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LONGITUDINAL GROWTH IN SUB-SCAPULAR AND CALF SKINFOLDS OF 2 TO 8-YEAR-OLD JAT SIKH AND SCHEDULED CASTE CHILDREN OF BATHINDA DISTRICT OF PUNJAB

KAVITA JARODIA AND RAJAN GAUR

ABSTRACT

The present longitudinal study was carried out with a view to understanding the physical growth status in sub-scapular and calf skinfolds of Jat Sikh and Scheduled Caste children, aged 2 to 8 years, of Bathinda District of Punjab. After the first data collection, two follow-ups were carried out after a gap of six months, each. The initial sample included 766 children, out of which only 694 (341 boys and 353 girls) remained after second follow-up. The data was collected from various government and private schools using stratified random sampling. The children were divided into eight age groups and they were followed longitudinally for one year and each child was measured on three occasions. A set of anthropometric measurements was taken on each subject out of which we report here longitudinal growth in sub-scapular and calf skinfolds. The Scheduled Castes in the present sample were found to be economically weaker than the Jat Sikhs of Bathinda District.

The peak velocities for sub-scapular skinfold for Jat Sikh boys and girls were seen at 3 and 9 years, respectively. For the Scheduled Caste children, peak velocities were noticed at 9 and 6 years for boys and girls, respectively. A weak mid-growth spurt was noticed for the sub-scapular skinfold. The mean sub-scapular skinfold decreased during first follow-up and increased subsequently during the second follow-up. In Jat Sikhs, the sub-scapular skinfold decreased up to 6 years and increased thereafter, while in Scheduled Castes a general decrease was noticed with age.The mean calf skinfold of Jat Sikh and Scheduled Caste children increased at successive follow-ups. The peak velocity for calf skinfold for Jat Sikh boys and girls was seen at 3 and 8 years, respectively. The same for Scheduled Caste boys and girls were noticed at 9 years, which could be related to mid-growth spurt. The mean calf skinfolds of girls were, in general, comparatively thicker than that of the boys. Caste differences in calf skinfold in the present sample were, on the whole, not significant ($p \leq 0.05$). More longitudinal investigations, on a complete set of

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skinfolds, are required to better understand the variations in the patterns of growth of body fat in different populations of India.

INTRODUCTION

Human growth, a natural process of increasing in size and becoming mature, reproducing and ultimately getting older proceeds through various stages of life, is an important process as it helps us to understand intra- and inter-population variations in the body size and shape. In addition, it is helpful to examine the morphological differences among populations occurring due to inheritance or changing growth patterns or changes in environment. Basically, growth is an increase in size, which is different from maturity or development that is an increase in functional ability (Cameron, 2002). Bogin (1999) defined growth as "quantitative increase in size or mass whereas the development is defined as progression of changes, either quantitative or qualitative, that lead from an undifferentiated or immature state to a highly organised, specialized and mature state".

By studying population variations in growth, reference charts of growth are prepared, which help us in analysing various health problems and provide suitable measures for their improvement. Understanding infant and child growth through various anthropometric measurements and their comparison with growth reference data are important for paediatric health assessment (Roche and Sun, 2003). It is known that growth pattern is a major indicator of physical health status of children in a population (Tanner, 1986) and children who suffer from growth retardation have much higher risk of mortality (Pelletier, 1994; Pelletier *et al.,* 1993). Therefore, assessment of growth and development in children has attracted the attention of paediatricians as well as health care providers (Lee *et al.*, 2005). Individual growth patterns differ widely because of differences in heredity, nutrition, environment, morbidity, living conditions and hygiene.

Most of the knowledge about human growth has come from longitudinal studies. Through these studies, growth process can be viewed as relationship between different growth phases (Hauspie *et al.*, 2004). Longitudinal growth studies, though more time consuming, expansive and more cumbersome than the cross-sectional studies (which give an idea of average change in growth), but provide a deeper understanding of growth, particularly with respect to growth velocity and timings of particular phases. While cross-sectional information just permits the examination of contrasts between people; a longitudinal report can inspect changes within the people and the variations in them (Farrington, 1991). Despite being time consuming and expensive to develop, it has been argued that longitudinal studies-based growth standards should be used to assess individual linear growth, rather than those based on cross-sectional studies (Lee *et al.*, 2004).

Count Philibert Gueneau De Mountbeillard's study of his son in late 1700 is

usually considered the first documented longitudinal study on growth (Scammon, 1927). Since then, interest in scientific studies on human growth grew and several studies were conducted on different populations of the world (Michelson, 1944; Hopkins, 1947; Krogman, 1941 and Kimura and Kitano, 1959). Because of the difficulty involved and expensiveness, most of the early longitudinal studies in the last century were conducted in the developed countries. Good literature reviews of the early longitudinal growth studies and those conducted in the major part of the 20th Century can be seen in writings of Scammon (1927), Krogman (1941), Eveleth and Tanner (1976) and Eveleth and Tanner (1990). In the last two decades, several longitudinal growth investigations have been conducted on various population of the world. To mention a few are: Deheeger *et al.* (2002), Ashizawa *et al.* (2005), Ayatollahi (2005), Lee *et al.* (2005), Marques *et al.* (2005), WHO (2006), Nooyens *et al.* (2007), Leitao *et al.* (2011), Wacharasindhu (2010), McKinnon *et al.* (2011), Johnson *et al.* (2012), Lourenço *et al.* (2012), Chae *et al.* (2013), Gong *et al.* (2013), Jones-Smith *et al.* (2013), Schott (2013), Zheng *et al.* (2013), Cole *et al.* (2014), Ghaemmaghami *et al.* (2015), Ayatollahi *et al.* (2016), Joubert *et al.* (2016), Svefors *et al.* (2016), Frankenberg *et al.* (2017), Huynh *et al.* (2015), Barbour-Tuck *et al.* (2018), Brei *et al.* (2018), Devakumar *et al.* (2018), Tower *et al.* (2018), etc.

As compared to the developed countries, only a few longitudinal growth studies have been conducted in India. Among the important longitudinal studies conducted in the last three decades on populations from India, mention may be made of Qamra *et al.* (1991), Agarwal and Agrawal (1994), Bhalla (1999), Rao *et al.* (2000), Rao (2001), Bhalla (2003), Ray (2004), Virani (2005), Palit *et al.* (2007), Paul *et al.* (2008), Sarkar *et al.* (2010), Sinha *et al.* (2010), Aggarwal *et al.* (2011), Kaur *et al.* (2012), Joseph *et al.* (2013), Ganvir *et al.* (2015), Parthasarthy *et al.* (2016), Kaur *et al.,* 2017, etc.

Of late, interest has deepened in the understanding and development of strategies for the prevention of excess fat gain in infancy and early childhood, in view of the rising rate of childhood obesity (Ahrens *et al.*, 2014). This interest basically emanates from the understanding that adiposity during childhood can persevere through adolescence and into adulthood (Péneau, *et al.*, 2011; Brei *et al.*, 2018). A recent meta-analysis confirmed the association estimating that obese children are five times more likely to become obese adults compared to non-obese children (Simmonds, *et al.*, 2015). Excess fat is considered as an important risk factor for various diseases in adulthood such as cardiovascular diseases and type 2 diabetes (Demerath, *et al.*, 2008) and certain forms of cancer (Must *et al.*, 1992). In view of these facts, the present longitudinal study was undertaken to investigate the fat growth, through two skinfold measurements, among infants and children. Limited longitudinal growth studies have been conducted on Indian populations and only a couple of studies have considered Punjabis and that too from urban areas. Thus, keeping in view the paucity of longitudinal growth studies on different caste groups of Punjab, the present research work was undertaken to investigate the physical growth status, with

respect to sub-scapular and calf skinfolds, of Jat Sikh and Scheduled Caste children of Bathinda District of Punjab using a longitudinal research design.

MATERIALS AND METHODS

Material

The present study is based on a sample of 766 Jat Sikh and Scheduled Caste children from the Bathinda District of Punjab State of north India. The data were collected using the linked longitudinal research design to understand the growth in the selected fat folds of the children. The children in the study ranged in age from 1.5 to 8.5 years. The initial sample consisted of 766 children (387 males and 379 females) while the final sample, that remained in the study on the third occasion of sampling, included 694 children (341 males and 379 females). For the present longitudinal study, the data were collected on three occasions, on each of the subjects, after a gap of six months. The subjects were followed up twice. The total number of subjects varied on each follow up. The final number of the subjects is of those who could be followed up the second time. As can be seen in Table-1, on the first occasion, the number of children in the sample was 766, which decreased to 700 on the first follow-up and to 694 on in the second follow-up. Thus, on each follow-up, the number of children in the sample decreased slightly as some students had left the school and some were not available due to other reasons.

Table-1: Distribution of the present sample according to caste group and gender

Data Set	Jat Sikh			Scheduled Caste			Grand Total
	Boys	Girls	Total	Boys	Girls	Total	(B: boys: G: girls)
First time	189	190	379	198	189	387	766 (387B; 379G)
Second time	173	181	354	177	169	346	700 (350B; 350G)
Third time	168	176	344	173	177	350	694 (341B; 353G)

Table-2 shows the age, gender and caste-wise distribution of the 694 children of the final data set in the present sample, during the second-follow-up.

