SHOE SIZE CHANGES - LAYMAN'S MARKER OF ONSET OF PUBERTY

Rathaur V. K.[1], Singh A. K.[2], Upadhyay A. N.[3], Jain S.[4], Jain A.[5], Jadaun P.[6]
[1,4,5,6]Department of Pediatrics, [3]Department of Gynaecology, VCSGGMS & RI, Govt. Medical College, Srinagar
[2]Department of Pediatrics, Govt. Medical College, Haldwani
Submitted on : -22-07-2012 Resubmitted on :-15-08-2012 Accepted on:-15-09-2012

ABSTRACT

The study was conducted on 1991 healthy children between 7 and 14 years of age to evaluate the relation between changes in foot length and different stages of puberty. The right foot length of study children was recorded and SMR staging was done. The difference in mean foot length was extremely significant statistically, between SMR 1 and 2 (P<0.0001). No significant difference in the mean foot lengths was found thereafter. Foot length was found to rise sharply in SMR 2, which coincides with the onset of puberty. It is suggested, that a rapid change in size of footwear i.e., Shoe Size changes be taken as Layman's marker of onset of puberty.

Key Words : Foot length, India, Puberty, SMR staging

INTRODUCTION

There is no well known marker to assess age of the onset of puberty. Parents are always eager to remain aware of it, so that they can give a close supervision and proper guidance at this vulnerable point of time. During these years the physiological and biological changes are more strongly correlated with pubertal maturation than chronological age. Common markers of pubertal onset include self or parental report of accelerated height velocity, menarche, and breast development in females & pubic hair appearance and voice changes in males. Difficulties in determining breast stage development in the obese child[1] and teen inaccuracies in self-report[2] limit the use of such methods. With increasing westernization and rapid downfall of moral values it becomes a greater concern for parents. According to one study[3], earlier puberty predicted having drunk alcohol, been drunk, smoked and used drugs <14 years as well as having a sexual debut and unprotected sex <16 years. As on date, there is no marker for common men to know at which point, they should be more vigilant regarding requirement of counselling and be prepared to interfere as and when the necessity arises. The availability of an easy, cost-effective, reliable, non-invasive method to assess the onset of puberty may be useful in both clinical and research settings. The primary purpose of this project was to determine if change in foot/shoe size may be used as a marker for the onset of puberty which is much easier for parents to notice, thus aiming at, if we can find some marker of onset of puberty for the common men. For this we compared the age at which the foot size increased, with the age when secondary sexual characteristics were observed. We also aimed at to know, whether there is any difference in age at onset of puberty between children residing in hilly and cold areas of Himalaya and those residing in warmer and plane areas of Rajasthan.

Corresponding Author:
DR. ANAND JAIN
Department of Pediatrics
VCSGGMS & RI Governmentf Medical College
Srinagar-246174, Garhwal, Uttrakhand (India)
E-mail : drjain_anand@yahoo.com

MATERIAL AND METHODS

This prospective non-interventional study was conducted at S. D. Public School, Haridwar (Uttarakhand) and Little Heart Public School, Hanumangarh Town, (Rajasthan). The study constituted of correlating the foot lengths in males and females with their SMR Stages. Subjects included in the study were healthy children in the age group of 7 to 14 years, belonging to the middle income socio-economic status defined by the Wealth Index Scale[4]. Ethical clearances were obtained from the Institutional Ethics Committees. We approached total 2586 healthy children in the age group of 714 years during the study period of two years from April 2010 to March 2012, of which 23% refused for SMR examination. Thus 1991 children (1022 males & 969 females) formed the final sample.

Right foot length measurement was taken using Brannock Foot Device. The subjects were made to stand barefooted with equal weight on both feet, placing their right heel in the heel cup. Foot length was recorded by looking straight down over the longest toe. We recorded the age in decimal years, as from the Date of Birth in school register. The sexual development was assessed by inspection of pubic hair in both sexes along with examination of breast in girls, and penis and testes in boys. Interpretation was based on Tanner's stages of sexual maturity[5]. Onset of puberty

was defined as Tanner breast stage 2 or pubic hair stage 2 [6] . All parameters were evaluated by the same team of workers and inter-observer variations in assessment of SMR stages and measurement of foot length were assessed from a subset of 59 participants who had repeat foot length measures; 48/59 had identical foot lengths, an additional 9/59 had repeat measures within 0.33 cm, and 2/59 had repeat measures within 0.66 cm. The interclass correlation for foot length in these 59 participants was 0.991. Statistical analysis was done and P-value calculated by using http://www.graphpad.com/quickcalcs/ttest2.cfm. A P-value less than 0.05 was considered to be significant, & less than 0.001 to be highly significant.

