GSC Advanced Research and Reviews

eISSN: 2582-4597 CODEN (USA): GARRC2

Cross Ref DOI: 10.30574/gscarr

Journal homepage: https://gsconlinepress.com/journals/gscarr/

(RESEARCH ARTICLE)

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Variations of skill-related fitness components in normal and overweight high school children

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GSC Advanced Research and Reviews, 2024, 18(03), 001–012

Publication history: Received on 12 January 2024; revised on 23 Februay 2024; accepted on 26 February 2024

Article DOI: https://doi.org/10.30574/gscarr.2024.18.3.0079

Abstract

Adolescence means "stepping into adult life." It is a prepubertal phase where the transmutation of childhood into adulthood occurs and the physical and psychosomatic growth of a child takes place. This study has focused on Normal & Over Weight in school going children aged between 10 and 19 years, and their status in skill related fitness. The minimum sample size for each group = 100. The subjects taken into the study were adolescent children with an age group of 10-19 years. For the study, all the students were taken from school who were studying between the 5th standard to 12th standards. After screening the children, the eligible students were randomly called to have their body composition assessed class and section-wise. The children were divided into two groups based on their Body Mass Index (BMI). The BMI was assessed with the weight in kgs divided by height in meters square of the child. The children were divided into two group and skill fitness outcome measures namely Broad Jump Test (BJT); Hand Grip Strength Test (HGS); Bent Arm Hang Test (BAH) were used. This study concluded that the physical fitness that includes skill fitness was decreased in Overweight than Normal weight adolescent boys and girls.

Keywords: Over Weight; Skill-Related Fitness; Bent Arm Hang Test (BAH); Hand Grip Strength Test (HGS); Broad Jump Test (BJT).

1. Introduction

Adolescence means "stepping into adult life." It is a prepubertal phase where the transmutation of childhood into adulthood occurs and the physical and psychosomatic growth of a child takes place. According to WHO, adolescence are teenagers aged between 10 and 19 years. This is the zestful period where the children tend to be more self-dependent and seeks social independence. The biological, cognitive and psychological development of child occurs at this age. The adolescent age is divided into Early Adolescent age is 11-13 years of age and Middle adolescent age consisting age group of 14-17 years and from 19 years; the children enter into adulthood. Various external and internal factors like social, genetical, economical, environmental, behavioral, self-esteem have a key role on the overall development of an adolescent [1]. The Indian School system has four levels of education. Lower primary (11to 12 years), upper primary (13 to 16 years) and higher secondary education (17 to 18 years). Adolescent children are high school children pursuing upper primary and higher secondary education. This is the most critical age where the children are vulnerable to obesogenic environment and are more prone for abnormal weight gain. Adolescent overweight and obesity are the most challenging metabolic disease facedglobally in the 21st century. For the past 20 years if we observe this adolescent obesity is on upsurge in both developed and developing countries creating an early mortality and morbidity in adult life [2]. The world-wide rapid escalation of this nutritional problem in thechildhood and adolescent age among all the developed and developing countries and its adulthood health outcomes has made the WHO rename the obesity as globesity[3].The prevalence of childhood and adolescence obesity can track into metabolic; cardiovascular; endocrinal;

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neurological; psychological; reproductive disorders in adult life [4]. As obesity is a manifestation of many non-communicable disorders, it is renamed as" New World Syndrome" creating stress on countries health care budget [5] . Rapidly developing societies and the changing life styles especially adopting poor dietaryhabits and inclination towards modernization is making the people lead a sedentary life. Obesity was once thought it was limited to adults but various studies have shown the rise of obesity and overweight in children over the past few decades in developed and as well as developing countries. The prevalence of adolescent overweight in India is between 2.2% to 25% [6]. According to the statistics of International Obesity Task Force, around 155million school children aged 5 to 17 years are Overweight globally and in that 30 to 45 million children are Obese [7].

