

Health Related Physical Fitness of Boys Aged 8 to 18 Years

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Abstract

Keeping in view the lack of information about health related physical fitness of young boys, the present investigation was carried out on 797 male children and youth belonging to Punjab and falling in the age range of 8 to 18 years. Four components of health related physical fitness namely cardiovascular endurance, muscular strength/endurance, flexibility and body composition were assessed using standard techniques. The results in general indicate a trend of improvement in cardio respiratory fitness of the boys belonging to the present study with increase in age. However when comparison is made with Prudential fitness gram standards Results indicate poor level of VO_2 max in boys of the present study, the results of muscular strength and endurance, an important health related component of fitness indicate variations in its development with respect to different body regions in boys of the present study from age 8 to 18 years. The muscles related to the upper body region like triceps, deltoid, pectorals major etc. are observed to develop relatively better in their strength endurance ability than the muscles belonging to abdominal, hip and leg regions. It is believed that disproportionate development of muscular strength endurance in boys of the present study may be due to their habitual life style and a craze for some selected muscular strengthening exercises, like use of dumbbells, lifting weights etc. in order to develop their body for an attractive physical appearance. Average percent body fat of these boys at all age level is observed to fall in the health fitness zone. However the percent body fat of boys of the present study after the age of 14 years and onwards exhibit a sharp rise, which continues up to 17 years of age.

Key Words: % **Body fat, Flexibility, Cardiovascular endurance, VO_2 max**

Introduction:

Keeping in view the fact that childhood physical fitness has important health consequences during adulthood (*Sallis et al., 1992*) a large number of studies on physical fitness have been reported from different countries of the world. Data on the physical fitness of children from Denmark (*Knuttgen, 1961*), England (*Campbell & Pohndof, 1961*), South Africa (*Sloan, 1966*), Belgium (*Hebbelinck and Borms, 1969*), Israel (*Ruskin, 1978*) and Japan (*Ishiko, 1978*) are available in the literature. All these reports made the health planners realise the importance of the contribution of Health Education and Physical Fitness in the development of total fitness. The practice of physical testing in children started thereafter in various countries.

The interest in studies on physical fitness in India is of comparatively recent origin. The emphasis of researchers in India has remained mainly on the reporting of physical growth and development patterns among different populations inhabiting the country, as is evident from a large number of publications reported in the literature in the last fifty years (*Fabich & Hamburger, 1941; Dawer, 1946; Currimbhoy, 1963; Vijayraghavan et al (1971); Khanduja et al., 1967; Neumann et al., 1969; Sidhu, 1969; Singh and Meenakshi, 1969; Bhandari et al., 1972; ICMR, 1972 & 1989; Lall, 1972; Mehta and Merchant, 1972; Bhatnagar, 1975; Kansal, 1981; Verma, 1983; Verma, 1988; Kumar and Bhalla, 1988; Chatterjee and Mandal, 1994; Joshi, 1996; Nischint, 1998; Kumar, 2001 and Ajita, 2001.*

No planned attempt seems to have been made to study the health related fitness in India. The present investigation therefore has been conducted with an aim to report the health related physical fitness of boys ranging in age from 8-18 years.

Materials and Methods:

The study has been conducted on a cross sectional sample of 797 male children and youth falling in the age range of 8 to 18 years. The subjects for the study were chosen on random basis from various educational institutes situated in the Patiala district of Punjab state and divided into eleven age groups on the basis of their age.

Table 1: Tests and Equipments Used For Assessing Various Components of Health Related Physical Fitness

Component	Test executed	
Cardiovascular Endurance	2.4 km run time	
Muscular Strength/Endurance	Upper Body	Pull ups
	Abdominal	Sit Ups
	Lower Body	Bench Jumps
Muscular Flexibility	Modified Sit and Reach Test	
Body skin folds-% Body Fat	Skin folds from biceps, triceps, sub scapular & supriliac sites (Harpenden Calliper)	

Various components of health related fitness were measured using standard techniques (Table 1).

Results and Discussion:

(i) Cardiovascular Endurance (Table 2 & Figure. 1):

Performance in 2.4 km run is considered to be a good indicator of cardiovascular endurance fitness, an

important component of health related physical fitness. The mean values of 2.4 km run time along with its SD have been enlisted in Table 2.

