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RELATIONSHIP BETWEEN LEG MEASUREMENTS, ENERGY INTAKE, MACRO-NUTRIENT INTAKE AND VERTICAL JUMP TEST AMONG ADOLESCENT BASKETBALL PLAYERS

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ABSTRACT

Vertical jump performance is a critical determinant of success in basketball, especially among adolescent athletes who are in a key developmental stage. This study investigates the relationship between leg measurements, energy and macronutrient intake, and vertical jump performance in adolescent basketball players. A cohort of 400 male basketball players (200 females and 200 males, n=100 from each age group of 10-12 yrs and 13-15 yrs) was assessed for leg measurements, including thigh, calf and ankle circumferences and foot width and length. Dietary intake was recorded using a 3-day food diary, with subsequent analysis of total energy and macronutrient consumption. Vertical jump height was measured using a standardized jump test procedure. The findings revealed significant positive correlations between all leg measurements and vertical jump performance, with greater muscle mass in the thighs and calves positively associated with higher jump heights. Additionally, a balanced intake of macronutrients, particularly adequate protein and carbohydrate consumption, was linked to better vertical jump outcomes. These results underscore the importance of both physical and nutritional factors in optimizing athletic performance among adolescent basketball players. This study provides valuable insights for coaches and sports nutritionists aiming to enhance vertical jump performance through targeted training and dietary interventions. Future research should explore longitudinal effects and intervention-based approaches to further substantiate these findings.

Keywords: *Vertical jump, leg measurements, macronutrient intake, athletic performance.*

INTRODUCTION:

Vertical jump performance is a critical measure of athletic ability, particularly in sports such as basketball where explosive power and jumping capability are essential for success. Understanding the factors that influence vertical jump height can provide valuable insights for enhancing training programs and optimizing performance. This research investigates the relationship between leg measurements, energy and macronutrient intake, and vertical jump performance among adolescent basketball players.

Vertical jump is a fundamental skill in basketball, essential for rebounding, shot-blocking, and dunking. The ability to jump higher than opponents can provide a competitive advantage, making it a key focus in athletic training (Gonzalez et al., 2020). Evaluating vertical jump performance helps in assessing an athlete's explosive leg power and overall physical conditioning (Markovic et al., 2004).

Leg measurements, including leg length, thigh, calf and ankle girth, are indicators of muscle mass and structural characteristics that contribute to jumping ability. Previous studies have shown that larger muscle cross-sectional area in the legs is associated with greater force production and improved vertical jump performance (Sheppard et al., 2012). Additionally, anthropometric factors such as limb length can influence leverage and biomechanics, affecting jump height (Mansour et al., 2018).

The dimensions of the foot—specifically foot width and length—also play a role in jump performance. Foot length and width are structural characteristics that can influence an athlete's balance, stability, and force generation during a vertical jump. The foot serves as the primary interface between the body and the ground, making its dimensions crucial for effective force transfer during the propulsion phase of a jump (Menant et al., 2008). A larger foot surface area may provide a more stable base, enhancing balance and allowing for greater force application (Lees et al., 2004).

Proper nutrition plays a crucial role in athletic performance, particularly in sports requiring explosive power. Adequate energy intake supports overall physical activity and recovery, while specific macronutrients—proteins, carbohydrates, and fats—each contribute uniquely to muscle function and endurance. Proteins are essential for muscle repair and growth, carbohydrates provide the primary energy source during high-intensity exercise, and fats serve as a sustained energy source (Burke et al., 2011). Research indicates that balanced macronutrient intake is critical for optimizing performance and recovery in athletes (Slater & Phillips, 2011).

Adolescence is a critical period for growth and development, and nutritional needs are heightened to support these processes alongside athletic demands. Inadequate nutrient intake during this stage can impair physical development and performance (Desbrow et al., 2014). Given the high energy and nutrient requirements of adolescent basketball players, understanding their dietary patterns and their relationship with performance metrics such as the vertical jump is essential for optimizing training and health outcomes (Skernevski & Lischka, 2021).

This study aims to explore the interplay between leg measurements, energy and macronutrient intake, and vertical jump performance among adolescent basketball players. By examining these variables, the research seeks to identify key factors that contribute to superior vertical jump performance and provide evidence-based recommendations for training and nutritional strategies tailored to this population.

METHODOLOGY:

The present study deals with the assessment of leg measurements, dietary intake with respect to energy, carbohydrates, protein and fat and vertical jump test of girls and boys engaged in regular basketball training.

Sample population and size:

Total 400 regular practicing basketballers (girls and boys) of age group 10 to 15 years were chosen from leading basketball clubs from Nagpur city, Maharashtra, India. 100 girls and 100 boys from each age group of 10 to 12 years and 13 to 15 years) were purposively selected.

Leg measurements:

Leg measurements like foot length, foot width along with girth measures like thigh calf and ankle were measured using non-stretchable plastic tape.

Nutrient intake:

Precise information on dietary intake of subjects was gathered through 24 hour's dietary recall method for three consecutive days (three day's dietary recall). This was done to collect very accurate information about the quantity of foods consumed by the basketballers. The data about food intake from their first meal of the after arising in the morning till the last meal consumed before bed time was collected. Information about inclusion of type and quantity of cereals, millets, pulses, legumes, vegetables (roots, tubers, green leafy and other), fruits, milk and its products, nuts, oil seeds, dry fruits, fats and oils, sugars, eggs, non-vegetarian foods (meat, chicken, fish, sea foods etc.). Based on 24 hour's dietary recall method for consecutive three days, nutritive values of diets consumed by the players were computed using the food composition tables given by Gopalan, C. et al. (2012) and Longvah, T. et al. (2017). Energy and macro-nutrients were calculated. Actual nutrient intake values of basketball players were compared with recommended dietary allowances (RDAs) (National Institute of Nutrition (NIN)/Indian Council of Medical Research (ICMR), 2009).

Vertical jump test:

The vertical jump test is also known as Sergeant jump test, was developed by Dr. Dudley Allen Sargent (1849-1924) (https://www.brianmac.co.uk/sgtjump.htm). For this test, players were asked to stand side on to the wall, keeping both feet remaining on the ground, reaching up as high as possible with one hand and then marking was made with chalk on the wall with the tips of their fingers (M1). From a static position, basketballer jumped as high as possible and second marking was done on the wall with the chalk on his fingertips (M2).The distance was then measured from M1 to M2 with the help of a tape. Scoring the vertical jump test was made by measuring the distance between the players standing reach, which was the highest point their hand could reach while they were standing up straight, against the highest point their hand reaches when they jumped (Nande, P. J. & Vali, S. A., 2010).

Normative data is not available for sergeant jump test for 10-13 yrs old children. But normative data is available for age group 13-16 yrs, based on which normative data for 10-13 yrs age group was derived which is presented in Table 1. Comparisons were done between the actual results of sergeant jump test of basketballers with the standard reference norms.