1.1. Pubertal Alterations in Body During Adolescence

During Puberty; sudden hormonal fluctuations and changes in the growth and size of the body alters the body composition. The changes in the body composition in this growth and maturational age cause metabolic changes which is a marker of the present and futurehealth of an individual. There is sexual dimorphism during puberty [8-10]. There is an increase in total body fat in both boys and girls; but there is a great increase of FFM and slow increase of FM in boys [11]. The proportion of total fat in girls increases rapidly at approximately 5.5 kg mean value at 8 years to nearly 15 kg at around 16 years; and after 16 it increases slowly. Where as in boys; the TBF from 5.0 kg mean value at 8 years increases to nearly 11.0 kg at around 14 years; after that the TBF reduces to nearly 9 kgat 16 years of age and thereafter reaches a plateau. In girls, the increase of FFM continuestill 15 years and thereafter it remains stable. In boys; FFM rises steadily between 8 to 18 years; with rapid increase between 12 to 15 years of age. The energy requirement increases during pubertal age (adolescence) due to alterations in body composition. This requirement depends on gender; prepubertal stage; energy expenditure, physical capacity and metabolic rate. The increase in testosterone and GH associated with puberty causes increase in energy expenditure during the pubertal phase when compared to prepubertal period. Adipose tissue is an important endocrine organ interacts with sex hormones influencing the changes in body composition. Certain changes in body composition during puberty leads to many risk factors like CVD; Osteoporosis; Type II diabetes; Obesity [10,12-15]. There is proven evidence that the changes in body composition tracks from childhood into adult life. There is a strong tracking of childhood and adolescence obesity into adulthood and mild tracking of obesity at birth into childhood. With BMI > 95th percentile among 8 to 13 years old children, 33% boys and 50% girls of these children possess obesity at adulthood. Whereas adolescents of age 13 to 18 years with BMI > 95th percentile, of these 50% males and 66% females possessed obesity in adult life. The weight during birth and infant age has a very low tracking correlation into later life [16].

The TBF and FFM levels during adolescence have a high positive transitional correlation into adult hood. At Puberty; adipose tissue is very active endocrine organ secreting various proteins in response to various metabolic changes. The adipokines suchas leptin; resisting; and adiponectin involve in lipid metabolism and energy homeostasis. Some of these adipokines are pro and some are anti-inflammatory [17]. Leptin plays a key role in energy homeostasis; regulates food intake, releases insulin and pubertal onset. Leptin's sensitivity prevents accumulation of FM and helps in preventing obesity, PCOs and other associated metabolic disorders with onset of obesity. Leptin is positivelycorrelated with more of subcutaneous adipose tissue. Research has confirmed the high circulating leptin levels in girls than in boys before, during and after puberty. Gonadal steroids create a sexual dimorphism in maintaining leptin concentrations. Hence leptin plays a key role on the onset of puberty and on the distribution of adipose tissue [18] 'C' reactive protein which is an inflammatory marker is inversely proportional to the circulating leptin levels. The relationship between increased inflammation due to excessive body fat explains that leptin possess anti-inflammatory properties [19]. The body composition changes during puberty influences the pubertal insulin resistance (HOMA-IR). The circulating leptin levels and IGF-1 during puberty influences the HOMA values [20]. Puberty is in direct proportion to decrease in insulin sensitivity [21,22]. Reduction of insulin sensitivity to approx. 1/3rd; increase in insulin levels and fasting blood glucose levels were observed from I, II, III tanner stages transition [23]. Adiponectin is potentially decreased during puberty and this cytokines plays a key role in controlling insulin resistance and differentiation of adipose tissue [24,25] linking visceral obesity and metabolic syndrome [25]. With the normal adiposity amounts in adolescent children, there is anincrease in serum HOMA-IR and fasting insulin levels observed in late pubertal periods than the pre and during pubertal periods indicating that with normal body composition also there is increase in insulin resistance. Further increase in FM associated with OWand Obesity in pubertal period further increases insulin resistance and increase in release of inflammatory cytokines from the adipokines affecting the health and motor fitness [20].

1.2. Definition of Adolescent Overweight

According to WHO; "Overweight" is defined as immoderate acquisition of fat in adipose tissue creating a negative impact on the health status of a child. The childhood obesity and overweight are based on two concepts. One is defined according to standardized growth charts based on age and the other is defined based on cut off points drawn based on clinical observation. Every country has their own charts designed according to their specifications. "Centre for Disease

control and Prevention" (CDC)," International Obesity task force"; Cole et al; WHO; Indian Association of Pediatrics classification systems are the most widely used and gold standard systems of classifying body composition in children and adolescents. They are the classification systems used globally. They have classified based on BMI percentiles in children and adolescents having high reliability and validity.

