The Internet Journal of Biological Anthropology
Volume 3 Number 1

Relationship of Obesity with Lumbar Range of Motion in School going Children of Amritsar, Punjab, India.

S Koley, N Kaur, J Sandhu

Citation

S Koley, N Kaur, J Sandhu. *Relationship of Obesity with Lumbar Range of Motion in School going Children of Amritsar, Punjab, India.*. The Internet Journal of Biological Anthropology. 2008 Volume 3 Number 1.

Abstract

The purpose of this study was to establish the relationship between obesity and lumbar range of motion in 300 randomly selected normal, healthy school going children (150 boys and 150 girls) aged 6-15 years of Amritsar, Punjab, India. Height, weight, body mass index (BMI), percent body fat, percent lean body mass, lumbar flexion, lumbar extension and lumbar lateral flexion were measured on all the subjects following the standard techniques. The findings of the study indicate highly significant negative correlations both in boys and girls, between BMI and lumbar flexion (r= - 0.528 and - 0.393 respectively), lumbar extension (r= - 0.339 and -0.471 respectively) and lumbar lateral flexion (r= - 0.421 and -0.318 respectively), between percent body fat and lumbar flexion (r= - 0.393 and -0.247 respectively), lumbar extension (r= - 0.221 and -0.413 respectively) and with lumbar lateral flexion (r= - 0.340 in boys only). It could be concluded that obesity in terms of BMI and percent body fat has some strong association with lumbar range of motion in the studied samples.

INTRODUCTION

Childhood obesity, now days, has become a serious medical complication and global epidemic[1] and physicians are increasingly recognizing that obese children experience considerable comorbidities[2]. In adults, too, obesity has been associated with musculoskeletal pain[34] . According to a study conducted by Jugesh et al[5] on 2008 school children aged between 9-15 years, the prevalence of obesity and overweight was 11.1% and 14.2% respectively in India. Discrimination against overweight children begins early in childhood and becomes progressively institutionalized[6]. Recent literatures [156] showed increase in overweight among children and teens. Since last four decades, for children aged 2 to 5 years, the prevalence of overweight increased from 5.0 percent to 13.9 percent; for those aged 6 to 11 years, prevalence increased from 6.5 percent to 18.8 percent; and for those ages 12 to 19 years, prevalence increased from 5.0 percent to 17.4 percent. These increasing rates of obesity and overweight have significant implications to the health care community[7]. Body mass index (BMI) is commonly used to identify obesity. It is also obvious that obesity was defined as a BMI ≥27.8 for males and ≥ 27.3 for females[8].

Adequate range of motion is necessary for the acquisition and maintenance of normal spinal movement patterns in the developing child[9]. During the growth and maturation process, spinal posture and mobility provide forces that contribute to the shape of the individual vertebra, which ultimately contribute to the posture and mobility of the mature spine[10]. Tanz[11] found great variation in mobility between subjects in both children and adults, the children in his study had notably larger average mobility than the adults. Taylor and Twomey[12] found that children from birth through 12 years of age had greater lumbar spine mobility in total flexion-extension and in rotation than those of 13 to 17 years of age and adults had less mobility than the 13- to 17-year-old group. Both adults and children were found to have great individual variability in lumbar spine mobility. So far sex differences are concerned; Haley et al[13] stated that girls had greater lumbar spine mobility than boys in flexion and side bending. Konndratek et al [14] provided the basic normative values for lumbar range of motion in children. Despite the greater prevalence of musculoskeletal disorders in obese adults, very few literatures are available regarding the consequences of childhood obesity on the development and functions of the musculoskeletal system. To fulfill the lacunae the present study was planned.

MATERIALS AND METHODOLOGY

The present cross – sectional study was based on randomly selected 300 normal healthy school going children (150 boys and 150 girls) from Khalsa College Public School, Amritsar, Punjab, India. The data were collected between July to October, 2007. Subjects were taken from the age groups 6-15 years with 30 subjects in each group (15 boys and 15 girls). Subjects were excluded in case of presence of any condition affecting spine or lower limbs including inflammatory disorders, neurological diseases, metastatic disease or low back pain. The age of the subjects were recorded from the school record, the subjects were divided in such a way that “age 6”, for instance refers to the children aged 5 years and 6 months through 6 years and 5 months and 29 days. Demographic information was collected in the form of questionnaire from each subject (with the help of the respective parents in case of small children). The study was approved by the local ethics committee.