It is observed that the performance of boys in this parameter exhibit a general trend of improvement from age 8 to 18 years, with the exception at the ages 9, 13 and 18 years. On an average, a boy at the age of 17 years complete the 2.4 km distance by taking about 19.4% lesser time as compared to the boy of age 10 years. Another important observation regarding this test indicates rapid improvement in performance in this test of cardio respiratory endurance from age 9 to 12 years (16.7%), hereafter from age 13 onwards, the improvement continues in this component of health related physical fitness but at a slower rate. The results in general indicate a trend of improvement in cardio respiratory fitness of the boys belonging to the present study with increase in age.

As per the fitness classification given by *Hoeger and Hoeger (1990)* based on performance of boys in 2.4 km run, boys of the present study from age 8 to 10 years are observed to possess fair level of fitness but after the age of 10 years the fitness of the present group of boys deteriorates and they are observed to belong to the average category. Vo_2 max/kg body weight has been calculated from the 2.4 km run timings of boys based on the conversion table given by *Cooper (1968)*. The average value thus calculated for the different age groups on boys of the present study has been compared in Figure. 1 with the Prudential Fitness Gram Standards for HFZ on American boys given by Cooper institute for Aerobic Research, Dallas, Texas (*Nieman, 1995*). Results indicate poor level of Vo_2 max in boys of the present study as compared to the Prudential fitness

gram standards. According to Cooper institute for aerobics, cardio respiratory endurance is the ability to continue or persist in strenuous tasks involving large muscle groups for extended period of time. It is the ability of circulatory and

respiratory systems to adjust to and recover from the effect of whole body exercise or work. According to *Ross (1985)*, low levels of cardio respiratory endurance are consistently linked with increased risk of heart diseases etc. in the later part of life.

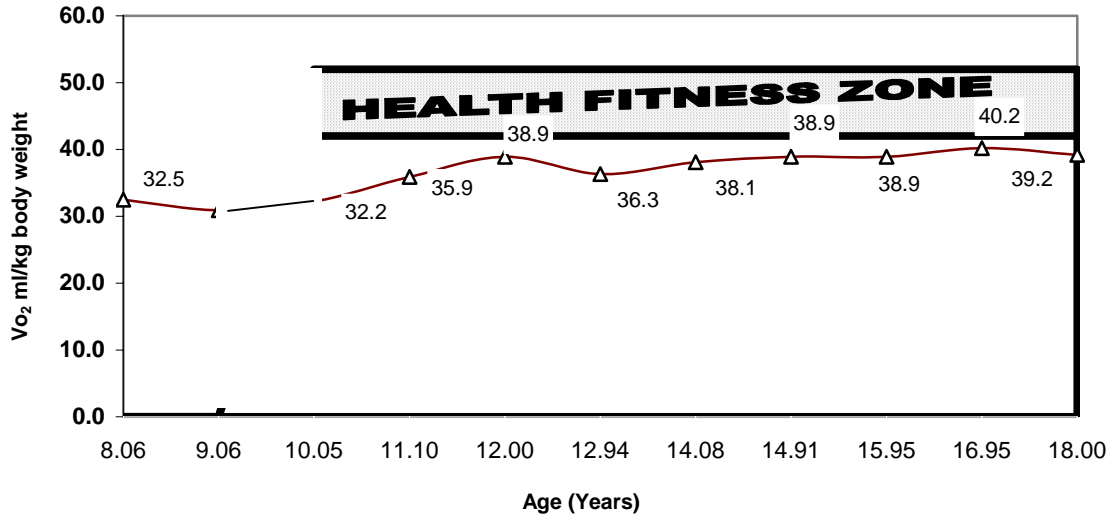


Figure 1: Age changes in Cardio vascular Endurance as indicated by predicted Vo₂max in Boys of the present study and their fitness status with respect to the Health Fitness Zone

Low levels of cardio respiratory fitness among Punjabi boys have also been reported by *Verma (1988)* in comparison to the boys belonging to Western countries. The results of the present study conducted after 14 years again point to the same trend. The results of the study indicate that despite increased health fitness awareness among the people, the health fitness scenario among the growing population is discouraging, may be due to the extra emphasis laid by the parents on the study of their children leading to neglect of physical activity. This indeed is alarming because childhood health fitness status is reported linked with the adult health fitness status.