Table 1 Classification for Children According to CDC, IAP, IOTF BMI

Underweight	BMI < 5th Percentile
Normal Weight	BMI 5th to < 85th Percentile
Overweight	BMI 85th to < 95th Percentile
Obese	BMI > 95th Percentile

1.3. Prevalence of Adolescent Overweight

Obesity is not only threatening adults; it is also alarming childrenand adolescents. Moreover, child and adolescent obesity is a precursor for adulthood obesity and its associated complications. There is a tenfold increase in adolescent (5-14 years of age group) obesity for the past 40 years. By 2022; the world will see enormous increase in childhood and adolescent obesity according to WHO. The obesity trends in adolescents have risen globally from 11 million in 1975 to 124 million in 2016. In addition to this, 213 million were overweight in 2016. In addition to this 213 millionwere overweight in 2016. National health and nutrition examination services (NHANES) IV in a survey done in 1999-2000 stated that 21% to 23% of children with age group of 6-17 years are overweight and 9 to 13%children are obese based on BMI percentiles. The WHO 2014 has alarmed the status of obesity and overweight globally and the inclination of this non communicable disorder in the 21st century. The International association for study of obesity (IASO) and international obesity task force (IOTF) evaluated that globally 200 million schoolchildren are either obese or over weight.

1.4. Prevalence in Asian countries

There is an upward slope in the prevalence of overweight and obese in children and adolescents in the past few decades. In 2008 it is estimated that 170 million children under 18 years of age are overweight or obese and 30% of these children may be associated with obesity related problems by 30% by 2030. Prevalence of overweight is 20.5% and obesity is 15.6% in European countries24.5% of overweight and obese in eastern Asian countries 11.9% overweight and obese in western Asian countries 3.5% in rural Bangladesh, 65% in Maldives, 30% in Iran and Saudi Arabia, 12.5 % inChinese children WHO stated that most of overweight and obese children live in developing countries thanin developed countries

1.5. Distribution of Fat

Though overweight and obesity are well defined, with anthropometric measures basedon national and or international growth curves, it is important to differentiate the pattern and type of fat distribution when it comes to the analysis of motor and health fitness since thefunctional capacity of neurological and musculoskeletal systems depend on the distribution of fat mass. This fat distribution pattern is very important in documenting the metabolic profile of adolescent obesity.

1.6. Anthropometric Measurements

1.6.1. Body Mass Index

It is simple, inexpensive and a widely used valid tool to measure adiposity in children andadults. It is based on the measurements of height and weight of an individual. Age, sex, and ethnicity have an effect on BMI of an individual. The main drawback of this technique it cannot exactly recognize the percentage of fat mass and lean mass. South Asians have a "thin but fat" phenotype possessing more of fat mass than lean mass for the same BMI. An increase in BMI related to age has been credited to FFM. but studies have shown that there is good correlation between BMI and body fat in children in both genders.

1.6.2. Skin fold measurements

The technique can be used to assess sub cutaneous adipose tissue (SAT) and can characterize body fat types based on SAT as Appendicular fat pattern; Truncal fat pattern; Lower body fat pattern, Upper body fat pattern. Body fat

percentage is derived by measuring Density of the body (DB) using population specific formula based on age and gender. The most sensitive calipers such as Lange, Herpenden and Holtain calipers are used to assess the skin fold measurements. The most measured sites are triceps; biceps; suprailiac; sub scapular, thigh and umbilical regions.

1.6.3. Childhood and Adolescent Obesity

Obesity and Overweight is an excess fat mass. It is an inflammatory disorder that encompasses several chronic disorders including cardiovascular diseases, cancers, dyslipidemia, respiratory disorders, hypertension, musculoskeletal disorders, diabetes,obstructive sleep apnea and psychological disorders in adult life. The root of all these diseases takes their initiation in childhood; remain silent and noticeable in adult stage. Excess adiposity in childhood is the precursor of all these disorders affecting almost all the organs of the body. The distribution of fat mass and the area where the adipose tissue is deposited is associated with health risks. There are two specific areas where the adipose tissue is deposited (Subcutaneous and Visceral). Visceral adiposity is an independent riskfactor for all the health consequences in adult life.

1.6.4. Childhood Obesity

Indians are Insulin resistant's and manifests the clinical presentation of "Insulin resistance syndrome." When compared to other ethnic population, Indians pursue high body fat percentage and more of central fat distribution (Visceral adiposity) for a given BMI. This particular phenotype is present since birth as stated by C. S. Yajnik et.al. Babies try to preserve their body fat during intrauterine development stage and possess small abdomen viscera and very low muscle mass. This is the reason that the infants are insulin resistance post natally. In Obese, triglycerides are initially stored in the subcutaneous adipose tissue and further increase in triglycerides leads to insulin resistance and further subcutaneous accumulation of lipid is inhibited. The triglycerides are then to the visceral adipocytes and ectopic sites leading to further hyperinsulinemia and increase in insulin resistance. Insulin resistance along with hyperinsulinemia is the first step in pathophysiology of type 2 Diabetes Mellitus. Next step is impairment of early secretionof insulin disposing to post prandial and hyperglycemia. Impairment of Glucose Tolerance (GIT) is the main problem in the Obese and Overweight children and adolescents leading to prediabetic stage. The "search for Diabetes in Youth" has conducted a large sample study and stated that adolescents with 10 to 19 years are more prone for T2DM.

