W48	W50	W52
Height (mm)	1623	1636	1646	1658	1687	1690	1695	1687	1658	1635
Weight (kg)	67.25	76.61	80.52	88.11	93.58	103.33	105.92	116.98	115.22	129.28
Bust (mm)	987	1030	1079	1120	1164	1191	1269	1295	1396	1480
Waist (mm)	870	922	976	1022	1060	1105	1157	1260	1245	1320
Hip (mm)	1027	1078	1120	1170	1178	1269	1282	1364	1341	1580

Sizing systems.

The sizing system for women's garments is quite complex. The literature and data outlined above show that firstly, no anthropometric survey of the Australian population has ever been conducted specifically for the clothing and design industry in Australia. Secondly, it shows that present day Australian Standards are based on outdated data. Thirdly, it shows that present day Australian Standards Sizing system is in reality inconsistent with the size and shape of present day Australian women. It could be further argued that the final sample of the women in the Berlei survey consisted of a disproportionate percentage of females in the age bracket of 15 to 24 years of age. Because the age group of the Berlei survey consisted of a large percentage of younger females, a realistic comparison of the Berlei data cannot be made with the American data of O'Brien and Shelton from which the American Standards were derived.

The problems associated with the clothing sizing system are not confined to any single country. Figure types and body shapes vary from country to country and sometimes within a country. Sizing systems also vary from country to country. Kunick (1967) refers to the terms "measurement and size" as being synonymous and puts forward the view that the first step in building a sizing system is to obtain reliable data of a population as a means of identifying the range of variation, and distribution of figure types. The International Organisation for Standardisation (1991) is of the view that the sizing of clothes concerns garments, not body size and therefore is an exercise in applied anthropometry.

Size uniformity.

There appears to be no uniformity of women's garment sizes between designers and manufacturers. Garments of the same labelled size and a similar cut can and do, vary quite significantly (Sew Trade Dec/Jan 1989-90, Winks 1997). Winks puts forward the view that a uniform system of sizing would benefit manufacturers, distributors and customers. He cites a figure from the United States Department of Commerce of 40 % of women's and children's garments sold are returned due to incorrect size. Although standardisation will not eliminate the problem Winks believes it will, however, minimise it.

Members of the Standards Association (Australian Standard 1997) expressed concern that there appears to be an increasing trend in the labelling of garments, where, size codes are being transposed one or two positions to the right of the designated size code. By moving the size code to the right of the body dimensions the garment is labelled smaller size. This they claim detracts from the usefulness of the size code as well as creating confusion for the consumer and adds to uncertainty of fit. The moving of the size code one or two positions down with respect to the body dimensions may be the reason that varying labels of the same size differ considerably in the fit of the garment.

An article in Sew Trade (1989-1990) cites Jerram, (chairman of the Australian Standard for the sizing of women's clothing during the 1970's and 1980's), who expressed the view that millions of dollars worth of garments and furniture are produced on statistics that have no real correlation to the Australian reality. Jerram claims that the standards for women and children's garments are old, incorrect and based on overseas data of the 1950s. Jerram also responded to an article in The Australian (September 1997) in which he expressed the view that the Australian Standards are not correct, and cannot be correct, until funding is made available to conduct a proper body survey of the Australian population. Moncrief, Public Relations Officer of Standards Australia (Ragtrader March 1998) supports Jerram's view that without much needed funding, the Australian clothing standards would remain unchanged. Jerram states that several attempts had been made to get funding for a proper anthropometric survey without success. He adds that retailers were prepared to assist with funding, however, manufacturers and the Government were reluctant to do so and that a Federal Minister of Consumer Affairs told him that an anthropometric survey was "not important".

Consumer frustration when buying garments.

The concern about the size and shape of Australian women dates back to at least the 1980's when the Woman's Day/Woman's World (October 1980) attempted to ascertain the shape of the average Australian woman. In an interview with an Australian Standards Representative they were told that the measurements in the Australian Standards were doubtful and inapplicable and that they believed that Australian women were taller and larger, however, there was no proof to support these comments.

It appears that Standards Association of Australia has over the years attempted to correct the standards for women's and children's clothing, which they believed were incorrect without success. The stress associated with buying garments will continue until appropriate changes to the sizing system are made. Without, however, a much needed albeit expensive and time consuming anthropometric survey being undertaken to ascertain in reality what is the current size and shape of the Australian female population the present flawed sizing system will be perpetuated. In short, it is apparent that the present sizing system is outdated, outmoded and inadequate for the present day Australian female population.

Media publicity.

Media publicity and articles over the past few decades have continually raised issues of concern in relation to consumer frustration when purchasing ready-made garments. Trying to buy clothes that fit for many females has become a frustrating experience. Various media articles refer to concerns and frustration women have expressed in attempts to purchase clothing that fits. The psychological effects and devastation of self-image that is emerging, as women appear to be changing shape has been the subject of much comment. Listed below are some media articles that contain commentary in relation to changing body shapes. The frustration experienced by women in particular, trying to buy clothes that fit and the psychological aspects associated with self-image and fear are a cause for concern. The fear is that of becoming fat and therefore being perceived to be undesirable and unfashionable.

Media articles.

Solving the Sizing Dilemma.	Ragtrader March; 1998.
This is a Call to Arms and bottoms, bellies and thighs and hips.	New Woman: April, 1997.
Your Body- Reality Check.	Dolly Magazine: August, 1997.
Go Figure-It's Official Women are Getting Bigger.	Cleo Magazine: September, 1996.
A Season where Nothing Suits.	The Advertiser: November, 1996.
Are women Changing Shape?	Sunday Mail: October, 1996.

Its Time to Get Real.	New Woman: July, 1995.
Fitting Up-The Fashion Fascists.	Sydney Morning Herald: November 1994.
What Shape is Miss Average.	Woman's Day / Woman's World: October, 1980.

An article (Appendix 3) was read to members of a Queensland Branch of Probis sometime in the latter part of the year 2000. A copy of the article was given to a female sales assistant at a swimwear boutique in Noosa Heads Queensland. On follow up for permission to use the article in this thesis it appears that it was taken from the Internet and no author's name was available. Although the article is related specifically to buying a swimwear outfit, it encapsulates the frustration stress and anxiety that many women experience when buying clothing.

According to the International Organisation for Standardisation (I.S.O) (1991) the problem with sizing has existed ever since the introduction of mass-produced ready to wear garments. Manufacturers needed to know what size garments to make as well as how to label them. The sizing problem is even more complex as individual manufacturers make garments to their own size charts or to the sizing of the retail houses they supply. The I.S.O believes this does not extend consumers choice but adds to the already complex task of finding a garment that is a reasonable fit for the wearer. Many manufacturers use psychological aspects and downsize their garments by labelling a size 12 garment a size 10 using the flattering approach in the hope of more sales. As stated earlier in the thesis, this is a practice that Australian Standards do not agree with but which is wide spread and entrenched.

The problem of sizing and fitting of women's clothing is not only a concern for Australian women, American women experience the same dilemma. Holzman (1996) cites Goldsberry that American sizes are derived from studies of American women during the 1940s and she claims that women's shapes have changed dramatically over the past several decades which she believes is due to changes in nutrition, lifestyle and ethnic composition.

Advanced technology in anthropometry.

During the past decade, highly sophisticated technology such as computer assisted imaging, shadow scanning and digital photography have become standard tools used in the discipline of applied anthropometry. Jones *et al.* (1989) conducted studies on British infants, children, youths and adults aged 16 to 65 years. The studies were conducted on behalf of Marks and Spencer Limited together with a syndicate of clothing manufacturers. The studies involved the use of a computerised television 3-D measurement system. Two studies were conducted with 4,500 and 6,500 participants in a nationally representative sample. It appears that the automated system was capable of taking measurements quickly, accurately and comprehensively, however, Jones *et al.* expressed the view that further studies on such a large scale are unlikely due to the high cost, the time and labour requirements.

Real body measurement will take the guessing out of the designing game (Consumer Reports 2000). The Civilian American European Surface Anthropometry Resource (CAESAR) project using a sophisticated laser three dimensional scanning system is about to provide more accurate data on the real proportions of the human figure. According to the report the largest database ever created will contain precise body dimensions of 8,000 people of different ages, ethnicities and varying shapes and sizes and will replace the outdated body measurements used by designers from the surveys conducted 60 years ago under the Works Projects Administration. Although it is not specified, it is assumed by this writer that the survey referred to in the Consumer report was in fact the survey conducted by O'Brien and Shelton on behalf of United States Department of Agriculture in co-operation with the Works Projects Administration (O'Brien and Shelton 1941).

The design of products and clothing for the 21st century will be based on new data obtained from the CAESAR project (Hughes 2000). The data will be collected from 4,000 people in the United States and 6,800 people across Netherlands and Italy. The participants will include male and female participants aged 18 to 65 years. The survey started during 1998 in Los Angeles. Since then cities such as Detroit, Houston and Minneapolis have also been included with other cities in America. San Francisco and Atlanta were specifically included so that a diverse range of the population will be obtained which included Asians, African Americans and Hispanic Americans.

Chapter 3: Material and Methods.

Introduction.

As discussed in Chapter 1, the aim of the present research required the collection of data to describe the distribution of the Australian women's body size and shape. This allowed for a comparison of present day Australian women with data of Australian Women over the past sixty years. This research required the collection of data to ascertain:

1. the size and shape of South Australian women using anthropometry.
2 the size and shape of South Australian women using standardised photographs.

This chapter will discuss methods and procedures used for the research. The first section deals with anthropometric measurements and the materials and equipment used for the data collection. The second section will discuss the photographic procedure and method used. For this survey both anthropometric and photographic data were collected between September 1998 and September 1999.

Ethics approval/procedure.

The University of Adelaide Human Research Ethics Committee approved the survey as project No H/24/98. Each participant was given an information sheet (Appendix 4) and a consent form (Appendix 5) to read and sign prior to their involvement in this study. Because of the sensitive nature and close proximity required when taking body measurements and photographs, due care was taken to ensure the participant's comfort and to avoid any embarrassment. All participants wore a closely fitted stretch cotton vest, over their own bra and pant for both the body measurements and photographs. This ensured consistency throughout the anthropometry and standardised and photographic components. During the photographic process participants wore a mask to partially cover the face, to avoid identification.

Participants.

All participants were self-selected to be a representative sample of the South Australian women's population. The participants were selected via those who responded to advertisements. Potential bias that may have occurred through this selection process did not appear prevalent due to the range and number of body sizes and shapes of the volunteers. Advertisements included brochures, newspaper, university open day, and verbal and written information to specific groups.

Media advertisements focused on a variety of sources, which included: educational institution, community groups, community health centres, professional groups, sports group, and social and hospitality groups.

The participants were from a diverse range of occupations and backgrounds. These included scientists, doctors, teachers, nurses, sales personnel, clerks, chefs, waitresses, cleaners, self-employed professionals, retirees and homemakers. The final age group categories assessed were 18-29, 30-39, 40-49, 50-59, 60-69, and 70-82 years. A sample of 163 women of varying socio-economic status took part in the survey, and upon analysis of the results this appeared to be representative of the South Australian population. All the participants except three were from the Adelaide area, and represented the Northern, Southern, Eastern and Western suburbs of Adelaide. The remaining three participants were from Queensland. For the purpose of this research this sample will hereafter be referred to as S.A Women (1998-1999).

Equipment.

A measuring garment consisting of a close fitting cotton stretch vest in a variety of sizes ranging from size 12 to size 24 were used for measuring the body dimensions and the taking of photographs. The cotton vests were chosen due to their easy laundering qualities. They had to be freshly washed for each participant for hygiene reasons. The measuring garment worn over the participants pant and bra was selected on the basis that the garment provided a close fit, which enabled body contours to be easily seen. It was also felt that the one-piece measuring garment being a sleeveless vest covering the waist, crotch and buttocks was less embarrassing for participants as compared to that of the measuring costumes of pant and bra used in previous studies (O'Brien and Shelton 1941, Board of Trade 1957). Although the

participants were willing to participate in the study, many were sensitive about their body shape and size. The use of the one-piece garment assisted the participants to be more relaxed and comfortable and was not in fact detrimental to the measuring procedure.

A fibre glass tape-measure 15 mm wide was used to take the body dimensions. Cotton waist tapes with velcro closing in a range of sizes were used. The waist tape closest to the waist measurement of the participant was used to define the natural waistline. The waist tapes were safer than the traditional method of using pins. A measurement chart (Appendix 6) was used to record: participant's body dimensions, height, weight, age, date of birth, place of birth, and the photographs of each participant. White self-adhesive stickers 20 mm by 20 mm wide were used to place landmarks on the body. A black marking pen was used to place cross marks on the adhesive stickers. A pen was used to record the body dimensions. A set of Soehnle digital weight scales was used to obtain the weight of each participant. A metal tape measure 15 mm wide and 50 mm long was used in conjunction with an L square ruler approximately 400 mm by 800 mm as an aid in taking the height measurement.

Procedure.

On completion of the consent form each participant was given the stretch cotton vest that closely approximated their body size, which they wore over their own pant and bra. Participants changed into the vest in a private area. All participants were most co-operative during the measuring process. Some participants, however, were a little sensitive in these circumstances and with all participants, the measuring and photographic procedure was performed as efficiently as possible to minimise embarrassment for the participant.

Landmarks.

With the volunteers permission 20 mm white self-adhesive stickers were used to place landmarks on the body. This method was preferred to direct pencil markings placed on the skin of each participant as used by O'Brien and Shelton (1941) and Board of Trade (1957). A black marking pen was used to place a cross mark at each specific point on the white sticker. Where possible the landmarks were placed with relevance to the skeletal structures (O'Brien and Shelton 1941).

In this study six landmarks were used to identify specific points from which measurements were taken on the body. The neck base was determined by placing landmarks at the 7th cervical vertebra (cervicale) , the intersection of right and left lateral neck points, shoulder points, and in the jugular notch. A landmark was also placed at the acromion extremities on the right and left side of the body to determine the shoulder joint position.

The waistline was defined by placing a cotton waist tape around the natural waistline. The waist tape was left in this position until all measurements were taken. The waistline location plays a major role in the measuring process, as this is the location that many measurements are taken to and from. Particular care was taken to make sure that the waist tape placed over the cotton vest stayed in the correct position throughout the measuring process.

Care was taken to ensure that the skeletal structure and anatomical points were taken into consideration throughout the measuring process, in part because of the limited number of landmarks used in this survey compared to previous studies such as O'Brien and Shelton (1941) and the Board of Trade (1957). The measuring technique was similar to the above studies and the landmarks that were used were comparable with those studies.

Body dimensions.

Thirty-seven body dimensions and weight were used in this survey. These dimensions were determined after the comparison of data from various studies (Appendix 2). These studies included: O'Brien and Shelton (1939), Lancaster (1957), Board of Trade (1957), International Standard Organisation I.S.O. 8559 (1989), Standard Table of Body Measurements for Women 55 and Older (1993), Standard table of body measurements and Adult Female Figure Types Sizes 2 - 20 (1995a), Australian Standard (1997). Two studies that provide well-documented descriptions of anthropometric measuring techniques of the human female body are the American study by O'Brien and Shelton (1941) and the British study conducted by the Board of Trade (1957). These two studies are illustrated and provide techniques and procedures for anthropometric studies specifically relevant to the clothing industry. They were used as guidelines for the anthropometric technique and procedures for this study. Where possible, all methods of taking the body dimensions were also consistent with I.S.O (1989). All body dimensions were taken with a metric tape measure and measurements were recorded to 1 mm accuracy. Wherever possible all measurements were taken on the right side

of body. This is comparable to O'Brien and Shelton (1941). The list of body dimensions assessed in this study is given here in the order in which they were taken and detailed measurement procedure descriptions follow.

List of body dimensions.

Neck girth circumference (neck base girth)
Bust girth circumference
Over bust circumference (chest)
Under bust circumference
Waist circumference
Upper hip circumference (abdominal ext)
Height of upper hip (waist to abdominal ext)
Lower hip circumference
Height of lower hip (waist to lower hip)
Centre front length (jugular notch to waist)
Front neck shoulder point to bust point
Front neck shoulder point to waist
Bust separation (horizontal between nipples)
Across chest distance
One shoulder length
Shoulder to shoulder distance
Centre back length
Back neck shoulder point to waist distance
Across back width
Side length
Armhole circumference
Upper arm (1/3 anatomical arm) circumference
Lower arm (2/3 anatomical arm) circumference
Elbow circumference
Wrist circumference
Hand circumference
Outside sleeve length
Waist to floor (waist length) height
Inside sleeve length (inside arm length)
Thigh circumference
Knee (bent) circumference
Inleg (crotch length)
Front to back crotch length
Waist to seat (crotch depth) distance
Trunk height (sitting)
Cervical height (standing)
Height
Weight (kg)

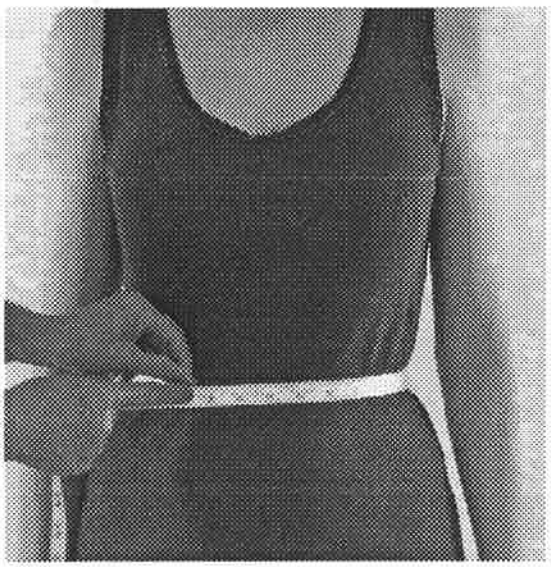
Measurements.

Before taking measurements each participant was asked to put on a standard cotton vest. The waist measurement was taken and recorded, then a waist tape was placed around the waist over the cotton vest and secured firmly. The waist tape was left in its position throughout the measuring process. All standing measurements were taken with the participant standing in an upright position and the body relaxed. Particular attention was taken to see that the participants did not raise or lower their shoulders whilst measurements were taken. All measurements taken from the upper section of the torso were taken to the bottom edge of the waist tape. The lower sections, for example, waist to floor were taken from the bottom edge of the tape to the required position, in this case the floor.

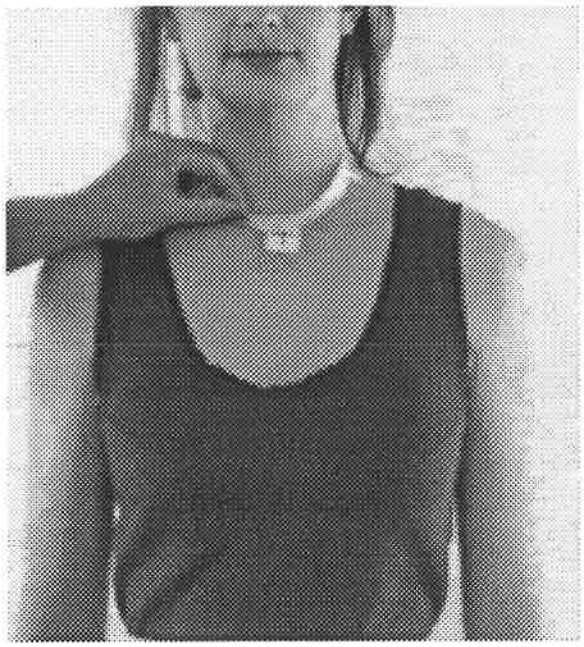
For all standing measurements the feet were placed approximately 60 mm apart and weight distributed evenly on both feet, comparable to Standard Table of Body Measurements for Adult Female Misses Figure Type, Sizes 2 - 20 (1995a). All body measurements were consistent with I.S.O (1989) unless otherwise stated. Estimates of accuracy and repeatability were not carried out since the method is subjective. The body measurements were taken according to the procedures as follows:

Waist circumference.

The waist circumference was taken over the vest at the narrowest part of the waistline. On some participants, however, the narrowest part of the waist was difficult to find, due to excess adipose tissue around the waist and the abdominal regions. On these participants this position was found by palpating the lateral torso midway between the iliac crest and the most inferior point of the lowest rib to find the waist position.



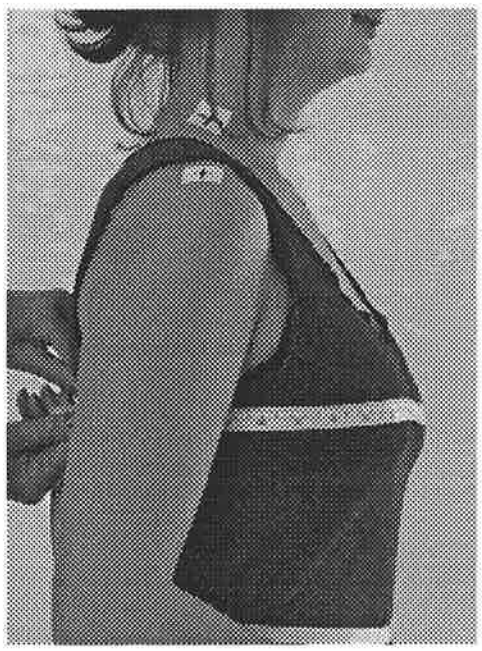
Neck girth circumference.



With the measurer standing in front of the participant the tape measure was placed over the landmark at the 7th cervical vertebra, around the neck touching the lateral landmarks on left and right side of the neck and shoulder intersection, then to the landmark at suprasternale. This method was not consistent with the I.S.O (1989) or the American studies, as a chainette was not used. It is expected the end result will be similar with both these methods as the chainette and tape measure were in the same position on the neck. The Board of Trade (1967) used a similar method to what is being used in this study.

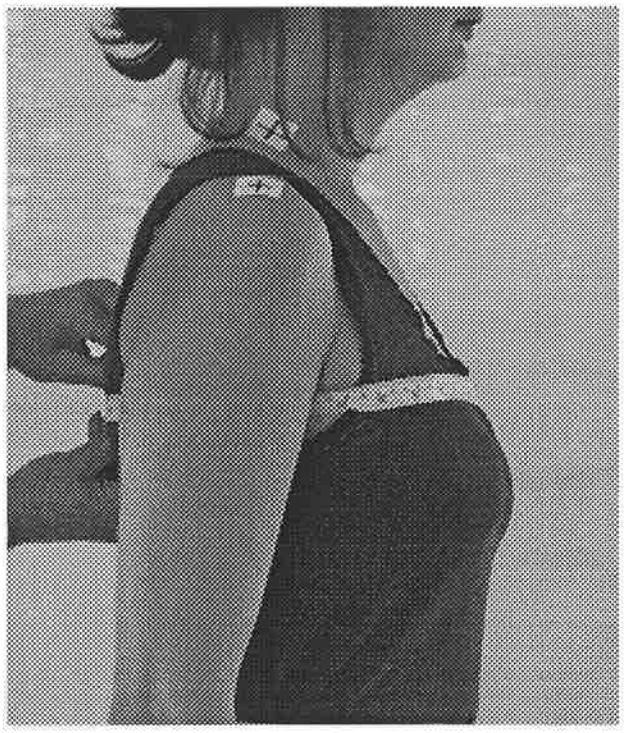
Bust girth.

With the measurer standing behind the participant the tape measure was placed horizontally around the body over the fullest part of the bust with the tape measure parallel to the floor. On some figure types particularly the fuller figure, the participant was asked to hold the tape measure over the fullest part of the bust whilst the tape was passed around the circumference of the bust. Care was taken to see that when the tape measure was placed around the bust there were no indentations on the fleshy part of the bust. The procedure of taking the bust measurement in this study is similar to that used in the Australian Standards 1972 and 1959 as well as, Shelton and O'Brien (1941), Board of Trade (1957) and A.S.T.M (1995b) (Appendix 2). This method was perceived to be more accurate and provided a procedure that would involve less technical error concerning how and where the bust girth circumference is taken.



Chest (over bust).

With the measurer standing behind the participant the tape measure was passed horizontally around the trunk, high up under the armpit, across the top of the bust, and around to back.



Under bust.

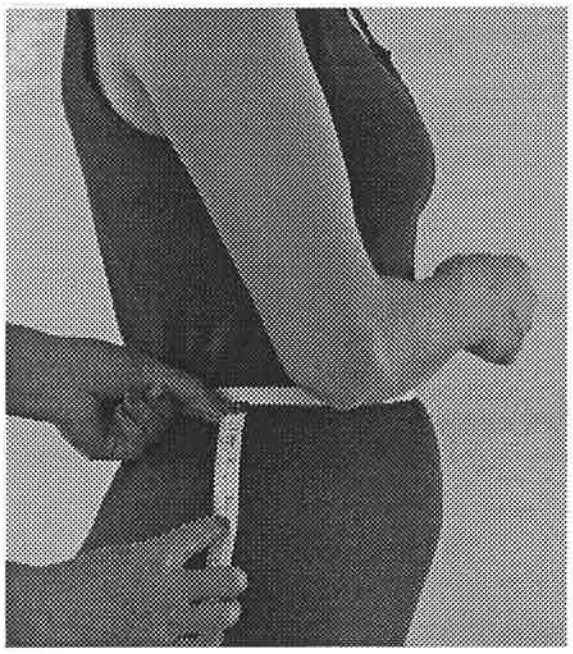
With the measurer standing behind the participant, the tape measure was placed horizontally around the torso under the breast, under the arm, then to the back. The tape measure was positioned parallel to the floor.

Upper hip (abdominal extension).

With the measurer standing in front of the participant, the tape measure was placed horizontally around the torso at the greatest anterior protrusion of the abdomen. The tape measure was parallel to the floor. This method was consistent with all studies reviewed.

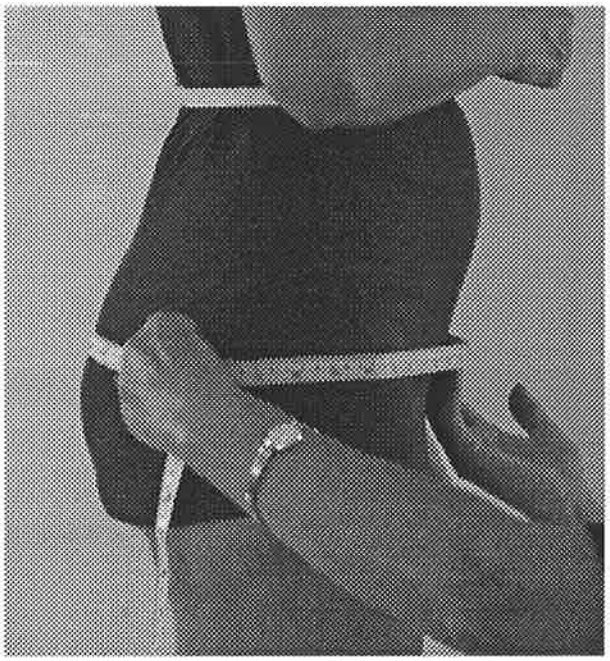
Waist to upper hip (abdominal extension).

With the measurer standing to the right of the participant, the tape measure was placed at the bottom of the waist tape on the right lateral position of the torso, then taken to the most prominent projection of the abdominal protrusion.



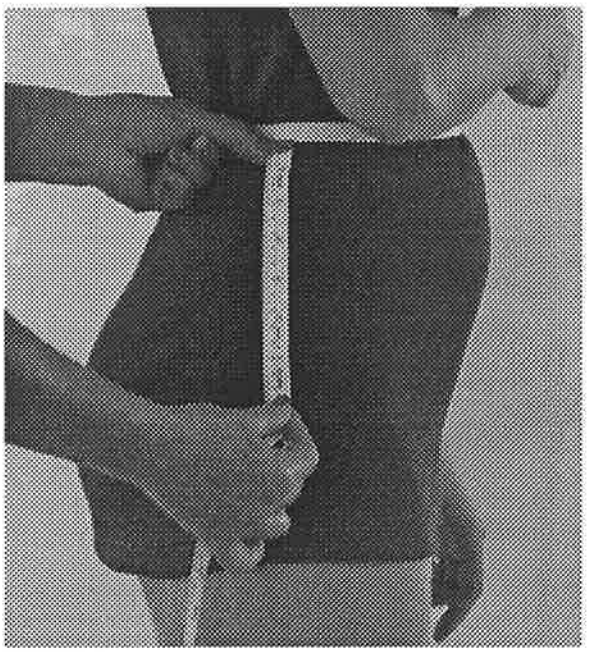
Lower hip circumference.

With the measurer standing in front of the participant, the tape was passed horizontally around the trunk at the fullest part of the posterior projection. (In reality the tape measure should be a little lower than shown in the photograph). The tape measure was parallel to the floor. The tape measure was held away from the body to allow for slight abdominal protrusion.



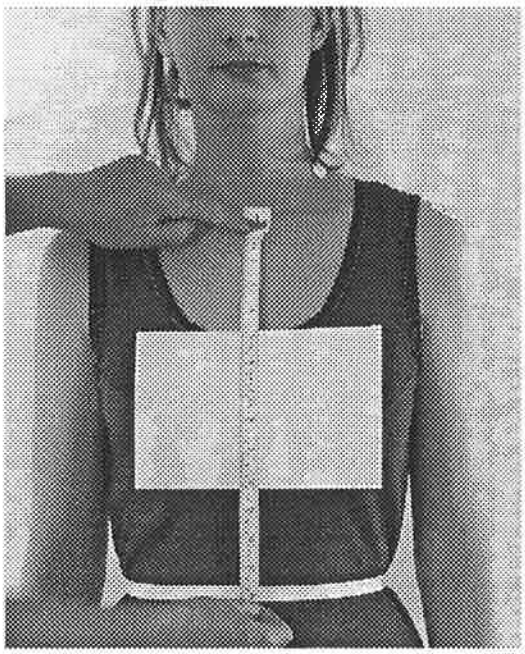
Waist to lower hip.

In most prior studies, the height of the lower hip was taken to the level of the trochanter with an anthropometer. In the absence of an anthropometer in this study, the height of lower hip measurement was taken with a tape measure on the lateral position from the bottom of the waist tape to the posterior projection.



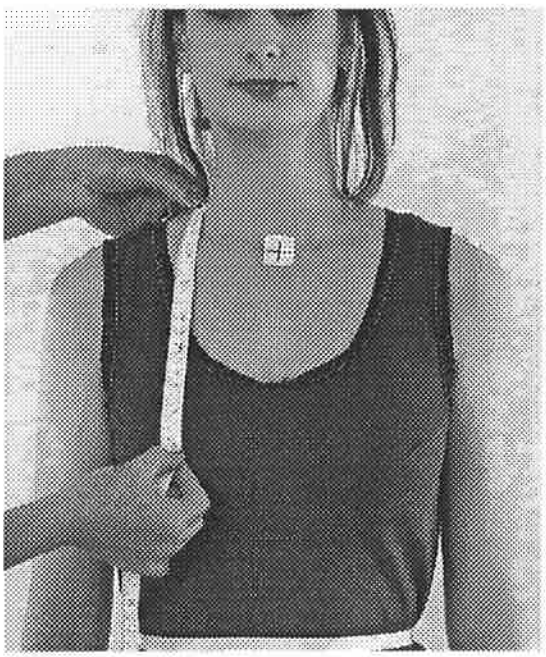
Centre front length.

A half piece of A 4 paper was placed over the bust prominence to keep the tape measure in line with the anterior protrusion of the bust. The measurement was taken from the landmark at the suprasternale over the bust prominence to bottom of the waist tape. This method was not consistent with all reviewed studies, as a sheet of paper is not usually used. The paper allows the tape measure to stay in line with the bust protrusion particularly with the fuller breast figure type. Although this method is not used in the other studies, previous work has found that a short centre front length may incur fitting problems particularly in the full bust figure type.



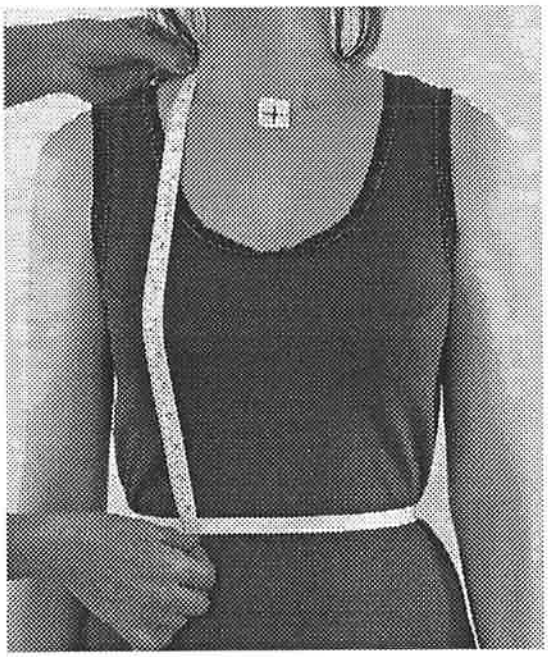
Front neck shoulder point to bust point.

With the measurer standing on the right side of the participant, the measurement was taken from the landmark at the intersection of the neck and shoulder point to the nipple.



Front neck shoulder point to waist.

With the measurer standing on the right side of the participant, the measurement was taken from the landmark at the intersection of the neck and shoulder point over the bust to the bottom of the waist tape.

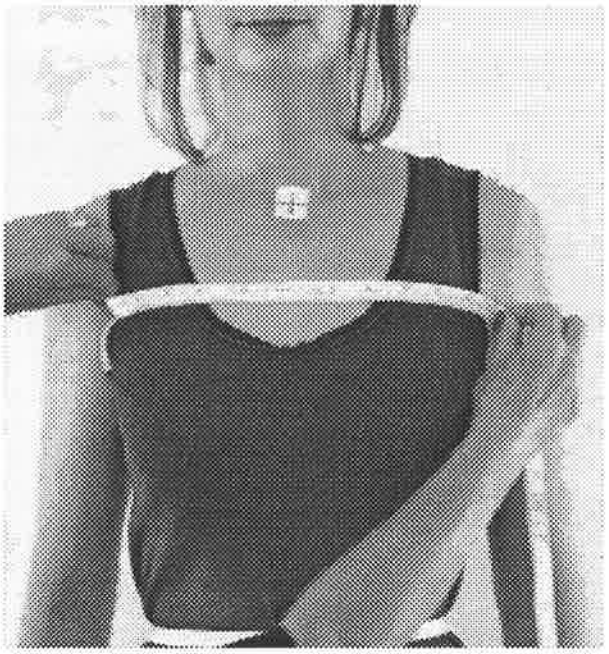


Bust separation.

The measurement was taken horizontally from one nipple to the other.

