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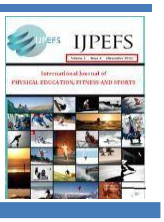

Full Length Article

Effects of Altitude on Growth of Circumference of Different Body Parts of 15 Years Old Adolescence

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Abstract: The purpose of the study was to find out the difference in circumference of different Body parts of 15 years old boys of Darjeeling. The samples are school students. Researcher had taken 106 male students each from Sukhia Pokhari Higher Secondary School (Alt.-7200 ft.), Trunbull higher Secondary school (Alt.-6700 ft.), Jnanpith High school(Alt.-3000 ft.) and Kadamtala High School(Alt.-430 ft.). Researcher had measured height and weight as personal data measured circumference of head, neck, arm relax, flex arm, waist, gluteal, calf and ankle.

It has been observed that there were significant differences in Head, neck, arm relax, flex arm and wrist.circumference.

Keywords: Body composition, Altitude, Girth measurement, Male students.

Introduction

Fat is the predictor of health of a human being. With the improvement in standards of living, decrease in physical activities, dependence of men on machine, dietary changes and other life style changes people are putting on extra weight. This gain in body weight and obesity is posing a real threat to health both in children as well as adults all over the world. Obesity has become a serious health problem in the developed as well as developing countries. In US current estimates have put the prevalence of overweight in adults at 61 % and of obesity at 26%. Similar patterns have been observed in majority of developing nations also. Globally the prevalence of obesity in women exceeds that in men. Over weight and obesity are risk factors for cardiovascular diseases, certain types of cancers, type 2 diabetes, hyper tension, osteoarthritis, gall stones, dyslipidemia and musculoskeletal problems. Children display the same co-morbid disease risk markers as for adults. As many as 75% of obese adolescents go on to become obese adults and carry the same risk of co-morbid disease in adulthood too. Simple anthropometrical measurements are taken to rule out obesity and are more practical both in the clinical practice and for large scale epidemiological studies. Body mass index (BMI) which is calculated as weight in kilograms divided by the square of height in meters is the most widely used and is a simple measure of body size. However this measurement does not account for variation in body fat distribution and abdominal fat mass. Excess intra-abdominal fat is associated with greater risk of obesity related morbidity than in overall adiposity. Waist circumference (WC) and waist-hip ratio (WHR) are the measures of visceral or abdominal fat mass. These measures are independent of height and muscle mass, have emerged as important predictors of risk of obesity related diseases and are thus very useful indicators of excess body fat and increased health risk. Measurements of WC and WHR are relatively simple and easier to calculate. It has been reported that WC and WHR showed significant association with myocardial infarction as compared to BMI. So the circumferences of the different body parts were measured to predict the body fat of an individual. As different altitude requires different body fat due to demand of the environmental conditions so fat percentage will vary on different altitudes.

Methods

Purpose of the Study

The purpose of the study was to find out the difference in circumference of head, neck, arm relax, flex arm, waist, gluteal, calf and ankle of 15 years old school going male adolescents.

The Subjects:

One hundred six school going male students from four different altitudes were selected randomly as the subject of study. The altitudes were 430 feet, 3000 feet, 6700 feet and 7200 feet respectively. The age of the subjects was 15 years.

Criterion Measures:

Researcher had measured age, height and weight as personal data and measured the circumference of head, neck, arm relax, flex arm, waist, gluteal, calf and ankle.

Result and Discussion

Table-1: Mean and S.D of height and weight of four different altitudes

		Height				Weight			
Altitude	**N**	**Mean**	**SD**	**SEm (±)**	**CD (P=0.05)**	**Mean**	**SD**	**SEm (±)**	**CD (P=0.05)**
Age 15									
Sukhiapokhori HS School	31	1.64	0.061	**0.010**	**NS**	49.39	5.566	**0.922**	**NS**
Trunbull HS School	25	1.63	0.069	**0.011**	**NS**	49.64	5.801	**1.027**	**NS**
Jnanpith High School	25	1.62	0.049	**0.011**	**NS**	50.48	5.067	**1.027**	**NS**
Kadamtala High School	25	1.63	0.042	**0.011**	**NS**	50.24	3.734	**1.027**	**NS**

From the above table it was found that the mean height of Group-I (7200 ft.), Group-II (6700 ft.), Group-III (3000 ft.) and Group-IV (430 ft.) were 1.64 mt., 1.63 mt, 1.62 mt. and 1.63 mt. Similarly the mean weights were 49.39 kg., 49.64 kg., 50.48 kg. and 50.24 kg.

