

## **Secondary sexual characteristics of stunted and non-stunted black South African boys living in a township in the North West Province**

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### **Abstract**

It is known that sexual maturation is dependent on genetic and environmental factors and socio-economic status. The purpose of this study was to describe secondary sexual characteristics of stunted and non-stunted black South African boys from a low socio-economic status living in a township in the North West Province. A total of 129 boys aged 12 to 16 years participated in the study. Height and weight were measured according to the standard protocol suggested by the International Society of Kinanthropometry, and secondary sexual maturation on voice changes, pubic hair and genital stage development were assessed by Tanner stage questionnaire. The results show an increasing height and weight with age among the boys. Furthermore, the results show that the non-stunted boys reached pubertal development earlier than the stunted boys, which starts first with sign of voice breaking at age 13.04(SD2.90) years followed by pubic hair and genital development. In conclusion, the boys were at a less developed pubertal stage compared to boys of a similar age in other studies and stunted boys tended to be at an even earlier development stage than non-stunted boys of a similar age.

**Keywords:** Secondary sexual characteristics, Tanner stage, voice development, adolescent stage, stunted and non-stunted black South African boys.

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## Introduction

Sexual maturation is a continuous process that extends from sexual differentiation in the period of the embryo through puberty to full sexual maturity and fertility (Malina, Bouchard & Bar-Or, 2004). Puberty is a dynamic period of development marked by rapid changes in body size, shape and body composition, all of which are sexually dimorphic (Marshall & Tanner, 1970; Tanner et al., 1976). During puberty, changing hormonal levels play a role in activating the development of secondary sex characteristics such as pubic hair growth, voice changes and facial hair growth (Malina *et al.*, 2004). The maturation of human voice as a function of age is characterized by changes in pitch of speech or speaking fundamental frequency, and it is often used as an indicator of voice activity (Pederson, Moller, Krabbe & Bennett, 1986). The maximum change in the male voice takes place at puberty (Vuorenskoski, Lenko, Tjerlund, Vuorenskoski & Perheentupa, 1978; Harries, Walker, Williams, Hawkin & Hughes 1997).

A study by Rees (1993) indicated that socio-economic changes in the industrialized countries that took place in the 20<sup>th</sup> century, resulted in earlier sexual maturation of children as it is manifested by the decrease in the age of menarche. The differences in the age of sexual maturation between populations are largely due to differences in socio-economic conditions as well as genetic factors (Eveleth & Tanner, 1990; Herman-Giddens, Slora, Wasserman, Bourdony, Bhapkar, Koch, Hasemeier, 1997; Herman-Giddens, Wang & Kock, 2001; Papadimitriou, Stephanou, Papantzimas, Glynos & Phillipidis, 2002; Karpati, Rubin, Kieszak, Marcus & Troiano 2002). Research studies revealed that stunted children had delayed growth (Martorell, Khan & Schroeder, 1994; Benefice, Garnier, Simondon, & Malina 2001), but it is however, not known how stunting affects the sexual maturation of the adolescent boys which warrant further investigation.

Numerous studies examining the sexual maturation of girls are available however, data on the sexual maturation of boys is considerably limited (Roche, Wellens, Attie & Siervogel, 1995; Wong et al., 1996; Willers, Engelhardt & Pelz, 1996; Fredriks, Van Buuren, Burgermeijer, 1997). A study by Harries *et al.* (1997) stated that parents do have a misconception that puberty has started in boys only when the voice has 'broken'. Research in the area of secondary sexual development in South African boys is limited. A study conducted by Cameron *et al.* (1993) investigated information on breast, pubic hair development in girls and genital and pubic hair development in boys, but does not seem to have investigated information on voice development. Findings from the latter study revealed that African rural children were consistently delayed in the age at which they entered each of pubertal events, but well-off urban children from Soweto were advanced. It is not known what the situation would be like in boys living in low-income townships of the North-West Province. Therefore, a cross-sectional

study was done to investigate the differences between development of secondary sexual characteristics (i.e. voice, pubic hair and genital development) of stunted and non-stunted black South-African school boys living in a township in Potchefstroom, in the North-West Province of South Africa.

## **Methods**

### **Subjects**

This cross-sectional research design forms part of the multidisciplinary Physical Activity in Youth (PLAY) study carried out on a group of high-school children in the North-West Province of South Africa in 2003. Two schools were purposefully selected from a total of five schools, because they are situated in those areas in the township where most stunted children were likely to be found. More details of the study are described elsewhere (Mamabolo, Kruger, Lennox, Monyeki, Pienaar, Underhay & Czlapka-Matyasik, 2007). For the study presented here, cross-sectional data on the baseline measurements for secondary sexual characteristics and anthropometric measurements of height and weight were used. These data were assessed in 129 boys aged 12-16 years. The aims of the study were explained to the subjects and parents who gave informed consent. The Ethics Committee of the North-West University approved the study (project number 04M01).