Table 1: Normative Data for Sergeant Jump Test

Age Groups (Yrs)	**Excellent**	**Above Average**	**Average**	**Below Average**	**Poor**
Females (Distance in cm)					
10-12*	>39.9	32.3-39.9	24.8-31.6	17.9-24.1	<17.9
13-15	>50.8	41.1-50.8	31.5-40.3	22.8-30.6	<22.8
Males ((Distance in cm)					
10-12*	>44.7	34.4-44.7	27.5-33.7	20.6-26.8	<20.6
13-15	>56.9	43.8-56.9	35-42.9	26.3-34.1	<26.3

* Derived Normative Data for Sergeant Jump Test

Source: Chu, D.A. 1996 and Nande, P. J. & Vali, S. A. (2010).

Statistical analysis:

Obtained data for basketballers were compared with the standards and recommended dietary allowances (RDAs). Percentage excess or deficit was calculated. Between and within group comparisons were done.

Mean and standard deviation along with minimum and maximum values were drawn and percentages were calculated for various parameters for female and male basketballers from age groups 10-12 yrs and 13-15 yrs.

z test: For females and males (for each age group) comparison between data and standards/RDAs was done using one sample z test. This large sample test (independent samples test) was used to assess the significance of the difference between sample mean and standard/RDA. Comparisons were done for hand measurements, nutrient intake and hand grip strength physical fitness parameters.

Two sample z test was used for within gender group comparisons. Female basketballers from age group 10-12 yrs were compared with those from age group 13-15 yrs whereas male basketballers from age group 10-12 yrs were compared with those from age group 13-15 yrs. This was done to see effect of age on various parameters.

To assess effect of gender on hand grip strength, between gender comparisons were done using two sample z test. For this, female basketballers from age group 10-12 yrs were compared with male basketballers from age group 10-12 yrs. Similarly, female basketballers from age group 13-15 yrs were compared with male basketballers from age group 13-15 yrs.

Critical value of z was tested at both 0.01 and 0.05 levels of significance (1.96 and 2.58, respectively).

Pearson's coefficient of correlation test: Pearson's product moment coefficient of correlation method was used to derive relationship between various parameters for each age group of female and male basketballers. Within group strength of relationship between various measures was assessed. A level of significance at both 5% (0.05) and 1% (0.01) levels was assumed to draw conclusions.

RESULTS AND DISCUSSION:

Foot width & foot length:

Feet are a complex system of muscles, bones, and ligaments that act as springs, levers, pivots and launching pads in basketball. By their unique structure, feet simultaneously support the weight, balance and propel the player and safely absorb the shocks of their motion (https://www.exploratorium.edu/sports/remarkablefeets/index.html). When the elemental role of feet in human motion is considered, it's not surprising that even such small variations in their structure affect sports performance. After all, footwork forms the foundation of most sports (http://www.exploratorium.edu/sports/remarkable_feets/).

In running sports like basketball, feet are the springs and levers that cushion and propel the player. In basketball, they're launching pads for leaps (https://www. exploratorium.edu/sports/remarkable_feets/).

Table 2 shows the data on foot width and foot length of basketballers.

Table 2: Data on Foot Width and Foot Length of Basketballers

Sr. No.	Parameters	GIRLS			BOYS		
		Age Group 10-12 Yrs (n=100)	Age Group 13-15 Yrs (n=100)	z Values ¶	Age Group 10-12 Yrs (n=100)	Age Group 13-15 Yrs (n=100)	z Values¶
1	**Foot Width (cm)**						
i	**M±SD**	9.35±0.69	9.93±0.72	**5.82***	9.73±0.97	10.19±0.86	**3.60***
ii	**Range**	7.50-11.50	8.50-12.50		8.00-12.00	8.50-13.00	
iii	**Standard**	7.63	8.83		7.77	9.47	
iv	**% Excess**	+22.54	+12.46		+25.23	+7.60	
v	**z Values#**	**24.90***	**15.32***		**20.15***	**8.38***	
2	**Foot Length (cm)**						
i	**M±SD**	23.14±1.35	24.11±1.09	**5.57***	22.95±1.50	25.16±1.67	**9.84***
ii	**Range**	19.50-26.50	21.00-26.50		19.50-27.50	22.00-31.00	
iii	**Standard**	20.93	23.30		21.36	24.60	
iv	**% Excess**	+10.56	+3.48		+7.44	+2.28	
v	**z Values#**	**16.39***	**7.40***		**10.59***	**3.35***	

¶ - z values are for between group comparison (i.e. comparison between age groups 10-12 yrs & 13-15 yrs); # - z values are for comparison between data of subjects & standards; * - Significant at both 5 % & 1% levels ($p<0.01$); ** - Significant at 5 % level but insignificant at 1 % level ($0.01<p<0.05$); Values without any mark indicate insignificant difference at both 5% & 1% levels ($p>0.05$).

Foot width is another critical dimension, as it affects the stability of the athlete during dynamic movements. Wider feet can provide a broader base of support, which may contribute to better balance and control during the take-off phase of a vertical jump (Menant et al., 2008). This stability is essential for generating maximum force and achieving higher jump heights. From Table 2, it is noted that the mean values of foot width were recorded as 9.35±0.69 cm, 9.93±0.72 cm, 9.73±0.97 cm & 10.19±0.86 cm and the mean values of foot length were recorded as 23.14±1.35 cm, 24.11±1.09 cm, 22.95±1.50 cm & 25.16±1.67 cm, respectively for girls aged 10-12 yrs, girls aged 13-15 yrs boys aged 10-12 yrs & boys aged 13-15 yrs. Mean values for both the foot parameters increased with the age in basketballers.

Range for foot width was found to be 7.50-11.50 cm, 8.50-12.50 cm, 8.00-12.00 cm and 8.50-13.00 cm whereas the range for foot length was noted as 19.50-26.50 cm, 21.00-26.50 cm, 19.50-27.50 cm and 22.00-31.00 cm in girls from 10-12 yrs, 13-15 yrs and boys from 10-12 yrs, 13-15 yrs, respectively. Difference of 4.00 cm, 4.00 cm, 4.00 cm & 4.50 cm was noted between the highest & lowest values for foot width of girls aged 10-12 yrs, girls aged 13-15 yrs boys aged 10-12 yrs & boys aged 13-15 yrs, respectively whereas a difference of 7.00 cm, 5.5 cm, 8.00 cm & 14.00 cm was noted between the highest & lowest values for foot width of girls aged 10-12 yrs, girls aged 13-15 yrs boys aged 10-12 yrs & boys aged 13-15 yrs, respectively. More variability was noted for individual readings of foot length among basketballers.