Table-2: Distributions of the children of final data set in various age groups

Age group (years)	Jat Sikh		Scheduled Caste	
	Boys	Girls	Boys	Girls
2	21	24	27	25
3	24	27	26	25
4	23	25	21	25
5	27	27	25	24
6	23	24	26	27
7	24	24	23	26
8	26	25	25	25
Total	**168**	**176**	**173**	**177**

The present study was conducted in the Bathinda District of Punjab. The district has three tehsils, namely Bathinda, Rampura Phul and Talwandi Sabo. The study was conducted on two dominant castes of the of the Bathinda District, namely the Jat Sikh and the Scheduled Castes. The data were collected from the rural as well as the urban schools of the area. The schools in the urban areas also have large number of students from rural school-going population, because of the less availability of schools in villages of the region. Both the government and private schools of the area were included in the study. The data were collected from the following 22 educational institutions of the three tehsils of Bathinda District:

Bathinda Tehsil: 1-Rose Marry Convent School, Bathinda; 2-Government Elementary School, Sibian; 3-Government Elementary School, Bathinda; 4-S.S.D. Krishan Vatika School, Bhokhra, Bathinda; 5-Little Flower Public Senior Secondary School, Bathinda; 6-Strawberry Fields School, Bathinda; 7-Mahavir Playway School, Bathinda; and 8-Daddy's Teddy's Playway School, Bathinda.

Rampura Phul Tehsil: 9-Bhartiya Model Senior Secondary School, Rampura Phul; 10-S.D. Kanya Mahavidyalaya, Rampura Phul; 11-Dev Samj Govt. High School, Rampura Phul; 12-Government Senior Secondary School, Rampura Phul; 13-Sarvhitkari Vidhiya Mandir School, Rampura Phul; 14-Lala Kasturi Lal Sarvhitkari Vidhiya Mandir, Rampura Phul; 15-Sarvhitkari Sishu Vatika, Rampura Phul; and 16-Bachpan Playway School, Rampura Phul.

Talwandi Sabo Tehsil: 17-St. Soldier Rational Public Senior Secondary School, Talwandi Sabo; 18-Universal Public Senior Secondary School, Talwandi Sabo; 19-Sarvhitkari Shishu Vatika Playway School, Talwandi Sabo; 20-Desmesh Public School, Talwandi Sabo; 21-Vidhya Niketan Public School, Talwandi Sabo; and 22-Baba Deep Singh Khalsa Senior Secondary School, Talwandi Sabo.

Methodology

Sampling: For the present study, stratified random sampling method was used in which the population was divided into smaller groups, called 'Strata' and random samples were taken from each stratum or group (Jat Sikhs and Scheduled Castes in this case) so that each stratum had equal probability of being selected. This method is useful in a longitudinal study design where the same cohort has to be studied repeatedly for few months or years. Only those members were considered who fell in the same age group and a random sample from each group was taken in a particular number, according to the cohort size, with reference to the population in question. The following formula, given by Krejcie and Morgan (1970) for sample size determination, was used:

$$S = X^2NP(1-P) \div d^2(N-1) + X^2P(1-P)$$

Where: S= required sample size; X^2*= the table value of chi-square for 1*

degree of freedom at the desired confidence level (3.841); N= the population size; P=the population proportion (assumed to be 0.50 since this would provide the maximum sample size); and d= the degree of accuracy expressed as a proportion (0.05).

Given a population of 100,139 Sikhs and 258,878 Scheduled Castes in Punjab (as per Census, 2011), and using the above formula, the sample size for present study of Jat Sikhs and Scheduled Castes turned out to be 383 each totalling to a sample of 766 individuals. Thus, the present study began with an initial sample of 766 children.

Age Grouping: Decimal age and age in months were obtained from date of birth of each individual following the method of Tanner and Whitehouse (1966). The age of each student was obtained from school records.

Anthropometric Measurements

For the present longitudinal study, a set of anthropometric measurements were taken by the First author (KJ) on each subject three times, after an interval of six months. However, in this communication, longitudinal growth in sub-scapular and calf skinfolds are being reported. These two fat folds were taken in millimetres with the help of a GPM skinfold calliper and employing the protocols of Weiner and Lourie (1981). These are explained as follows:

1. ***Sub-scapular Skinfold (mm):*** Sub-scapular skinfold was measured at the inferior angle of the right scapula. The diagonal fold was picked up by standing behind the right side of the subject. The subject was asked to stand in an upright position with weight distributed equally on both feet, with shoulders relaxed and arms hanging loosely on sides. The skinfold was picked at 45 degrees to the spine and across the line that bisects the inferior angle of the scapula. For convenience, inferior angel of the scapula was located by bringing the arm behind the back, causing the scapula to protrude. The skinfold was grasped with the index finger and thumb of left hand and picked up roughly 2.0 cm above the medial to the inferior angle of the scapula. With right hand, the jaws of the calliper were applied to the fold and the thickness was noted to the nearest 0.1mm.
2. ***Calf Skinfold (mm):*** The calf skinfold was measured with subject seated on a chair or stool, with legs resting on floor so that the knee was bent at right angle. The skinfold was picked vertically on the medial (inner) side of the calf at the point of the maximum calf girth. The jaws of the calliper were applied to the fold and the reading was recorded to the nearest 0.1mm.

Technical Error of Measurement: Before final data collection, a pilot survey was conducted on a subset of 25 subjects to find out the technical error of measurements (TEM) and coefficient of reliability (R) using the following

formula:

$$TEM=\sqrt{\frac{\sum D^2}{2N}}$$

Where: D is the differences between measurements; N is the number of individuals measured on two occasions.

Coefficient of reliability (R), which ranges from 0 to 1 (Ulijaszek and Kerr, 1999), was calculated using the following equation:

$$R=1-\left(\frac{TEM^2}{SD^2}\right)$$

Where: TEM is technical error of the measurement, as calculated by first equation; SD^2 *is the total inter-subject variance.*

As the variance of R approach 1, the amount of variance due to measurement error decreases. The recommended values of R range from 0.75 (Reynolds et al., 2008) to 0.95 (Ulijaszek and Kerr, 1999). Table-3 displays the TEM and R of the two skinfolds considered here. It is clear from Table-3 that the TEM was low and the R values of the two measurements were more than the range suggested by Ulijaszek and Kerr (1999), indicating good reliability. The data thus collected were analyzed using suitable statistical tools.

Table-3: Technical error of measurement (TEM) and coefficient of reliability (R) of Sub-Scapular and Calf Skinfolds

Sr. No.	Measurement	TEM	(R)
1	Sub-Scapular Skinfold	0.045	0.999
2	Calf Skinfold	0.179	0.994

The Study Area: The sample for the present investigation was collected from the urban and rural areas of Bathinda District of Punjab State (Figure-1). Punjab State extends from 29^0 32′ to $32^0$30′ North latitude and 73^0- 56′ East longitude. According to 2011 Census, the state had an area of 50,362 sq. km. and a population of 27,704,236 individuals. Punjab is a Sikh majority state who constitute 57.69% of the population. Besides Sikhs, Hindus (38.49%), Muslims (1.93%) and Christians (1.26%) also inhabit the state. Bathinda District is one of the 22 districts the state of Punjab. It lies in the southern part of the state, which is also known as Malwa region, that is situated on the bank of river Satluj. The other two regions of the state are Majha and Doaba regions. The Bathinda District is surrounded by Sirsa and Fatehabad Districts of Haryana State in the south, Sangrur and Mansa Districts in the east, Moga District in the northeast and Faridkot and Muktsar Districts in the northwest. The headquarters of the district administration are in the Bathinda Town. As per 2011 Census, Bathinda District had a total population of 1,388,525 (645,328 females and 743,197 males), population density of 414 per square kilometres, a

literacy rate of 68.2% (males 73.79%: females 61.94%), sex ratio of 868 and an area of 3,353 square kilometres. According to the 2011 Census, the district consists of 281 villages (279 inhabited and 2 uninhabited) and 12 towns distributed over three tehsils, viz., Bathinda (119 villages), Rampura Phul (75 villages) and Talwandi Sabo (87villages). All the tehsils have been converted into sub-divisions. Agriculture is the mainstay of the district. Major cultivated crops of the region are wheat, paddy and cotton. Other crops grown in the area include oilseeds, gram, wheat, vegetables, etc. Cotton is an important commercial crop of the district. Main horticulture crops are grapes, kinnow, ber, guava, etc. The staple food of the area is wheat chapatis, dal and vegetables. The major fairs and festivals of the Punjab State and the Bathinda District include Baisakhi, Gurupurabs, Lohri, Basant Panchami, Muktsar Maghi Fair, Hola Mohalla, Diwali and Dushehra. Punjabi is the spoken language in Bathinda District and the script is Gurmukhi. In urban areas, besides Punjabi, Hindi is also spoken. The official work is generally conducted in Gurmukhi script.

