PUBERTAL DEVELOPMENT IN WHITE AND COLOURED URBAN SCHOOLGIRLS

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DECLARATION

I, Carol Ann Thomas, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other University.

I empower the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signed by candidate

31 August 1994

Date

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INTRODUCTION

In 1962 Tanner published his book "Growth at Adolescence"[1]. The variations in patterns of pubertal development in both girls and boys in the United Kingdom which he described have now become the 'gold standard' against which all other pubertal development is measured. While numerous studies have been done in Western countries,[2,3,4,5,6,7,8,9,10,11,12] little data is available from Africa and there are comparatively few South African studies. These are listed in Table I in chronological order.

Table I: Mean age at menarche: South African data

Author (1st)	Year	Sample size	Population	Menarche Mean (SEM)/[SD] yrs
Kark[13]	1943	1038	rural, black	15,65 [1,11]
Kark[14]	1953	1259	urban, Indian	13,56 (0,07)
Kark[15]	1956	392	urban, Indian	13,60 [0,06]
Benjamin[16]	1960	1000	urban, white	14,60
Oettle[12]	1961	1002	urban, black	14,89 (0,09) [1,66]
Burrell[18]	1961	27036 20384	rural, black 'poor' 'not poor'	15,42 (0,04) 15,02 (0,03)
Margolius[19]	1970	1693	urban, coloured	13,20 [0,04]
Frere[20]	1971	1688 3150	urban, black 'poor' 'average'	14,76 (0,04) 14,75 (0,04)
Richardson[21]	1977	415 405	urban, black rural, black	13,00 14,00
Chaning-P[22]	1987	362	urban, black urban, white	13,90 [1,70] 13,10 [1,40]
Cameron[23]	1988	42	ex-kwashiorkor coloured girls	14,17
Wright[24]	1989	162 148	urban, Indian urban, black	12,25 12,70
Cameron[25]	1990	121 148	rural, black urban, black (private school)	14,63 [1,12] 13,20 [1,22]

SEM = Standard error of mean
SD = Standard deviation

In 1943 Emily Kark in her pioneering study produced the first data on South African black girls.[13] In 1961 Burrell, Healy and Tanner[18] published their large study on the

age at menarche of black girls living in Transkei. The most recent work on the pubertal development of South African girls of all races has been published by Cameron and his co-workers over the past decade.[23,24,25]

Over the last hundred years there has been a trend towards earlier age of pubertal development and menarche throughout Europe[2,4,5,7,8,11,26,27,28,29,30] and the United States of America.[2,8,11,12,31,32] It is now generally accepted that pubertal development is a good marker of the general health and well-being of a community, and, as socio-economic standards equalize, the differentiation between the various social groups disappears.

Factors such as nutrition, physical health, social and psychological factors all influence the age of onset and the rate of progression of pubertal change. Chronic disease and malnutrition[33] result in delayed puberty. When reviewing the literature, Tanner found that although climate and race may affect the time of adolescence, nutrition was the factor with most impact. Genetic factors also play a role as daughters frequently experience menarche at an age close to their mother's menarchal age.[1]

Pre-puberty is characterised by a lowered pituitary sensitivity to circulating gonadotrophins. With the onset of pubertal changes, this to circulating gonadotrophins increases sensitivity. A suggested mechanism is that the increase in adrenal androgens which occurs at age 7 to 8 years, well before the physical signs of puberty are evident, plays a role in altering gonadal sensitivity. The mechanism by which this is achieved has not yet been elucidated, but Hill *et al*[34] have obtained data from a study of serum hormone levels in Caucasian and Bantu girls that early adrenal maturation in the former may explain the earlier menarche (12,6 years Caucasian; 14,9 years Bantu) found in their study:- the Caucasian girls showed higher dehydroepiandrostenedione (DHEA) levels and higher DHEA/androstenedione ratios at all stages studied, although luteinising hormone and testosterone values were comparatively higher in the Bantu girls. This work has not however since been substantiated.

Tanner[35] points out that, although the influence of increased adrenal androgen production as having an initiating role in puberty is an attractive hypothesis, it cannot

be the most important, because girls with Addison's disease who lack adrenal androgens nevertheless undergo pubertal changes at the normal time.

Frisch hypothesised that a girl should reach a critical body weight (48 kg) to achieve menarche.[36] Later work by the same researcher suggests that a shift in body composition toward a greater percentage fat is more important than total weight.[37] Indeed, moderately obese girls (20 - 30% over normal weight) have earlier menarche than normal weight girls. Conversely, anorectics and intense exercisers have delayed menarche.[38,39,40,41]

Johnston[42] challenged this hypothesis on the basis that there had been a failure by Frisch and Revelle to recognise that the three variables, height, weight and age, were interrelated. A critical appraisal of the original hypothesis by Trussell[43] found it plausible, but the evidence for it too weak. Billewicz *et al*[44] rejected the hypothesis, commenting on the dangers of reaching conclusions based on derived, instead of, on observed data.

Frisch[37] defended her hypothesis in later publications, but revised it, suggesting that a 17% critical fat mass is the factor necessary to initiate menstruation, rather than the total body mass, and that regular ovulation and reproductive maturity are achieved with further increase in body fat (23%).

The Frisch hypothesis appeals to gynaecologists because of the phenomenon of "weight-related amenorrhoea" following weight loss. Given the fact that androgens are aromatised to oestrogens in adipose tissue and that, presumably, increased oestrogen production will result in the appearance of the oestrogen dependent stages of puberty, the Frisch hypothesis may well be of significance. The basis for this would be that increased body fat will produce a larger substrate from which oestrogens can be produced.

The trend towards earlier menarche over the last century, as has been seen in developed countries, has not been the case in most developing countries.

Tanner[45] investigated age at menarche in areas in Africa other than South Africa. One such study was done in Nigerian school girls and published in 1962. The subjects studied were highly privileged, given the conditions of the day, and the mean age at menarche was assessed as being 14,07 ± 0,16 years. This was noted by the authors as being approximately the average menarchal age of British girls 30 years earlier.

A Ugandan study (1964) by Burgess and Burgess,[46] also of subjects of higher social class than that of South African studies to date, reported a mean menarchal age of 13,4 ± 0,165 years. The conclusions of the investigators were: "The good socio-economic status of these girls and comparison of their development with other African groups suggest that their growth pattern might serve as a standard for other Bantu-speaking girls in East Africa." It must be emphasised that these studies are all relatively dated.

Kulin[33] studied the effect of chronic childhood malnutrition on pubertal growth and other stages of pubertal development, including menarche, in Kenya. Urban well-nourished girls had a mean age of menarche at 13,2 ±1,5 years, whereas rural Kenyan girls of disadvantaged circumstance had a mean age of menarche of 15,3 ±2,2 years. It is noteworthy that this is a fairly recent study published in 1982. Kulin *et al* found that height was the best indicator of adequate long term nutrition. Proportion of body fat bore little relationship to onset of sexual maturation, once again calling into question the original Frisch hypothesis.[36]

Authors like Chaning-Pearce and Solomon[22] have employed simplified schemes for pubertal development based on Tanner staging because of the difficulty in assessing intermediate stages of pubertal development. This, and different means of analysis of data, often makes direct comparison of published data difficult.

Despite the above problems it would appear that white South African children assessed in the mid 1980's tend to be similar in their development[22] when using Marshall and Tanner's 1969 findings in children in the United Kingdom as a reference population.[4] Black, Indian and Coloured South African girls (Table I), probably due to a number of environmental factors, tend to have delayed development relative to the United Kingdom group of 25 years ago.

Age at menarche appears to have decreased over the last 50 years in white, coloured and black South African girls in both urban and rural settings (Table I). This is similar to the trend (referred to as the secular trend) of decreasing age of menarche in many Western developed countries. The trend in the West has been attributed to improved socio-economic conditions and population health in these communities. These countries provide services to the indigent in the form of health care, sanitation, nutritional support and educational facilities.

In Oslo, a decline in mean menarchal age from 14,6 years to 13,3 years for women born between 1905 and 1940 has been reported by Brudevoll *et al.*[26] Widholm and Kantero,[30] in Finland, found that the mean menarchal age was 15,42 years in 1915, 14,25 years in 1950 and 13,16 in 1969.

Marshall and Tanner's[4] 1969 United Kingdom and Largo's[8] 1987 Swiss data are listed in Table II.

Table II: Mean age at stages of puberty in girls in the United Kingdom and Switzerland

Pubertal stage	British girls Mean [SD] years	Swiss girls Mean [SD] years
Breast stage 2	11,50 [1,10]	10,90 [1,20]
Pubic hair stage 2	11,64 [1,21]	10,40 [1,20]
Breast stage 3	12,15 [1,09]	12,20 [1,20]
Pubic hair stage 3	12,36 [1,10]	12,20 [1,20]
Pubic hair stage 4	12,95 [1,06]	13,00 [1,10]
Breast stage 4	13,11 [1,15]	13,20 [0,90]
Menarche	13,47 [1,12]	13,40 [1,10]
Pubic hair stage 5	14,41 [1,21]	14,00 [1,30]
Breast stage 5	15,33 [1,74]	14,00 [1,20]

Similar trends have been reported in the United States with a decline in the mean age at menarche from 14,05 years for North Carolina College girls born in 1896-1900 to 13,23 years for those born in 1930.[12] More recently Wyshak[31] published data showing a decline in mean menarchal age from 13,19 years for women born prior to 1920 to 12,44 years for those born in or after 1940. Data from the United States by Zacharias *et al*[12] published in 1976 reports a mean menarchal age of 12,83 ±1,22 years.

