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"Association of BMI and Hand grip strength in school children in rural area of Maharashtra in India."

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Abstract:

Introduction: School is plays crucial role in physical fitness and health promotion in children. In developing countries like India, under nutrition is common in school children. This condition is more prominent in rural area of India, due to lack of education, health facilities and poverty. The present study was planned to find out correlation of BMI and Hand Grip Strength in school children around rural area of Loni (Bk); and to determine the gender differences in the same.

Methodology: A cross-sectional study carried out on 388 school children of age group between 5 to 15 years were examined, out of which 178 were male and 200 were female. Seven groups according to age were created viz. <6, <7, <8, <9, <10, <11, <14, <15 years. Height, weight and hand grip strength were measured with S.I. measuring tape, Bathroom scale and Baseline hand held dynamometer respectively. The correlation between age, height, weight, BMI and hand grip strength was analyzed by Pearson's correlation test. The differences between variables amongst both gender was analyzed by student t test.

Conclusion: The results of present study shown significant difference in BMI and Hand Grip Strength of Boys and Girls. Though this is an interim study showing correlation between BMI & handgrip strength showing under nutrition among school going children, will be helpful for other researchers in future.

Keywords: School children, BMI, hand grip strength, under nutrition.

Introduction:

The school children often engaged in various physical activities. Their growing physique needs more nutrition.The role of the school comes into focus here as children spend their larger life time in school. School may play a crucial role by helping to identify children with low physical fitness and by promoting positive health behaviors such as encouraging children to be active with special interest in the intensity of the activity. The family too could help by complementing the efforts of the school in ensuring children are active at home. As stated by the American academy of pediatrics (AAP), "physical activity needs to be promoted at home, in the community and at school, but school is perhaps the most encompassing way for all children to benefit" (American academy of pediatrics, 2006).[1]

'Under nutrition' is one of a primary cause of illness and premature mortality among children in developing countries.[2] Children residing in rural areas of India, disproportionately suffer more from under nutrition when compared to their urban counterparts.[3]In urban regions, there is risk of childhood obesity causing cardio-vascular as well as musculo-skeletal complications in future. Similarly, in rural region due to lack of education, poverty and insufficient health facilities school children tends to grow undernourished.

According to survey of ASER (Annual Status of Education Report) in Maharashtra state, 98.9 per cent of children of age group 6-14 years are attending either government or private schools.[4]Numbers of recent studies[5-6] have drawn attention to increases in fatness and declines in aerobic fitness in school

age children. The implications of decreasing fitness levels in children are considerable in previous studies it is observed that there is positive correlation between hand grip strength with weight, height and body surface area.[7]Age dependent increase of hand grip strength in boys and girls as well as inter-gender differences was strongly associated with changes of fat free mass during their childhood.[8]Hand grip strength and body mass index (BMI) are well established indicators of nourishment and considered as growth indicators.[1] With this background the present study was planned to find out correlation between hand grip strength and BMI of the school children, as well as to determine the gender differences in the same.

Methodology:

In present cross-sectional study total of 388 of school children of age group between 5 to 15 years were examined, out of which 178 were male and 200 were female. All were learning in various primary schools around Loni (Bk) in Maharashtra in India. The investigators visited respected schools within time period of 4 months; May 2012 to November 2012. The children were divided into 7 groups according to their age for comparing variables, viz. <6, <7, <8, <9, <10,<14, <15. The data collected in form of height, weight for body mass index (BMI) and hand grip strength. Three anthropometric traits, viz. height, weight and BMI, and right hand grip strength were taken on each subject. The height (to the nearest 0.1 cm) and weight (to the nearest 0.1 kg) of the subjects were measured with S.I. unit measuring tape and bathroom scale weighing machine respectively.BMI was then calculated using the formula [weight (kg)/height $(m)^2$]. The grip strength of right hand was measured using a standard Baseline hand held grip dynamometer (Jamar Scientific Instruments Co. LTD)* at sitting position with shoulder adducted and neutrally rotated and elbow in ninety degree flexion and resting on table. The subjects were asked to put maximum force on the dynamometer thrice. The average value was recorded in kilograms. Student's t test and Pearson's coefficient of correlation were used for statistical analyses.

*Baseline Hand held dynamometer, (Jamar®)
3700; Sagamore Parkway North P.O. Box 5729
Lafayette, IN 47903 USA, Tel: 765.423.1505
Fax: 765.423.4111 E-mail: info@lafayetteinstrument.com
www.lafayetteinstrument.com

Data Analysis and Results: The distribution of mean and standard deviation of height is given in **Table 1**. Maximum mean value in boys observed in age group <15 years (162.75 cm±9.81) whereas, lowest in age group <6 years (110.63 cm±3.86). In girls maximum mean value (150.65cm±4.80) found in age group<15 years, and minimum (109.25±6.29) in age group <6 years. In all age groups, <15 years age group shown extremely significant difference ($p<0.001$) in which ($t=4.255$), <8 and <10 years age groups noted significant differences ($p<0.05$) where ($t=2.339$) and ($t=2.208$) respectively. Age group <6years ($t=0.701$), <7 years ($t=0.476$), <9 years ($t=0.312$) and <14 years ($t=1.526$) found no significant differences between boys and girls.