OBSERVATIONS

Of total 1991 children analyzed, 1022 were males and 969 were females. Number of children in each age group and sex was as shown in table 1. SMR staging was done in all the subjects and the data were rearranged and grouped according to their SMR stages in males & females as depicted in table 2.The P-values of differences in mean foot Length in different groups is shown in table 3.

An extremely significant difference was observed in mean foot lengths between SMR 1 and 2 in males as well as in females (P<0.0001) as depicted in Table 3. No significant differences in the mean foot lengths were found thereafter (Table 3). Mean foot lengths of children residing in different areas, age wise is shown in table 4. Mean ages of onset of puberty in children residing in different areas, sex wise is also depicted in table 5.

DISCUSSION

A sharp rise in foot length was found in SMR stage 2, which coincides with the onset of puberty, whereas the differences in foot lengths in the subsequent SMR stages were found to be insignificant. Pubertal growth and physical development occur due to activation of the hypothalamic-pituitary- gonadal axis in late childhood. For both sexes, growth acceleration begins in early adolescence, but peak growth velocities are not reached until SMR 3-4[6]. It is well known that physical growth during puberty begins distally, with enlargement of the hands and feet, followed by the arms and legs and finally the trunk and chest[7]. As expected the enlargement of the hands and feet should occur before SMR 3-4. We found that foot length reached almost adult values at the onset of puberty i.e. at SMR 2. Results of this study are in conformity with those of Mitra et al, 2011,[10]. This observation is significant because it occurs well before the start of Pubertal Height Spurt, which is well notable by parents as sudden gain in height and coincides with SMR 3-4 or 4-5 i.e. at a time when puberty is well set in. At this point of time, valuable & delicate period of puberty onset, when parent's attention is most vital, has already passed away. It appears that a noticeable sudden change in size of footwear, say from 7 to 8 or alike in an

Table-1: Distribution of children age and sex wise

Age in Years	Males (n=1022)	Females (n=969)
7	449	422
8	163	152
9	80	78
10	77	74
11	71	69
12	67	63
13	60	59
14	55	52

Table-2: Means of Foot Length in cms.with SMR Stage in Both Sexes

SMR Stages	Males (n=1022)	Females (n=969)
SMR 1		
Subjects n	584	408
Mean	16.49	16.83
SD	1.706	1.121
SMR 2		
Subjects n	154	234
Mean	18.12	18.09
SD	0.973	0.661
SMR 3		
Subjects n	101	146
Mean	18.26	18.13
SD	0.809	0.759
SMR 4		
Subjects n	108	123
Mean	18.28	18.24
SD	0.719	0.731
SMR 5		
Subjects n	75	58
Mean	1844	18.41
SD	0.798	0.648

Table-3 : P-values of Mean Difference of Foot Length (cm), SMR Stage & Sex wise

Group mean foot length (1)	Group mean foot length (2)	p-value of difference b/w (1) & (2)
SMR 1 Males, 16.49	SMR 2 Males, 18.12	<.0001 (Extremely significant)
SMR 1 Females, 16.83	SMR 2 Females, 18.09	<.0001 (Extremely significant)
SMR 2 Males, 18.12	SMR 3 Males, 18.26	>.05 (Not significant)
SMR 2 Females, 18.09	SMR 3 Females, 18.13	>.05 (Not significant)
SMR 3 Males, 18.26	SMR 4 Males, 18.28	>.05 (Not significant)
SMR 3 Females, 18.13	SMR 4 Females, 18.24	>.05 (Not significant)
SMR 4 Males, 18.28	SMR 5 Males, 18.44	>.05 (Not significant)
SMR 4 Females, 18.24	SMR 5 Females, 18.41	>.05 (Not significant)

Table-4 : Mean foot lengths of children residing in different areas age wise

Age in Years (1)	Hilly Area Mean of foot length (2)	Plane Area Mean of foot length (3)	P-value of foot length (2) & (3)
7 Years	16.16 cms	16.26 cms	Not significant
8 Years	16.30 cms	16.38 cms	Not significant
9 Years	17.28 cms	17.49 cms	Not significant
10 Years	17.67 cms	17.91 cms	Not significant
11 Years	17.94 cms	18.07 cms	Not significant
12 Years	18.07 cms	18.23 cms	Not significant
13 Years	18.23 cms	18.33 cms	Not significant
14 Years	18.39 cms	18.41 cms	Not significant
Mean	16.87 cms	16.98 cms	Not significant

Table-5 : Mean age of onset of puberty in children from different areas.