Dewhurst[47] comments that in developed countries the menarchal age has been the lowest among the higher social strata until the 1950's and that since then the lower strata have not only caught up, but has continued to follow the secular trend. He further comments that the "precise components of the socio-economic change have not been identified but nutrition is likely to be the most important with freedom from chronic disease no doubt also playing a part."

In highly developed countries where differences in socio-economic factors are small, the mean menarchal age differences are equally small or do not exist. Furu[27] found no age difference between different socio-economic groups in Stockholm and Lindgren[28] found no age difference in Sweden as a whole.

Racial differences are seen in this country, but may reflect different levels of social well-being.

Emily Kark's initial work in 1943[13] was cross-sectional, but she had the opportunity to follow the development of 392 pre-menarchal Indian girls longitudinally and found the average age of onset of menarche to be 13,60 ±0,06 years. In girls of the upper social classes 1, 2 and 3 (classification of S. Kark[48]) the mean age of menarche was 5,3 months before those girls in social classes 4 and 5. The more socio-economically advantaged girls commenced menarche at 13,44 years whereas the disadvantaged group of girls menstruated at age 13,88 years. This supported her view that social class was an important variable in the onset of pubertal development, although the differences between the classes were not statistically significant.[15]

In 1960 Benjamin[16] found that white women experienced first menstruation at 14,6 years (range of 9 to 23 years). This study, although it relied on recalling an event in the past, is of relevance to this study as it was set in Cape Town, as is this study, and assesses the average onset of menarche in white girls. It must, however, be remembered that the data reported in 1960 reflected menarchal age as long as thirty years before. In his study Benjamin also showed that the age of menarche did not appear to have any significant bearing on the age of menopause.

Oettle and Higginson's 1961 study was initiated because of the noted racial differences in incidence of genital cancers.[17] The differences in incidence of certain cancers in women prompted an investigation of endocrine activity, including onset of menarche. The cancers which concerned the investigators were endometrial, cervical, ovarian and breast cancer. The authors collected data during routine diphtheria immunization. The need for sensitivity toward subjects when assessing pubertal milestones soon became apparent as "it was soon found that privacy was desirable, and once this was ensured, refusals became infrequent". Probit analysis was used and a mean age at menarche of 14,89 ±1,66 years was found. When the authors compared their findings with published data on other population groups it was found that the mean age at menarche found for black girls from Alexandra township was considerably older than those in English schoolgirls, Nigerian negroes, Negroes in New York or Indian girls in Durban. The figures were closer to those obtained for "pagan" Negroes in Northern Nigeria, aboriginals in Central India or rural Cingalese. The mean figure found by Oettle and Higginson was still higher than for the aforementioned populations. They conclude that, based on their and previous work, "where social classes can be distinguished in a homogeneous population, those with a poorer nutritional status show a later mean age of menarche." This effect of nutrition would support the Frisch hypothesis of critical body fat.

It was becoming evident that socio-economic status is an important variable impacting on pubertal development and Michelson, already as early as 1944, went as far as to state that when social classes are equal mean ages at menarche will be as well, thus eliminating any racial difference.[2] Our study is aimed at testing this notion.

Unlike Oettle and Higginson, Burrell *et al* found that "Bantu girls experience no embarrassment at answering this question (about menstruation); they are proud of reaching maturity." This either reflects differences in attitudes of girls in rural vs urban settings or differences in attitudes of the respective investigators towards their subjects. Burrell, Healy and Tanner in their 1961 study of "South African Bantu schoolgirls living in the Transkei Reserve" maintained that nutrition is the most important environmental factor and that climate, as shown before by other workers, has very little, if any, influence on onset of pubertal development.[18]

The authors found that the Transkei girls matured latest when compared to the same groups that Oettle and Higginson[17] used for comparison. They reported: "Besides being the latest maturing, the Bantu are probably among the worst off groups economically so far studied. Any genetical influences tending to produce earlier or later menarche than in Europeans are at present completely masked."

Burrell *at al*[18] had divided these rural girls into "poor" and "not-poor" groups and so doing found a five month difference between these groups of girls. The "not-poor" group mean age at menarche was 15,02 ±0,03 years whereas the "poor" group mean age at menarche was 15,42 ±0,04 years. A seasonal effect was found, but no explanation was offered.

Baanders-Van Halewijn and de Waard[3,10] make the point that onset of menarche does not necessarily mean that a girl has reached reproductive maturity as most early menstrual cycles are anovulatory. Differences in ages of onset of menarche does therefore not reflect onset of first ovulation (Baanders-Van Halewijn use the term ovularche for first ovulation). These authors assessed ovulation by using urinary sediment epithelial cell karyopyknotic indices and urinary pregnanediol levels obtained during one menstrual cycle in Dutch and South African 'Bantu' girls. Fifty percent of Dutch girls at age 15 were ovulatory and only 17,6% of black girls were ovulatory. Thus they found that "not only menarche but also ovularche occurs earlier in Dutch girls than in Bantu girls". Age at menarche was not investigated by these authors.

In about the same time as the above investigations of South African girls were published, Malcolm's study in New Guinea, a developing country, yielded a mean age of onset of menarche of 15,6.[49] Girls in New Guinea still have a high mean menarchal age, Roche in 1979 finding an even higher menarchal age than before of 17,5 to 18 years.[50]

In 1970 Margolius[19] investigated the age at menarche in South African urban coloured girls living in Johannesburg, recognising the value of menarchal age as an indicator of nutritional and, therefore, socio-economic status. The age of menarche was assessed as being 13,20 ±0,042 years with a range of 10 to 16 years. Margolius also found that there was a difference in onset of menarche in girls from different socio-economic

groups. In the poorer girls at age 13 only 38,2% had reached menarche, whereas 62,5% of the 13 year old girls who attended a private Catholic convent school had menstruated. The author comments on earlier menarche for bigger girls, but there was no statistical significance. The influence of being older or younger for school standard was questioned, but not specifically investigated.

In Frere's study[20] of urban "Bantu" girls of "poor nutritional status" and "average nutritional status", no statistical significance was found (14,75 ±0,04 years and 14,76 ±0,04 years respectively).

The Frisch hypothesis was once again brought into question by Richardson and Pieters[21], as many of the South African black girls in their study had still not menstruated despite having attained sufficient body weight and body fat. Tanner[38] expressed himself in the British Medical Journal about the Frisch hypothesis in the following manner: "The idea that a weight at which menarche occurs in an individual can be 'identified' like a steroid in gas-liquid chromatographic analysis, is quite false."

The study by Cameron *et al*[23] represents one of the few longitudinal studies done in this country. Unfortunately, because of the nature of the population sample studied, the data cannot be extrapolated to the general population. The authors found that 42 ex-Kwashiorkor 'Cape coloured' girls displayed catch up growth, despite severe malnutrition. Each stage of pubic hair development was consistently delayed when compared to Marshall and Tanner's 1969 British data.

Pubic and axillary hair development is relatively independent of breast development and menarche, being the result of pubertal changes in adrenal androgen production.[12] These stages of development are rarely commented on in the studies reviewed.[1,22] Our study aims at investigating breast development and menarche as well as pubic and axillary hair development.

Breast development is often the first sign of the development of secondary sexual characteristics and occurs approximately 2,5 years before the onset of menstruation. Menarche on the other hand always occurs after peak height velocity has been reached.[4] Both breast development and menarche are oestrogen dependent events.

Extra-glandular production of oestrogen occurs in fat including bone marrow and these pubertal stages of development may thus be related to body fat content.

The studies reviewed have used menarche as an easily identifiable landmark during puberty, representing a fixed point in the continuum of pubertal development. Using menarche as a marker also obviates the need for physical examination of the subjects studied. The start of breast development (Tanner breast stage 2) has also been assessed as an easily identifiable landmark with less inter- and intra-observer error.

Age at start of breast development in South Africa is known from only five studies,[21,22,23,24,25] as occurring between 10,42 and 12,70 years. All girls in Cameron's study had started breast development by age 15. The results of these studies are found in Table III.

Table III: Mean age of Tanner breast stage 2: South African data

Author (1st)	Year	Sample size	Population	Breast Stage 2 mean [SD] years
Richardson[21]	1977	405	rural, black	11,0
Chaning-P[22]	1987	362	urban, black urban, white	11,50 [1,30] 11,50 [1,40]
Cameron[23]	1988	42	ex-kwashiorkor coloured girls	11,31
Wright[24]	1989	162 148	urban, Indian urban, black	12,25 12,70
Cameron[25]	1990	121 148	rural, black urban, black (private school)	11,69 [1,87] 10,42 [1,47]

SD = Standard deviation

In the study by Wright *et al*[24] it is pointed out that breast development in black girls is about 6 months earlier than other reports on British, Swedish and 'Cape coloured' samples. They go on to emphasise that, while early maturation is generally thought of as indicative of a good environment, within the context of urbanisation in Southern Africa, their samples represented stable and probably good socio-economic conditions.

