# Evaluation of physical growth and sexual maturation rating of Adolescent boys

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## Abstract

**Introduction**: The present study is an attempt to evaluate the incidence of malnutrition as well as obesity. We have evaluated physical growth and sexual maturity rating of 10-18 years adolescent boys–overweight Vs Normal Vs Underweight. **Material and Methods**: A random sample of 530 adolescent boys (one private English Medium and one Govt. Hindi Medium School) between the ages of 10-18 years during the period of August 2008 to August 2009 constituted the material for this study. Weight, Height and BMI and Sexual maturation rating (SMR) were calculated. **Results**: Nearly 39% of the adolescent boys studied were either underweight (31%) or overweight (8%). All overweight adolescent boys have their mean weight more as compared to WHO 50th centile. Normal weight and underweight adolescent boys have lesser mean weight as compared to WHO 50th centile. All overweight and normal weight adolescent boys have their mean height lesser as compared to WHO 50th centile. All underweight adolescent boys except for age group of 12 yr have their mean height lesser as compared to WHO 50th centile. Underweight boys achieved different stages of genital growth prior to normal weight and overweight boys but lag behind as compared to Tanner. It was obvious that underweight boys achieved different stages of pubic hair growth prior to normal weight and overweight boys. **Conclusion**: Present study indicates that incidence of overweight children is also increasing significantly. Adolescent psychological need should be assessed and they should be given knowledge regarding their normal sexual growth pattern to decrease their anxiety.

**Key words:** Obesity in Adolescent, SMR, Early maturer, BMI in Adolescent.

## Introduction

The origin of the word adolescence is from Greek Latin word 'adolesere' which means 'to grow' or to grow to maturity[1]. It is a period of rapid and extensive series of anatomical, biochemical, emotional, psychosocial and secondary sexual changes in encompassing the age range from 10 – 19 years. The pattern of these changes is in turn modified and individualized by genetic potential as well as environmental and socio-cultural influences.

Today adolescents are going through stormy period of life with tremendous academic, emotional pressures and expectations because of changing lifestyle, higher degree of competitiveness, peer pressure and influences of tube culture.

Adolescence proceeds across three distinct periods– early, middle and late, each marked by a characteristic set of salient biologic, psychological and social issues. However individual variation is substantial, both in terms of the timing of somatic and secondary sexual changes and quality of the adolescents experience.

Growth assessment is an essential component of paediatric health surveillance because almost any problem within the physiologic, interpersonal and social domains can adversely affect growth.

## Material and Methods

A random sample of 530 adolescent boys between the ages of 10-18 years during the period of August 2008

to August 2009 constituted the material for this study. A random sample was drawn from two different schools; one private English Medium and one Govt. Hindi Medium School reflecting students from all socioeconomic strata of society.

A formal request was made to the Head of these institutions for permission to carry out this study. Having ensured our acceptance, the students were approached in small batches of 40 students at a time in the absence of class teachers. They were requested to fill in a questionnaire after being explained that the object of the study was to determine their physical growth and sexual maturation. They were examined for genital and pubic hair for their sexual maturation rating confidentially.

Protection of individual identity and confidentiality of responses were ensured by maintaining anonymity by allotting code numbers to each subject. To avoid any deliberate distortion of responses they were promised that the result would be communicated to them after analysis.

*Section I:* of questionnaire was designed to gather general information regarding age, sex, birth order, parental education, occupation, per capita income, Weight, Height and BMI.

### a)  Weight:

The weighing scale used in this survey measuring in kilo grams up to accuracy of 100gms. The zero error of the machine was regularly eliminated before taking the weight. Boys were made to stand barefoot on the centre of the platform, without touching anything and their weight recorded.

### b)  Height:

The height was measured with an anthrop meter. It consisted of wooden platform 24"X18" to which 10" wide vertical plank was fixed, which could measure up to a tenth of a centimetre. A rectangular wooden head board was used. Boys with barefooted, were made to stand on the flat platform with the feet joined and making an angle of $45^0$ with each other each other. Heels, buttocks, shoulders and back of head were made to touch the upright plank. The head was held comfortable erect, such that the lower borders of the orbits were in the some horizontal plane is the external auditory meatus. The hands were made to hang at the sides in a natural manner. During the measurement, the child was asked to take a deep breath, relax the shoulders and stretch up to be as tall as possible. Top knots of Sikh boys were opened. The headpiece was moved down until it touched the child's head and keeping the headpiece in position the child was asked to *get off the anthrop meter. The height of the child was then recorded.*

### c)  Body Mass Index (BMI)

It is calculated by formula given below
BMI= Weight/ Height X Height
Weight in Kilogram & Height in meters.