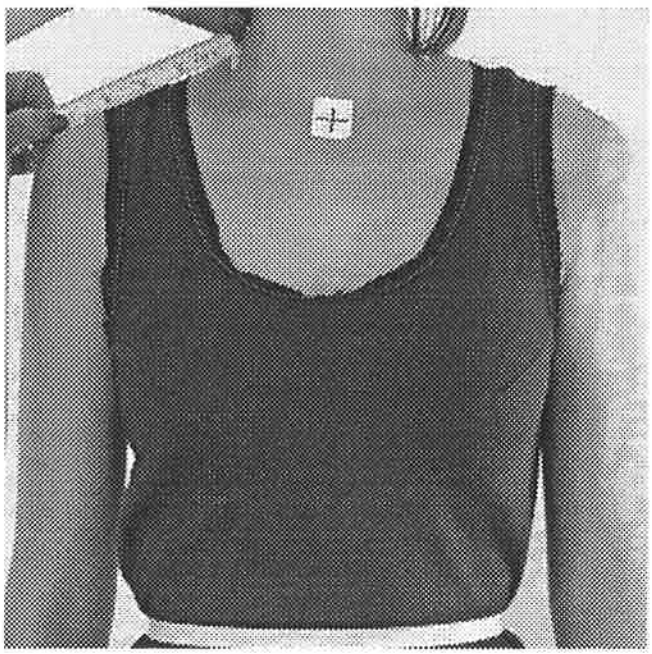
Across chest.

The measurement was taken horizontally from the crease at the left axilla (armpit) to the crease at the right axilla.



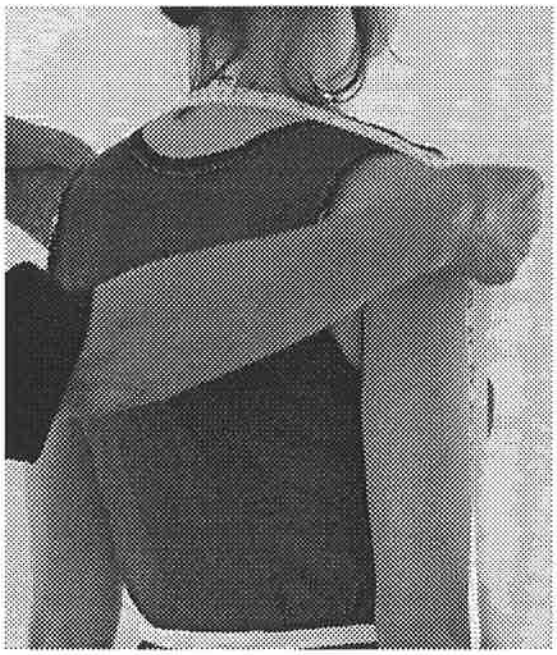
Shoulder length.

Standing at the right side of the participant, the measurement was taken from the intersection of the neck and shoulder point to the tip of the acromion.



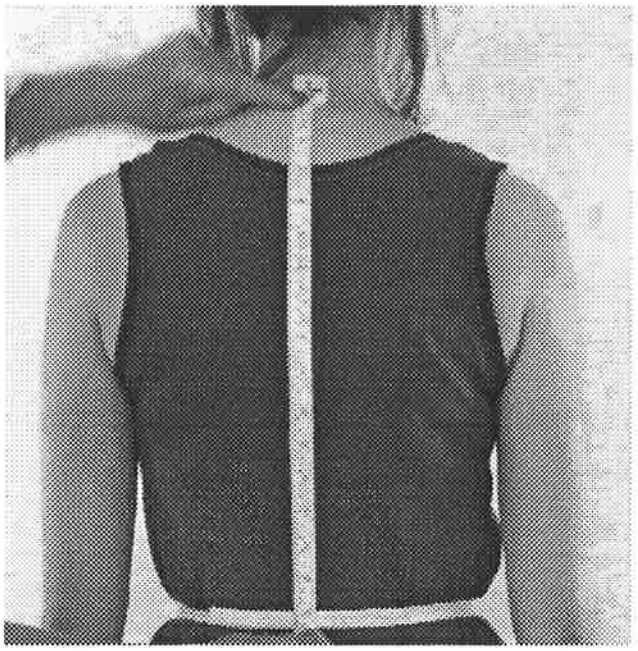
Shoulder to shoulder.

With the measurer standing in front of the participant the measurement was taken of the distance of the shoulders between the left and right acromial tips (for the purpose of the photograph the measurement was taken standing at the back of the participant).



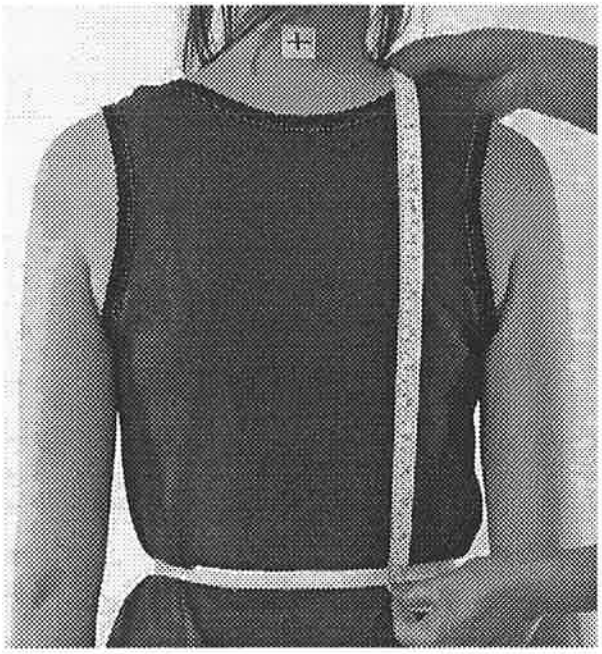
Centre back length.

The measurement was taken from the landmark at the spine of the 7th cervical vertebra down the spine to the bottom of the waist tape.



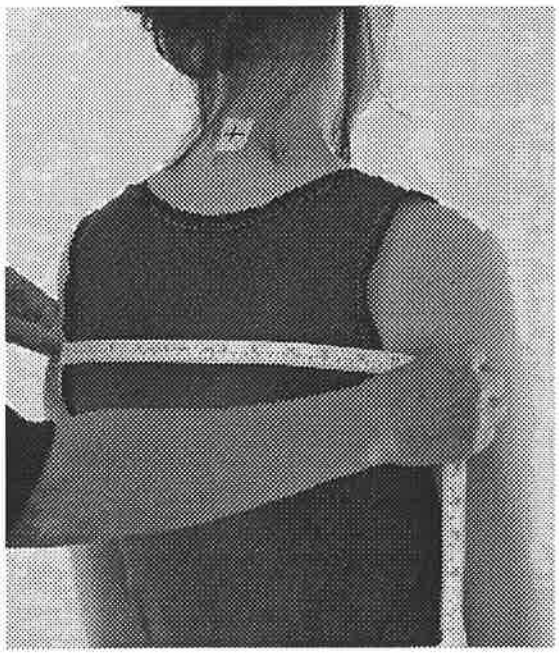
Back neck point to waist.

With the measurer standing at the right side of the body, the measurement was taken from the landmark at the intersection of the back neck and shoulder point over the scapulae to the bottom of the waist tape.



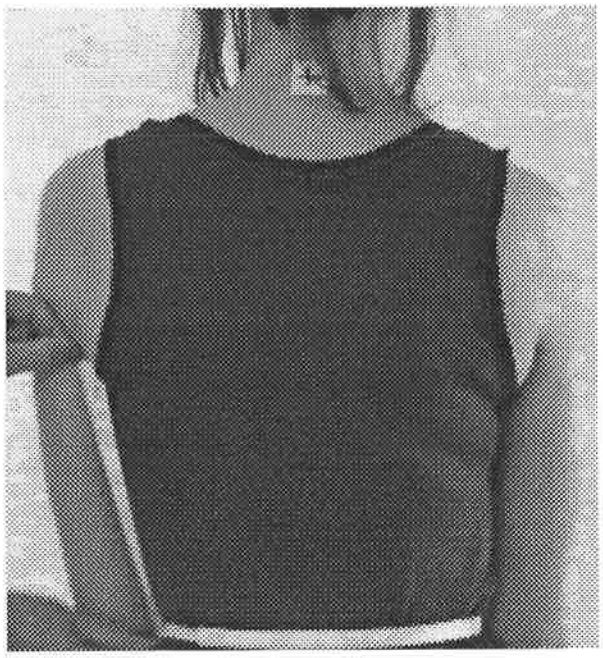
Across back width.

The participant clasped her hands slightly in front of the body. The measurement was taken from the posterior axillary crease on the left to the posterior crease on the right axilla.



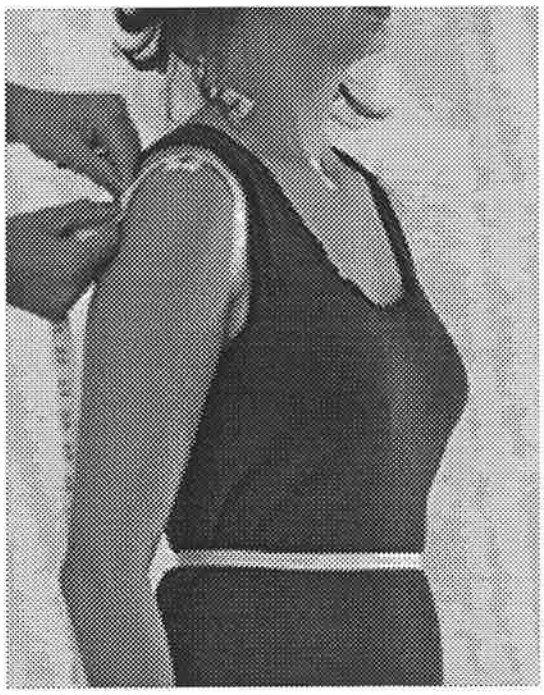
Side length.

The participant was asked to clasp her hands slightly in front of her body. The measurement was taken from the top of the posterior axillary crease to the waist tape. The method differed slightly from other reviewed studies. Reviewed studies have taken this measurement from the midpoint at the underarm. It was felt that the method used was more appropriate and repeatable.



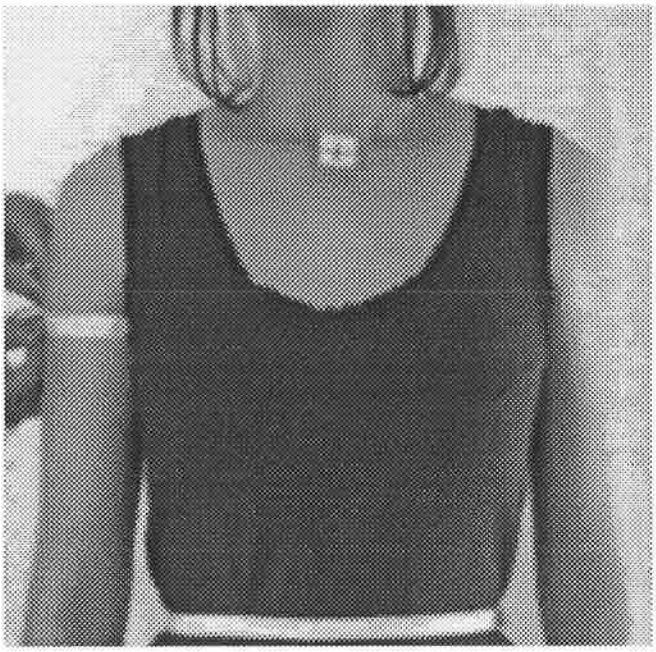
Armhole.

With the measurer standing to the right of the participant, the tape measure was placed under the axilla around the armhole to the acromion process.



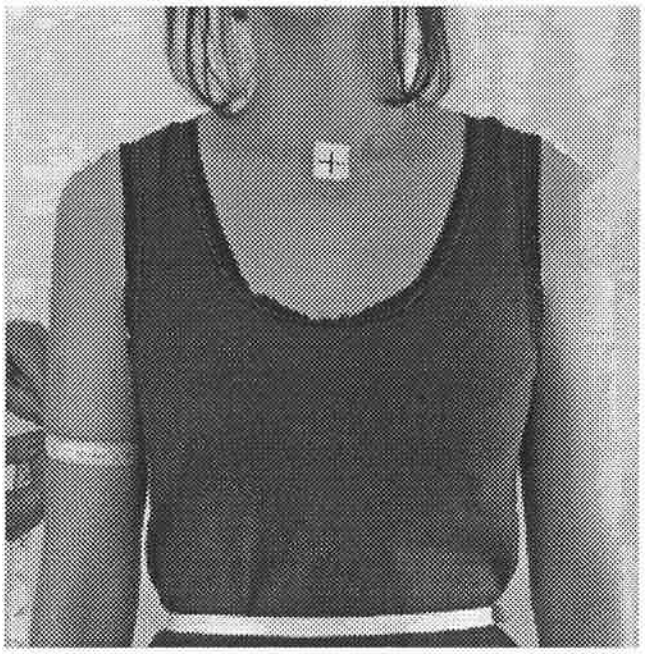
Upper arm.

With the measurer standing to the right of the participant, the tape measure was placed circumferentially under the axilla around the arm at 1/3 of the anatomical arm.



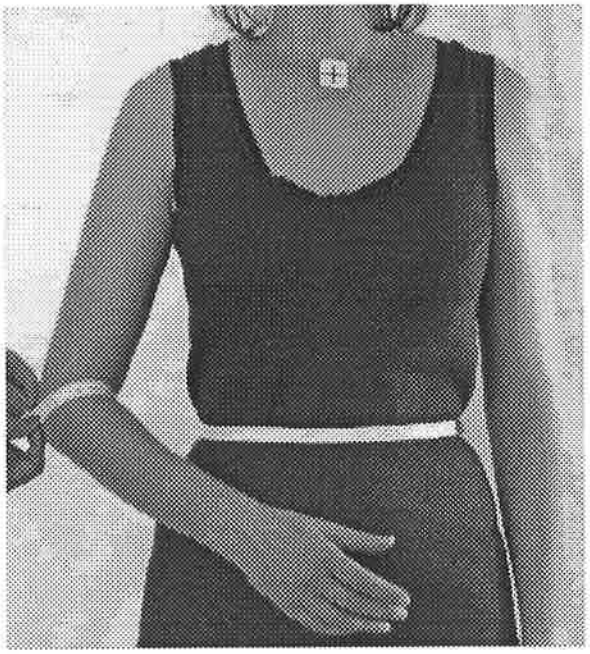
Lower Arm.

With the measurer standing to the right of the participant the tape measure was placed circumferentially at a point two thirds down of the distance of the anatomical arm.



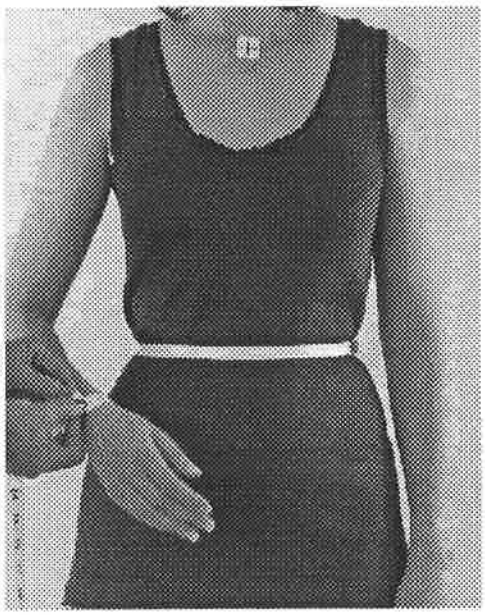
Elbow.

With the arm flexed at 45 degrees the elbow was measured circumferentially from the olecranon around the anterior elbow crease returning to the olecranon.



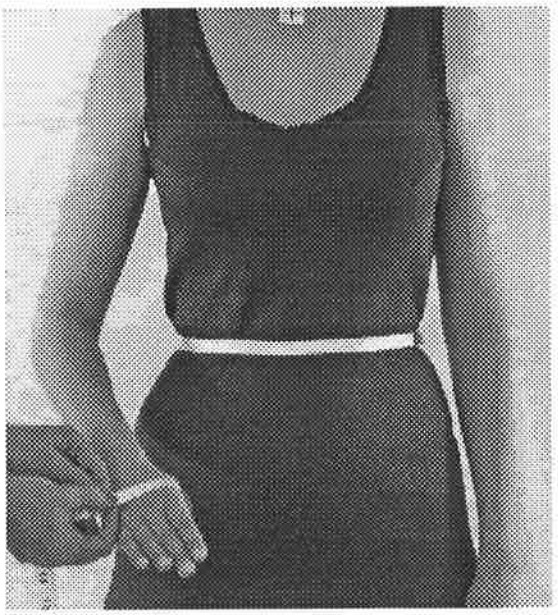
Wrist.

The wrist was measured circumferentially at the level of the ulnar styloid process (wrist bone).



Hand girth.

With thumb tucked under fingers and fingers extended, the hand was measured circumferentially at the level of the first metacarpal head (base of thumb).

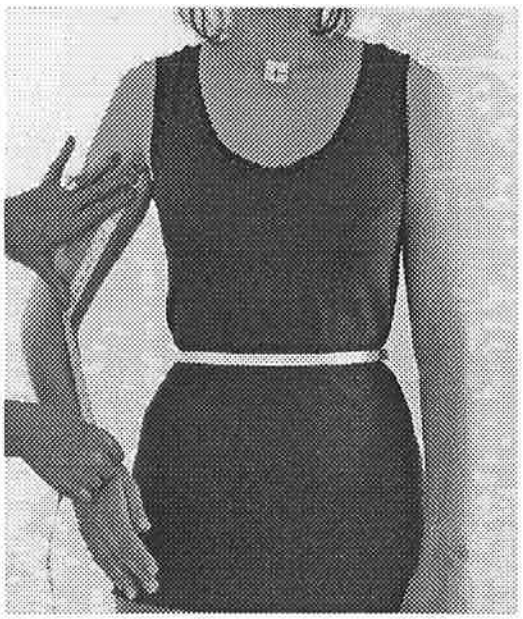


Outside sleeve length.

With the arm flexed at 45 degrees, the measurement was taken from the landmark at the acromion over the olecranon to the styloid process of the radius. The method of taking the outside length measurement differed in this study from other studies. In this study the arm was flexed at a 45 degree angle compared to 90 degree angle in the other studies. On comparing the two methods it was found that the 90 degree angle gave a slightly longer length and may therefore be a good point, on the other hand, when the arm is in a relaxed position the sleeve length may be too long.

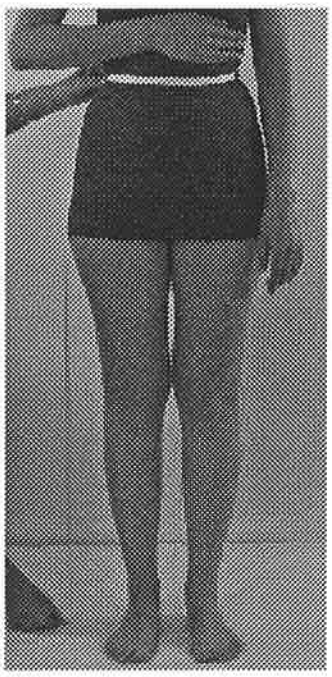
Inside sleeve length.

With the participant's arm bent at a 45 degrees angle, the measurement was taken from the anterior axillary crease to the ulnar styloid process at the wrist. The method differed slightly from other studies in which the measurement was taken at the midpoint on the underarm. In this study it was taken from the anterior axillary crease to the ulna, which was consistent with the method of taking the outside sleeve length and appeared to be more anatomically appropriate.



Waist to floor.

With the measurer standing at the right side of the participant, the measurement was taken from the bottom of the waist tape over the lateral contour of the hip straight down to the floor.

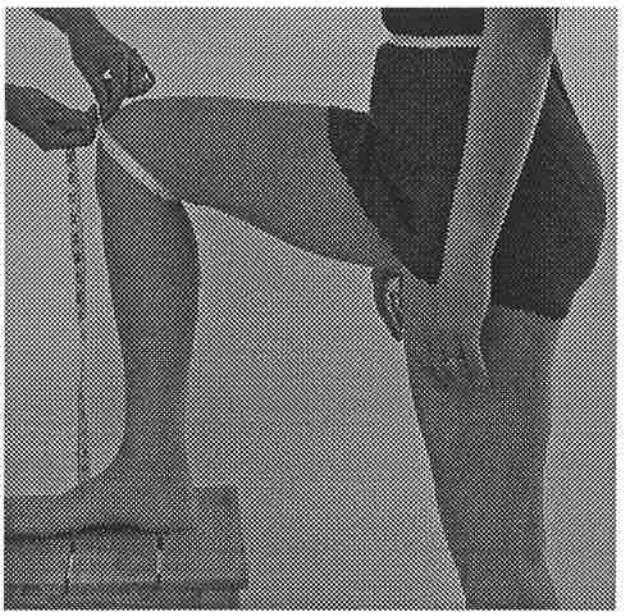


Thigh.

The thigh measurement was taken circumferentially at the highest thigh position close to the crotch. (In reality the tape measure should be slightly higher than in the photograph).

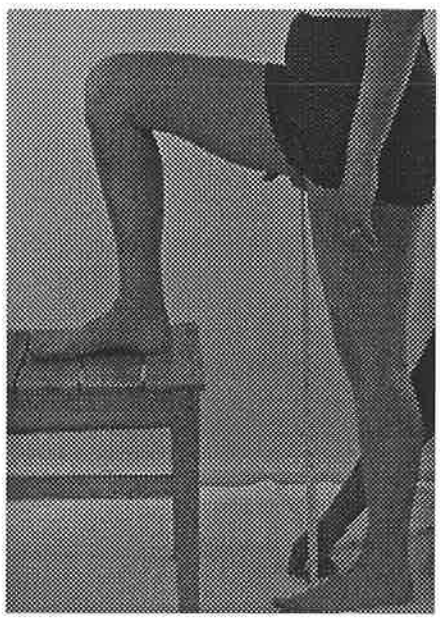
Knee.

With the right foot placed on a chair and knee bent at 90 degrees the tape measure was passed under the knee and over the most promenient point of the patella.



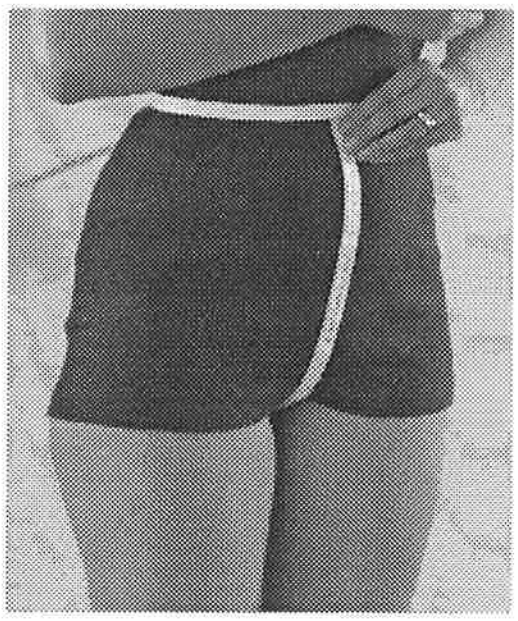
Inleg.

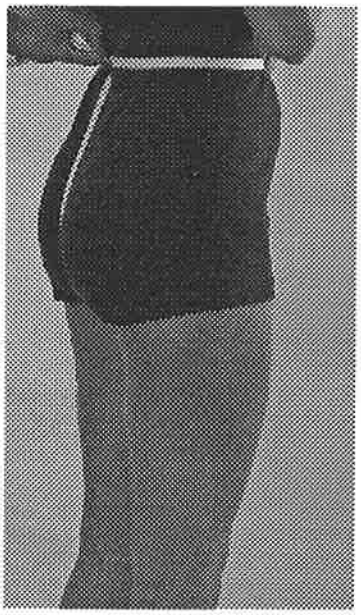
With the right foot on a chair, the participant held the tape at the ischial tuberosity, avoiding embarrassment, whilst the measurer took the tape straight down to the floor.



Front to back crotch.

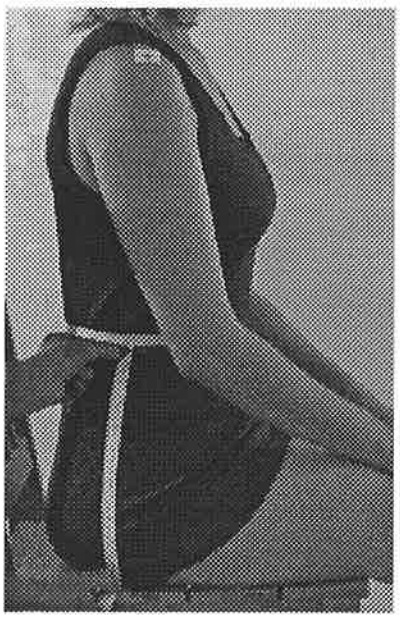
The participant held the tape measure at the bottom of the waist tape anteriorly. The tape was then passed between the crotch to the bottom of the waist tape at the back.





Waist to seat.

With the participant sitting in an upright position on a flat surface, the measurement was taken from the bottom of the waist tape following the contours of the body to the flat surface of the chair.



Trunk Height (sitting).

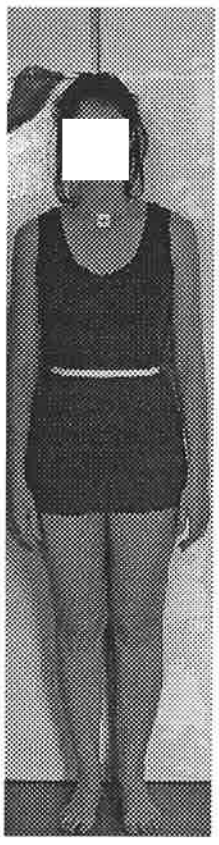
With the participant sitting in an upright position on a flat surface, measurement was taken from the spine of the 7th cervical vertebra down the vertebral column to the flat surface.

Cervical height (standing).

With the participant standing upright close to the tape measure the L-Square ruler was placed at the spine of the 7th cervical vertebra with the other side of the ruler parallel to the wall. The participant's head was in the Frankurt horizontal plane. That is when the orbital, which is the lower portion of the eye socket, is in the same horizontal line as the tragion which is the notch superior to the tragus of the ear (Norton and Olds 1996). Shelton and O'Brien (1941) refer to the Frankfurt plane as the Reids baseline (the line above the tragus to the baseline of the eye socket).

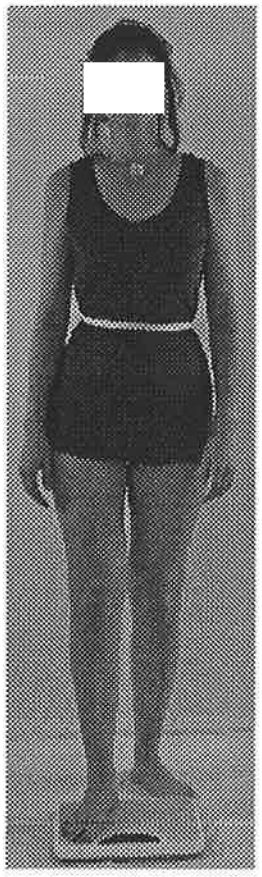
Height (stature).

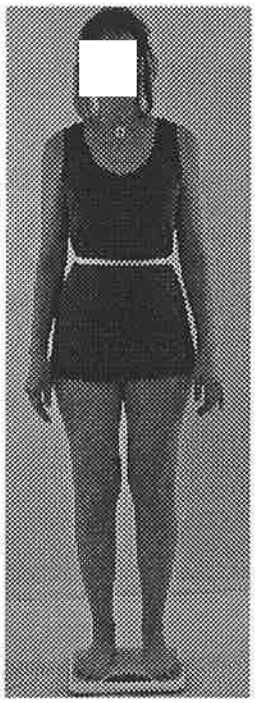
Height was measured using a 15 mm wide metal tape measure attached to a flat wall with strips of tape at approximately every 500 mm. The participant stood in an upright position with weight distributed evenly on both feet. The participant was wearing the cotton vest, without footwear. The head was held in the Frankfurt plane. A right-angled ruler was placed on top of the participant's vertex and the other side of the ruler was placed parallel to the wall. The measurement was read where the horizontal arm of the ruler touched the metal tape that was attached to the wall. Height was recorded to the nearest 2 mm. Particular attention was taken to ensure that the hair did not interfere with the final measurement. This method was similar to other studies (O'Brien and Shelton 1941, International Organisation for Standardisation 1989). Although an anthropometer was not used in this study, it may be concluded that this method compares favourably to other studies.



Weight.

Weight was taken with the participant wearing the cotton vest over her bra and pants and without footwear. A portable set of lightweight Soehnle digital weight scales was used to measure the weight of each participant. Knight and Eldridge (1984) used a similar measuring device a Seca 760 lightweight spring balanced scales with a large platform and dial. They state that although the spring-balanced scales are not as accurate or reliable as beam balanced devices the excess weight of the beam balanced scales is impractical for the interviewer to carry. Norton and Olds (1996) support Knight and Eldridge (1984) and believe that the traditional instrument used for measuring weight is the beam-balanced device. They state that the electronic scale is becoming more acceptable and that the accuracy of these scales is equal to a beam balance, provided that the calibrations are maintained. They also add that the inexpensive digital bathroom scales are easily transported and have an accuracy of within 50 g. Therefore this method of weight measurement is justified and believed to be sufficiently reliable for comparison of results to other studies. The manufacturer initially calibrated the scales and then calibration was checked prior to each measurement being taken by ensuring that the scales were at 0-0. The scales are capable of measuring up to 130 kg in weight. The participant activated the scales by applying pressure with one foot firmly on the scales. The foot was removed. Whilst the scales were activated the participant placed both feet evenly on the scales to distribute weight evenly. The participant's weight was recorded to the nearest 1kg.





Standardised analysis of photographs.

The purpose of the photographic section of this study was to visually assess and evaluate the current size and shape of each participant. To do this, photographs were taken of the whole body. Three photographs of each participant were taken with the subject standing. The picture of each participant was taken in the anterior aspect, posterior aspect and the lateral aspect. The three photographs enabled observation of the size and shape of each participant, as well as distribution of body mass and composition. Estimates of accuracy and repeatability were not conducted as the method is subjective.

On completion of the measurements, the participants, wearing the same measuring garment, went to the area set up for the photographic section. The anthropometric and the photographic sections were set up in close proximity to one another and in the same room where possible. This allowed a smooth transition from the measurement section to the photographic area. The two sections being in close proximity saved time and was less threatening to the participant. Although all participants agreed to take part in both sections of the research many participants felt a little embarrassed being photographed in the measuring garment, therefore the transition to the photographic area was made as simple as possible. Sensitive issues were taken into account to ensure as little embarrassment as possible for the participant.

Equipment and materials.

The equipment and materials for the photographs consisted of: a portable metal stand 2,100 mm high x 900 mm wide with a wire grid that consisted of 100 mm x 100 mm squares, a wooden platform 100 mm high x 700 mm wide that was used in conjunction with the stand, two face masks, a bottle of disinfectant, a selection of hair ties, paper squares numbered from 1 to 175, an adjustable tripod, two portable lights on stands, a digital camera, two media smart cards and a floppy disk adaptor, a 2.3 metre length of fabric for the backdrop, an electric power cord extension, and various size stretch cotton vests for the measuring garment.

Preparation /procedure for taking photographs.

The portable stand and the backdrop were set up approximately 800 mm apart. The platform was placed close to the stand with the centre of the platform in line with a vertical gridline. The digital camera was set on the tripod approximately 8 meters from the portable grid. The camera was connected to an electrical outlet. When lighting was not sufficient, portable lights were set up either side of the participants. Participants with long hair were asked to put their hair up using the hair ties provided. The waist tape was checked to see that it was in the correct waist position. Landmarks used for the anthropometry section were left on for the photographs. The participant was assisted onto the platform, which was placed behind the screen. The facemask was then put on.

Figure 3b. Anterior Aspect of Photograph for S.A Women (1998-1999).

The photograph of the anterior aspect was taken first. The participant stood on the platform, which was placed close to the stand. The centre of the body was aligned to the centre of a vertical gridline. The participant's feet were approximately 50 mm apart with weight distributed evenly on both feet. The head was held in the Frankurt plane.

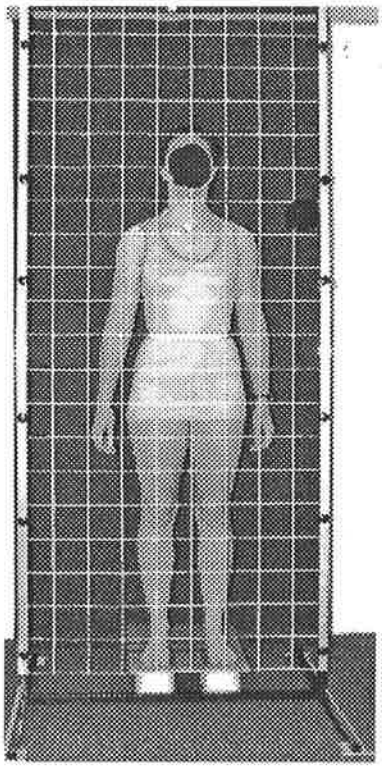


Figure 3c. Posterior Aspect of Photograph for S.A Women (1998-1999).

The second photograph was taken of the posterior aspect. The participant faced the backdrop and assumed the same posture as for the anterior aspect. The centre back of the body was aligned to a vertical gridline on the stand. The head was held in the Frankurt plane.

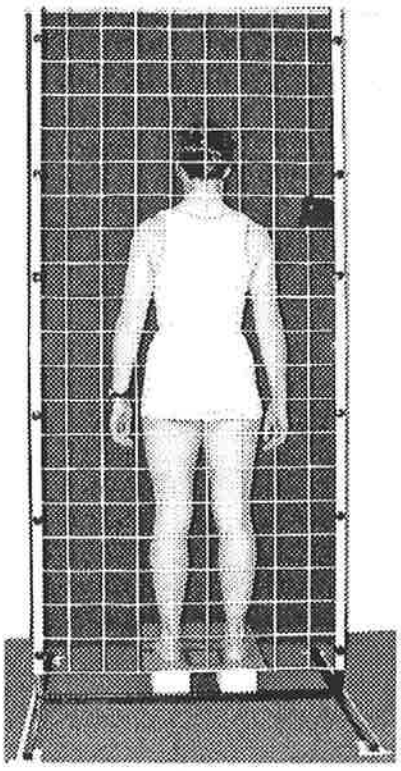
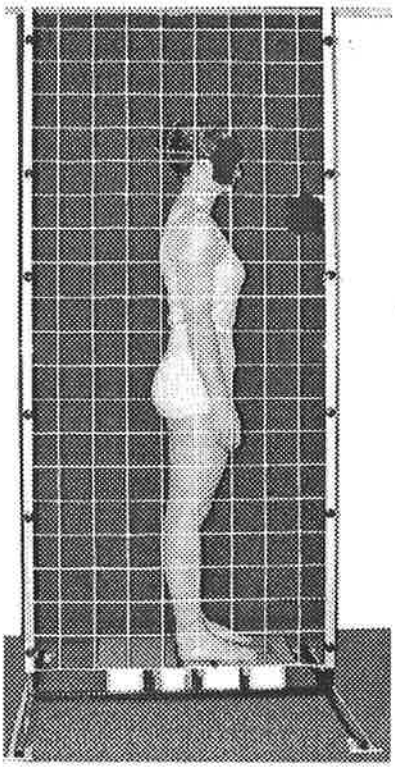


Figure 3d. Lateral Aspect of Photograph for S.A Women (1998-1999).