(ii) Muscular Strength / Endurance (Table 2 & Figures 2-4):

For all our essential basic activities both muscular strength/endurance are required. This has been measured and results related to this are presented and discussed as follows:

- (a) Upper body strength/endurance
- (b) Abdominal strength/endurance
- (c) Lower body strength/endurance.

Upper Body Strength/Endurance (Table 2 and Figures. 2):

The mean values of upper body muscular strength/endurance as measured by pull up test in boys from age 8 to 18 years are given in Table 2. A general trend of increase in this component of health related physical fitness is observed from age 12 to 18 years. Before this age, the boys do show a general increase in pull up

scores from age 8 to 12 years, but the magnitude of increase in this parameter is

observed to be of smaller magnitude than that observed between 13 to 18 years.

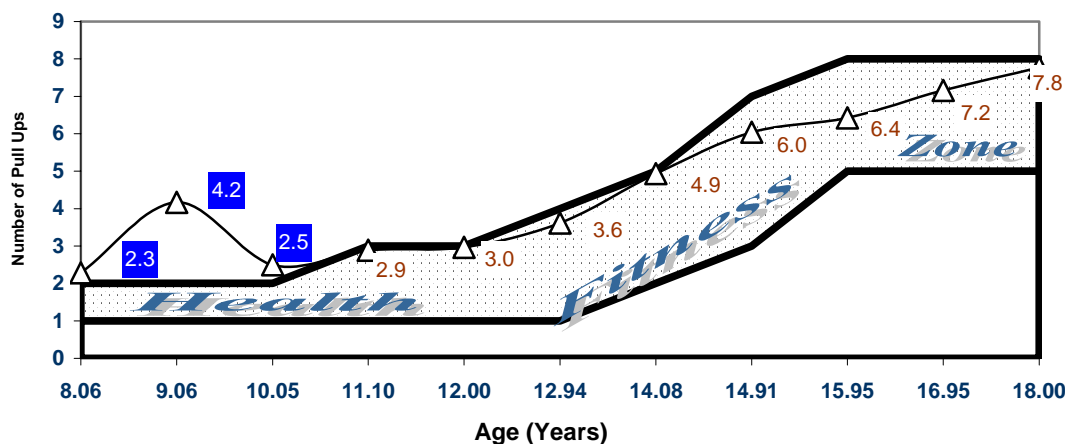


Figure 2: Age changes in upper body strength/ endurance as measured by pull up test in Boys of the present study and their fitness status

Pull up test measures the strength /endurance of arms and shoulders muscles. Percentage gain in the strength/endurance of muscles of arms and shoulders from age 8 to 12 years has been found to be about 59% as compared to a gain of 115% recorded in these muscles from 13 to 18 years of age among Punjabi boys. Increased gain in the muscular strength endurance of arms and shoulders from age 13 to 18 years can be ascribed to the occurrence of adolescent spurt in Punjabi boys during this phase of growth. Comparison of the muscular strength/endurance scores of Punjabi boys with the norms reported by Ross *et al*, (1985 & 1987) on American boys of similar ages, reveals comparable values. As per norms reported by them, Punjabi boys are found to possess average strength endurance values at different age levels between 10 to 18 years. At the age of 8 and 9 years, the Punjabi boys are found to exhibit better upper body strength /endurance than their American

counterparts (Figure. 2).

Abdominal Muscular Strength /Endurance (Table 2 Figure. 3):

This has been assessed by sit up and bent leg Curl up tests. The results indicate a general trend of increase in sit up score, though at varying rates from age 8 to 14 years. After the age of 14 years, a gradual decrease in sit up-score is seen with increase in age.

Gakhar & Malik (1999) also reported a similar trend of increase in sit up scores with increase in age in Jat school children of Delhi. The boys of the present study however are observed to demonstrate better scoring in this test than their age peers studied by the above authors.