Body Mass Index (BMI) Classification of children and adolescent

| BMI Percentile for age | Weight status |
|---|---|
| <5th percentile | Underweight |
| 5th – 84th percentile | Normal weight |
| 85th – 94th percentile | At risk for overweight |
| ≥95th percentile | Overweight |

*Overweight* was defined as BMI 95th percentile or more[2].

*Underweight* was defined as BMI less then 5th percentile[2]. (*NCHS 2000*).

*Section II:* Sexual maturation rating (SMR) was calculated by physical examination (Genital *stage and Pubic hair stage*)[3].

### GENITAL GROWTH: [3]

Stage I: Pre-adolescent, testes, scrotum and penis of about the same size and proportions as in early childhood.

Stage II: Enlargement of scrotum and of testes. The skin of the scrotum reddens and changes in texture little or no enlargement of penis.

Stage III: Enlargement of the penis, that occurs at first mainly in length. Further growth of testes and scrotum.

Stage IV: Increase size of penis with growth in breadth and development of glans. Further enlargement of testes and scrotum; increased darkening of scrotal skin.

Stage V: Genitalia adult in size and shape. No further enlargement takes place.

### Pubic HAIR

Stage I: Pre-adolescent. The vellus over the pubes is not further developed than that over abdominal wall, i.e. no pubic hair.

Stage II: Sparse growth of long, slightly pigmented downy hair, straight to only slightly curled, appearing chiefly at the base of the penis.

Stage III: Considerably darker, coarser and more curled. The hairs spread sparsely over the junction of the pubes. It is at this stage that pubic hair is first seen in an ordinary black and white photograph of entire body.

Stage IV: Hair now resembles adult in type, but area covered by it is still considerably smaller than in adult. No spread to the medial surface of thigh.

Stage V: Adult quantity and quality with distribution of the horizontal pattern and spread to medial surface of things but not up linea alba on above the base of the inverse triangle.

## Results

**Table 1:** Showing percentage wise distribution of overweight, normal weight and underweight adolescent boys

|  | (N) | Percentage (%) |
|---|---|---|
| Overweight | 42 | 8 |
| Normal weight | 324 | 61 |
| Underweight | 164 | 31 |
|  | **530** | **100** |

As per Table 1 Nearly 39% of the adolescent boys studied were either underweight (31%) or overweight (8%) remaining 61 % were having normal weight.

All overweight adolescent boys had their mean weight more as compared to WHO 50[th]centile. Normal weight and underweight adolescent boys has lesser mean weight as compared to WHO 50[th]centile. All overweight and normal weight adolescent boys had their mean height lesser as compared to WHO 50[th]centile. All underweight adolescent boys except for age group of 12 yr had their mean height lesser as compared to WHO 50th centile.

As per Table 5 maximum number of late adolescent belongs to G3 to G5 category.

Nearly one third of the subjects studied deviated from the group of normal maturity. They were either late maturer (29.4%) or early maturer (4%).

From the present study it was obvious that underweight boys achieved different stages of genital growth prior to normal weight and overweight boys but lag behind as compared to Tanner[2].

It was obvious that underweight boys achieved different stages of pubic hair growth prior to normal weight and overweight boys. It was also obvious that pubic hair growth stage 2 and stage 3 for underweight boys precedes Tanner stage.