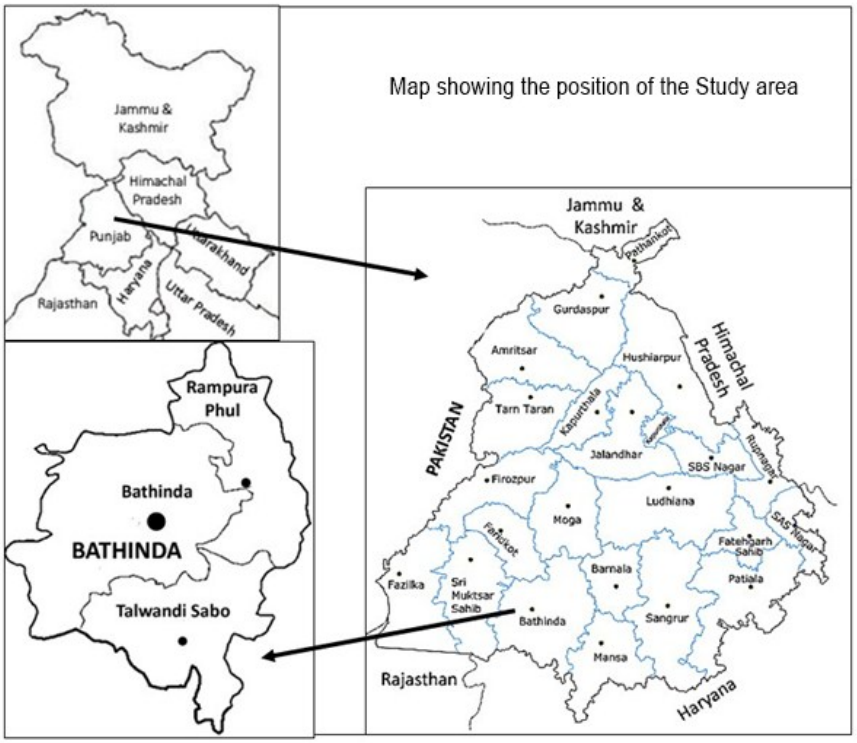


Figure-1: Generalised map of the study area showing the location of Bathinda District

RESULTS

The present linked logitudinal growth study of body fat folds is based on a sample of 766 urban and rural Jat Sikh and Scheduled Caste children aged 2 to 8 years of Bathinda District of Punjab State. Sub-scapular and calf skinfolds of

each child were measured on three ocassions after a gap of six months. For example, in the case of sub-scapular skinfold, ssf1 represents measurement on first occasion, ssf2 represents measurement taken on the same subject on the first follow-up after six months and ssf3 denotes the second follow-up measurement taken on the third ocassion on the same individual, i.e., after a gap of one year. The attained mean growth at various ages for three measurement occasions have been depicted as three distance curves for each skinfold. The growth velocity for the two skinfolds was investigated to quantity the growth changes within the time interval. Growth velocity indicates the current status of a child (Harrison *et al.*, 2014). The growth velocity was computed following Ghaemmaghami *et al.* (2015) and Bairagi (1986) as under:

$$V = \frac{M_{M+1} - M_n}{\Delta t}$$

Where: V = Growth velocity of a measurement; M_n *and* M_{n+1} = measurements at adjacent occasions; Δt = time interval between measurements.

For a continuous velocity curve from 2 to 8 years, the means of the second follow up of the previous age group were averaged after clubbing with that of the first occasion of the next age group.

Sub-scapular Skinfold

Table-4 and Table-5 depict the descpritive statistics for sub-scapular skinfold of 2 to 8 years old children of Bathinda District. Age-wise means of this skinfold for Jat Sikh boys and girls are shown in Table-4. It is evident from the table that the mean sub-scapular skinfold decreases during first follow up and increases subsequently during the second follow-up, i.e., ssf1>ssf2<ssf3. For instance, in case of Jat Sikh boys, at the age of 2 years, the average sub-scapular skinfold (ssf1) was 6.28mm, which decreases to 5.95mm (ssf2) after six months and then increases to 6.91 mm (ssf3) after 1 year. Over the entire age range, a minor net gain of 0.20 mm in mean sub-scapular skinfold was registered.

As in the case of Jat Sikh boys, for Jat Sikh girls also, within each age group, the mean values of sub-scapular skinfolds by and large, decreased during the first follow-up, followed by a subsequent increase in the second follow-up. The overall, mean sub-scapular skinfold of Jat Sikh girls showed a gradual decrease with increase in age upto 6 years and a gain thereafter. Over the entire age range, the girls recorded a net gain of 1.45 mm, from 6.24 mm at 2 years to 7.69 mm at 8 year, which was clearly more than that gained by the Jat Sikh boys.

Table-4: Descriptive statistics for sub-scapular skinfold (mm) of 2-8 years old Jat Sikh boys and girls of Bathinda District

Age Group (Years)	Follow-up sequence	Boys N	Boys Mean	Boys S.D.	Girls N	Girls Mean	Girls S.D.
2	ssf1	21	6.28	0.74	24	6.24	1.19
	ssf2	21	5.95	0.91	24	6.40	1.34
	ssf3	21	6.91	0.81	24	7.26	1.32
3	ssf1	25	6.77	1.41	27	6.49	1.57
	ssf2	25	6.60	1.48	27	6.52	1.05
	ssf3	25	6.96	1.52	27	7.11	1.05
4	ssf1	25	5.90	1.59	26	5.95	1.47
	ssf2	25	5.43	0.91	26	5.77	1.03
	ssf3	25	6.46	1.12	26	6.57	1.25
5	ssf1	27	5.57	0.96	28	5.90	1.55
	ssf2	27	5.49	0.64	28	5.71	1.14
	ssf3	27	6.82	1.02	28	6.46	1.17
6	ssf1	25	5.26	0.89	24	5.68	.95
	ssf2	25	5.18	0.95	24	5.37	.91
	ssf3	25	6.09	1.01	24	6.36	1.01
7	ssf1	21	5.50	1.18	23	6.02	1.97
	ssf2	21	5.60	1.36	23	5.95	1.29
	ssf3	21	6.82	1.83	23	6.66	1.15
8	ssf1	24	5.58	1.11	24	6.86	2.86
	ssf2	24	5.87	1.53	24	6.71	1.96
	ssf3	24	6.48	0.98	24	7.69	1.97

ssf1: sub-scapular skinfold on Ist occasion; ssf2: sub-scapular skinfold at 1st follow-up after 6 months; ssf3: sub-scapular skinfold at 2nd follow-up after 12 months.

Figure-2: Distance curves of sub-scapular skinfold (mm) of Jat Sikh boys, followed up every six months for 1 year

(ssf1= mean sub-scapular skinfold on Ist occasion; ssf2= mean sub-scapular skinfold at 1st follow-up; ssf3= mean sub-scapular skinfold at 2nd follow-up).

Figure-2 displays the distance curves of mean sub-scapular skinfolds of Jat Sikh boys, depicting yearly gain. After an initial increase from 2 to 3 years, the curves, on the average, decline up to 6 years and then rise again, thereafter, with some variations in ssf3. For ssf3, the initial gain from 2 to 3 years was comparatively less when compared with ssf1 and ssf2.The period of maximum increase was seen from 6 to 7 years, where the maximum gain of 0.73 mm/year was seen for ssf3.

Figure-3: Velocity curve for sub-scapular skinfold (mm) of Jat Sikh boys of Bathinda District showing gain in sub-scapular skinfold per six months

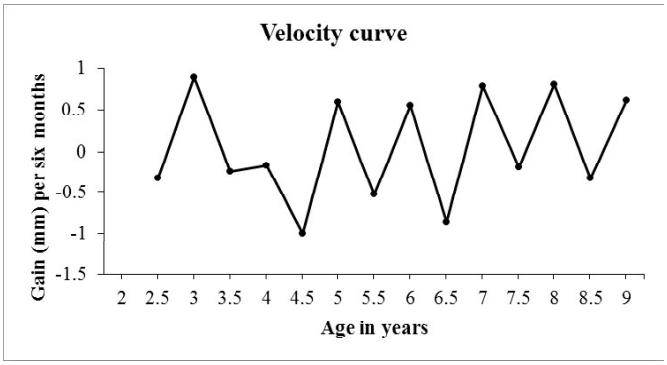
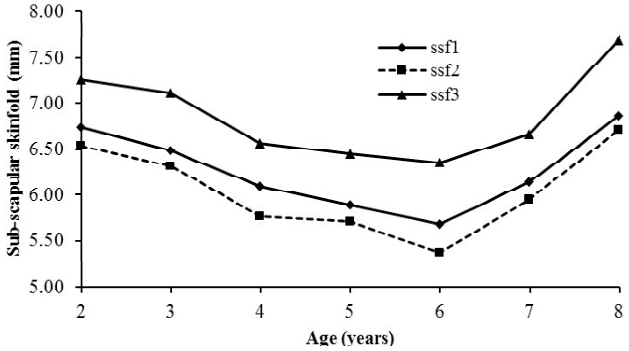


Figure-3 shows the velocity curve for sub-scapular skinfold of Jat Sikh boys of Bathinda. The curve shows a fluctuating pattern, indicating alternating peaks and troughs of almost similar strengths, but the peak at 3 years was a comparatively sharper one. The maximum growth velocity of the sub-scapular skinfold, per six months, was registered from 2.5 to 3 years (i.e., 0.89 mm).

Figure-4: Distance curves of sub-scapular skinfold (mm) of Jat Sikh girls, followed up every six months for 1 year



(ssf1= mean sub-scapular skinfold on Ist occasion; ssf2 = mean sub-scapular skinfold at 1st follow-up; ssf3= mean sub-scapular skinfold at 2nd follow-up).

