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Physiology

ANALYSIS OF BMI & BODY FAT % BY FORMULA IN COLLEGE LEVEL CRICKETERS GROUP & SEDENTARY CONTROL GROUP AT JODHPUR

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ABSTRACT

Objective - To measure ,evaluate & compare ; body composition by BMI & Body Fat & in age & gender matched cricketers group & sedentary life style group

Methods -Research was conducted at Dr. S.N. Medical College Jodhpur. Approved by Institutional Ethical Committee. Study design was Observational Analytic Comparative Cross Sectional Study. Written informed consent was taken from 40 Human male subjects out of which 20 Cricketers & 20 Sedentary Life style group between 20-25 years of age were included out of randomly recruited subjects ;those have answered NO to Physical Activity Readiness Questionnaires. Intervention was of Cricket sport of 20-20 overs version of 3 hours time in afternoon session with frequency 3-5 days of week ;acclimatized for one year. BMI was measured as Body mass (kg) / Stature (m) x Stature (m) as per South Asian Population using Consensus statement. Measurement of Body Fat was done by Predicting Percentage Body Fat From Body Mass Index by Gallaghar etal. formula Equation to predict percentage of Body Fat Evaluation of body fat % was done as per American Council on Exercise recommendations.For statistical analyses microsoft office, excel sheet, graph pad software, numbers and percentages, mean and standard deviations chi square and Fisher exact test. Unpaired t Test. Pearson's correlation coefficient, p value < 0.05 was considered as statistically significant; were used.

Result - In our study age of 20 male subjects of Cricketers group in (n = 20) in years was (Mean±SD 22.25±1.33),while age that of sedentary group (n=20) age was (Mean±SD 22.3±0.80) (p = 0.886). BMI (kg/m^2) in Cricketer's group (Mean±SD 21.81±1.78) was significantly less (P = 0.027*) than in Sedentary group (Mean±SD 23.04±1.61) Cricketers group BMI mean category was in normal range while that of sedentary group was in overweight range. Body Fat % in Cricketer's group (Mean±SD 18.32±2.80) was significantly less (P =0.018*) than in Sedentary group (Mean± SD 20.33±2.12) Cricketers group Body Fat category as well as that of sedentary group was in average range. A significant positive correlation was observed between BMI & Body Fat in cricketers (r=-0.995 , p = <0.0001) as well as in sedentary group (r=-0.982,p = <0.0001) means as BMI increases ; Body fat also increases.

Conclusion – In cricketer's group of medical students , body composition variables as BMI & Body fat was significantly less & decrease in BMI was associated with decrease in Body Fat , in comparison with sedentary life-style group of medical college students. Further in cricketers group BMI, Body fat; ranges as per standard classification were in Normal, Average, while in that of sedentary group these ranges were in Overweight ,Average category. So intervention of healthy lifestyle in form of cricket sport improves fitness.