**Table 2:** Age wise distribution of overweight, normal weight and underweight adolescent boys showing age wise distribution of boys. Incidence of underweight adolescent is maximum in late adolescent while overweight adolescent belongs to age group 15-17 years.

| Age(Yrs) | Total | Overweight | Normal weight | Underweight |
|---|---|---|---|---|
|  | **530** | **42** | **324** | **164** |
| 11 | 30 5.67% | 3 7.14% | 18 5.56% | 9 5.49% |
| 12 | 36 6.79% | 3 7.14% | 22 6.79% | 11 6.70% |
| 13 | 36 6.79% | 4 9.52% | 16 4.49% | 16 9.76% |
| 14 | 80 15.09% | 4 9.52% | 52 16.05% | 24 14.63% |
| 15 | 80 15.09% | 12 28.57% | 48 14.81% | 20 12.2% |
| 16 | 148 27.92% | 4 9.52% | 88 27.16% | 56 34.14% |
| 17 | 120 22.64% | 12 28.57% | 80 24.69% | 28 17.07% |
| **(N)** | **530** | **42** | **324** | **164** |

**Table 3:** Showing mean weight (kg) in overweight, normal weight and underweight adolescent boys (present study) as compared to WHO.

| Age | WHO 50TH centile | Overweight | Normal weight | Underweight |
|---|---|---|---|---|
| 11 | 31.7 | 42.7 ±0.6 | 30.6 ±2.1 | 27.9 ±1.6 |
| 12 | 40.3 | 48.3 ±1.5 | 39.2 ±3.24 | 32.5 ±2.9 |
| 13 | 45.4 | 52 ±3.37 | 43.3 ±1.44 | 33.5 ±3.5 |
| 14 | 50.8 | 57.3 ±2.40 | 44.7 ±7.7 | 39.2 ±5.8 |
| 15 | 56 | 61 ±1.15 | 50.7 ±5.9 | 44.8 ±5.3 |
| 16 | 60.8 | 63.6 ±3.9 | 49.5 ±5.7 | 45.0 ±4.1 |
| 17 | 64.4 | 65.5 ±4.03 | 51.8 ±4.8 | 46.6 ±8.4 |

**Table 4:** Showing mean height (cm) in overweight, normal weight and underweight adolescent boys (present study) as compared to WHO.

| Age | WHO 50th centile | Overweight | Normal weight | Underweight |
|---|---|---|---|---|
| 11 | 143.3 | 131 ±1.0 | 133 ±2.0 | 142.8 ±3.9 |
| 12 | 149 | 140.3 ±2.0 | 144.6 ±7.51 | 150.2 ±5.2 |
| 13 | 155.7 | 144 ±1.41 | 152.9 ±4.29 | 152.3 ±8.32 |
| 14 | 163.5 | 152.8 ±2.6 | 160.4 ±13.5 | 155.6 ±10.7 |
| 15 | 169.8 | 157.6 ±2.08 | 164.5 ±6.75 | 163.2 ±5.8 |
| 16 | 173.5 | 160.1 ±4.03 | 165.8 ±8.65 | 170.0 ±8.5 |
| 17 | 175.3 | 161.7 ±5.56 | 168.1 ±7.81 | 170.4 ±9.0 |

**Table 5:** Showing percentage wise distribution of different stages of genital growth in adolescent boys

| Age Stage | 11 | 12 | 13 | 14 | 15 | 16 | 17 | Total |
|---|---|---|---|---|---|---|---|---|
| G1 | 7 | 3 | 1 | 0 | 0 | 0 | 0 | 11 (2%) |
| G2 | 17 | 21 | 15 | 20 | 4 | 1 | 0 | 78 (14.8%) |
| G3 | 6 | 11 | 17 | 50 | 29 | 35 | 1 | 149 (28.1%) |
| G4 | 0 | 1 | 3 | 9 | 36 | 32 | 6 | 87 (16.4%) |
| G5 | 0 | 0 | 0 | 1 | 11 | 80 | 113 | 205 (38.7%) |
| Total | 30 | 36 | 36 | 80 | 80 | 148 | 120 | 530 |

**Table 6:** Showing percentage wise distribution of Early maturer, Normal maturer and Late maturer

| | (N) | Percentage |
|---|---|---|
| Early maturer | 21 | 4% |
| Normal maturer | 353 | 66.6% |
| Late maturer | 156 | 29.4% |
| Total | 530 | 100% |

**Table 7:** Showing the mean ages at which different stages of genital growth are achieved as compared with Tanner is shown

| Source | G2 | G3 | G4 | G5 |
|---|---|---|---|---|
| **1. Present study** | | | | |
| Overweight | 13.4±1.14 | 15.0±1.04 | 15.3±0.95 | 16.8±0.62 |
| Normal weight | 12.8±1.28 | 14.5±1.32 | 15.4±0.72 | 16.6±0.56 |
| Underweight | 12.3±1.25 | 13.6±1.33 | 14.8±1.14 | 16.3±0.63 |
| **2. Marshall and Tanner** | 11.6 | 12.9 | 13.8 | 14.9 |