Table no-2: Mean and S.D of circumference of different body parts

		Head				Neck			
Altitude	**N**	**Mean**	**SD**	**SEm (±)**	**CD (P=0.05)**	**Mean**	**SD**	**SEm (±)**	**CD (P=0.05)**
Sukhiapokhori HS School	31	53.59	1.757	**0.231**	**0.648**	31.79	2.538	**0.309**	**0.866**
Trunbull HS School	25	53.51	0.847	**0.257**	**0.720**	32.05	1.264	**0.344**	**0.964**
Jnanpith High School	25	54.44	1.273	**0.257**	**0.720**	33.49	1.206	**0.344**	**0.964**
Kadamtala High School	25	53.06	0.900	**0.257**	**0.720**	30.72	1.226	**0.344**	**0.964**
		Arm relax				**Flex arm**			
Sukhiapokhori HS School	31	22.99	1.944	**0.323**	**0.905**	25.52	2.206	**0.361**	**1.012**
Trunbull HS School	25	22.24	1.972	**0.360**	**1.009**	25.15	2.091	**0.402**	**1.127**
Jnanpith High School	25	22.54	1.178	**0.360**	**1.009**	25.87	1.427	**0.402**	**1.127**
Kadamtala High School	25	21.54	1.945	**0.360**	**1.009**	23.96	2.161	**0.402**	**1.127**
		Forearm				**Wrist**			
Sukhiapokhori HS School	31	23.31	1.300	**0.230**	**NS**	16.17	0.648	**0.099**	**0.278**
Trunbull HS School	25	22.56	1.359	**0.256**	**NS**	15.91	0.545	**0.110**	**0.308**
Jnanpith High School	25	23.30	1.063	**0.256**	**NS**	16.01	0.543	**0.110**	**0.308**
Kadamtala High School	25	22.78	1.368	**0.256**	**NS**	15.63	0.404	**0.110**	**0.308**
		Waist				**Gluteal**			
Sukhiapokhori HS School	31	64.41	4.385	**0.760**	**NS**	79.76	10.402	**1.182**	**NS**
Trunbull HS School	25	64.37	2.999	**0.847**	**NS**	81.63	3.974	**1.316**	**NS**
Jnanpith High School	25	66.52	3.469	**0.847**	**NS**	83.19	3.118	**1.316**	**NS**
Kadamtala High School	25	63.50	5.579	**0.847**	**NS**	78.94	4.821	**1.316**	**NS**
		Calf				**Ankle**			
Sukhiapokhori HS School	31	31.49	2.434	**0.418**	**NS**	21.48	2.189	**0.308**	**NS**
Trunbull HS School	25	30.46	2.934	**0.466**	**NS**	20.31	0.896	**0.343**	**NS**
Jnanpith High School	25	31.36	1.272	**0.466**	**NS**	20.76	1.194	**0.343**	**NS**
Kadamtala High School	25	30.50	2.323	**0.466**	**NS**	20.97	2.070	**0.343**	**NS**