ANTHROPOMETRY

The various parameters, viz. height, weight, BMI, lumbar flexion, lumbar extension and lumbar lateral flexion were measured by standard methods15,16,17 . The height was recorded during inspiration using a stadiometer (Holtain Ltd., Crymych, Dyfed, UK) to the nearest 0.1 cm, and weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. BMI was then calculated using the formula weight (kg)/height2 (m)2. Lumbar flexion, lumbar extension and lumbar lateral flexion were measured as per the methods described by Mayer et al.[16] with inclinometer. Percent body fat was measured according to Siri’s equation[17] which included; for boys, percent body fat = [(495 / Body Density) – 457] and for girls, percent body fat = [(501/ Body Density)-457].

Data analysis

Descriptive statistics (mean ± standard deviation) were determined for all directly measured and derived variables. Comparisons between school going boys and girls for all the measured variables were made using an independent t-test. Pearson’s correlation coefficients were used for correlation coefficient test. Data were analyzed using SPSS (Statistical Package for Social Science) version 7.5. A 5% level of probability was used to indicate statistical significance.

RESULTS AND DISCUSSION

Table1a and b show the distribution of mean values and standard deviations of height, weight and BMI in school going boys and girls of Amritsar. In height, both boys and girls have a specific trend of age wise increment with girls having higher height than the boys do until the age of 9 years after which boy’s attained higher height. The minimum mean values for height were recorded as 117.93cm in boys and 120.01cm in girls in the age group 6+ years and the maximum mean values 168.23cm in boys and 157.78cms in girls in the age group 15+ years with highly significant differences ($p \leq 0.001$) in the age group 9+ years (t = 4.66) and 15+ years (t = 4.46) between boys and girls. In case of weight, girls had higher mean weight than boys corresponding to their higher heights, the minimum mean values (21.30kg in boys and 23.19kg in girls) were found in the age group 6+ years and the maximum mean values (53.70kg in boys and 50.11kg in girls) were noted in age group 15+ years with statistically significant differences ($p \leq 0.05$) in age group 7+ years (t = 3.25) and age group 8+ years (t = 3.58) and highly significant differences ($p \leq 0.001$) in age group 9+ years (t = 5.75) between them. BMI as being dependent upon both height and weight showed the similar trend as weight, mean values being higher in girls owing to the greater weight; the minimum mean values (14.85 kg/m^2 in boys and 14.86 kg/m^2 in girls) were noted in age group 10+ years and maximum mean values (19.31 kg/m^2 in boys and 20.16 kg/m^2 in girls) were noted in the age group 14+ years in boys and age group 15+ years in girls. Statistically significant differences ($p \leq 0.05$) were found in age group 7+ years (t=3.41), 8+ years (t=3.22), 9+ years (t=4.14) and age group 13+ years (t=2.08) between them for this trait.

Figure 6

Table 4: Correlation co-efficient (r) of lumbar flexion, extension and lateral flexion with 5 parameters

Age Group (years)	Height (cm)					Weight (kg)				
	Boys		Girls		t-value	Boys		Girls		t-value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
6+	117.93	±4.83	120.01	±5.77	1.07	21.30	±2.85	23.19	±3.49	1.62
7+	123.15	±8.11	127.69	±5.14	1.83	22.73	±3.81	28.73	±6.05	3.25*
8+	126.71	±4.01	130.87	±7.94	1.81	24.47	±2.74	29.93	±5.24	3.58*
9+	126.71	±4.01	134.85	±5.45	4.66*	24.47	±2.74	31.20	±3.61	5.75*
10+	137.57	±2.08	136.43	±5.58	0.75	28.07	±4.22	27.57	±3.68	0.35
11+	144.64	±4.52	143.73	±7.06	0.42	35.00	±8.97	34.13	±6.66	0.30
12+	149.01	±12.07	147.03	±6.11	0.57	38.07	±7.08	36.63	±6.52	0.58
13+	152.51	±9.67	151.31	±5.43	0.42	40.43	±7.68	44.67	±8.40	1.44
14+	158.26	±7.42	157.23	±5.06	0.44	48.74	±12.78	45.67	±7.29	0.81
15+	168.23	±7.15	157.78	±5.99	4.46**	53.70	±13.35	50.11	±9.87	0.84

* indicates $p \leq 0.05$; ** indicates $p \leq 0.001$

Figure 3

Table 2: Age-wise distribution of mean values and standard deviations of percent body fat and percent lean body mass in boys and girls of Amritsar.