**Table 8:** Showing the mean ages at which different stages of pubic hair growth are achieved as compared with Tanner is shown

| Source | P 2 | P 3 | P 4 | P 5 |
|---|---|---|---|---|
| **1. Present study** | | | | |
| Overweight | 13.5±1.3 | 14.6±1.02 | 15.6±1.12 | 16.9±0.8 |
| Normal weight | 12.6±1.2 | 14.5±1.3 | 15.4±0.82 | 16.6±0.61 |
| Underweight | 12.5±1.28 | 13.8±1.35 | 14.8±1.08 | 16.3±0.59 |
| **2. Marshall and Tanner** | 13.4 | 13.9 | 14.4 | 15.1 |

## Discussion

### *Physical growth*

As per Table 1 Present study shows the prevalence of overweight and underweight adolescent boys is 8% and 31% respectively.

Prevalence of overweight increased in Brazil (from 4.1 to 13.9), China (from 6.4 to 7.7) and United states (from 15.4 to 25.6) whereas decreased in Russia (from 14.5 to 13.1). Prevalence of underweight increased in Russia (from 6.9 to 8.1) but decreased in Brazil (from 14.8 to 8.6) & China (from 14.5 to 13.1)[4].

Sexual maturation in normal weight adolescent boys achieved prior to both overweight and underweight adolescent boys but underweight adolescent boys mature sexually before overweight adolescent boys[4].

Prevalence of overweight and underweight is 11% and 10% respectively in our country[5].

Overweight and underweight adolescents predispose more illness, both physical and mental & more personality changes in comparison to normal weight adolescents. Overweight causes more morbidity and mortality than underweight. Overweight not only causes much psychological morbidity, but is also a primary risk factor in development of hypertension, cardiovascular disease, stroke, diabetes mellitus, hyperlipidemia, osteoarthritis and cancer of prostate[6]. Underweight causes fatigue, lack of energy and increased susceptible to infection[6]. These adolescents are more risk for hip fracture[6]. Epidemiological evidence indicates that overweight as well as underweight have a higher prevalence of psychiatric disorders[7].

*Overweight* groups have tendency to be sociable, warm and cheerful. They are also more impulsive & curious.

*Underweight* groups have more anxiety, anger and depression[8].

As per Table 3, All overweight adolescent boys have their mean weight more as compared to WHO 50th centile. Normal weight and underweight adolescent boys have lesser mean weight as compared to WHO 50th centile. All overweight adolescent boys of present study have their mean weight more as compared to studies done on average Indian adolescent boys[9,10,11,12]. Underweight adolescent boys of present study have their mean weight lesser as compared to western and average Indian adolescent boys[3]. As per Table 4 All overweight and normal weight adolescent boys had their mean height lesser as compared to WHO 50th centile. All underweight adolescent boys except for age group of 12 yr had their mean height lesser as compared to WHO 50th centile.

It is well established that the time of maximum growth in height is closely correlated with sexual maturation[13, 14,15,16,17]. All underweight adolescent boys of present study had their mean height more as compared to studies done on average Indian adolescent boys[9,10,11,12]. Overweight adolescent boys of present study have their mean height lesser as compared to western and average Indian adolescent boys[3].

As per Table 6 & 7 : From the present study it was obvious that underweight boys achieved different stages of genital growth prior to normal weight and overweight boys but lag behind as compared to Tanner[3].

Similar results are seen in this study where Sexual maturation in normal weight adolescent boys achieved prior to both overweight and underweight adolescent boys but underweight adolescent boys mature sexually before overweight adolescent boys[4].

Studies done by[4,18] Chicago revealed early maturing boys had lower BMI than their counterparts; whereas early maturing girls had greater measures of BMI. Early sexual maturation was related to increased height but not to increased body weight in boys, while it was associated with both increased height and weight in girls.

As per Table 8 it was obvious that underweight boys achieved different stages of pubic hair growth prior to normal weight and overweight boys. It was also obvious that pubic hair growth stage 2 and stage 3 for underweight boys precedes Tanner stage.