Figure-4 shows the distance curves of mean sub-scapular skinfolds of Jat Sikh girls, followed longitudinally, for a year. All the curves showed a gradual decrease in mean sub-scapular skinfold upto 6 years. Thereafter, an increase was noticed upto 8 years. The period of maximum increase was seen from 7 to 8

years during which the maximum gain of 1.03 mm/year was seen for ssf3.

The descriptive statistics for sub-scapular skinfold of Scheduled Caste boys

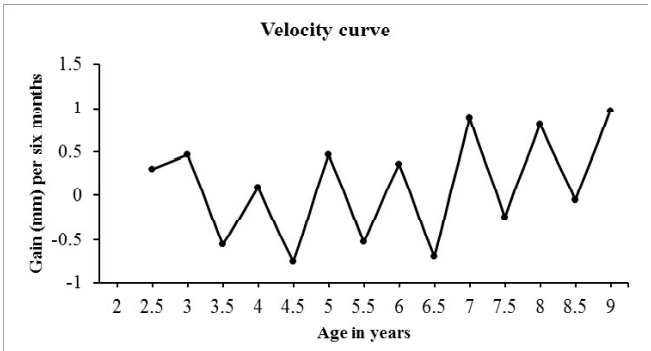


Figure-5: Velocity curve for sub-scapular skinfold (mm) of Jat Sikh girls of Bathinda District showing gain in sub-scapular skinfold per six months.

Figure-5 shows the velocity curve of sub-scapular skinfold for Jat Sikh girls of Bathinda District.The curve shows a fluctuating pattern with multiple peaks alternating with troughs. However, the peak with maximum intensity was seen at 9 years. The maximum growth velocity, per six months, of the skinfold was registered from 8.5 to 9 years during which the skinfold gained 0.98 mm.

Table-5: Descriptive statistics for sub-scapular skinfold (mm) of 2-8 years old Scheduled Caste boys and girls of Bathinda District

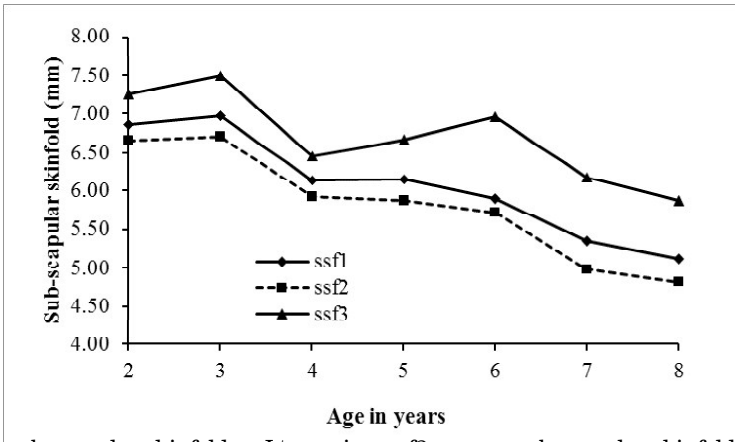
Age Group	Follow- up	Boys			Girls		
(Years)	sequence	N	Mean	S.D.	N	Mean	S.D.
2	ssf1	30	6.86	1.65	26	6.22	1.02
	ssf2	30	6.75	1.67	26	6.27	1.14
	ssf3	30	7.25	1.67	26	6.95	1.21
3	ssf1	24	6.48	1.57	29	7.27	1.39
	ssf2	24	6.71	1.52	29	7.47	1.35
	ssf3	24	7.49	1.57	29	8.07	1.15
4	ssf1	20	6.02	1.36	25	6.33	1.34
	ssf2	20	5.93	1.15	25	6.16	1.09
	ssf3	20	6.30	1.09	25	7.17	0.94
5	ssf1	25	5.77	0.88	21	6.14	1.29
	ssf2	25	5.87	1.09	21	5.76	0.95
	ssf3	25	6.67	1.56	21	7.12	1.39
6	ssf1	26	5.67	1.46	27	6.14	1.26
	ssf2	26	5.72	1.40	27	5.92	1.12
	ssf3	26	6.96	1.40	27	7.38	1.15
7	ssf1	23	5.04	1.32	29	6.11	1.32
	ssf2	23	4.99	1.19	29	5.80	1.30
	ssf3	23	6.17	1.17	29	6.94	1.33
8	ssf1	25	5.13	0.99	20	5.78	1.41
	ssf2	25	4.82	0.64	20	5.57	1.29
	ssf3	25	5.88	0.91	20	6.17	1.25

ssf1: sub-scapular skinfold on Istoccasion; ssf2: sub-scapular skinfold at 1st follow-up after 6 months; ssf3: sub-scapular skinfold at 2nd follow-up after 12 months

and girls of Bathinda is presented in Table-5. It is evident from the table that the mean values of sub-scapular skinfold for Scheduled Caste boys decreased slightly during the first follow-up and then increased during the second follow-up within an age group, i.e., ssf1>ssf2<ssf3.Thus, at the age of 2 years, the average sub-scapular skinfold (ssf1) was 6.86mm, which showed little gain to7.25mm after one year (ssf3), when followed longitudinally within the age group every six months. Overall, the mean sub-scapular skinfold of Scheduled Caste boys showed a gradual decrease with increase in age, with some variations in ssf3.

Among Scheduled Caste girls, except for the age group 2 and 3, the values for mean sub-scapular skinfolds showed a trend similar to that for the Scheduled Caste boys, i.e., ssf1>ssf2<ssf3. On the whole, the mean sub-scapular skinfold of Scheduled Caste girls showed a general trend of decrease with increase in age, after an initial increase.

Figure-6: Distance curves of sub-scapular skinfold (mm) of Scheduled Caste boys, followed-up every six months for 1 year



(ssf1= mean sub-scapular skinfold on Ist occasion; ssf2 = mean sub-scapular skinfold at 1st follow-up; ssf3= mean sub-scapular skinfold at 2nd follow-up).

Figure-6 shows the distance curves of mean sub-scapular skinfolds of Scheduled Caste boys, followed longitudinally. As is evident from the figure, in general, after an initial increase, all the curves showed a gradual decrease in mean sub-scapular skinfold values, but the period of maximum decrease was seen from 3 to 4 years.

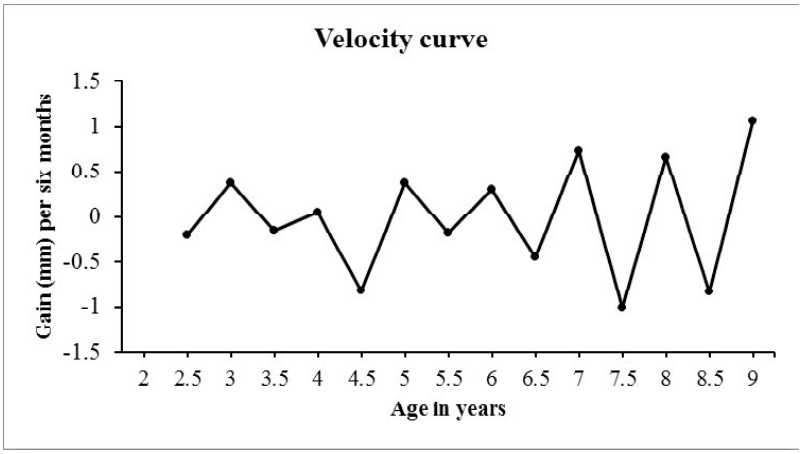
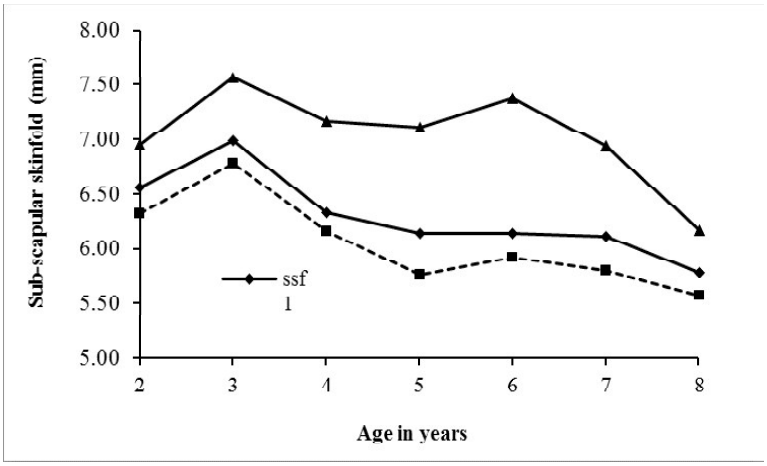


Figure-7: Velocity curve for sub-scapular skinfold (mm) of Scheduled Caste boys of Bathinda District showing gain in sub-scapular skinfold per six months

Figure-7 shows the velocity curve for sub-scapular skinfold of Scheduled Caste boys of Bathinda District in the present sample. Like other skinfolds, the curve shows a fluctuating pattern, showing many smaller peaks of nearly equal strength, but the strongest peak was noticed at 9 years. The maximum velocity of growth was recorded from 8.5 to 9 years during which the skinfold gained

Figure-8: Distance curves of sub-scapular skinfold (mm) of Scheduled Caste girls, followed-up every six months for 1 year1.06 mm.