Sexual hair development is not considered to be oestrogen dependent, but dependent on adrenal hormonal production. Most studies do not assess these androgen dependent stages of development. Tanner's work is the most complete on the subject[7].

Chaning-Pearce and Solomon[22] are the only South African researchers who have produced data on axillary hair development. It must be noted that their data published in 1987 refers to a study performed in 1976 and 1977. Their findings on axillary hair development is shown in Table IV.

Table IV: Chaning-Pearce + Solomon[22] - Axillary hair development

Ethnic Group	Axillary Hair Stage 2 mean [SD] years	Axillary Hair Stage 5 mean [SD] years	Year	Sample size	Population
Whites	12,2 [1,4]	15,4 [1,5]	1976	355	urban
Blacks	12,3 [1,2]	16,4 [1,8]	1977	362	urban

SD = Standard deviation

The available data on pubic hair development for South Africa is listed in Table V. Wright *et al*[24] found that pubic hair development was not advanced or delayed in relation to different ethnic groups.

Table V: Pubic hair development: South African data

Author (1st)	Year	Sample size	Population	Pubic Hair Stage 2 mean [SD] yrs	Pubic Hair Stage 5 mean [SD] yrs
Chaning-P[22]	1987	355	White	11,3 [1,2]	14,8 [1,5]
		362	Black	12,1 [1,4]	16,2 [1,7]
Wright[24]	1989	162	Indian	-	15,0
		138	Coloured	11,00	16,47
		141	White	10,65	-

SD = Standard deviation

As is clear from the literature review, the secular trend seen in developed countries is occurring in South Africa and there is a need to document this trend at regular intervals.

AIM OF THE STUDY

The aim of this study was to compare pubertal development between the two main ethnic groups in the Cape, controlling for social class.

This study aimed to investigate:

1. The age of menarche and other stages of pubertal development of white and coloured school girls living in greater Cape Town.

2. The relationship between the age of menarche and the other stages of pubertal development, social class and race.

3. The influence of home environment (childminder, sibling number, maternal education) on onset of menarche and breast development.

This data further contributes to a larger study on pubertal development of all representative ethnic groups and social classes in the Cape.

Our hypothesis is that social class, and not race, is a major determinant of pubertal development.

METHODS

STUDY DESIGN

We undertook a cross-sectional descriptive and comparative study of all stages of pubertal development using the staging criteria of Marshall and Tanner[3], comparing white and coloured girls* and different social groups.

Tanner pubertal development staging criteria were adhered to.[3]

TANNER PUBERTAL STAGES

BREAST STAGES

Stage 1 (BR1): Pre-adolescent: elevation of the papilla only

Stage 2 (BR2): Breast bud stage: elevation of the breast and papilla as a small mound with enlargement of the areola diameter.

Stage 3 (BR3): Further enlargement of breast and areola with no separation of their contours.

Stage 4 (BR4): Projection of the areola and papilla to form a secondary mound above the level of the breast.

Stage 5 (BR5): Mature stage: projection of papilla only due to the recession of the areola to the general contour of the breast.

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* Due to the historical racial divisions in South Africa the naming of people by race is clarified. White refers to persons of Caucasian origin, coloured refers to persons of mixed race and black refers to persons of Negroid origin.

PUBIC HAIR STAGES

Stage 1 (PH1): Pre-adolescent: nil

Stage 2 (PH2): Sparse growth of long, slightly pigmented downy hair, straight or slightly curled, appearing chiefly along the labia.

Stage 3 (PH3): Considerably darker, coarser and more curled hair which spreads sparsely over the junction of the pubes.

Stage 4 (PH4): Adult type hair, but area covered still less than most adults.

Stage 5 (PH5): Adult in quantity and type and distributed as an inverse triangle. The spread is to the medial thighs, but not up to the linea alba or elsewhere above the base of the inverse triangle.

AXILLARY HAIR STAGES

Stage 1 (AX1): No terminal axillary hair is visible.

Stage 2 (AX2): A few darker, terminal hairs can be discerned.

Stage 3 (AX3): The quantity of hair has increased and the adult stage is reached.

The data collection started in 1990, initially in white schools, then later included coloured schools when educational authority consent was obtained.

CONSENT

Consent to perform these studies was obtained from the Ethics and Research committee of the University of Cape Town Medical School.

Consent to perform the study was also obtained from the relevant education authorities, school principals and staff after wide consultation. The study was

perceived to be of a sensitive nature as it related to race and adolescent sexuality and all efforts were made to ensure that all involved were satisfied with the manner in which researchers conducted the study.

Each subject's parent, parents or legal guardian received a letter of explanation about the study and was asked to fill in information about educational standard achieved and occupation of both the mother and the father. This information was used to determine the social class of the girl by using the social class stratification method devised by Schlemmer and Stopforth at the Centre of Applied Social Studies (CASS), University of Natal.[51] This classification allows for the heterogeneous nature of social class, community status and race by occupation in South Africa. A consent form was then signed and parents were given the option of being present during the pubertal assessment of their daughter. See Appendix 1.

SOCIAL CLASS

The subjects were categorised into four social groups. These groups do not refer to one social class only, but to categories as described below:

Social group 1	Social class I, II and III
Social group 2	Social class IV and V
Social group 3	Both parents unemployed
Social group 4	Parents or parental occupation not known

At the time of examination the girls themselves could refuse consent to examination even if parental consent had been obtained for their inclusion in the study.

The team of researchers were all women (Carol Thomas, Zephne van der Spuy and Fiona Nugent).

QUESTIONNAIRE

A questionnaire was filled in at the time of the study. The questionnaire had two components: social history and a clinical assessment. The social history was taken to

assess age, family size, the principal childminder, social class and race of the subject. The clinical examination included triceps and subscapular skinfold, height and weight measurements. Tanner staging of pubertal development was performed for breast, axillary and pubic hair. Age at menarche was obtained by questioning the subject and/or her parent. A copy of the questionnaire used is attached as Appendix 2.

STATISTICAL ANALYSIS

Statistical Analysis was performed by the Institute of Biostatistics at the Medical Research Council, Tygerberg.

The software package used was Statistical Analysis Systems[52,53] (SAS) and General Linear Models Procedure was performed on the Medical Research Council main frame computer.

The Chi-square test was used to test for associations in categorical data. $p < 0,05$ was taken as statistically significant.

For continuous data the Wilcoxon 2-Sample test was used to test for differences between 2 groups.

Spearman correlation coefficients were used to test for correlations.

RESULTS

POPULATION

Nine hundred and seventeen urban schoolgirls were recruited for the study. Five hundred and fifty two girls were white and 365 were coloured.

Three hundred and eighty eight had reached menarche. There were 253 white and 135 coloured post-menarchal girls.

The social class distribution of the population sample is indicated graphically in Figure 1. Social class distribution is uneven between the two ethnic groups. The social class distribution was dependent on the willingness of parents to allow their daughters to be recruited for the study.

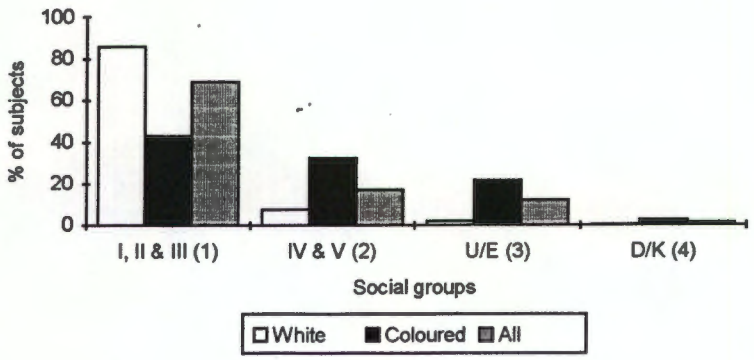

Figure 1: Social class distribution by ethnic groups

The ages of girls studied ranged from 7 to 19 years and all the girls lived in greater Cape Town.

About 15% of all girls were cared for by single mothers (whites 16,4%, coloureds 14,8%). Figure 2 illustrates who the childminders of the subjects are.

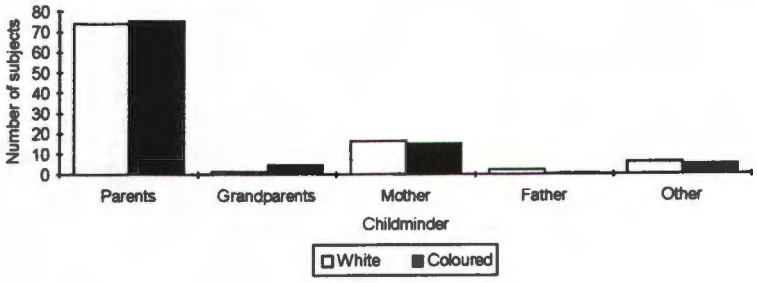

Figure 2: Childminders

About one third of white mothers (31,8%) had achieved a secondary education, whereas only 15,3% of coloured mothers had a secondary education. Less than one percent (0,76%) of white mothers had a primary education, but 26% of coloured mothers had primary education only. (Figure 3).

