

## The Perils of Puberty

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### Abstract

*Puberty and adolescence represent a transitional phase from childhood to adulthood, and are defined by the attainment of secondary sexual characteristics and reproductive capability, occurring concomitantly with psychological and social development. The perils of puberty lie in the difficult and complex inter-relationship of biological, psychological and social changes, as the adolescent strives to adjust to new social roles and identities, and new reproductive capacities. An appreciation of these changes in normal puberty is essential to all professionals caring for adolescents.*

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### Introduction

Adolescence is a biopsychosocial maturational process, with the biological changes including completion of linear growth and sexual maturation (puberty), maturation of enzyme systems such as cytochrome P450 systems, accretion of peak bone mass, and the development of sexually dimorphic adult patterns in blood lipids, blood pressure, haemoglobin and red cell indices. Puberty is defined as the attainment of secondary sexual characteristics and reproductive capability, and occurs alongside rapid psychological and social development during early and mid-adolescence. While the majority of the psychological and social changes of adolescence have little to do with puberty, the rapid hormonal changes of puberty on top of the development of adult thinking capacities and social development can make adolescence a time of very turbulent adaptation for some individuals.

The timing and tempo of biological, psychological and social development each proceed independently in each individual, although each strand can influence the others.<sup>1</sup> Those who are pubertally early developers may be late in developing cognitive skills or vice versa, and it is imperative to assess biological and psychosocial maturity separately. Timing (when elements begin) and tempo (the pace of change) may also vary between individuals, in both pubertal development and psychosocial development.<sup>2</sup> When looking after young people, it is important for clinicians to

understand the normal changes of puberty and to anticipate the changes and 'perils' associated with puberty. This will be considered in three main areas:

- A. Physical and hormonal changes
- B. Sexuality
- C. Emotional and psychosocial adaptations

### A. Physical and Hormonal Changes

While the exact trigger of puberty is still unidentified, the physical changes of puberty can be considered as a re-emergence of gonadotropin secretion from a period of relative quiescence in childhood. The cascade of pituitary-gonadal maturation is initiated by a nocturnal sleep-related augmentation of gonadotropin secretion in pulse amplitude and frequency, with a resultant rise in gonadal sex steroids.

There is a wide variation in the age of onset and duration of puberty between males and females, and among ethnic or racial groups.<sup>3</sup> The age of onset for normal puberty in developed countries is from 9 to 14 years in boys, and 8 to 13 years in girls. However, there has been recent controversy regarding a possible recent lowering of the age of puberty.<sup>4,5</sup> The age of puberty decreased dramatically in most developed countries during the first half of the twentieth century due to better nutrition. There is some evidence that elements of puberty are occurring earlier by 1 year in White girls and 2 years in Afro-American girls;<sup>4</sup> however, there

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has been no shift in the age of menarche (the gold standard for age of puberty) in Britain and the USA since the 1960s.<sup>5</sup>

Physical growth involves an interaction between the body's endocrine and skeletal systems. During puberty, the main hormones which influence growth are growth hormone and the gonadal sex steroids, both of which participate in the pubertal growth spurt. The average age for the commencement of an increase in height velocity is 9 years in girls and 11 years in boys, while the peak height velocity occurs at a mean of 11.5 years in girls and 13.5 years in boys. Pubertal growth accounts for approximately 20 percent of final height, averaging 23 to 28 cm in females, and 26 to 28 cm in males. The average growth spurt lasts 24 to 36 months. Males are 12 to 13 cm taller than females on the average, primarily because of the 2-year delay in bone closure, and secondarily from the increased magnitude of the male growth spurt of 2 to 3 cm.<sup>6</sup>

During puberty, there are also differences in body composition between the sexes. In females, the lean body mass decreases from about 80% of body weight in early puberty, to about 75% at maturity. While the lean body mass increases in total amount, it decreases in percentage, because of the increase in adipose mass. In males, the lean mass increases from 80% to approximately 90% at maturity, a primary reflection of increased muscle mass from circulating androgens.<sup>6</sup>

However, the secondary sexual characteristics are the main changes which occur in the adolescent period. Tanner et al<sup>7,8</sup> devised the sexual maturity ratings (SMR) for puberty, ranging from stage 1 (prepubertal) to stage 5 (fully pubertal). For females, this is based on breast development, which is the first sign of puberty, and pubic hair development. For males, this is based on the testicular volume, appearance of the scrotum and phallus, and pubic hair.

Male sexual development begins at an average age of 11.6 years with testicular volumes from 4 ml. In Singapore, the median age of a testicular volume of 4 ml was 11 years.<sup>9</sup> Spermatogenesis, the onset of sperm emission, indicates the establishment of spermatogenesis. The median age of occurrence is 13.4 years, with an average testicular volume of 11.5 ml. The average length of completion of puberty is 3 years. Female sexual development begins at an average of 11.2 years. On the average, menarche occurs in American girls at 12.3 years. In Singapore, the earliest age for menarche was 11 years, and 100% of normal girls had already experienced menarche by 15 years.<sup>9</sup> However, the age of menarche has gradually decreased in the last century, although recent trends indicate that this trend appears to be ceasing.

The physical and hormonal changes which adolescents

undergo, can result in tremendous concern and anxiety, and can be considered as one of the many perils of puberty. Many adolescents may worry whether their bodies are right, or will be right. The anxieties and sensitivities are often heightened by the wide variation in timing of puberty, with resultant differences in physical maturity of similar-aged adolescents. Health care workers counselling adolescents must understand the changes in variations of normalcy, and be equipped with the insight and skills to detect the adolescent concerns about their physical changes, even if their concerns are not initially overtly stated. It is essential to sense the profound effects which these changes may have on some adolescents, and to provide the reassurance or help depending on whether the changes are within or outside normal standards of variation.

