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Study of Body Growth in Boys with Steroid Sensitive Nephrotic Syndrome

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Abstract

Background: Steroids are mainstay of the treatment of Nephrotic syndrome and their effect on growth of children studied by earlier workers for lack of consensus, presented conflicting views. Therefore, in this study, we attempted to study pattern of growth of Indian boys with steroid sensitive nephrotic syndrome in terms of some selected anthropometric parameters.

Methods: 121 boys between 9 to 16 years of age diagnosed as cases of steroid sensitive Nephrotic syndrome were measured for Weight, Height, Chest Circumference, Biacromial diameter, Bicristal diameter, Triceps skinfold thickness and Subscapular skinfold thickness at half yearly age intervals following a mixed longitudinal growth research design. Tanner's method was used to compute mean (±SD) distance and velocity growth values for different body parameters of boys.

Results: Growth of height, weight, chest circumference, biacromial diameter and bicristal diameter in boys with steroid sensitive Nephrotic syndrome in general, was found to be compromised as compared to their normal counterparts but was severely affected for height between 14 to 16 years of age and they became short statured individuals. Exceptions to this were triceps and subscapular skinfold thicknesses which in general, measured fatter than normal boys.

Barring triceps skinfold thickness, peak growth velocity for all other body parameters measured amongst boys with SSNS was attained at the same age of 14.5 years. Attainment of peak height velocity (PHV) and peak weight velocity (PWV) as compared to their normal Indian and western counterparts was found to be substantially delayed and also measured lesser in magnitude.

Conclusions: The relatively impaired auxological status recorded amongst boys with SSNS appears to be due to influence of chronic nature of the disease itself as well as effect of steroid therapy which is known to impair growth of children. On the contrary, growth of subcutaneous fat measured in terms of triceps and subscapular skinfold thicknesses exhibited relatively fatter attainments amongst boys with SSNS than their normal counterparts.

Keywords: Nephrotic Syndrome; Growth; Steroids.

Introduction

Nephrotic syndrome is a manifestation of glomerular disease, typically characterized by heavy proteinuria (>40mg /m2 /hr), hypoalbuminemia (<2.5 g/dl), edema and hyperlipidemia (serum cholesterol >200 mg/dl).[1,2] The worldwide prevalence is approximately 12-16 cases per 100,000 children with an annual incidence of 2-7 per 100,000 children.[5] It occurs, most commonly in

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age of 2-8 years which corresponds to a period of relatively steady growth. Daily exposure to supraphysiologic concentration of glucocorticoids over prolonged period is known to affect growth of these children.[3] The loss of insulin-like growth factor-I (IGF-1) and IGF binding protein-3 (IGFBP-3) found in Nephrotic children may prompt growth retardation. In addition, glucocorticoid therapy is believed to be associated with elevation of serum IGF-I levels suggesting potential development of IGF resistance.[4] considered as one of main factors responsible for growth retardation.

Available information relating to effect of steroid therapy on growth of patients with steroid sensitive Nephrotic syndrome remains inconclusive as it lacks clear consensus. Studies conducted by earlier researchers[3,6-12,22-25] show that growth of steroid-sensitive nephrotic syndrome patients gets affected, while those carried out by others[17,18,19,20] reveal no effect on growth of these patients. However, studies by some workers[13-16] revealed effect of steroid therapy on growth of children with nephrotic syndrome during initial years of disease, as these patients ultimately became adults with normal height. It has also been further noticed that most of auxological information on these patients has emanated from developed western world, and their growth in majority of instances, was studied in terms of height, and hardly any attention was paid to study growth of other body parameters. As compared to western world, longitudinal studies conducted on the growth of Indian children with SSNS are scarce. Therefore, we attempted to explore and understand growth dynamics of some selected body parameters of adolescent boys with steroid-sensitive Nephrotic syndrome using mixed longitudinal growth research design.

Patients and Methods

121 boys between 9 to 16 years of age diagnosed as cases of steroid sensitive Nephrotic syndrome (as per criteria given by Indian Academy of Pediatrics)[1] who had successfully completed their treatment comprised sample for this study. These children were born to parents representing mixed socio-economic strata, and inhabited north western parts of India. These subjects were enrolled from the Nephrotic Clinic of Advanced Pediatrics Center, PGIMER, Chandigarh. Children with other chronic diseases, severe malnutrition and secondary Nephrotic syndrome were excluded from the study. Children who had received cyclophosphamide/ cyclosporine/levamisole and those who developed steroid resistance during course of the study were also not included.