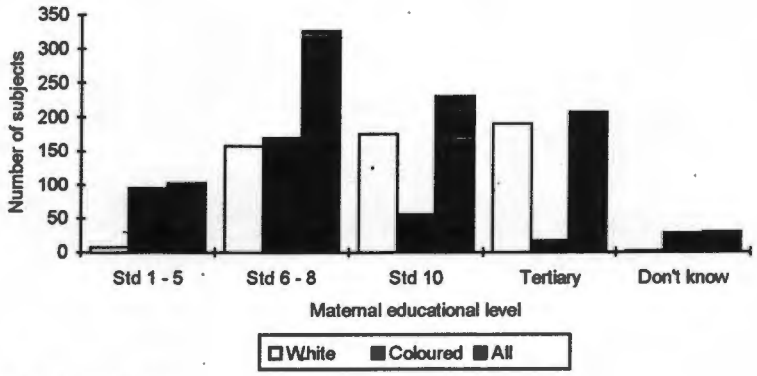

Figure 3: Maternal education

In Figures 4 and 5 the distributions for maternal occupation and paternal education are illustrated, respectively.

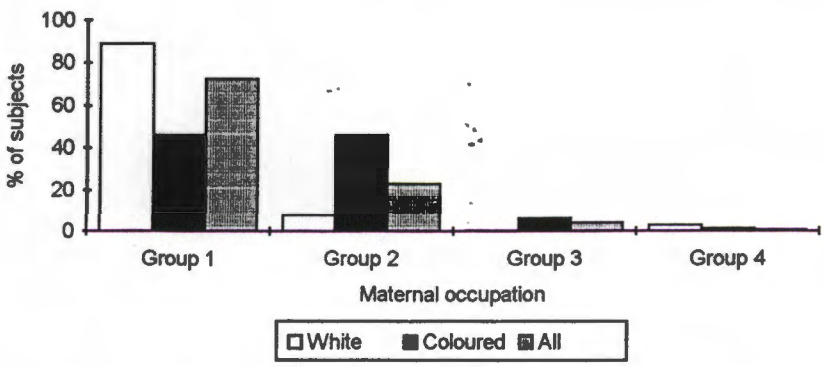

Figure 4: Maternal occupation

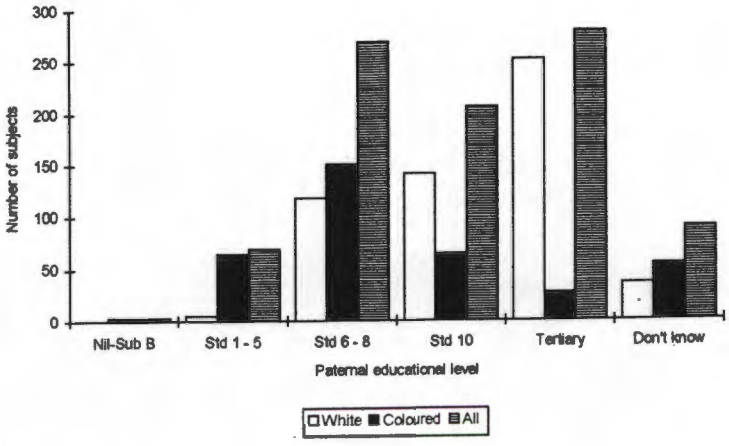

Figure 5: Parental education

White girls had fewer siblings: 91,6% had three or less siblings vs 78,7% of coloured girls. No white girl had more than 6 siblings. The range for number of siblings for coloured girls was 0 to 11. Distribution of number of siblings is shown in Figure 6.

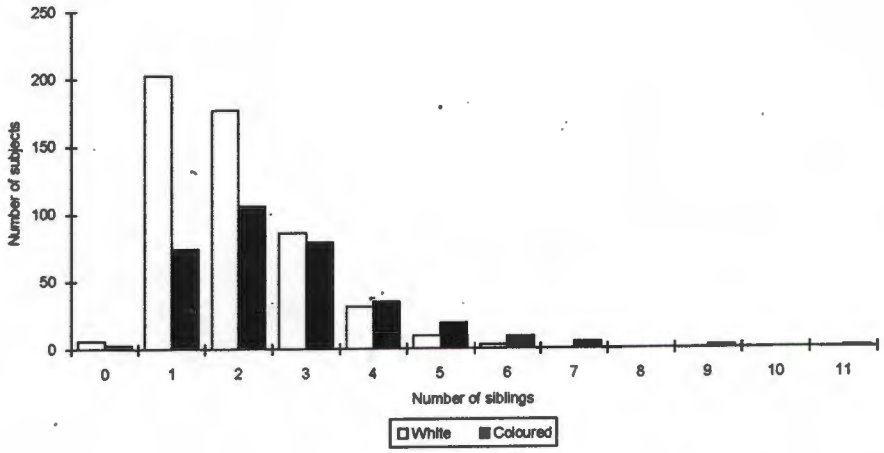

Figure 6: Distribution of sibling number

The mean age of white subjects was 12,95 ±2;76 years and that of coloured subjects was 12,20 ±2,44 years. The spread of ages is indicated by the histogram in Figure 7.

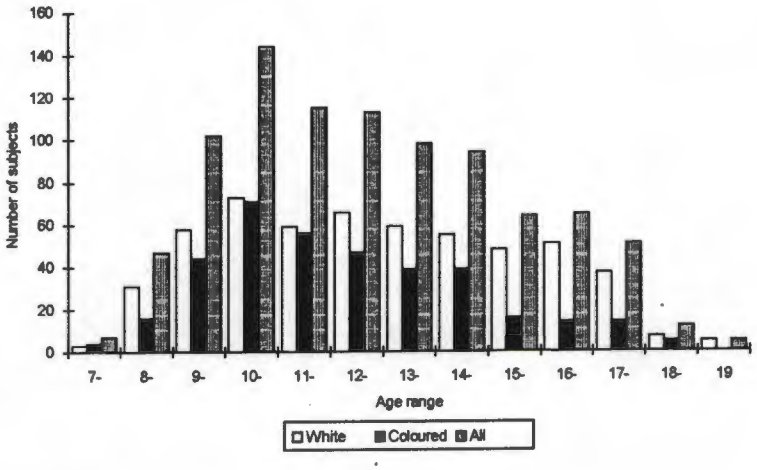

Figure 7: Age distribution

Statistical analysis was not possible for Social groups 3 and 4 in both ethnic groups due to insufficient numbers.

BODY MASS INDEX

Skinfold measurements of the triceps and subscapular regions were measured in 305 subjects. These measurements correlated with body mass index (BMI) as calculated from height and weight measurements (weight (kg)/height $(m)^2$). The subscapular skinfold measurement correlation (Spearman correlation coefficient 0,66953) with BMI was good. Triceps skinfold measurements significantly correlated with BMI (Spearman correlation coefficient 0,37062), but not as well as the subscapular skinfold measurements. It was evident that the less examination there was of the subjects, the more acceptable the study was to the girls and their guardians. Subscapular and triceps skinfold measurements were thus abandoned in favour of the simpler and less time-consuming height and weight measurements.

The mean BMI for all menarchal white girls was 20,82 ±2,86 (median 20,42; range 14,88 - 13,17) and all menarchal coloured girls was 20,70 ±3,53 (median 18,21; range 11,14 - 36,6). There was no statistically significant difference in BMI between white and coloured girls. The mean BMI for all menarchal girls was 20,77 ±3,11.

BMI did not correlate with mean menarchal age. No statistically significant difference in BMI was found between menarchal girls of Social groups 1 and 2.

BMI at all stages of pubertal development for whites and coloureds has been plotted in Figures 8, 9 and 10.

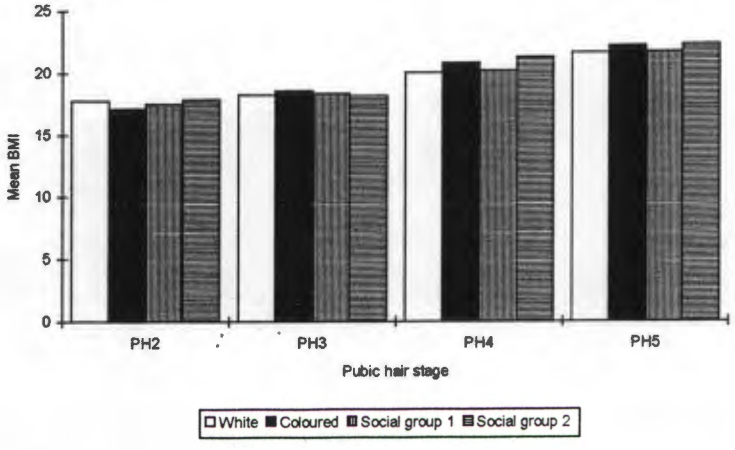

Figure 8: Mean BMI at pubic hair stages

Table VI: Mean BMI at pubic hair stages

Pubic hair stage	White Mean BMI [SD]	Coloured Mean BMI [SD]	Social group 1 Mean BMI [SD]	Social group 2 Mean BMI [SD]
PH2	17,80 [2,68]	17,13 [2,46]	17,53 [2,44]	17,92 [3,11]
PH3	18,30 [2,81]	18,57 [2,81]	18,37 [2,85]	18,13 [2,10]
PH4	20,05 [2,30]	20,84 [3,16]	20,22 [2,54]	21,25 [3,09]
PH5	21,62 [3,09]	22,18 [4,07]	21,68 [3,38]	22,31 [3,73]