1.6.5. Physical Fitness

Physical Fitness is the healthy coordinated functioning of cardiorespiratory; endocrinal; metabolic; musculoskeletal; haemato-circulatory; neurological and psychologicalsystems of the body to do activities without fatigue. Evaluating the physical fitness of an individual implies checking the functional capacity of all the systems of the body. Physical activity and Physical fitness are the two identical terms which depend on each other for maintaining the health status of an individual. Physical activity is the ability of the skeletal muscles to perform movement, with caloric expenditure. Physical inactivity is recognized by WHO as the 4th main cause of mortality worldwide. It has been hypothesized that participating in regular physical activity can increase the physical fitness of a person. WHO in 2010 has stated 81% of adolescents aged 11-17 years were physically inactive globally and that girls are more inactive (84%) than boys (78%). The rapid urbanization, socioeconomic status and the environmental factors play akey role on adolescents making them physically inactive impacting their fitness levels. One of the important risk factors of physical inactivity in childhood is obesity and is the root cause of all the endocrine-metabolic; cardio respiratory and all the other causes of disorders in adulthood. Regular physical activity and healthy diet maintain the optimal body composition and fitness profile of a person. For these reasons; it is important to notethat assessing physical fitness is recognized as an important health marker and a predictorof mortality and morbidity in adulthood. Many studies have documented that the drastic decrease in physical activity during a person's life time is during 13 to18 years of age. There is strong evidence that children with low physical fitness are more prone for mental and emotional distress; poor cognitive functioning and poor academic performance.

Until recent years it was presumed that obesity and diabetes are adulthood diseases but it is found that the precursor of adulthood metabolic disorders is childhood obesity and diabetes. Physical fitness is influenced to some extent genetically and substantially from environmental factors. Physical fitness is divided into health and skill(motor) physical fitness. Fitness parameters were taken from Eurofit fitness testing battery to assess the complete fitness of adolescents in this study. The test battery has a high reliability and validity in testing the physical fitness of school children. The Eurofit fitness testing battery includes health and skill fitness components. The health components include assessment of BMI & skinfold thickness, Cardiorespiratory fitness, flexibility, trunkmuscle endurance. The skill fitness parameters include Balance, upper body strength and endurance, hand grip strength, agility, upper limb speed, lower limbs power. Apart from health and skill parameters, Waist circumference was measured as it better predicts visceral adiposity in children and adolescents.

1.7. Skill Related Fitness

1.7.1. Balance

Postural problems in school children are the most common problems affecting their day-to-day activities. Few postural problems affect the growth and overall development of a child and few problems show an impact on the quality of life. Most of the postural problems start in childhood and lead to structural and functional limitations in adulthood. The postural instability leads to loss of balance or simply in other words balance depends on the postural stability of an individual. Posture depends on age, body weight, sex, segmental structure of musculoskeletal system, neural adaptations, psychological status, level of physical activity and life style of an individual. In school children of 13-17 years (adolescent age group) the distribution of body fat, physical inactivity, sedentary life style shows a significant impact on postural stability affecting balance. Balance is considered as an important motor fitness parameter and assessment in childhood will decide the quality of life in adulthood.

1.7.2. Hand Grip Strength

Hand is the most vital and ineluctable organ in humans responsible for performing almost all the activities of daily living and in sports. Its role in doing precise and gross motor movements in every individual is inevitable. Hence hand is considered as an important vital organ that discriminates humans from primates. Many functional activities of daily living like eating, holding, throwing, washing, brushing, playing etc. requires the gripping activities of the hand using thumb and the fingers. Therefore, hand grip strength is an important biomarker reflecting the nutritional status and physiological functions of all the systems of the body in an individual. Poor grip strength in childhood is a predictor of decreased quality of life and early mortality in adult life. Hand grip strength is the maximum amount of force that can be generated in a single muscular contraction against a resistance. It is quantified by the capacity of the hand to squeeze a dynamometer using maximum tension generated from forearm and hand muscles. Jamar Dynamometer is a valid tool to measure handgrip strength and is found tohave high validity and reliability. Hand grip strength is evaluated by the clinicians to know the disease status of theindividual. Muscle strength is expressed in terms of absolute and relative muscle strength.

