INTRODUCTION

1.1 General Introduction

One of the most serious public health challenges of the 21st century is obesity. Obesity or overweight is the condition in which the body stores excess amount of body fat/adipose tissue. The terms over fatness and overweight are commonly used interchangeably. With the modernization and technological advancement, globally the trend of obesity is increasing alarmingly, especially in the urban population. Nevertheless, the problem of over fatness seems to be steadily affecting many low and middle income countries as well. Thus, indicating that the trend is no more restricted to wealthy or high socio-economic class.

1.1.1 Obesity prevalence

Globally, as per World Health Organization (www.who.org) since 1980, the worldwide prevalence of obesity has more than doubled. In 2014, more than 1.9 million adults (≥18 years) were overweight i.e. estimated prevalence of overweight was 39% (38% men and 40% women); off these more than 600 million were obese (13% prevalence, 11% men and 15% women). In 2013, 42 million children less than 5 years of age were overweight or obese.

In Indian scenario, Ramachandran et al. (2002) studied a group of 4700 school students and reported the prevalence of overweight as 17.8% for boys and 15.8% for girls. Chhatwal et al. (2004) reported that in 2008 school children (both male and female) the prevalence of overweight and obesity was 14.2% and 11.1% respectively. In the same year, study conducted by Khadilkar and Khadilkar, reported prevalence of 25.1% and 8.1% respectively of overweight and obesity in 1228 school going boys aged 10-15 years, from Pune city. In another study conducted by Kaur et al. (2008) on 16,595 school going children of Delhi, aged between 5-18 years belonging to varied socio-economic groups, reported a higher prevalence of overweight and obesity in students belonging to high income group as compared to students belonging to middle and low income group. Raj et al. (2007) observed that in a sample of 24,842 children aged 5-16 years residing in Ernakulam district, Kerala, the percentage of overweight children increased from 4.94%
in 2003 to 6.57% in 2005, with significant increase of weight both in boys and girls. Rao et al. (2006) reported that in 1146 children in Pune city, the prevalence of overweight was 27.5% for boys and 20.9% for girls. Khadilkar et al. (2011) documented that the prevalence of overweight and obesity was 18.2% and 23.9% as per IOTF and WHO classification respectively, in a sample of 20243 children aged 2-17 years, with higher prevalence in boys than girls. Goyal et al. (2010) documented that in 5664 school children aged 12-18 years belonging to varied socio-economic status, the prevalence of overweight in girls and boys was 9.2% and 14.3% respectively and the prevalence of obesity in girls and boys was 1.5% and 2.9% respectively.

**Why adolescent obesity is a matter of huge concern?**

Over the past few years, the prevalence of overweight and obesity has increased considerably across the globe and this problem remained unnoticed till as early as mid-1990’s. It was in 1997 that, for the first time, the World Health Organization convened a consultation of experts from different countries specialized in the field of obesity to deal with the problem of obesity and its consequences. Consequently, a report was published in 1998 by the WHO which included a recommendation to classify body fatness i.e. overweight and obesity on the basis on BMI (body mass index) and thus laid the foundation of modern classification of body weight depending upon the various BMI categories. This classification was subsequently subjected to rigorous testing on various body composition modules. Though it has significant scientific lacunae in weight categorization on basis of body height and weight alone, it is still globally accepted index to classify body weight. In children, overweight and obesity are defined relative to selected gender- and age-specific percentiles of a reference population. Subsequently, WHO developed the Growth Reference Data for the children aged 5-19 years. It was a reconstruction of the 1977 National Center for Health Statistics (NCHS)/WHO reference and used the original NCHS data set supplemented with data from the WHO child growth standards sample for young children up to age 5. Hence, classification of overweight and obesity varies in children and adolescents in comparison to the adults.