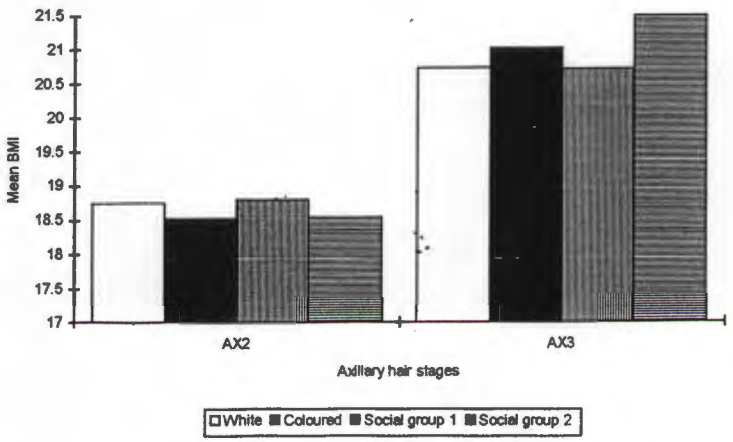

Figure 9: Mean BMI at axillary hair stages

Table VII: Mean BMI at axillary hair stages

Axillary hair stage	White Mean BMI [SD]	Coloured Mean BMI [SD]	Social group 1 Mean BMI [SD]	Social group 2 Mean BMI [SD]
AX2	18,75 [2,44]	18,53 [2,88]	18,81 [2,75]	18,55 [2,66]
AX3	20,73 [2,88]	21,01 [3,82]	20,72 [3,09]	21,49 [3,73]

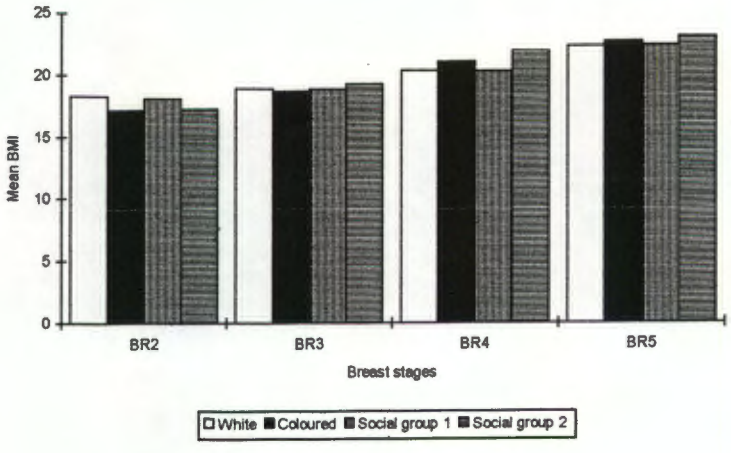

Figure 10: Mean BMI at breast stages

Table VIII: Mean BMI at breast stages

Breast stage	White Mean BMI [SD]	Coloured Mean BMI [SD]	Social group 1 Mean BMI [SD]	Social group 2 Mean BMI [SD]
BR2	18,30* [2,76]	17,14* [2,75]	18,08* [2,88]	17,23* [2,76]
BR3	18,85 [2,27]	18,61 [2,90]	18,79 [2,47]	19,20 [2,60]
BR4	20,30 [2,30]	21,02 [2,98]	20,24 [2,48]	21,87 [2,29]
BR5	22,28 [3,40]	22,62 [4,02]	22,32 [3,51]	23,05 [4,36]

* $p < 0,0001$
* $p < 0,0082$

The mean BMI in breast stage 2 was statistically significantly lower (17,14 ± 2,75; median 16,56; range 13,46 - 30,30) for coloured subjects than whites (18,30 ± 2,76; median 18,03; range 13,88 - 32,04) $p < 0,0001$.

There was a difference in mean BMI in breast stage 2 in Social groups 1 and 2: Social group 1 18,08 ±2,88; Social group 2 17,23 ±2,76. $p < 0,0082$

MEAN AGES OF STAGES OF PUBERTAL DEVELOPMENT

PUBIC HAIR DEVELOPMENT

The mean age of white subjects in pubic hair stage 2 is statistically lower than for coloured subjects: $p < 0,0001$.

The mean age of whites in pubic hair stage 5, however, is significantly higher than that of coloureds ($p < 0,0439$). Because this study is cross-sectional there is no way of knowing when a girl entered a stage and, therefore any stage 5 of puberty is a continuum. For example, if the upper age of recruits was 20 years, then the mean age of stage 5 would increase. Similarly, if the lower age of the study population was 5 years, the mean in any stage 1 of puberty would decrease. This phenomenom of statistical significance was seen in most stages 1 and 5 of pubertal development and for the reasons given will not be reported on for interpretation.

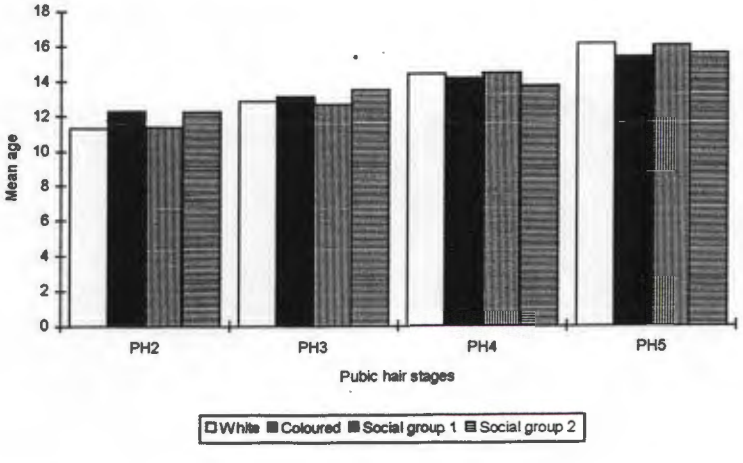

Figure 11: Mean age at pubic hair development

Table IX: Mean age at pubic hair stages

Pubic hair stage	White Mean age [SD]	Coloured Mean age [SD]	Social group 1 Mean age [SD]	Social group 2 Mean age [SD]
PH2	11,33* [1,37]	12,30* [1,07]	11,44# [1,29]	12,27# [1,28]
PH3	12,89 [1,74]	13,13 [1,01]	12,71^ [1,68]	13,54^ [1,79]
PH4	14,45 [1,72]	14,23 [1,12]	14,50+ [1,81]	13,76+ [1,31]
PH5	16,13 [1,42]	15,40 [1,09]	16,03 [1,57]	15,60 [1,90]

White median age PH2 11,13 yrs; Range 8,70 - 15,09 yrs
Coloured median age PH2 12,24 yrs; Range 9,70 - 14,78 yrs
* $p < 00001$
# $p < 0,0059$
^ $p < 0,0071$
+ $p < 0,0288$

There is a difference between the mean ages of pubic hair stage 2 ($p < 0,0059$) in the different Social groups. The girls from Social group 2 were, on average, older in pubic hair stage 2 (Social group 2 12,27 years; Social group 1: 11,44 years). There were statistically significant differences between the Social groups in pubic hair development stages 3 ($p < 0,0071$) and 4 ($p < 0,0288$), as well.

AXILLARY HAIR DEVELOPMENT

The mean age in both ethnic groups in axillary hair stage 2 was 12,73 years. There was statistical significance between coloureds and whites axillary stage 3 ($p < 0,0027$), but the 'open- ended' nature of this stage makes statistical interpretation difficult.

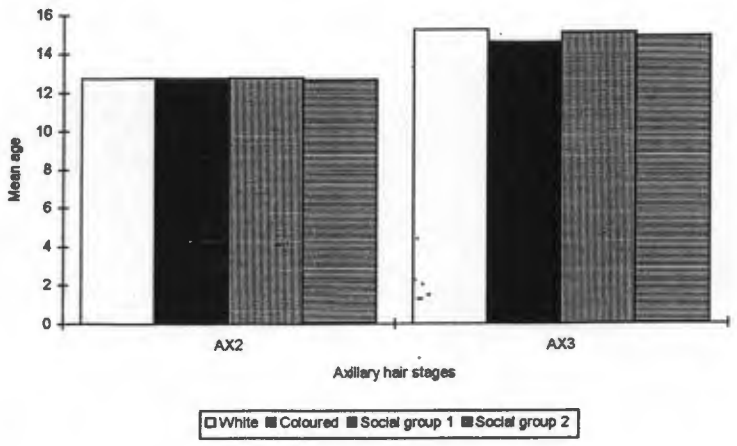

Figure 12: Mean age at axillary hair development

Table X: Mean age at axillary hair stages

Axillary hair stage	White Mean age [SD]	Coloured Mean age [SD]	Social group 1 Mean age [SD]	Social group 2 Mean age [SD]
AX2	12,73 [1,61]	12,73 [1,60]	12,76 [1,78]	12,66 [1,54]
AX3	15,25 [1,76]	14,61 [1,72]	15,10 [1,87]	14,88 [1,81]

BREAST DEVELOPMENT

There was no statistically significant difference in mean ages in all stages of breast development between ethnic groups or between Social groups.