1.7.3. Broad Jump

It is also called long jump and is one of the important motor components to determine strength and power of the lower limbs. Broad jump consists of 5 phases.

- Approach Run
- The final two strides
- Take off
- Action in air
- Landing phase.

1.7.4. Bent Arm Hang (Bah)

Bent Arm Hang (BAH) is a weight bearing anti-gravity skill and is one of the important components to determine the skill/motor fitness of an individual. The main objective of the test is to assess the flexor muscle strength of the elbow joint especially the biceps brachii and brachioradialis. The bent arm hang can be biomechanically phased into free suspension and flexed arm hang.

1.8. Hypothesis

- Alternate Hypothesis: There may be significant variation in skill fitness parameters between overweight and normal weight adolescents male and female.
- Null Hypothesis: There may n o t be significant variation in skill fitness parameters between overweight and normal weight adolescents male and female.

2. Materials and methodology

2.1. Study Design

This is a cross-sectional comparative observational study.

2.2. Study Duration

The study period is approximately 6 months, from March 2018 to August 2018.

2.3. Sampling Design

Convenience Sampling.

2.4. Sample Size

Based on the previous studies the prevalence of Obesity was 8.87 % and the prevalence of Overweight in adolescents was 15.12%, the risk difference was 5% and theconfidence interval was 95%.

The minimum sample size for each group = 100.

Study Population: The subjects taken into the study were adolescent children with an age group of 10-19 years (as per WHO guidelines). For the study, all the students were taken from school who were studying between the 5th standard to 12th standards.

The main focus was to study the effect of fitness in adolescent obese and overweight children. This particular age group was selected because adolescence is a period where there is intense growth and physical and psychological changes take place.

The fat mass starts accumulating in this pubertal period and the social, cultural, physical, and environmental factors play an important role in the development of appropriate body composition in this age. Any excess fat mass at this age leads to various health risks in future life. So, developing fitness or preventing obesity in this particular group is best suitable for the healthy growth of the children.

2.5. Inclusion Criteria

School children between 10-19 years; School children from Bikaner city only; Both genders included; Overweight children, Normal weight

2.6. Exclusion Criteria

Girls who are in the menstrual cycle; Musculoskeletal disorders; Hormonal, genetic, or syndromic disorders (Endogenous Obesity); Hypothyroidism Crushing's syndrome Growth hormone deficiency; Children with difficulty in understanding; Anemic children; Children less than 10 years and greater than 19 years of age.

2.7. Methodology

- **For the Assessment of Body**: Digital weighing scale; Stadiometer; Calculator; Pen and Paper; Harpenden skin fold caliper; Marker pen
- **For the Assessment of Outcome Measure:** Flat non-slippery surface/ground; 20m measuring tape; Cones – 2; Music player; Recording sheet; Flexibility box; Stop Watch; Jamar Hydraulic hand dynamometer
- **Children's Health Screen Test:** After obtaining permission from the parents, a date was obtained from the class in charge to conduct a health screening camp for the students, class-wise to check whether the students were stable enough to undergo the fitness tests. The PAR-Q questionnaire was filled up by all the children.
- **Procedure:** After screening the children, the eligible students were randomly called to have their body composition assessed class and section-wise. The children were divided into two groups based on their Body Mass Index (BMI). The BMI was assessed with the weight in kgs divided by height in meters square of the child. The children were divided into: - **GroupA:** Normal Weight Group; and **Group B:** Over Weight Group
- The above groups formed based on the IOTF, WHO, Cole et. al and CDC classification systems. The BMI and % BF was one of the health fitness parameters taken from the Eurofit testing battery to assess the body composition of school ***a***dolescent children.
- **Outcome Measures:** After categorizing the subjects into two groups students were assessed for physical Fitness. The fitness parameters were 'Skill fitness' parameters taken from the Eurofit testing Battery, a valid fitness testing tool specifically used to assess the complete fitness of school children.

2.8. Skill fitness outcome measures

- Broad Jump Test (BJT)

- Hand Grip Strength Test (HGS)
- Bent Arm Hang Test (BAH)

3. Results

3.1. Data Analysis

Data was analyzed by using SPSS software version 25.0.