The role of feet in basketball is often overlooked. The demands placed on feet are huge, especially during sport. In basketball, there is a lot of strain put on the feet and lower limbs, even a small problem with the feet can have an impact on performance and can potentially lead to more serious issues. In present study, high significant differences were observed for all the four groups of basketballers in comparison to the standards for foot width ($z=8.38$ to 24.90, $p<0.01$) as well as for foot length ($z=3.35$ to 16.39, $p<0.01$). Younger girls and boys had higher values of differences for both the measurements against the standards. All four age groups of female & male basketballers possessed significantly wider & longer feet than standards for age & gender, with % excess ranged as 7.60 to 24.90 (for foot width) & 2.28 to 16.39 (for foot length) (Table 2). Foot length has been shown to correlate with athletic performance metrics, including sprinting and jumping. A study by Mismail et al. (2021) found that longer foot length can enhance the lever arm, improving the biomechanical efficiency of movements such as jumping. This is particularly relevant for adolescent athletes, whose growth spurts can result in rapid changes in foot size and overall biomechanics.

Longer and broader feet provide stability to maintain body balance in basketball while executing throw, as they are the springs and levers that cushion and propel the player. When comparisons of foot width and foot length values were done between younger groups & older groups of girls as well as between younger groups & older groups of boys, the differences were found to be significant ($p<0.01$) for foot width ($z=5.82$ for girls, 3.60 for boys) as well as for foot length ($z=5.57$ for girls and 9.84 for boys).

Change of foot length and width with age has been reported in a few anthropometric studies in literature. Cheng, J. C. et al. (1997) studied change of foot size with weight bearing in 2829 children aged 3 to 18 yrs and demonstrated that the foot length and width were found to increase linearly from the age of 3 years until 12 years in girls and 15 years in boys followed by a phase during which the increase plateaued. The foot length and width increased significantly on weight bearing at all ages in both genders with a mean of 2.1 to 4.4 mm or 3.1% to 4.8%, respectively.

Overall, here for the present study, younger boys had wider feet than younger girls but less longer feet than younger girls. Older groups of boys showed wider & longer feet than older group of girls (Table 2).

Research specifically investigating the correlation between foot dimensions and vertical jump performance in adolescent basketball players is limited. However, general studies on biomechanics and sports performance suggest a significant relationship. For instance, a study by Wagner et al. (2018) on soccer players indicated that those with larger feet had better balance and jump performance, which could be extrapolated to basketball players given the similarities in athletic demands.

Understanding the role of foot dimensions can help in designing more effective training programs. Coaches and trainers can incorporate exercises that enhance foot strength and stability, potentially improving vertical jump performance. Furthermore, recognizing the impact of foot size on performance can inform footwear choices, ensuring that athletes use shoes that optimize their foot mechanics.

Foot width and length are important but often overlooked factors that can influence vertical jump performance in adolescent basketball players. Larger foot dimensions may provide enhanced stability and force generation capabilities, contributing to better jump performance. Future research should focus specifically on basketball players to validate these findings and explore intervention strategies that can leverage these insights to enhance athletic performance.

Leg circumferences:

Leg area training could be the most neglected and underrated aspect of sports performance. But it's critical, since activation for most athletic movements starts with the feet. Ensuring that the thigh, calf and ankles are functioning properly is not only important for injury prevention, it also goes a long way toward maximizing speed, mobility, agility, power, force production and explosiveness while playing basketball.

Over the time, as these lower-leg area muscles remain semi-dormant and decrease in strength and size, the body develops compensation patterns to manage the lack of muscular activity in the lower leg and foot area. This, in turn, has a negative impact on muscle function throughout the lower body, hips and core, as well as the upper torso.

Like all skeletal muscles, the musculature that surrounds the feet and ankles are designed not only for movement but also for force absorption. When these muscles don't function as they should, it severely limits the shock absorption capabilities of the lower body. Besides impeding power, speed and agility, these forces are transferred to the joints, tendons, ligaments and surrounding connective tissue. This affects the performance of the player (https://www.stack.com/a/the-importance-of-foot-and-ankle-workouts).

Balance control improvement is one of the most important goals in sports and exercise. Proprioception plays an essential role in balance control, and ankle proprioception is arguably the most important component contributing to balance control in sport, because during most sports activities, the ankle-foot complex is the only part of the body contacting the ground. Ankle proprioception provides essential information to enable adjustment of ankle positions and movements of the upper body, in order to successfully perform the complex motor tasks required in elite sport (Han, J. et al., 2015; di Giulio, I. et al., 2009 & Sasagawa, S et al., 2009). Data on mean, standard deviation, minimum, maximum and z values of thigh circumference, calf circumference and ankle circumference of basketballers is presented in Table 3.

Table 3: Data on Thigh Circumference, Calf Circumference and Ankle Circumference of Basketballers

Sr. No.	Parameters	GIRLS			BOYS		
		Age Group 10-12 Yrs (n=100)	Age Group 13-15 Yrs (n=100)	z Values ¶	Age Group 10-12 Yrs (n=100)	Age Group 13-15 Yrs (n=100)	z Values ¶
1	**Thigh Circumference (cm)**						
i	**M±SD**	42.29±5.66	47.46±4.67	**7.05***	40.22±5.87	42.24-4.94	**2.63***
ii	**Range**	28.00-65.00	37.00-59.50		25.00-54.50	31.50-54.00	
iii	**Standard**	45.10	49.03		44.10	49.53	
iv	**% Deficit**	-6.23	-3.20		-8.80	-14.72	
v	**z Values#**	**4.97***	**3.36***		**6.61***	**14.76***	
2	**Calf Circumference (cm)**						
i	**M±SD**	28.29±3.28	30.89±2.70	**6.12***	27.67±3.55	30.25±3.30	**5.32***
ii	**Range**	22.00-42.50	23.00-41.50		17.50-36.50	25.00-41.00	
iii	**Standard**	32.83	35.60		31.83	36.03	
iv	**% Deficit**	-13.83	-13.23		-13.07	-16.04	
v	**z Values#**	**13.87***	**17.45***		**11.70***	**17.53***	
3	**Ankle Circumference (cm)**						
i	**M±SD**	19.43±1.93	20.67±2.05	**4.40***	19.41±2.41	20.45±1.99	**3.34***
ii	**Range**	16.00-25.00	17.50-33.00		11.00-27.00	17.00-27.00	

iii	**Standard**	18.07	20.63		18.37	20.80	
iv	**% Deficit/Excess**	+7.53	+0.19		+5.66	-1.69	
v	**z Values#**	**7.04***	**0.19**		**4.30***	**1.77**	

¶ - z values are for <u>between group comparison</u> (i.e. comparison between age groups 10-12 yrs & 13-15 yrs); # - z values are for comparison between data of subjects & standards; * - Significant at both 5 % & 1% levels (p<0.01); ** - Significant at 5 % level but insignificant at 1 % level (0.01<p<0.05); Values without any mark indicate insignificant difference at both 5% & 1% levels (p>0.05).