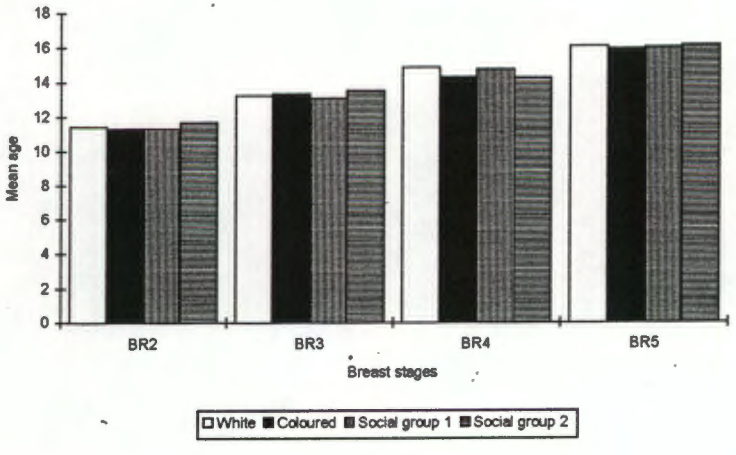

Figure 13: Mean age at breast development

Table XI: Mean age at breast stages

Breast stages	White Mean age [SD]	Coloured Mean age [SD]	Social group 1 Mean age [SD]	Social group 2 Mean age [SD]
BR2	11,44 [1,40]	11,33 [1,23]	11,29 [1,35]	11,66 [1,21]
BR3	13,32 [1,85]	13,32 [1,81]	13,09 [1,88]	13,52 [1,83]
BR4	14,85 [1,84]	14,28 [1,63]	14,75 [1,82]	14,25 [1,69]
BR5	16,07 [1,53]	15,94 [1,73]	16,00 [1,69]	16,14 [1,30]

White median age BR2 11,51 yrs; Range 7,49 - 14,58 yrs
Coloured median age BR2 11,42 yrs; Range 9,07 - 14,80 yrs

MENARCHE

The mean age at menarche for coloured girls (n = 135) is 12,63 years (±1,10 years; median 12,58; minimum 9,83 and maximum 15,50 years). The mean age at menarche

for white girls (n = 246) is slightly higher at 12,94 years (±1,10 years; median 13,00; minimum 10,17 and maximum 16,00 years).
This difference between the age at menarche for coloureds and whites is statistically significant (p < 0,0060).

In social group 1, there is a statistically significant difference between coloureds and whites for age at menarche (p < 0,0045). Coloureds have a lower mean menarchal age than whites.

Table XII: Mean age at menarche in social groups

Social group	White Mean age [SD]	Coloured Mean age [SD]
Group 1	12,92* [1,07]	12,48* [1,21]
Group 2	13,00 [1,23]	12,78 [0,94]

* p < 0,0045

There was no statistical significance between ethnic groups in Social group 2: 13,00 ± 1,23 years; coloureds 12,78 ±0,94 years.

The mean age at menarche for the whole group (whites and coloureds; n = 388) was 12,83 ±1,11 years.

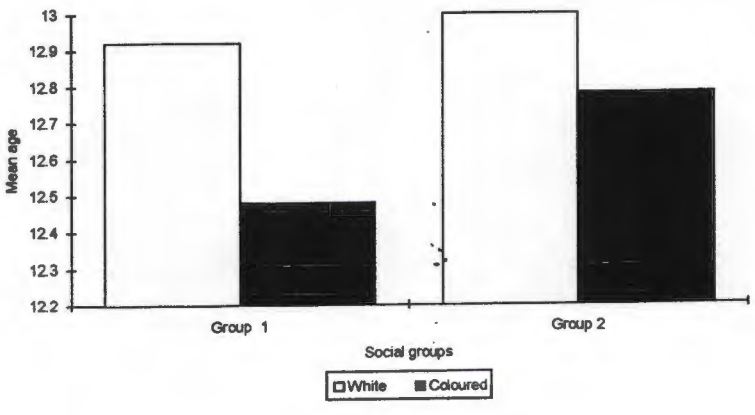

Figure 14: Mean age at menarche

There was a trend towards earlier average menarche in the whole group and in the different ethnic groups (especially in coloured girls), if the mother had a tertiary education, but these differences were not statistically significant. The trends are shown in Figure 15. The data has been tabulated in Table XIII (Figure 15).

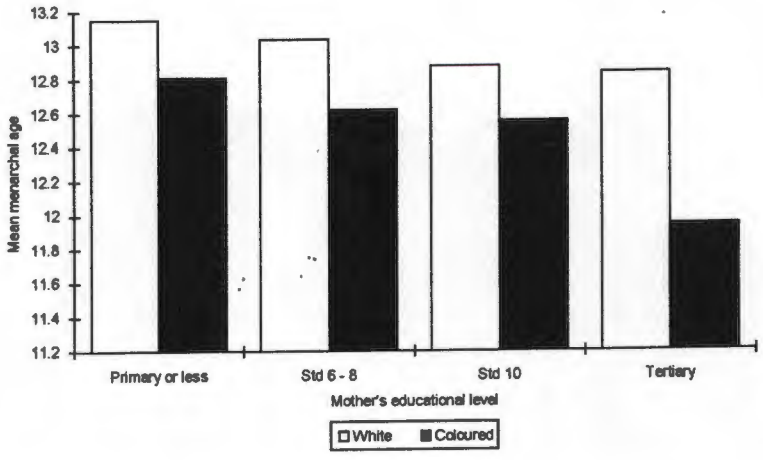

Figure 15: Mean age of menarche and maternal educational level

Table XIII: Mean age of menarche and maternal educational level

Mother's educational level	White Mean age [SD]	Coloured Mean age [SD]
Primary school or less	13,15 [1,16]	12,81 [0,97]
Std 6 - 8	13,03 [1,10]	12,62 [1,13]
Std 10	12,87 [1,09]	12,55 [1,21]
Tertiary	12,83 [1,10]	11,94 [1,16]

Differences in menarchal age were assessed when the child was not cared for by both parents. No statistical difference was found between the nuclear family and other childminders. Results are tabulated in Table XIV.

Table XIV: Mean age at menarche and family size

Number of siblings	White Mean age [SD]	Coloured Mean age [SD]
3 or less	12,94* [1,12]	12,62* [1,01]
> 3	13,20 [0,92]	12,93 [1,22]

White median menarchal age (3 or less siblings) 13,00; Range 10,17 - 16,00 yrs
Coloured median menarchal age (3 or less siblings) 12,58; Range 9,83 - 15,50 yrs
* $p < 0,0125$

There was a statistically significant difference between the menarchal age of white and coloured girls from smaller families ($p < 0,0125$). A coloured girl with three or less siblings had an earlier mean menarchal age (12,62 ±1,01 years) than her white peers (12,94 ±1,12 years).

SUMMARY OF RESULTS

Table XV: The mean age [SD] at each stage of puberty for whites, coloureds and for each social group. (BR = breast stage; PH = pubic hair stage; AX = Axillary hair stage)

			All girls	
Stage	**White**	**Coloured**	**Social group 1**	**Social group 2**
BR2	11,44 [1,40]	11,33 [1,23]	11,29 [1,35]	11,66 [1,21]
PH2	11,33 * [1,37]	12,33* [1,07]	11,44* [1,29]	12,27* [1,28]
AX2	02,73 [1,61]	12,73 [1,60]	12,76 [1,78]	12,66 [1,54]
BR3	13,32 [1,85]	13,32 [1,85]	13,09 [1,88]	13,52 [1,83]
PH3	12,89 [1,75]	13,13 [1,01]	12,71* [1,68]	13,54* [1,79]
BR4	14,85 [1,84]	14,28 [1,63]	14,75 [1,82]	14,25 [1,69]
PH4	14,45 [1,75]	14,23 [1,12]	14,50* [1,81]	13,76* [1,31]
AX3	15,25 [1,76]	14,61 [1,72]	15,10 [1,87]	14,88 [1,81]
BR5	16,07 [1,53]	15,94 [1,73]	16,00 [1,69]	16,14 [1,30]
PH5	16,13 [1,42]	15,40 [1,09]	16,03 [1,57]	15,60 [1,90]

Table XVI: Mean Menarchal age

	Mean age [SD]	**Median Age**
Coloured	12,63* [1,10]	12,58*
White	12,94* [1,10]	13,00*
Social group 1	12,81 [1,12]	
Social group 2	12,86 [1,05]	

1. There is a statistically significant difference between the mean age at menarche for coloureds and whites ($p < 0,0060$). White girls have a mean menarchal age of 12,94 ±1,10 years (median 13,00 years; range 10,17 - 16,00 years). Coloured girls have earlier mean menarchal age of 12,63 ±1,10 years (median 12,58 years; range 10,17 - 14,83 years).