(ssf1= mean sub-scapular skinfold on Ist occasion; ssf2 = mean sub-scapular skinfold at 1st follow-up; ssf3= mean sub-scapular skinfold at 2nd follow-up).

Figure-8 shows the distance curves of mean sub-scapular skinfolds of Scheduled Caste girls, who were followed up longitudinally for a period of one year. All the curves show an initial increase from 2 to 3 years followed by a gradual decrease, with minor variation at 6 years in ssf3.The period of maximum increase was seen from 2 to 3 years during which gain of 1.20 mm/year was noticed for ssf2.

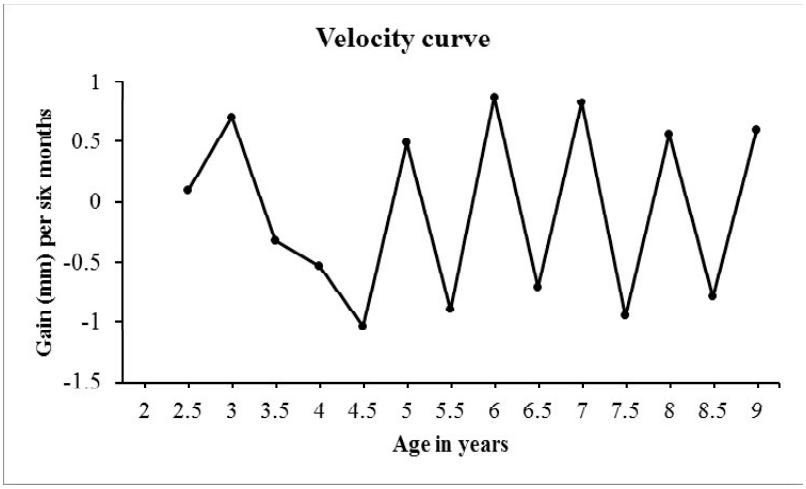


Figure-9: Velocity curve for sub-scapular skinfold (mm) of Scheduled Caste girls of Bathinda District showing gain in sub-scapular skinfold per six months

Figure-9 shows the velocity curve for sub-scapular skinfold of Scheduled Caste girls of Bathinda District. The curve shows a fluctuating pattern with smaller peaks and troughs but the sharpest peak was seen at 6 years. From 3 to 4.5 years, the growth velocity declines after which it increased and decreased alternatively and the pattern became very fluctuating.

Calf Skinfold (mm)

Descpritive statistics for calf skinfold of 2 to 8 years old Jat Sikh and Scheduled Caste children of Bathinda District have have been presented in Tables-6 and 7, respectively. As can be seen in the Table-6, when followed longitudinally every 6 months for 1 year, in most age groups, the mean calf skinfold of Jat Sikh boys increased with successive follow-ups, so that means at 2nd follow-up (csf3) was greater than a that of 1st follow-up (csf2), which was greater than that of first time measurement csf1 (i.e., csf3>csf2>csf1). For example, at the age of 2 years the average calf skinfold (csf1) was 7.35 mm, which increased to 8.41 mm after one year (csf3), when followed longitudinally within the group every six months. After an initial increase from 2 to 3 years, the mean calf skinfold of Jat Sikh boys decreased from 3 to 6 years and increased very nominally, thereafter.

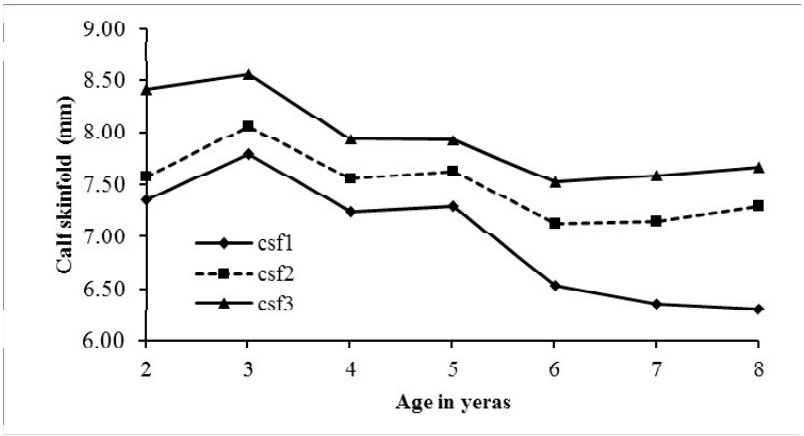
For Jat Sikh girls, the mean values of calf skinfolds displayed a variable age trend. The mean calf skinfold first increased upto 3 years and then declined upto 5 years. From 7 to 8 years a sharp increase in mean values of this skinfold was noticed.

Table-6: Descriptive statistics for calf skinfold (mm) of 2-8 years old Jat Sikh boys and girls of Bathinda District.

Age Group (Years)	Follow- up sequence	Boys N	Boys Mean	Boys S.D.	Girls N	Girls Mean	Girls S.D.
2	csf1	21	7.35	1.51	24	8.16	2.07
	csf2	21	7.58	1.50	24	7.62	1.92
	csf3	21	8.41	1.48	24	8.20	1.61
3	csf1	25	7.79	1.59	27	8.51	1.24
	csf2	25	8.06	1.58	27	8.66	1.22
	csf3	25	8.56	1.87	27	9.14	1.43
4	csf1	25	7.24	1.51	26	7.92	1.64
	csf2	25	7.56	1.36	26	7.75	1.54
	csf3	25	7.94	1.51	26	8.20	1.20
5	csf1	27	7.29	2.30	28	6.87	1.71
	csf2	27	7.63	1.74	28	7.09	1.86
	csf3	27	7.92	1.64	28	7.49	1.60
6	csf1	25	6.54	1.62	24	7.60	1.54
	csf2	25	7.53	2.19	24	7.95	1.40
	csf3	25	6.98	1.31	24	7.94	2.26
7	csf1	21	6.35	2.37	23	6.80	1.43
	csf2	21	7.15	2.10	23	7.53	1.63
	csf3	21	7.59	2.29	23	8.30	1.60
8	csf1	24	6.30	2.17	24	8.50	4.54
	csf2	24	7.29	2.75	24	9.03	3.10
	csf3	24	7.67	2.41	24	9.49	3.32

(csf1 : calf skinfold on Istoccasion; csf2: calf skinfold at 1st follow-up after 6 months;
csf3 : calf skinfold at 2nd follow-up after 12 months)

Figure-10: Distance curves of calf skinfold (mm) of Jat Sikh boys, followed up every six months for 1 year



(csf1= mean calf skinfold on Ist occasion; csf2 = mean calf skinfold at 1st follow-up; csf3= mean calf skinfold at 2nd follow-up).

Figure-10 presents the distance curves of calf skinfold of Jat Sikh boys in the present sample. The figure depicts an initial increase from 2 to 3 years, followed by a gradual decrease with increase in age upto 6 years and a slight increase, thereafter. The period of maximum increase in calf skinfold was seen from 2 to 3 years.

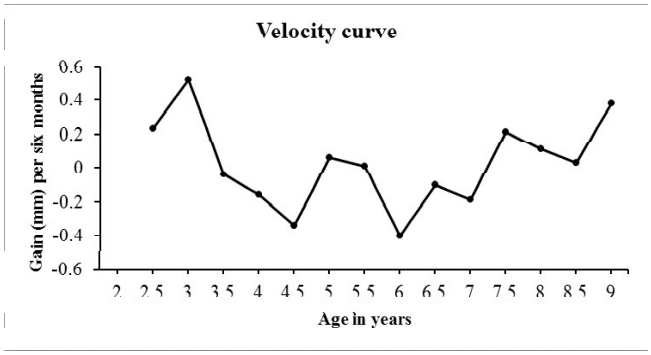
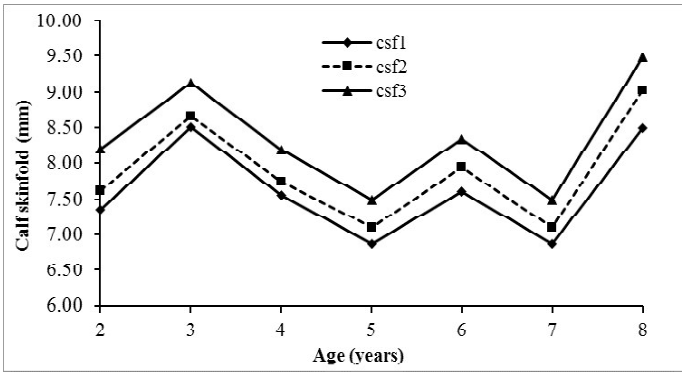


Figure-11: Velocity curve for calf skinfold (mm) of Jat Sikh boys of Bathinda District showing gain in calf skinfold per six months

Figure-11 shows the velocity curve for calf skinfold of Jat Sikh boys of Bathinda when followed longitudinally every 6 months for 1 year, depicting gain in calf skinfold every six months. The curve shows a fluctuating pattern, indicating one peak at 3 years and another smaller one at 9 years. A period of deaccelartion of growth velocity could be noticed from 3 to 4.5 years and pace of growth starts picking up after 6 years. The maximum gain of 0.52 mm in calf skinfold per six months was registered from 2.5 to 3 years. The period of minimum growth was seen from 5.5 to 6 years.