KEYWORDS : Cricket BMI Body Fat Fitness

INTRODUCTION -

In physical fitness body composition is used to describe the percentages of fat, bone, water and muscle in human bodies.(1) National Physical Fitness Program (NPFP) by Government of India reflects the importance of physical fitness. (2) Body mass index (BMI) is defined as the body mass divided by the square of the body height ,and is expressed in units of kg/m^2, resulting from mass in kilograms and height in metres. The BMI is generally used as a means of correlation between groups related by general mass and can serve as a vague means of estimating adiposity .The duality of the BMI is that, while it is easy to use as a general calculation, it is limited as to how accurate and pertinent the data obtained from it can be. Generally, the index is suitable for recognizing trends within sedentary or overweight individuals because there is a smaller margin of error. The BMI has been used by the WHO as the standard for recording obesity statistics since the early 1980s. BMI categories are generally regarded as a satisfactory tool for measuring whether sedentary individuals are underweight, overweight, or obese with various exceptions, such as athletes, children, the elderly, and the infirm. Assumptions about the distribution between muscle mass and fat mass are inexact. BMI generally overestimates adiposity on those with more lean body mass (e.g., athletes) and underestimates excess adiposity on those with less lean body mass. Overweight and obese individuals are at an increased risk for the following diseases: Coronary heart disease, Dyslipidemia,Type 2 diabetes, Gall bladder disease, Hypertension, Osteoarthritis, Sleep apnea, Stroke, Infertility, At least 10 cancers, including endometrial, breast, and colon cancer ,epidural lipomatosis. Among people who have never smoked, overweight/obesity is associated with 51% increase in mortality compared with people who have always been a normal weight.(3) The body fat percentage (BFP) is of a human or other living being is the total mass of fat divided by total body mass, multiplied by 100; body fat includes essential body fat and storage body fat. Essential is necessary to maintain life and reproductive functions. The percentage of essential body fat for women is greater than that for men, due to the demands of childbearing and other hormonal functions. Storage body fat consists of fat accumulation in adipose tissue, part of which protects internal organs in the chest and abdomen. A number of methods are available for determining body fat percentage, such as measurement with calipers or through the use of bioelectrical impedance analysis. The body fat percentage is a measure of fitness level, since it is the only body measurement which directly calculates a person's relative body composition without regard to height or weight. The widely used body mass index (BMI) provides a measure that allows the comparison of the adiposity of individuals of different heights and weights. While BMI largely increases as adiposity increases, due to differences in body composition, other indicators of body fat give more accurate results; for example, individuals with greater muscle mass or larger bones will have higher BMIs. As such, BMI is a useful indicator of overall fitness for a large group of people, but a poor tool for determining the health of an individual. Epidemiologically ,the percentage of body fat in an individual varies according to sex and age. Essential fat is the level at which physical and physiological health would be negatively affected, and below which death is certain. Above that level, controversy exists as to whether a particular body fat percentage is better for one's health. Athletic performance might be affected by body fat: one source indicates that the ideal body fat percentage for athletic performance is 12-18% for women and 6-15% for men. Bodybuilders may compete at essential body fat range, in fact certified personal trainers will suggest them to keep that extremely low level of body fat only for the contest time. However, it is unclear that such levels are ever actually attained since ; the means to measure such levels are, as noted below, lacking in principle and inaccurate, and about 4–6% is generally considered a physiological minimum for

human males. (4) The obesity epidemic has focused special attention on the amount of physical activity needed to achieve and maintain a healthy weight. The Dietary Guidelines for Americans provides guidance for both caloric intake and physical activity related to this issue. (5) In the past cricket in most Commonwealth countries was played solely during the summer months, but its popularity has increased so much that it has lost its 'season' and is now being played throughout the year. Because of the longer season, cricket players are exposed to more demanding schedules, with more time spent training and practicing. (6) Higher body weights are also associated with increases in all-cause mortality. Obese individuals may also suffer from social stigmatization and discrimination. Overweight and obesity pose a major public health challenge. Normal BMI range is 18.5 – 24.9 kg/m^2 Overweight is here defined as a body mass index BMI of 25 to 29.9 kg/m^2 and obesity as a BMI of ≥ 30 kg/m^2. However, overweight and obesity are not mutually exclusive, since obese persons are also overweight. Overweight and obesity are especially evident in some minority groups, as well as in those with lower incomes and less education.(7) In a research in 50 male adults at Karamsad India BMI in mean & SD was 24.62 ± 3.31 and Body Fat % by monitor in mean & SD was 25.32 ± 6.42 (8) In another research at Medical college Kathmandu in 79 Male students had BMI Kg/Met^2 Mean & SD was 22.20 ± 3.20 (9) Research in Physiotherapy students n= 242 , between age 18-25 ; results showed percentage of participants having the following BMI: underweight 40 (16.53%), normal or healthy weight 168 (69.42%), overweight 30 (12.4%), obese 4 (1.65%) (10) Research in cricket Clubs at Lahore revealed that mean height & SD for adult cricketer was 1.73±0.15 meter. Mean & SD of weight for cricketers was is (69.36±6.16), Mean BMI for cricketers was 21.87±4.29 kg/m^2 , Out of 28 Cricket athletes 2 (7.1%) were in Underweight category, 22 (78.6%) are at Normal level of BMI, 4 (14.3%) were in Overweight and no one is Obese. (11) In study of District level cricketers the mean and S.D cricketers BMI is 22.44, 3.75 respectively. While the mean and S.D of % of Body Fat of cricketers were 12.53, 4.55 respectively. (12) There is mounting evidence that body fat percentage (BF%) are well known as indicator of nutritional status. A growing literature also suggests that BF% maybe a more important predictors for population to become overweight and obese. Moreover, evaluations on BF could help social agencies to gain some insight into implementation and monitoring of health and nutrition policies as well as evaluations on how public health information are perceived and actualized by the population. The mean of BF% among Chinese adults was 22.8% (95% CI: 22.6–23.0) in male and 33.3% (95% CI: 33.2–33.5) in female. BF% among the Chinese population steadily increased across all age. (13) Dympna Gallagher etal study was to examine a potential new approach for developing percentage body fat ranges. The approach taken was to link healthy body mass index (BMI; in kg/m2) guidelines established by the National Institutes of Health and the World Health Organization with predicted percentage body fat. The prediction formulas were then used to prepare provisional healthy percentage body fat ranges based on published BMI limits They proposed approach and initial findings provide the groundwork and stimulus for establishing international healthy body fat ranges.(14) There are a number of proposed formulae that relate body fat to BMI. These formulae are based on work by researchers published in peer-reviewed journals, but their correlation with body fat are only estimates; body fat cannot be deduced accurately from BMI. Body fat may be estimated from the body mass index by formulae derived by Deurenberg and co-workers. When making calculations, the relationship between densitometrically determined body fat percentage (BF%) and BMI must take age and sex into account. (15) Research Question was to measure ,How much Body Composition (BMI & Body Fat) are in College level Cricketers group & Sedentary control group ?