2. In social group 1, the higher socio-economic group, there is a statistically significant difference between coloureds and whites for age at menarche ($p < 0,0045$): coloured girls 12,48 ±1,10 years; white girls 12,92 ±1,07 years.

3. Coloured girls from smaller families, on average, have a menarchal age (12,62 ± 1,01 years; median age 12,58; range 9,83 - 15,50) which is lower than white girls from similar families (12,94 ± 1,12 years; median age 13,00; range 10,17 - 16,00). $p < 0,0125$

4. Although not statistically significant, there are trends to earlier menarche when maternal educational level is highest, family size is smaller (irrespective of the difference seen between coloureds and whites) and the child is cared for by both its parents.

5. Body mass index in the girls studied does not correlate with onset of menarche.

6. The mean body mass index in breast stage 2 is statistically significantly lower (17,44 ± 2,75; median 16,56; range 13,46 - 30,30) for coloureds than for whites (18,30 ±2,76; median 18,03; range 13,88 - 32,04). $p < 0,0001$

7. The mean body mass index in breast stage 2 is statistically significantly lower (17,23 ±2,76) in Social group 2 than Social group 1 (18,08 ±2,88). $p < 0,0082$.

8. Statistically significant differences were found between ethnic groups and socio-economic groups in stages of pubic hair development. White girls had a lower mean age in pubic hair stage 2 ($p < 0,0001$) than coloured girls. In pubic hair stage 2 Social group 1 subjects were, on average, younger than Social group 2 subjects ($p < 0,0059$). For later stages of pubic hair development, PH3 and PH4, Social group 1 subjects had statistically higher mean ages ($p < 0,0071$; $p < 0,0288$, respectively).

9. There were no statistically significant differences between ethnic groups or Social groups in all stages of breast development, although there was a trend towards higher mean age in breast stages 2 and 3 in Social group 2.

DISCUSSION

There were unexpected problems encountered in this study. Two different education authorities exist for the two ethnic groups studied. Despite stringent conditions regarding confidentiality and sensitivity toward subjects, the Department of Education (education authority for whites) readily consented to the performance of the study. However, the same could not be said about the Department of Education and Culture (education authority for coloureds). After considerable difficulty in ascertaining who had authority in this department to grant consent for access to schools, subsequent correspondence regarding this matter spanned a period of eighteen months before consent to enter coloured schools was obtained. Up to this point all coloured girls included in the study were scholars at traditionally white or private schools.

Identities of schools participating cannot be revealed so as to protect identity of participants. This is in compliance with one of the conditions set by education authorities.

Recruitment of subjects was dependent on parental consent and the ultimate social class distribution was a result thereof. Parents of girls in Social Group 1 appeared to be more favourably disposed toward academic research, whereas Social Group 2 and 3 parents tended to be suspicious of the motives of the researchers. The social class distribution difference between coloureds and whites is representative of the general social class distribution of these two ethnic groups in the Cape Town area.

Parental concerns included:

- the fear of psychological **and** physical trauma inflicted on their daughters
- whether the researchers were investigating sexual abuse incidence or cases in various schools
- whether they themselves, and their marital harmony, were being investigated
- whether sexual activity by their daughters was being investigated

School principals and staff raised similar concerns, including the concern about underlying political motives concerning race, class, sexual education, contraception and population regulation.

The potential for sample bias was appreciated. The researchers had no control over the selection of schools of the Department of Education as a list of schools where access would be allowed was provided. A second factor was the enthusiasm (or lack thereof) of individual heads of schools with respect to subject recruitment. Researchers were dependent on the principals to distribute and retrieve consent forms from the parents. Heads of schools also chose the classes from which girls were selected.

There were a number of withdrawals from the study. Withdrawal from the study occurred when parents withdrew their initially given consent, because they had indicated that they would like to be present during the examination of their daughters and were then unable to come to the school on the day of the study. We did not find that parents whose daughters were relatively immature to be more protective and concerned about the proposed examination. In fact, the opposite was found. Parents were also aware that the researchers were critically screening for pubertal developmental abnormalities and would inform them and ensure appropriate referral to health services.

We were overwhelmed with immature recruits and the number of these subjects were curtailed.

The number of subjects assumed to be recruited decreased on the day of examination due to a degree of "pre-publicity mis-information" at one school. Pupils at this scool, not recruited for the study spread the rumour that "they stick objects into your vagina". Those subjects who participated in the study were remarkably unperturbed by the performance of the study, the older girls often asking about their development and seeking reassurance about normality.

On occasion time constraints imposed by the length of time available during school hours (for example, during the physical education period) resulted in logistic difficulties

in the performance of this study. This is one of the reasons why skinfold measurements, which showed good correlation with body mass index, were abandoned. The second reason was the need to minimise the length and extent of physical examination of the girls as requested by the education authorities and school principals.

Age of onset of pubertal development serves as an important index of socio-economic status and provides important information about when reproductive competency is reached within communities. Socio-economic well-being is dependent on numerous variables and as an entity cannot be defined. Variables identified include nutrition, social class, family size, level of parental education and access to health service infra-structure which offer preventative and curative services. The last variable may act independent of social class, as seen in European countries. This is exemplified by the Scandinavian countries where the differences in socio-economic factors are small resulting in a mean age at menarche which is virtually the same for all socio-economic groups.[27,28]

We have shown that for urban school girls in Cape Town the various stages of pubertal development occur at similar ages as girls from developed countries. In 1969 Marshall and Tanner reported on the mean ages of the onset of breast and pubic hair development, and menarche.[4] Our results are listed for comparison with the data from the United Kingdom in Table XVII. The study population in the 1969 study was not representative of the British population as "most of them had poor socio-economic backgrounds", but "nevertheless, in excellent physical health, well fed, and their growth and stature within normal limits." In this study they comment that the girls in their study reached menarche, on average, 4 months later than the population of London.[4] The trend to lower menarchal age has, however, stabilised in the United Kingdom and no further change has been observed.[47]

Table XVII: United Kingdom data[4] listed for comparison

Stage	United Kingdom	White	Coloured
BR2	11,50 [1,10]	11,44 [1,40]	11,33 [1,23]
PH2	11,64 [1,21]	11,33 [1,37]	12,33 [1,07]
BR3	12,15 [1,09]	13,32 [1,85]	13,32 [1,85]
PH3	12,36 [1,10]	12,89 [1,75]	13,13 [1,01]
BR4	12,95 [1,06]	14,85 [1,84]	14,28 [1,63]
PH4	13,11 [1,15]	14,45 [1,75]	14,23 [1,12]
Menarche	13,47 [1,12]	12,94 [1,10]	12,63 [1,10]
BR5	14,41 [1,21]	16,07 [1,53]	15,94 [1,73]
PH5	15,33 [1,74]	16,13 [1,42]	15,40 [1,09]

We have in this study documented the mean age of each stage of axillary hair development and have found no statistically significant differences or trends between coloureds and whites or between social groups 1 and 4. This is keeping with findings of Wright *et al*[24].

A paucity of data exists on axillary hair development. Our data reveals a mean age for axillary hair stage 2 of 12,73 ±1,61 and ±1,76 years for white girls and coloured girls respectively. This compares favourably with the results found by Chaning-Pearce and Solomon[22] who reported a mean age of 12,2 ±1,4 years for whites and a mean age of 12,3 ±1,2 years for blacks at the same stage of axillary hair development. The population studied by these researchers was in urban Johannesburg in 1976 and 1977.

Chaning-Pearce and Solomon, found that blacks developed pubic hair later than their white peers.[22] In our study there was a significant difference between the mean ages of pubic hair stages 2 between coloureds and whites, whites having lower mean ages for pubic hair stage 2. This difference was also found between Social groups 1 and 2. Social group 1 subjects had a lower mean age in pubic hair stage 2 than Social group 2 subjects. These differences may suggest an ethnic as well as a social class difference. While a racial difference can be explained on genetic grounds, adrenarche, being oestrogen independent, is difficult to explain based on social class.

Our hypothesis that social class will be a major determinant of pubertal development has not been borne out for all stages of puberty in our study. The reasons for this may

lie in the fact that the sample of girls studied were a select group of girls who had access to formal education and, therefore, probably had better access to other resources like adequate food and medical care. Another factor may be that the differential between classes is smallest in urban settings. Children who are not attending schools are difficult to access, but when studied, may provide different results to that found in this study.

More difficult to account for is the ethnic statistically significant difference between onset of menarche for white and coloured school girls. One explanation may be the smaller number of coloured school girls who participated in the study. If more coloured subjects had been recruited, this ethnic difference could possibly disappear. Race as an important determinant of onset of pubertal development has largely been refuted on the basis that if racial differences do exist, the overall contribution to the timing of puberty is likely to be small one. The differences would be obscured by nutritional differences and differences in other health factors.[11,47,54,55] It is difficult to believe that race *per se* is the factor contributing to earlier onset of puberty in coloured girls as this ethnic group is not homogeneous, being a mixed race. Within the Western Cape region, where most coloured people live, there has been rapid improvement in socio-economic conditions and urbanisation relative to other areas in South Africa where people have historically been disadvantaged. The emergence of a larger sector of the coloured community forming part of middle income groups may account for the conditions necessary to result in the reported low menarchal age. Coloured girls in the study tended to be lighter than the white girls and did not have increased body mass and, therefore, increased percentage body fat. An opposite finding may have supported the Frisch hypothesis and help explain the earlier mean menarchal age found in coloured girls.