Figure-12: Distance curves of calf skinfold (mm) of Jat Sikh girls, followed-up every six months for 1 year



(csf1= mean calf skinfold on Ist occasion; csf2 = mean calf skinfold at 1st follow-up; csf3= mean calf skinfold at 2nd follow-up).

Distance curves of calf skinfold of Jat Sikh girls are depicted in Figure-12. Though all the curves showed alternate peaks and troughs, but the period of maximum increase in calf skinfold was seen from 7 to 8 years. After an early increase, the curves decline till 5 years to rise and fall alternately upto 7, after

which a sharp gain in mean calf skinfold was registered by the girls in the present sample. The maximum gain of 1.99 mm/year was seen from 7 to 8 years for csf3.

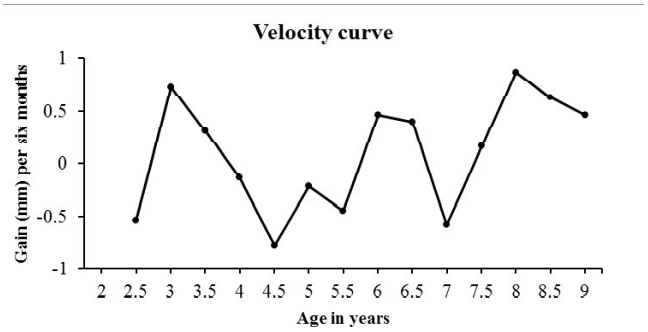


Figure-13: Velocity curve for calf skinfold (mm) of Jat Sikh girls of Bathinda District showing gain in calf skinfold per six months

The velocity curve for calf skinfold of Jat Sikh girls of Bathinda District, depicting gain in calf skinfold every six months, is presented in Figure-13. The curve shows a fluctuating pattern, displaying sharp peaks at 3 years and 8 years. The maximum gain of 0.87 mm in calf skinfold per six months was registered from 7.5 to 8 years. From 3 to 4.5 years, a deacceleration in growth velocity was noticed after which the velocity somewhat picks upto 6 years.

Table-7: Descriptive statistics for calf skinfold (mm) of 2-8 years old Scheduled Caste boys and girls of Bathinda District

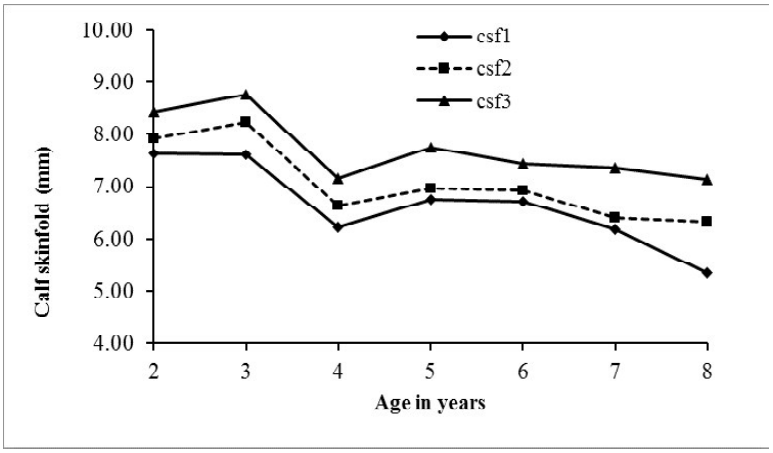
Age Group (Years)	Follow- up sequence	Boys N	Boys Mean	Boys S.D.	Girls N	Girls Mean	Girls S.D.
2	csf1	30	7.62	1.59	26	7.98	2.01
	csf2	30	7.92	1.54	26	8.38	1.88
	csf3	30	8.42	1.67	26	8.61	1.76
3	csf1	24	7.60	2.12	29	7.98	2.17
	csf2	24	8.23	2.98	29	8.63	1.92
	csf3	24	8.77	2.26	29	9.28	1.49
4	csf1	20	6.23	1.47	25	7.86	1.73
	csf2	20	6.63	1.46	25	8.12	1.63
	csf3	20	7.16	1.97	25	8.56	1.63
5	csf1	25	6.76	1.74	21	7.50	1.46
	csf2	25	6.97	1.46	21	7.67	1.67
	csf3	25	7.75	1.59	21	8.70	1.72
6	csf1	26	6.71	1.60	27	7.83	2.08
	csf2	26	6.92	1.88	27	8.33	2.34
	csf3	26	7.43	1.71	27	8.96	2.39
7	csf1	23	6.19	1.88	29	7.09	2.11
	csf2	23	6.40	2.08	29	7.75	2.29
	csf3	23	7.35	1.86	29	8.36	2.09
8	csf1	25	5.36	1.54	20	6.72	2.24
	csf2	25	6.32	1.70	20	7.36	1.86
	csf3	25	7.14	1.71	20	8.25	2.31

(csf1 : calf skinfold on Istoccasion; csf2: calf skinfold at 1st follow-up after 6 months;
csf3 : calf skinfold at 2nd follow-up after 12 months).

The descriptive statistics for calf skinfold of Scheduled Caste boys and girls of Bathinda District is depicted in Table-7. It is evident from the table that, in boys, the mean calf skinfold increased gradually within each age group (i.e., csf3>csf2>csf1). Thus, for example, at the age of 2 years, the average calf skinfold (csf1) was 7.62mm, which increased to to 8.42mm, after one year (csf3), when followed-up longitudinally within the group every six months. Considering the whole age range, a trend of decrease in mean calf skinfold was noticed among Scheduled Caste boys.

The Scheduled Caste girls also showed a similar pattern of growth in mean calf skinfold, in whom, within the age group, the mean calf skinfold increased when measured every 6 months for an year (Table-7). Overall, the mean calf skinfold of Scheduled Caste girls also showed a trend of slow decrease in mean calf skinfold with increase in age, though some variations were noticed in some age groups.

Figure-14: Distance curves of calf skinfold (mm) of Scheduled Caste boys, followed up every six months for 1 year



(csf1= mean calf skinfold on Ist occasion; csf2 = mean calf skinfold at 1st follow-up; csf3= mean calf skinfold at 2nd follow-up).

Figure-14 displays the distance curves of calf skinfold of Scheduled Caste boys in the present sample. With some variation, all the curves showed a gradual general decrease in mean calf skinfold with advancing age. The period of maximum increase in calf skinfold was seen from 4 to 5 years, during which a gain of 0.59 mm/year was seen for csf3. The period of slowest growth was noticed from 3 to 4 years.

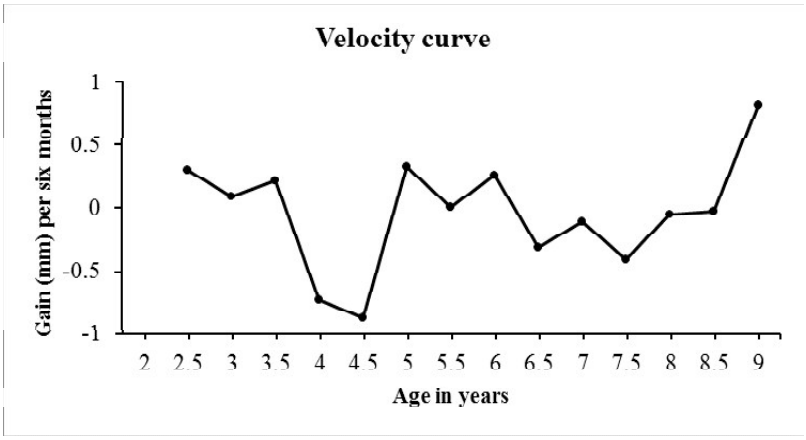
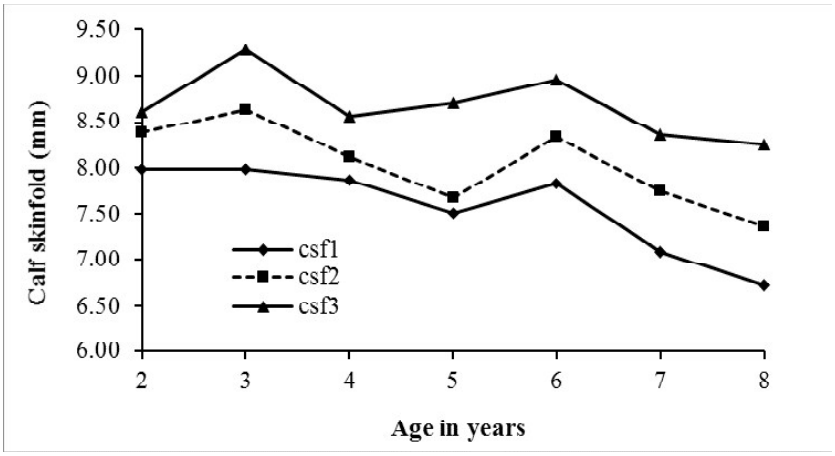


Figure-15: Velocity curve for calf Skinfold (mm) of Scheduled Caste boys of Bathinda District showing gain in calf Skinfold per six months

Figure-15 shows the six monthly growth velocity for calf skinfold of Scheduled Caste boys of Bathinda District. Like other skinfolds, the curve for this skinfold also displays a fluctuating pattern, recording one major peak at 9 years. The maximum growth velocity in calf skinfold, per six months, was registered from 8.5 to 9 years during which a gain of 0.82 mm was registered. The period of deacceleration in growth velocity was noticed from 3.5 to 4.5 years.