In **Table 2**; distribution of mean and standard deviation of weight is shown. Maximum mean values in boys demonstrated by age group <15 years (49.25kg±13.14), while lowest was of <7 (16.03kg±1.68). In girls maximum mean value was of age group <15 years (40.31kg±8.35) while lowest was shown by <6 years (15kg±1.51). The age group<10 shown highly significant difference ($p<0.001$) where,($t=2.638$); age group <6 and <15 years were quite significant ($p<0.05$) in which ($t=1.781$) and ($t=1.914$) respectively. Whereas, age group <7 years ($t=1.147$), <8 years ($t=1.573$), <9 years ($t=0.9451$) and <15 years ($t=0.513$) noted no significant differences amongst them.

Age group (yrs)	Height (Cm)				
	Boys		Girls		't' value
	Mean	SD	Mean	SD	
<6	110.631	3.8616	109.25	6.2962	0.7015
<7	110.6	4.6694	109.788	5.5931	0.4768
<8	119.25	6.7324	115.517	4.8669	2.339
<9	122.619	6.2545	123.3	5.8698	0.3128
<10	128.913	9.9631	123.939	6.9143	2.208
<14	133.3333	23.0882	143.705	10.1166	1.526
<15	162.75	9.8107	150.657	4.8016	4.255

(SD=Standard Deviation)

Table 1: Distribution and difference of height measurement in boys and girls

Age group	Weight				
	Boys		Girls		't' value
	Mean	SD	Mean	SD	
<6	16.3947	1.9761	15	1.5118	1.781
<7	16.0333	1.6871	15.6760	1.9659	1.147
<8	19.1875	1.8755	18.3620	1.9221	1.573
<9	20.8571	3.2652	19.8	2.7507	0.9451
<10	25.0869	7.08976	21.2727	3.6402	2.638
<14	31.8333	20.8654	34.9411	8.8067	0.513
<15	49.25	13.1497	40.3142	8.3587	1.914

(SD=Standard Deviation)

Table 2: Distribution and difference of weight in boys and girls

Table 3 displays distribution of BMI in boys and girls in various age groups, in which maximum mean value was recorded in age group of <15 years (18.31kg±2.781) and lowest was in <7 years (13.104±1.204). In girls, maximum mean value of BMI noted in age group <15 years (17.71±3.25) and minimum in <6 years (12.59±1.053). The analysis revealed that age group <10 years shown significant difference ($p<0.05$) ($t=2.238$), <6 years shown quite significant ($p<0.05$) where ($t=1.725$). The age group <7 years ($t=1.197$), <8 ($t=778$), <9 years ($t=1.373$), <14 ($t=0.017$) and <15 years ($t=0.352$) shown no significant difference in BMI of boys and girls.

BMI					
Age group	Boys		Girls		t' value
	Mean	SD	Mean	SD	
<6	13.4973	1.3001	12.5987	1.0531	1.725
<7	13.1043	1.2048	13.1721	1.3429	1.197
<8	13.5691	1.2485	13.8451	1.3139	0.7784
<9	13.8531	1.4263	13.096	2.0931	1.373
<10	14.8578	1.9440	13.7706	1.6735	2.238
<14	16.175	5.1634	16.2029	2.5069	0.0176
<15	18.31	2.7819	17.7114	3.2535	0.3524

(SD=Standard Deviation)

Table 3: Distribution and difference of BMI in boys and girls

Table 4 shows hand grip strength measurement in boys and girls of various age groups. In the boys maximum mean hand grip strength was in age group <9 years (16.54kg±8.30) while, minimum seen in age group <6 years (7.41kg±3.70). In girls, maximum mean value was seen in age group <10 years (13.82±6.41) while minimum in age group <15 years (3.63±2.53). The analysis shown, extremely significant difference in age group <15 years (t=6.227) while, age group >14 years (t=2.318) and >7 years (0.578) shown significant difference in hand grip strength of boys and girls.

Hand grip strength					
Age group	Boys		Girls		t' value
	Mean	SD	Mean	SD	
<6	7.4178	3.7021	8.24	2.1663	0.5833
<7	9.8816	5.1725	8.3345	4.0446	0.5784
<8	10.983	4.5255	11.7206	5.9094	0.501
<9	16.5452	8.3050	14.224	6.2509	0.8273
<10	15.6052	9.1242	13.8254	6.4116	0.8583
<14	11.6633	7.4330	4.7023	5.9356	2.318
<15	12.9975	5.2537	3.632	2.5301	6.227

(SD=Standard Deviation)

Table 4: Distribution and difference of hand grip strength in boys and girls.