Table no-3: Analysis of variance of circumference of different body parts

Source	Head					Neck				
	Sum of Squares	df	Mean Square	F	Sig.	Sum of Squares	df	Mean Square	F	Sig.
Altitude	24.790	3	8.263	5.011	.003	97.437	3	32.479	10.952	.000
Error	168.195	102	1.649			302.493	102	2.966		
Total	305273.71	106				108950.33	106			
Source	**Arm relax**					**Flex arm**				
	Sum of Squares	df	Mean Square	F	Sig.	Sum of Squares	df	Mean Square	F	Sig.
Altitude	30.040	3	10.013	3.087	.031	52.282	3	17.427	4.315	.007
Error	330.818	102	3.243			411.923	102	4.038		
Total	53386.26	106				67501.530	106			
Source	**Forearm**					**Wrist**				
	Sum of Squares	df	Mean Square	F	Sig.	Sum of Squares	df	Mean Square	F	Sig.
Altitude	11.107	3	3.702	2.261	.086	4.287	3	1.429	4.749	.004
Error	167.052	102	1.638			30.695	102	.301		
Total	56270.56	106				26982.510	106			
Source	**Waist**					**Gluteal**				
	Sum of Squares	df	Mean Square	F	Sig.	Sum of Squares	df	Mean Square	F	Sig.
Altitude	124.279	3	41.426	2.311	.081	280.674	3	93.558	2.161	.097
Error	1828.517	102	17.927			4416.342	102	43.297		
Total	445471.32	106				696991.44	106			
Source	**Calf**					**Ankle**				
	Sum of Squares	df	Mean Square	F	Sig.	Sum of Squares	df	Mean Square	F	Sig.
Altitude	24.002	3	8.001	1.476	.225	19.699	3	6.566	2.232	.089
Error	552.714	102	5.419			300.043	102	2.942		
Total	102343.54	106				46680.140	106			

Table-4: Least Significant Difference and Multiple Comparisons for circumference of different body parts

		Head		Neck	
(I) Altitude	(J) Altitude	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.
Sukhiapokhori HS School	Trunbull HS School	0.086	0.805	-0.254	0.584
	Jnanpith High School	-0.846*	0.016	-1.694*	0.000
	Kadamtala High School	0.530	0.128	1.070*	0.023
Trunbull HS School	Jnanpith High School	-0.932*	0.012	-1.440*	0.004
	Kadamtala High School	0.444	0.224	1.324*	0.008
Jnanpith High School	Kadamtala High School	1.376*	0.000	2.764*	0.000
		Arm relax		**Flex arm**	
Sukhiapokhori HS School	Trunbull HS School	0.750	0.126	0.367	0.498

	Jnanpith High School	0.440	0.362	-0.349	0.520
	Kadamtala High School	1.440*	0.004	1.555*	0.005
Trunbull HS School	Jnanpith High School	-0.300	0.552	-0.716	0.211
	Kadamtala High School	0.700	0.175	1.188*	0.039
Jnanpith High School	Kadamtala High School	1.000	0.052	1.904*	0.001
		Forearm		**Wrist**	
Sukhiapokhori HS School	Trunbull HS School	0.742*	0.033	0.266	0.074
	Jnanpith High School	0.010	0.976	0.162	0.274
	Kadamtala High School	0.530	0.126	0.546*	0.000
Trunbull HS School	Jnanpith High School	-0.732*	0.046	-0.104	0.504
	Kadamtala High School	-0.212	0.559	0.280	0.074
Jnanpith High School	Kadamtala High School	0.520	0.154	0.384*	0.015
		Waist		**Gluteal**	
Sukhiapokhori HS School	Trunbull HS School	0.04	0.971	-1.870	0.293
	Jnanpith High School	-2.11	0.066	-3.434	0.055
	Kadamtala High School	0.91	0.428	0.822	0.643
Trunbull HS School	Jnanpith High School	-2.16	0.075	-1.564	0.403
	Kadamtala High School	0.86	0.472	2.692	0.151
Jnanpith High School	Kadamtala High School	3.02*	0.013	4.256*	0.024
		Calf		**Ankle**	
Sukhiapokhori HS School	Trunbull HS School	1.026	0.104	1.169*	0.013
	Jnanpith High School	0.130	0.835	0.717	0.123
	Kadamtala High School	0.986	0.118	0.505	0.276
Trunbull HS School	Jnanpith High School	-0.896	0.177	-0.452	0.354
	Kadamtala High School	-0.040	0.952	-0.664	0.174
Jnanpith High School	Kadamtala High School	0.856	0.196	-0.212	0.663

From the above table, in the age group of 15, the mean circumference of head of Group-A (7200 ft.) was 53.59 cm. whose circumference was second among the groups with standard deviation of 1.757; in the same manner the mean head circumference of Group-B (6700 ft.) was 53.51cm. which was third in the groups with variation of .847, the mean value of Group-C (3000 ft.) was highest among the group and the mean value was 54.44cm. with variation of 1.273 and the Group-D (430 ft.) was the lowest in group having mean head circumference of 553.06 cm. with standard deviation of .900. As Critical difference was significant in neck circumference among the 15 years boys of four different altitudes, analysis of variance was conducted in table-11B where "F" value (5.011) shows significant difference. So further L.S.D was conducted in table-11C to know where the difference lies and it was found that there was significant difference between Group-A and Group-C, between Group-B and Group-C and between Group-C and Group-D. For head circumference of age group 15, groups may be arranged in descending order as Group-C>Group-A>Group-B>Group-D.