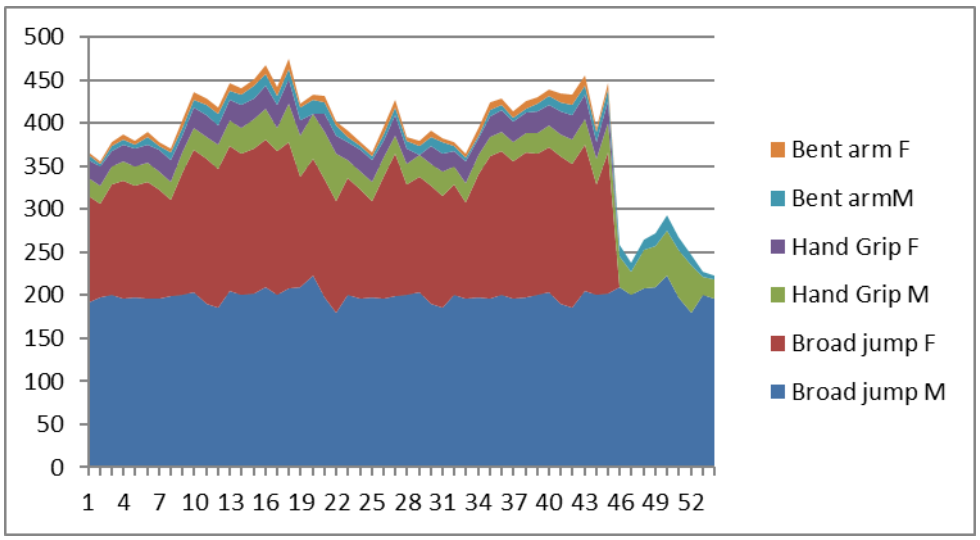
3.1.1. Group A

Table 2 Mean and SD of Age, Weight & Height of Male & Female in Group A

	Group A (Male)			Group A (Female)		
	Age	**Weight**	**Height**	**Age**	**Weight**	**Height**
Mean	14.222	59.148	158.463	14.173	57.282	155.43
N	54	54	54	46	46	46
Std. Deviation	2.133	7.382	10.136	2.204	7.157	9.318

Table 3 Mean and SD of Skill Fitness Outcome Measures in Group A

	Gender	**N**	**Mean**	**SD**	**Std. Error Mean**
Broad Jump Test	M	54	229.944	6.283	0.855
	F	46	189.826	3.854	0.568
Hand Grip Strength	M	54	29.211	10.181	1.385
	F	46	22.493	2.318	0.341
Bent Arm Hang	M	54	18.259	2.084	0.283
	F	46	10.260	1.692	0.249



*(X axis: No. of Participants; Y axis: Broad Jump – **cm**, Bent Arm – **second**, Hand Grip - **kg**)

Figure 1 Comparison between Male & Female Skill Fitness Outcome Measure in Group A

Table 4 Comparison between Male & Female Skill Fitness Outcome Measures in Group A by using Independent t test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Broad Jump Test	Equal variances assumed	6.62	0.012	37.66	98	0.000	40.11	1.065	38.004	42.231
	Equal variances not assumed			39.07	89.57	0.000	40.11	1.026	38.078	42.158
Hand Grip Strength	Equal variances assumed	39.99	0.000	4.37	98	0.000	6.71	1.535	3.67	9.763
	Equal variances not assumed			4.70	59.38	0.000	6.71	1.427	3.868	9.572
Bent Arm Hang test	Equal variances assumed	3.28	0.073	20.82	98	0.000	7.99	0.384	7.23	8.760
	Equal variances not assumed			21.17	97.79	0.000	7.99	0.377	7.248	8.748