Frisch and Revelle[19] offered a hypothesis that attainment of critical body size might be a factor involved in the alteration of the sensitivity of the hypothalamic centres responsible for the onset of puberty. They are also of the opinion that a critical body size is attained before final stages of maturity are achieved.

Accurate maturity assessment of boys should include not only clinical examination but also radiological assessment of age and estimate of hormones secretion.

The various stages of adolescent begin at different ages in each individual. Hence, longitudinal studies are indispensable for correct assessment.

## Conclusion

Underweight adolescent boys achieved different stages of sexual maturation prior to normal weight and overweight adolescent boys. All overweight adolescent boys of present study had their mean weight more as compared to WHO 50th centile. Normal weight and underweight adolescent boys had lesser mean weight as compared to WHO 50th centile. All overweight and normal weight adolescent boys had their mean height lesser as compared to WHO 50th centile. All underweight adolescent boys except the age group of 12 yr had their mean height lesser as compared to WHO 50th centile. Overweight adolescent boys constituted 8%, normal weight 61% and underweight adolescent boys 31%. Early maturing adolescent boys constitutes 4%, normal maturing 66.6% and late maturing adolescent boys 29.4%. Further longitudinal studies, correlating anthropometry, bone age and secondary sex characters with hormonal secretion need to be undertaken.

## References

1. Agarwal K, Satyavathi NK. *Review on adolescent growth studies part A: Physiological aspect and environmental factors. Indian* J Pediatr 2004;71(6):565-67

2. Kliegman, Behrman, Jenson. Nelson Text Book of Pediatrics, 17th ed. W. B. Saunders Company; 2004.p 61.

3. Tanner JM. Growth at Adolescence, Oxford 2nd ed. Oxford, England, Blackwell scientific publications; 1962.

4. Wang Y, Monteiro C, Popkin M. Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. *Am J Clin Nutr* 2002;75(6):971-77.

5. Elizabeth KE. A Novel growth assessment chart for adolescents. *Indian Pediatr* 2001;38:1061-64.

6. Elizabeth KE. *Nutrition and child development, 3rd ed. Paras publication, Hyderabad;2004:p 61.*

7. *Lusky* A, *Barell V, Lubin F, et al. Relationship between* morbidity and *extreme values* of *body mass index* in *adolescents. Int J Epidemiol 1996;25(4):829-34.*

8. Terracciano A, Sutin R, McCrae R, et al. *Psychosom Med* 2009;71( 6):682-89.

9. Rao. Health of school children in Pune. *Indian J Child Health* 1957;6:877.

10. Singh R. A cross-sectional study of growth in five somatometric of Punjabi boys aged 11-18 yrs. *Am J Phys Anthropol* 1970;32:129.

11. Agarwal DK, Agarwal KN, Upadhyay S, et al. J,Physical and Sexual growth pattern of affluent Children 5-18 years Age. *Indian Paediatr* 1992;29(10):1248-82.

12. Tripathi AM Physical growth during adolescence in Delhi School children. *Indian Paediatr* 1976;13:191.

13. *Boas F.* The *growth* of first-born *children. Sci Am* 1895;1:*402-4.*

14. *Simmons K, Greulich W.*Menarchial Age and the Height, Weight and Skeletal Age of Girls 7-17 years. *J Pediatr* 1943;22:518-48.

15. *Stuart HC. Normal Growth and Development during Adolescence. N Engl J Med* 1946;234:666–72.

16. Nicolson AB, Hanley C. *Indices* of *physiological maturity*: derivation and *interrelationships*. *Child Dev 1953*;*24*(1):*3–38*.

17. Deming J. Application of the Gompertz curve to the observed pattern of growth in length of 48 individual boys and girls during the adolescent cycle of growth. *Hum Biol* 1957;29:83-120.

18. *Wang Y. Is obesity associated with early sexual maturation? A comparison of the association in American boys verse girls. Pediatrics 2002;110:903-10.*

19. Frisch R, Revelle R. The height and weight of girls and boys at the time of initiation of the adolescent growth spurt and relationship to menarche. *Hum Biol* 1971; 43: 140-159.

**How to cite this article ?**

Gedam DS, Waseem M, Chansoria M. Evaluation of physical growth and sexual maturation rating of Adolescent boys. *J Nepal Paediatr Soc* 2012;32(2):117-123.