Recent scientific literature indicates that obese children (BMI ≥95\textsuperscript{th} percentile) have increased tendency to become overweight adults and hence possess a greater
positive predictive value than overweight children (BMI ≥85th percentile but <95th percentile) (Guo and Chumela, 1999; Malina and Katzmarzyk, 1999). Adolescence is a period of heightened concern regarding obesity. The incidence of obesity increases during this period and tends to persist into adulthood. Furthermore, the overweight and obese children are more likely to develop non-communicable diseases like diabetes and cardiovascular diseases at a younger age (Must and Strauss, 1999; Daniels et al., 2000). Obese children and adolescents suffer from both short-term and long-term health consequences (Dietz, 2004). The most significant health consequences of childhood overweight and obesity, that often do not become apparent until adulthood, include cardiovascular diseases (mainly heart disease and stroke), diabetes, musculoskeletal disorders, especially osteoarthritis and certain types of cancer (endometrial, breast and colon) (Chu et al., 1998).

1.1.2 Causes of obesity

An individual’s body weight is intricately controlled by several intracellular and extracellular mechanisms which aim to maintain a balance between the energy intake and the energy output. An energy intake less than the energy output results in negative energy balance and thus leads to underweight of normal weight status. On the contrary, an excess of energy intake over and above the energy output leads to a positive energy balance and hence, leads to overweight or obesity. The energy mechanisms in the human body are accurately controlled and therefore, it can be concluded that even small increments in the positive energy balance gradually lead to obesity, if not controlled over time. There is ample research evidence that apart from the genetic contribution towards obesity development and maintenance, the environment also contributes hugely towards obesity. The probable causes of obesity are summarized below.

1.1.2.1 Genetic and perinatal influences on obesity

Genes play a major role in phenotype determination. Scientists have identified an obesity causing gene, referred to as “Ob gene” which secrets a hormone-leptin (Montague et al., 1997). Leptin is produced by the adipocytes and is secreted in proportion to the fat mass of an individual. It interacts and modifies the cellular processes consequently leading to obesity (Zhang et al., 1994). The interaction at various levels, of
about 250 types of genes leads to obesity (Rankinen et al., 2002). Genetic mutations (Farooqi and O’Rahilly, 2000) as well as candidate alleles in the insulin gene (LeStunff et al., 2001) lead to risk of early-onset of obesity. Efforts are being made to map the genetic loci of obesity causing syndromes, such as Prader-Willi, Bardet-Biedl, Cohen, and Alstrom syndromes, but the molecular interactions these genes cause, which ultimately lead to obesity are yet to be established. Furthermore, single gene defects contribute only to a small fraction of obese individuals (Farooqi and O’Rahilly, 2000).

Apart from genes, perinatal factors also contribute towards obesity. Whitaker and Dietz (1998) hypothesized that prenatal over-nutrition plays a critical role in lifelong obesity. They established that maternal obesity lead to transfer of greater nutrient portion to the foetus which induces permanent changes in infant appetite by neural and hormonal functioning or energy metabolism. Numerous studies have demonstrated high correlation between maternal obesity, high birth weight and obesity later in life. All these lead to a grave consequence, that obesity epidemic may progress over generations without any further contribution from genetic or environmental factors. Brophy et al. (2012) demonstrated that in order of significance, the major risk factors for adult obesity were, being unfit during childhood, having an obese father and having a higher birth weight. Lustig (2001) reported that children who were bottle fed had greater risk of adolescent’s obesity than those fed on breast milk. Taste preference, psychological factors (control of feeding rate, baby versus parent) and physiological changes due to intrinsic factor specific to human milk, could serve as possible explanation.

The pattern of adiposity varies with age. During early childhood BMI tends to decrease up to the age of 5-6 years and again begins to increase by early adolescence. This phenomenon is referred to obesity rebound (Rolland-Cachera et al., 1984). Investigators have predicted that children who exhibited early rebound obesity were more susceptible to risk for obesity later in life (Whitaker et al., 1998; Wisemandle et al., 2000).