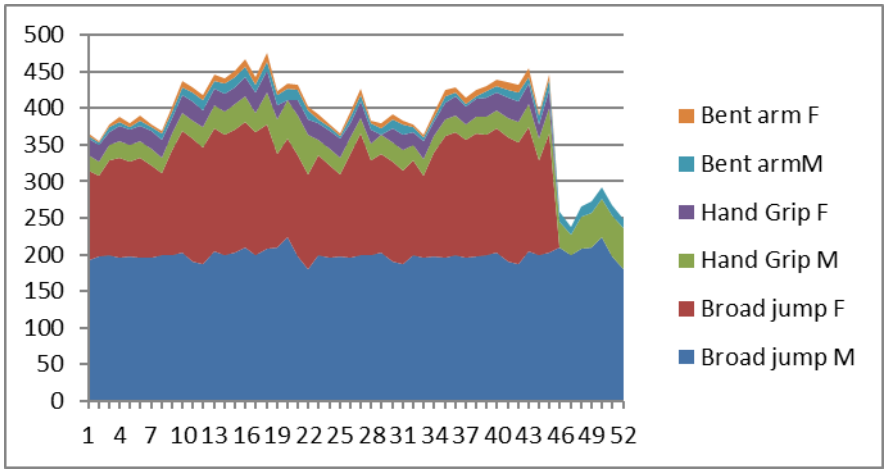
3.1.2. Group B

Table 5 Mean and SD of Age, Weight & Height of Male & Female in Group B

Group B Male				Group B Female		
	Age	Weight	Height	Age	Weight	Height
Mean	14.173	66.942	157.980	13.979	64.229	152.687
N	52	52	52	48	48	48
SD	2.486	9.565	12.065	2.207	8.043	9.230

Table 6 Mean and SD of Skill Fitness Outcome Measures in Group B

	Gender	N	Mean	SD	Std. Error Mean
Broad Jump Test	M	52	214.886	9.219	1.278
	F	48	174.270	13.384	1.931
Hand Grip Strength	M	52	29.688	10.751	1.490
	F	48	22.233	2.471	0.356
Bent Arm Hang Test	M	52	14.288	4.117	0.571
	F	48	10.020	2.809	0.405



*(X axis: No. of Participants; Y axis: Broad Jump – **cm**, Bent Arm – **second**, Hand Grip - **kg**)

Figure 2 Comparison between Male & Female Skill Fitness Outcome Measure in Group B

Table 7 Comparison between Male & Female Skill Fitness Outcome Measures in Group B by using Independent t test

		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
Broad Jump Test	Equal variances assumed	0.139	0.710	17.78	98	0.000	40.613	2.283	36.082	45.145
	Equal variances not assumed			17.53	82.58	0.000	40.613	2.316	36.005	45.221
Hand Grip Strength	Equal variances assumed	43.88	0.000	4.69	98	0.000	7.455	1.589	4.300	10.609
	Equal variances not assumed			4.86	56.80	0.000	7.455	1.532	4.385	10.525
Bent Arm Hang	Equal variances assumed	17.77	0.000	6.00	98	0.000	4.267	0.710	2.857	5.678
	Equal variances not assumed			6.09	90.45	0.000	4.267	0.700	2.876	5.658

4. Discussion

The data was collected from high school aged 10 to 19 years adolescents who were studying 7th to 10th grade in Government and private schools of Bikaner. The students were categorized into groups based on their BMI. Each group

consisted of 100 children including males and females. There were 55 male and 45 female in obese group; 52 male and 48 female in overweight group and 54 male and 46 female in normal weight group. All the children underwent health and skill fitness assessment.

In the Over Weight group mean age of male was 14.173, mean weight 66.942, mean height was 157.980 & standard deviation of male age was 2.486, weight was 9.565 and height was 12.065 while in mean age of female was 13.979, mean weight 64.229, mean height was 152.687 & standard deviation of female age was 2.207, weight was 8.043 and height was 9.230. In the Normal Weight group mean age of male was 14.222, mean weight 59.148, mean height was 158.463 & standard deviation of male age was 2.133, weight was 7.382 and height was 10.136 while in mean age of female was 14.173, mean weight 57.282, mean height was 155.43 & standard deviation of female age was 2.204, weight was 7.157 and height was 9.318.

4.1. Effect of Body Mass Index (BMI) On Physical Fitness

On the comparison of BMI between Obese, Overweight and Normal weight male and female. The mean value of obese male was 31.369 and SD 1.086. The mean value of overweight male was 26.700 and SD .820. The mean value of Normal weight male was 23.488 and SD .860. The P value obtained was < 0.0001 which was less than 0.05. This shows Over Weights that there was a significant difference between the groups. The mean value of obese female was 31.082 and SD .847. The mean value of overweight female was 27.445 and SD .797. The mean value of Normal weight female was 23.615 and SD .784. The P value obtained was < 0.0001 which was less than 0.05. This shows that there was a significant differencebetween the groups in females. The BMI was more in obese males and females followed by Over Weight males and females and followed by normal weight males and females. The most cause of Obesity and Over Weight in children and adolescents is due to obesogenic environment; high caloric dense food; lack of physical activity in school and at home; stress. Irregular eating behaviors lead to increase in fat accumulation above the optimal level for a given height and weight. BMI in adolescence can predict adult BMI and adult total LBM. Even BMI alterations during adolescence can predict the adult visceral fat. It is clear that Obesity during adolescence can lead to various cardiovascular and metabolic disorders. Studies have documented that skeletal muscle fat may hinder Over Weight and motor fitness of an individual. Fitness is a marker of individual's health. With puberty there is an accumulation of extra fat mass. More over the excess weight with obesity or overweight keeps the individual physically inactive. There is an increase risk in developing metabolic syndrome (MetS) with obesity, BMI > 95th percentile which causes rise in triglycerides (>110mg/dl), high blood sugar due to insulin resistance (>110mmol/100ml) and hypertension (>90th percentile) and all cause of musculoskeletal, endocrinal, reproductive, cardiovascular and psychological disorders. Increase in BMI in adolescents leads to 30% increase in early mortality in adulthood (Engeland et al.,2004). There is strong evidence that assessing body composition during adolescence provides information regarding their future health as pubertal alterations in body composition is a marker for many physiological and psychological changes.