Sit-ups measure the strength/endurance of abdominal group of muscles, which include rectus abdominalis and obliques. The results indicate increase in the abdominal strength/endurance of these muscles with increase in age in boys of the present study. Comparison of sit up

scores of boys of the present study from age 15 years onwards with the normative data reported on American boys by Ross *et. al*,

(1985 & 1987) reveal poor status of the former as compared to the later.

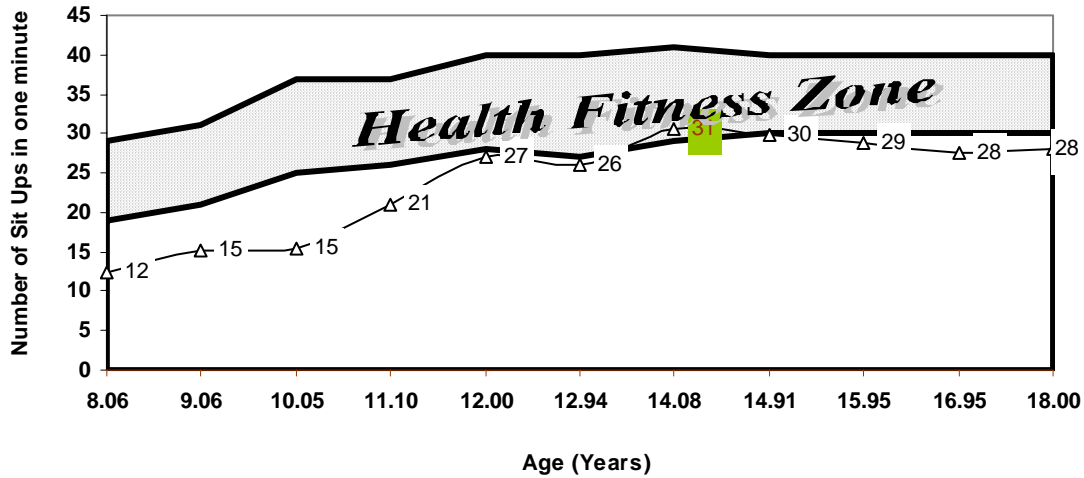


Figure 3: Age changes in abdominal strength/endurance as measured by sit up test in Punjabi Boys and their fitness status with respect to the Health Fitness Zone

Muscular strength/endurance are considered to be crucial for everyone's physical well-being and therefore is considered an important component of health related physical fitness. It becomes although more important if the strength under consideration relates to the abdominal region. Flabby muscles of the abdomen having low tone invite deposition of fat in the abdominal adipose area along with protrusion of belly that can lead to the development of biomechanical problems related to posture and can affect the spinal nerves. The poor abdominal muscular strength/endurance exhibited by boys of the present study, point to the negative life style being lead by them. In order to have a healthy adult population, it is felt that there is a need to create awareness among the general public about the importance of the health related fitness among the youth of Punjab.

Lower Body Muscular Strength /Endurance (Table 2 & Figure. 4):

Bench jumps test has been administered for assessing the muscular strength /endurance of the lower body of the boys of the present study.

The execution of this test involves the use of major muscles namely glutei, quadriceps, gastronomies and soleus. Mean values of this parameter exhibit a general pattern of increase from age 8 to 15 years, where after, the mean values are found to decrease slowly but continuously up to the age of 18 years. The boys belonging to 15-year age group show maximum value of mean bench-jump score. Comparison of average bench scores with the bench jump scores in American boys reported by Hoeger & Hoeger (1990) reveal poor lower body muscular strength/endurance in boys of the present study at all age levels (Figure. 4).