In this study, the mean values computed were 42.29±5.66 cm, 47.46±4.67 cm, 40.22±5.87 cm & 42.24±4.94 cm for thigh circumference; 28.29±3.28 cm, 30.89±2.70 cm, 27.67±3.55 cm & 30.25±3.30 cm for calf circumference and 19.43±1.93 cm, 20.67±2.05 cm, 19.41±2.41 cm & 20.45±1.99 cm for ankle circumference in girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs, respectively.

Among girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs, the range for thigh circumference was noted as 28.00-65.00 cm, 37.00-59.50 cm, 25.00-54.50 cm & 31.50-54.00 cm respectively whereas the range for calf circumference was noted as 16.00-25.00 cm, 17.50-33.00 cm, 11.00-27.00 cm & 17.00-27.00 cm respectively (Table 3).

Kilinc, F. and Turna, B. (2018) compared some biomotoric properties and anthropometric measurements in male basketball (n=15;15.5±0.74 years) and football (n=15; 16.3 ±0.9 years) players from the Muratpasa high school but found no statistically significant differences in the comparison of thigh circumference and calf circumference in boys from both the teams (p<0.05). Mean thigh & calf circumference for basketballers were 50.20±5.29 cm & 34.96±3.25 whereas mean thigh & calf circumference for footballers were 50.90±13.42 cm & 34.10±2.86 cm, respectively. Jakovljevic, S. et al. (2011) recorded mean±standard deviation, minimum and maximum values of calf circumference as 35.21±2.67 cm, 30.50 cm and 43.00 cm, respectively, whereas 51.17±4.05 cm, 44.00 cm and 61.00 cm, respectively for thigh circumference in 14 years old Serbian elite male basketball players.

For the present study, there found wide variations for individual readings of calf circumference for girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs, with a difference of 20.5 cm, 18.5 cm, 19.0 cm & 16.0 cm was noted between the highest & lowest values, respectively (Table 3). These differences could be attributable to fat deposition patterns, development of muscle mass, dietary intake etc.

Mean values of thigh circumference & calf circumference for girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs were significantly lower than the standards (z=3.36 to 14.76 for thigh girth & z=11.70 to 17.53 for calf girth, respectively, $p<0.01$). However, with the exception of the group of older boys, rests of the three groups i.e. girls aged 10-12 yrs & boys aged 10-12 yrs showed significantly higher mean ankle circumference than standards [(z=7.04 ($p<0.01$), z=0.19 ($p>0.05$) & z=4.30 ($p<0.01$), respectively] & the % excess were calculated as 7.53, 0.19 & 5.66, respectively. Boys from age group 13-15 yrs failed to meet the standard for mean ankle circumference with % deficit of 1.69 (z=1.77, $p>0.05$).

For the present research, effect of age on these three leg circumferences i. e. thigh, calf & ankle was found to be strong, with older girls & boys showed significantly ($p<0.01$) larger mean thigh, calf & ankle circumference than younger girls & boys, respectively [z=7.05 & 2.63, z=6.12 & 5.32 & z=4.40 & 3.34, respectively for girls (10-12 yrs) vs. girls (13-15 yrs) and boys (10-12 yrs) vs. boys (13-15 yrs), respectively]. The study of Chandra, K. and Pant, G. (2016) on 24 male basketball and volleyball players belonging to 20-25 years of age from Pune, revealed that the basketball players had mean and SD of calf muscle (34±2.95) and thigh segment (51.08±3.27), which was more or less similar to volleyball player's measurements and there was no statistically significant difference found.

It is clear from one of the study which was based on anthropometric profile of female (n=13) and male (n=46) players (18-22 yrs) engaged in different sports disciplines carried out by Nande, P. et al. (2008) that female hurdle racers had largest mean thigh circumference (51.5±6.5 cm) followed by half marathon group (49.7±2.4 cm), lowest value (43.5±1.7 cm) in male volleyballers having ranged between 45.8 to 47.3 cm in rest of the groups of male; the maximum was for athletics. However, for calf circumference, Nande, P. et al. (2008) reported highest mean value among female players-hurdle racing (33.0±3.0 cm) & lowest for badminton players (30.0±1.5 cm), whereas it was greater in (43.6±3.6 cm) in male weight lifters and lowest (34.3±2.8 cm) in volleyballers. In a study conducted by Gaurav, V. et al. (2010), calf circumference was significantly ($p<0.05$) higher for basketball players when compared to volleyball players from age group 18-25 years selected from different colleges affiliated to Guru Nanak Dev University, Amritsar, Punjab, India. No significant differences were found on the variables of calf circumference and thigh circumference among different age groups ranged between 12 to 19 years of state level male volleyball players of Chandigarh (India) in a study carried out by Singh, T. N. et al. (2017). It has been depicted from a study carried by Singh, T. N. et al. (2012) that there were significant differences obtained on anthropometric variables such as calf circumference & thigh circumference between 14-16 yrs old residential school (n=25) and non-residential (n=25) school boys of

Chandigarh. Studies on ankle circumference of players engaged in basketball or any other games are not done exclusively.

Nutrient intake:

Energy demands during the basketball season are substantial and may be even higher during off-season training. Choosing foods that provide the energy to support competition and training is essential and can also be quite challenging. Although total energy intake is important to counteract weight loss during the season, the source of the calories is critical to provide the muscle with the right type of fuel. The body's preferred fuel during high-intensity activities such as basketball is carbohydrate. Basketball players should consume a high-carbohydrate diet; that is to say that at least 55-65% of total calories in the diet should come from food rich in carbohydrate such as cereals, millets, sugars, starches, fruits, vegetables, etc. The range of carbohydrate intake suggested for basketball players is 5-7 (and up to 10) g/kg body weight depending upon playing time and the time of year (preseason, in-season, or postseason). Protein is very important nutrient for actual athletic performance. A sufficient protein intake is important for the building of muscle mass and the recovery of damaged tissues. It is generally known that an increased need for protein is found in children and adolescent athletes because as they start with regular physical training, muscle mass builds up. The recommendation for daily protein intake for basketball players is 1.4-1.7 g/kg of body weight. Besides protein & carbohydrates, dietary fats are important for the synthesis of hormones and cell membranes, as well as proper immune function. Athletes should strive to eat heart-healthy fats such as mono-unsaturated fats as well as omega-3 fats and avoid saturated fats and trans fats present in processed foods. Energy intake from fat should make up the remainder of calories after protein and carbohydrate recommendations are met. The role of nutrition in sports performance is very important. Proper nutrition must be available prior, during and post competition (Osterberg, K., 2017 and Indoria, A. and Singh, N., 2016).