1.1.2.2 Diet and obesity

As previously stated, obesity is a consequence of positive energy balance. The main macronutrients constituting a typical diet are fats, carbohydrates and proteins.
Several investigators have reported that consuming a diet rich in fat for prolonged period of time, increases the risk for obesity. Furthermore, foods which have high trans-fat have been associated with cardio-vascular diseases and diabetes. A diet rich in food with high glycaemic index is also linked with increased risk for adiposity even in children. A possible explanation could be the post prandial increase in blood sugar levels (Foster-Powell and Miller, 1996) and a consequent regulation of appetite by means of alternations in the levels of circulating hormones which stimulate hunger and alter the feeling of satiety (Ebbeling and Ludwig, 2001; Ludwig, 2002). All of these lead to overeating in children and consequent obesity (Ludwig et al., 1999).

Furthermore, increase in portion/meal size, multiple and frequent meals in conjunction with sweetened beverages and ready availability of processed/fast/junk food at cheaper rates, all have contributed towards increased adiposity in early adolescence (Swinburn et al., 2004; Veugelers et al., 2005). Fast food typically has least fibre content, is low in antioxidants and mineral and vitamins, has high trans-fat content, is high on glycaemic index and is energy dense. Furthermore, the amount and the number of times junk food is eaten from outside (of the house) increased risk for adolescent obesity (French et al., 2000; Binkley et al., 2000).

### 1.1.2.3 Family and cultural factors

Research has proved that children whose parents do not engage in regular physical activity with them (either on weekdays or weekends) and who do not encourage outdoor games, have greater risk of obesity. Unfit parents who themselves do not engage in physical activities also fail to promote healthy fitness habits in children. Also, families which seldom have meals cooked at home and consume more packed food tend to have more fatty children. Furthermore, families which do not sit together and have meals, indirectly affect adiposity within the family members. Primarily, it contributes towards obesity as it leads to a decrease in healthy food consumption, an increase in television viewing time which in turn encourages “mindless eating” (Gillman et al., 2000; Neumark-Sztainer et al., 2003).
1.1.2.4 Socio-economic status (SES) and obesity

Numerous studies have reported an association between socio-economic status and obesity. It has been well documented that children belonging to low socio-economic families had a greater probability of becoming overweight or obese (Katzmarzyk and Ardern, 2004; Power et al., 2005). Studies in the United States, Canada, Europe and other countries have reported a similar trend (Ellaway et al., 1997; Van-Lenthe et al., 2002; Robert et al., 2004). Fred et al. (2012) investigating relationship between a country’s economic development, socio-economic status, and obesity, amongst 67 countries, reported that incidence of obesity increased with the country’s economic development. Furthermore, individuals with higher socio-economic status had greater probability to become obese. Ravishankar (2012) reported that developing nations like India were evidencing constant increased levels of malnutrition with a simultaneous rise in overweight and obese amongst its nationals.

1.1.2.5 Physical activity and sedentary time

Physical activity is defined as any bodily movement produced by the contraction of skeletal muscles which results in substantial increase in energy expenditure. Exercise (form of physical activity) is a planned, structured, and repetitive bodily movement conducted with an aim to improve or maintain one or more component of physical fitness. Physical fitness has typically been defined as a set of attributes or physical characteristics that an individual possesses or achieves to be able to perform a physical activity. These characteristics can be skill-related or health-related. Furthermore, it is of scientific importance to mention the intensity of exercise to reap health related physical activity benefits. It is widely established that a lifestyle with a positive energy balance, more sedentary time and less physical activity all contribute to adiposity.

Findings of numerous cross-sectional studies demonstrate that a lifestyle with physical inactivity (absence of age specific moderate to vigorous physical activity) and excess of sedentary time lead to risk of increased adiposity in children (Trost et al., 2001; Andersen et al., 1998). Hence, even moderate reduction in physical inactivity i.e. engaging in moderately vigorous physical activity and reducing television watching by 1 hour per day can reduce risk of obesity by 10% (Hernandez et al., 1999). Television
viewing promotes weight gain not just because of compromised time spent in physical activity, but it also leads to over-eating (thought to be related to the advertisements on television), which promotes unhealthy eating habits (Robinson, 1998; Epstein et al., 2002).