It was found from the study of M.E. Zaki, N.E. Hassan and S.A. El-Masry (2008), the average head circumference of 15 year old Egyptian adolescents was was 54.42 cm. with S.D of 1.54. Analysing the result of head circumference it may be concluded that the present study has close proximity to [1].

Similarly, in the age group of 15 years, the mean value of neck circumference of Group-A was 31.79cm. which was third among the group with standard deviation of 2.538; in the same manner the mean value of neck circumference of Group-B was 32.05 cm. which ranks second in the group with variation of 1.264, the mean value of Group-C was highest among the group and the mean value was 33.49 cm. with variation of 1.206 and the Group-D was the lowest ranking group having mean value of

neck circumference of 30.72 cm. with standard deviation of 1.226. As Critical difference was significant in neck circumference among the 15 years boys of four different altitudes, analysis of variance was conducted in table-11B where "F" value (10.952) shows highly significant difference. So further L.S.D was conducted in table-11C and it was found that there was significant difference between Group-A and Group-C, between Group-A and Group-D, between Group-B and Group-C, between Group-B and Group-D and between Group-C and Group-D. For neck circumference of age group 15, groups may be arranged in descending order as Group-C>Group-B>Group-A>Group-D.

From table, it was found that in the age group of 15, the mean circumference of arm of Group-A (7200 ft.) was 22.99 cm. which was first among the groups with standard deviation of 1.944; in the same manner the mean arm circumference of Group-B (6700 ft.) was 22.24cm. which was last in the groups with variation of 1.972, the mean value of Group-C (3000 ft.) was second among the group and the mean value was 22.54cm. with variation of 1.178 and the Group-D (430 ft.) was the lowest in group having mean arm circumference of 21.54 cm. with standard deviation of 1.945. As there was difference in mean arm circumference among the 15 years boys of four different altitudes, analysis of variance was conducted in table-12B where "F" value (3.087) found shows significant difference. So further L.S.D was conducted in table12C to know where the difference lies and it was found that there was significant difference between Group-A and Group-D only. For Arm circumference of age group 15, groups may be arranged in descending order as Group-A>Group-C>Group-B>Group-D.

It was found from the study of C.D.Fryar, Q.Gu and C.L Ogden (2012), the average arm circumference of 15 year old adolescents of United States was 29.2 cm [2]. with SEM of 0.5, for Chhattisgarh Jawahar Navodaya Vidyalaya adolescents it was 22.65cm.with S.D of 2.37 and for Chhattisgarh Kendriya Vidyalaya students it was 23.72cm. with S.D of 3.1 (M. Shukla, R. Venugopal and M. Mitra-2008), for Shabar Tribal Adolescents of Orissa it was 21.7 cm [3]. with S.D of 1.8 (Suman Chakrabarty and Premananda Bharati -2008) and for Bengali Boys of Nimta, North 24 Parganas, West Bengal it was 21.3 cm [4]. with S.D of 2.7 [5](Ashish Mukhopadhyay, Mithu Bhadra and Kaushik Bose-2005) and for male students of 24 Pgs (N), West Bengal, it was 21.03cm. with S.D of 0.84 [6]. Analysing the result of arm circumfertence it may be concluded that the present study has close proximity to all above researchers except [2].