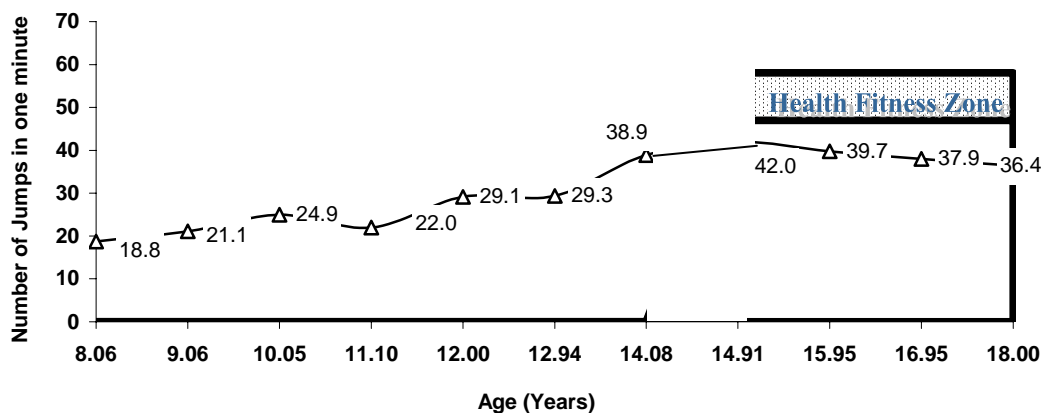


Figure 4: Age changes in Lower Body Muscular strength/endurance as measured by Bench Jump test in Boys of the present study and their fitness status with respect to the Health Fitness Zone

In nutshell the results of muscular strength/endurance, an important health related component of fitness indicate variations in its development with respect to different body regions in boys of the present study from age 8 to 18 years. The muscles related to the upper body region like triceps, deltoid, pectorals major etc. are observed to develop relatively better in their strength endurance ability than the muscles belonging to abdominal, hip and leg regions. This disproportionate development of major regions of the body needs an explanation and analysis. It is believed that disproportionate development of muscular strength/endurance in boys of the present study may be due to their habitual life style and a craze for some selected muscular strengthening exercises, like use of dumbbells, lifting weights etc. in order to develop their body for an attractive physical appearance. In addition to this, demands of their daily rural activities involve the use of upper body system mainly arms for fodder to be cut by machine, lifting of objects, milking the cattle and so on. These factors may be contributing to the better development of

muscular strength and endurance of upper body in Punjabi boys. Mechanisation in cities of Punjab has already made an impact on the life style of the people. Sedentariness is the outcome of modernisation and mechanisation that has led to the reduction in daily physical activities involving walking, jogging etc. This might have lead to the poor muscular strength/endurance development in the abdominal and lower body regions. The results of the present study need to be taken seriously in view of the fact that poor development of muscular strength and endurance is known to be associated with a number of health related problems, the most important of which is low back pain and another related to the postural problems. (Deyo, 1991, Plowman, 1992, Biering et al., 1994).

(iii) **Flexibility (Table 2 & Figure. 5):**

Flexibility is another very important component of health related physical fitness and is defined as the functional capacity of joint to move through full range of movement. Muscles, ligaments and tendons contribute largely to the amount of movement possible at a joint. The age changes in flexibility in boys of the

present study have been studied by the Modified Sit and Reach test. At the age of 8 years, a mean value of 3.8 inches is observed and with increase in age a slow and continuous decline in this parameter is witnessed up to the age of 11 years. Thereafter, a general trend of increase in modified sit and reach scores are observed leading to a maximum average value of 5.4

inches exhibited by 18-year-old boys. Comparison of the boys of the present study with the normative data on youth in the Canadian Fitness Survey (Stephens & Craig, 1988) yields very valuable information. The boys of the present study are found to possess poor levels of flexibility as compared to the Canadian norms (Figure. 5).