Data on daily mean intake of energy, carbohydrates, protein and fat by basketballers is demonstrated in Table 4.

Table 4: Data on Daily Mean Intake of Energy, Carbohydrate, Protein and Fat by Basketballers

Sr. No.	Parameters	GIRLS			BOYS		
		Age Group 10-12 Yrs (n=100)	Age Group 13-15 Yrs (n=100)	z Values ¶	Age Group 10-12 Yrs (n=100)	Age Group 13-15 Yrs (n=100)	z Values ¶
1	**Energy (kcal)**						
i	**M±SD**	1865±282	2242±204	**10.88***	2181±159	2479±183	**12.27***
ii	**Range**	1280-2359	1521-2714		1792-2557	2000-2806	

iii	**RDA**	2010	2330		2190	2750	
iv	**% Deficit**	-7.24	-3.76		-0.41	-9.87	
v	**z Values#**	**5.17***	**4.31***		**0.57**	**14.80***	
2	**Carbohydrate (g)**						
i	**M±SD**	314.91±55.05	380.37±33.90	**10.12***	372.79±26.05	411.08±35.04	**8.77***
ii	**Range**	188.26-404.89	242.80-455.55		311.63-430.82	311.74-471.41	
3	**Protein (g)**						
i	**M±SD**	48.41±7.57	58.84±7.22		56.90±5.90	64.02±5.00	
ii	**Range**	29.99-64.24	37.31-72.54		41.52-68.51	52.93-72.64	
iii	**RDA**	40.40	51.90	**9.97***	39.90	54.30	**9.21***
iv	**%Excess**	+19.83	+13.37		+42.61	+17.90	
v	**z Values#**	**10.58***	**9.62***		**28.82***	**19.44***	
4	**Fat (g)**						
i	**M±SD**	45.69±6.49	53.94±7.97	**8.03***	51.35±6.30	64.26±5.79	**15.09***
ii	**Range**	35.07-60.63	37.79-72.41		37.67-66.29	51.41-78.21	

¶ - z values are for between group comparison (i.e. comparison between age groups 10-12 yrs & 13-15 yrs); # - z values are for comparison between data of subjects & standards; * - Significant at both 5 % & 1% levels ($p<0.01$); ** - Significant at 5 % level but insignificant at 1 % level ($0.01<p<0.05$); Values without any mark indicate insignificant difference at both 5% & 1% levels ($p>0.05$).

Irrespective of the age and gender, all the groups of players had lower mean daily intake of energy than RDAs (1865±282 kcal, 2242±204 kcal, 2181±159 kcal and 2479±183 kcal in girls from 10-12 yrs, 13-15 yrs age groups and boys from 10-12 yrs, 13-15 yrs age groups, respectively). Deficit intake of energy can lead to compromised work capacity.

Nande, P. et al. (2008) assessed energy intake and expenditure in 59 players (13 female & 46 male players), aged 18-22 years, engaged in different sports disciplines such as athletics, volleyball, cricket, judo, gymnastics, weight lifting, hurdle racing, half marathon, badminton, cross country etc. and found that irrespective of the sport group, female players ($t=3.62$, $p<0.01$) and male players ($t = 8.05$, $p<0.01$) showed mean intakes of energy below their respective RDA's. Cabral, C. A. C. et al. (2006) aimed to diagnose the nutritional status of the 24 athletes from weight lifting permanent Olympic team of the Brazilian Olympic Committee, aged 16-23 yr, 12 males (19.7±2.4 yr) and 12 females (19.2±1.8 yr) and in the study, 83% of the athletes presented energy intake below the recommended values, considering the high level of physical activity, resulting in daily caloric deficiency.

For the present research, the mean energy intake by younger group of boys was found to be greater than that of younger girls. Similarly, mean energy intake by older group of boys was found to be greater than that of older girls. A difference of 316 kcal was observed between the mean intake of energy intake by girls and boys aged 10-12 yrs whereas it was

237 kcal in case of girls and boys aged 13-15 yrs. Older group of female players consumed significantly higher amounts of energy than younger group of female players (z=10.88). Similarly, older group of male players consumed significantly higher amounts of energy than younger group of male players (z=12.27). The mean energy intake among girls (10-12 yrs), girls (13-15 yrs), boys (10-12 yrs) and boys (13-15 yrs) was calculated as 49.91, 47.59, 60.41 and 55.69 kcal/kg actual mean body weight/day, respectively. Majority of basketballers consumed daily energy intake below RDA. Unfortunately, 71% of 13-15 yrs aged male basketballers were found to have energy intake below RDA followed by 52% of 10-12 yrs aged girls, 50% of 13-15 yrs aged girls and then 31% of 10-12 yrs aged boys. 21%, 31%, 50% and 24% of girls from 10-12 yrs and 13-15 yrs age groups and boys from 10-12 yrs and 13-15 yrs age groups respectively consumed adequate intake of energy in their diets. Also, 5%, 19%, 19% and 27% of girls (10-12 yrs), girls (13-15 yrs), boys (10-12 yrs) & boys (13-15 yrs) respectively showed daily energy intake above RDAs.

Mean carbohydrate intake by girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs was 314.91±55.05, 380.37±33.90, 372.79±26.05 and 411.08±35.04 g, respectively which was found to be increased with age in both the genders. The mean intake of carbohydrate in girls aged 13-15 yrs was higher by 65.46 g than in girls aged 10-12 yrs (z=10.12) whereas it was higher by 38.29 g in boys aged 13-15 yrs as compared to boys aged 10-12 yrs (z=8.77). This is because older groups in both genders had higher energy intake and a major portion of energy came from carbohydrate in their diets. The mean intake of carbohydrate per kg actual body weight was calculated as 8.42, 8.07, 10.32 and 9.23 g/kg/day for girls aged 10-12 yrs and 13-15 yrs and boys aged 10-12 yrs and 13-15 yrs, respectively.

Mean values of daily protein intake for all the groups of basketballers were found to be significantly higher than RDAs (z=10.58, 9.62, 28.82 and 19.44, respectively for girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs and boys aged 13-14 yrs, $p<0.01$). The mean values for daily protein intake were recorded as 48.41±7.57 g, 58.84±7.22 g, 56.90±5.90 g and 64.02±5.00 g with % excess (in comparison with RDAs) of 19.83, 13.37, 42.61 and 17.90 %, respectively for girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs. In comparison to girls, boys showed far higher mean protein intake than RDAs which was clearly reflected from z values (Table 4).