### *Anthropometric measurements*

The boys' height and weight were measured according to standard procedures as described by the International Society for Advancement of Kinanthropometry (ISAK, 2001). A stadiometer was used to measure height to the nearest 0.1cm and Schoenle electronic scale to measure weight to the nearest 0.1kg. Children with a height-for-age z-score below -2 according to the Centers for Disease Control standards were categorised as stunted (CDC) (CDC/NHCS, 2008).

### Secondary sexual characteristics

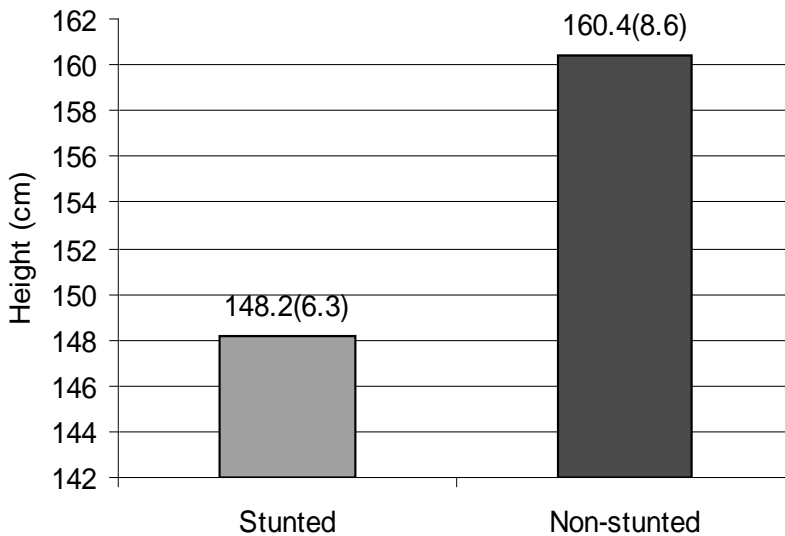
Secondary sexual characteristics of the subjects were measured using the Tanner stages (Tanner, 1962). The self-assessment techniques were used to assess the genital (G) and pubic hair (PH) developments as described by 5 Tanner stages. These stages were categorised as follows: G1 and PH1= no pubic hair (pre-pubertal or prepubescent state), G 2-G4 and PH2-PH4 development of pubic hair (pubertal or pubescent state) and G5 and PH5 developed pubic hair (adult male characteristics). Further, voice changes were rated on Tanner three-stage scale: 1= unbroken (childlike, pre-pubertal; V1); 2= signs of breaking but not fully broken (pubertal stage; V2); and 3= definitely broken or adult characteristics (V3). Each subject completed the Tanner questionnaire with the assistance of two authors (MAM and RLM).

## Statistical analysis

Means and standard deviations were calculated for stunted and non-stunted boys separately. Differences between stunted and non-stunted boys were calculated using the t-test. All statistical analyses were calculated by the Statistical Package for the Social Sciences (SPSS) (2006) software version 15.

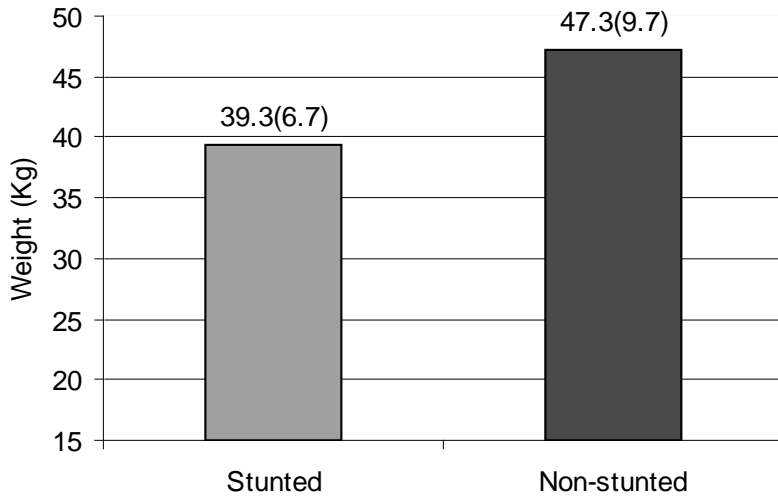
## Results

Figures 1 and 2 present the descriptive information of anthropometric growth parameters of stunted and non-stunted adolescent boys. In figures 1 and 2, the results show that the stunted boys were significantly shorter and lighter as compared to the non-stunted boys.