A statistically significant difference was also found between coloureds and whites in social group 1, as it was found between the ethnic groups in the whole sample.

The lack of difference in the mean menarchal age found between Social group 1 and Social group 2 girls probably reflects the decreasing disparity between the access these 2 groups have to basic nutrition and medical care in urban areas.

The degree of social disadvantage between Social groups 1 and 2 is becoming less pronounced and is thus in keeping with similar trends in developed countries where class differences have no or minimal impact on pubertal development, provided social infra-structure is adequate.

Although there were no statistically significant differences found in onset of puberty between social groups, there was a slight trends toward earlier development in the higher social groups. The indirect indicators of socio-economic status (maternal education and family size) revealed the most obvious trends. Scott[56] in 1961 reported later puberty for girls who hailed from large families in the London County district.

Increasing literacy among women not only has the effect of personal empowerment for the individual women, but may have profound impact on the general health of communities.

Body mass index, as an index of nutrition, did not correlate with mean menarchal age, but in breast stage 2 there were statistically significant differences between coloureds and whites, as well as between Social group 1 and 2. The more socio-economically advantaged children presumably would be better nourished and, therefore, be more likely to enter oestrogen dependent breast development earlier than those in Social group 2.

The most accurate information regarding puberty is obtained by longitudinal studies. If a cross-sectional study is performed, as in this case, larger numbers of subjects are needed for statistical significance. A cross-sectional design for this study was decided on due to the difficulty of longitudinal follow-up and the difficulty of gaining repeated access to schools. It was found in this study that subjects were easier to recruit in the younger age groups, perhaps because parents and school teachers thought that it would have less psychological impact on the girls studied. Adolescents more readily withdrew themselves from the study.

At the commencement of this study the researchers did not appreciate the difficulties that would be encountered in gaining access to schools and the recruitment of subjects. A study of this nature has certain time constraints in order for the data to

remain relevant. Ideally more coloured schoolgirls should have been included in the study. After four personal visits to the Department of Education and Culture to gain access to the appropriate persons who should be approached for consent to enter coloured schools, it became clear that recruitment was going to be a major stumbling block to the timeous completion of the study. Recruitment problems at coloured schools were further compounded by the perception that this study had a hidden political agenda based on race. Often we were not able to allay fears expressed by school principals, staff and parents in this regard.

The social class distribution of whites and coloureds is also skewed. Also with in the white group as a whole, there were more Social group 1 subjects. It was extremely difficult to find greater numbers of social group 2 white subjects for three reasons. The first was an obvious reluctance by school principals, staff and parents of this group to subject these girls to questioning and examination. The second reason relates to the actual social class distribution of white schoolgirls in the Western Cape with most white schoolgirls enjoying higher socio-economic advantage. The final reason for the preponderance of social group 1 white schoolgirls in the study is the access to schools allowed by the Department of Education. We were provided with a list of schools we were allowed to visit. This appeared to be representative of the social groups we aimed to target for the study, but, as mentioned earlier, recruitment at Department of Education schools in lower socio-economic areas was considerably lower than at schools situated in more privileged areas.

It may be useful in the future to include pubertal dating in the routine medical examinations performed at schools by the state as an easier method of gaining information about puberty as a health indicator.

Seventy five percent of girls live with both their parents and the rest are cared for by single parents, grandparents, siblings or in institutions. Childminders other than both parents do not adversely influence the onset of puberty in the population sample.

It is known from studies in developed countries that the age at onset of puberty decreases as differences between socio-economic groups equalise. Absence of chronic malnutrition and disease also contributes to the health of communities. The

results of this study supports the findings in Europe of decreasing age at onset of puberty as socio-economic improvement occurs.

CONCLUSIONS

In the Western Cape coloured and white girls enter puberty at similar ages to girls in Western developed countries. Stage for stage of pubertal development the group studied still displayed a general trend to higher mean ages than their United Kingdom counterparts in 1969, except for mean menarchal age.

Coloured girls as a group, as well as those from smaller families and in higher socio-economic groups (Social group 1) have an earlier onset of menarche when compared to white girls and other Social groups.

These are among the lowest mean ages for menarche reported in this country (Table I) and is supportive evidence of a secular trend within South Africa, with rural-urban, inter-race and inter-regional gradients reflecting current socio-economic conditions.

It is pleasing to report that there appears to be a narrowing of the gap between the difference in general well-being of other coloured and white school girls in Cape Town, but this should not allow for a complacent attitude, especially when compared to the known data for other areas in South Africa.

It is imperative that health service provision should be made for the needs of young women who are achieving sexual maturity so young.

Regular assessment of the secular trend in pubertal development should be made in South Africa to serve as an index of general population well-being or lack thereof.

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APPENDICES

Appendix 1: Example of consent form signed by legal guardians of subjects, with accompanying letter.

Appendix 2: Example of questionnaire used to obtain data at time of examining each subject.

UNIVERSITY OF CAPE TOWN

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Gynaecological Oncology and Colposcopy
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Dear Patient

The Department of Obstetrics & Gynaecology, of the University of Cape Town Medical School is conducting a study of the health and development of children and adolescents. Our aim is to assess what is needed to ensure the best conditions for the physical development of young people.

This study involves your child being examined on her school premises by qualified medical personnel. The examination consists only of taking measurements of the body namely height and weight and checking physical development. There is no gynaecological examination and no part of the examination can be harmful in any way to your child. No samples (such as blood or urine) are taken. The examination is provided free of charge and consent to allow your child to be examined does not result in any obligation to anyone on your part. If, in the course of our assessment, we detect any individual health problems we shall, of course notify you. All the findings of this study are completely confidential.

We should appreciate it a great deal if you would agree to your daughter participating in this study. Please indicate your consent to having her examined by signing in the space provided below and returning this form to her school. Should you wish to be present at the examination please indicate this below. In addition if you have consented to her taking part in this study we should appreciate it if you would supply us with the information requested at the back of this letter.

Thank you for your co-operation.

Yours sincerely

ZEPHNE M. VAN DER SPUY PhD, MBChB, MRCOG
PROJECT CO-ORDINATOR/ASSOCIATE PROFESSOR

I ..... do not object to my

daughter ..... being examined by the personnel of the Department of Obstetrics & Gynaecology of the University of Cape Town Medical School.

I *do / *do not wish to be present at the examination. (*Delete where applicable)

If you agree to your daughter participating in this study, please would you supply the following information:

1. **Daughter's Name:** .....

2. **Date of Birth:** .....

3. **Father:**

   - Highest education standard passed: .....
     (including secondary or tertiary education)

   - Father's occupation: .....

4. **Mother:**

   - Highest education standard passed: .....
     (including secondary or tertiary education)

   - Mother's occupation: .....

THANK YOU FOR YOUR HELP

PUBERTY STUDY

Case Number [ ][ ][ ] 3

Name [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] 23

School [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] 23

Area [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] 23

Date (ddmmyy) [ ][ ][ ][ ][ ][ ] 29

Date of Birth (ddmmyy) [ ][ ][ ][ ][ ][ ] 35

Age Years [ ][ ] 39

Months [ ][ ] 39

Race

Black	1	Coloured	2	Asian	3	White	4

40

Father's Education

Nil	1	Sub A & B	2
Std 1 - 5	3	Std 6 - 8	4
Std 10	5	Tertiary 6 - 8	6
Don't know	7		

[ ] 41

Father's Occupation

Social Class	1 - 5	Don't know	6
Unemployed	7	Father unknown	8
Non-Supporting	9		

Specify .....

[ ] 42

Mother's Education

Nil	1	Sub A & B	2
Std 1 - 5	3	Std 6 - 8	4
Std 10	5	Tertiary 6 - 8	6
Don't know	7		

[ ] 43

Mother's Occupation

Social Class	1 - 5	Don't know	6
Unemployed	7	Mother unknown	8
Non-Supporting	9		

Specify .....

[ ] 44

Child Minder

Parents	1	Single mother	2
Single father	3	Grandparent	8

Sibling specify .....

Institution specify .....

Other specify .....

[ ] 45

umber of sibilings older than subject [ ][ ] 47

umber of siblings younger than subject [ ][ ] 49

umber of siblings alive excluding subject (don't know = 99) [ ][ ] 51

ge of oldest sibling [ ][ ] 53

ge of youngest sibling [ ][ ] 55

chool Standard | Sub A | 1 | Matric | 12 | [ ][ ] 57

[ ] 58

Rural	1	Urban	2

Examination

Height (cm) [ ][ ][ ] 61

Weight (kg) [ ][ ] 63

BMI x 10 $\frac{\text{Wt (kg)}}{\text{Ht (m)}^2}$ [ ][ ][ ] 66

Breasts Tanner Stage 1 - 5 [ ] 67

Pubic Hair Tanner Stage 1 - 5 [ ] 68

Axillary Hair Tanner Stage 1 - 5 [ ] 69

Menarche Age Years [ ][ ] 71

Months [ ][ ] 73

Skin Fold Triceps [ ][ ][ ] 76

Subscapular [ ][ ][ ] 79