The difference in the mean intake of protein by younger & older groups of girls i.e. 10-12 yrs and 13-15 yrs was found to be 10.43 g whereas the difference was 7.12 g between younger & older groups of boys i.e. 10-12 yrs and 13-15 yrs. The older groups of girls &

boys showed significantly higher mean daily intake of protein than younger groups of girls & boys (z=9.97 for girls aged 10-12 yrs vs. girls aged 13-15 yrs and z=9.21 for boys aged 10-12 yrs vs. boys aged 13-15 yrs)(p<0.01). The mean protein intake per kg body weight per day was derived as 1.29 g, 1.24 g, 1.57 g and 1.43 g, respectively for girls aged 10-12 yrs, girls aged13-15 yrs, boys aged 10-12 yrs and boys aged 13-15 yrs. Younger group of male basketballers consumed higher mean daily protein than younger group of female basketballers & a difference of 8.49 g was noted between them for mean daily protein intake. Similarly, older group of male basketballer consumed 5.18 g excess mean daily protein than older group of female basketballers. Majority of the basketballers i.e. 36% of girls aged 10-12 yrs , 46% of girls aged 13-15 yrs, 83% of boys aged 10-12 yrs and 75% of boys aged 13-15 yrs consumed excess protein in their diets. 59% girls (10-12 yrs), 49% girls (13-15 yrs), 17% boys (10-12 yrs) and 24% boys (13-15 yrs) had adequate intake of protein whereas 5% from each group of female players and 1% of boys aged 13-15 yrs reported to have protein intake below RDAs.

Similar to protein intake, mean daily intake of fat was also higher in older groups than younger groups of basketballers. The differences in the mean fat intake between 10-12 yrs & 13-15 yrs age groups were recorded as 8.25 g in girls and 12.91 g in boys. Mean fat intake was derived as 45.69±6.49 g, 53.94±7.97 g, 51.35±6.30 g and 64.26±5.79 g, respectively for girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs and boys aged 13-15 yrs. Older age groups of female and male basketballers consumed significantly higher mean daily fat than younger groups of female and male basketballers (z=8.03 for girls aged 10-12 yrs vs. girls aged 13-15 yrs and z=15.09 for boys aged 10-12 yrs vs. boys aged 13-15 yrs, p<0.01). Fat intake in girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs and boys aged 13-15 yrs was found as 1.22, 1.14, 1.42 and 1.44 g/kg, respectively.

Sergeant jump test, which is also called as vertical jump test, was developed by Dr. Dudley Sargent. Sergeant jump test is considered to be a valid and reliable measure of lower-body explosive power. Elite basketball athletes are put through the vertical jump test to see how well they can compete in this aspect of the sport, as jump height is needed in the game of basketball. Vertical jump height has been shown to correlate with maximal strength and sprint performance and is therefore of interest to many strength and conditioning professionals. Maximum jump height can provide key information about functional capacity and performance in many sports, and is considered as an essential motor skill in a range of team sports including basketball. For this reason, athletes who compete in this sport go through training programs to increase their jump height. The athlete's jump height can be affected by a multitude of factors which should be considered when reviewing the results such as shoulder range of motion, fatigue, motivation, displacement from the take-off point, flexing of the hips and knees or ankles (https://www.scienceforsport.com/vertec-jump - test/#toggle-id-1).

Results of sergeant jump test for basketballers are presented in Table 5.

Table 5: Data on Sergeant Jump Test of Basketballers

Sr. No.	Subjects	Parameters	Distance Jumped (cm)		z Values¶
			Age Group 10-12 Yrs (n=100)	Age Group 13-15 Yrs (n=100)	
1	GIRLS	Mean±SD	23.21±5.45	25.81±6.33	3.12*
		Range	10.00-36.00	13.00-49.50	
		Performance Assessment Based on Mean	Below Average	Below Average	
2	BOYS	Mean±SD	24.28±6.42	26.57±5.97	2.62*
		Range	8.50±46.00	14.00-39.00	
		Performance Assessment Based on Mean	Below Average	Below Average	
z Values■			0.42	0.74	-

¶ - z values are for between group comparison (i.e. comparison between age groups 10-12 yrs & 13-15 yrs); ■ - z values are for between gender comparison (i.e. comparison between girls & boys from age group 10-12 yrs & between girls & boys from age group 13-15 yrs); * - Significant at both 5 % & 1% levels (p<0.01); ** - Significant at 5 % level but insignificant at 1 % level (0.01<p<0.05); Values without any mark indicate insignificant difference at both 5% & 1% levels (p>0.05).

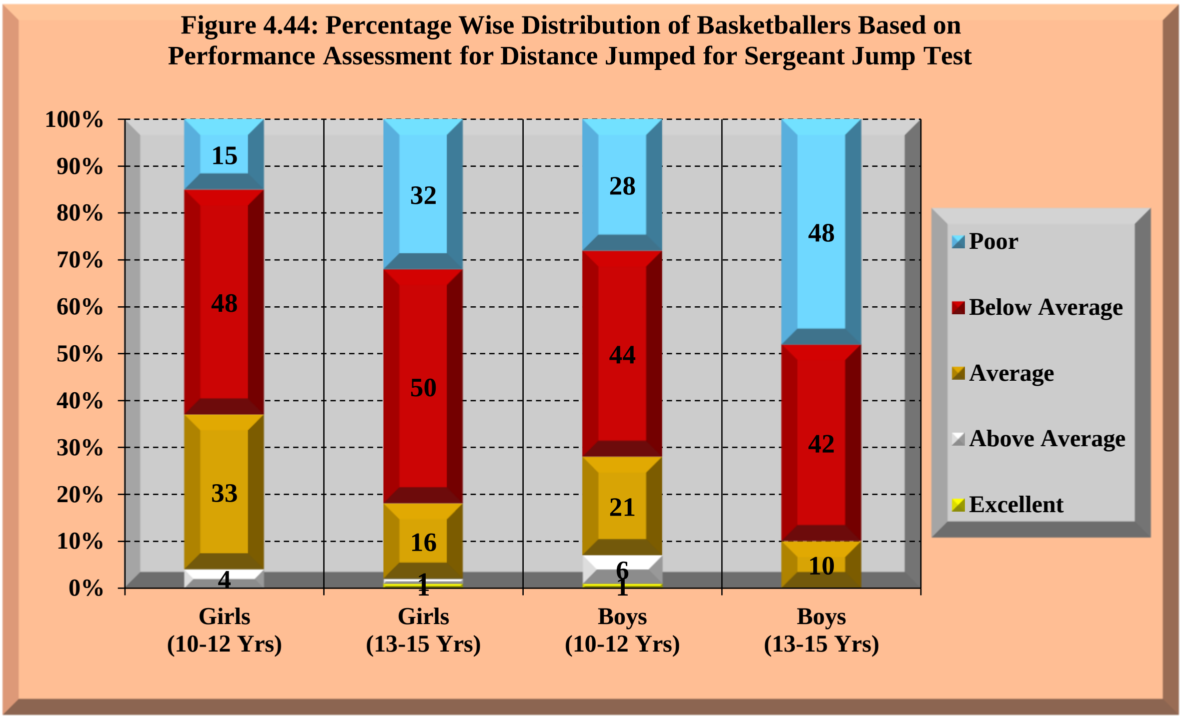
The main goal of the sergeant jump test is to measure how high an athlete can jump which is based on their explosive lower limb power. The jump height of athletes is one of the measures often used for rating basketball players as it is a factor in how well they can perform or be matched up against other players. For these reasons, professional teams and their scouts take the vertical jump scores of athletes very seriously and it is one of the main components in professional athlete assessments for the games like basketball (http://theexercisers.com/how-to-increase-vertical-jump/how-to-measure-vertical-jump/vertical-jump-test-sargent-jump-test/).