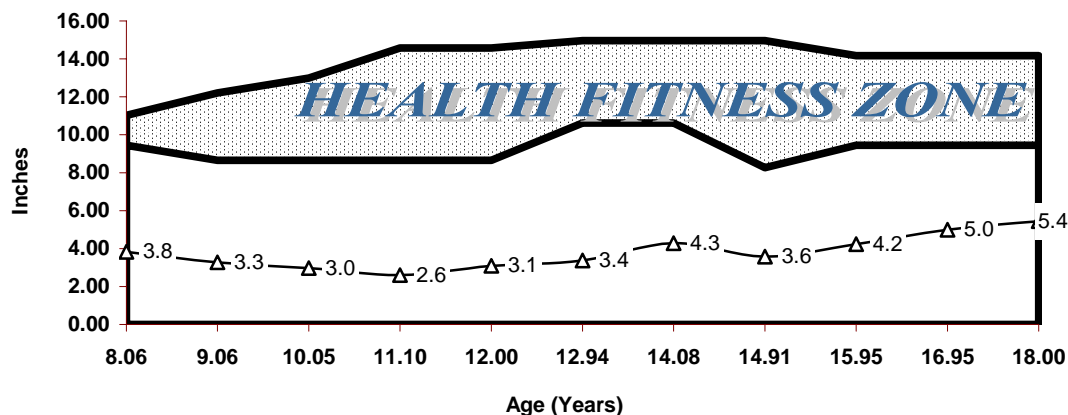


Figure 5: Age changes in Flexibility as measured by Modified Sit and Reach Test in Boys of the present study and their fitness status with respect to the Health Fitness Zone

According to Heyward (1991) flexibility is the capacity of a joint to move freely through its full range of motion. The limitation to joint flexibility is tightness of soft tissue structure like joint capsules, muscle tendons and ligaments. The more muscle can stretch the better becomes the flexibility of a joint. Good flexibility is important for joint health and prevention of injuries. In addition leg back and hip muscles must be strong and flexible to prevent problems like low back pain. The decrease in flexibility around 14 to 15 years of age is believed to be due to the adolescent changes taking place in the body especially the increased muscular development and associated structures during this phase of growth. As this phase passes off the adolescent processes lead to the stabilization of muscles and associated

structures like tendons, ligaments etc, that lead to once again in the gain in the flexibility during the rest of the period of growth. Physiologically speaking, the maturation of proprioceptive neuron and muscular facilitation also matures after the adolescent, thus leading to increases in flexibility in the latter part of the growth. The lower level of the flexibility in boys of the present study in comparison to their American age peers reflects on their habitual life style. Decrease in physical exercise levels in the society, in general is considered the most plausible explanation for this. Almost a complete neglect of physical education curriculum, which used to be an important and integral part of our educational system in the past, may be responsible for this state.

(iv) Percent Body Fat (Table 2 & Figure. 6):

Body composition is another very important component of health related physical fitness. People whose body composition is optimal tend to be healthier. Possession of excess body fat is known to be linked with the risk of running chronic

diseases like blood pressure, diabetes, hypertension etc. *Sourenson and Sonne (1988), Mossberg (1989) and Serdula et al. (1993)* reported that fatty children become fat adults in their later part of life.

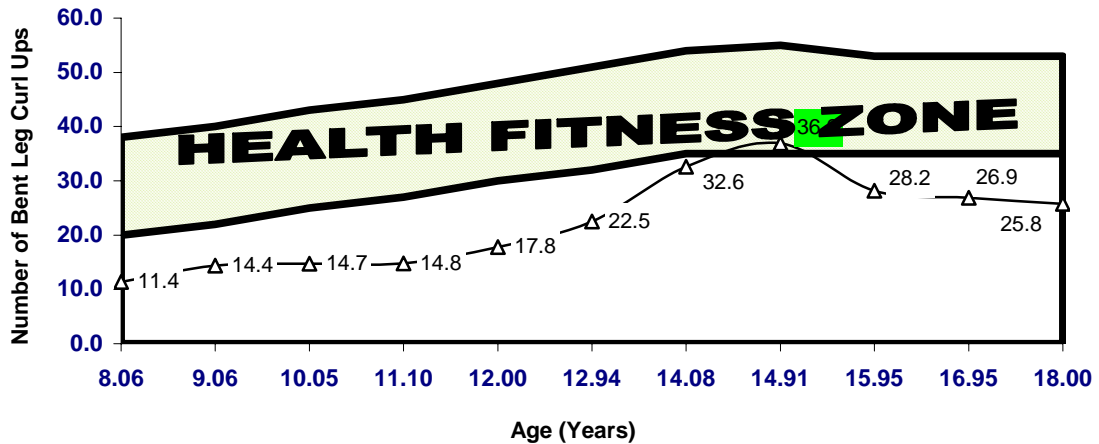


Figure 6: Age changes in percent body fat as predicted from skin folds in Punjabi Boys and their fitness status with respect to the Health Fitness Zone

Keeping in view the importance of percent body fat during childhood, body fat assessment has been carried out in boys of the present study from 8 to 18 years of age. Mean values of percent body fat exhibited by these boys at different age levels, is given in Table 2 and also illustrated in the form of distance curve in Figure. 6. On an average, 8 year old boys possess 12.0% body fat that increase to 14.3% at the age of 11 years, where after a gradual decrease occurs till 14 years of age. After this age up to the age of 17 years, the boys exhibit a sharp rise in percentage body fat and touch the highest mean of 17.5%.