Every child was measured for Weight, Height, Chest Circumference, Biacromial diameter, Bicristal diameter, Triceps skinfold thickness and Subscapular skinfold thickness at 6 monthly intervals with time tolerance of ±1 month in Growth Laboratory/Clinic of the department following mixed-longitudinal growth research design. Body weight was measured with the help of Electronic Weighing Scale up to the accuracy of ±50g. Height was measured using Stadiometer (Make:Holtain Ltd) upto accuracy of ±1 mm. Fiber glass tape was used to measure chest circumference up to ±1mm of accuracy. Harpenden Skinfold Caliper with a least count of 0.2 mm was used to measure skinfold thicknesses. A Spreading caliper was used to measure the two body diameters (i.e.biacromial and bicristal) up to accuracy of ±1 mm. Prior to actual data collection a thorough training with respect to all anthropometric measurements was provided to the investigator until magnitude of intra/inter-observer error became ±50g for body weight, ±2mm for height, ±0.2 mm for skinfold thicknesses and up to ±1 mm for chest circumference as well as two body diameters. Tanner's 1951 method[26] was employed to compute mean ±SD of distance (gross size) as well as velocity (rate of growth) related statistics from mixed- longitudinally obtained data for different growth parameters.

Results

Mean and standard deviation (SD) computed for different body parameters measured among boys with steroid-sensitive Nephrotic syndrome (SSNS) are shown Table 1. Height and Weight of children with SSNS showed a regular increase between 9 to 16 years of age (Fig. 1 and 2). This increase however, remained relatively sharper upto 13.5years, thereafter it became comparatively slower. As compared to their normal American (CDC 2000)[28] and Indian affluent counterparts (Agarwal et. al. 1992)[27], height of boys with steroid sensitive Nephrotic syndrome measured shorter throughout. (Fig. 1)

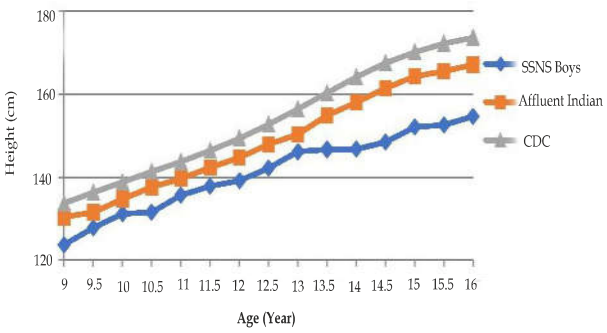

Fig. 1: Comparison of Mean Height (cm) of Normal Boys and Steroid-Senstive Nephrotic Syndrom Boys.

Children with SSNS in general, weighed lighter than their normal CDC (2000)[28] counterparts, but when compared with affluent Indian boys (Agarwal et. al.)[27] they depicted an inconsistent trend. (Fig. 2)

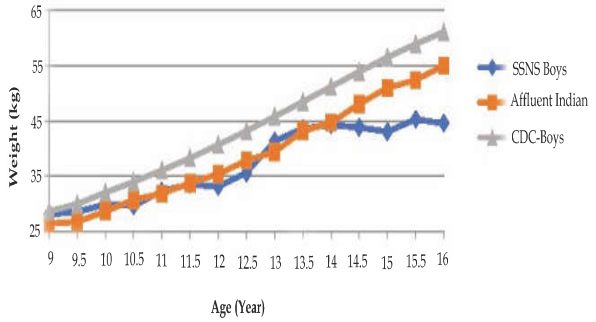

Fig. 2: Comparison of Mean Weight (kg) of Normal Boys and Steroid-Senstive Nephrotic Syndrom Boys.

Mean chest circumference (cm) amongst boys with SSNS grew regularly with advancement of age, yet magnitude of its increase was inconsistent. Growth of shoulder and hip measured in terms of biacromial diameter and bicristal diameter respectively, amongst boys with SSNS showed an uninterrupted increase in mean values between 9 to 16 years of age. As compared to other body parameters the pattern of growth of triceps and subscapular skinfold thicknesses exhibited highly fluctuating trend. In general, boys with steroid sensitive Nephrotic syndrome remained fatter than their normal affluent Indian counterparts depicting a tendency to become obese with advancement of age. (Table 1)

Yearly growth velocities computed for each of the body parameters measured in boys with steroid sensitive Nephrotic syndrome are shown in Table 2. Height growth velocity in boys with steroid sensitive Nephrotic syndrome in general increased regularly, to attain peak height velocity (PHV) measuring 2.25 cm/year between 14 to 15 years of age in magnitude. Weight velocity (kg/year) amongst boys with steroid sensitive Nephrotic syndrome experienced a regular increase to attain peak weight velocity (PWV) measuring 2.35 Kg/ year at 14.5 years. Thereafter, it showed sudden deceleration. The magnitude of yearly height and weight growth velocities measured lesser in boys with steroid sensitive Nephrotic syndrome when

Table 1: Mean and Standard Deviation of Height, Weight, Chest Circumference, Biacromial Diameter, Bicristal Diameter, Triceps Skinfold Thickness, Subscapular Skinfold Thickness in Steroid-Sensitive Nephrotic Syndrome Boys.