The data in Table 5 clearly reveals that the older basketballers surpassed the younger basketballers with respect to the mean vertical distance jumped. The test is used to monitor the athlete's bilateral (two legged) explosive power by measuring how high they can jump. The mean values for this test were noted as 23.21±5.45 cm, 25.81±6.33 cm, 24.28±6.42 cm and 26.57±5.97 cm in girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs, respectively. The distance jumped by players were recorded as high as 49.50 & 46.00 cm in girls & boys, respectively and it was recorded as short as 10.00 & 8.50 cm in girls & boys, respectively (Table 5). The results of sergeant jump test showed 'below average' performance based on means in both the genders from 10-12 yrs and 13-15 yrs age groups.

Lidor, R. and Ziv, G. (2010) reviewed a series of studies (n=26; 15 observational and 11 experimental) examining vertical jump performances in female and male basketball players & it was found that vertical jump values varied greatly, from 22 to 48 cm in female players and from 40 to 75 cm in male players.

For the present study, when the performance of vertical jump test was compared between younger & older age groups, it was seen that older female & males jumped significantly longer mean distance than younger females & males, respectively ($z=3.12$ for younger vs. older female basketballers and $z=2.62$ for younger vs. older male basketballers, $p<0.01$). The differences could be attributed to longer duration of training & greater height of older players. Gender wise comparisons revealed that younger & older male basketballers jumped longer mean vertical distance than younger & older female basketballers, respectively, however, the differences were very insignificant ($z=0.42$ & 0.74, respectively, $p>0.05$). Greene, J. J. et al. (1998) determined possible anthropometric and performance sex differences in a population of 54 female and 61 male high school basketball players & performance testing for sergeant jump test revealed that the males were able to jump significantly higher than the female subjects.

Figure 1 shows percentage wise distribution of basketballers based on performance assessment for distance jumped for sergeant jump test.



Vertical jump is often used as a measurement of lower-body power, and thus as an indirect measure of performance. As Figure 1 clearly shows, 33, 16, 21 & 10% of girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs, respectively, found to have 'average performance' for this test. Very few players among female players of 10-12 yrs age group (4%), female players of 13-15 yrs age group (1%) & male players of 10-12 yrs age group (6%) gave 'above average' performance whereas only 1% from older girls & 1% from younger boys could manage to perform 'excellently' for sergeant jump test. Majority of players i.e. 48% girls of 10-12 yrs age group, 50% of girls from 13-15 yrs age group, 44% of boys from 10-12 yrs age group & 42% of boys from 13-15 yrs age group had 'below average' performance as also represented in Figure 4.44. It is noted that 15% of girls from 10-12 yrs age group, 32% of girls from 13-15 yrs age group, 28% of boys from 10-12 yrs age group & 48% of boys from 13-15 yrs age group performed 'poorly' for the sergeant jump test showing weak lower-body explosive power.

The basketball game contains different elements like running, jumping, and extending. Jumping ability of the basketball players depends on their strong thigh and calf muscles, players need to have strong hips to hyperextend their legs and propel the body forward as well. Strong abdominal muscles and upper body, as well upper extremities allow basketballers to throw their body up into the air. Combination of all these muscle movements, indicate the importance of explosive force, speed, level of aerobic endurance, and anaerobic abilities, which basketballers should possess to make their game (Rexhepi, A. M. and

Brestovci, B., 2010). Das, P. and Mishra, P. (2015) conducted a comparative study on selected fitness components of 13-19 years old female basketball and volleyball players in a total of 22 players & found no significant difference between female basketball and volleyball group with respect to leg explosive strength measured by vertical jump test. Abdelkrim N. B. et al. (2010) compared the physical attributes of elite men basketball players according to age and specific individual positional roles in 45 players from 3 national basketball teams (Under-18 years, Under-20 years, and Senior) and observed that Under-20 and Senior players were faster and had better sergeant jump test ($p<0.05$) performance than Under-18 players. Akilan, N. and Chittibabu, B. (2014) evaluated the effectiveness of a basketball specific endurance circuit training on leg explosive power measured through vertical jump test on 24 high school male basketball players from Manjakuppam, Cuddalore & the result showed that leg explosive power ($t=2.345$, $p=0.03$) improved significantly in sports specific endurance circuit training group.

Correlates of leg measurements, nutrient intake and vertical jump test performance:

Among female basketballers aged 10-12 yrs, female basketballers aged 13-15 yrs, male basketballers aged 10-12 yrs, male basketballers aged 13-15 yrs, the intakes of energy, carbohydrate, protein & fat reflected significant ($p<0.01$) & positive correlations with different body breadths such as foot width (r=0.4009, 0.2705, 0.5038 & 0.5169 for energy intake, respectively; r=0.3534, 0.2211, 0.4887 & 0.4712 for carbohydrate intake, respectively; r=0.2972, 0.3071, 0.4668 & 0.3474 for protein intake, respectively and r=0.4461, 0.2259, 0.3207 & 0.4185 for fat intake, respectively). The above results indicate the importance of energy & macronutrients for players in this growing age.

Among female basketballers aged 10-12 yrs & 13-15 yrs as well as among male basketballers aged 10-12 yrs & 13-15 yrs, intakes of energy, carbohydrate, protein & fat showed significant ($p<0.01$) & positive correlations with foot length (r=0.3747, 0.4416, 0.5949 & 0.3526, respectively for energy intake; r=0.3604, 0.3930, 0.5120 & 0.2990, respectively for carbohydrate intake; r=0.3616, 0.3131, 0.4185 & 0.3329, respectively for protein intake and r=0.2603, 0.3837, 0.5537 & 0.3091, respectively for fat intake);

Body girths are highly influenced by dietary intake of energy. In the present study, energy intake depicted highly strong positive & significant correlation with different body girths like thigh circumference (r=0.4730, 0.6462, 0.6918 & 0.5004, respectively, $p<0.01$); calf circumference (r=0.4239, 0.6059, 0.7497 & 0.5351, respectively, $p<0.01$) & ankle circumference (r=0.4247, 0.5456, 0.6384 & 0.5593, respectively, $p<0.01$) in girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs, respectively

Similar to energy intake, among all four groups of basketballers (i.e. girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs), carbohydrate intake reflected strong positive & significant correlations with thigh circumference (r=0.4740, 0.6247, 0.6716 & 0.4037, respectively, p<0.01); calf circumference (r=0.3819,0.5517, 0.7313 & 0.4406, respectively, p<0.01) & ankle circumference (r=0.4003, 0.5320, 0.6110 & 0.4678, respectively, p<0.01). Carbohydrates through the diets if not utilized, are stored as adipose tissues. Here, among basketballers, intake of carbohydrate resulted in fat deposition & hence, there were direct relationship existed between carbohydrate intake & all body circumferences.