Age in Years (1)	Age in Years of Children Hilly Area (1)	Age in Years of Children Plane Area (2)	P-value of difference between (2) & (3)
Females	8.96 years	8.57 years	Not significant
Males	10.22 years	9.86 years	Not significant
Both Sex	9.61 years	9.23 years	Not significant

adolescent child , can be suggested as a marker of onset of puberty, there by signaling requirement of necessary parental attention rather than by sudden gain in height, a signal being used till now.

Also that it is often easier for the parents and children to recall a change in footwear rather than remembering the onset of breast development or appearance of pubic hair, hence providing a rough idea regarding the onset of puberty in clinical settings[8]. In addition it has the advantage that children have no hesitation in expressing the foot/shoe size change, but they may hesitate or hide changes in breast tissue size & / or pubic hairs. Although foot length has previously also been shown to be an effective early marker of puberty[8,10], or an early marker of growth of spine[9], it has not been studied from this angle earlier. It is suggested, that a rapid change in size of footwear i.e., Shoe Size changes be taken as Layman's marker of onset of puberty.

The age of onset of puberty in children residing in hilly and cold areas of Himalaya was found to be higher than of those residing in warmer and plane areas of Rajasthan as expected but the difference was not found to be significant statistically. The mean foot length was also found to be lower in hilly areas as compared to planes at all ages, but here again the difference was not significant statistically. Larger studies in future might tell us whether these differences are significant. .

ACKNOWLEDGMENTS

We are thankful to The Principal VCSGGMS & RI Government Medical College and to the Principal and the staff of both the Schools for their kind permission and excellent co operation without which this study was not possible & to the team of junior staff involved in the anthropometric measurements and SMR staging during the study period.

CONCLUSION

A rapid change in size of footwear i.e., Sudden Shoe Size change may be taken as Layman's marker of onset of puberty, which is one of the earliest and the most easily notable feature of onset of puberty, signaling thereby start of a critical time for needful of all concerned, besides medical importance.

REFERENCES

1. Herman-Giddens ME, Kaplowitz PB, Wasserman R. Navigating the recent articles on girls' puberty in Pediatrics: What do we know and where do we go from here? Pediatrics. 2004;113:911917. [PubMed]
2. Dorn LD. Measuring puberty. J Adolesc Health. 2006;39:625626. [PubMed]
3. Jennifer D, Mark A B Early pubertal onset and its relationship with sexual risk taking, substance use and anti-social behaviour: a preliminary cross-sectional study .B M C Public Health; Publisher BioMed Central,. 2009; 9:446 [PubMed]
4. Patel AB, Prabhu AS, Dibley MJ, Kulkarni LR. A tool for rapid socioeconomic assessment. Indian J Pediatr. 2007;74:349-52
5. Tanner JM. Growth and Adolescence, 2nd ed. Oxford, England: Blackwell Scientific Publications; 1962.
6. Marcell AV. Adolescence. In: Kliegman RM, Behrman RE, Jenson HB, Stanton BF (eds). Nelson Textbook of Paediatrics, 18th edn. Vol 1, Philadelphia: Saunders; 2007; p. 60-5.
7. Gupte S, Sahni AK. Adolescence. In: Gupte S (ed) The Short Textbook of Pediatrics, 10th edn. New Delhi: J vaypee Brothers; 2004. p.55-63
8. Ford KR, Khoury JC, Biro FM. Early markers of pubertal onset: height and foot size. J Adolesc Health. 2009;44: 500-1.
9. Busscher et al. Scoliosis 2011,6:1 http//www.scoliosisjournal.com/content/6/1/1.
10. Mitra S, Samanta M, Sarkar M, Chatterjee S. Foot length as a marker of pubertal onset. Indian Pediatrics2011;48:549-551.