Figure-16: Distance curves of calf skinfold (mm) of Scheduled Caste girls, followed up every six months for 1 year



(csf1= mean calf skinfold on Ist occasion; csf2 = mean calf skinfold at 1st follow-up; csf3= mean calf skinfold at 2nd follow-up).

Figure-16 presents the distance curves of calf skinfold of Scheduled Caste girls**.** The curves, with some variation, showed an overall trend of slow decrease in mean calf skinfold, with increase in age. However, most curves registered a nominal rise from 2 to 3 and from 5 to 6 years and a sharp decline from 6 to 8 years.

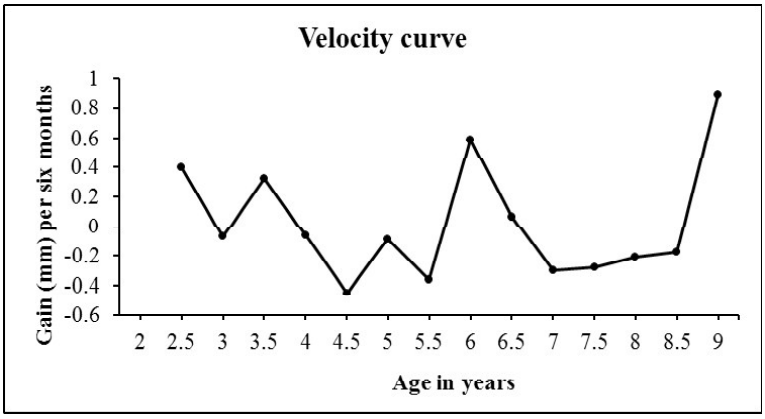


Figure-17: Velocity curve for calf skinfold (mm) of Scheduled Caste girls of Bathinda District showing gain in calf skinfold per six months

Figure-17 shows the velocity curve for calf skinfold of Scheduled Caste girls of Bathinda District depicting gain in calf skinfold every six months. The curve showed a fluctuating pattern; sharp peaks could be noticed at 6 and 9 years. The maximum gain of 0.89 mm in calf skinfold per six months was registered from 8.5 to 9 years.

Gender Differences: Table-8 displays the results of student's t-test for gender differences for sub-scapular skinfold among Jat Sikh and Scheduled Caste boys and girls of Bathinda District. For Jat Sikhs, statistically significant gender differences ($p \leq 0.05$) could be noticed only in age group 8; while among Scheduled Castes, the gender differences were statistically significant ($p \leq 0.05$) at age group 4, 7 and 8 years.

Table-9 shows the results of Student's t-test for gender differences in calf skinfold among Jat Sikh and Scheduled Caste children of Bathinda District. The table shows that, among Jat Sikhs, statistically significant gender differences ($p \leq 0.05$) were present only in age groups 3, 6 and 8 years, even though at most of the ages the girls registered higher mean values as can be seen in Table-10. Among Scheduled Caste children, the statistically significant ($p \leq 0.05$) gender differences were seen for age groups 4, 6, 7 and 8. Thus, more significant gender differences were noticed among Scheduled Caste children as compared to the Jat Sikh children, though at some ages the mean calf skinfold of girls were thicker than that of the boys.

Table-8: Student's t-test showing gender differences for sub-scapular skinfold of Jat Sikh and Scheduled Caste children of Bathinda District

Age Group (Years)	Follow- up sequence	Jat Sikh N		t-value	p-value	Scheduled Caste N		t-value	p-value
		Boys	Girls			Boys	Girls		
2	ssf1	21	24	0.12	0.91	30	26	1.71	0.09
	ssf2	21	24	-1.31	0.20	30	26	1.26	0.22
	ssf3	21	24	-1.05	0.30	30	26	0.75	0.46
3	ssf1	25	27	0.68	0.49	24	29	-1.94	0.06
	ssf2	25	27	0.23	0.82	24	29	-1.92	0.06
	ssf3	25	27	-0.43	0.67	24	29	-1.54	0.13
4	ssf1	25	26	-0.14	0.89	20	25	-0.77	0.44
	ssf2	25	26	-1.25	0.22	20	25	-0.71	0.48
	ssf3	25	26	-0.33	0.75	20	25	-2.87	0.01*
5	ssf1	27	28	-0.93	0.34	25	21	-1.15	0.25
	ssf2	27	28	-0.86	0.35	25	21	0.36	0.72
	ssf3	27	28	1.23	0.23	25	21	-1.02	0.32
6	ssf1	25	24	-1.59	0.12	26	27	-1.24	0.22
	ssf2	25	24	-0.73	0.47	26	27	-0.57	0.57
	ssf3	25	24	-0.94	0.35	26	27	-1.19	0.24
7	ssf1	21	23	-1.04	0.31	23	29	-2.92	0.01*
	ssf2	21	23	-0.88	0.38	23	29	-2.31	0.03*
	ssf3	21	23	-0.35	0.73	23	29	-2.20	0.03*
8	ssf1	24	24	-2.04	0.05*	25	20	-1.81	0.07
	ssf2	24	24	-1.65	0.11	25	20	-2.57	0.02*
	ssf3	24	24	-2.68	0.01*	25	20	-0.92	0.36

* Significant gender difference ($p \leq 0.05$); ssf1: sub-scapular skinfold on Ist occasion; ssf2: sub-scapular skinfold at 1st follow-up after 6 months; ssf3: sub-scapular skinfold at 2nd follow-up after 12 months.

Table-9 shows the results of Student's t-test for gender differences in calf skinfold among Jat Sikh and Scheduled Caste children of Bathinda District. The table shows that, among Jat Sikhs, statistically significant gender differences ($p \leq 0.05$) were present only in age groups 3, 6 and 8 years, even though at most of the ages the girls registered higher mean values as can be seen in Table-10. Among Scheduled Caste children, the statistically significant ($p \leq 0.05$) gender differences were seen for age groups 4, 6, 7 and 8. Thus, more significant gender differences were noticed among Scheduled Caste children as compared to the Jat Sikh children, though at some ages the mean calf skinfold of girls were thicker than that of the boys.

Table-9: Results of Student's t-test showing gender differences for calf skinfold of Jat Sikh and Scheduled Caste children of Bathinda District.

Age Group	Follow- up	Jat Sikh				Scheduled Caste			
(Years)	sequence	N		t-value	p-value	N		t-value	p-value
		Boys	Girls			Boys	Girls		
2	csf1	21	24	-0.67	0.51	30	26	-0.85	0.39
	csf2	21	24	-0.07	0.94	30	26	-1.02	0.32
	csf3	21	24	0.44	0.66	30	26	-0.41	0.68
3	csf1	25	27	-0.45	0.65	24	29	-1.72	0.09
	csf2	25	27	-0.53	0.13	24	29	-0.59	0.56
	csf3	25	27	-1.53	0.03*	24	29	-0.99	0.33
4	csf1	25	26	-2.34	0.13	20	25	-2.43	0.02*
	csf2	25	26	-1.23	0.23	20	25	-2.41	0.02*
	csf3	25	26	-0.68	0.49	20	25	-2.62	0.02*
5	csf1	27	28	0.77	0.44	25	21	-1.56	0.13
	csf2	27	28	1.09	0.28	25	21	0.22	0.83
	csf3	27	28	0.98	0.33	25	21	-1.95	0.06
6	csf1	25	24	-2.35	0.03*	26	27	-2.18	0.04*
	csf2	25	24	-1.55	0.13	26	27	-2.42	0.02*
	csf3	25	24	-1.83	0.07	26	27	-2.68	0.01*
7	csf1	21	23	-0.77	0.45	23	29	-1.59	0.12
	csf2	21	23	-0.67	0.51	23	29	-2.19	0.03*
	csf3	21	23	-0.12	0.91	23	29	-1.83	0.07
8	csf1	24	24	-2.14	0.04*	25	20	-2.41	0.02*
	csf2	24	24	-2.05	0.05*	25	20	-1.94	0.06
	csf3	24	24	-2.17	0.04*	25	20	-1.85	0.07

* Significant gender difference ($p \leq 0.05$); csf1: calf skinfold on Ist occasion; csf2: calf skinfold at 1st follow-up after 6 months; csf3: calf skinfold at 2nd follow-up after 12 months.

Caste Differences: Table-10 shows the results of Student's t-test for caste differences for sub-scapular skinfold between Jat Sikh and Scheduled Caste children of Bathinda District. As can be seen in the table, in case of boys, statistically significant caste differences ($p \leq 0.05$) were seen only in groups, 2, 6 and 8. Among girls, the caste differences were statistically significant ($p \leq 0.05$) for age groups 3, 6 and 8.