The third photograph was taken laterally. This time the participant stood on the platform with the lateral aspect of the body in line with a vertical gridline.



Throughout the photographic process care was taken to see that the head was kept in the Frankurt plane, the weight was distributed evenly on both feet, the shoulders were relaxed and the participant was standing in an upright but relaxed position. To ensure standardisation all photographs were taken in the same way with the participants standing in the same position on the platform, which was marked for feet placement. The camera was focused on the centre of the body and the total body was taken without distortion. This process was similar to that used by Sheldon *et al.* (1970).

On completion of the photographic segment, each participant's photographs were downloaded onto the computer from the digital camera using a floppy disk adaptor. The photographs were then transferred to each individuals anthropometric body dimension chart, matching the numbers on the chart with the number on the photographs. The three photographs of each participant were enlarged and printed to size A4 paper. The larger copies were examined, then sorted into similar groups of body shapes. Each group was given a letter from the alphabet that described the body shape of each group. The author devised the method used to name the body types, after consultation and training by the supervisor in the use of the technique. This method was adapted solely for this research.

Description of current South Australian women.

Several statistical parameters are needed to describe the characteristics of current South Australian Women. After obtaining raw data from the 36 measurements on the 163 participants, descriptive statistics were performed. All statistics, unless otherwise noted, were performed on Microsoft Office Excel 97. The average, minimum, maximum and standard deviation were determined for each body dimension to describe the data set. The Body Mass Index (B.M.I) and Concity Index (C.I), which are measurements of body fatness, were calculated (Eq.1 and E.q. 2).

B.M.I =Weight (kg)/Height^2 (m) [Eq. 1]

$$\textbf{Conicity Index} = \frac{Girth\ (mm)}{0.109\sqrt{\frac{Wt\ (kg)}{Ht\ (m)}}} \qquad \text{[Eq. 2]}$$

The averages of the major body dimensions were discussed in reference to the average Australian Standards. To assess body dimension trends within the S.A population, the relationship of body dimensions to participant's age was plotted. Regression analysis was performed to describe relation to age. Significance in all tests was taken at $p=<0.05$ level. Coefficient of determination (R^2) and trend line equation are given. A visual comparison was then conducted from plotting weight-height trends of current S.A women to Australian Standard (1997), short, average and tall women.

Comparison of current size and shape of South Australian women to other studies.

A major focus of this study was to compare current data to previous and overseas data upon which the Australian Standards Clothing Size System is based.

Secular trends of current South Australian women compared to prior Australian studies.

As stated previously, anthropometric studies of women worldwide have been few, therefore little anthropometric data are available. From other studies where data have been collected, there has been a range of different body dimensions assessed and methods used. Therefore, in analysing Australian trends over time and overseas comparisons only two measurements were used. The measurements of height and weight were reported in all studies and consistent methods of measurement appeared to be used. These measurements were used to assess trends of women's size and shape.

To assess changes in the size and shape of Australian women over time the average weight and height were plotted from a number of studies from the year 1926 to 2000. The coefficient of determination (R^2), trend lines and equations are displayed.

Where data from previous studies were comparable, within age groups, a bar graph was plotted for both height and weight to show differences between the Australian studies, including S.A data of different years, within age groups.

Only studies whose data could be categorised into similar age groups were used. The age groups were 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59. Age groups of less than 25 and greater than 59 were not included, as some studies analysed did not extend their sample range to these age groups.

Secular trends of Australian women compared with overseas data.

Descriptive statistics of S.A data and recent American and Great Britain studies were compared. Trend lines in weight and height over time for each country were plotted and compared.

Analysis of standardised photographs.

Digital photos were visually compared and all participants were grouped into similar categories. Comparisons were made to published figure type literature, for the number of categories obtained and characteristic of each category. Basic descriptive statistics of major body dimensions and weight were calculated for each type.

One way ANOVA analysis of variance has been used to test the differences between anthropometric variables for each somatotype, as well as age, conicity index and body mass index

Chapter 4: Results.

Introduction.

The first section of this chapter will present the results of the anthropometric survey of body measurements taken on 163 adult females during 1998 and 1999 and hereafter will be referred to as the S.A Women (1998-1999). The second section will present the findings of the standardised analysis of photographs. As stated earlier, the same 163 participants took part in both sections of this study.

Anthropometric results.

The average height of S.A women (1998-1999) was 1622 mm. This can be seen in Table 27 along with the average values of height, weight, age, conicity index (C.I) and body mass index (B.M.I) and their descriptive statistics. The average weight of the participants was 65.17 kg. The average age was 44. The B.M.I of 24.72 was rather high, being at the upper end of the acceptable range recommended by the W.H.O (1998) who suggest the rating for normal classification of B.M.I to be 18.5-24.9. The acceptable range recommended by N.H.M.R.C (1997) is $\geq 20 \leq 25$. The conicity index was also high at 1.92 which much exceeded the 1.0 value considered to be normal (Mueller *et al.*1996).

Table 27: The averages of height, weight, age, conicity index, and body mass index for S.A Women measured in 1998-1999

	Average	Standard Deviation	Minimum	Maximum
Height (mm)	1622	75.3	1420	1820
Weight (kg)	65.2	13.8	38	116
Age	44	15.2	18	82
Conicity Index	1.9	0.3	1.6	2.6
Body Mass Index (kg/m^2)	24.7	4.5	18.6	35.1

Averages for body dimensions of the S.A Women 1998-1999.

Averages for the 36 body dimensions are discussed here and displayed with descriptive statistics in Table 28.

The average neck girth circumference was 384 mm which is between an Average Women size 14 and 16 of the existing Australian Standard (1997) (AS).

The average bust girth circumference was 983 mm which is between an Australian Standard (1997) Average Women size 16 and 18. The average waist circumference was 808 mm this corresponds to Australian Standard (1997) Average Women size 18.

The average upper hip (abdominal extension) was 960 mm. This closely approximates Australian Standard Average Women size 18, which is 970 mm. The average lower hip circumference was 1027 mm which is in between the A.S Average women size of 16 to 18.

Centre front length average was 359 mm. This corresponds to Australian Standard (1997) Average Woman sizes 18, 20, 22 which are all 360 mm. The average front neck shoulder point to bust point (nipple) was 264 mm which corresponds closely to Australian Standard (1997) Average Women size 18 which is 265 mm. The bust separation width was 204 mm which equates to size 22 of the Australian Standard (1997) Average Women.

The average across chest width measurement was 358 mm which appears to be quite large compared to Australian Standard Average Women. Australian Standard size 16 is 320 mm, sizes 18 and 20 are both 330, size 24 is 350 mm, and size 26 is 360 mm. The shoulder length was 129 mm, once again larger than Australian Standard Average Women, which ranges from 110 mm for size 8 to the largest size of 120 mm for size 26.

The centre back length was 413 mm. This equates closely to Australian Standard Average Women sizes 18 and 20, which are both 410 mm. The across back width was 394 mm which well exceeded the Australian Standard Average Women size ranges of size 16 which is 340 mm, size 18 is 350 mm, size 20 is 370 mm, size 22 is 380 mm and size 24 is 39 mm. The side length was 204 mm which equates to Australian Standard Average Women size 20.

The armhole circumference was 420.4 mm which is between Australian Standard Average Women size 16 and 18. The upper arm circumference was 311 mm which equates to Australian Standard Average Women size 18. The outside sleeve length average was 587 mm which is slightly smaller than Australian Standard Average Women, this may possibly be due to the different placement of the arm when the measurement was taken.

The average waist to floor length was 1028 mm which closely approximates Australian Standard Average Women size 16. The average thigh measurement was 610.0 mm which is close to the Australian Standard Average Women size 18, which is 620 mm. The average inleg measurement was 796 mm. There was no comparable Australian Standard Average Women measurement as the largest measurement, which is size 26, was 750 mm and the smallest which is size 8 is 720 mm. The front to back crotch measurement was 728 mm which is in between Australian Standard Average Women size 12 and 14.

The average height was 1622 mm which is between Australian Standard Average Women size 10 and 12. The average weight was 65.17 mm which compared to Australian Standard Average Women size 16.

The remainder of the measurements seems to be correspondingly large. Their averages are in Table 28.

Table 28: Descriptive statistics of the 36 body dimensions of S.A Women measured during 1998-1999. Sample size 163. All measurements but weight are in millimetres.

Body Dimensions	Average	Standard Deviation	Minimum	Maximum
Neck girth circumference	384	22.1	330	465
Bust girth circumference	983	105.6	790	1330
Overbust circumference	916	78.3	750	1180
Under bust circumference	860	95.4	665	1180
Waist circumference	808	115.7	615	1170
Upper hip circumference	960	121.9	740	1360
Height of upper hip	83	6.9	70	110
Lower hip circumference	1027	100.7	825	1320
Height of lower hip	178	14.2	130	220
Centre front length	359	26.3	200	350
Front neck shoulder point to B.P	264	26.3	200	350
Front neck shoulder point to waist	431	28.8	330	525
Bust Separation	204	21.1	165	270
Across chest	358	23.9	295	430
Shoulder length	129	7.9	105	145
Shoulder to shoulder	393	19.9	330	440
Centre back length	413	24.5	345	480
Across back width	394	31.2	330	485
Back neck shoulder point to waist	445	27.7	395	505
Side length	204	18.3	160	250
Armhole circumference	420	39.9	310	530
Upper arm circumference	311	37.7	210	420
Lower arm circumference	295	36.2	215	400
Wrist circumference	169	10.4	145	205
Hand circumference	220	10.9	195	250
Outside sleeve length	587	28.7	505	660
Inside sleeve length	396	23.9	320	470
Waist to floor	1028	55.6	880	1180
Thigh circumference	610	66.2	415	835
Knee circumference	406	38.9	345	570
Inleg	796	54.0	645	965
Front to back crotch	728	57.6	610	910
Waist to seat	274	19.2	230	320
Cervical Height	1404	77.2	1220	1660
Trunk height	658	33.9	550	730
Height	1622	75.3	1420	1820
Weight (kg)	65.2	13.8	38	116

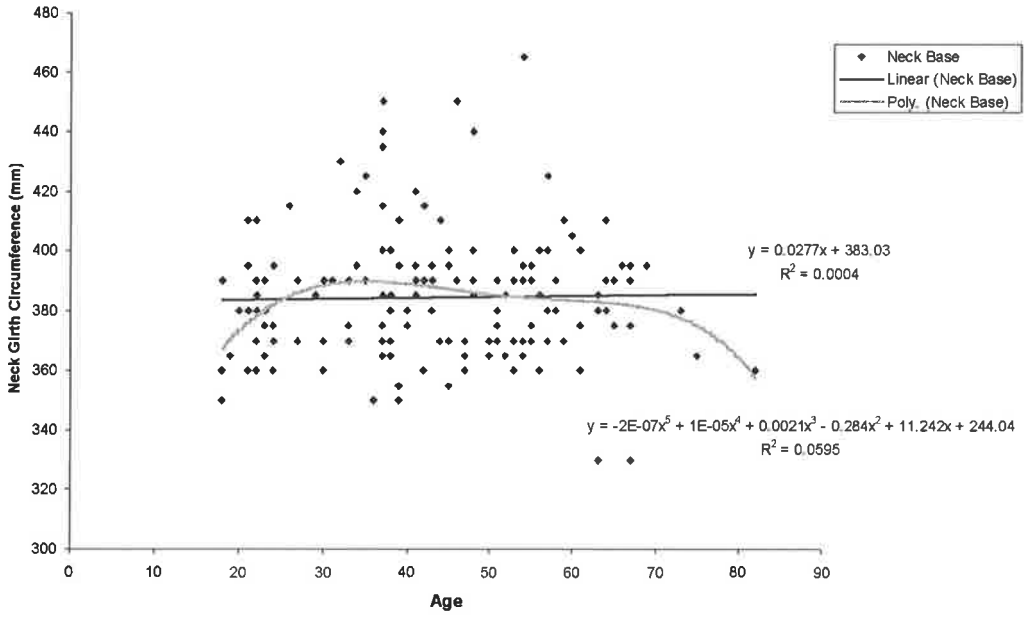
Relationship between body dimensions and age.

A number of trends were observed between particular body dimensions and age of the participants. These are discussed and graphical representation can be observed in Figure 4 through to Figure 25. The remainder of the graphs can be seen in Appendix 7. The following graphs (Figures 4 to 25) display the body dimensions used in this study and show trends of the body dimensions with age. Due to the limited number of subjects past the age of 68 years caution should be applied in the analysis of the data from this age on. Given the generally low r^2 values, ranging between 0.05 and 0.19, these graphs should be interpreted with caution.

Neck circumference with age.

There was a slight trend for an increase in the neck measurement with age (Figure 4), however, this was not statistically significant (p=<0.05). A regression polynomial curve was plotted and the coefficient of determination was only 0.06 therefore 6 % of the variation in neck girth circumference can be explained by age. The polynomial curve indicates that there was a closer relationship than the linear relationship. The polynomial relationship was a closer relationship than the linear relationship. The polynomial curve shows that there is a steady increase in the neck measurement from 18 to 25 years, a peak at age 50 with a steady decline at age 50 to age 60 and a vast decline thereafter.

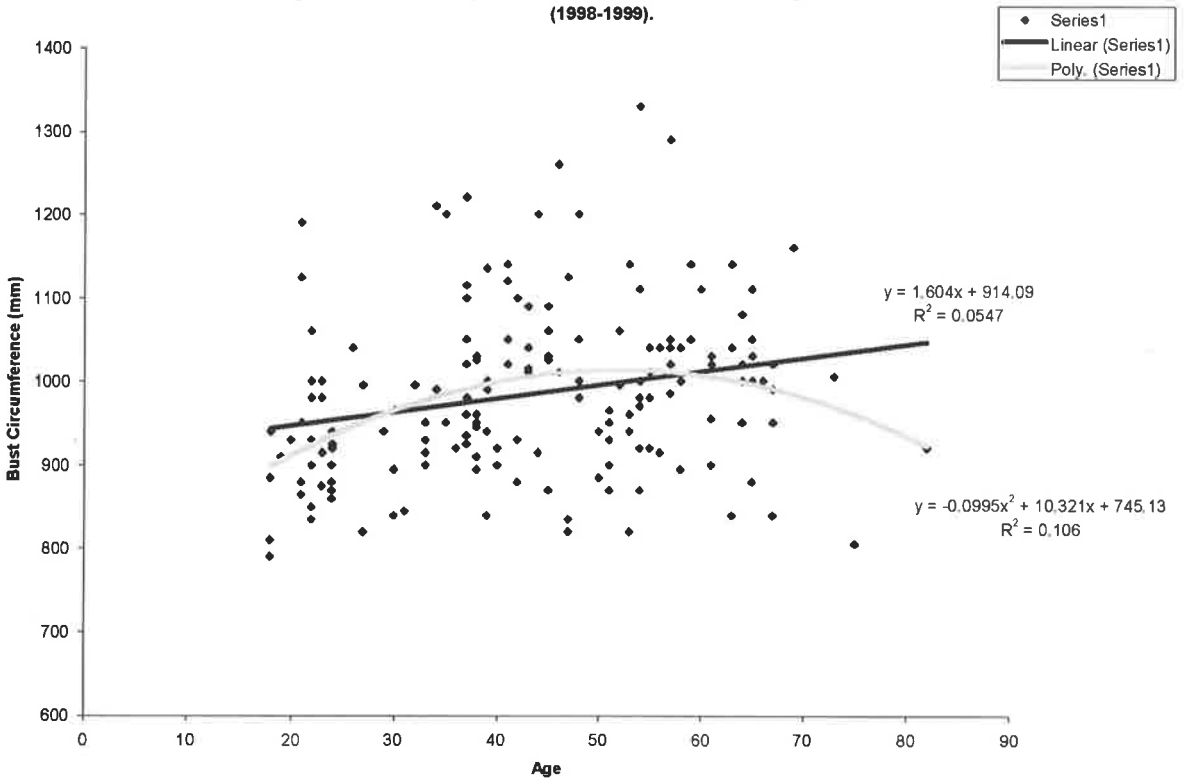
Figure 4. Relationship between Neck Girth Circumference and Age of S.A. Women (1998-1999).



Bust circumference with age.

There was an increase for bust circumference with age (Figure 5) which was statistically siginificant (p=0.003). In the linear regression, 5 % of the variation in bust circumference was explained by age. For the polynomial regression, however, 10 % of the variation was explained by age, thus suggesting the polynomial relationship fitted the data closer than the linear relationship. The curve indicates that there is a slight increase in bust circumference from the age of 18 to 30 years. The graph peaked at approximately 50 years with a slow decline to approximately 58 years where a vast decline occurred onwards.

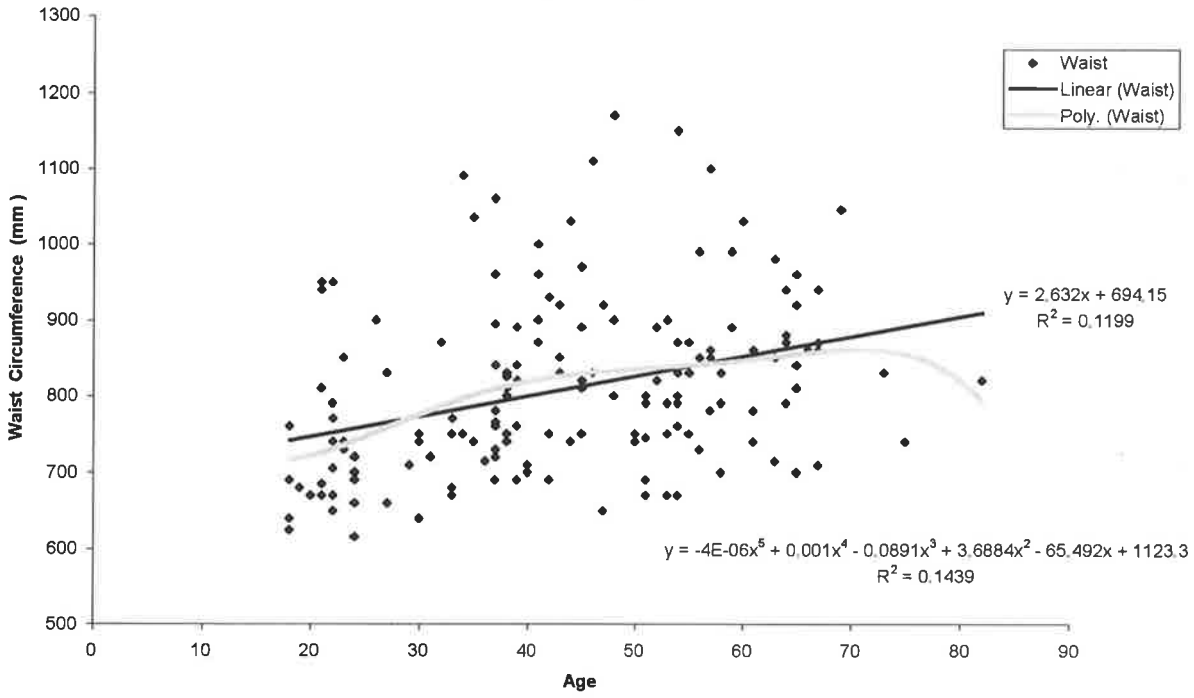
Figure 5. Relationship between Bust Circumference and Age S.A. Women (1998-1999).



Waist circumference with age.

There was an increase of waist circumference with age (Figure 6) which was statistically significant (p=<0.001). In linear regression, 12 % of the variation can be explained by age. For the polynomial regression, 14 % of the variation can be explained by age. The polynomial curve shows a slight increase from 18 years to approximately 28 years with the curve reaching an initial peak at approximately 38 years. A slight positive trend was maintained till approximately 67 years with a very steady decline to about 70 years and a vast decline onwards, noting the limited number of data points past the age of 70 years.

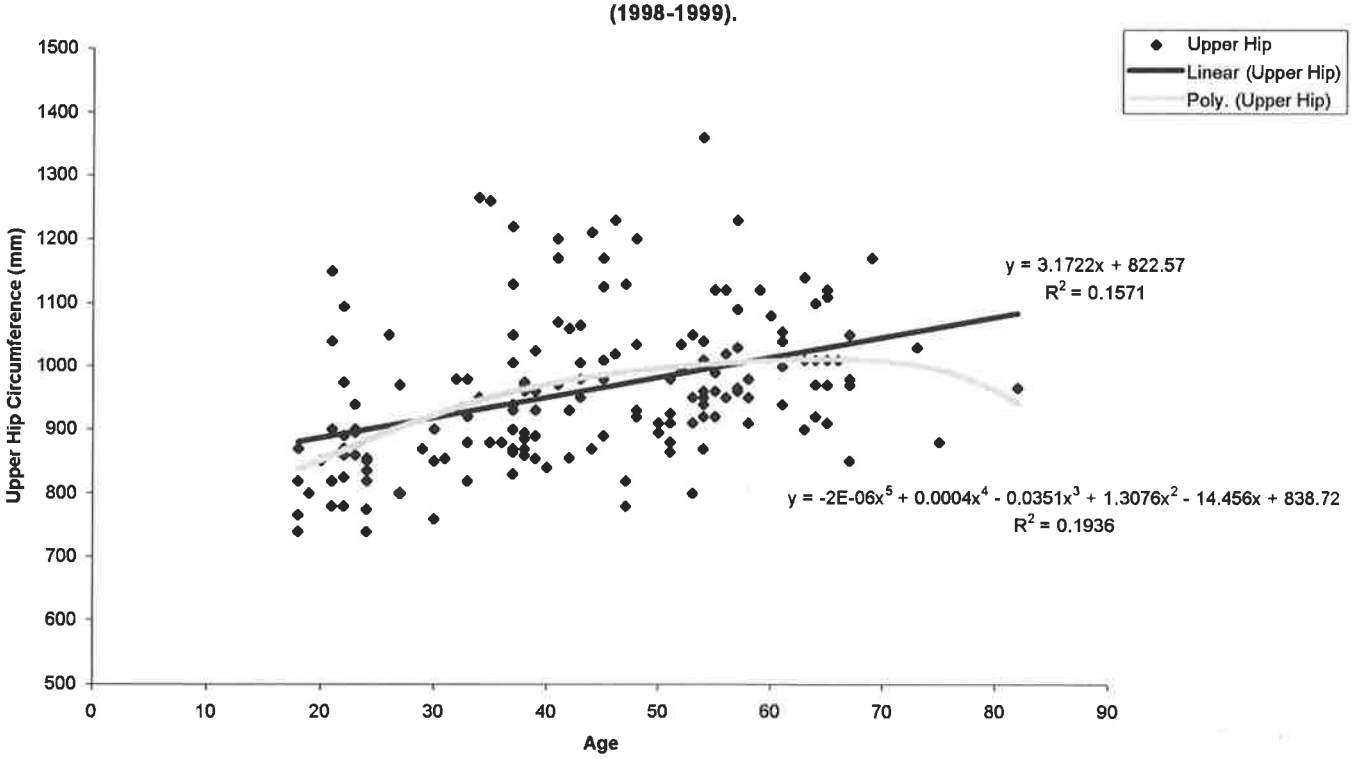
Figure 6. Relationship between Waist Circumference and Age of S.A. Women (1998-1999).



Upper hip circumference with age.

There was an increase of upper hip circumference with age (Figure 7) which was statistically significant (p=<0.001). In the linear regression, 16 % of the variation can be explained by age. For the polynomial regression, 19 % of the variation can be explained by age. The polynomial curve indicates there was a steady increase from 18 to 30 years, a slight increase from 30 to 54, and a vast decline occurring onwards.

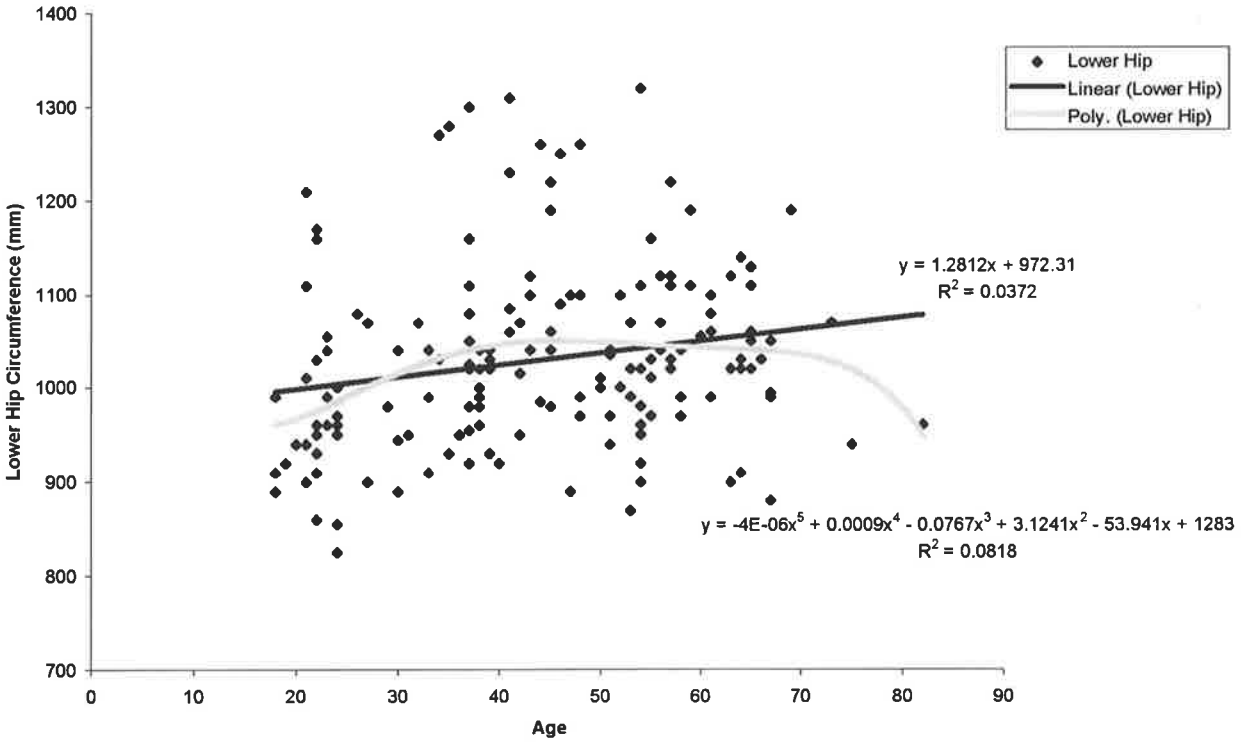
Figure 7. Relationship between Upper Hip Circumference and Age of S.A. Women (1998-1999).



Lower hip circumference and age.

There was an increase of lower hip circumference with age (Figure 8) which was statistically significant (p=0.014). In the linear regression, 4 % variation in lower hip circumference was explained by age. For the polynomial regression, 8 % of the variation was explained by age. The polynomial relationship shows a slight increase starting at 18 years, reaching a peak at approximately age 40 then a steady decline to age 68 years and a vast decline onward, noting the limited number of subjects in this study after the age of approximately 68 years.

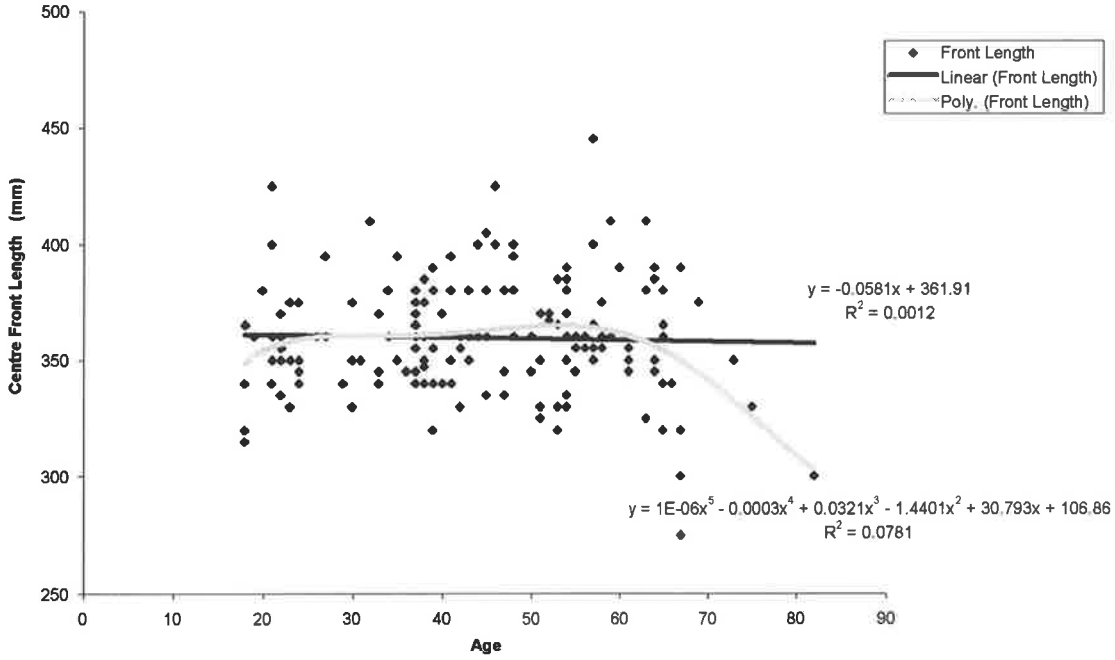
Figure 8. Relationship between Lower Hip Circumference and Age of S.A. Women (1998 1999).



Centre front length with age.

There was no significant increase of centre front length with age (Figure 9). In the linear relationship only 1 % of variation in the centre front can be explained by the variation in age. For the polynomial relationship only 7 % of the variation was explained. The R^2 suggests only a very weak biological relationship with age.

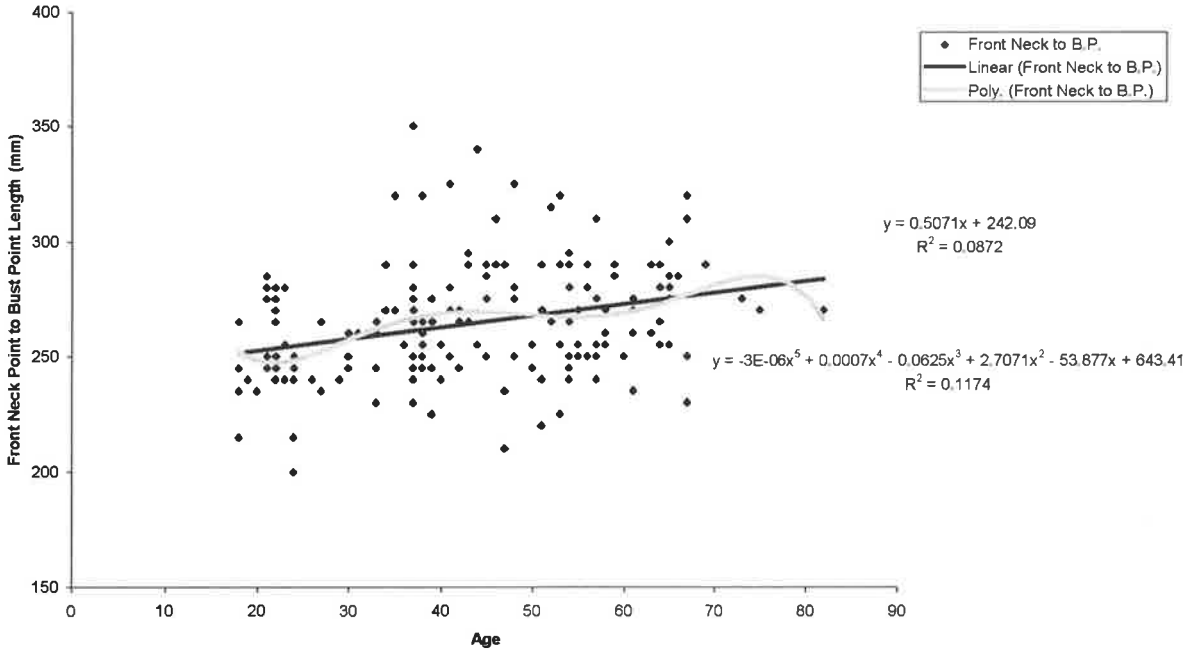
Figure 9. Relationship between Centre Front Length and Age of S.A. Women (1998-1999).



Front neck point to bust point length with age.

There was a positive trend (p=001) for an increase in the front neck point to bust point with age (Figure 10). However only a small proportion in the variation of the length of front neck point to bust point was explained by age. In the linear relationship only 8 % of variation in the front neck point to bust point length can be explained by age. For the polynomial relationship 11 % of the variation can be explained by age. This indicates a very weak biological relationship between the length of front neck point to bust point with age. The polynomial relationship shows a steady increase from about age 20 reaching an initial peak at about age 40 with a second peak at age 72 where a decline then occurs.

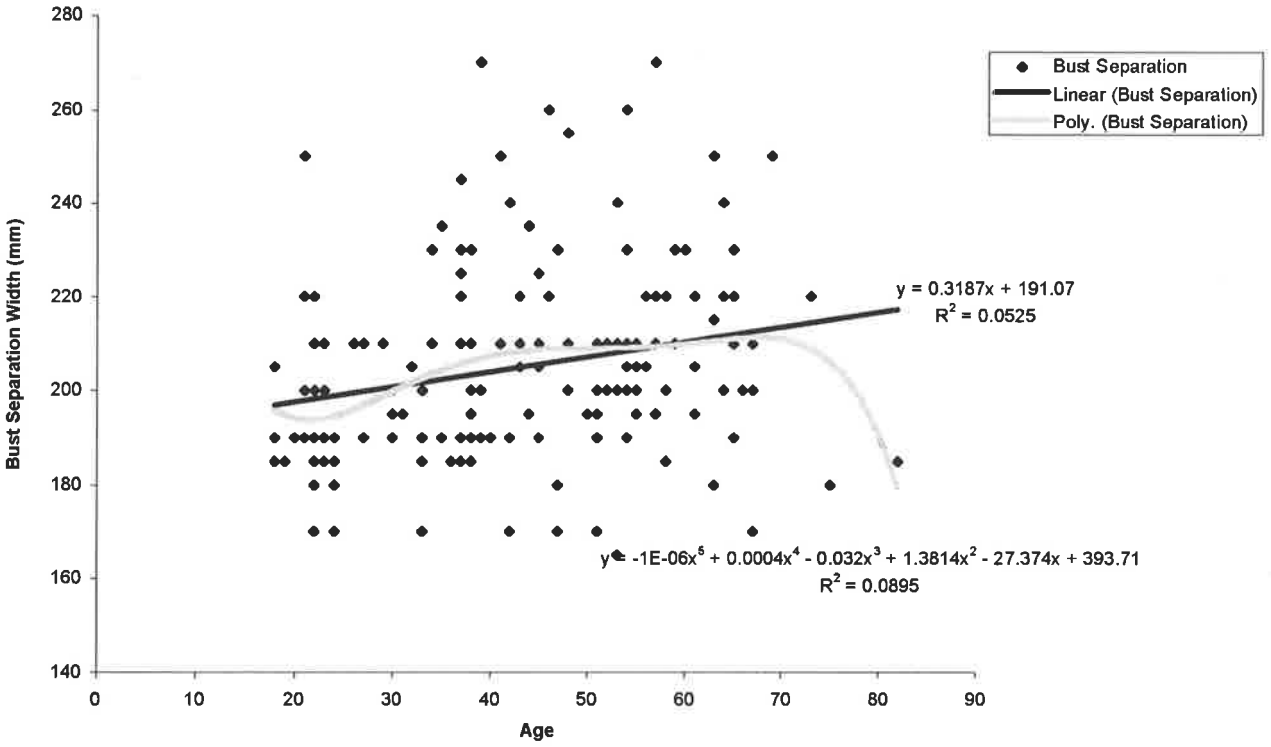
Figure 10. Relationship between Front Neck Point to Bust Point Length and Age of S.A. Women (1998-1999).