Age Group (years)	Percent body fat					Percent lean body mass				
	Boys		Girls		t-value	Boys		Girls		t-value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
6+	14.83	±3.12	21.02	±3.78	4.88**	85.17	±3.12	79.01	±3.78	4.86**
7+	14.65	±2.19	21.02	±3.78	5.63**	85.35	±2.18	78.98	±3.78	5.65**
8+	15.59	±2.97	21.05	±3.78	4.39**	84.41	±2.97	78.98	±3.78	4.37**
9+	15.59	±2.97	20.83	±3.46	4.45**	84.41	±2.97	79.17	±3.46	4.45**
10+	14.23	±3.62	17.89	±2.52	3.21*	85.74	±3.60	82.11	±2.52	3.19*
11+	18.22	±5.81	21.01	±3.31	1.61	81.78	±5.81	78.99	±3.30	1.62
12+	19.59	±4.81	21.21	±2.30	1.18	80.41	±4.81	78.79	±2.30	1.18
13+	19.73	±4.08	25.30	±3.38	4.08**	80.27	±4.08	74.70	±3.38	4.08**
14+	22.81	±5.62	23.40	±3.73	0.34	77.23	±5.55	76.60	±3.73	0.36
15+	19.65	±6.05	25.63	±4.46	3.16*	80.35	±6.05	74.44	±4.15	3.12*

* indicates p≤0.05; ** indicates p≤0.001

Figure 4

Table 3a: Age-wise distribution of mean values and standard deviations of lumbar flexion and lumbar extension in boys and girls of Amritsar.

Age Group (years)	Lumbar Flexion					Lumbar Extension				
	Boys		Girls		t-value	Boys		Girls		t-value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
6+	60.60	±2.56	60.00	±1.65	0.76	30.80	±2.34	31.07	±2.81	0.28
7+	60.33	±2.09	58.07	±2.25	0.31	32.40	±1.80	31.20	±3.59	1.16
8+	60.00	±1.25	59.47	±1.36	1.12	29.40	±0.47	30.00	±1.31	1.04
9+	60.00	±1.25	58.00	±2.04	3.24*	29.40	±1.80	33.07	±1.22	6.51**
10+	61.40	±1.96	59.80	±1.97	2.23*	30.73	±1.58	36.13	±8.89	10.90**
11+	60.07	±1.58	57.80	±1.90	3.56*	32.27	±1.83	29.67	±0.98	4.85**
12+	62.33	±2.02	58.00	±8.82	1.85	29.13	±2.59	32.00	±2.39	3.15*
13+	61.00	±1.69	58.93	±3.63	2.80	33.07	±2.60	29.87	±2.92	3.16*
14+	59.87	±2.17	59.27	±2.34	0.73	32.13	±2.67	29.53	±3.02	2.50*
15+	59.47	±3.09	59.27	±2.41	0.17	31.93	±3.15	29.27	±3.63	2.15*

* indicates p≤0.05; ** indicates p≤0.001

The distribution of mean values and standard deviations of lumbar flexion, lumbar extension and lumbar lateral flexion of school going boys and girls of Amritsar are given in table 2. In case of lumbar flexion, the minimum mean values (58.33° in boys and 57.80° in girls) were noted in the age group 7+ years in boys and age group 11+ years in girls and the maximum mean values (62.33° in boys and 60.00° in girls) were found in the age group 12+ years in boys and age group 6+ years in girls. Statistically significant differences (p≤0.05) were found in age group 9+ years (t=3.24), 10+ years (t=2.23) and in age group 11+ years (t=3.56) between the two sexes. In case of lumbar extension, the minimum mean values (29.13° in boys and 29.27° in girls) were noted in the age group 12+ years in boys and age group 15+ years in girls and the maximum mean values (33.07° in boys and 36.13° in girls) were recorded in the age group 13+ years in boys and age group 10+ years in girls. Statistically significant differences (p≤0.05) were found in age group 12+ years (t=3.15), 13+ years (t=3.16), 14+ years (t=2.50) and in age group 15+ years (t=2.15) and highly significant differences (p≤0.001) were noted in the age

Figure 5

Table 3b: Age-wise distribution of mean values and standard deviations of lumbar lateral flexion in boys and girls of Amritsar.