MATERIAL & METHODS -

Our study setting was Dr. S.N. Medical College Jodhpur. Approval of Institutional Ethical Committee was taken. Design of our research was Observational Analytic Comparative Cross Sectional Study. Written informed consent was taken from 40 Human male subjects out of which 20 Cricketers & 20 Sedentary Life stylers between 20-25 years of age were included out of randomly recruited subjects ;those have answered NO to Physical Activity Readiness Questionnaires. (16) Intervention was of Cricket sport of 20-20 overs version of 3 hours time in afternoon session with frequency 3-5 days of week ;acclimatized for one year. Height of subjects was recorded by Stadiometer in meters(17) Weight of subjects was recorded by a digital bathroom scale is a scale on the floor which a person stands on. The weight is shown on an LED or LCD display.(18) BMI Measurement = Body mass (kg) / Stature (m) x Stature (m) .Evaluation of Body Mass Index can be done for South Asian Population using Consensus statement Normal BMI: 18.0-22.9 kg/m^2, Overweight: 23.0-24.9 kg/m^2, Obesity: >25 kg/m^2 (19) Measurement of Body Fat was done by Predicting Percentage Body Fat From Body Mass Index The basic assumption underlying BMI guidelines lies in its supposed close association with body fatness and consequent morbidity and mortality. This measure exhibits a somewhat higher yet still moderate association with body fat and disease risk than estimates based simply on stature and body mass. The following independent variables predict %BF:1. BMI 2. Age in years 3. Gender: Male or female 4. Race: White, African American, Asian Calculate Body Mass Index Equation to predict percentage of Body Fat % BF = 63.7 - 864 x (1 -BMI) -12.1 X Sex 0.12 x Age 129 x Asian x(1 - BMI) - 0.091 x Asian X Age - 0.030 x African American x Age where gender =1 for male and 0 for female; Asian =1 and 0 for other races; African American =1 and 0 for other races ;age in years; BMI=body weight in kg/ stature m^2 (20)(21) American Council on Exercise recommendations shows that body fat % in Men categorized as Essential fat 2–5 %, Athletes 6-13 %, Fitness 14-17 %,Average 18-24%, Obese 25% + (22) The data was collected in Microsoft office excel sheet . All statistical analyses were performed using Graph Pad software. The qualitative data were expressed in numbers and percentages for categorical variables and the quantitative data were expressed as mean and standard deviations for continuous variables. The difference in proportion was analysed by using chi square and Fisher exact test. The difference in mean among the groups was analysed using Unpaired t Test. Pearson's correlation coefficient between quantitative variables. A p value < 0.05 was considered as statistically significant.