Bust separation width with age.

There was an increase of bust separation width with age (Figure 11) which was statistically significant (p=0.03). In the linear relationship 5 % of the variation of the bust separation was explained by age and 8 % in the polynomial regression. The polynomial relationship shows a steady increase from the age of 18 to about 30 reaching an initial peak at approximately 40 years, which plateaus to age 68 before a sharp decline occurs onwards.

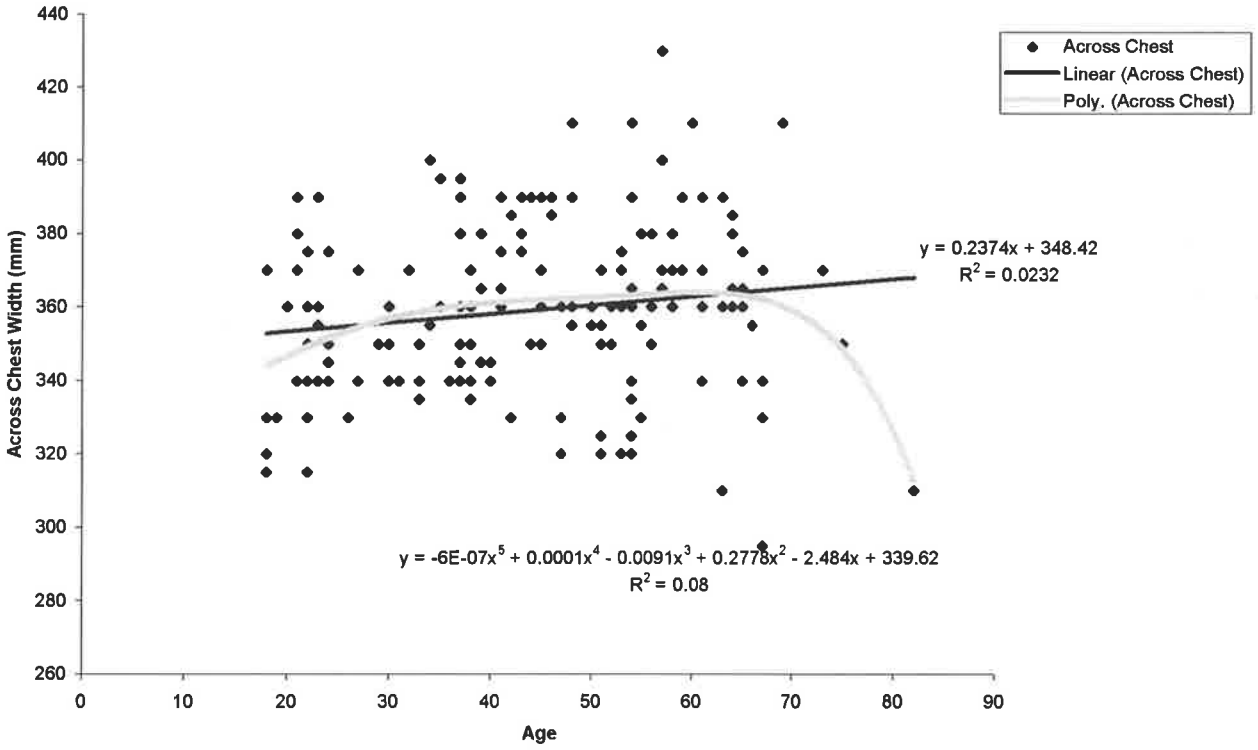
Figure 11. Relationship between Bust Separation Width and Age of S.A. Women (1998-1999).



Across chest width with age.

There was a slight trend for an increase in the across chest width measurement with age (Figure 12) however this is not statistically significant ($p=<0.05$). In the linear relationship only 2 % of the variation in across chest width was explained by age.

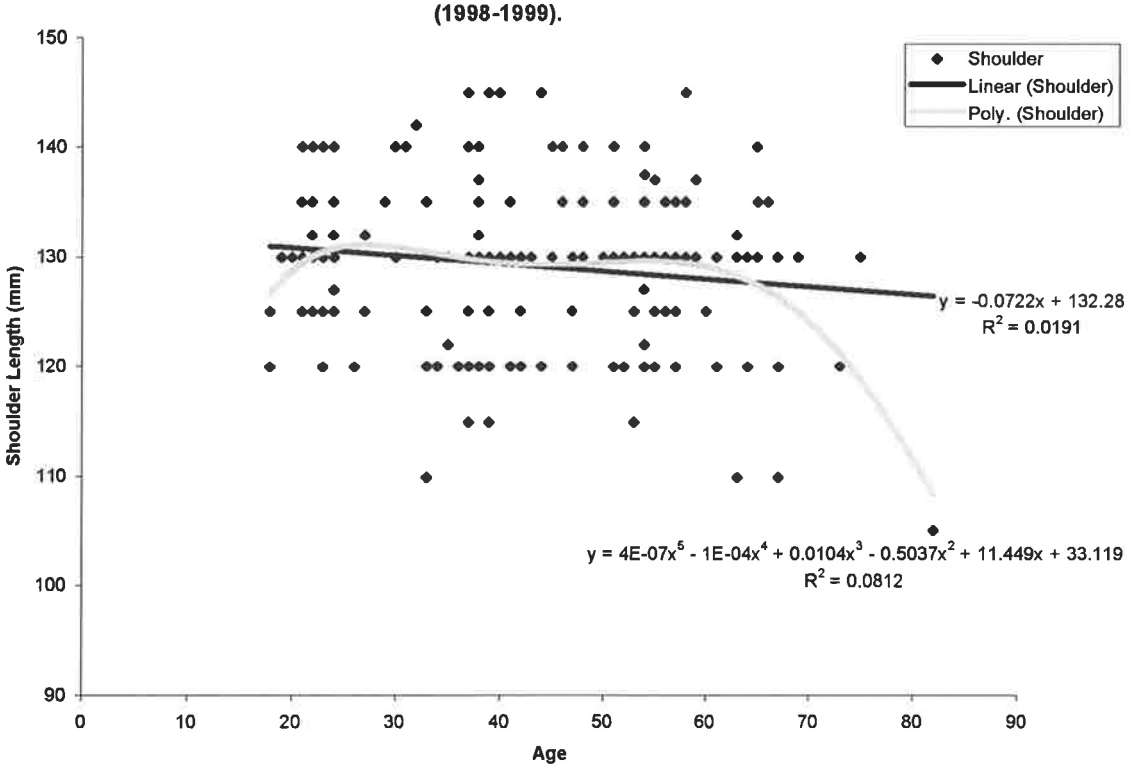
Figure 12. Relationship between Across Chest Width and Age of S.A. Women (1998-1999).



Shoulder length with age.

There was a slight decrease in the shoulder length measurement with age (Figure 13) again this was not statistically significant (p=<0.05). The linear regression shows only 2 % of the variation in shoulder length measurement was explained by age. For the polynomial relationship only 8 % of the variation was explained by age.

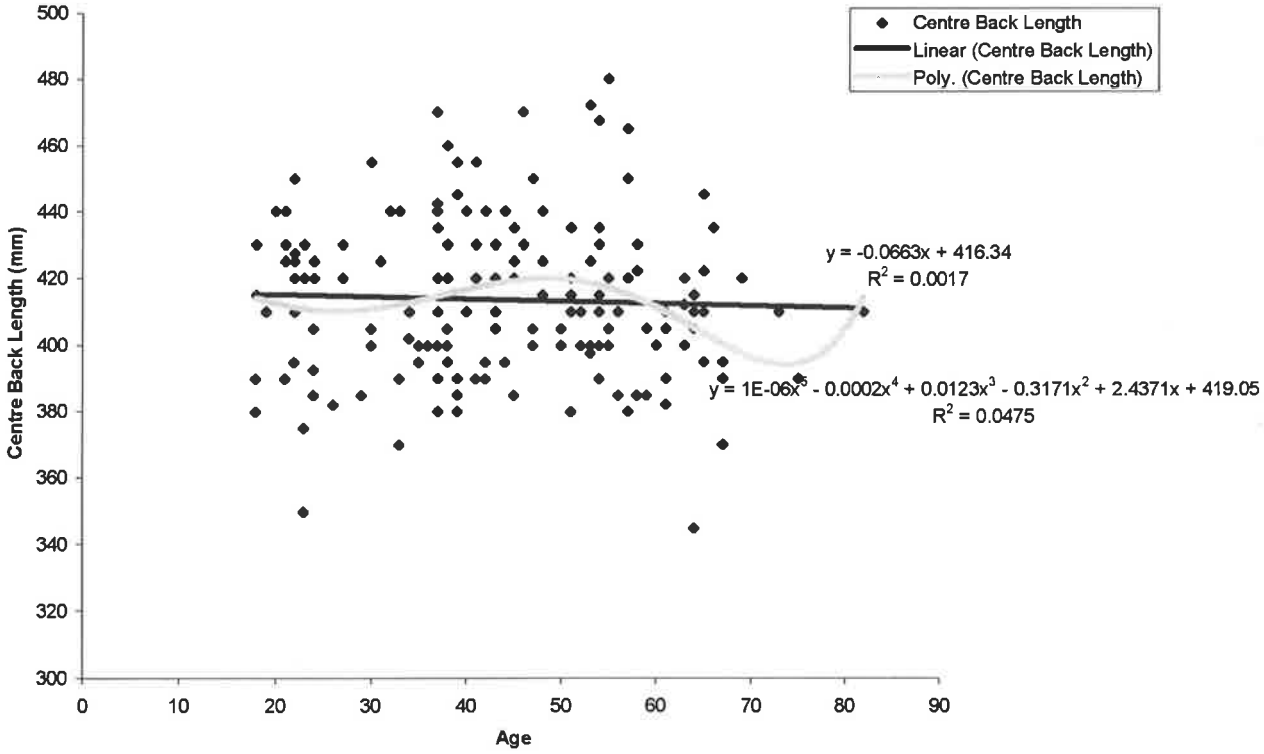
Figure 13. Relationship between Shoulder Length and Age of S.A. Women (1998-1999).



Centre back length and age.

There was no increase of the centre back length with age (Figure 14). The linear regression shows 0 % variation of centre back length was explained by age and for the polynomial relationship only 5 % of the variation in centre back length measurement was explained by age.

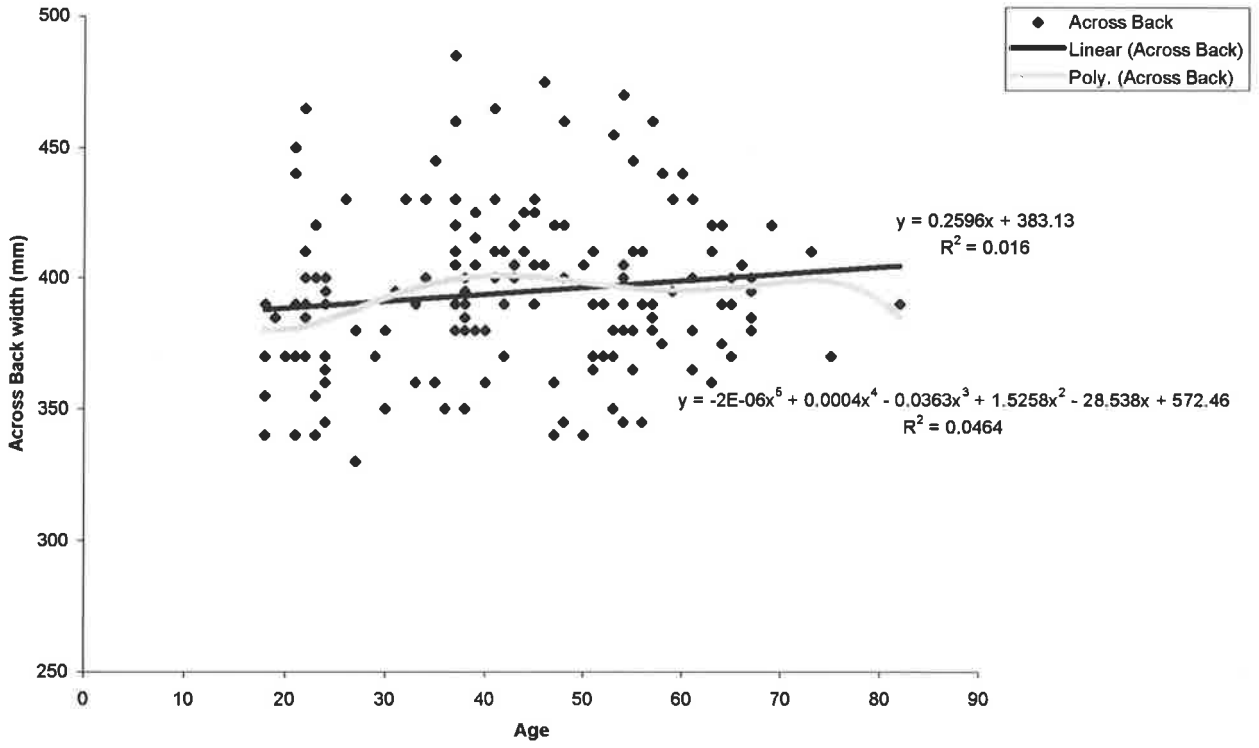
Figure 14. Relationship between Centre Back Length and Age of S.A. Women (1998-1999).



Across back width with age.

There was a slight trend for an increase in the across back width measurement with age (Figure 15) however this was not statistically significant ($p=<0.05$). The linear regression relationship shows only 2 % of the variation in across back width measurement was explained by age and for the polynomial regression 5 % of variation was explained by age.

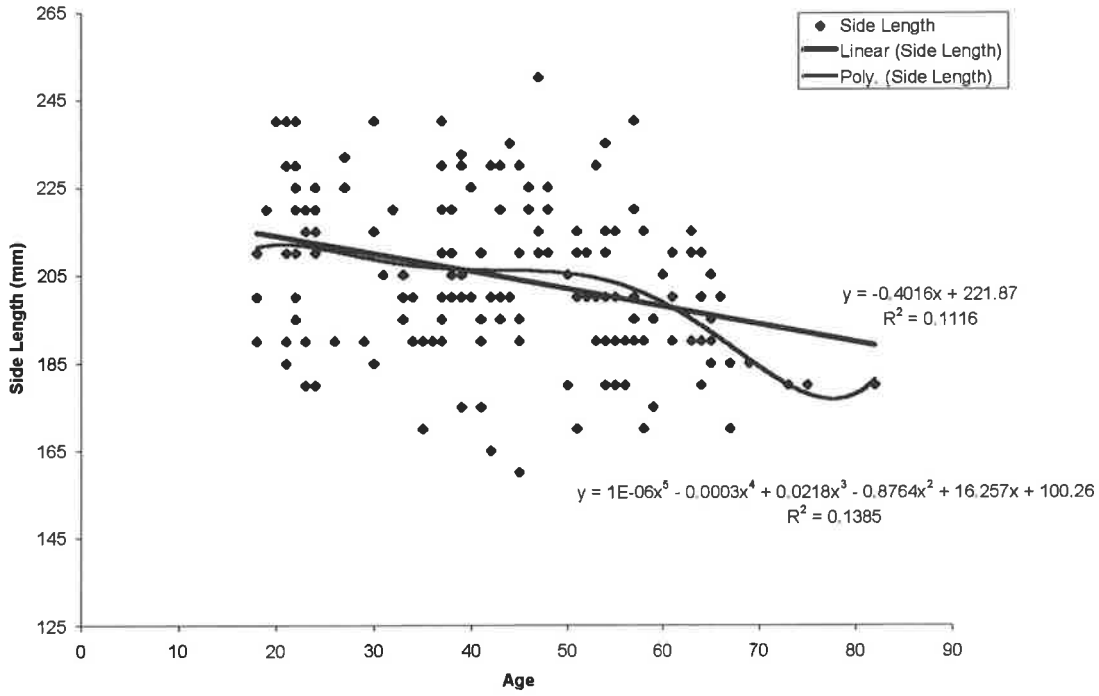
Figure 15. Relationship between Across Back Width and Age of S.A. Women (1998-1999).



Side length measurement with age.

There was a statistically significant trend (p=0.01) for a decline of the shoulder length measurement with age (Figure 16). In the linear relationship only 11 % of the variation can be explained by age. For the polynomial relationship 14 % of the variation in the side length measurement can be explained by age. The polynomial curve shows a plateau to age 50 where a decline occurs to about age 75 then an increase to approximately 82. Note the small number of data points after age 68.

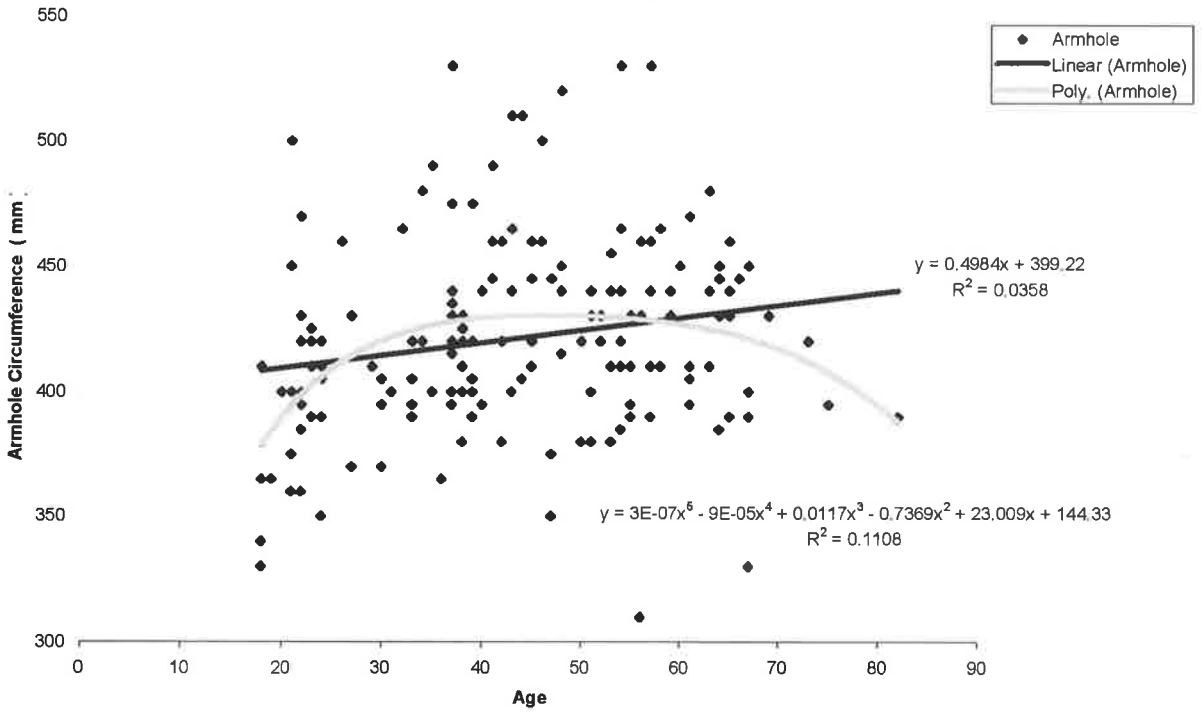
Figure 16. Relationship between Side Length and Age of S.A. Women (1998-1999).



Armhole circumference with age.

There was a statistically significant positive relationship (p=0.001) between armhole circumference and age (Figure 17). However, in the linear regression only 4 % of the variation in the armhole circumference was explained by age, and for the polynomial regression only 11 % of the variation in the armhole circumference was explained by age. This is of very weak biological significance. The polynomial relationships indicated a sharp increase in the armhole measurement from age 18 to about age 38, which then plateaus steadily with a decline occurring from approximately age 58.

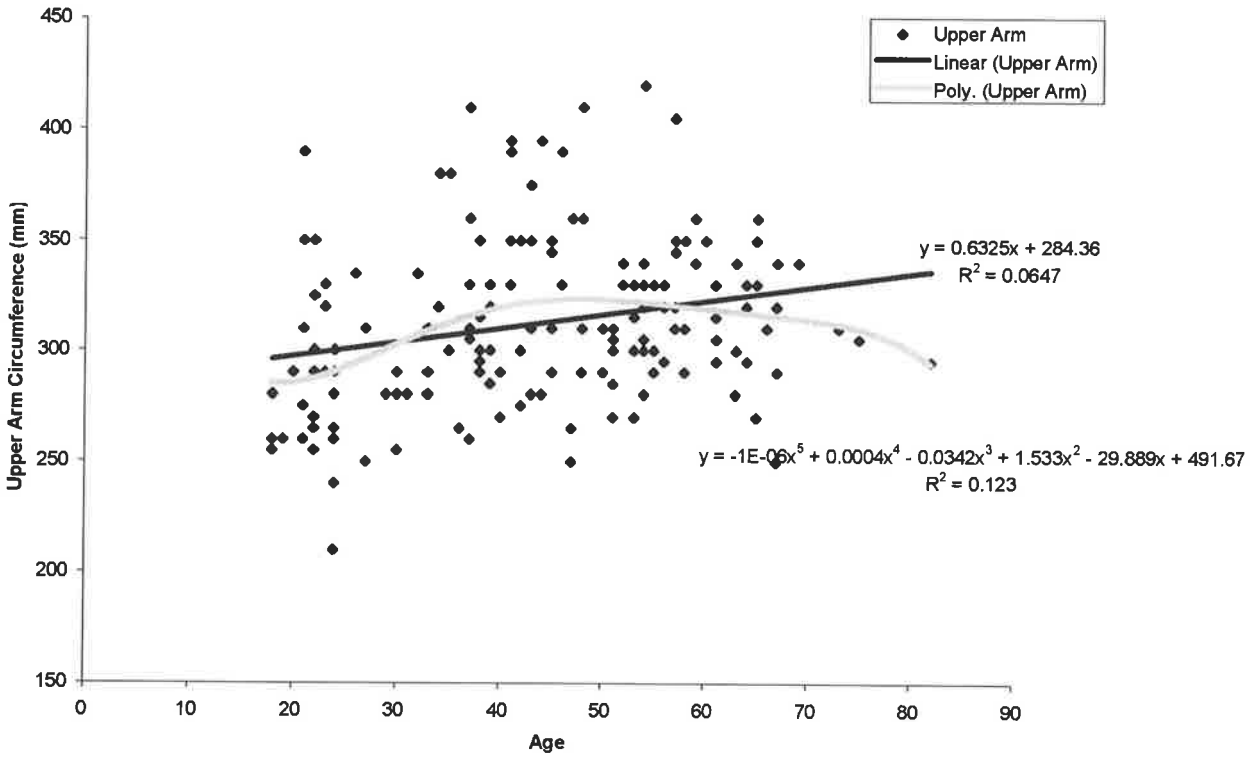
Figure 17. Relationship between Armhole Circumference and Age of S.A. Women (1998-1999).



Upper arm circumference with age.

There was a statistically significant positive relationship (p= 0.001) between upper arm circumference and age (Figure 18). However, in linear relationship only 6 % of the variation in the upper arm circumference was explained by age. For the polynomial relationship 12 % of the variation in the upper arm circumference was explained by age. The polynomial curve shows a sharp increase from age 18 reaching a peak at about age 45 with a steady decline about 58 onwards.

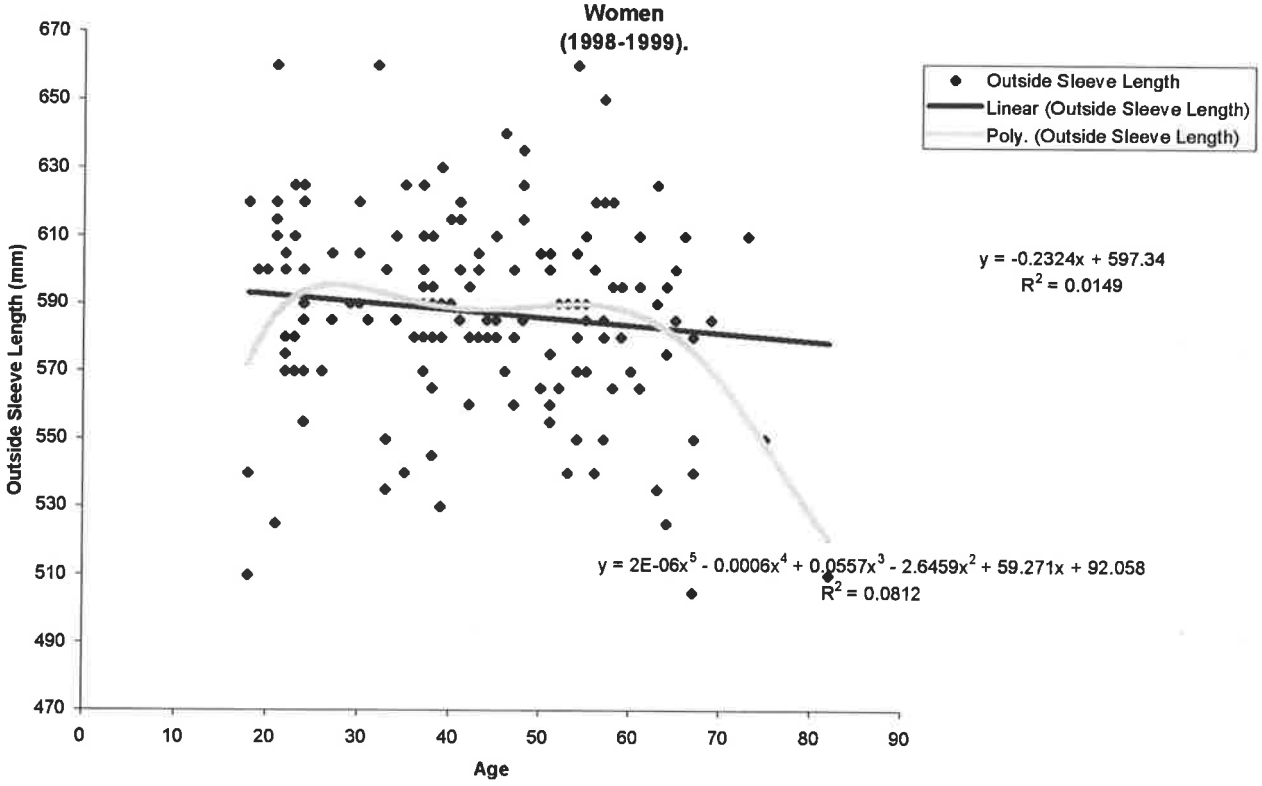
Figure 18. Relationship between Upper Arm Circumference and Age of S.A. Women (1998-1999).



Outside sleeve length with age.

There was a negative relationship between outside sleeve length and age (Figure 19). The linear regression shows that only 1 % of the variation can be explained by age and for the polynomial regression only 8 % of the variation in age be explained.

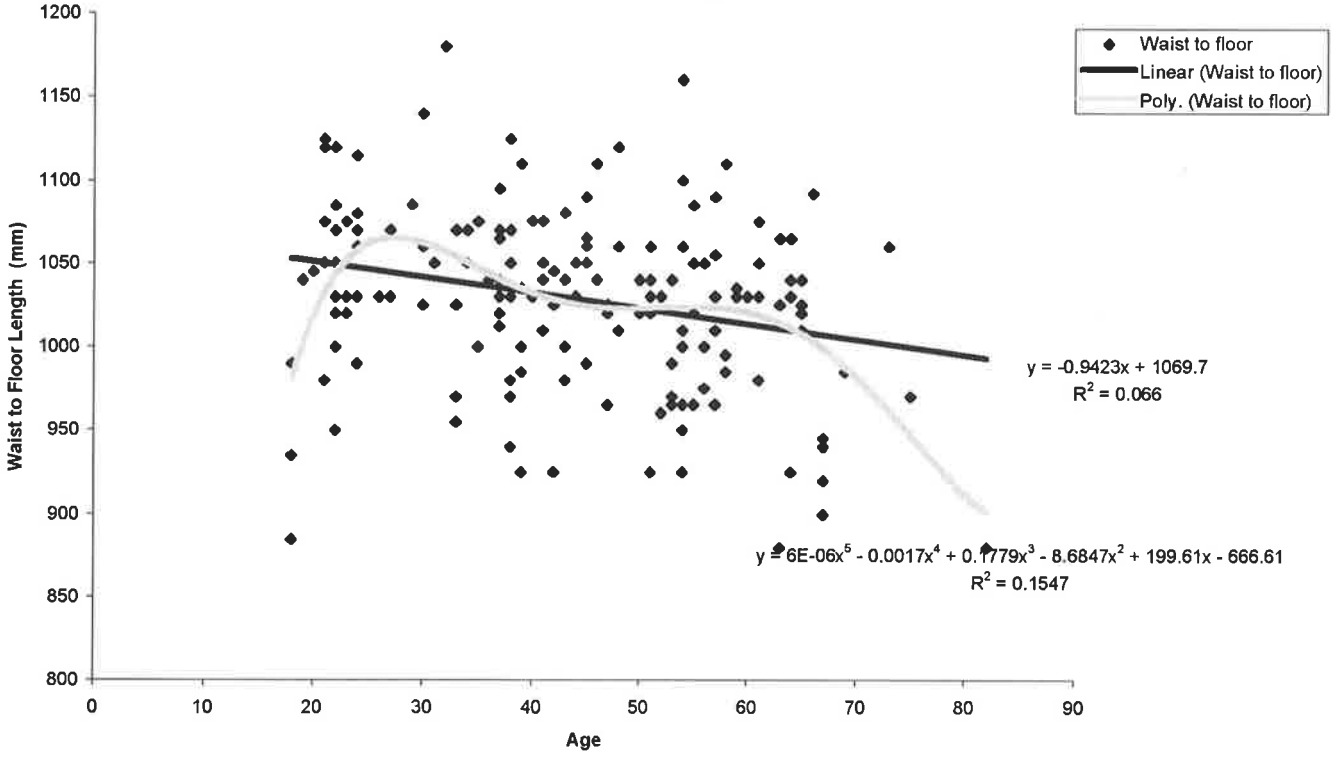
Figure 19. Relationship between Outside Sleeve Length measurement and Age of S.A. Women (1998-1999).



Waist to floor length with age.

There was a positive significant relationship between waist to floor length and age (Figure 20) which was considered statistically significant (p=0.001). However, the linear regression shows that only 7 % of the variation in the waist to floor length can be explained by age. For the polynomial regression only 15 % of the variation can be explained by age in the waist to floor length starting from age 18. The polynomial relationship suggests a sharp increase in waist to floor length from age 18 reaching a peak at about age 28, then steadily decreasing to approximately age 38 remaining on a plateau until approximately age 60 then declining onwards.

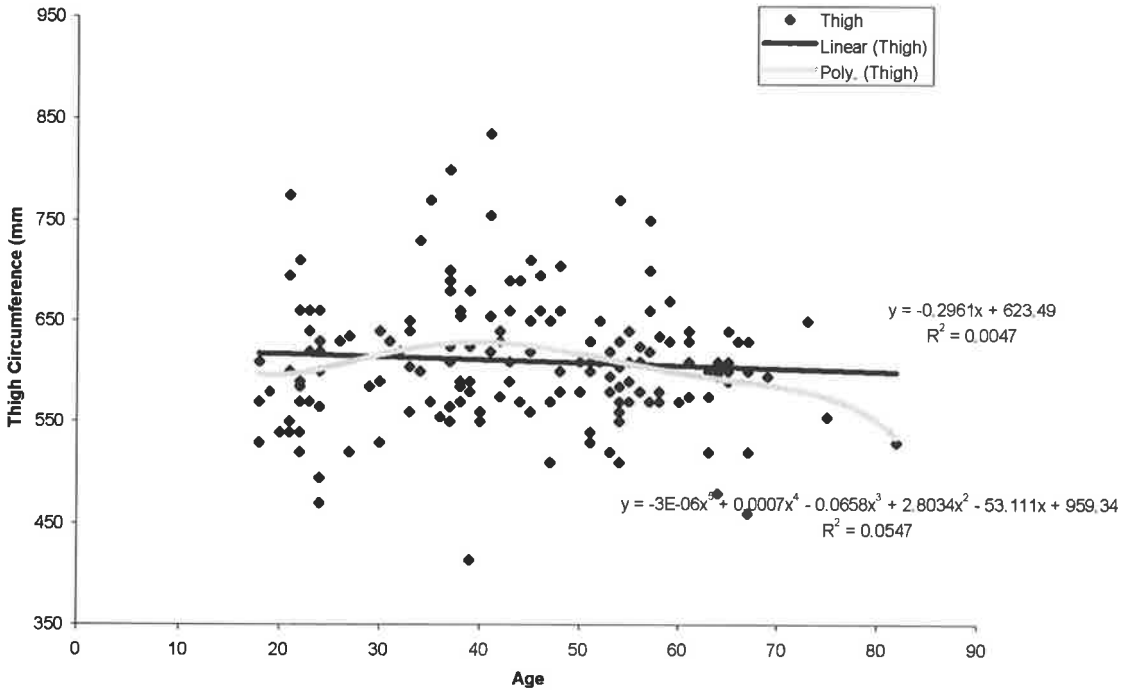
Figure 20. Relationship between Waist to Floor Length and Age of S.A. Women (1998-1999).



Thigh circumference with age.

There was no significant relationship observed between thigh circumference and age (Figure 21). The linear regression shows that 0 % of the variation in thigh circumferences can be explained by age and for the polynomial regression only 5 % of the variation can be explained by age.