Age Interval (±year)	Height (cm) Mean ± SD	Weight (kg) Mean ± SD	Chest circumference (cm) Mean ± SD	Biacromial diameter (cm) Mean ± SD	Bicristal diameter (cm) Mean ± SD	Triceps skinfold thickness (mm) Mean ±SD	Subscapular skinfold thickness (mm) Mean±SD
9.0	123.7 ±8.13	28.1 ±9.22	62.3 ±6.90	25.8 ±2.75	18.6 ±2.19	13.1 ±6.23	11.8 ±8.58
9.5	127.7 ±6.61	28.6 ±6.34	62.5 ±5.94	26.4 ±2.20	18.7 ±2.28	11.2 ±5.22	8.9 ±6.19
10.0	131.1 ±5.13	29.9 ±3.90	62.9 ±3.83	27.2 ±1.72	19.3 ±1.35	11.1 ±4.07	8.8 ±4.55
10.5	131.5 ±5.85	29.6 ±4.54	62.9 ±4.39	27.2 ±2.01	19.3 ±1.68	10.7 ±4.21	8.7 ±4.08
11.0	135.6 ±6.93	32.3 ±6.31	63.1 ±4.46	28.0 ±2.09	19.7 ±1.40	11.1 ±3.89	8.2 ±2.80
11.5	137.8 ±7.94	33.5 ±7.17	64.3 ±5.12	28.3 ±2.35	19.9 ±1.77	12.5 ±5.04	9.1 ±3.34
12.0	139.1 ±7.34	33.1 ±7.07	63.9 ±5.81	28.6 ±2.38	19.7 ±1.52	11.7 ±7.04	8.7 ±4.63
12.5	142.1 ±6.66	35.6 ±7.04	65.6 ±6.40	29.2 ±2.00	20.3 ±1.94	12.8 ±5.79	8.9 ±3.89
13.0	146.1 ±9.66	41.3 ±10.93	69.7 ±7.41	29.9 ±2.19	21.1 ±1.77	16.1 ±6.14	12.4 ±6.65
13.5	146.6 ±8.87	43.6 ±10.44	71.2 ±8.52	30.2 ±2.20	21.6 ±2.54	17.2 ±7.63	15.6 ±9.09
14.0	146.7 ±5.43	44.2 ±10.31	72.0 ±10.30	30.3 ±1.79	21.6 ±3.33	19.9 ±9.57	17.3 ±11.07
14.5	148.4 ±7.14	43.8 ±7.97	71.7 ±7.73	30.5 ±2.21	21.7 ±2.89	17.0 ±8.32	14.2 ±11.14
15.0	152.0 ±8.32	43.0 ±9.33	70.1 ±5.57	31.7 ±2.98	22.1 ±1.34	12.1 ±5.65	9.2 ±3.98
15.5	152.5 ±9.60	45.3 ±8.92	72.5 ±6.59	32.3 ±2.55	22.7 ±2.35	14.6 ±6.05	11.5 ±5.91
16.0	154.6 ±5.11	44.5 ±7.73	72.7 ±8.28	32.9 ±1.28	22.6 ±1.59	13.9 ±7.05	11.1 ±6.02

Table 2: Mean and standard deviation of Yearly Height velocity (cm/year), weight velocity (kg/year), chest circumference velocity (cm/year), biacromial diameter velocity (cm/year), bicristal diameter velocity (cm/year), triceps skinfold thickness velocity (mm/year), subscapular skinfold thickness velocity (mm/year), in adolescent boys with Steroid-Sensitive Nephrotic Syndrome.

Age interval (±year)	Height velocity (cm/year) Mean ± SD	Weight velocity (kg/year) Mean ± SD	Chest circumference velocity (cm/year) Mean ±SD	Biacromial diameter velocity(cm/year) Mean± SD	Bicristal diameter velocity (cm/year) Mean±SD	Triceps SFT velocity (mm/year) Mean ± SD	Subscapular SFT velocity (mm/year) Mean± SD
9.0-10.0	1.5 ±0.82	1.2 ±1.26	1.2 ±1.13	0.7 ±0.93	1.1±1.55	0.08±1.57	0.3 ±1.63
10.0-11.0	1.7 ±1.15	1.2 ±1.24	1.2 ±1.05	0.5 ±0.61	1.1± 0.90	0.4 ±1.27	0.2 ±0.79
11.0-12.0	1.7 ±1.09	1.3 ±1.15	1.3 ±1.33	0.7 ±0.80	0.7±0.97	0.09±2.31	0.2 ±2.07
12.0-13.0	1.7 ±1.07	1.4 ±1.49	1.5 ±1.33	0.8 ±0.68	1.0±0.93	0.3 ±2.74	0.1 ±1.67
13.0-14.0	2.0 ±2.01	1.3 ±1.75	1.6 ±1.64	0.4 ±0.88	0.7±0.66	0.3 ±3.40	0.03±2.60
14.0-15.0	2.2 ±2.61	2.3 ±3.47	2.1 ±2.42	1.2 ±1.18	1.5±1.47	0.5 ±3.10	0.7 ±2.77
15.0-16.0	1.5 ±1.34	1.5 ±0.22	0.7 ±0.31	0.3 ±0.59	0.5±0.35	0.8 ±2.32	0.2 ±1.49