In the same way it was found that in the age group of 15 years, the mean value of flex arm circumference of Group-A was 25.52 cm. which was second among the group with standard deviation of 2.091; in the same manner the mean value of flex arm circumference of Group-B was 25.15 cm. which ranks third in the group with variation of 2.091, the mean value of Group-C was highest among the group and the mean value was 25.87 cm. with variation of 1.427 and the Group-D was the lowest ranking group having mean value of flex arm circumference of 23.96 cm. with standard deviation of 2.161. As there was significant critical difference in flex arm circumference among the 15 years boys of four different altitudes, analysis of variance was conducted in table-12B where "F" value (4.315) found shows significant difference. Further L.S.D was conducted in table-12C to know where the difference lies and it was found that there was significant difference between Group-A and Group-D, between Group-B and Group-D and between Group-C and Group-D. For Flex arm circumference of age group 15, groups may be arranged in descending order as Group-C>Group-A>Group-B>Group-D.

Similarly from table, it was found that in the age group of 15, the mean circumference of forearm of Group-A (7200 ft.) was 23.31 cm. which was highest among the groups with standard deviation of 1.300; in the same manner the mean forearm circumference of Group-B (6700 ft.) was 22.56cm. which was last in the groups with variation of 1.359, the mean value of Group-C (3000 ft.) was second among the group and the mean value was 23.30cm. with variation of 1.063 and the Group-D (430 ft.) was the third in group having mean forearm circumference of 22.78cm. with standard deviation of 1.368. Though there was no critical difference in forearm circumference among the 15 years boys of four different altitudes, analysis of variance was conducted in table-13B where "F" value (2.261) found shows no significant difference. Further L.S.D was conducted in table-13C to know whether the difference may occur in between the groups, which shows significant difference between Group-A and Group-B and between Group-B and Group-C. For Forearm circumference of age group 15, the groups may be arranged in descending order as Group-A>Group-C>Group-D>Group-B.

Similarly it was found from table-13A that in the age group of 15 years, the mean value of wrist circumference of Group-A was 16.17cm. which was highest among the group with standard deviation of .648; in the same manner the mean value of wrist circumference of Group-B was 15.91cm. which ranks third in the group with variation of .545, the mean value of Group-C was second among the group and the mean value was 16.01 cm. with variation of .543

and the Group-D was the lowest ranking group having mean value of wrist circumference of 15.63cm. with standard deviation of .404. As Critical difference was significant in wrist circumference among the 15 years boys of four different altitudes, analysis of variance was conducted in table-13B where "F" value (4.749) shows significant difference. So further L.S.D was conducted in table-13C to know where the difference lies and it was found that there was significant difference between Group-A and Group-D and between Group-C and Group-D. For Wrist circumference of age group 15, groups may be arranged in descending order as Group-A>Group-C>Group-B>Group-D.

It was found from the study of A. Ramezankhani, Y. Mehrabi, P. Mirmiran and A.Fereidoun (2011) that the average wrist circumference of 15 years old Iranian adolescents was 16.9 cm [7]. with S.D of 1.1. Analysing the result of wrist circumference it may be concluded that the present study has close proximity to [7].

From table, it was found that in the age group of 15, the mean circumference of waist of Group-A (7200 ft.) was 64.41 cm. which was second among the groups with standard deviation of 4.385; in the same manner the mean waist circumference of Group-B (6700 ft.) was 64.37cm. which was third in the groups with variation of 2.999, the mean value of Group-C (3000 ft.) was highest among the group and the mean value was 66.52cm. with variation of 3.469 and the Group-D (430 ft.) was the lowest in group having mean waist circumference of 63.50 cm. with standard deviation of 5.579. Though there was no significant critical difference in waist circumference among the 15 years boys of four different altitudes, analysis of variance was conducted in table-14B where "F" value (2.311) found shows no significant difference. Further L.S.D was conducted in table-14C which shows significant difference between Group-C and Group-D. For Waist circumference of age group 15, groups may be arranged in descending order as Group-C>Group-A>Group-B>Group-D.

It was found from the study of C.D.Fryar, Q.Gu and C.L Ogden (2012) that the average waist circumference of 15 year old adolescents of united states was 80.9 cm [2]. with SEM of 1.41, for Shabar Tribal Adolescents of Orissa it was 61.6 cm. with S.D of 3.6 (Suman Chakrabarty and Premananda Bharati-2008) and for Bengali Boys of Nimta, North 24 Parganas, West Bengal it was 62.7 cm [4]. with S.D of 7.2 [5].

