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## **Age at menarche and the evidence for a positive secular trend in urban South Africa**

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## ABSTRACT

Menarcheal age was estimated for 287 (188 Black; 99 White) urban South African girls born in Soweto-Johannesburg in 1990. The median menarcheal age for Blacks was 12.4 years (95% confidence interval [CI] 12.2, 12.6) and 12.5 years (95% CI 11.7, 13.3) for Whites. Data from six studies of menarcheal age, including the current study, were analyzed to examine the evidence for a secular trend between 1956 and 2004 in urban South African girls. There was evidence of a statistically significant secular trend for Blacks, but not Whites. Average menarcheal age for Blacks decreased from 14.9 years (95% CI 14.8, 15.0) in 1956 to 12.4 years (95% CI 12.2, 12.6) in the current study, an average decline of 0.50 years per decade. Fewer data were available for Whites, but average menarcheal age decreased from 13.1 years (95% CI 13.0, 13.2) in 1977 to 12.5 years (95% CI 11.7, 13.3) in the current study, an average decline of 0.22 years per decade. The diminishing age at menarche and the current lack of difference between Blacks and Whites is probably reflective of the continuing nutritional and socio-economic transition occurring within South Africa.

## INTRODUCTION

Menarcheal age is a key maturity indicator of female development and reflects population health. Knowledge of the timing of menarche is important as early pubertal development, in particular, has been linked with an increased risk of negative sequelae (e.g., Anderson et al., 2003; Siervogel et al., 2003; Mendle et al., 2007). Table 1 provides a summary of the previous studies of menarcheal age in Black and White girls born in Soweto-Johannesburg. Menarcheal age estimates from these studies were between 14.9 years (95% CI 14.8, 15.0) in 1956 (Oettle and Higginson, 1961) and 13.0 years (95% CI 12.7, 13.3) in 2003 (Norris and Richter, 2005).

## TABLE ONE NEAR HERE

Contemporary estimates of menarcheal age in urban South African girls are important to help understand the transitioning nature of the South African society in recent decades. Estimating average menarcheal age and examining how it has changed over time may help to gauge recent changes in health and well-being in South Africa. This article therefore aims to determine current menarcheal age for urban Black and White South African girls and to examine the evidence for a secular trend between 1956 and 2004.

## SUBJECTS AND METHODS

Menarcheal ages were available for a total of 287 girls (188 Black; 99 White), who were part of the Bone Health (BH) sub-sample of the Birth-to-Twenty (Bt20) birth cohort set in Soweto-Johannesburg, South Africa (Richter et al., 2007). *Status quo*

methods were used to assess menarcheal age through annual self-complete questionnaires between 9.0 and 14.9 years of age. The adolescents and their caregivers provided written informed consent and ethical approval was obtained from the University of the Witwatersrand Committee for Research on Human Subjects.

All data analyses were undertaken using SPSS version 15.0 (Chicago, IL). Data from the current study were collected in categorical yearly age group bands and cumulative percentage plots constructed. Median menarcheal age was derived by fitting logistic curves to these plots. Equation 1 was used to fit the logistic model and Equation 2 was used to derive achievement percentiles:

$$y = 1/(1/u + (b_0 * (b_1 t))) \quad (1)$$

$$t = \ln((1/y - 1/u)/b_0) / \ln b_1 \quad (2)$$

where  $y$  = % achieved,  $u$  = upper boundary (100%),  $b_0$  =  $b$  coefficient,  $b_1$  =  $b$  constant and  $t$  = age (years).

In addition to data from the current study, menarcheal age estimates from five previous studies in Soweto-Johannesburg (Oettle and Higginson, 1961; Frere, 1971; Chaning-Pearce and Solomon, 1987; Cameron and Wright, 1990; Norris and Richter, 2005) were used to investigate the evidence for a secular trend in menarcheal age between 1956 and 2004. Ninety-five percent confidence intervals (95% CI) were calculated from median and standard error or mean and standard deviation measures provided in previous studies.