The two parameters used to assess the physical performance are muscular strength and cardiovascular endurance. These two attributes play a very important role in various kinds of exercises and sports. Isometric strength is defined as the ability to exert force under a given set of conditions defined by body position, the body movement by which force is applied, movement type and movement speed. It has also been defined as the maximal amount of force a muscle or muscle group can generate in a specified movement pattern at a specified velocity of movement against some resistance (Knuttgen and Kraemer, 1987). Muscle strength is expressed in terms of force (Newton) and torque (Newton meter). It is observed that the interaction between intramuscular strength and external forces result in actions in related joints, in static performance (with no movement, isometric muscle work) or in dynamic performance (involving an increase or decrease in joint angle; isotonic or isokinetic muscle work) (Knuttgen and Komi, 1992).

There are many factors which determine the strength generating ability of muscle or muscle group(s). The genetic code exerts the greatest influence on muscle-fiber type distribution. The environmental, nutritional, hormonal, exercise and neural factors interact to regulate skeletal muscle mass and corresponding strength development in an individual.

Strength generating ability varies as a function of age of an individual (Astrand and Rodahl, 1991). Both men and women seem to be able to increase strength throughout puberty and adolescence, reaching a peak around 20-25 years of age; after this time, this ability begins to level off and in some cases declines. After the age of 25 years, a person generally loses an average of 1% of his/her maximal remaining strength each year. Strength characteristics also vary amongst genders. These differences could be attributed to variability factors between both the sexes, such as (i) differences in muscle cross-sectional area amongst men and women, (ii) absolute muscle strength on score basis (i.e. total force in lb or kg) which indicates that men possess considerably greater strength than women for all muscle groups tested, (iii) strength differences related to architectural
differences and (iv) as relative strength related to body mass or fat free body mass (FFM). It is observed that no difference exists in muscle “quality” of men and women; the observed gender differences in absolute muscle strength merely reflects differences in muscle quality (cross-sectional area) rather than muscle fiber architectural characteristics (e.g. muscle fiber pennation angle) or metabolic functions. Men and women generally do not differ significantly in their upper/lower body strength when comparisons are made using ratio scores with lean body mass as the divisor (Heyward et al., 1986).

As mentioned above, the maximal strength potential of a muscle also depends upon its physiologic cross-section and efficiency of the neuro-muscular system and the function of motor unit in producing muscular force viz. the number of motor units being recruited, firing rate of each motor unit and synchronization of motor unit firing. Strength is also determined by biomechanical factors (the joint angle and the point of insertion of the muscle to the joint angle) which dictate how muscle force can be generated through a system of levers to an external object. The length of muscle also governs the tension that can be generated by the muscle (length-tension relationship); the length of the muscle at which the interaction of cross-bridges between actin and myosin filaments within the sarcomere is at maximum produces maximal muscle force or tension.

The contribution for success in physical performance apart from muscle strength also goes to endurance both of which are closely associated with each other. As one improves, there is a tendency for other to improve also (Barnes, 1980). Strength in isotonic context is defined as the ability of a muscle to develop torque and endurance is the muscle’s ability to sustain torque. Endurance encompasses both muscular and cardiovascular endurance. Muscular endurance is semantically the opposite of fatigue and is measured as number of times that a repetitive sub-maximal contraction can be properly performed at a constant rate or the ability of muscle to delay the onset and minimize the manifestation of fatigue (Milner-Brown et al., 1986). This is also referred to as isometric endurance (Petrofsky et al., 1975).