Similarly from table, in the age group of 15 years, the mean value of gluteal circumference of Group-A was 79.76 cm. which was third among the group with standard deviation of 10.402; in the same manner the mean value of gluteal circumference of Group-B was 81.63 cm. which ranks second in the group with variation of 3.974, the mean value of Group-C was highest among the group and the mean value was 83.19 cm. with variation of 3.118 and the Group-D was the lowest ranking group having mean value of gluteal circumference of 78.94cm. with standard deviation of 4.821. Though there was no significant critical difference in gluteal circumference among the 15years boys of four different altitudes, analysis of variance was conducted in table-14B where "F" value (2.161) found shows no significant difference. Further L.S.D was conducted in table-14C which shows significant difference between Group-C and Group-D. For Gluteal circumference of age group 15, groups may be arranged in descending order as Group-C>Group-B>Group-A>Group-D.

It was found from the study of Suman Chakrabarty and Premananda Bharati (2008) that the average gluteal (hip) circumference of 15 year old Shabar Tribal Adolescents of Orissa was 75.3 cm [4]. with S.D of 3.4 and for Bengali Boys of Nimta, North 24 Parganas, West Bengal it was 78 cm. with S.D of 6.3 [5].

From table, in the age group of 15, the mean circumference of calf of Group-A (7200 ft.) was 31.49 cm. which was highest among the groups with standard deviation of 2.434; in the same manner the mean calf circumference of Group-B (6700 ft.) was 30.46cm. which was lowest in the groups with variation of 2.934, the mean value of Group-C (3000 ft.) was second among the groups and the mean value was 31.36cm. with variation of 1.272 and the Group-D (430 ft.) was the third in group having mean calf circumference of 30.50 cm. with standard deviation of 2.323. As there was no critical difference in calf circumference among the 15 years boys of four different altitudes, analysis of variance was conducted in table-15B where "F" value (1.476) found shows no significant difference. So further L.S.D was conducted in table-15C and found no significant difference. For Calf circumference of age group 15, groups may be arranged in descending order as Group-A>Group-C>Group-D>Group-B.

It was found from the study of Margaret A. McDowell, C. D. Fryar, C. L. Ogden and Katherine M. Flegal (2008), the average calf circumference of 15 year old adolescents of United States was 37.1 cm [8]. with SEM of 0.34, for Chhattisgarh J. N. V. adolescents it was 32.1 cm. with S.D of 3.34 and for Chhattisgarh K. V. students it was 32.93 cm. with S.D of 3.29 (M. Shukla, R. Venugopal and M. Mitra-2008), for Shabar Tribal Adolescents of Orissa it was 28.8cm [3].with S.D of 1.8 (S. Chakrabarty and P.

Bharati -2008) and for Bengali Boys of Nimta, W.B it was 29.3 cm [4]. with S.D of 2.8 [5].

Similarly from table, in the age group of 15 years, the mean value of ankle circumference of Group-A was 21.48 cm. which was highest among the group with standard deviation of 2.189; in the same manner the mean value of ankle circumference of Group-B was 20.31 cm. which ranks last in the group with variation of .896, the mean value of Group-C was third highest among the group and the mean value was 20.76 cm. with variation of 1.194 and the Group-D was the second ranking group having mean value of ankle circumference of 20.97 cm. with standard deviation of 2.070. Though there was no significant critical difference in ankle circumference among the 15years boys of four different altitudes, analysis of variance was conducted in table-15B where "F" value (2.232) found shows no significant difference. Further L.S.D was conducted in table-15C which shows significant difference between Group-A and Group-B. For Ankle circumference of age group 15, groups may be arranged in descending order as Group-A>Group-D>Group-C>Group-B.

Conclusion

From above findings following conclusions can be drawn;

- Group-A (Altitude-7200 ft.) male students had greater arm relax, forearm, wrist, calf and ankle circumference among four different altitudes.
- Group-C (Altitude-3000 ft.) male student had greater head, neck, flex arm, waist and gluteal circumference.

Recommendation

- Similar type of study can be done for different age groups.
- Similar type of study can be done on other anthropometric measurements.
- Similar type of study can be done on different altitude.

Reference:

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