## **B. Hormones and Sexuality**

Major developments in sexual behaviour and drives accompany the development of reproductive capacity during adolescence. Gender identity, the sense of being male or female, develops in very early childhood, largely under the influence of social cues with an uncertain contribution from biology. During adolescence, sexual drives and behaviours increase dramatically, driven by both biological libido (resulting from the hormones of puberty) and socially generated motivation (in which social influences specify the rewards of sex and to whom they apply).<sup>10</sup>

A common picture in the lay and even medical mind is of the "raging hormones" of puberty driving irresistible sexual urges and aggressive behaviour during adolescence. In fact, the extent to which increasing hormone levels drive sexual behaviour is uncertain. There is some evidence that pubertal development and hormone levels drive sexual initiation, particularly in males.<sup>11</sup> However, the average age of initiation of intimate sexual behaviours differs dramatically between countries and cultural groups, illustrating that social (e.g. acceptability of sexual behaviour before marriage, availability of partners) and psychological factors (e.g. gender orientation, confidence, sense of attractiveness) are more important than mere hormone levels.<sup>10</sup>

It is important to note that sex steroid levels have little relationship to gender orientation or identity. Homosexual exploration is frequent in early adolescents of both sexes and homosexuality has no relationship with testosterone or oestrogen levels. Similarly, no hormonal abnormalities have been found in young people with Gender Identity Disorder (GID or transgendered young people).

## **C. Emotional and Psychosocial Aspects**

The majority of the psychological and social changes of

TABLE I: EFFECTS OF DIFFERENT PUBERTAL TIMING

|               | Early puberty                                                                                                                                                     | Late puberty                                                                                                                                                                                            |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Biological    | Taller than peers – but later may end up short                                                                                                                    | Short stature – but should later achieve normal height<br>Osteoporosis                                                                                                                                  |
| Psychological | Positive psychological effects in boys – higher self-esteem<br>Negative psychological effects in girls – low self-esteem                                          | Low self-esteem in boys<br>No major problems in girls                                                                                                                                                   |
| Social        | Different from peers in physical development; regular menses in girls<br>Treated as adolescent while still a child – more may be asked of them than they are able | Different to peers<br>Treated as less mature than real age by adults and peers<br>Difficulty in separating from parents due to apparent immaturity<br>Difficult getting work due to apparent immaturity |

adolescence are probably little influenced directly by changing pubertal hormones. Psychological changes in thought patterns and cognitive ability are driven by increasing maturation and myelination of the adolescent brain.<sup>12</sup> Between the ages of 6 to 11 years, children generally think concretely, understanding only the immediate and short-term consequence of actions or events. Ideas and concepts can only be manipulated through using concrete representations. From the age of 12 years onwards, thought patterns begin to change to formal operational or abstract thought, the ability to manipulate ideas rather than things, imagine the future, and conceive of multiple outcomes of actions. These capacities are important for the development of a settled personal and sexual identity.<sup>1</sup> These cognitive changes, like the hormonal changes of puberty, are universal to all races and cultures.

In contrast, the majority of social development is culture specific, varying with social and cultural norms regarding the roles of children and adults in society. Biological and psychological changes occur within the context of an individual's social environment. The essential social tasks of adolescence are developing a sense of personal identity, moving from dependence to independence, and developing mature relationship with peers. These challenges exist across all cultures; however the timing of changes and the point at which successful completion is expected varies greatly between cultures.<sup>13</sup> In Western societies, adolescence commonly extends over many years, with its endpoints marked by relative financial independence after the completion of education. In contrast, in some societies, the social rights and responsibilities of adulthood are conferred at initiation ceremonies or rites.

Increasing hormone levels during puberty may influence areas of behaviour outside of sexual behaviour. This evidence is particularly strong for aggression in relation to testosterone in boys and depression in relation to oestrogen in girls.<sup>14</sup> Large studies of the development of depression through adolescence show that rates of depression increase dramatically to adult rates from Tanner breast stage 3 in girls onwards, while in boys rates decrease from Tanner

pubic hair stage 3 onwards. This effect is independent of age and socio-demographic factors.<sup>15</sup> Without resorting too strongly to biological determinism, these findings (replicated by others) suggest strongly that mental health and behaviour during adolescence and thereafter are partly influenced by the changing hormonal milieu. The timing of puberty also has some impact on emotional well-being, as outlined in the Table I.

There is no evidence that hormone levels are “raging” during adolescence. Levels of testosterone in males and oestrogen in females increase slowly during stages 2 to 4 of puberty, initially secreted mostly at night and reaching adult levels by Tanner genital or breast stage 4 (mean age 14.0 years in boys and 13.1 years in girls). Rather than fluctuating or “raging” hormones, difficult adolescent behaviour (e.g. moodiness, aggression) is probably a result of the individual having to adjust to unaccustomed levels of hormones in the context of increasing physical strength and new social roles and responsibilities.

## Conclusion

Adolescence is a time when an individual must adjust to new social roles, new cognitive capacities, new reproductive capacities and unaccustomed levels of sex steroids in both the body and the brain. Puberty itself is often seen as emblematic of adolescence, however few of the psychological and social changes of adolescence are directly driven by sex steroids. Rather, it is the inter-relationship of biological, psychological and social change and the pace of change that can make puberty perilous.

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