Observation & Result -table: 1 Comparison Of Bmi Between Cricketers Group (n=20) & Sedentary Group (n=20)

Variables	Cricketers Group (Mean±SD)	Sedentary Group (Mean±SD)	t value	p value
Age (yrs)	22.25±1.33	22.3±0.80	0.143	0.886
Weight (kg)	65.15±6.29	69.01±5.54	2.062	**0.046***
Height (mt)	1.73±0.08	1.73±0.06	0.115	0.909
BMI (kg/m2)	21.81±1.78	23.04±1.61	2.288	**0.027***
Body fat (%)	18.32±2.80	20.33±2.12	2.554	**0.018***

***Significant**

Table 2: Evaluation Of Bmi Category Of Cricketers Group (n=20) & Sedentary Group (n=20)

BMI (KG/MET^2) N=20	Medical Cricketers Group N (%)	Sedentary Group N (%)	Chi-square value	p-value	Remark
Normal BMI 18.0-22.9	14 (70%)	8 (40%)	3.636	0.056	Not significant
Over weight 23.0-24.9	6 (30%)	12 (60%)			
Obesity >25	0 (0%)	0 (0%)			

Table 3: Evaluation Of Body Fat Categories Of Cricketers Group (n=20) And Sedentary Group (n=20)

Body Fat % In Men	Cricketers Group N (%)	Sedentary Group N (%)	Statistical Test	P value
Essential Fat 2-5%	0 (0%)	0 (0%)	-	-
Athletes 6-13%	1(5%)	0 (0%)	Fisher exact test	0.500
Fitness 14-17%	7 (35%)	2 (10%)	Fisher exact test	0.053
Average 18-24%	12 (60%)	18 (90%)	Fisher exact test	0.028 (Significant)
Obese 25% ±	0 (0%)	0 (0%)	-	-

Chi square 4.978, P value 0.083 (NS)

Table 4:Pearson's Correlation Coefficient Of Variables In Cricketers And Sedentary Group

Relation between	Cricketer Group		Sedentary Group	
	r value	p value	r value	p value
Height and Weight	0.593	**0.005****	0.521	**0.018***
Height and BMI	-0.323	0.164	-0.38	0.098
Height and Body fat	-0.353	0.126	-0.383	0.095

Weight and BMI	0.567	**0.009****	0.589	**0.006****
Weight and Body fat	0.539	**0.014***	0.571	**0.008****
BMI and Body fat	0.995	**<0.0001*****	0.982	**<0.0001*****