Age group (years)	Boys		Girls		t-value
	Mean	SD	Mean	SD	
6+	22.07	±3.17	19.27	±2.49	2.69*
7+	22.93	±1.83	21.33	±4.37	1.31
8+	18.33	±2.19	17.73	±1.75	0.83
9+	18.33	±2.19	18.60	±1.18	0.41
10+	17.40	±1.88	19.47	±1.50	3.32*
11+	16.47	±0.91	17.27	±1.44	1.82
12+	17.47	±2.29	18.60	±1.24	1.68
13+	18.80	±1.42	18.73	±2.94	0.08
14+	17.13	±4.85	19.13	±1.73	1.50
15+	18.00	±2.70	21.80	±3.59	3.28*

* indicates p≤0.05

{image:5}

group 9+ years (t=6.51), 10+ years (t=5.90) and in age group 11+ years (t=4.85) between them. In case of lumbar lateral flexion, the minimum mean values (16.47° in boys and 17.27° in girls) were noted in the age group 11+ years and the maximum mean values (22.93° in boys and 21.80° in girls) were found in the age group 7+ years in boys and age group 15+ years in girls. Statistically significant differences (p≤0.05) were found in age group 6+ years (t=2.69), 10+ years (t=3.32) and in age group 15+years (t=3.28) between them.

Table 3 shows the distribution of mean values and standard deviations of percent body fat and percent lean body mass in school going boys and girls of Amritsar. In case of percent body fat, the minimum mean values (14.23% in boys and 17.89% in girls) were found in the age group 10+ years and maximum mean values (22.81% in boys and 25.30% in girls) in age group 14+ years in boys and 15+ years in girls with statistically significant differences (p≤0.05) in age group 10+ years (t = 3.21) and age group 15+ years (t=3.16) and highly significant differences (p≤0.001) in age group 6+ years (t = 4.88), 7+ years (t=5.63), 8+ years (t=4.39), 9+ years (t=4.45) and in age group 13+ years (t=4.08) between boys and girls. In case of percent lean body mass, the minimum mean values (77.23% in boys and 74.44% in girls) were noted in the age group 14+ years in boys and age group 15+ years in girls and the maximum mean values (85.74% in boys and 82.11% in girls) were recorded in age group 10+ years with statistically significant differences recorded (p≤0.05) in age group 10+ years (t = 3.19) and age group 15+ years and highly significant differences (p≤0.001) in age group 6+ years (t=4.86), 7+ years (t=5.65), 8+ years (t=4.37), 9+ years (t=4.45) and in age group 13+ years (t=4.08).

The correlation co-efficient of lumbar flexion, lumbar extension and lumbar lateral flexion with other five parameters in boys and girls of Amritsar are shown in table 4. In boys, highly significant positive correlations were observed between percent lean body mass and lumbar flexion (r=0.391), lumbar extension (r= 0.220) and lumbar lateral flexion (r=0.341) and in girls, highly significant positive correlations were noted with lumbar flexion (r=0.248) and with lumbar extension (r=0.413). In boys, highly significant negative correlations were observed between percent body fat and lumbar flexion (r= -0.393), lumbar extension (r= - 0.221) and lumbar lateral flexion (r=-0.340) and in girls, highly significant negative correlations were noted with lumbar flexion (r= - 0.247) and lumbar extension (r= - 0.413). Highly significant negative correlations were observed between BMI and lumbar flexion (r= - 0.528 in boys and r= - 0.393 in girls), lumbar extension (r= - 0.339 in boys and r= - 0.471 in girls) and lumbar lateral flexion (r= - 0.421 in boys and r= - 0.318 in girls). Highly significant negative correlations were observed between weight and lumbar flexion (r= - 0.285in boys and r= - 0.279 in girls), and lumbar lateral flexion (r= - 0.423 in boys only) and with lumbar extension (r= - 0.380 in girls only). For height, statistically significant positive correlation were observed with lumbar extension (r=0.164) and highly significant negative correlation with lumbar lateral flexion (r=0.372) in boys and statistically significant negative correlation with lumbar extension (r= - 0.173) in girls.