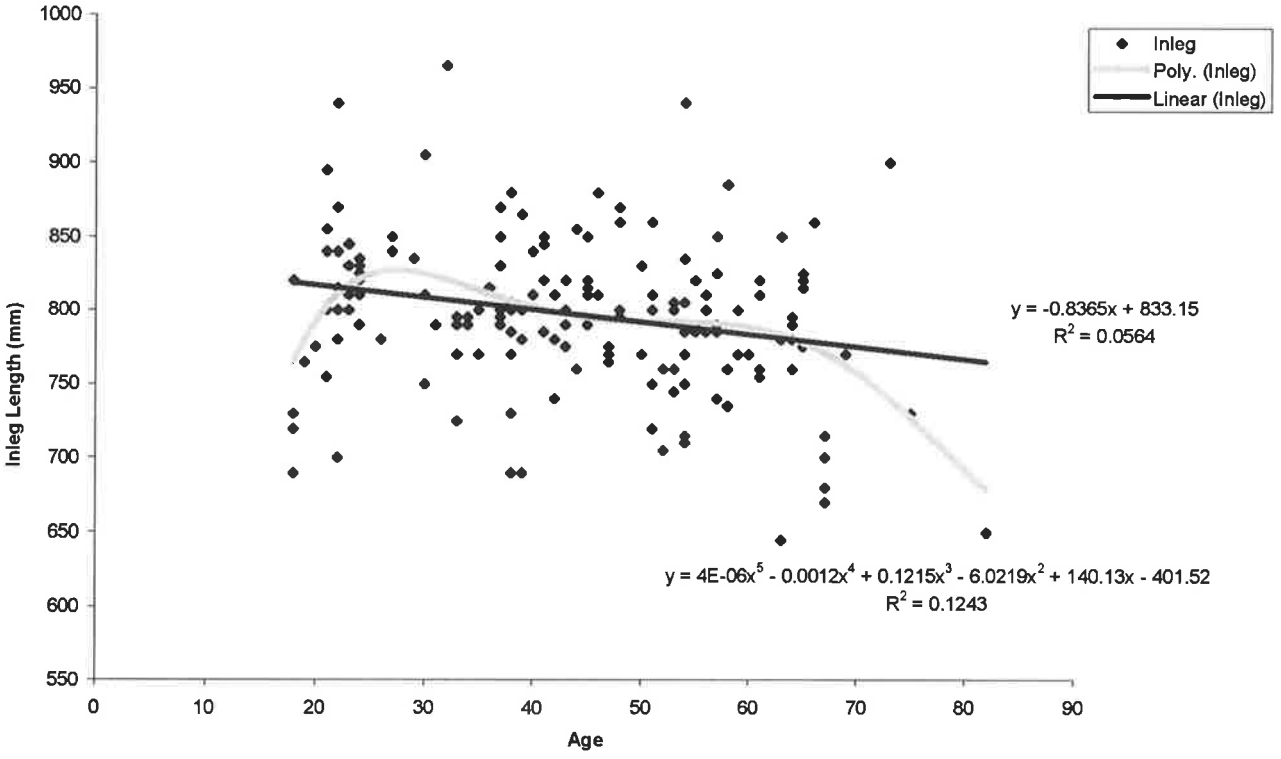
Figure 21. Relationship between Thigh Circumference and Age of S.A. Women (1998-1999).



Inleg measurement with age.

There was a statistically significant (p=0.002) trend for a steady decline in the relationship between inleg length measurement and age (Figure 22). However, the linear regression shows only 5 % of the variation can be explained by age and for the polynomial curve only 12 % of the variation can be explained by age in the inleg measurement. The polynomial curve shows there was a sharp increase in inleg measurement reaching a peak at approximately age 28, where a decline occurred to about age 40 remaining in a plateau to about age 60, where a sharp decline occurred.

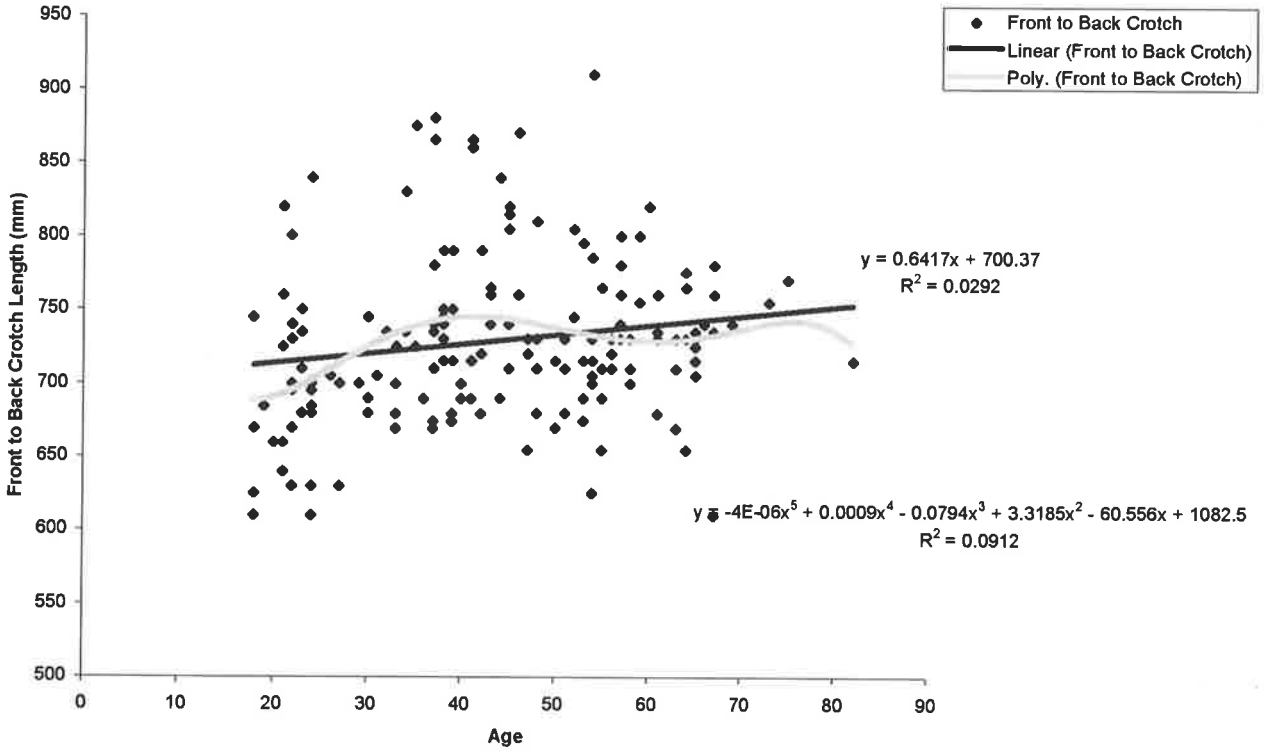
Figure 22. Relationship between Inleg Length and Age of S.A. Women (1998-1999).



Front to back crotch length with age.

There was a statistically significant (p=0.029) trend for a steady increase in front to back crotch measurement with age (Figure 23). The linear regression shows that only 2 % of the variation in front to back crotch length measurement can be explained by age, whereas in the polynomial regression 9 % of the variation can be explained by age. The polynomial curve shows a sharp increase from age 18 then plateaus to a second peak at age 70 where a decline occurs onwards.

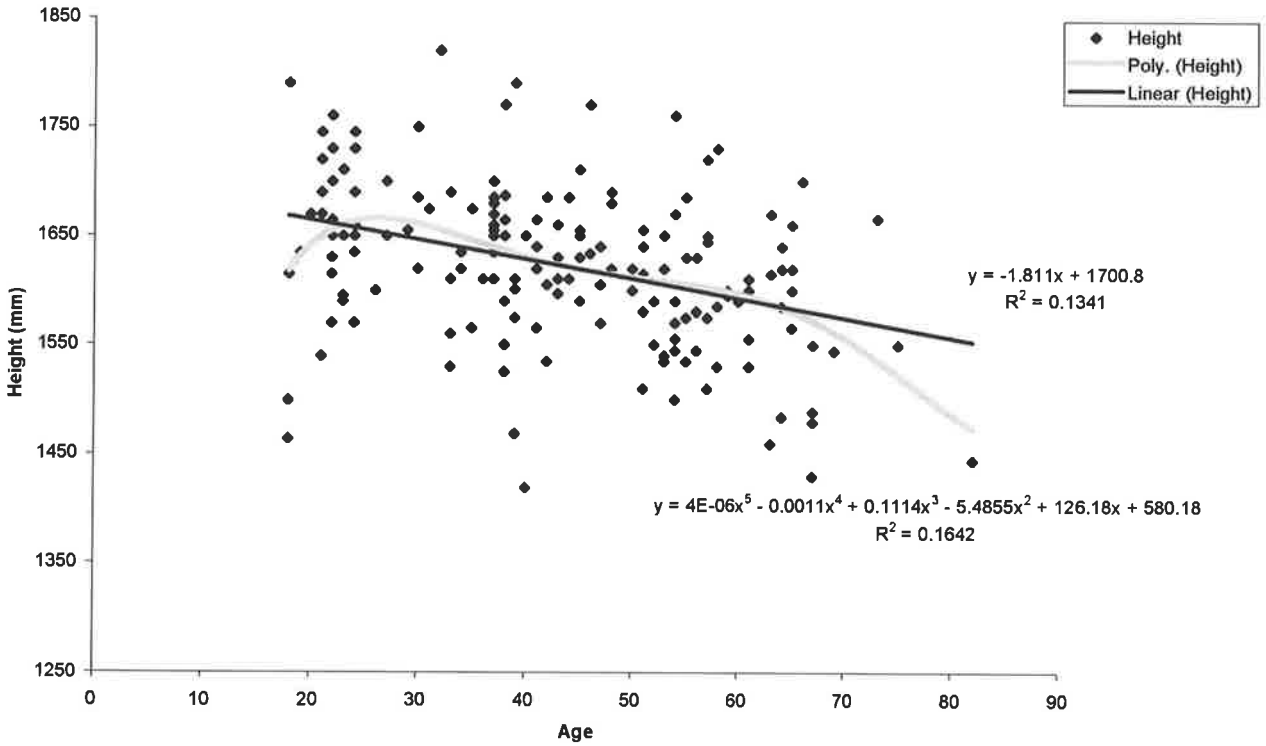
Figure 23. Relationship between Front to Back Crotch Length Measurement and Age of S.A. Women (1998-1999).



Height with age.

There was a statistically significant (P=<0.001) trend for a decline in height with age (Figure 24). The linear regression shows that 13 % of the variation in height can be explained by age and the polynomial regression shows that 16 % of the variation can be explained by age. The polynomial curve shows a sharp increase from age 18 reaching a peak at age 24 declining steadily to about age 64 with a vast decline onwards.

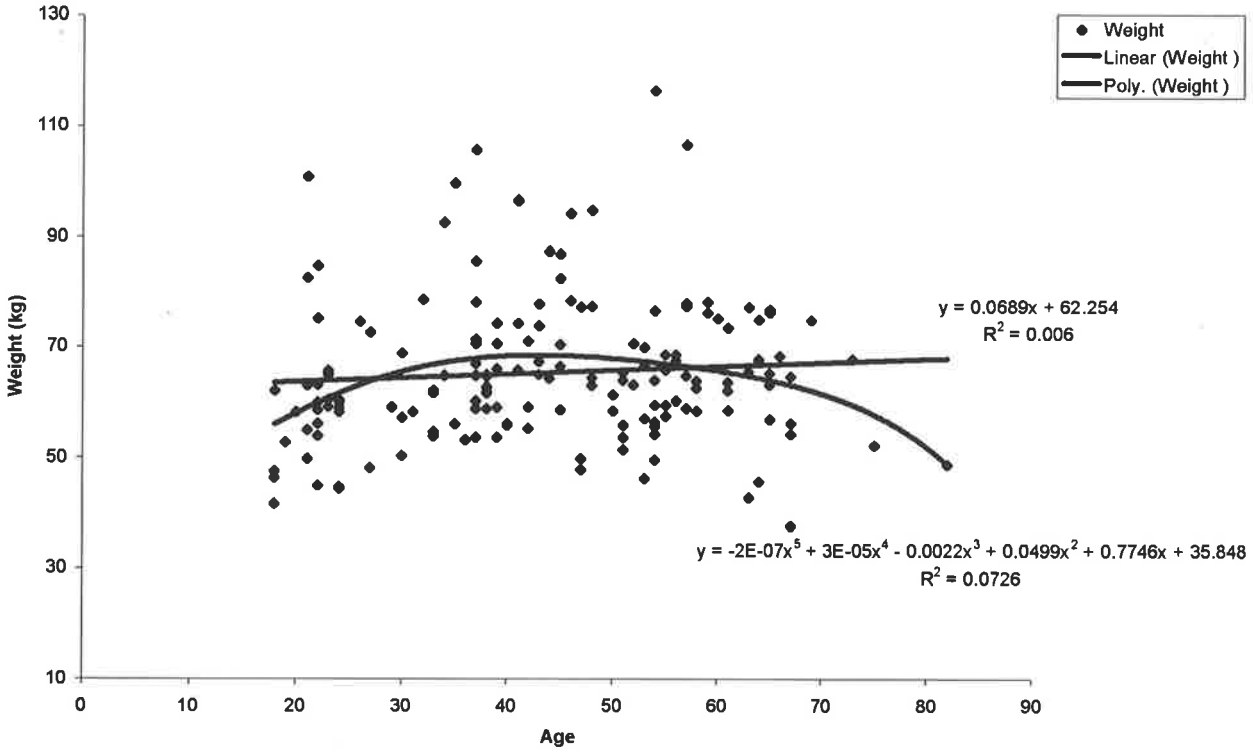
Figure 24. Relationship between Height and Age of S.A. Women (1998-1999).



Weight with age.

There was no trend for weight with age (Figure 25). The linear regression showed 0 % of the variation in weight can be explained by age and for the polynomial curve only 7 % of the variation can be explained by age. The polynomial curve shows a very weak biologically significant correlation was observed.

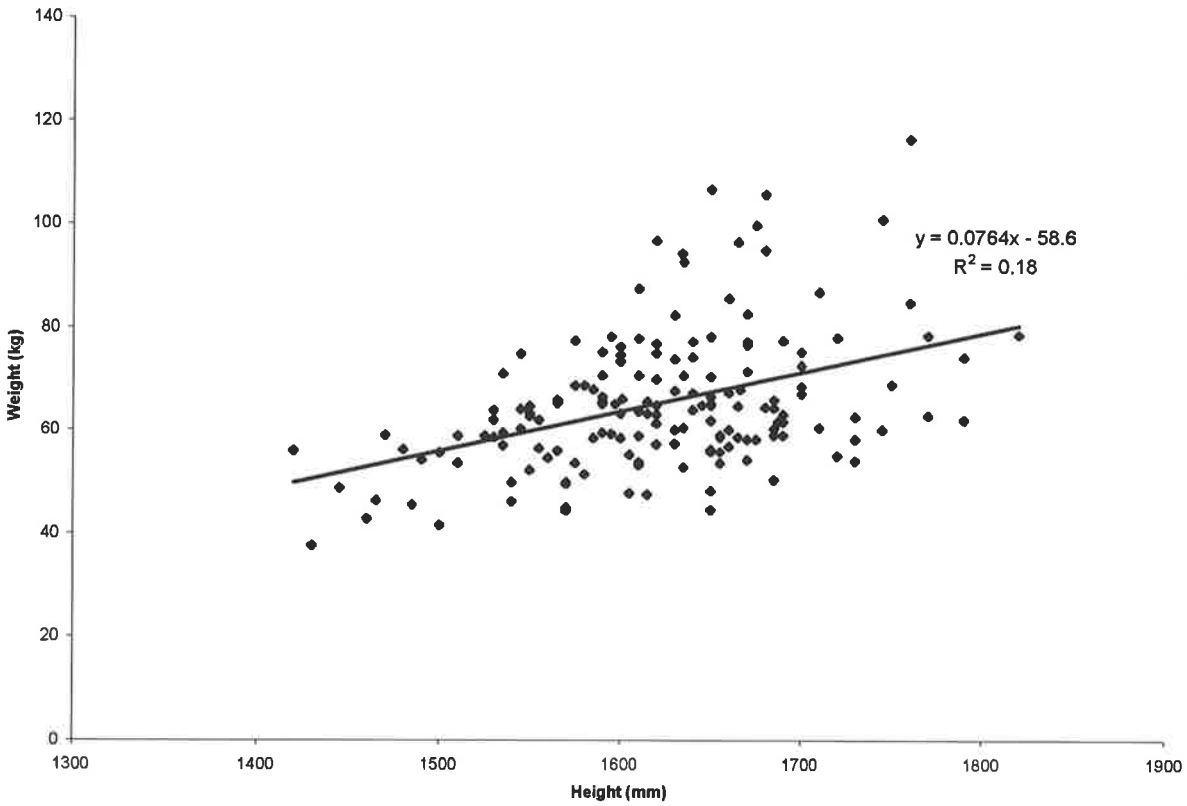
Figure 25. Relationship between Weight and Age of S.A. Women (1998-1999).



Weight with height.

There was significant positive relationship between the increase in weight with height (Figure 26). The linear regression showed a 18 % variation in height can be explained by weight and vice versa.

Figure 26. Relationship between Weight and Height of S.A Women (1998-1999.)



Comparison of averages of S.A Women (1998-1999) body dimensions with current Australian Standard (1997).

The results from this study indicate there are considerable differences in the body dimensions of this study compared to the body dimensions used in the current 1997 Australian Standard. In comparing current S.A data to Australian Standard (1997) for clothing design and production, it can be seen (Figure 27) that there are major differences between the observed S.A measurements and the Australian Standard (1997) for the short, average and tall height and weight categories. In each category the Australian Standard have a much greater trend slope than does the S.A Women's trend line. Thus in each category the increase of weight with height was of greater significance in the Australian Standard, than the S.A women's categories. There was a significant but small trend in height while the secular trend in weight was substantial. This indicated that there are implications for the clothing and fashion industry in relation to the sizing of women's clothing in Australia. The data from this study were analysed and compared to the current Australian Standard (1997) Average Women size category which consisted of 8 sizes starting from Australian Standard size 12 to size 26 (Table 29).

Figure 27. Comparison between Australian Standard (1997) Height and Weight Trends with S.A Women (1998-1999), sorted into Australian Standard Height Categories.

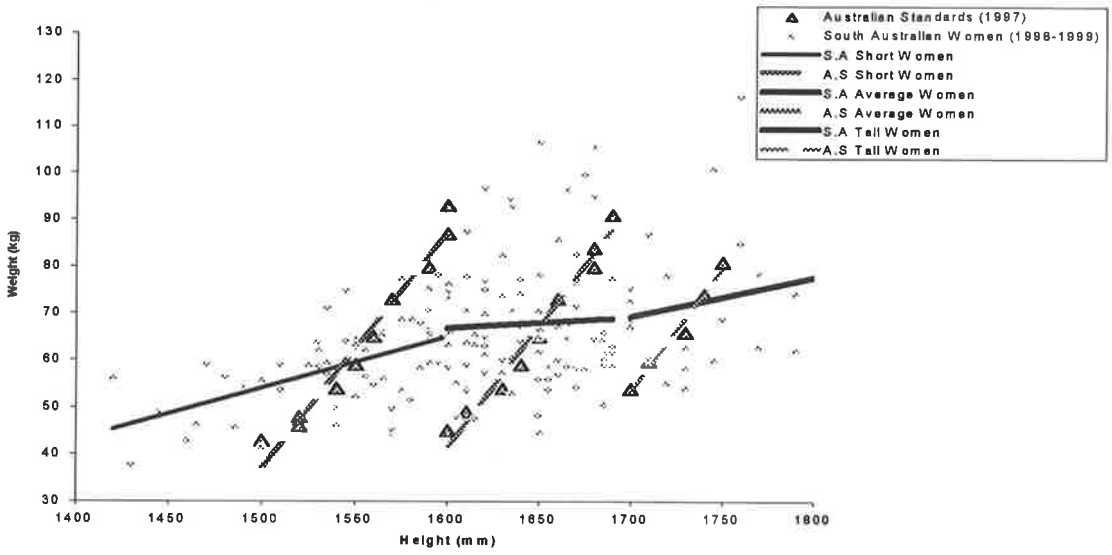


Table 29 **Comparison of average body dimensions of S.A. Women (1998-1999) with average women Australian Standard (A.S.) (1997).**

Body Dimensions (mm)	S.A Women (1998-1999)	A.S.12	A.S.14	A.S.16	A.S.18	A.S.20	A.S.22	A.S.24	A.S.26
Height (mm)	1622	**1630**	1640	1650	1660				
Weight (kg)	65.2	54	59	**65**					
Girth Measurements									
Neck	384	370	**380**	**390**					
Bust	983	850	900	**950**	**1000**				
Waist	802	650	700	750	**800**				
Upper Hip	960	830	870	910	**970**				
Lower Hip	1028	900	950	**1000**	**1050**				
Armhole	420	380	400	**410**	**430**				
Upper arm	312	260	280	290	**310**				
Thigh	610	530	560	590	**620**				
Lengths									
Centre front length	359	340	350	350	**360**				
Front shoulder to B P	264	235	245	255	**265**				
Shoulder length	129	110	115	115	115	115	115	**120**	**120**
Centre back length	413	390	4000	400	**410**	**410**			
Side length	204	215	215	210	210	**205**			
Outside sleeve length	587	**590**							
Waist to floor	1028	1010	**1020**	**1030**					
Inleg	797	730	730	740	740	740	740	750	nil
Front to back crotch	728	**720**							
Widths									
Bust Separation	205	180	180	185	185	190	**205**		
Across chest width	359	300	310	320	330	330	340	**350**	**360**
Across back width	39	320	330	340	350	370	380	**390**	**400**

Secular trends of current Australian women with previous Australian literature.

Due to similarity in methods the data from this study were compared to previous Australian literature, to show trends in Australian women's body sizes over time. This indicated that there was a significant biological trend for both size and shape of Australian Women over time. Nine Australian studies were reviewed from 1927 to 1999 to assess these trends (Table 30).

Table 30: Summary of Australian women's height and weight literature used for the assessments of trends over time. (Self reported data not included).

Table Summary of Australian Women's Height and Weight Literature used for the following Assessments of Trends Over Time. Self reported data not included.

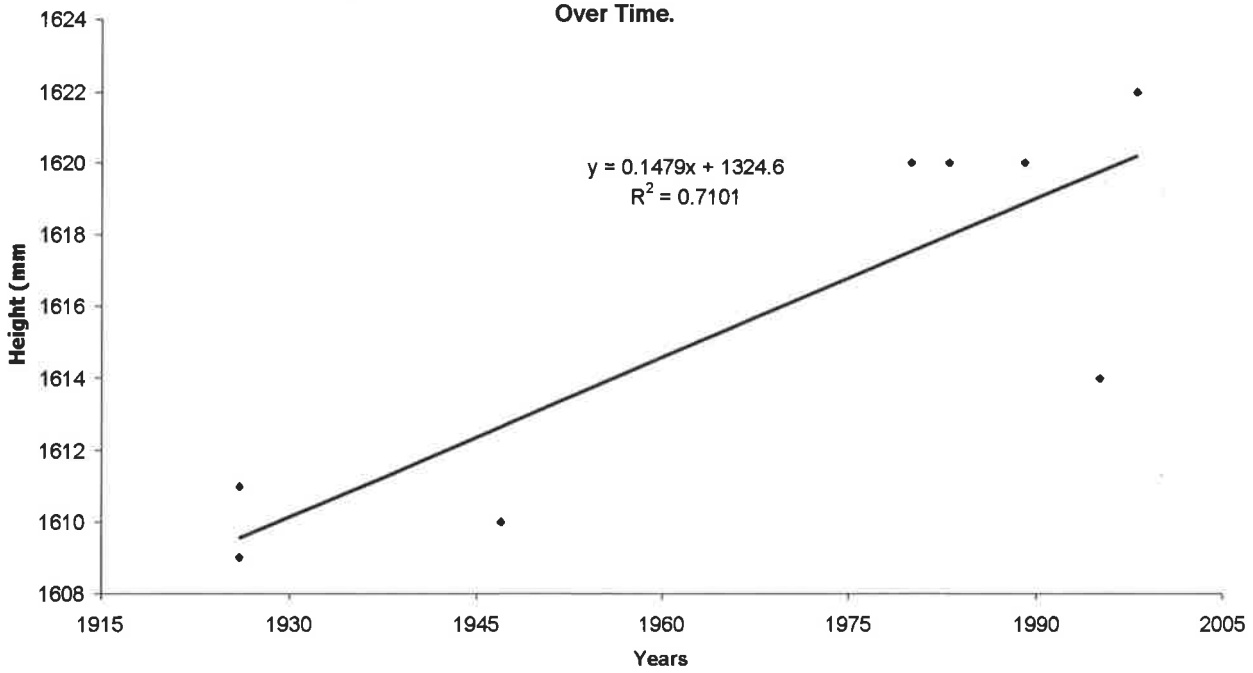
Author	Berlei Research Branch (1927)	Woodhill (1952)	Lancaster (1957)	Australian Bureau Statistics (1995)	National Heart Foundation (1980)	National Heart Fondation (1983)	National Heart Fondation (1989)	National Heart Fondation (1989)	South Australian Women (1998-1999)	Patterson and Brown (2000)
Year of Survey	1926-1927	1947	1926-1928	1995	1980	1983	1988	1988	1998-1999	1999
Sample Size	4000	5270	5230	6118	2785	3824	4631	948	161	450
Ages	15-65	15-55	15-65	15+	25-64	25-64	25-64	20-69	18+	25-39
Place of Survey	NSW, Vic, Qld, SA.	All states and Territories (W.A.A.A.F) (A.W.A.S) (A.M.W.A.S.) (A.M.P).	NSW, Vic, Qld, SA.	All States and Territories.	Syd, Mel, Perth, Hob, Ade, Bris.	Syd, Mel, Perth, Hob, Bris, Ade.	All Aust Capital Cities.	Adelaide	Adelaide.	Bris, Melb, Newscastle.
Height (mm)	1609	1610	1611	1614	1620	1620	1620	1616	1622	1645
Weight (kg)	64.27	nil	59.12	67	64	64	65.4	66	65.2	66

*(W.A.A.A.F) Aust. Women's Auxiliary Air Force; (A.W.A.S) Aust. Women's Army Services; (A.M.W.A.S.) Aust. Medical Women's Army Services; (A.M.P) Aust. Mutual Provident.

Height over time.

There was a positive trend for height over time (Figure 28). The linear regression relationship shows that 71 % of the variation in height is explained by years. It should be noted that the three studies conducted post 1995 have a vast amount of variation between them. This variation may be explained by the surveying of different age groups among these studies (Table 30). The high 1999 values by Patterson and Brown (2000) were excluded from calculating the linear regression because they contained only subjects within the 25-39 age group. Chandler and Bock (1991) have shown that individual height decreases for women starting from age 30, where 0.24 mm is the estimated decline from peak height. At age 69 there is approximately 42.08 mm decline from peak stature. By limiting the data set to age 39 the population average may be overestimated due to the decreasing height in adults past age 39. Limiting the survey to individuals over the age of 25 also limits the number of people that are still growing or have reached their height potential.

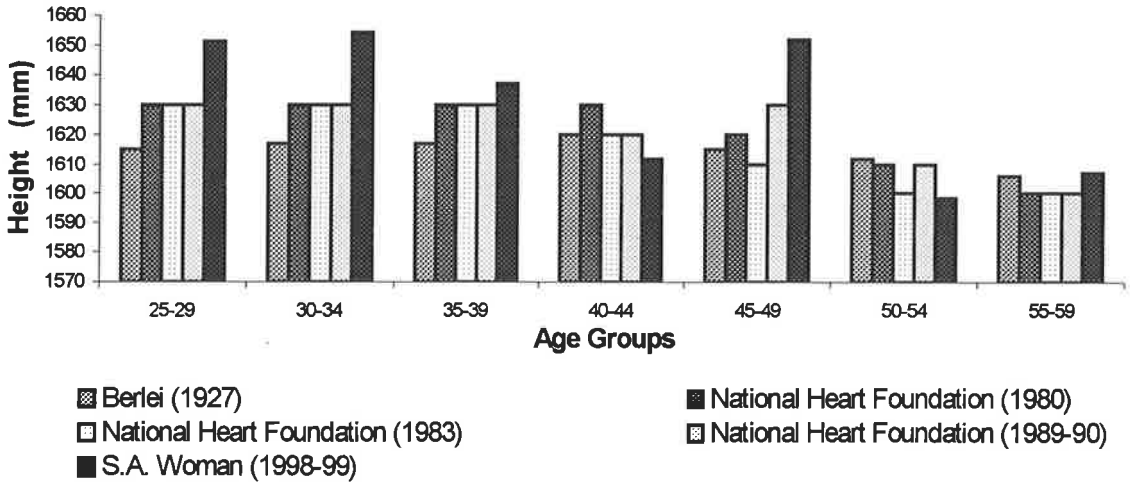
Figure 28. Variation in Height of Australian Women Over Time.



Comparison of height within age groups of previous literature.

Figure 29 shows there was a general negative trend of height with age. In the age group 40-45 this decline occurs in all studies except the recent S.A Woman (1998-1999) study. For the age groups of: 25-29, 30-34, and 35-39 there was an increase observed over time between the studies. For the age groups of: 40-44, 45-49, 51-54, and 55-59 there was no clear increase or decrease in height over time between the studies. However, in the 45-49 age category there was an increase except for the 1983 National Heart Foundation study where the lowest value was obtained for this age group across all studies.

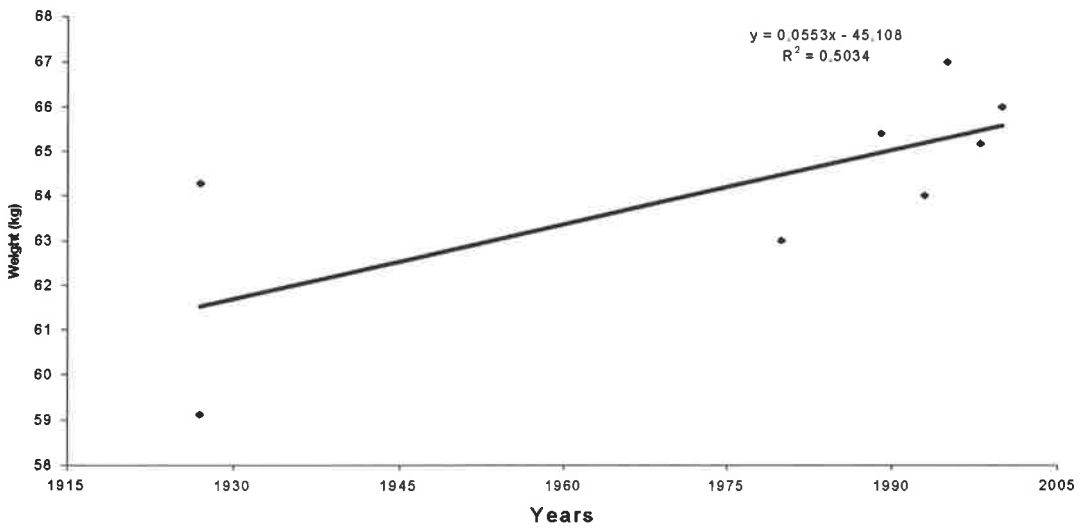
Figure 29. Australian Studies Average Height compared within Age Groups.



Weight over time.

There was a positive trend in the increase of weight over time (Figure 30), noting, however, the low number of data points between 1930 and 1980. The linear regression showing a strong biological trend, with 50 % of the variation in weight being explained by years. It should be noted that the two surveys of 1926-1927 and 1926-1928 were not independent. The 1926-1927 data were from an interim report (Berlei 1927) which was based on 4,000 individuals. The 1926-1928 data were based on the full Berlei study (Unpublished) which consisted of 5,230 individuals that were analysed and later published by Lancaster (1957). The large amount of variation in the average weight between these two reports is expected to be a result of the mean age and the number of the individuals sampled. In the Berlei (1927) interim report, 51.9 % of participants were under the age of 24 years. In the Lancaster (1957) study, there were an extra 1,232 people and the mean age of participants was given at 28 years. The mean age difference is expected to have a significant influence on the mean weight.

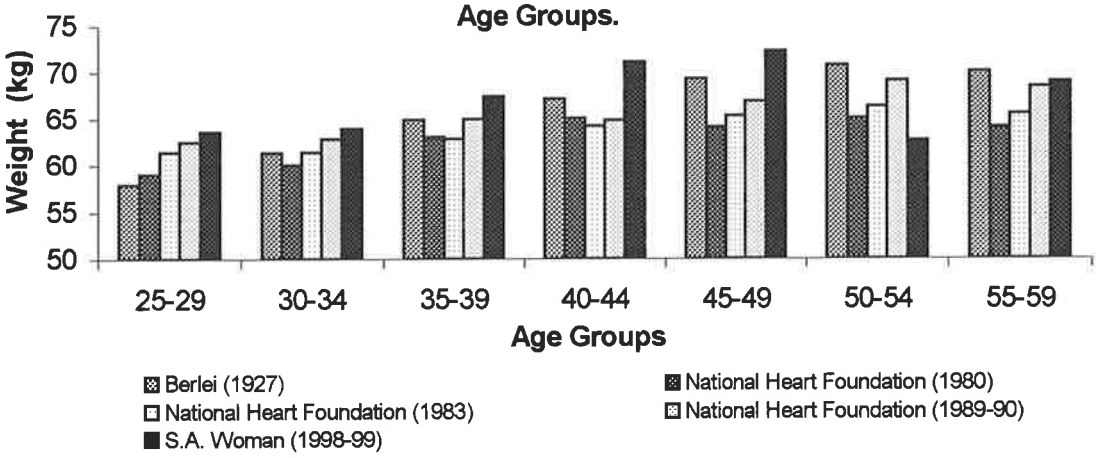
Figure 30. Variation in Weight of Australian Women Over Time



Average weight of Australian women compared in age groups to previous literature.

Generally there is a slight increase in weight from 25-29 years of age to the 40-49 age group (Figure 31). The mean weight very slightly decreases onwards. This finding supports the data collected during this study where a very weak correlation was observed between weight measurement and age. In this correlation the highest weight age category observed was of individuals between 40 and 50 years. Similar to height trends, there was an increase observed over time between the studies for the age group 25-29. There are generally no trends over time between the studies for the other age groups.

Figure 31. Australian Studies Average Weight Compared within Age Groups.



Comparison of Australian secular trend to overseas secular trend data.

The data from six overseas studies were compared with Australian studies to show secular trends in body size and shape over time. These studies showed that there was significant biological trend for both size and shape of overseas and Australian women over time. However, it appeared that Australian trends differed from overseas women. The studies ranged from 1939 to 1993 which included three studies from America and three studies from Great Britain (Table 31). Although no Australian data appear in Table 31, they can be seen in Table 30.

Table 31: Summary of height and weight of data of women from overseas countries compared.