Baseline data on the health related fitness level pertaining to body composition of school aged American children were made available with the release of First National Children and Youth Fitness

Studies (NCYFS-I) in 1985 and subsequently by the President Council of Physical Fitness and Sports School population fitness survey in 1987. NCYFS-II also published data related to health related fitness on US children (*Pate and Ross, 1987; Ross et al., 1987; Ross and Pate, 1987*).

Comparison of percent body fat possessed by boys of the present study at different age levels with the similar data reported on American children has been made. The results reveal that on an average, these boys fall in the health fitness zone limits (given by Cooper Aerobic Research Institute), which has been reported to be between 10 to 25% in the above mentioned studies. Average percent body fat of these boys at all age level is observed to fall in the health fitness zone. However the

percent body fat of boys of the present study after the age of 14 years and onwards exhibit a sharp rise, which continues up to 17 years of age. As far as the age trends in percent body fat are concerned our results agree with *Kansal (1981) and Giri (1990)*. At the age of 17 years maximum average value of percent body fat (17.5%) is seen in the present study. In the opinion of the investigator these observations may have a negative effect on the health and well being of boys of the present study.

A comparison of percent body fat of boys belonging to the present study with a similar data reported by *Kansal (1981) and Giri (1990)* also reveal greater percent

body fat possessed by the former. This means that boys of the present study have become fatter since 1990. Probably the negative life style coupled with increased energy intake seems to be the reason for this type of trend in the present study. The trend of increase in fatness in the boys of the present study is a signal for the health planners and if remedial measures are not planned in time, the consequences of this will be bad not only to the population concerned but also to the state. The observation needs to be taken seriously because increased body fat is known to be associated with a wide variety of health problems.

Table 2: Mean values of various components of health related fitness

Mean Age (Years)		8.06	9.06	10.05	11.10	12.00	12.94	14.08	14.91	15.95	16.95	18.00
	N	75	65	78	80	79	70	65	70	70	75	70
2.4 KM Runtime [min]	Mean	15.25	16.01	15.33	13.94	12.70	13.47	13.10	12.81	12.80	12.35	12.49
	SD	3.19	3.10	2.96	2.11	1.63	2.76	2.25	2.39	2.20	1.76	1.98
Pull Up Score	Mean	2.3	4.2	2.5	2.9	3.0	3.6	4.9	6.0	6.4	7.2	7.8
	SD	1.13	1.91	1.19	1.33	1.43	1.71	2.30	2.76	3.04	3.39	3.53
Sit Up Score	Mean	12.5	15.2	15.4	21.1	27.1	26.0	30.6	29.8	28.7	27.7	28.0
	SD	6.2	6.6	7.1	10.2	9.2	12.6	11.0	10.4	8.5	7.3	8.7
Bench Jumps	Mean	18.8	21.1	24.9	22.0	29.1	29.3	38.9	42.0	39.7	37.9	36.4
	SD	8.2	9.1	11.6	7.7	10.0	14.8	10.5	14.2	14.6	15.7	15.0
Sit & Reach (inches)	Mean	3.8	3.3	3.0	2.6	3.1	3.4	4.3	3.6	4.2	5.0	5.4
	SD	1.79	1.62	1.33	1.20	1.49	1.66	1.70	1.65	1.61	1.71	2.40
Percent Body fat	Mean	12.0	13.6	14.2	14.3	13.9	13.6	13.3	15.4	17.0	17.5	14.5
	SD	3.16	3.99	5.27	4.82	5.44	4.30	4.36	4.19	4.50	4.57	4.49

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