In the present study, upper body and lower body strength have been measured using push-up and curl-up tests. Studies have reported negative correlation of muscular strength (component of health-related fitness) with adiposity, even in adolescents.
Cardio-vascular endurance relates to body’s ability to sustain prolonged rhythmical exercise. Apart from genetic endowment (Bouchard et al., 1992), environmental, exercise, nutritional, hormonal and neural factors, cardio-vascular endurance also depends upon (i) VO$_2$max which is the highest rate at which an individual can consume oxygen during exercise, it limits the capacity to perform aerobic exercise and is best single index of aerobic fitness, (ii) peak VO$_2$ represents highest oxygen uptake elicited during an exercise test to voluntary exhaustion, (iii) pulmonary VO$_2$ kinetics is an index of overall conditioning of the pulmonary cardio-vascular and muscular system and is a result of delicate interplay between various mechanisms regulating oxygen delivery (Presentation Theory) and oxygen utilization (Utilization Theory) by skeletal muscle, (iv) economy of movement measured in terms of Delta Efficiency and (v) lactate threshold: % VO$_2$ at lactate threshold integrates both VO$_2$max and performance VO$_2$max (% VO$_2$ measured for longer time) (McArdle et al., 2000; Wilmore and Costill, 2005).

Apart from the factors described above, endurance performance also varies as a function of age-related changes. It has been observed that endurance performance is poorer in children, adolescents and older individuals. Considerable performance decrements occur between ages 30-86 years. It is observed that VO$_2$max declines ~ 1% each year in adult men and women.

1.2 Obesity and academic performance

Health benefits of regular physical activity are well documented. However, researchers are also demonstrating the cognitive and academic benefit of physical activity. A healthy diet is a balanced mixture of carbohydrates, proteins and fats along with minerals and vitamins which is necessary to maintain an individual’s health. Junk food/fast food hampers a child’s cognitive functioning which consequently affects the academic performance of the pupil. Zhang et al. (2005) conducted a study which analysed the average American diet and its effect on the child’s cognitive processing and academic scores, and concluded that the diet which was rich in polyunsaturated fatty acids and cholesterol was linked to poor cognitive functioning (academic performance)
and poor physical activity performance respectively. Hence, overweight or obese adolescents who consume more junk food have diminished academic performance because the food primarily lacks in essential macro and micro-nutrients vital for the cognitive processing by the brain.

Ample research evidence (collected through various epidemiological and cross-sectional studies as well as longitudinal studies) exists which indicates an association of overweight/obesity with poor academic performance (Dwyer et al., 2001; Datar et al., 2004; Shore et al., 2008; Welk et al., 2010). Studies by several researchers have positively linked aerobic capacity with cognitive processing and academic achievement (Dwyer et al., 2001; Hillman et al., 2005 and 2009a; Castelli et al., 2007; Cottrell et al., 2007; Buck et al., 2008; Shore et al., 2008; Eveland-Sayers et al., 2009; Keeley and Fox, 2009; Aktop, 2010; Wittberg et al., 2010). Roberts et al. (2010) conducted an empirical study and concluded that fitness was a stronger predictor of academic performance than overweight.

Furthermore, the benefits of physical activity on academic performance have been documented and since overweight or obese adolescents have less physical activity scores, they, in-turn, also exhibit poor academic scores. Grissom (2005) demonstrated that in a sample of 884,715 school students of California, belonging to 5th, 7th and 9th grade, a positive association was observed between physical fitness (measured by Fitnessgram, a physical fitness test) and academic performance scores (measured by Stanford Achievement Test 9th edition, a standardized norm-referenced achievement test). However, the researcher stressed that though the association existed it did not imply casualty. Rather improvement in physical activity may lead to improvement in academic performance, by unknown mechanisms. The above mentioned studies indicated that physical fitness/health coincided with mental health (mensana in corporesano), and suggested that improving one (physical fitness through physical activity) might lead to improvement in the other (academic performance scores).