4.2. Hand Grip Strength Among Overweight & Normal Adolescents

On the comparison of grip strength measured by hand dynamometer between and within overweight and normal weight adolescent males and females. The mean value of obese males in grip strength was 29.712 and SD 10.928. The mean value of Over Weight males in grip strength was 29.688 and SD 10.751. The mean value of normal weight males was 29.211 and SD 10.181. The P value obtained was <0.0001 which was less than 0.05 stating that there was a significant difference between the three groups. The increase in grip strength was more in Over Weighted followed by normal weight males. There is positive correlation observed between increase in body composition and grip strength. The mean value of Over Weight females in grip strength was 22.233 and SD 2.471. The mean value of normal weight females was 22.493 and SD 2.318. The P value obtained was <0.0001 which was less than 0.05 stating that there was a significant difference between the three groups. The increase in grip strength was more in Over Weight females followed by normal weight females. There is positive correlation observed between increase in body composition and grip strength. The grip strength is more in males when compared to females during the pubertal period due to the male testosterone hormone which increases the recruitment of type II muscle fiberswhich rely on glycolytic capacity. The inverse correlation between BMI and handgrip strength and this could be due to Over Weight physical fitness associated with physical inactivity. Another reason for increase in grip strength in males than females may be the forearm length to height is greater in males than females. So, forearm girth is more in males. Because of the increase in length of forearm, there is greater leverage for increased force production in males than females. Males generally are taller than females with the same age and the increased arm length causes increase in tension producing capacity of muscles and increased force output generation resulting in increased grip strength.

4.3. Broad Jump (BJ) Performance Among Over Weight and Normal Weight Adolescents

When comparing the broad jump performance between the Overweight and Normal weight groups in both males and females. The mean value of Over Weight males was 214.886 and SD 9.219. The mean value of normal weight maleswas 229.944 and SD 6.283. The P value obtainedwas <0.0001 which was less than 0.05 stating that there was a significant difference between the three groups. It was observed that normal weight adolescent males could jump better than the other two groups. Over Weight children and obese children had poor jump performance. The mean value of Over Weight females was 174.270 and SD 13.384. The mean value of normal weight females was 189.826 and SD 3.854. The P value obtained was <0.0001 which was less than 0.05 stating that there was a significant difference between the three groups. It was observed that normal weight adolescent females could jump better than the other two groups Over Weight children and obese children had poor jump performance.

4.4. Bent Arm Hang Performance Among Overweight and Normal Adolescents

On comparison of bent arm hang (BAH) measured in seconds between and within over weight and normal weight adolescent males and females. The mean value of Over Weight males in bent arm hang was 14.288 and SD 4.117. The mean value of normal weight males in bent arm hang was 18.259 and SD 2.084. The P value obtained was <0.0001 which was less than 0.05. This stated there was a highly significant difference between the two groups. Normal weight people were better than Over Weight group. Over Weight group performance was poor when compared to normal groups. The mean value of Over Weight females in bent arm hang was 10.020 and SD 2.809. The mean value of normal weight females in bent arm hang was 10.260 and SD 1.692. The P value obtained was <0.0001 which was less than 0.05. This stated there was a highly significant difference between the threegroups.

5. Conclusion

The result of this study has shown that the physical fitness that includes skill fitness was decreased in Overweight than Normal weight adolescent boys and girls.

Compliance with ethical standards

Disclosure of conflict of interest

There is no conflict with anyone on this study and none other than above-mentioned author & co-author's has interest in this study.

Statement of informed consent

The consent form has been obtained from the participant in the presence of their parents.

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