Among girls (10-12 yrs), girls (13-15 yrs), boys (10-12 yrs) & boys (13-15 yrs), protein intake also showed moderate to strong correlations which were significant (p<0.01) with thigh circumference (r=0.3775, 0.3899, 0.4866 & 0.4304, respectively); calf circumference (r=0.4567, 0.4135, 0.5893 & 0.3644, respectively) & ankle circumference (r=0.3760, 0.2874, 0.4902 & 0.4077, respectively) in girls aged 10-12 yrs & 13-15 yrs & boys aged 10-12 yrs & 13-15 yrs, respectively.

Fat is the concentrated source of dietary energy. For the present research, like other two macronutrients-carbohydrate & protein, fat intake among girls aged 10-12 yrs, girls aged 13-15 yrs, boys aged 10-12 yrs & boys aged 13-15 yrs demonstrated significant positive correlation with thigh circumference (r=0.2971, 0.4953, 0.5037 & 0.5102, respectively, p<0.01); calf circumference (r=0.3669, 0.5094, 0.5135 &0.5582, respectively, p<0.01) & ankle circumference (r=0.3430, 0.4263, 0.4637 & 0.5537, respectively, p<0.01).

The results of correlates of energy & energy giving nutrients clearly indicate the important role of diet balanced in carbohydrate, protein & fat in attaining required physical dimensions during the period of growth.

Ankle circumference had positive relationships with foot width (r=0.3223 to 0.6558) & foot length (r=0.1504 to 0.4883) which were mostly significant (p<0.01) among all age groups of basketballers. This means that broader & longer the foot, larger the ankle girth.

Length of the feet is considered to be an important measure in the field of sports. Sergeant jump test performance (r=0.0022 to 0.2607, p>0.05); sit ups test performance (r=0.0159 to 0.2825, p>0.05) depicted positive correlations with foot length in all four age groups of players. These correlations demonstrate that feet act as spring and launching pads that propel the player forward. Saiyed, M. Z. et al. (2015) determined the relationship of limb girth, segmental limb length, and hamstring flexibility with vertical jump in male sports players from basketball, football and cricket aged between 18 to 25 years and there was a moderate positive correlation of hand length and foot length with vertical jump.

For the present study, there was negative correlation between sergeant jump test performance and thigh circumference in girls aged 10-12 yrs & 13-15 yrs (r= -0.0800 & -0.0246, respectively, p>0.05). Pandey, P. and Yadav, B. K. (2012) identified the relationship between selected anthropometric variables and explosive strength among 40 district and sub-division level female basketball players having age of 21-25 years from districts of Uttar Pradesh and a positive but insignificant correlation was found between vertical jump and thigh & calf circumference.

Jumping ability of basketball players depends on their strong thigh and calf muscles which work toward maximizing speed, mobility, agility, power, and explosiveness in players while playing basketball. Correlation of sergeant jump test performance with calf circumference was observed to be negative in girls from 10-12 yrs & 13-15 yrs age group (r=-0.0025 & -0.0370, respectively, p>0.05) and positive among boys from 10-12 yrs & 13-15 yrs age group (r=0.0851 & 0.0412, respectively, p>0.05). Sharma, H. B. et al. (2017) examined the relationship between anthropometric characteristics and vertical jump in 54 national level hockey and cycling players of 11-21 years and results indicated significant positive correlation of vertical jump test with thigh and calf circumference in male players. Endo, Y. and Sakamoto, M. (2014) reported that lower extremity tightness and balance were significantly correlated in 33 male junior high school baseball players.

The relationship between physical fitness levels of performance and anthropometric characteristics of male athletes aged 9-12 years old taekwondoists was investigated by Sevinc, D. & Yilmaz, V. (2017) and performance of vertical jump test were found to be positively correlated with the anthropometric features like calf and thigh circumferences. Sergeant jump test performance (r= -0.0120 to -0.1320, p>0.05) had insignificant and negative correlations with ankle circumference in players. Vertical jump test performance (r=0.0141 to 0.1151, p>0.05) reflected positive correlation with energy intake indicating the importance of sufficient energy intake to sustain physical activities in sport.

Carbohydrate is the primary source used by the skeletal muscles during endurance exercise, which showed its positive effect among young players. However, excess carbohydrate may get deposited as adipose tissues which may hamper aerobic work capacity. Failing to consume adequate carbohydrates after exercising can lead to fatigue and muscle soreness. Female & male basketballers showed positive correlations of vertical jump test performance (r=0.0320 to 0.1327, p>0.05) with carbohydrate intake which show that carbohydrate is the most important fuel source for athletes that provides energy to perform efficiently in each of the fitness parameters. Vertical jump test performance (r=0.0018 to 0.1531, p>0.05) was positively correlated with protein intake in all four age groups of basketballers.

CONCLUSION

This study elucidates the significant relationships between leg measurements, energy and macronutrient intake, and vertical jump performance among adolescent basketball players. The findings indicate that greater muscle mass in the thighs and calves, as evidenced by larger circumferences and appropriate leg length proportions, is positively associated with superior vertical jump height. Furthermore, a balanced diet with adequate protein and carbohydrate intake is crucial for optimizing jump performance, underscoring the critical role of nutrition in athletic development.

These results highlight the importance of integrating tailored physical training and nutritional strategies to enhance athletic performance in young basketball players. Coaches and sports nutritionists should focus on developing strength and muscle mass in the lower limbs while ensuring that athletes receive adequate and balanced macronutrient intake to support their energy needs and muscle recovery processes.

The implications of this study suggest that a holistic approach, combining targeted physical conditioning and strategic nutritional planning, can significantly improve vertical jump performance and overall athletic potential in adolescent basketball players. Future research should consider longitudinal studies and intervention-based designs to further validate these findings and explore additional factors that may influence athletic performance. By understanding and applying these insights, stakeholders in youth sports can better support the development and success of young athletes, contributing to their long-term health and performance outcomes.

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