**Figure 1:** Means (SD) for height of stunted and non-stunted adolescent boys

Table 1 presents the descriptive information on sexual maturation characteristics of stunted and non-stunted black township boys living in North-West province of South Africa. The results show that the non-stunted boys' pubertal development starts with sign of voice (V2) breaking at the mean age of 13.04(2.9) years, followed by pubic hair (PH2), and genital development (G2). The study shows that the non-stunted reached their maturation much earlier than the stunted ones. The non-stunted boys reached pubertal voice development 8.5 months (0.71 years) earlier than the stunted ones, followed by pubic hair and genital development. The stunted boys showed more delayed development, although the differences were not statistically significant.



**Figure 2:** Means for weight (SD) of stunted and non-stunted adolescent boys

**Table 1:** Mean (SD) differences between ages of secondary sexual characteristics of stunted and non-stunted Potchefstroom boys of South Africa

Variable	Stunted boys N=28	Non-stunted boys N=108	Level of significance of difference*
Age (years)	15.0(1.3)	14.8(1.4)	P=0.58
Age of Tanner stage 2 of hair distribution	15.7(1.2)	14.1(1.2)	P=0.139
Age of Tanner stage 2 of genital development	14.9(1.2)	14.2(1.2)	P=0.104
Age of voice break (years; V2)	13.04(2.9)	12.33(3.5)	P=0.34

\* T-test

## Discussion

The present study provides data on secondary sexual characteristics of maturation in a group of stunted and non-stunted black boys from a low socio-economic township in South Africa. The results show that both the stunted and non-stunted boys in this population attained sexual maturation somewhat later as compared to children in other studies. Papadimitrou *et al.* (2002) revealed that Greek boys reached their genital stages 2-5 from ages 11.0, 12.2, 13.3, 14.2 years and pubic hair (2-5) occurred at ages 11.5, 12.7, 13.4, 14.1 years. Herman-Giddens *et al.*, (2001) found that white, African American, and Mexican American boys' pubertal hair development occurred at the ages 11.2, 12.0, 12.3 years respectively, and stage 2 for genital growth were 9.5, 10.1 and 10.4 years respectively. When the present study was compared to other South African studies done on Vaalwater and Soweto children by Cameron *et al.* (1993), boys in the present study were much more delayed in genital and pubic hair development. In the present study all children came from a low socio-economic

township. Although stunted and non-stunted boys were of similar age, the stunted boys tended to be much more delayed in Tanner stages of pubertal development than the non-stunted boys. The non-stunted boys also tended to experience pubertal voice change earlier than stunted boys, although these differences were not statistically significant.

The present data show that maximal voice changes in boys occurred towards the beginning of puberty, and these results were consistent with findings reported by others (Vuorenskoski et al., 1978; Harries et al., 1997; Karlberg & Taranger, 1976). This was however, contrary to what was reported in Greek boys where voice changes occurred between stages G3 and G4 (Harries et al., 1997). The reasons for these contrary findings may have been due to differences in genetic, environmental factors and socio-economic status as pointed out by several authors (Malina et al., 2004; Rees, 1993; Eveleth & Tanner, 1990; Herman-Giddens et al., 1997; Herman-Giddens et al., 2001; Papadimitriou et al., 2002; Karpati et al., 2002).

It should be realised that some of the unique strengths of this study can also generate limitations. The cross-sectional nature of the study, sample size and the inclusion of older boys may be the limitation of the study, as it may be possible that some elements of development might have happened as early as 8 years. However, an important limitation of the study was the fact that self-assessment of Tanner's five stages of sexual maturation was undertaken in which the children were expected to indicate their levels of sexual maturation. Therefore, errors could arise in the children's interpretation of their levels of sexual development. Direct assessment of the children's stages of sexual maturation was not feasible in this study because of the cultural sensitivity associated with such assessments among the children. Therefore, the present findings should be interpreted in the light of this limitation. This is, however, unlikely because most boys in the present study reached Tanner stage 2 only at 14 years. The strength of this study however, is that it added more information in particular voice development as another sexual maturation characteristic of black adolescent boys, which in itself contributes scientific knowledge to this field of research. More so, such scientific information was limited in the South African boys. Furthermore, the present data may not be used for generalisation of all South African boys, because it was only based on a small sample of selected stunted and non-stunted black boys from two schools in a low socio-economic township.

In conclusion, the present findings showed that the boys attained their full sexual maturation late as compared to the few reported studies in the literature. Additionally, the study showed differences in voice development between stunted and non-stunted boys, with non-stunted having attained voice development earlier than the stunted ones. The study therefore, warrants a need for further studies which will cover a large number of children at an earlier age

and all levels of socio-economic status so as to get a clear picture about secondary sexual maturation in black South African boys.

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