1.3 Obesity and self-esteem

As early as the 1880’s, psychologists from around the globe have been researching on self-esteem and trying to define it. As presented in Inventive personality
type, Reich (1986) defined self-esteem as "the expression of discrepancy or harmony between self-representation and the wishful concept of the self." As examined by William (1890), self-esteem was thought to be an internal review procedure; he contended that self-esteem, in the most simplest way, could be assessed as the ratio of an individual’s successes to his/her pretensions, "Self-esteem=Success/Pretensions." Where, pretensions are regarded as objectives, ambitions, purposes, or targets, whereas successes comprise of the perception of the accomplishment of those pretentions. As an individual accomplishes greater number of their individual pretentions, the ratio grows bigger and consequent enhancements in self-esteem can be observed. It is noteworthy to mention, that if an individual is unable to attain a particular pretension or doesn’t fair well enough as compared to others in the same area of pretention attainment, self-esteem is bound to be affected negatively (William, 1890).

In the modern context, self-esteem is defined as an individual’s sense of self-competence and self-worth. As defined by Romin et al. (1995), self-competence is "a generalized sense of one's own efficacy or power". Self-worth or self-respect is primarily admitting oneself unreservedly and possessing the feeling that one is earnest of living and accomplishing happiness. It makes an individual feel that he/she matters and is important. It is noteworthy to mention that self-esteem is blighted if either self-competence or self-worth is deficient.

Self-esteem signifies the judgment an individual makes and normally upholds with reference to himself/herself. It conveys an attitude of consent or dissatisfaction and implies the magnitude to which an individual upholds the conviction of self-worth, being capable, important and prosperous/successful. The perception is subjective and is communicated to others by means of verbal reports and behavioral expressions. Self-esteem is usually deliberated as the evaluative constituent of the self-concept (a broader depiction of the self that comprises perceptive, social facets along with evaluative or affective ones (Blascovich and Tomaka, 1991). While the self-esteem is frequently used to denote a universal awareness of self-worth, self-confidence or body-esteem (narrower conceptions) refer to a sense of self-esteem in more explicit spheres. Furthermore, self-esteem behaves as an attribute and doesn’t remain the same throughout one’s life. It is
subjected to fluctuations with peaks during early childhood and adulthood and dips during adolescence and old age.

Many authors have attempted to quantify/measure self-esteem by means of varied approaches. Of those many approaches, the empirical ones are worthy of mention and include: the direct self-report method (Bills et al., 1951; Coopersmith, 1967), the indirect method (Lesser and Abelson, 1959; Ziller, 1969), unstructured interviews (Silber and Tippett, 1965), projective methods (Machovfr, 1949; Spitzer, 1969) and scoring/rating systems (Dittes, 1959 a, b; Coopersmith, 1967). The most profoundly accepted and popularly used measures to assess self-esteem are the one’s proposed by Rosenberg (1965), Rosenberg Self-Esteem Scale and the second one is by Coopersmith (1967/1981, revised), Coopersmith Self-Esteem Inventory.

The former scale was initially formulated to assess adolescents' global perceptions of worthiness or acceptance of self. It is considered the gold standard and is used as a reference to compare other measures of self-esteem. It incorporates 10 items (recorded by employing four-point retorts, ranging from intensely disagree to intensely agree. The elements are face valid, and the scale is easy to comprehend and fill and takes not more than 15 minutes to administer. The scale is all-encompassing, with adequate validity (convergent and discriminant) and reliability (internal consistency and test-retest), (Blascovich and Tomaka, 1991).

The Coopersmith Self-Esteem Inventory was formulated to measure mindset one has for himself/herself as well as attitude towards family, friends, school and individual interests and preferences. The self-esteem inventory was aimed to be employed on adolescents and children. For each item (total 50 items), the subject was required to choose between two options "like me" or "unlike me." The self-esteem inventory has two forms, a School Form (for age group 8-15 years) and an Adult form (age group 16 years and older). The self-esteem inventory has good reliability (internal consistency and test-retest) and validity (convergent and discriminant) (Blascovich and Tomaka, 1991).

In the present study the self-esteem inventory-long form (suitable for pupils 8 years and above), designed by Coopersmith (1967) was employed to assess the attitudes and behavior towards self in social, academic, family and personal settings. It analyzed the set of convictions and feelings/thought a person possessed with oneself while facing
the world. Many studies have demonstrated that being overweight or obese negatively affected the self-esteem in children/adolescents.