Significant, **Very Significant, ***Highly Significant

DISCUSSION -

Cricket sport involves hitting ball with bat ,sprinting between wickets and running to stop balls, as well as bowling and throwing. That's why Health benefits of cricket include :Endurance and stamina, Balance and Coordination, Physical fitness ,Improving hand-eye coordination. Other benefits of cricket includes Team skills Social skills such as cooperation, communication and learning how to cope with winning and losing .Social interaction as it's a great way to meet new people and make new friends. (23) In our study age of 20 male subjects of Cricketers group in (n = 20) in years was (Mean±SD 22.25± 1.33),while age that of sedentary group (n=20) age was (Mean± SD 22.3±0.80) In comparison there was no significance difference between age of these two groups was found (p = 0.886) Further comparison in following variables were done between age matched groups. In our study BMI (kg/m^2) in Cricketer's group (Mean±SD 21.81±1.78) was significantly less (P = 0.027*) than in Sedentary group (Mean±SD 23.04±1.61) & in evaluation as per south asian population using consensus statement ; Cricketers group BMI mean category was in normal range while that of sedentary group was in overweight range.In our study Body Fat % in Cricketer's group (Mean±SD 18.32±2.80) was significantly less (P =0.018*) than in Sedentary group (Mean± SD 20.33±2.12) & in evaluation as the American Council on Exercise recommendations shows ;Cricketers group Body Fat category as well as that of sedentary group was in average range.In our study A significant positive correlation was observed between BMI & Body Fat in cricketers (r=-0.995 , p = <0.0001) as well as in sedentary group (r=-0.982,p = <0.0001) means as BMI increases as Body fat increases. Similarly another research showed that BMI strongly correlate with BF % estimated by bioelectrical impedance, in this sub population of South Asian adults. This relationship was curvilinear in nature and was significantly influenced by age and gender. Their findings support the importance of taking age and gender in to consideration when using BMI to predict body fat percentage/obesity, in a population. (24) In another research the relationship between absolute body weight, relative body weight (in percent of normal weight predicted from age and height) percent body fat (determined by densitometry), and pulse rate at rest, and during and after walking on the treadmill was investigated in 45 sedentary young men (Group A), 26 more active young men (Group B), and 82 sedentary middle-aged men (Group C). A significant correlation between resting pulse rate and relative obesity occurred in the sedentary groups A and C, but not in the active group B. During walking, all groups exhibited a highly significant correlation between fat content and absolute and excess pulse rate. Relative and absolute body weight showed a similar relationship to a lesser degree. The correlation declined during recovery.(25) Body Mass Index' biggest flaw is that it does not take into account the person's body fat versus muscle (lean tissue) content. Muscle weighs more than fat (it is denser, a cubic inch of muscle weighs more than a cubic inch of fat). Therefore, BMI will inevitably class muscly, athletic people as fatter than they really are. A 6ft-tall Olympic 100 meter sprinter weighing 90kg (200lbs) may have the same BMI (26) as a couch potato of the same height and weight. A BMI calculation would class both of them as overweight. That calculation is probably right for the sedentary couch potato, but not for the athlete. (26) Body mass index (BMI) is a person's weight in kilograms divided by the square of height in meters. BMI is an inexpensive and easy screening method for weight category—underweight, healthy weight, overweight, and obesity. BMI does not measure body fat directly, but BMI is moderately correlated with more direct measures of body fat . Furthermore, BMI appears to be as strongly correlated with various metabolic and disease outcome as are these more direct measures of body fatness (27) BMI is a measurement of relative body weight, not body composition. Because lean mass weighs far more than fat, many adolescent athletes are incorrectly classified as obese based on BMI. Skinfold testing provides a more accurate body assessment than BMI in adolescent athletes. Correct body composition data can help to provide better diet and activity guidelines and prevent the psychological problems associated with being labelled as obese. (28) Still, the following formula designed for adults proved to be much more accurate at least for adults: states that adult body fat percentage is equal to (1.39 x BMI) + (0.16 x age) - (10.34 x gender) - 9, with gender equal to 1 for men and 0 for women to account for the lower body fat percentage of men. (29) Research revealed statistically significant differences (p ≤ 0 .005 - 0 .0000)) were noted in weight,, BMI,, thigh length,, total leg length, calf and hip circumferences,percent body fat and back strength between cricketers and controls. Descriptive statistics of anthropometric characteristics in Indian Inter University male cricketers BMI (kg/m2) in Mean & SD was 21.09 ± 2.7 & in control was 23.57± 3.61 while body fat percentage known from skin fold thickness in cricketers was 15.79 ± 3.63 & in control was 19.11 ± 5.42 (30)In a research over South African UniversityCricketers Height in meter Mean± SD was 1.76±.06 Weight was 78.59±10.78 & Body Fat % was 12.72±4.80 (31)In another research over South African University Club Cricketers Mean values were Height 1.79 Met., Weight was 76.78 Kg., BMI 23.99 Kg/Met^2 & Body Fat by Skin Fold Method was 10.14 % (32) In a randomized controlled study involving 87 pre-collegiate boys of age group of 16-18 years ,the BMI kg/m^2 were Mean 19.90 & SD 3.74 while Body fat % were Mean 11.63 & SD 4.61 , (33) However, just like the old height-weight tables, the BMI does not consider the composition of the body weight (i. e, proportion of muscle tissue vs. fat tissue) Body composition can be ·measured in terms of total body water (isotope dilution, bioelectric impedance analysis), bone density (photon absorptiometry), lean tissue mass (potassium40), density (underwater weighing, air displacement plethysmography), and thickness of various tissues (ultrasound, radiography, skinfolds) .Body composition assessment can be based on four-component (mineral , water, protein, and fat) , three-component (body water, protein + mineral. and fat, or body water + protein , mineral and fat), or two-component (fat-free mass and fat mass) models. The four-component model is the most accurate. Subcutaneous fat can be "sampled" as skinfold thicknesses, and a sum of skinfolds can be converted to a body fat percentage with formulas derived from the relationship of the sum of skinfolds to a body composition standard based on a two-, three-, or four-component model. The recommended body fatness for males is 10% to 20%, and for females is 15% to 25%.There is concern about obesity and anorexia for those above and below these values, respectively. (34) Body fat % in various sports for optimum performances are in males Football 9.4- 12.4 , Gymnastics 4.6 Swimming 5.0- 8.5 Tennis 15.2- 16.3 Track and field Distance runners 3.7- 18.0 Volleyball 21.3- 25.3 Wrestling 4.0--14.4.The body fat percentage consistent with excellence in performance is different for men and women, and varies within gender from sport to sport. Average values for a team should not be applied to any single individual without regard to over all health status as seen in diet, sleep, and mental outlook. Further, it is "natural" for some athletes to have a higher body fatness than others in order to perform optimally. (35) Obesity is a complex multifactorial chronic disease that develops from an interaction of genotype and the environment. Our understanding of how and why obesity develops is incomplete, but involves the integration of social, behavioral, cultural, physiological, metabolic and genetic factors. Calculating BMI is simple, rapid, and inexpensive, and can be applied generally to adults. In obesity interactive influences of numerous factors occurs as social, behavioral, physiological, metabolic, cellular, and molecular. Genetic influences are difficult to elucidate and identification of the genes is not easily achieved in familial or pedigree studies. Furthermore, whatever the influence the genotype has on the etiology of obesity, it is generally attenuated or exacerbated by nongenetic factors. The environment is a major determinant of overweight and obesity. Environmental influences on overweight and obesity are primarily related to food intake and physical activity behaviors . In countries like the United States, there is an overall abundance of palatable, calorie-dense food. In addition, aggressive and sophisticated food marketing in the mass media, supermarkets, and restaurants, and the large portions of food served outside the home, promote high calorie consumption. Many of our sociocultural traditions promote overeating and the preferential consumption of high calorie foods. For many people, even when caloric intake is not above the recommended level, the number of calories expended in physical activity is insufficient to offset consumption. Mechanization limits the necessity of physical activity required to function in society. Many people are entrenched in sedentary daily routines consisting of sitting at work, sitting in traffic, and sitting in front of a television or a computer monitor for most of their waking hours. BMI is a practical indicator of the severity of obesity, and it can be calculated from existing tables. BMI is a direct calculation based on height and weight, regardless of gender. The limitations of BMI as a measure of total body fat, nonetheless, must be recognized. For example, BMI overestimates body fat in persons who are very muscular and can underestimate body fat in persons who have lost muscle mass (e.g., the elderly). Clinical judgment must be used in interpreting BMI in situations in which it may not be an accurate