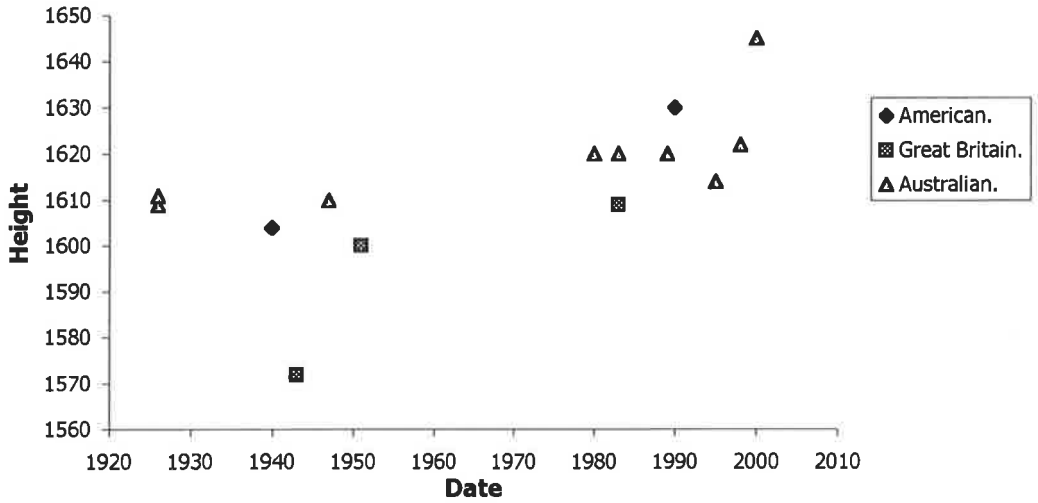
	American			Great Britain		
Author	**O'Brien and Shelton (1941)**	**Frisancho (1990)**	**A.S.T.M. (1995b)***	**Kemsley (1950)**	**Board of Trade (1957)**	**Knight and Eldridge (1984)**
Year of Survey	1939-1940	1990	1993	1943	1951	1983
Sample Size	10042	16615	6786	33500	5000	5000
Ages	18+	18-74	55+	14-75	18-70	16-64
Height	1604	1630	1664	1572	1600	1609
Weight	60.5	63.5	nil	54.2	60.02	62

*A.S.T.M. American Society for Testing and Materials.

Height over time between Australian women and overseas women.

There was a strong positive trend for height of women from America and Great Britain over time. The Australian data indicate that although there was a positive trend in height, this was not as strong as the trend in height for the American and Great Britain women (Table 32). This can be seen by comparing the slopes of the trend lines plotted. The slope of both American and Great Britain are similar. The data from Great Britain although shorter in height than the American data also indicate that there is a strong biological trend in height. It should be noted that the methods used in the Kemsley (1943) report of Great Britain study were slightly different to the other studies. This study was conducted with participants wearing shoes. A correction of 38.1 mm was made to allow for shoe height. Australian data also suggest a positive trend in height although, this increase was not as substantial as in America or Great Britain. It should also be noted that the A.S.T.M (1995b) study may not be representative of the population due to its focus being women 55 years and older.

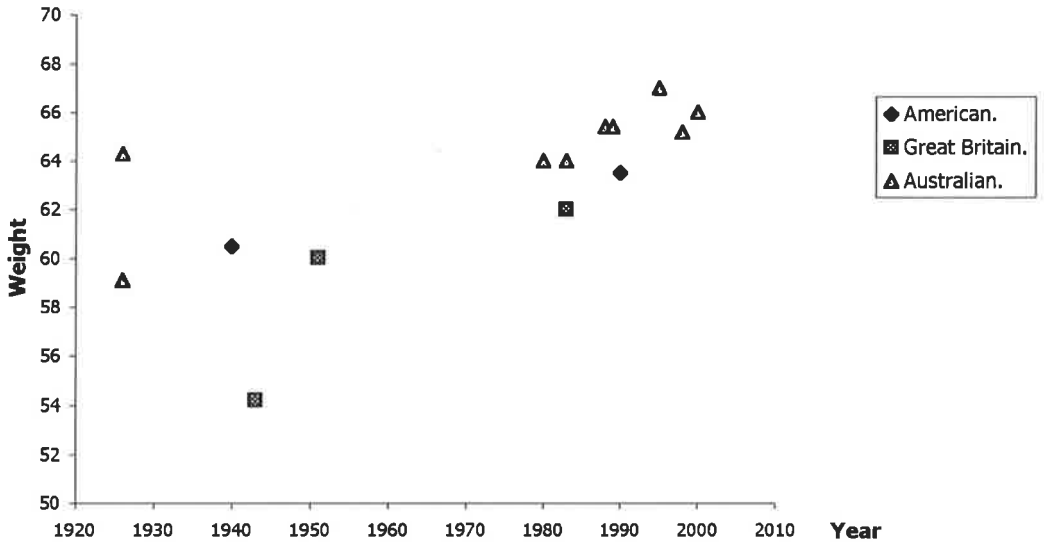
Figure 32: Comparison of Secular Trends in Height Over Time between Australian, American and Great Britain Data.



Weight over time between Australian women and overseas women.

There was a positive trend that was significant for weight over time of Australian, American and British Women (Figure 33). The Great Britain study shows a vast increase in weight. However, these trends differed between countries. With all data included increases in both Australia and America were similar, thus weight has increased at a similar rate over time. The plot of all data from Great Britain indicated a very different trend to the other countries, this being a very significant increase. The significant difference is suspected to be a result of a different method in one study: the Kemsley (1943) report where all individuals were weighed with shoes on. A uniform correction figure was applied to all data. For weight 2.72 kg was allowed. This difference in method may make the use of these data in trend lines with other studies invalid due to the unknown accuracy of this correction. When Kemsley's (1943) data are removed, the trend in Britain becomes similar to that observed in both the American and Australian data.

Figure 33: Comparison of Secular Trends in Weight Over Time between Australian, American and Great Britain Data.



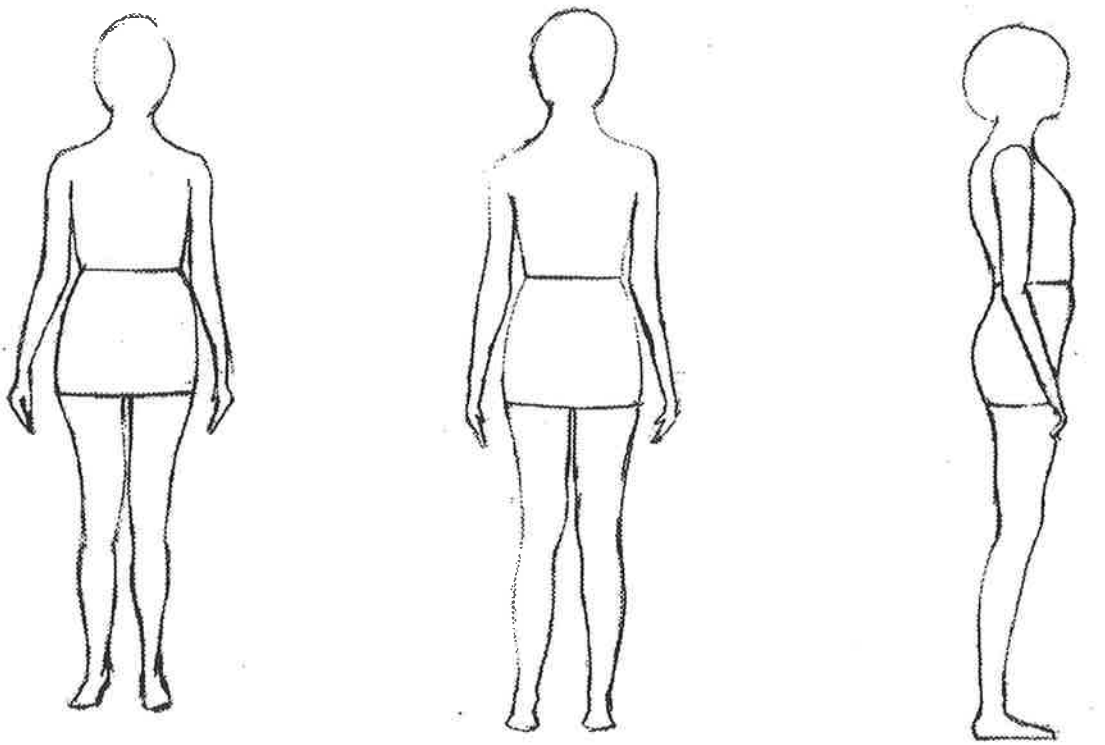
Results of the analysis of standardised photographs

This section deals with the analysis of the photographs, which involved sorting body outlines of participants into groups for the identification of body types emerging from this study. Averages for each body type were then calculated. The body types were compared to other studies of somatotyping. As stated previously, the same participants took part in both the anthropometric and photographic components of this study. The enlarged three photographs (anterior, posterior and lateral) of each participant were examined and grouped by shape. Using this procedure, five different body types were identified and were labelled by capital letters similar to typical body shapes. The first was the slim figure type labelled I. The second figure type was labelled A, which consisted of a small waist with large hip and thighs. The third figure type was labelled X the features being muscular and reasonably well proportioned. This figure type may be referred to as the average figure type. The fourth figure type H is well rounded with thick arms and legs. The final figure type was labelled XH being a combination of both muscular and roundness. Further descriptions and illustrations of each figure type follows together with average body dimensions of height, weight, bust, waist, hip, Conicity Index and Body Mass Index of each figure type.

Figure type I.

The first figure type was labelled I which indicated a slim body type (Figure 34). This figure type can be compared to a stick or straight up and down shape where the shoulder and hip are almost in a straight line. The anterior and posterior photographs depict the slim or stick figure type. The lateral photograph showed that a sway back figure was evident and was reasonably consistent throughout in this particular figure type. The ages ranged from 18 years to 75 years with the average age of 37 years.

Figure 34: Anterior, Posterior and Lateral Silhouette of Figure Type I.



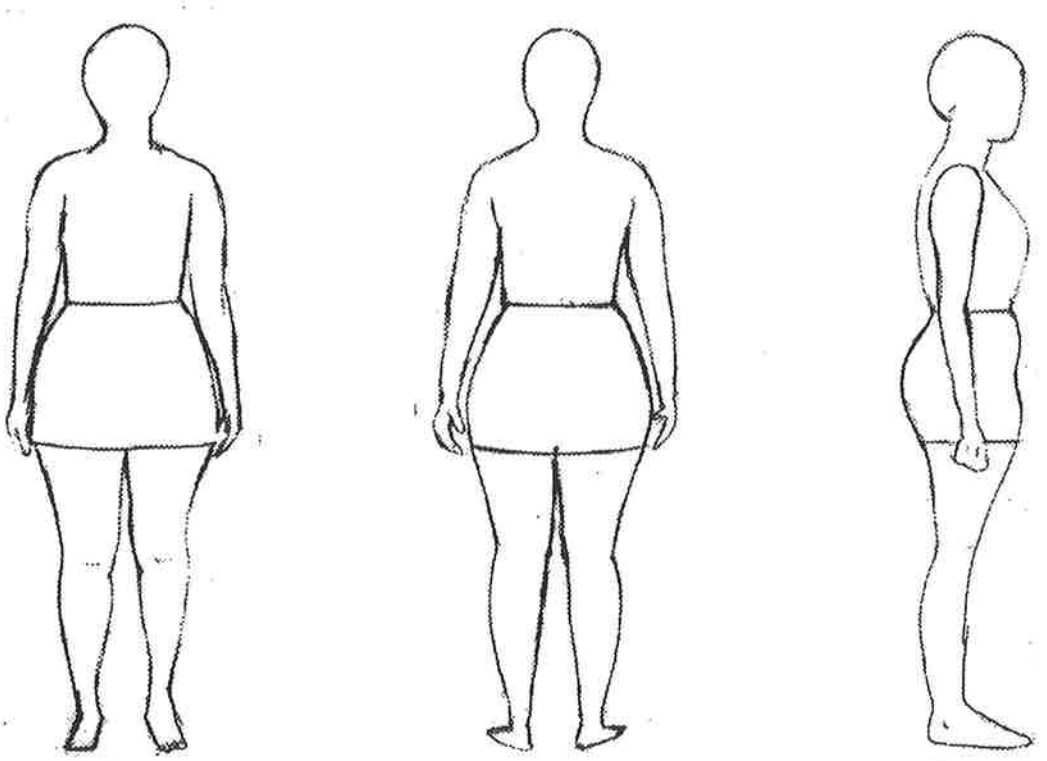
Anterior. Posterior. Lateral.

The somatotype for Figure type I in this study could be referred to as an ectomorph, which is the somatotyping used by Sheldon *et al* (1970) when referring to a slim physique. Cabot (1997) on the other hand refers to a slim figure type as a thyroid figure type.

Figure type A.

The A shape is often referred to as a pear shape, it has a small waist with width flaring out at the lower hip and thighs. A straight line drawn from the shoulder and joining up at the thigh would present a noticeable angle at the hip line through to the thigh. The height of this figure type ranged from 1525 mm to 1750 mm with an average height of 1637 mm. The weight ranged from 46 kg to 96 kg with an average weight of 59.38 kg. The average bust measurement was 903 mm. The average upper hip was 879 mm and the average lower hip measurement was 985 mm. The difference between the bust and lower hip measurements is 82 mm. The difference between the average upper hip and average lower hip measurement was approximately 11 mm which indicates flaring out at the hip and thigh areas of the body. The anterior and posterior photographs of this figure type show an outline from the shoulders flaring out towards the thighs depicting an A shape. The lateral view of the photograph shows a sway back with a prominent derriere.

Figure 35: Anterior, Posterior and Lateral Silhouette of Figure Type A.

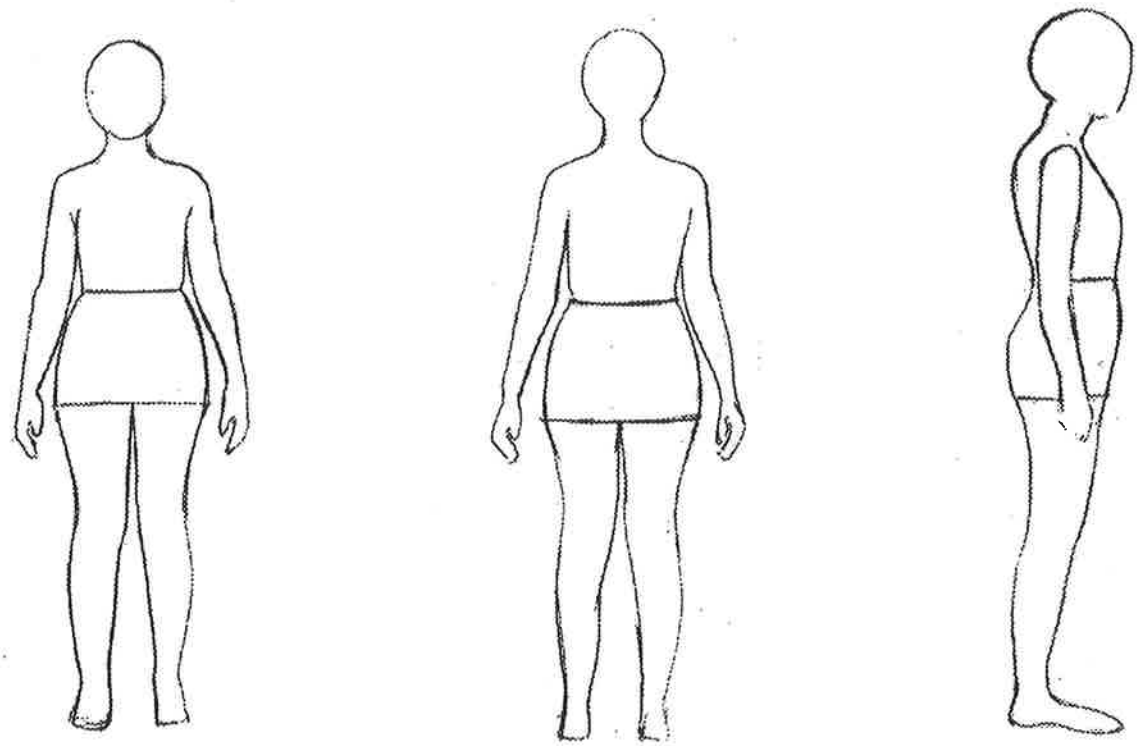


Anterior. **Posterior.** **Lateral.**

Figure type X.

The third figure type was labelled X. This figure type is thickset, muscular with some waist definition. A line drawn from the shoulder to the hip would present at the hip line with a slight angle. The height of this figure type ranged from 1400 mm to 1820 mm with the average height being 1626 mm. The weight ranged from 53.8 kg to 78.6 kg with the average weight being 63.3 kg. The average bust measurement was 970 mm. The average upper hip was 922 mm and the lower hip measurement was 1006 mm. There was a difference of 36 mm between bust and lower hip measurement. The anterior and posterior photographs show a muscular figure type, which is reasonably well proportioned.

Figure 36: Anterior, Posterior and Lateral Silhouette of Figure Type X.



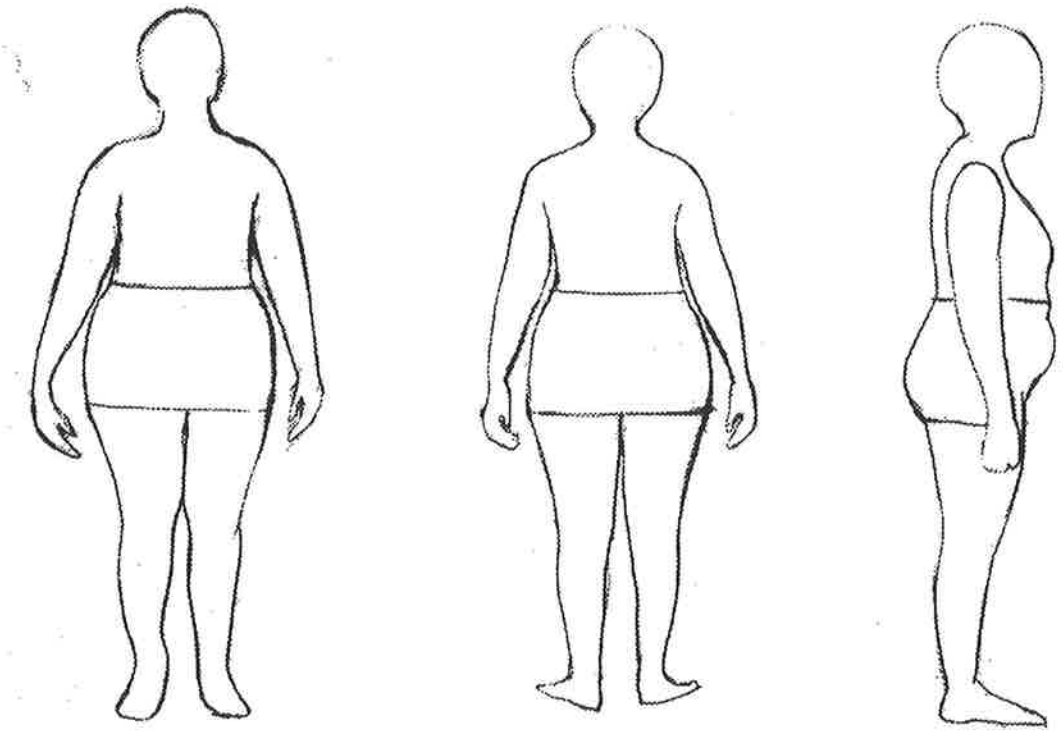
Anterior. Posterior. Lateral.

Using Sheldon *et al.* (1970) somatotyping this figure type could possibly be called mesomorph. According to Cabot's (1997) classification of figure types, the X figure type in this study would be comparable to the android figure type.

Figure type H.

The H figure type is fuller in the waist and abdomen area with very little waist definition. In many subjects with this figure type no waist definition was evident. The height ranged from 1445 mm to 1770 mm with an average height of 1608 mm. The weight ranged from 49 kg to 116 kg, with the average weight being 76 kg. The average bust measurement was 1076 mm. The average upper hip measurement 1083 mm and the lower hip measurement 1117 mm. There was 41 mm difference between bust measurement and lower hip measurements and 34 mm between the average upper hip measurement and average lower hip measurement. This difference suggests there is more subcutaneous fat in this region than the other figure types in this study. The anterior and posterior photographs show thickness around the waist and upper hip and the lateral photographs shows fullness in the abdominal region.

Figure 37: Anterior, Posterior and Lateral Silhouette of Figure Type H.



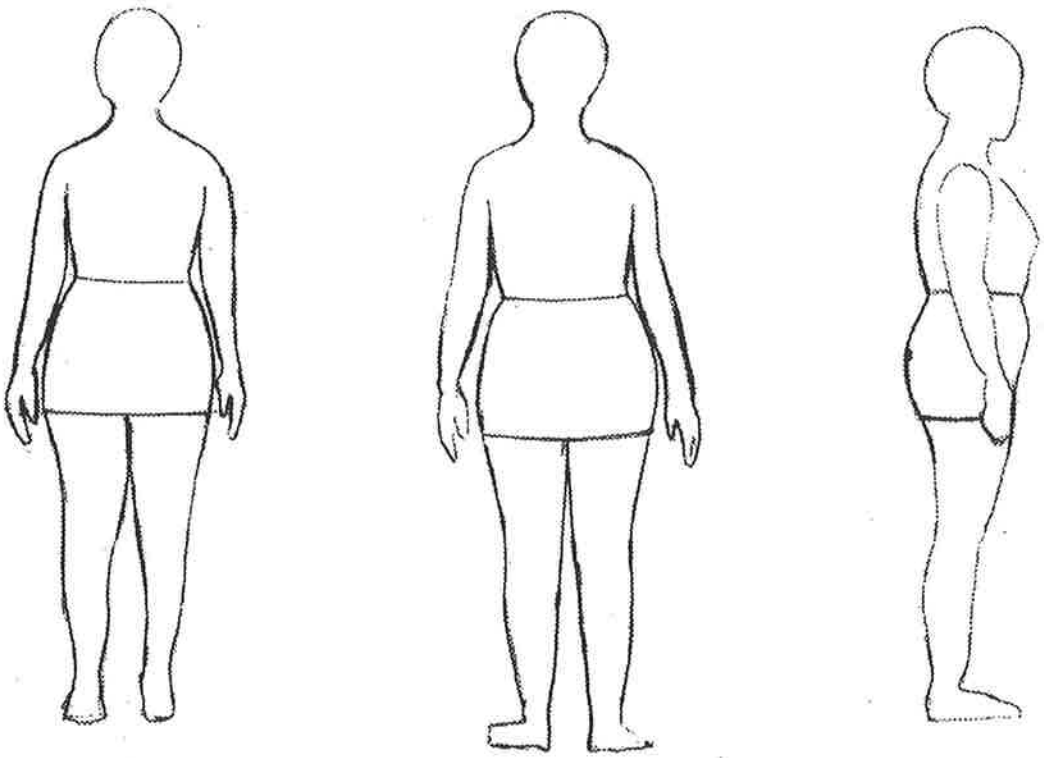
Anterior. **Posterior.** **Lateral.**

Figure type H is referred to by Sheldon *et al.* (1970) as endomorph. Cabot refers to this shape as a lymphatic figure type.

Figure type XH.

Figure type X-H is a combination of the thickset muscular type of X with a combination of H, which has thickness around the waist and abdominal areas. The height of this figure type ranged from 1535 mm to 1720 mm with an average height of 1628 mm. The weight ranged from 65.4 kg to 78 kg the average weight was 68.85 kg. The average bust girth measurement was 1011 mm. The average upper hip measurement was 984 mm and average lower hip measurement was 1042 mm. The difference between the bust measurement and the lower hip measurement was 58 mm. The anterior and posterior photographs show a combination of the muscular figure with some fullness around the abdomen but has a little more waist definition than figure type H.

Figure 38: Anterior, Posterior and Lateral Silhouette of Figure Type XH.



Anterior **Posterior** **Lateral**

Averages for figure type I.

The average body dimensions and descriptive statistics of figure type I are shown in Table 32. The averages, standard deviation, minimum plus maximum of height, weight, age, conicity index, and body mass index are displayed. This figure type includes 30 individuals (18.4 %) out of the total sample size, of 163 subjects. The average height was 1614 mm, the average weight was 54.40 kg. The average age of the participants in this figure type was 37.13. The conicity index exceeded the recommended value of 1. However, the body mass index, of 20.85 was within the acceptable and normal range.

Table 32: Figure type I. Results and comparison of height, weight, age, conicity index and body mass index (N=30).

Figure Type I	Average	Standard Deviation	Minimum	Maximum
Height (mm)	1614	98.84	1430	1790
Weight (kg)	54.40	8.89	37.6	74.2
Bust (mm)	908	64.95	790	1020
Waist (mm)	727	78.25	615	940
Hip (mm)	935	53.70	825	1050
Age	37.13	18.50	18	75
Conicity Index	1.73	0.18	1.55	2.12
Body Mass Index	20.85	2.50	18.38	23.15

Averages for figure type A.

The average body dimensions and descriptive statistics for figure type A are shown in Table 33. This figure type includes 32 individuals (19.6 %) out of the total sample of 163 subjects. The average height was 1614 mm (the same as figure type I) and the average weight was 59.38 kg (larger than the figure I). The average age was 37.78. The average conicity index of 1.71 exceeded the recommended rating. The body mass index of 22.15 was slightly higher than figure type I, however, was in the acceptable and normal range.

Table 33: Figure type A. Results and comparison of height, weight, age, conicity index and body mass index (N=32).

Figure Type A	Average	Standard Deviation	Minimum	Maximum
Height (mm)	1637	61.40	1525	1750
Weight (kg)	59.38	11.55	46.2	96.6
Bust (mm)	903	73.01	810	1120
Waist (mm)	722	76.09	640	960
Hip(mm)	985	103.03	870	1310
Age	38.00	15.45	18	73
Conicity Index	1.71	0.17	1.56	2.19
Body Mass Index	22.15	3.72	19.86	31.54

Averages for figure type X.

The average body dimensions and descriptive statistics for figure type X are shown in Table 34. This figure type comprises of 31 individuals (19 %) out of the total sample size of 163 subjects. The average height was 1626.45 mm, and the average weight was 63.33 kg. Weight is heavier in this figure type than figure types A and I. The average age was 40.06. The average conicity index was 1.83, which is higher than the recommended rating. The body mass index is at the top end of the normal or acceptable range.

Table 34: Figure type X. Results and comparison of height, weight, age, conicity index and body mass index (N=31).

Figure Type X	Average	Standard Deviation	Minimum	Maximum
Height (mm)	1626.45	88.99	1395	1820
Weight (kg)	63.33	6.39	53.8	78.6
Bust (mm)	970	52.86	885	1100
Waist (mm)	773	60.32	670	900
Hip (mm)	1006	47.01	910	1100
Age	40.06	11.19	21	64
Conicity Index	1.83	0.13	1.71	2.02
Body Mass Index	24.03	2.49	27.64	23.72

Averages for figure type H.

The average body dimensions and descriptive statistics for figure type H are shown in Table 35. This figure type is comprised of 51 individuals (31.2 %) of the total sample size of 163 subjects. The average height was 1608 mm, the average weight was 75.91 kg. The conicity index of 2.20 well exceeded the recommended rating. The average body mass index of 29.11 came into the top end of overweight and into the pre-obese stage.

Table 35: Figure type H. Results and comparison of height, weight, age, conicity index and body mass index (N=51).

Figure Type H	Average	Standard Deviation	Minimum	Maximum
Height (mm)	1608.41	74.40	1445	1770
Weight (kg)	75.91	15.63	48.8	116.4
Bust (mm)	1076	103.12	870	1330
Waist (mm)	924	103.94	690	1170
Hip(mm)	1117	96.25	940	1320
Age	50.01	13.61	21	82
Conicity Index	2.20	0.22	1.73	2.66
Body Mass Index	29.11	4.02	23.37	37.15

Averages for figure type XH.

The average body dimensions and descriptive statistics for figure type XH are shown in Table 36. This figure type consists of 19 individuals (11.6 %) out of the sample of 163. The average height was 1628.88 mm and the average weight was 66.85 kg. The average age was 52.72. The average conicity index was 1.96, which is well above the recommended rating, and the body mass index of 25.15 exceeded the normal range and fell into the lower range of overweight.

Table 36: Figure type XH. Results and comparison of height, weight, age, conicity index and body mass index (N=19).

Figure Type XH	Average	Standard Deviation	Minimum	Maximum
Height (mm)	1628.88	58.49	1535	1720
Weight (kg)	66.85	7.00	56.4	78
Bust	1011	52.46	935	1110
Waist	828	42.91	750	870
Hip	1042	43.97	960	1110
Age	52.72	10.96	21	66
Conicity Index	1.96	0.093	1.83	2.00
Body Mass Index	25.15	1.71	23.93	26.36

The number of participants in figure types I, A, X were similar. The sample size of figure type I was 30, figure type A was 32 and figure type X was 31. For figure type H, however, the number almost doubled with 51 individuals. The group with the smallest number of individuals was XH with 19. Since it is of intermediate character between H and X its smaller size is not a problem. The frequencies of various body types indicate that they characterise well the majority of individuals in the sample, and possibly in the population. Table 37 shows the comparison of average height and weight between figure types I, A, X, H, and XH.

Table 37: Comparison of average figure types I, A, X, H, XH, with height and weight.

Figure Type	I	A	X	H	XH
Height (mm)	1655	1655	1620	1610	1630
Weight (kg)	53.6	58.6	61.2	77.8	67.6

One way ANOVA.

One way ANOVA was used to assess significance of differences between the five somatotypes. Five anthropometric variables of height, weight, bust, waist and hip circumference, were used as well as age, conicity index and body mass index. The results indicate significant differences between somatotypes in all the variables except height. The result of height was non significant ($p=0.516$). Results for all other variables were highly significant at $p<0.0001$.

Chapter 5: Discussion

Introduction

The aim of this study was to characterise the changing size and shape of Australian women. This was achieved by comparing existing studies on the changes in biological characteristics of women with data presented on anthropometry and morphology of South Australian women, to assess their current size and shape. The implications of these findings on current data used in the clothing design and production industry were then assessed.

This survey (S.A Women 1998-1999) measured a sample of 163 female participants aged from 18 to 80 years of age. The average height was 1622 mm and the average weight was 65.17 kg. The sample size of this study is relatively small compared to the other studies such as those in Tables 30 and 31. However, upon assessment of the variance in results, the sample was considered appropriate for a preliminary study of this kind and was also considered representative of South Australian Women. The data from National Heart Foundation show the same height and weight for the 1980 and the 1983 studies. The data from the 1989 study show the same height but with an increase in weight of 1.4 kg. The consistency of these data may be because all the studies used the same age group and were conducted in the same cities (Table 30).

Secular trends of current South Australian women compared to prior Australian studies.

Comparison of the Australian studies from 1928 to 1999 indicates that there was a very small increase in height of Australian women over time (Figure 28). It was only approximately 11 mm. The average height of the S.A Women (1998-1999) study was 1622 mm which corresponds to the three National Heart Foundation's studies of 1980, 1983, and 1989 (Table 30). The average height of the Australian Bureau of Statistics (1995) is 8 mm shorter than the S.A Women (1998) and 6 mm shorter than National Heart Foundation studies. The cities analysis survey (National Heart Foundation 1989) shows height and weight data of Adelaide women. The height and weight of that study corresponds closely to height and weight of S.A Women (1998-1999) see Table 30. There appears to be no published data specifically for

South Australian women from the Australian Bureau of Statistics at this point in time. The study by (Patterson and Brown 2000), however, showed an increase of 23 mm in height, which shows the increase over time to be approximately 35 mm. It is suggested that this increase may be due to the age group of the participants surveyed in that study, being only in the 25-39 age bracket. The difference in height may be due to the reduction of stature with age (Chandler and Bock 1991). The average height of the subjects in the Woodhill (1952) study was similar to that of the Berlei data suggesting that the increase in height between 1927 and 1952 was less post 1932. It should also be noted that the data in the Woodhill (1952) study were not from an anthropometric survey as such but were obtained through medical records of Women's Auxiliary Services and insurance records. Figure 28 shows that there was a positive trend, although small, for an increase in height with age.

The average weight of this study was 65.2 kg and is similar to that of the National Heart Foundation (1989) and Patterson and Brown (2000) studies. The average weight of the Bureau of Statistics (1995) however is 1.83 kg heavier (Table 30). There is a large variation in weight of (5.15 kg) between the Berlei Research Branch (1927) data, which were presented as the interim report of the Berlei study and Lancaster (1957) publication of the final 1928 Berlei data. This may be due to the sample size and the final age grouping of the sample. The variation in the average age between these two reports is expected to be a result of the higher age of the extra 1,232 subjects in the Lancaster (1957) report. In the Berlei Research Branch (1927) interim report, 9 % of subjects were under the age of 24 years, whereas in the Lancaster report, the mean age was 28 years. Figure 30 shows a positive increase of weight over time. Although the data used in these studies appear to be valid consideration may need to be given to some possible inconsistencies. For example, Lancaster (1957) questioned the age distribution of the participants in the Berlei study as well as the sample containing more subjects of the athletic type. Although attempts were made to obtain a representative sample of the Australian population, the Berlei (1927) final sample contained a disproportionate number of younger females between the ages of 15 and 24 years.

Even with these inconsistencies of methods it still appears that there has been a strong increase in weight over time. While the increase in height was small, this indicates that the average size and shape of the Australian women has changed over the past 74 years. This is anticipated to have major implications on the Australian clothing design industry.

For South Australian women the average bust circumference measurement was 983 mm, this was much higher than the average bust circumference of 880 mm reported by Berlei (1927). This great variation between studies may be a result of differences in methods. The Berlie (1927) study was conducted in swimwear, whereas in this study measurements were taken with participants wearing a bra and the measuring garment. However, there was still a large difference between the two studies in both waist and hip measurements, with the S.A women measurements larger than the Berlei data. For the waist measurement the S.A Women's average was 808 mm and in the Berlei (1927) study the waist measurement was 723 mm. In the Board of Trade (1957) study the average waist measurement was 682 mm. The hip measurement also differed between the three studies, however, the difference was not as great as the bust and waist measurements. The average hip measurement in the S.A Women (1998-1999) study was 1027 mm in the O'Brien and Shelton (1941) study the average hip measurement was 988 mm and the average hip measurement of the Board of Trade was 975 mm. Table 38 shows the comparison of studies of Australian women, in relation to the sample size, age, height and weight.

Table 38: Average Height, Weight, Age, and Sample Size of Australian Women compared.

Date of survey	Sample Size	Age	Height (mm)	Weight (kg)	Source/Date Published
1926-1928	5000	15-65	1611.00	59.10	Lancaster (1957)
1951	5270	17-48	1610.00	-	Woodhill (1952)
1998-1999	168	18-80	1621.90	65.17	S.A Women (1998-1999)

Australian women compared with women from overseas.