Ample research evidences existed which validated the notion that an individual’s health status did affect his/her self-esteem (Wooley, 1995; Brown, 1997; Faith et al., 2000). Fat stigmatization adversely affects self-esteem. Faith et al., (2002) reported that while engaging in physical activity with peers, BMI was positively correlated with weight teasing in both overweight and obese children in a sample of 5th to 8th grade school students (both boys and girls), which consequently lead to the development of an adverse attitude towards sports by the overweight or obese child and which, in lieu, limited the participation to mild to moderate intensity sports. In another empirical study by Pierce and colleagues (1997) conducted on obese children aged between 9-11 years, reported that the obese children narrated being “embarrassed doing physical activity and playing sports”. The results demonstrated that body size limited participation in sports (72% subjects) whereas, almost 90% of the obese students thought that their participation in sport would improve provided they lost adequate quantities of weight. Hence, it might be assumed that being fat negatively affected the child’s self-esteem and also lead to avoidance attitudes towards physical activity and sports.

1.4 Purpose

There are a number of studies evaluating the effect of obesity on physical performance (Lloyd et al., 2003; Cureton et al., 1975; Slaughter et al., 1977; Cureton et al., 1977 and 1995; Pate et al., 1989; Cureton et al., 1991; Rowland et al., 1999; Deforche et al., 2003; Ortega et al., 2005; Tokmakidis et al., 2006; Mota et al., 2010), academic performance (Gortmaker et al., 1993; Sargent and Blanchflower, 1994; Li, 1995; Mo-Suwan et al., 1999; Cawley, 2004; Robert and Chandra, 2004; Crosnoe and Muller, 2004; Datar et al., 2004; Datar and Sturm, 2006; Sabia, 2007; Kaestner et al., 2009; Edwards et al., 2011; Abdelalim et al., 2012; Li and O’Connell, 2012) and self-esteem (French et al., 1995; Wardle and Cooke, 2005; Wang et al., 2008) but the effects of obesity on these variables are controversial. Obesity negatively influences all these three variables in different races across the globe. But there are studies conducted by researchers which negate the above mentioned findings, i.e., they fail to demonstrate any
Introduction

negative influence of obesity on self-esteem, few physical performance variables and academic performance (Mo-suwan et al., 1999; Datar et al., 2004; Mendelson et al., 1982; Wadden et al., 1984). Hence, there is paucity of conclusive evidence regarding the proposed detrimental influence of increased body weight on the physical and psychological aspects of adolescents. The purpose of the experiment was to investigate whether obesity exerts an effect on the self-esteem, physical performance variables and academic performance of school going adolescents of Punjab. Conflicting results of previous studies necessitated incorporation of a wider weight range of weight categories i.e. underweight, healthy/normal-weight, over-weight and obese. Hence, the effect of body weight on four weight categories was examined on self-esteem, physical performance variables and academic performance, to predict any weight-response relation. Moreover, physical measurement such as skinfold assessment (to predict percent body fat) and waist circumference assessments were done to cross validate an individual’s weight status (as calculated from BMI and BMI percentiles) and to observe for any patterns or associations between the weight status and skinfold measurements and between body weight and percent body fat.

1.5 Aims and Objectives

• To compare physical performance variables, academic performance and self-esteem of obese children with normal weight adolescents.
• To examine the relationship between obesity and physical performance variables in adolescents.
• To examine the relationship between obesity and academic performance in adolescents.
• To examine the relationship between obesity and self-esteem in adolescents.
• To determine the relationship between academic performance and physical performance variables.
• To determine the relationship between academic performance and self-esteem.
• To compare the gender differences in physical performance, academic performance and self-esteem in adolescents with respect to obesity.
1.6 Hypothesis

There would be significant differences in physical performance variables, academic performance and self-esteem between obese and normal weight adolescents. Significant gender differences would be there between male and female adolescents.

Null Hypothesis

Obesity would have no effect on the self-esteem, academic and physical performance of school children.