indicator of total body fat. Examples are the presence of edema, high muscularity, muscle wasting, or for very short people. The relationship between BMI and body fat content varies somewhat with age, sex, and possibly ethnicity because of differences in factors such as composition of lean tissue, sitting height, and hydration state . For example, older persons often have lost muscle mass and have more fat for a given BMI than younger persons, women may have more fat for a given BMI than men, and persons with clinical edema may have less fat for a given BMI than persons without edema. Nevertheless, these differences generally do not markedly influence the validity of BMI cut-points either for classifying individuals into broad categories of overweight and obesity or for monitoring weight status of individuals in clinical settings .An increase in physical activity is an important component of weight loss therapy since it leads to increased expenditure of energy. An increase in physical activity is an important component of weight loss therapy, although it will not lead to substantially greater weight loss over 6 months. Most weight loss occurs because of decreased caloric intake. Sustained physical activity is most helpful in the prevention of weight regain. (7)) Increased Physical Activity is advocated in NPCDS National Programme for prevention and control of Cancer, Diabetes , Cardiovascular disease and Stroke (36)

CONCLUSION -

In cricketer's group of medical students , body composition variables as BMI & Body fat was significantly less & decrease in BMI was associated with decrease in Body Fat , in comparison with sedentary life-style group of medical college students. Further in cricketers group BMI, Body fat ranges as per standard classification were in Normal, Average, category while in that of sedentary group these ranges were in Overweight ,Average, category. So intervention of healthy lifestyle in form of cricket sport improves fitness standard of individual & public as various physical fitness related programmes are launched in country India.

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