## RESULTS

Median menarcheal age derived from the logistic curves was 12.4 years (95% CI 12.2, 12.6) for Blacks and 12.5 years (95% CI 11.7, 13.3) for Whites. Figure 1 shows average menarcheal age of Black and White urban South African girls from the Soweto-Johannesburg area between 1956 and 2004. These data show evidence for a statistically significant secular trend towards earlier menarche in Black, but not White girls. Average menarcheal age for Black girls declined from 14.9 years (95% CI 14.8, 15.0) in 1956, to 13.9 years (95% CI 13.8, 14.0) in 1977, to 12.4 years (95% CI 12.2, 12.6) in the current study (average decline = 0.50 years per decade). There were relatively fewer data available for White girls, and there was a non-significant menarcheal age decline from 13.1 years (95% CI 13.0, 13.2) in 1977 to 12.5 years (95% CI 11.7, 13.3) in the current study (average decline = 0.22 years per decade).

## FIGURE 1 NEAR HERE

## DISCUSSION

Median menarcheal age for Blacks was 12.4 years (95% CI 12.2, 12.6) and 12.5 years (95% CI 11.7, 13.3) for Whites. These ages were significantly younger for Blacks than any other previous South African study of menarcheal age. The most recent papers (since 1990) reported mean ages of 13.0 years (95% CI 12.7, 13.3) (Norris and Richter, 2005) and 13.2 years (95% CI 13.0, 13.4) (Cameron and Wright, 1990) for urban Black girls. A previous study of urban White girls reported a mean age of 13.1 years (95% CI 12.9, 13.3) (Channing-Pearce and Solomon, 1987).

The results from this study indicate that there is evidence for a statistically significant secular trend in menarcheal age in Black, but not White, urban South

African girls. The decline has been more pronounced for Blacks (0.50 years per decade) compared to Whites (0.22 years per decade). In a study examining menarcheal age of urban Black South African girls between 1960 and 1990, Cameron et al. (1991) reported a rate of decline of 0.73 years per decade. Although the rate of decline has slowed in recent years, South Africa is continuing to show a rapid decline in menarcheal age. In addition to the socio-economic transition influencing the timing of menarche, it is possible to hypothesize that the positive secular trend in menarcheal age within South Africa could be partly due to the rising levels of overweight and obesity. In contrast to reports from developed countries where Blacks were in advance of Whites (e.g., Kaplowitz et al., 2001; Sun et al., 2002; Anderson et al., 2003), Black and White urban South African girls achieved menarche at similar ages.

The interpretation of secular trends is difficult, particularly as geographical location, SES, methodologies and sampling techniques vary between studies. Furthermore, whilst the evidence for a secular trend is based on the assumption of a linear trend, the relationship may actually be curvilinear as there may be a lower limit to which menarcheal age can fall. This is evident in developed countries where a plateau in menarcheal age appears to have been reached (Viner, 2002; Chumlea et al., 2003). Whilst menarcheal age is continuing to show a decline in South Africa, the decrease seen between the 2003 and 2004 studies (13.0 to 12.4 years) may suggest that the relationship is in fact curvilinear as opposed to linear for urban Black girls.

## CONCLUSIONS

Median menarcheal age was 12.4 years (95% CI 12.2, 12.6) for Blacks and 12.5 years (95% CI 11.7, 13.3) for Whites. Unlike findings from some developed countries

there was no statistically significant difference in menarcheal age between the two ethnic groups within this study. There is evidence for a statistically significant positive secular trend of declining menarcheal age in Black, but not White, girls in the BH cohort. The average decline in menarcheal age was 0.50 and 0.22 years per decade for Black and White girls respectively. This suggests that urban girls in South Africa are continuing to show a decline in menarcheal age and as yet, have not experienced the plateau seen in some developed countries. This implies that environmental factors such as SES and nutrition continue to influence this biological process in South Africa, whereas in developed countries these environmental factors may have less influence and a lower limit of menarcheal age may have been reached.