{image:6}

The purpose of the study was to explore the correlations between obesity in terms of BMI and percent body fat and lumbar flexion, extension and lumbar lateral flexion in school going children aged 6-15 years of Amritsar. The present study revealed that, by about 9-10 years in girls and 11-12 years in boys, the rate of growth began to increase. Girls had higher height than boys till the age of 9 years after which boys attained higher height than girls. But in another study conducted by Malina[18] this rate of growth occurred by about 10-11years in girls and 12-13 years in boys. This acceleration in height marks the beginning of the adolescent growth spurt, a period of rapid growth. The rate of growth increases until it reaches a peak then gradually decreases and eventually stops. Highly significant negative correlations were identified between BMI and lumbar flexion, extension and lateral flexion in both boys and girls which were consistent with findings of Michele et al[19] which concluded that obesity also was related significantly to the flexibility measurements. Highly significant negative correlations were found in the present study between percent body fat and lumbar range of motions in boys and with lumbar flexion and extension in girls. The similar findings were noted by Gilleard and Smith[20] showing decreased range of forward flexion motion and concomitant increases in hip joint moment which gave insight into the aetiology of functional decrements and musculoskeletal pain seen in obesity. The Body weight and lumbar flexion also showed highly significant negative correlations in both school going boys and girls showing that greater body weight was associated with lesser lumbar flexion.

References

1. Kosti RI and Panagrotakos DB (2006) The epidemic of obesity in children and adolescent in the world. Cent Eur J Public Health, 14:151-159.
2. Cruz ML, Shaibi GQ, Weigensberg MJ, Spruijt-Metz D, Ball GD and Goran MI (2005) Pediatric obesity and insulin resistance: chronic disease risk and implications for treatment and prevention beyond body weight modification. Annu Rev Nutr, 25: 435–468.
3. Peltonen M, Lindroos AK and Torgerson (JS 2003) Musculoskeletal pain in the obese: a comparison with a general population and long-term changes after conventional and surgical obesity treatment. Pain, 104: 549–557.
4. Andersen RE, Crespo CJ, Bartlett SJ, Bathon JM and Fontaine KR (2003) Relationship between body weight gain and significant knee, hip, and back pain in older Americans. Obes Res, 11:1159–1162.
5. Jugesh C, Manorma V and Riar SK (2004) Obesity among pre-adolescent and adolescents of a developing country (India). Asia Pac Clin Nutr, 13(3):231-52.
6. William HD (1998) Health consequences of obesity in youth: Childhood predictors of adult disease. Pediatrics, 101:518-525.
7. Barlow S (2007) Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: Summary report. Pediatrics, 120:S164-S192.
8. Robert CW, Margaret SP, Jeffery AW and William HD (1998) Early adiposity rebound and the risk of adult obesity. Pediatrics, 101: 1-6
9. Brooks-Scott S (1997) Mobilization for the Neurologically Involved Child. San Antonio: Therapy Skill Builders.
10. Gajdosik C and Gajdosik R (2006) Musculoskeletal development and adaptation. In:. Physical Therapy for Children. St. Louis: Elsevier, 3:191-216.
11. Tanz SS (1953) Motion of the lumbar spine: a roentgenologic study. Am J Roentgenol, 69: 399-412.
12. Taylor J and Twomey L (1980) Sagittal and horizontal plane movement of the human lumbar vertebral column in cadavers and in the living. Rheumatol Rehab, 19: 223-232.
13. Haley S, Tada W and Carmichael E (1986) Spinal mobility in young children: a normative study. Phys Ther, 66:1697-1703.
14. Konndratek M, John K, Christine S and Ronald O (2007) Normative Values for Active Lumbar Range of Motion in Children. Pediat Phy Therap, 19(3): 236-244
15. Weiner JS and Lourie JA (1969) Human Biology: A guide to field methods.1BP No. 9, Blackwell, London.
16. Mayer TG, Kondraske G, Beals SB and Gatchel R J

(1997) Spinal range of motion: Accuracy and sources of error with inclinometer measurement. Spine, 22: 1976-1984.
17. Siri W E (1961) Body composition from fluid space and density. In Brozek J. & Hanschel A. (Eds.), Techniques for measuring body composition. National Academy of Science, Washington DC. Pp. 223-244.
18. Malina RM (1999) Normal weight gain in growing children. Healthy Weight J, 13: 37-38.
19. Michele C.B, Stanley JS, Ann S and Mark DW (1987) Spinal Flexibility and Individual Factors That Influence It. Phy Ther, 67(5): 653-658.
20. Gilleard W and Smith T (2007) Effect of obesity on posture and hip joint moments during a standing task, and trunk forward flexion motion. Int J Obesity, 31: 267–271.

Author Information

Shyamal Koley, Ph.D.
Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University

Navneet Kaur, M.S.P.T.
Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University

J.S. Sandhu, M.S. (Ortho.)
Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University