Figure 1-4 shows the correlation in age, height, weight, hand grip strength and BMI in form of correlation coefficient (*r*). The Pearson correlation test was used for analysis. Height, weight BMI and hand grip strength shows significant positive correlation with increasing age, in boys and girls.

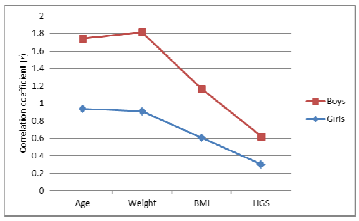


Figure 1: Comparison of age with height, weight, BMI and hand grip strength by Pearson's correlation coefficient.

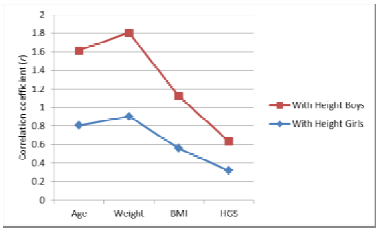


Figure 2: Comparison of height with age, weight, BMI and hand grip strength by Pearson's correlation coefficient.

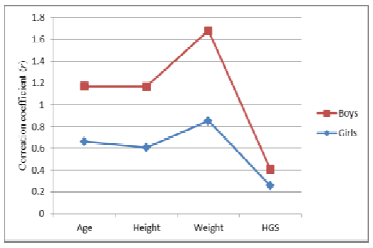
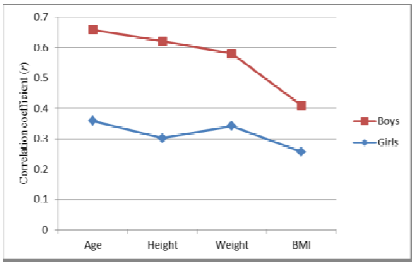


Figure 3: Comparison of BMI with age, height, and weight by Pearson's correlation coefficient.



Discussion:

The results of present study denote normal growth of height according to age, with significant differences in boys and girls. Maximum height was in girls (age group <15, mean150.65cm±4.80). Weight has been shown in boys comparatively girls maximum in age group <15 years. These findings support outcomes of Khadilkar et al (2009)[9] which shows increment in height of boys and girls aged between 5-18 years (1.7 cm in boys and 2 cm in girls) as well as, suggesting that boys are getting heavier than girls. The increasing gap between obese and thin boys is also revealed by results showing, marked growth of weight from 10th year of age to 14th year. The BMI of children shows significant malnourishment in both boys and girls; prominently more in girls according to indices provided by Agarwal KN et al (2001)BMI for children.[10]Chatterjee and Chowdhuri (1991) shown that, right and left handgrip strength was positively correlated with age, height, weight and body surface area.[11]It is also reported that handgrip strength determines the muscular strength of an individual (Foo 2007).[12]Thus hand grip strength is proved to be good predictor of physical strength of the individual. The current study depictsgradual decline in hand grip strength after 7 years of age till 14 years in boys, and sudden drop in hand grip strength after 10 years in girls. These findings represents decline in physical strength according to age in both boys and girls. The correlation coefficient (*r*) shows noticeable positive correlation between age, height, weight, BMI, and hand grip strength between boys and girls. The figures 1 to 4 shows striking decline in correlation between variables in girls comparatively boys. This denotes the weakening physical condition of girls in comparison of boys. A study by Amusa et al (2011) has shown similar results for hand grip strength and physical performance testing in South African children.[1] In India

similar study by Bharati et al (2005) has concluded that, girls shown lower anthropometric measurements than boys in Raichur district, Karnataka.[13]

These differences may have been occurred due to more male centered point of view of parents. Parent education is essential in rural areas along with proper diet and nutrition advice for school going children. The dropping physical strength could be severe issue in future. The increasing malnutrition could result in stunting and wasting.[14] Also, decreased physical performance due to loss of strength can result in obesity and related complications, like cardio-vascular problems. Hence; proper exercise training and sports facilities are also required for physical conditioning of children.

The findings of the present study would be of great value in medical anthropology research, population genetics studies and in physical therapy treatment strategies. In order to properly diagnose various nutritional deficits and its association with physical and physiological traits and concentrating on improvement of school going children for stop further deterioration in their health more future studies, required.

Conclusion:

The present study concludes that, there is under nutrition and decline in physical strength among rural school going children especially in girls of age 5 to 15 years within area of Maharashtra in India. Though this is an interim study showing correlation between BMI & Handgrip strength among school going children showing under nutrition ,will be helpful for other researchers in future.

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