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TABLE 1. Estimates of menarcheal age (95% confidence interval) for urban Black and White girls born in the Soweto-Johannesburg area

Reference	Year of data collection	Sample size	Age of participants (Years)	Socio-economic status	Ethnic group	Average age ( <sup>†</sup> denotes median) at menarche (95% confidence interval)
Oettle and Higginson (1961)	1955-56	1002			Black	14.9 (14.8, 15.0)
Frere (1971)	1964	3150		Middle	Black	14.8 <sup>†</sup> (14.7, 14.9)
Chaning-Pearce and Solomon (1987)	1976-77	355	3.5-18.5		Black	13.9 (13.8, 14.0)
		362			White	13.1 (13.0, 13.2)
Cameron and Wright (1990)	1988	148	6.0-19.0	High	Black	13.2 (13.0, 13.4)
Norris and Richter (2005)	2003	90	10.0-18.0	Low/Mid	Black	13.0 (12.7, 13.3)

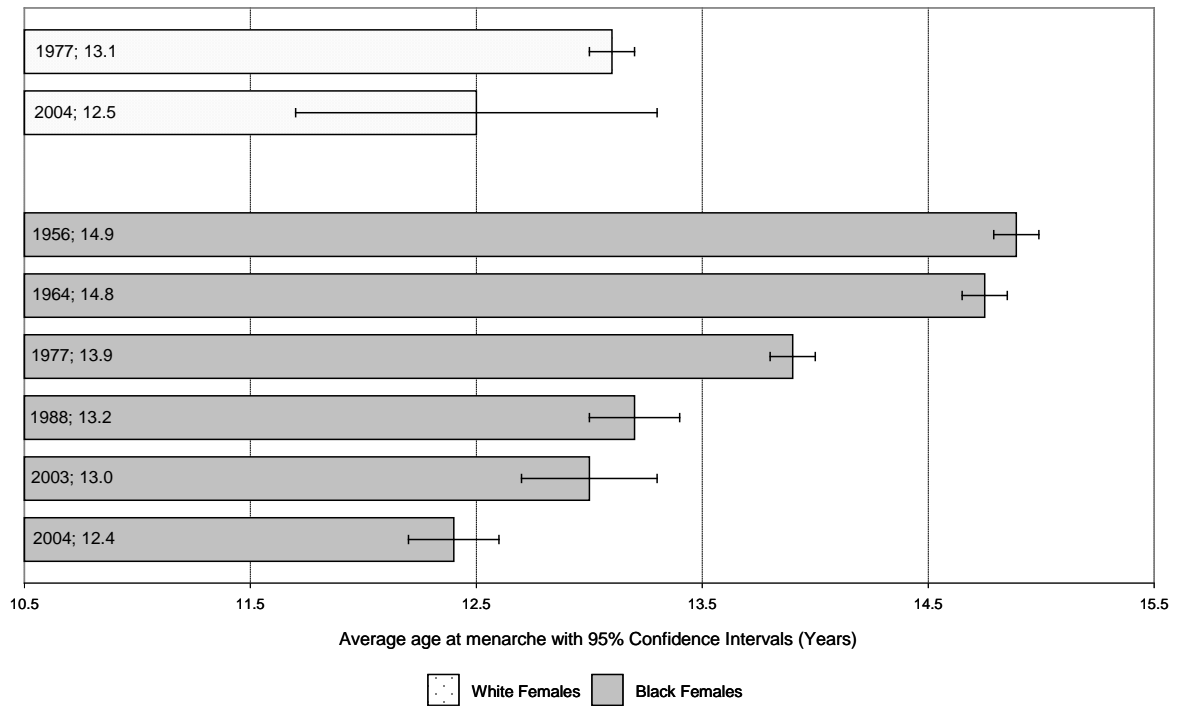


Fig. 1. Average menarcheal age (95% confidence intervals) for White and Black urban South African girls between 1956 and 2004.