compared with their normal well-off Chandigarh[30] and Leeds counterparts.[31] Further, attainment of peak height (PHV) and weight (PWV) velocities in boys with steroid sensitive nephrotic syndrome was delayed as compared to normal Chandigarh and Leeds children.

Mean chest circumference growth velocity measuring 1.23±1.13 cm/year between 9 to 10 years of age showed regular increase to attain a peak value measuring 2.11cm/year at 14.5 years of age. Thereafter, like height and weight it experienced a rapid deceleratory trend to measure 0.78cm/year between 15 to 16 years of age. In general, growth velocities of biacromial diameter, bicristal diameter, triceps skin fold thickness and subscapular skinfold thickness depicted inconsistent trend with a high degree of variability around the mean values (Table. 2)

Discussion

The distance growth curves plotted for height and body weight (Fig 1 and 2) of children with steroid sensitive nephrotic syndrome (SSNS) demonstrated a regular increase in mean values of these two auxological parameters, throughout the period of this study. However, rapidity of this increase was relatively sharper upto around 13.5 years, whereafter it became slower. Boys with SSNS measured shorter than their normal American (CDC)[28] and affluent Indian[27] counterparts as their height growth curve ran below those plotted for children of American and Indian origin. The relative magnitude of this statural growth retardation was found to be greater when contrasted with their normal American[28] than Indian[27] counterparts and it increased in magnitude beyond 13.5 years with advancement of age. This may be due to effect of chronic nature of the disease itself and influence of steroid therapy with which boys with SSNS were treated. Shorter height attainments noticed amongst our study subjects i.e. boys with steroid sensitive Nephrotic syndrome resemble with the findings of Donatti et. al.[6], Emma et. al.[7], Kitamura[8], Tsau et. al.[9], Hung et. al.[10], Osamu et. al.[11], Salim et. al.[12] Mohan et. al.[3], Rees et. al.[21], Motoyama et. al.[22], Ayoub et. al.[23], Alan M[24] and Allen DB[25] who also observed shorter height in SSNS children. Significantly, more severe height growth retardation yielding short stature amongst boys with SSNS during peripubertal age recorded by Kitamura et. al.[8], Emma et. al.[7] and Salim et. al.[12] are similar to our findings. However, these observations are at variance with those of Saha et. al.[17], Adhikari et. al.[18], Ruth et. al.[19] and Abbas et. al.[20] who did not notice any difference in mean height attainments of children with steroid-sensitive nephrotic syndrome as compared to their normal peers. Height growth curve plotted for children with SSNS not only ran below those of the American and Indian children but exhibited parallelism until 13.5 years, afterwards it suddenly diverged to impair height more severely, to make them short individuals.

It has further been observed that like height and weight, growth of chest circumference, biacromial diameter and bicristal diameter in boys with steroid sensitive Nephrotic syndrome was also compromised as compared to their normal counterparts.[27,28,29] Exception to this were triceps and subscapular skinfold thicknesses which in general had more of fat than normal boys and became fatter between 12 to 14 years due to excessive deposition of appendicular fat at triceps, as well as truncal fat in the subscapular region.

Boys with steroid sensitive nephrotic syndrome not only experienced delay in attainment of peak height and weight velocities, but the magnitude of peak height velocity (PHV) and peak weight (PWV) velocity was found to be substantially lesser than their normal Chandigarh[30] and Leeds counterparts[31], which may be the reason for relatively shorter height (Fig 1) and lighter weight (Fig. 2) attainments noticed amongst boys with SSNS as compared to their normal peers. However, inter-population auxological comparison for other body parameters could not be attempted because of the non-availability of suitable sets of comparative data on normal subjects belonging to different population stocks.

Conclusions

The relatively impaired auxological status recorded amongst boys with SSNS appears to be due to influence of chronic nature of the disease itself as well as effect of steroid therapy which is known to impair growth in children. On the contrary, growth of subcutaneous fat measured in terms of triceps and subscapular skinfold thicknesses exhibited relatively fatter attainments amongst boys with SSNS than their normal counterparts.

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