A number of anthropometric studies of women have been conducted overseas, which have supplied limited data that have been used for the Australian clothing standard. Studies of American women, and British women are presented in Table 31 of which three were conducted in America, and three in Great Britain. As stated previously, four studies played a major role in the formation of the present Australian Standard Size-Coding Scheme for women's clothing and are presented with other studies in Tables 30 and Table 31. These studies are: Woodhill (1952)

Australian study, O'Brien and Shelton (1941) American study, Berlei Australian data (Lancaster 1957), and Kemsley's (1950) Great Britain study. Comparisons of the Australian studies and overseas studies highlight differences in the data in relation to dates of survey, height, weight, age and sample size.

There was a positive secular trend for height of women from America and Great Britain over time. The trend for Australian women was not as strong as that of the American or Great Britain women. Although there is a positive trend in height over time for women from Great Britain they are shorter in height than both the Australian and American women (Figure 32). The height of the average woman in the S.A 1998-1999 study was 1622 mm compared to the American data of Frisancho (1990) which was 1630 mm. The height in the American study of Women 55 years and over (A.S.T.M 1995 b) was 1664 mm. The American women are approximately 24 mm taller than the S.A Women (1998-1999) study. The data from the American studies (Table 39) show that there was an increase in height of approximately 30 mm to 45 mm. The average values of the Great Britain studies appeared to be lower than the S.A data (Table 40). Kemsley (1950) reported a measured height of 1574 mm and Eldridge and Knight (1984) recorded 1609 mm. These averages were 50 mm and 13 mm respectively lower than the average of the S.A women's value.

There was also a positive trend for weight over time of Australian, American and Great Britain women. Figure 33 shows the slope for American women and Australian women to be similar indicating that the rate of weight increase over time has been similar. The Great Britain data show a different trend to that of the Australian and American data showing a very strong positive trend in weight. The vast difference in the slope of the trend line of the Great Britain data may be a result of the Kemsley (1950) data, where individuals in the study were weighed wearing shoes and clothing. There was a uniform correction applied to all individuals, however, with an unknown accuracy for comparison to other studies. Eldridge and Knight (1984) suggest that the Kemsley's study did not have a statistically representative sample, and there was limited control over the measuring technique due to the locations and personnel involved in the survey. With the exclusion of the Kemsley (1950), data from analysis the Great Britain slope was similar to that of both the Australian and American data although the average weight was lower than both the Australian and American trends. Caution should, however, be exercised due to the limited number of studies involved in assessing trends. The average weight of the S.A Women (1998-1999) was 65.2 kg compared

with the average weight of American data of Frisancho (1990) of 63.5 kg and the Great Britain study of Knight and Eldridge (1984) of 62 kg. Kemsley (1950) reported a mean weight of 54.20 kg, which was 11 kg under the average weight of the S.A data. According to Mokdad *et al.* (2000) (previously referred to in the literature review), the self-reporting average weight of the American women in 1999 was 68.7 kg, which is 4.90 kg more than the Frisancho (1990) study and 3.58 kg higher than the S.A Women (1998-1999) result. Although the data from the Mokdad *et al.* (2000) study were from self-reporting studies it has been found that people usually underestimate their weight. Therefore it appeared appropriate that reference could be made to this study to compare changes over time.

Table 39: Comparison of average height, weight, age, and sample size of American women.

Date of Survey	Sample Size	Age	Height (mm)	Weight (kg)	Source/ Date Published
1939-1940	10042	18+	1604.00	60.50	O'Brien and Shelton (1941)
1990	16615	18-74	1630.00	63.50	Frisancho (1990)
1993	6786	55+	1650.09	61.11	A.S.T.M (1995 b)
1999		18 +		68.70	Mokdad et al.(2000)

Table 40: Comparison of average height, weight, age, and sample size of Great Britain women

Date of survey	Sample size	Age	Height (mm)	Weight (kg)	Source/date published
1943	33500	14-75	1572.00	54.20	Kemsley (1950)
1980	5000	16-64	1609.00	62.00	Knight and Eldridge (1984)

Comparison of South Australian women to Australian Standard (1997).

The analysis of the averages of the thirty-six body dimensions used in this study (Table 28) shows some very interesting results when compared with the Australian Standard Average Women (1997). There was no particular size that the average measurements from this study could be equated with in the present Australian Standard. The majority of the average measurements in this study fall within the Australian Standard (1997) size 16 and size 18 classifications. Three measurements in the length section and three measurements in width section equate to the larger sizes of 22, 24 and 26 (Table 29).

The three width measurements in this study which include bust separation, across chest width, and across back width indicate quite large differences compared to Australian Standard (1997). The French Sizing System (Rodwell 1968) for a bust size of 900 mm cited the across back measurement as 355 mm compared to the Australian Standard 1970, 1972, 1975 and 1997 where 355 mm equates to Australian Standard size 18 which has a bust measurement of 1000 mm. It is of particular interest that these three measurements are all on the upper section of the torso, and that all of the three measurements are associated with width in the upper torso.

Comparison of clothing standards to changes in shape and size of South Australian women.

Clothing size standards have been prepared to enable a person to buy a garment that closely approximates their size and to be a reasonable fit. An analysis of data obtained in this study with clothing standards indicates that the present sizing system is outdated and unrealistic for present day Australian women. The original Australian Clothing Standard prepared in 1959 were based mainly on data of the American population after they were compared by Lancaster (1957) with the Australian Berlei data from 1926-1928, O'Brien and Shelton (1941) American data, Kemsley (1950) British data and Woodhill (1952) Australian data. Differences have been shown between SA data and both earlier Australian data, such as Berlei (1927) and overseas studies including Kemsley (1950) and O'Brien and Shelton (1941). These have also been seen in comparing average body dimensions to Australian Standard Women's Size Coding Scheme. Differences can also be viewed (Figure 27) in the

sharp increase in the trend line of the Australian Standard (1997), showing the variation in height and weight trends of the Australian Standard (1997) compared to the S.A Women (1998-1999) for the average, short and tall women categories. The I.S.O (1989) makes reference to the incremental steps in height between each size in the Australian Standard Size Coding Scheme as can be observed in this figure. The S.A data also plotted in this figure shows that the Australian Standard (1997) data have not come from an anthropometric survey. The trend line of the S.A Women's data show an increase in weight with height but to a lesser degree. Holzman (1996) puts forward the view that there appear to be assumptions that as women become taller they also become wider, and this was supported by the results of this study. The differences between current data, the present Australian Standard and the American studies that the Australian Standard were based on, indicate that the Australian Standard (1997) needs to be revised.

This study identified 5 main figure types. Figure Type 1 - slim stick like figure (somatotype is referred to as ectomorph). Figure Type A - pear shaped with flaring out at lower section of the torso of the hip and thigh (no somatotype). Figure Type X – thick set, muscular with some waist definition (somatotype referred to as mesomorph). Figure Type H - fuller waist and abdomen with little or no waist definition (endomorph). Figure Type X-H - combination of thick set, muscular and fuller waist and abdomen although not as thick in the abdomen area as the endomorph (somatotype is a combination of endomorph and mesomorph). There were seven main categories with two extra minor categories in the Australian Standard (1959) (Tables 6-14). The nomenclature used to identify the size category in the Australian Standard (1959) referred to Misses, Misses Plus, Women's, Women's Plus, Women's Half Size, Tall Size, Juniors', Larger Women's, and Women's Slender (2.28). The percentages of each size category (Table 5) were based on American data. Australian Standard (1997) has only 5 categories (Tables 13-17) which are Average Women, Short Women, Tall Women, and Slim and Full hip Women. It is of particular interest that the two sizes which, do not appear to be included in the existing 1997 Standard are, The Women's Half Sizes and the Women's Full Hip sizes, with a fuller waist. It was of particular interest that the S.A Women's (1998-1999) data identified a figure type with a fuller waist and abdomen (endomorph). This figure type rated the highest percentage in the S.A Women's (1998-1999) figure types (Figure Type H). The Berlei data (Berlei Research Department Branch Report 1928) also catered for the fuller waist and abdomen (Figure 3a). With the trends observed in

this study it would appear that a classification that catered for the proportion of the population with a larger waist and abdomen could be included in Clothing Size Standards.

Implication of current Australian women's size and shape on clothing design and the production industry of women's ready made clothing.

From the literature review and the results of this study it appears that the size and shape of Australian women have changed quite considerably over the past century. The literature also suggests that it is inappropriate to assume that overseas body dimensions for females are comparable to Australian women. A review of the current Australian Standard Size Coding Scheme of body dimensions for the clothing design and production industry would provide appropriate standards for use in the industry. To obtain an accurate and reliable Size Coding Scheme a national anthropometric survey is required to ascertain the current size and shape of Australian Women.

Chapter 6: Conclusion.

The literature review indicated that the biological characteristics of the human female body may have changed significantly over the past century. The results of this study indicate that there have been significant changes in the size and shape of Australian women and that there is a strong indication that Australian women are heavier and slightly taller at present than the previously used anthropometric data indicates.

The changes in size and shape of Australian women have implications for the clothing design and production industry. The increase in weight appears also to be a major concern for health authorities due to the increase in morbidity and risk factors associated with overweight and obesity.

There has been no scientific anthropometric survey conducted in Australia for clothing size standards. The current Australian clothing standards for women are based on outdated American data, which contributes to inconsistencies in the sizing system used for the production of women's garments in Australia. Although the sample size of this preliminary study is relatively small, it does, however, provide the basis for a further more comprehensive study.

A scientific anthropometric survey of the Australian population is required to obtain more up to date data on the current size and shape of Australian women.

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Appendix 1.

International Bra Size Chart (Lingerie Company of Australia 2001).

Country	Size	Size	Size	Size
Australia	10	12	14	16
France	85	90	95	100
International	32	34	36	38

Appendix 2

Comparison of Terminology and Location of Female Body Dimensions (Australian, American, British, I.S.O.)

Data/Date of Survey	Australian Women (Berlie) 1926-1928	American Women 1939-1940	British Women 1951-1954	Reference Document Defining Location of Body Dimension ISO (1989)	American Women Based on O.Brien and Shelton (1941)	American Women 1993	American Women Based on U.S. Dept of Commerce Standard (CS 215-58)	South Australian Women 1998-1999
Source and Date of Publication	Lancaster (1957)	O'Brien and Shelton (1939 40)	Board of Trade (1957)	International Standard Organisation I.S.O.8559 (1989)	Standard Table of Body Measurements for Adult Female Figure Types Sizes 2-20 (1995a)	Standard Table of Body Measurements for Women Aged 55 and Older (All Figure Types) (1995b)	Australian Standard AS 1344 1997 Size Coding Scheme for Women's-Underwear, Outerwear and Foundation Garments (1997)	Berry (1999)
Age Range	15-65	18+	18-71		Adult	55+		18-82
Sample size	5250	14,698	5,000		10,042	6,786		163
Number of Body Dimensions	19	59	37	39	40	47	30	38
Body Dimensions: Horizontal/Girth								
Head Girth								
Neck Girth				Tape measure passed around the Adam's apple at the 7th cervical vertebra.				
Mid Neck Girth					Measure mid neck circumference 25 cm above base of neck.	Same as size 2-20		
Neck Base Girth		Chainette passed over the cervicale to the base of the front neck (the chainette was then measured along the anthropometer).	Starting at the cervicale the measured moved around the subject taking small progressive steps around the neck base touching the lateral and anterior marks at the neck base.	Using the chainette over the base of the 7th cervical vertebra neck and shoulder intersection and the medial superior borders of the left and right clavicles.	Tape measure standing on edge touching the cervical at back neck and shoulder point then to the hollow at front neck.		Chainette placed over the 7th cervical vertebra touching intersection of neck and shoulder points and left and right medial superior borders of the clavicles	Standing in front of the participant the tape measure was placed over the landmark at the 7th cervical vertebra, around the neck touching the lateral landmarks on left and right side of the neck and shoulder intersection, then to the landmark at the suprasternale.
Bust Girth	Measured at the level of its maximum	Tape placed horizontally over the fullest part of the bust	Tape passed under subjects right arm around the trunk and over the level of the bust prominence. Where the bust prominence was low, the posterior arc was held on the lowest point of the shoulder blade.	Tape passed over the shoulder blades (scapulae) under the armpits (axillae) then across the nipple	Measured horizontally around the body under the arms across nipple with tape parallel to floor	Measured over the fullest part of the breast and parallel to floor.	Same description as I.S.O.	Standing behind the participant the tape measure was placed horizontally around the body over the fullest part of the bust with the tape measure parallel to the floor.

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Chest Girth (Overbust)		The tape placed horizontally around the trunk under the arms at the level of the armscye through underarm midpoints and to the anterior and posterior arcs of the girth.	Tape passed through underarm midpoints with the anterior arc over the chest and horizontally across the back.	Tape measure passed over shoulder blades (scapulae) under armpits (axillae) and across the nipples.				Standing behind the participant the tape measure was passed horizontally around the trunk, high up under the armpit and across the top of the bust and around to back.
Under Bust Girth				Horizontal girth below the breasts.			Same description as I.S.O.	Standing behind the participant the tape measure was placed horizontally around the torso under the breast, under the arm then to the back. The tape measure was placed parallel to the floor.
Waist Girth	Measured at the level of its maximum indentation of the lumbar part of the spine.	Tape passed around the body at waist level and recorded during normal breathing at midpoint of expiration.	Tape passed around the body at waist level.	Measured at the natural waist line between the top of the iliac crest and the lower ribs.	Measured around the body at waist level.	Measured at waist level immediately below the lowest rib; not always parallel to floor.	Same description as I.S.O.	The waist circumference was taken over the vest at the narrowest part of the waistline. On some participants, however, the narrowest part of the waist was difficult to find, due to excess adipose tissue around the waist and the abdominal regions. On these participants it was necessary to palpate the lateral torso midway between the iliac crest and the most inferior point of the lowest rib to find the waist position.
Waist Sitting Girth	With the subject sitting waist circumference measured at maximum indentation of the lumbar (corresponding to abdominal extension of O'Brien & Shelton)							

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High Hip Girth (Abdominal Extension)		Tape passed around the body at the greatest extension of the abdomen	Tape passed around the body at the greatest extension of the abdomen		Measured at high hip level approximately down 7.5 centimetres from waist parallel to floor	Same as size 2-20	Measured horizontally at the abdominal extension	Standing in front of the participant the tape measure was placed horizontally around the torso at the greatest anterior protrusion of the abdomen. The tape measure was parallel to the floor.
Lower Hip Girth	Tape horizontal at the level of the greater posterior projection	Tape passed around the body at hip level with the plane of girth horizontal	Tape passed around the body at the at the hip level	Measured around the buttocks at level of the greatest lateral trochanteric projections	Maximum at the maximum hip circumference parallel to the floor	Measured at the maximum prominence of buttocks parallel to the floor.	Same description as I.S.O.	Standing to the right of the participant the tape measure was placed was placed at the bottom of the waist tape on the right lateral position of the torso, then taken to the most prominent projection of the abdominal protrusion.
Sitting Spread Girth		With the subject in a sitting position the tape was passed under and over the thighs				Tape placed loosely around full hip whilst subject sits on chair. Reposition tape with subject seated.		
Thigh Girth		Tape passed around the largest part of the thigh parallel to the floor		Measured at the highest thigh position	Measured at the upper leg close to crotch	Same as size 2-20	Measured at the highest thigh position with subject standing	The thigh measurement was taken circumferentially at the highest thigh position close to the crotch.
Mid Thigh Girth		Taken between the hip level and the tibiale parallel to the floor		Midway between the hip and the knee	Measured midway between hip and knee	Same as size 2-20		
Bent Knee Girth		Tape passed around the centre front and upper border of the midpoint of the patella with the subject in a sitting position						Right foot placed on a stool knee bent at a 90% angle the tape passed under the knee and over the patella

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Knee Girth (Standing)		Taken at the level of the tibiale parallel to the floor	Taken at the level of the tibiale parallel to the floor	Leg straight and knee measured at the tibial level	Leg straight knee circumference measured over knee cap with tape parallel to the floor	Same as size 2-20	Same description as I.S.O.	With the right foot placed on a chair and knee bent at 90% angle the tape measure was passed under the knee and over the most prominent point of the patella.
Lower Knee Girth				Measured horizontally below the right knee cap				
Calf Girth		Taken at the maximum level of the calf girth parallel to the floor	Taken at the maximum level of the calf girth parallel to the floor	Maximum calf girth measured with leg slightly apart	Maximum circumference of the lower leg (between knee and ankle)	Same as size 2-20		
Minimum Leg Girth		Taken horizontally above the lateral and medial malleoli at the maximum girth		Measured horizontally just above the ankle				
Ankle Girth				Measured around the centre of ankle bone	Measured over the inner and outer bony prominence	Same as size 2-20		
Armscye Girth (Armhole)		Tape measure placed under the arm around the arm hole to the top of the shoulder	Tape passed under the armpit and over the shoulder and the anterior and posterior armscye.	With the tape measure passed through underarm midpoint then vertically over the shoulder			Same description as I.S.O.	Standing to the side of the participant the tape measure was placed under the allixa around the armhole to the acromion process.
Upper Arm Girth		Taken at the level of the armscye and upper arm	Tape placed under right upper arm at armscye level of trunk then horizontally around the arm girth	The maximum girth of the upper arm at the lowest scye level	Maximum upper arm circumference between shoulder joint and elbow		Same description as I.S.O.	Standing to the right of the participant the tape measure was placed circumferentially under the axilla around the arm at 1/3 of the anatomical arm.
Lower Arm Girth								Standing to the right of the participant the tape measure was placed circumferentially at a point two thirds down of the distance of the anatomical arm.

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Elbow Girth		Tape placed over the olecrannon and bisected the angle of the bent elbow		With arm bent at 90 degrees measure elbow girth	Same description as I.S.O.		Same description as I.S.O.	With the arm flexed at 45 degrees the elbow was measured circumferentially from the olecranon around the anterior elbow crease returning to the olecranon.
Forearm Girth		Tape placed around the forearm with the elbow held at 90 degrees						
Wrist Girth		Taken around the mid anterior wrist point and over the extremity of the ulna and the radius		Measure over wrist bone	Measure over the inner and outer prominence at lower end of forearm			The wrist was measured circumferentially at the level of the ulna styloid process (wrist bone)
Hand Girth				Maximum girth over the knuckles with fingers together and thumb excluded				With thumb tucked under fingers and fingers extended the hand was measured circumferentially at the level of the first metacarpal head (base of thumb).
Vertical Trunk Girth (Trunk Circumference)		With the tape measured passed between the legs under the crotch over the centre of the right shoulder then over the largest part of the right breast		Same description as O'Brien & Shelton (Trunk Circumference)	Same description as O'Brien & Shelton	Same description as O'Brien & Shelton		

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Body Dimensions: **Width**								
Abdomen Seat Diameter			Subject standing with buttocks touching the wall with slight pressure. A piece of paper was placed at point of contact between the wall and subject, pressure then released enough for the paper to be removed. Using an anthropometer the measurement was taken from wall to abdominal extension point					
Lateral Diameter of the Waist	Lateral diameter measured at the same height as the waist circumference							
Antero - Posterior Diameter at Abdominal Prominence	Antero - Posterior diameter measured at level of the abdominal prominence							
Waist Diameter	Waist Diameter is the Antero - Posterior diameter taken at the level of the waist circumference							
Maximum Lateral Hip Diameter	Subject standing taken at the level of the maximum hip projection							
Scye Width			Using anthropometer the sliding arm touched the landmarks on the anterior arm crease and the posterior arm crease					

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Shoulder Slope		Protractor placed on intersection of shoulder with neck base and right armscye	Shoulders in natural relaxed position protractor placed on intersection		see A.S.T.M. D 5585			
Shoulder Width (Shoulder to Shoulder)			The blades of the anthropometer from one acromion point to the other.	Horizontally from the left to the right acromion extremities.	Measure across the back from one shoulder joint to the other.	Horizontally from the left to the right acromion extremities.		Standing at the back of the participant measure the distance of the shoulders between the left and right acromial tips.
Cross-Back Width (Across Back) (Posterior Back Width)		Tape placed horizontally at the level of the spinous process of the 7th thoracic vertebra taken from left to right armscye	Measured from the left posterior armscye and extended horizontally to right posterior armscye	Measured horizontally halfway between upper and lower armscye levels (arms at side of body) *	On back measure from armscye to armscrye at back break point (arms at side of body)	Same as size 2-20	Same description as I.S.O.	The participant clasped her hands slightly in front of the body. The measurement was taken from the posterior axillary crease on the left to the posterior crease on the right axilla.
Anterior Chest Width (Across Chest)		Measure horizontally from left armscye to the right armscye	Taken horizontally on subjects right anterior armscye and extended to left anterior armscye		Measure from armscye to armscye at front break point		Measure from armscye to armscye midway between shoulder and bottom of armscye	The measurement was taken horizontally from the crease at the left axilla (armpit) to the crease at the right axilla.
Bust Separation (Bust Width Prominence) (Highest Bust Level Width)		Tape placed above the right bust to the landmark above the left bust at the armscye level	From right bust to left bust	Measure horizontally between nipples	Horizontally from one bust apex to the other	Same as size 2-20	Same description as I.S.O.	The measurement was taken horizontally from one nipple to the other.
Bitrochanteric Width			The anthropomerer was placed at the right and left hip level at the trochanteric projection					
Anterior Bust Arc		Taken from the left sideseam over the fullest part of the bust to the right sideseam	On the trunk in line with the under arm midpoint at the level of the largest bust prominence			Taken from the left sideseam over the fullest part of the bust to the right sideseam.		
Anterior Waist Arc		Taken from the right sideseam at the waist level across the front to the left sideseam				Measured across the front of the body at waist level from one imaginary side seam to the other imaginary side seam.		

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Abdominal Extension Arc		Taken from the right sideseam at the greatest level of abdominal extension to the left sideseam				Measure across the front abdominal level from side seam to side seam.		
Posterior Hip Arc		Tape placed at the average hip level on the left side across to the right side				Measure across the back at fullest part of hip from side seam to side seam.		
Bust Projection	Bust projection defined as (maximum) antero - posterior measurement at level of the bust							

Body Dimensions:

Length

Stature/Height	Standing in measuring device (ruled board attached to a platform) height taken to nearest half inch	Subject standing erect feet as close together as comfortable using Reid's base line parallel to the floor(the line above the tragus to the line above the eye socket)	Subject stood erect feet together as comfortable, palms on thigh, eyes directed forward An anthropometer was used, vertical position was checked with vertical structure (door)	Measured from the crown of the head to the ground with feet together	Measured from the top of the head to the soles of feet	Measured from the crown of the head to the ground with feet together.	Same description as I.S.O.	Standing in an upright position and the head held in the Frankfurt plane, an L square ruler was placed on top of the participant's vertex and the other side of the ruler was parallel to the floor. The measurement was read at the level the L-square touched the metal tape that was attached to the wall.
Trunk Length (Trunk Height) Sitting		From the table to the cervical		Subject sitting on a flat surface measure from the 7th cervical vertebra to top of flat surface		Subject sitting on a flat surface measured from the 7th cervical vertebra to top of flat surface.		With the participant sitting in an upright position on a flat surface, measure from the spine of the 7th cervical vertebra down the vertebral column to the flat surface.

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Cervical Height		From the cervicale to the floor	From cervicale to floor	From the 7th cervical down the contour of the spinal column passed hip level to ground	Same description as I.S.O.	From the 7th cervical down the contour of the spinal column passing hip level to ground.	Same description as I.S.O.	With the participant standing upright close to the tape measure the L-Square ruler was placed at the spine of the 7th cervical vertebra with the other side of the ruler parallel to the wall. The participant's head was in the frankurt plane.
Cervical to Knee Hollow				From the 7th cervical vertebra following the contour of the spinal column over the hip and vertically to level of knee hollow				
Shoulder Height	Height was taken to the upper part of the right acromion process							
Bust Height	Height of greatest prominence of the bust	Taken from floor to centre of the rib cage in line with the bust prominence						
Waist Height	Taken to the inner most point of the waist at back (opposite the spine of the fourth lumbar vertebra)	From the floor to the waist in the mid axillary region at the margin of the lowest rib		From the natural waist line to the ground using anthropometer	On the side of the body measure from waist level following the contour of the body to the floor		Same description as I.S.O.	
Waist to Abdominal Extension								On the side seam measure from the bottom of the waist tape at the waistline to the most prominent projection of the abdominal
Waist to Lower Hip		From the waist to the hip level	From waist tape on right side to average hip level	On the side of the body from the natural waist line to lateral trochanteric projection			From natural waist to the hip at greatest lateral trochantric projections	Standing in front of the participant measure from the bottom of the waist tape on the right lateral position of the trunk to the most prominent part of the hip projection.

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Outside Leg Length (Waist to Floor) (Waist Height)			From waist level on right side perpendicular to the floor	From waist to ground using tape measure		Side waist height taken by adding waist to hip height and hip height together (Waist height obtained by measuring from centre back and following contour of hip to floor.		Standing at the right side of the participant the measurement was taken from the bottom of the waist tape over the lateral contour of the hip straight down to the floor.
Foot Length				Horizontal distance between the most prominent toe and the most prominent part of the heel		Horizontal distance between the most prominent toe and the most prominent part of the heel.		
Upper Hip Height to Floor (Abdominal Prominence)	Measured from floor to the most prominent part of the abdominal projection	From the floor to the abdominal projection			On the side of the body measured from the abdominal extension to the feet	Same as size 2-20		
Hip Height to Floor (Posterior Projection)	From the floor to the most prominent part of the posterior projection	From the floor to the trochantor major	From the floor to the trochantor major	From the trochanteric projection to the ground	On the side of the body from full hip level to the feet	Same as size 2-20	Same description as I.S.O.	
Height of Thigh Fold	The junction between trunk and the thigh with subject sitting (Poupart's Ligament)							
Thigh Length				Measured on inside of leg between crotch (perineum) and knee				
Crotch Height (Gluteal Fold) (In Leg)	Taken to the junction of the gluteal (buttock) muscle with the posterior aspect of the thigh	On the back from the floor to the centre of the crotch		Distance between crotch and ground	From crotch straight down to the feet	Same as size 2-20	Measured from the crotch to the ground	With the right foot on a chair the participant held the tape at the ischial tuberosity whilst the measurer took the tape straight down to the feet.
Body Rise Height				On the back of the body measured from the waist and crotch level				

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Crotch Depth (True Rise) (Waist to Seat)			Sitting erect on a firm surface and arms folded across the chest. Tape placed at the waist level and extended perpendicular to the seat		Sitting on flat surface measure from waist level on the side of the body to the flat surface			With the participant sitting in an upright position on a flat surface, the measurement was taken from the bottom of the waist tape following the contours of the body to the flat surface of the chair.
Total Crotch Length (Front to Back Crotch Length)		Left foot on chair tape placed at centre front over the genitourinary space and the perineum to the back waist level		Measured from the centre front at waist level through crotch to the centre back waist level	Same description as I.S.O.	Same description as I.S.O.	Same description as I.S.O.	The participant held the tape measure at the bottom of the waist tape anteriorly. The tape was then passed between the crotch to the bottom of the waist tape at the back.
Anterior Crotch Length		Left foot on chair tape placed at centre front over the genitourinary space to the perineum						
Knee Height		From the floor to the tibiale	From the floor to the tibiale	From the tibial to the ground	From the crease at back of knee to soles of feet	Same as size 2-20	Same description as I.S.O.	
Ankle Height		Floor to ankle		Measured from outer ankle bone to the ground	From middle of outer ankle bone to the ground	Same as size 2-20		
Scye Depth (Posterior)		From the cervicale to the point in the median sagittal plane that was located whilst measuring the chest girth	From the clavicle to the landmark at the level of the armpit	From the 7th cervical to upper edge of tape passed horizontally under armpits	Same description as I.S.O	Measure from the cervicale to upper edge of tape passed horizontally under the armpits.		
Front Waist Length (Anterior) (Centre Front Length)		From the neck base at the centre front to the waist line	From the anterior neck base down the centre front to the waist tape		From centre front neck base to waist level	Same as size 2-20		A piece of paper was placed over the bust prominence to keep the tape measure in line with the anterior protrusion of the bust. The measurement was taken

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Shoulder to Waist Height (Centre Shoulder to Waist)		From the waist over the fullest part of the bust to the shoulder line						
Front Neck Shoulder Point to Waist (Neck Shoulder to Waist)			From the centre of the shoulder over the right breast to the waist tape	From intersection of shoulder and neck point over nipple to front waist			From the intersection of the neck and shoulder point over the nipple to front waist	From intersection of neck and shoulder point over bust to waist tape
Shoulder Length		From the intersection of neck base and shoulder point to the arm scye	From the intersection of shoulder and neck to the intersection of shoulder and armscye	From the intersection of shoulder and neck point to the acromion	Same description as I.S.O	From the intersection of shoulder and neck point to the acromion.	Same description as I.S.O.	Standing at the right side, of the participant measure from the intersection of the neck and shoulder point to the tip of the acromion.
Front Neck Shoulder Point to Breast Point Length (Bust Point)		From the intersection of the shoulder and neck point to the fullest part of the bust		From intersection of shoulder and neck point to bust point	Same description as I.S.O.	Same description as I.S.O.	Same description as I.S.O.	Standing on the right side of the participant, the measurement was taken from the landmark at the intersection of the neck and shoulder point over the bust to the bottom of the waist tape.
Side Length (Trunk Line) (Armscye to Waist)		From the midpoint at underarm to the waist level (trunk line)	From underarm midpoint to average waist level				From the midpoint at underarm to the waist level (Same description as O'Brien & Shelton)	The participant was asked to clasped her hands slightly in front of body. The measurement was taken from the top of the posterior axillary crease to the waist tape.
Cervicale to Waist Length (Cervicale to centre front length)		From the cervicale through the intersection of the neck base and shoulder over the fullest part of the breast to the waist level	From the cervicale to intersection of shoulder and neck then extended to waist level at centre front	Same description as O'Brien & Shelton		Same description as O'Brien & Shelton		
Cervicale to Breast Point (Neck to Bust)			From the intersection of shoulder and neck to the bust prominence	From 7th cervical around base of back neck to the nipple				

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Back Neck Point to Waist								Standing at the right side of body measure from the landmark at the intersection of the back neck and shoulder point over the scapulae to the bottom of the waist tape.
Centre Back Length (Posterior) (Nape to Waist)		From the cervicale to the waistline at the centre back	From the cervicale to the waist line at centre back	Same description as O'Brien & Shelton	Same description as O'Brien & Shelton	Same description as O'Brien & Shelton	Same description as O'Brien & Shelton	The measurement was taken from the landmark at the spine of the 7th cervical vertebra down the spine to the bottom of the waist tape.
Outside Sleeve Length (Posterior Arm Length) (Arm Length) (Shoulder to Wrist)		From the intersection of the armscye and shoulder olecranon to the distal limit of the ulna	Right fist clenched and placed on upper hip, thumb towards the front. Measurement taken from intersection of armscye and shoulder over the olecranon to the distal end of ulna	Arm bent at 90 degrees with fist clenched and placed on hip, measure from the acromion over the elbow to the wrist bone	Arm bent at 90 degrees and hand placed on hip, measure from the acromion over the elbow to the wrist bone		Same description as I.S.O.	With the arm flexed at 45 degrees the measurement was taken from the landmark at the acromion over the olecranon to the radius styloid process
Upper Arm Length (Shoulder to Elbow)		From the intersection of the armscye and shoulder to the olecranon		Arm bent at 90 degrees and hand placed on hip, measure from shoulder joint to the centre elbow bone	Same description as I.S.O.	Same description as I.S.O.		
Hand Length				With fingers and thumb extended measure between the top of middle finger and first crease at base of arm				
Anterior Arm Length (Inside Length) (Under Arm to Wrist)		From the midpoint at the underarm to the mid anterior wrist point	With arm extended laterally approximately 30%, fingers extended measure from underarm midpoint to the anterior wrist point	From midpoint of armpit to the wrist bone (arm hanging naturally)		Measure from armpit to midpoint of inside wrist bone.	Same description as I.S.O.	With the participant's arm bent at 45 degrees angle the measurement was taken from the anterior axillary crease to the ulna styloid process at the wrist

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7th Cervical to Wrist (Cervicale to Wrist)				With the arm bent at 90 degrees measure from the 7th cervical vertebra from the top of the shoulder to the shoulder joint then to wrist bone	Same description as I.S.O.			
Weight	Weight taken with subject wearing swimming costume without shoes	Weight taken with the subject wearing pant and bra	Wearing pant and bra Dial set at zero weight recorded in stones. Converted to pounds				Taken without clothes	The participant activated the digital scales by applying pressure with one foot firmly on the scales. This activated o-o on the screen. The foot was removed then both feet were placed on the scales with body weight distributed

Appendix 3.

Buying a Bathing Suit for the Fuller Figure.

This poem was read by a member of Probis at a Queensland Probis meeting sometime in the late 2000. A copy of the poem was given to a female sales assistant at a swimwear boutique in Queensland. On follow up for permission to use this article in this thesis it appears that the poem was taken from the Internet and no name was available.

I have just been through the annual pilgrimage of torture and humiliation known as buying a bathing suit. When I was a child the bathing suit for a woman with a mature figure was designed for a woman with a mature figure. It was boned, trussed and reinforced, not so much sewn together as engineered. They were built to hold back and uplift and they did a darn good job. Todays stretch fabrics are designed for the prepubescent girl with a figure chipped from marble. The mature figure has a choice she can either show up in the maternity department and try on a floral costume with a skirt, and coming away looking like a hippopotamus escaped from Disney's Fantasia or she can wander around every department store, trying to make a sensible choice from what amounts to a designer range of rubber bands. What choice did I have?

I wandered around made my sensible choice entered into the chamber of horrors known as the fitting room. The first thing I noticed was the extraordinary tensile strength of the stretch material. The Lycra used in the bathing suits was developed, I believe by NASA to launch small rockets from a slingshot, which gives the added bonus that if you manage to actually lower yourself into one of these bathing suits, you are protected from shark attacks. Any shark taking a swipe as your passing midriff would immediately bounce back and suffer whiplash. I fought my way into the bathing suit, but as I twanged the shoulder strap into place I gasped in horror, my bosoms had disappeared! Eventually I found one of them cowering under my left armpit. It took awhile to find the other. At least I discovered it flattened besides my seventh rib.

The problem is that modern bathing suits have no bra cups, the mature woman is meant to wear her bosom spread across her chest like a speedbump. I realigned my speedbump and rounded squarely on the mirror to take a full view assessment. The bathing suit fitted alright, but unfortunately, it fitted those bits of me willing to stay inside of it. The rest of me was oozing out rebelliously from the top, bottom and sides. I looked like a lump of play dough wrapped in insufficient clingwrap. As I tried to work out where all those extra bits had come from, the infant salesgirls popped her head through the curtain and said, "Oh, that suit is perfect. It is you!" I replied I was not so sure and asked what else she had to show me. She brought in a cream colored one that made me look like a lump of unraveled masking tape, then a floral two piece which gave me the appearance of an over sized napkin in an odd shaped serviette ring. I tried on a black number with a cutout midriff and looked like a jellyfish in mourning. I refused to struggle into some leopard bathers with a ragged frill, and did not try on a bright pink pair that had such a high cut leg I thought I would have to wax my eyebrows to wear it.