Table-10: Results of Student's t-test showing caste differences for sub-scapular skinfold among Jat Sikh and Scheduled Caste boys and girls of Bathinda District

Age Group	Follow-up	Boys				Girls			
(Years)	sequence	N		t-value	p-value	N		t- value	p-value
		JS	SC			JS	SC		
2	ssf1	21	30	-1.51	0.14	24	26	0.07	0.95
	ssf2	21	30	-1.99	0.05*	24	26	0.39	0.69
	ssf3	21	30	-0.86	0.39	24	26	0.85	0.39
3	ssf1	25	24	0.68	0.49	27	29	-1.97	0.05*
	ssf2	25	24	-0.24	0.81	27	29	-2.91	0.01*
	ssf3	25	24	-1.22	0.23	27	29	-3.25	0.01*
4	ssf1	25	20	-0.26	0.79	26	25	-0.95	0.35
	ssf2	25	20	-1.62	0.12	26	25	-1.32	0.19
	ssf3	25	20	0.49	0.63	26	25	-1.92	0.06
5	ssf1	27	25	-0.76	0.45	28	21	-0.58	0.56
	ssf2	27	25	-1.54	0.13	28	21	-0.18	0.86
	ssf3	27	25	0.42	0.68	28	21	-1.81	0.08
6	ssf1	25	26	-1.21	0.24	24	27	-1.44	0.16
	ssf2	25	26	-1.62	0.12	24	27	-1.91	0.06
	ssf3	25	26	-2.58	0.02*	24	27	-3.34	0.01*
7	ssf1	21	23	1.22	0.23	23	29	-0.21	0.84
	ssf2	21	23	1.58	0.12	23	29	0.42	0.68
	ssf3	21	23	1.42	0.16	23	29	-0.81	0.42
8	ssf1	24	25	1.52	0.14	24	20	1.55	0.13
	ssf2	24	25	3.18	0.01*	24	20	2.23	0.03*
	ssf3	24	25	2.26	0.03*	24	20	2.98	0.01*

* Significant caste difference ($p \leq 0.05$); ssf1: sub-scapular skinfold on Ist occassion; ssf2: sub-scapular skinfold at 1st follow-up after 6 months; ssf3: sub-scapular skinfold at 2nd follow-up after 12 months; JS=Jat Sikh; SC= Scheduled Caste.

Table-11 presents the caste differences for calf skinfold between Jat Sikh and Scheduled Caste boys as well as girls of Bathinda District. It can be seen in the table that, among boys, no statistically significant caste differences ($p \leq 0.05$) were present in any age group. However, in the case of girls few statistically significant ($p \leq 0.05$) caste differences were seen at 5 and 8 years. For other groups, the caste differences were by and large statistically insignificant ($p \leq 0.05$). It emerges that caste differences in calf skinfold in 2 to 8 years old boys and girls in the present sample were, on the whole, not significant.

Table-11: Results of Student's t–test showing caste differences for calf skinfold between Jat Sikh and Scheduled Caste children of Bathinda District.

Age Group	Follow-up	Boys				Girls			
(Years)	sequence	N		t-value	p-value	N		t-value	p-value
		JS	SC			JS	SC		
2	csf1	21	30	-0.29	0.77	24	26	-0.29	0.76
	csf2	21	30	-0.78	0.44	24	26	-1.42	0.16
	csf3	21	30	-0.03	0.97	24	26	-0.85	0.39
3	csf1	25	24	1.36	0.18	27	29	-0.23	0.82
	csf2	25	24	-0.25	0.79	27	29	0.05	0.96
	csf3	25	24	-1.19	0.24	27	29	-0.36	0.72
4	csf1	25	20	1.24	0.22	26	25	0.11	0.92
	csf2	25	20	1.45	0.15	26	25	-0.02	0.99
	csf3	25	20	1.49	0.14	26	25	-0.92	0.36
5	csf1	27	25	0.95	0.35	28	21	-1.36	0.18
	csf2	27	25	1.47	0.14	28	21	0.44	0.66
	csf3	27	25	0.38	0.70	28	21	-2.54	0.02*
6	csf1	25	26	-0.38	0.69	24	27	-0.44	0.66
	csf2	25	26	-0.36	0.72	24	27	-0.69	0.49
	csf3	25	26	-1.06	0.29	24	27	-1.57	0.12
7	csf1	21	23	0.24	0.81	23	29	-0.56	0.57
	csf2	21	23	1.18	0.24	23	29	-0.39	0.69
	csf3	21	23	1.42	0.16	23	29	-0.11	0.92
8	csf1	24	25	1.75	0.08	24	20	1.59	0.12
	csf2	24	25	1.48	0.14	24	20	2.12	0.04*
	csf3	24	25	0.89	0.37	24	20	1.42	0.16

* Significant caste difference ($p \leq 0.05$); csf1: calf skinfold on Ist occassion; csf2: calf skinfold at 1st follow-up after 6 months; csf3: calf skinfold at 2nd follow-up after 12 months, of the same subject; JS=Jat Sikh; SC=Scheduled Caste.

DISCUSSION

It is well understood that in a longitudinal study each individual is measured periodically over a number of years. But in order to obtain the simplest type of velocity standards, individuals have only to be measured twice (Eveleth and Tanner, 1990). Intensive longitudinal studies follow-up a set of children over longer periods and are very time consuming. In order to reduce time consumption, linked longitudinal studies may be conducted, in which subject is followed after two to six months, thus reducing time consumption and the study can be relatively quickly conducted (Eveleth and Tanner, 1990). The present study has also followed a linked longitudinal protocol. A brief discussion of the results on longitudinal growth in sub-scapular and calf skinfolds of the present sample of Jat Sikh and Scheduled Caste children of Bathinda District is presented here.

Sub-scapular Skinfold: The peak velocity for Sub-scapular Skinfold for Jat Sikh boys was noticed at 3 years (Figure-3) and for Jat Sikh girls at 6.5 to 7 years (Figure-5). Similarly, the peak velocity for Scheduled Caste boys was seen at 8.5 to 9 years (Figure-7) and for girls comparatively early at 5.5 to 6 years (Figure-9). It has been suggested that juvenile spurt is generally observed from 6-8 years (Cameron, 2002). The caste differences in sub-scapular skinfold do not present a clear pattern; at some ages the Jat Sikhs have slightly thicker folds, while at other ages the Scheduled Castes have slightly higher values of this skinfold.

In the present sample, barring a few exceptions, the gender differences in growth in sub-scapular skinfold were, in general, statistically not significant. These results are consistent with general understanding, that sex differences are very less visible during pre-school years (Roche and Sun, 2003; Cameron, 2002; Ayatollahi *et al.*, 2016). Statistically significant caste differences ($p \leq 0.05$) were seen at 2, 6 and 8 years in boys and 3, 6 and 8 years in girls ($p \leq 0.05$).

The mean sub-scapular skinfold values of the present study were compared with the 50th percentile values of available age matched longitudinal data, in this case the Hungarians. The Hungarian data is based on the first longitudinal study conducted on Hungarian children by Jubert and Gyenis (2016) who followed a cohort every year between birth and 18 years of age. From the Table-12 it is clear that the sub-scapular skinfolds of the Hungarian children were, by and large, thicker in most ages than the Jat Sikh and Scheduled Caste boys and girls in the present study, which could be due to ethnic and socioeconomic differences.

Calf Skinfold: In Jat Sikh boys, an early peak in calf skinfold growth velocity was seen at 3 years (Figure- 11). In Jat Sikh girls the peak velocity was noticed at 7 to 8 years (Figure-13). Among Scheduled Caste children, the peak velocity was registered at 8 to 9 years in boys as well as girls (Figures15 and 17). The peaks probably represent the mid-growth spurts, as has been suggested in his work by Cameron (2002).

Table-12: Comparison of mean Sub-scapular Skinfold (mm) of Jat Sikh and Scheduled Caste boys and girls of Bathinda District with longitudinal data of Hungarians

Age in years	Hungarians (Jubert and Gyenis, 2016), 50th percentile		Jat Sikh (Present Data)		Scheduled Caste (Present Data)	
	Boys	Girls	Boys	Girls	Boys	Girls
3	7	7	6.77	6.49	6.48	7.27
4	6	7	5.90	5.95	6.02	6.33
5	6	7	5.57	5.90	5.77	6.14
6	6	7	5.26	5.68	5.67	6.14
7	5	6	5.50	6.02	5.04	6.11
8	6	6	5.58	6.86	5.13	5.78

The girls in this sample recorded, on the average, thicker calf skinfolds than the boys and statistically significant gender differences ($p \leq 0.05$) were present at 3, 6 and 8 years among Jat Sikhs and at 4, 6, 7 and 8 years among Scheduled Caste children. More significant gender differences were noticed among Scheduled Caste children as compared to the Jat Sikh children. On the whole, the Caste differences in calf skinfold between 2 to 8 years old Jat Sikh and Scheduled Caste boys and girls in the present sample did not present a clear pattern. Thus, it could be assumed that the children were, by and large, similarly affected by the nutritional and other environmental factors. The present linked longitudinal study considers only two skinfolds. In order to have a more comprehensive understanding of growth in overall body fat, it is necessary to study other skinfolds, which we plan to undertake in the near future. More longitudinal investigations are required to better understand the variations in the patterns of growth of skinfold in different populations of India. Such studies are significant in view of the fact that excess fat in infancy and early childhood can persist into adulthood as obese children are five times more likely to become obese adults (Péneau, *et al.*, 2011; Brei *et al.*, 2018; Simmonds, *et al.*, 2015) and in adults excess fat is associated with several diseases such as cardiovascular diseases, type 2 diabetes and certain forms of cancer (Demerath, *et al.*, 2008; Must *et al.*, 1992).

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