Finally I found a suit that fitted. It was a cheap, comfortable and bulge friendly, so I bought it. It was not till I got home that I read the label, which said, "Material may become transparent in water". But I am determined to wear it anyway. I just have to learn to swim in the sand.

Appendix 4.

University of Adelaide
Department of Anatomical Sciences

Information Sheet

ProjectTopic: The Changing Size and Shape of Australian Women

Dear Participant

As part of my higher degree research I am conducting a study on the changing size and shape of Australian women. The purpose of the study is to conduct an anthropometric and photographic study to ascertain the current body size and shape of a population sample of Australian women over time.

For this study, I am seeking volunteers who are willing to have their measurements taken, together with four photographs. The measurements and the photographs are taken with the participant wearing their pant and bra, which will be covered by a lightweight body suit supplied by us. Approximately 30 body measurements are required as well as height and weight. Three photographs are to be taken in a standing position and one in a sitting position. The time required in total will be approximately 30 minutes.

Confidentiality, of participants will be taken into consideration. Names will not be used and the face of participants will be covered when photographs are taken.

The measurements and photographs will be taken at the University of Adelaide in the Department of Anatomical Sciences

Your consent to participate in this study does not result in any obligation to anybody on your part. You may withdraw your consent at any time. The results of this study may be published in scientific journals, however, you will not be identified in any way.

Please indicate your consent by signing the attached sheet. You may keep a copy for your records.

Thank you for your cooperation.

Kathleen Berry
If you have any queries please feel free to contact me,
Office hours telephone (08) 83033369.

Appendix 5.

THE UNIVERSITY OF ADELAIDE

STANDARD CONSENT FORM

See also information Sheet attached

1. I, *(please print name)*

   hereby consent to take part in the research project entitled:

   Changing Size and Shape of Australian Women

2. I acknowledge that I have read the Information Sheet entitled:

   Changing Size and Shape of Australian Women

3. I have had the project, so far as it affects me, fully explained to my satisfaction by the research worker. My consent is given freely.

4. I have been informed that, while information gained during the study may be published, I will not be identified and my personal results will not be divulged.

5. I understand that I am free to withdraw from the project at any time.

6. I am aware that I should retain a copy of this Consent Form, when completed, and the relevant Information Sheet.

   Signature/date

WITNESS

I have described to *(name of subject)*

the nature of the procedures to be carried out. In my opinion she/he understood the explanation.

Name

Signature/date

STATUS IN PROJECT

Appendix 6.

Anthropometric / Photographic Survey

Number: 98/_____

Date:_____ Date of Birth: Place of Birth: _____

Dimensions	
Neck Base Girth	
Bust Girth	
Over Bust	
Under Bust	
Waist	
Upper Hip (Abdominal Ext)	
Height of Upper Hip	
Lower Hip	
Height of Lower Hip	
Centre Front Length	
Front Neck /Sh/ Pt to Bust Point.	
Front Neck /Sh /Pt to Waist Tape	
Bust Separation	
Across Chest	
Shoulder	
Shoulder to Shoulder	
Center Back Length (7^{th} cervical)	
Back Neck /Sh Pt to Waist	
Across Back	
Side Length	
Armhole	
Upper Arm (1/3 Upper Arm)	
Lower Arm (2/3 Upper Arm)	
Elbow	
Wrist	
Hand	
Outside Sleeve Length	
Inside Sleeve Length	
Waist to Floor (waist length)	
Thigh	
Knee	
Inleg	
Front to Back Crotch	
Waist to Seat)	
Trunk Height (Sitting)	
Cervical Height (Standing)	
Height (MM)	
Weight (kg)	

Front

Back

Lateral

Appendix 7. (Figures 34 and 35).

Figure 34. Over Bust and Age of S.A. Women (1999) compared..

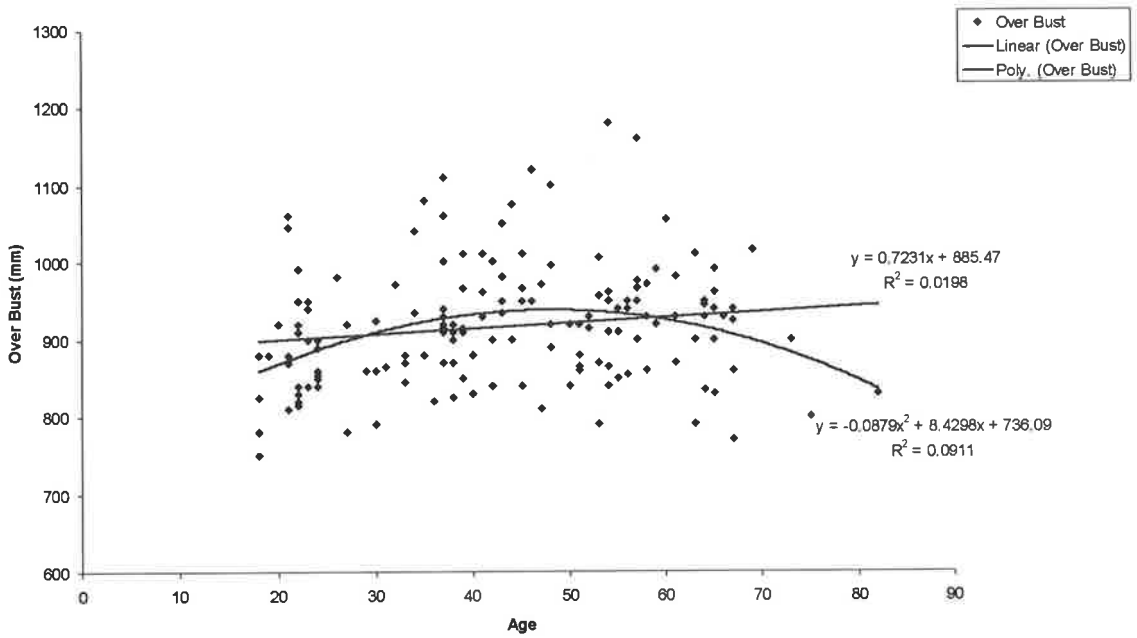
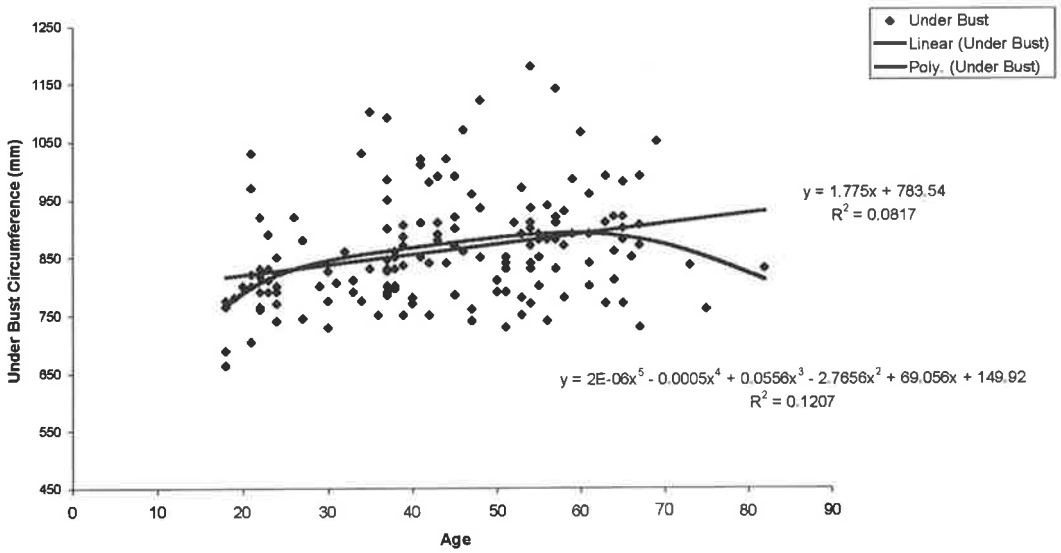


Figure 35. Under Bust Circumference and Age of S.A. Women (1999) compared



Appendix 7. (Figures 36 and 37).

Figure 36. Height of Upper Hip and Age of S.A. Women (1999) compared.

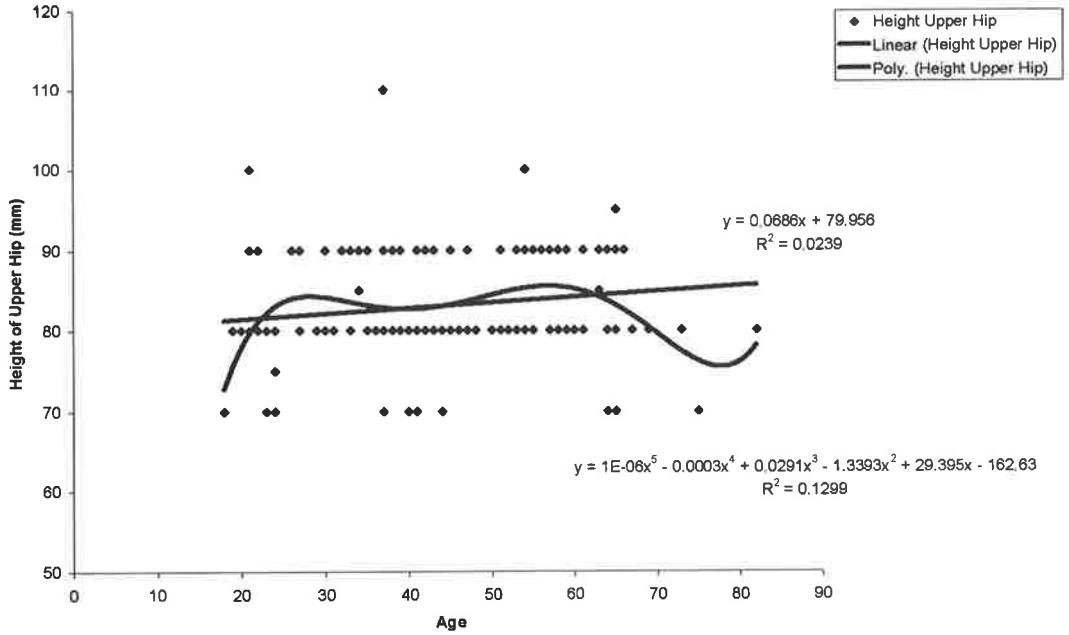
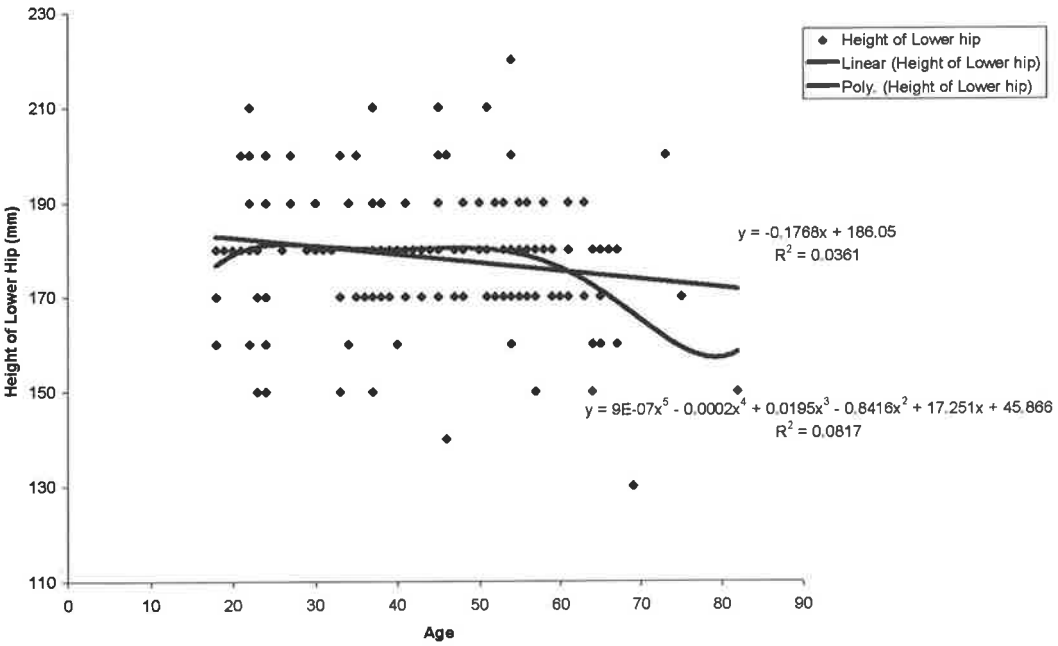


Figure 37. Height of Lower hip and Age of S.A. Women (1999) compared.



Appendix 7. (Figures 38 and 39).

Figure 38. Front Neck Shoulder Point to Waist Length and Age of S.A. Women compared.

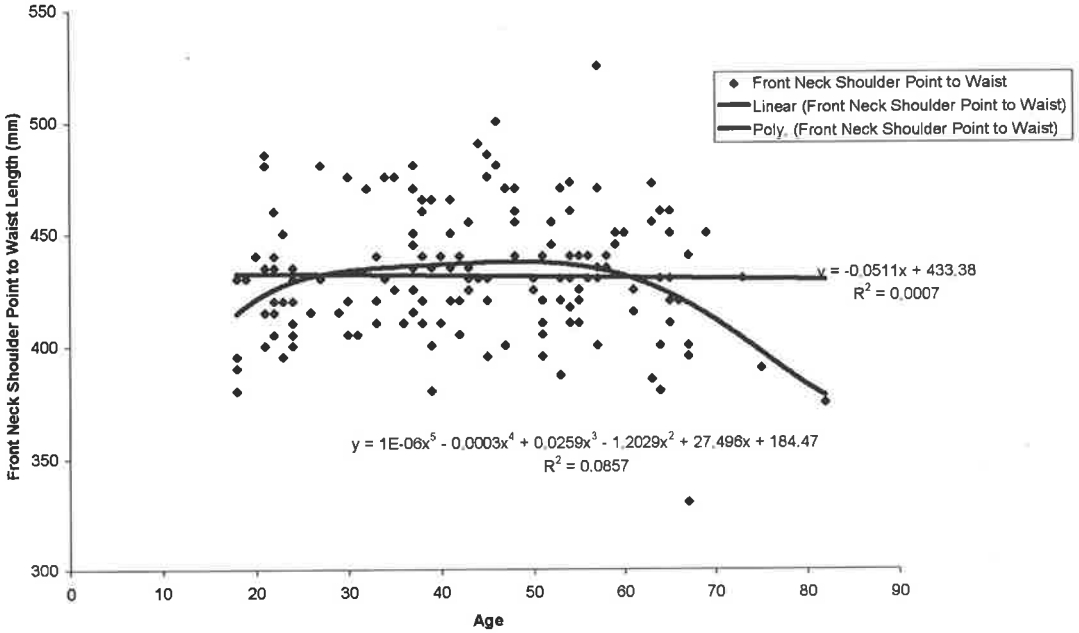
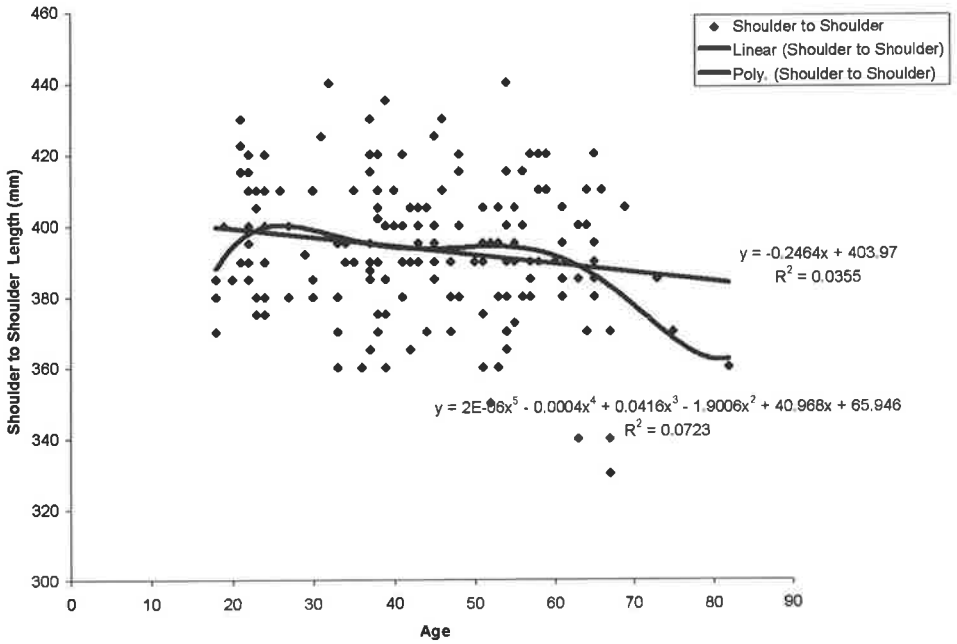


Figure 39. Shoulder to Shoulder Length and Age of S.A. Women (1999) compared.



Appendix 7. (Figures 40 and 41).

Figure 40. Back Neck Shoulder Point to Waist Length and Age of S.A. Women (1999) compared.

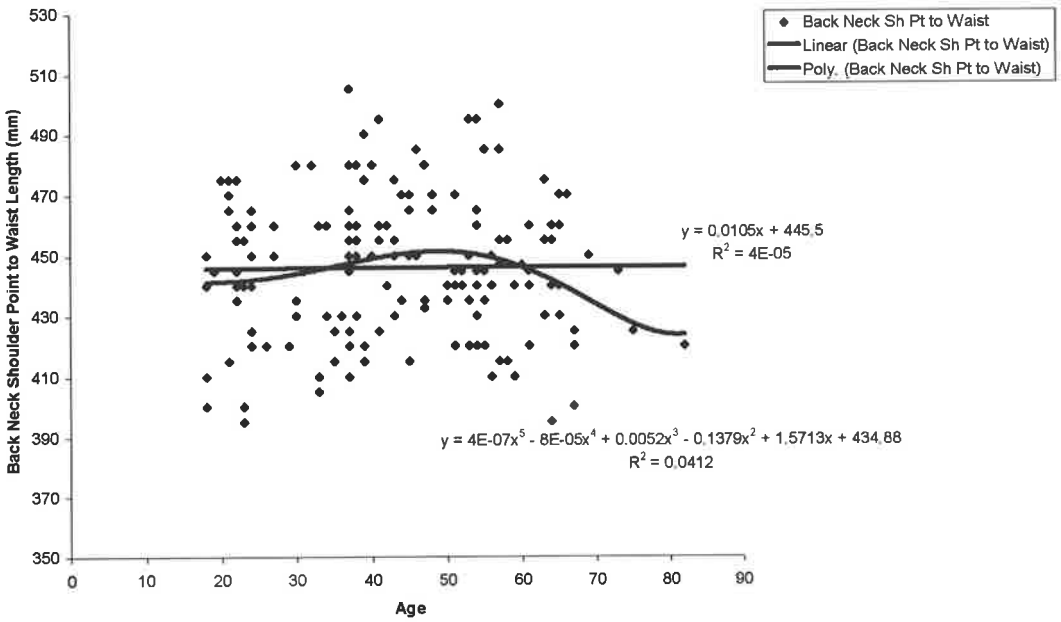
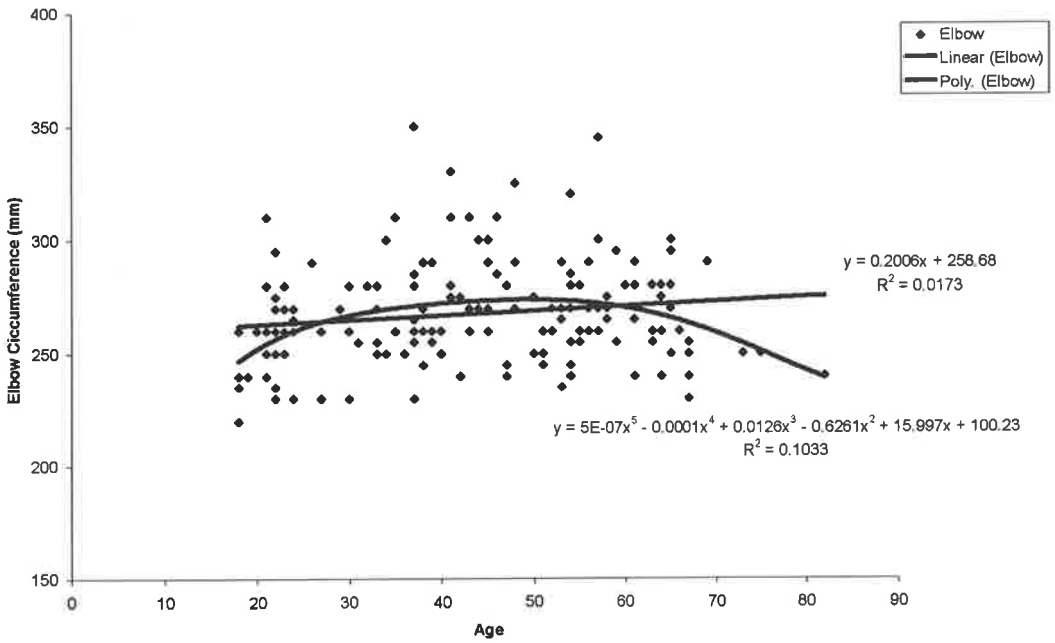


Figure 41. Elbow Circumference and Age of S.A. Women (1999) compared.



Appendix 7. (Figures 42 and 43).

Figure 42. Lower Arm Circumference and Age of S.A. Women (1999) compared.

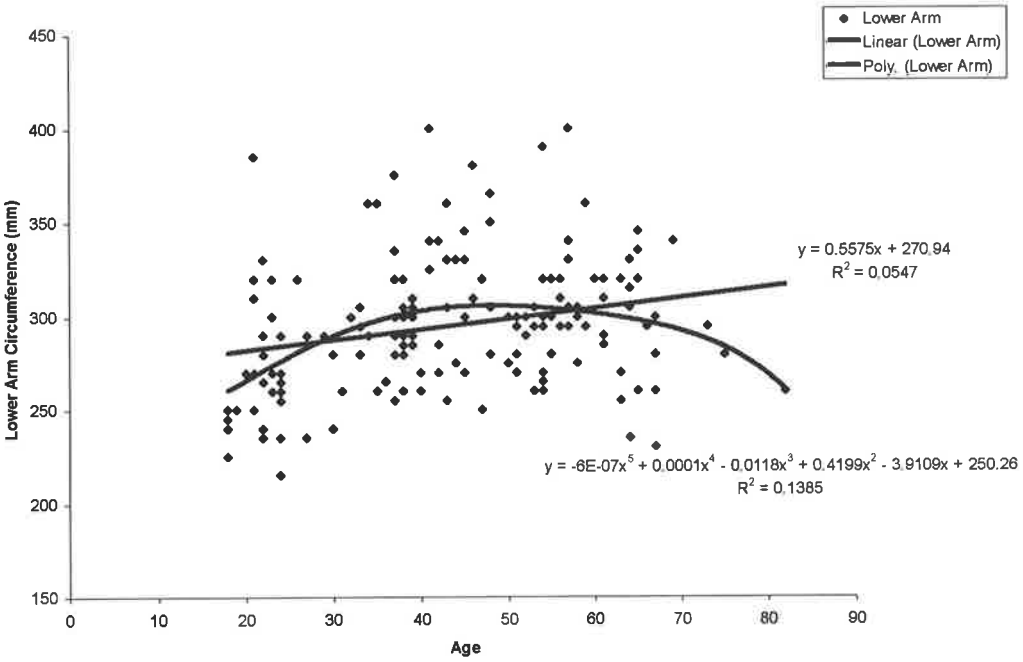
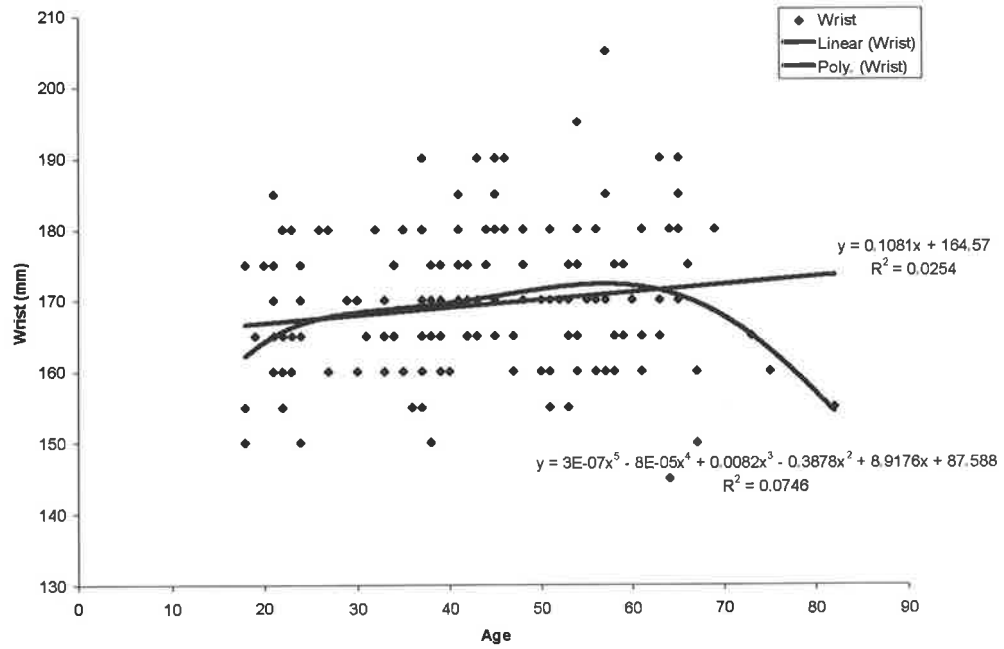


Figure 43. Wrist Circumference and Age of S.A. Women compared.



Appendix 7. (Figures 44 and 45).

Figure 44. Hand Circumference and Age of S.A. Women (1999) compared.

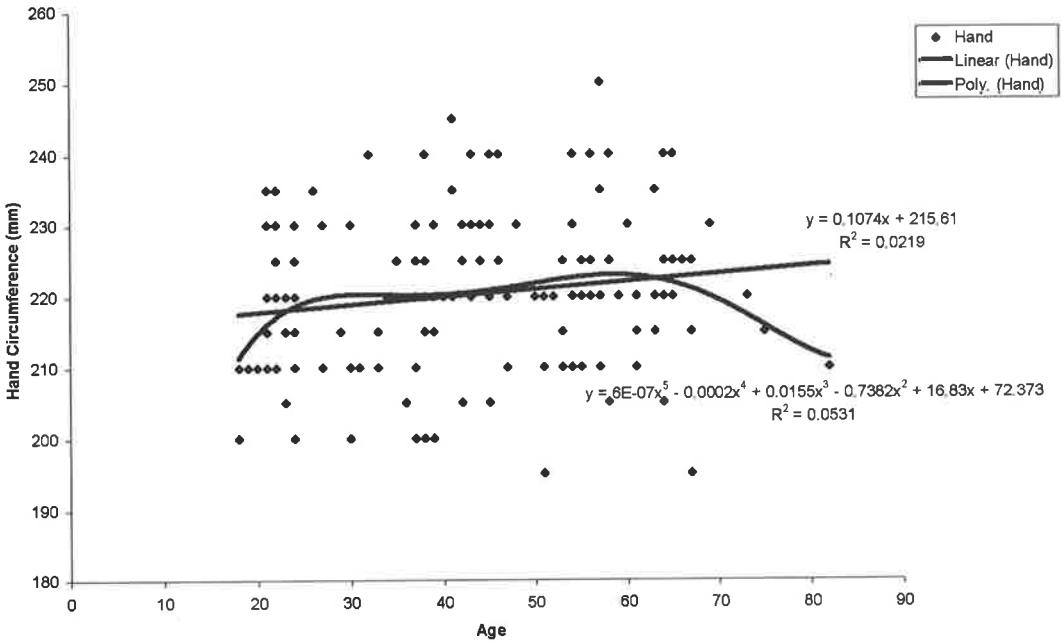
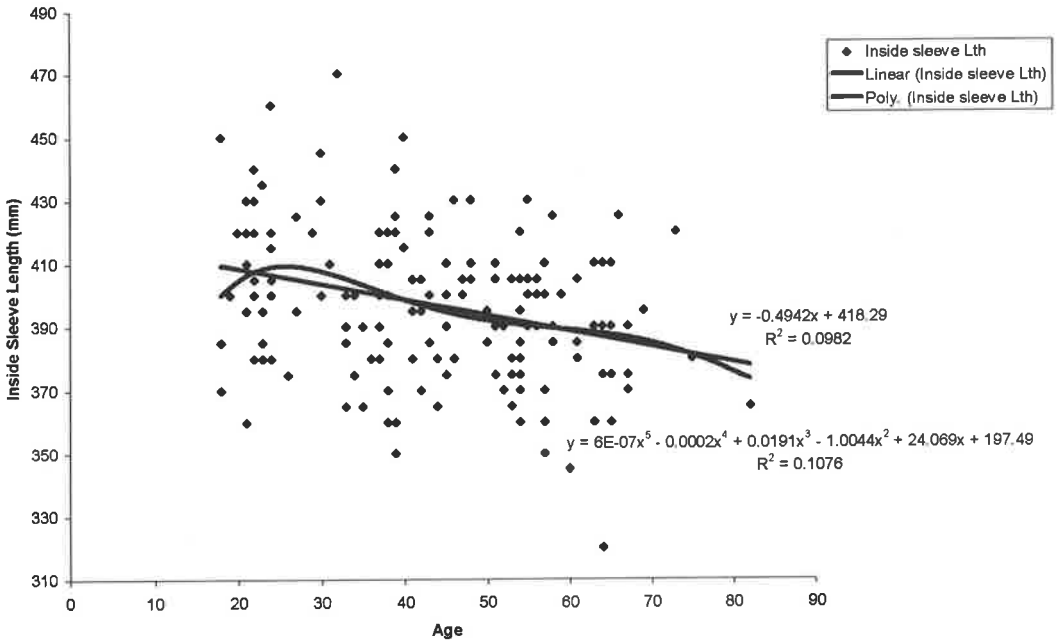


Figure 45. Inside sleeve Length and Age of S.A. Women compared.



Appendix 7. (Figure 46 and 47).

Figure 46. Knee Circumference and Age of S.A. Women compared.

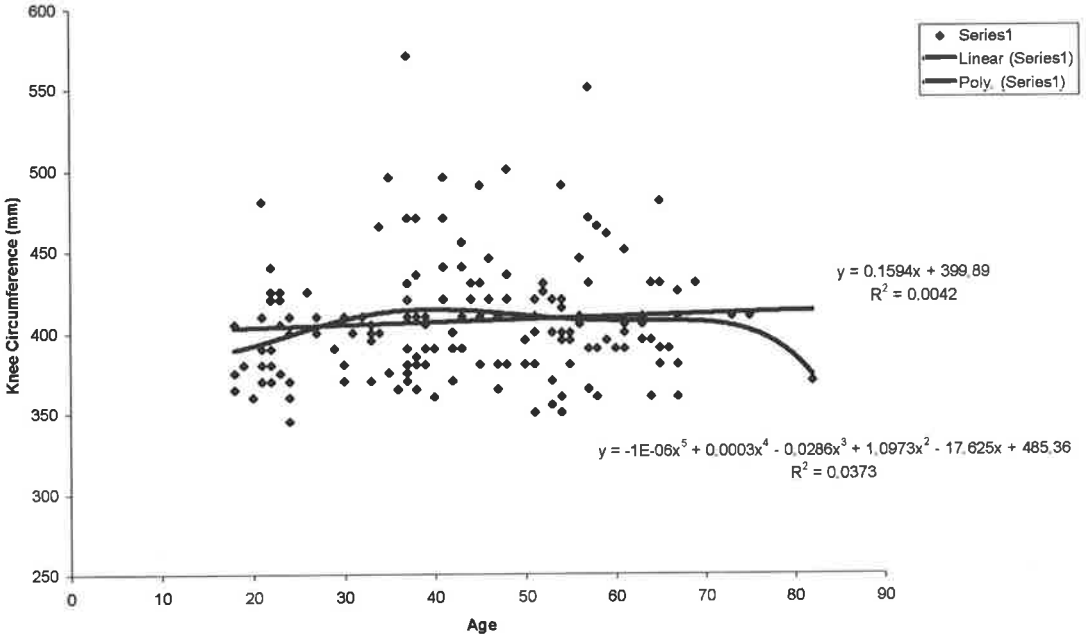
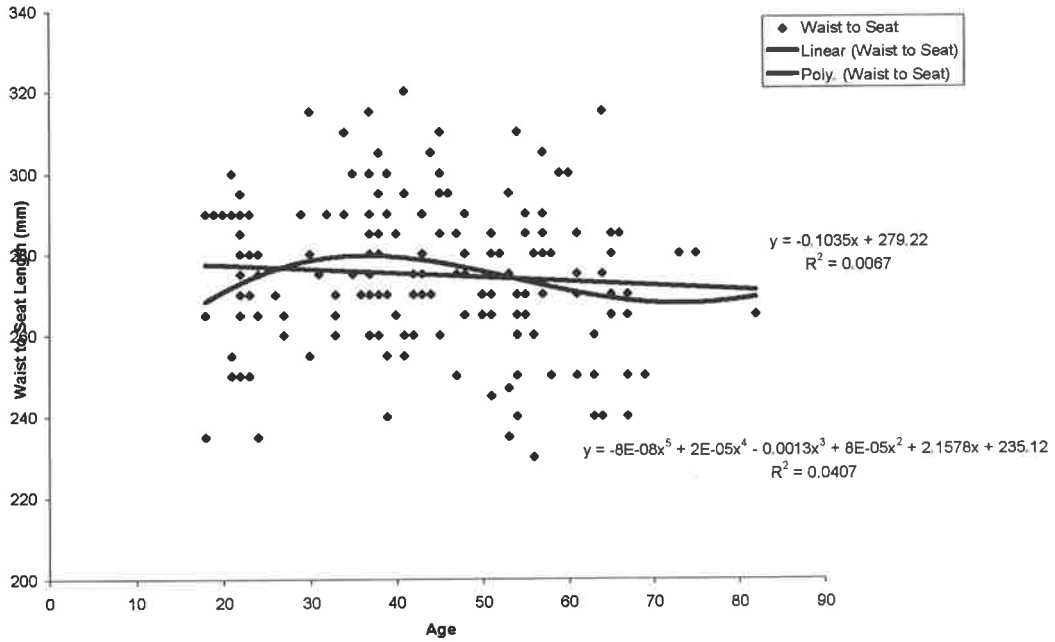


Figure 47. Waist to Seat length and Age of S.A. Women compared.



Appexdix 7. (Figure 48).

Figure 48. Relationship between Cervical Height Standing and Age of S.A.Women (1998-1999).