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A study of Correlations between dominant handgrip strength with some selected anthropometric and physiological characteristics in inter-college male volleyball players of West Bengal, India

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Abstract
The purpose of the present study was to estimate the dominant handgrip strength and its correlations with selected anthropometric and physiological characteristics in inter-college volleyball players. Three anthropometric characteristics, two body composition parameters, two physical and two physiological characteristics were measured on randomly selected 40 inter-college volleyball players (40 males) aged 18–25 years from inter collage volleyball competition held in Vidyasagar Universities, Paschim Midnapore, West Bengal, India. An adequate number of control (40 males) subjects were also taken from the same place for comparisons. The results indicated statistically significant ($p \leq 0.05$-0.01) differences between the male volley ball players and the controls in height, weight, BMI, right handgrip strength, left handgrip strength, %BF (Percent body fat), %LBM (Percent lean body mass), heart rate and VO2 max. It may be concluded that dominant handgrip strength had some strong positive correlations with all the variables studied in inter-college volleyball players.

Keywords: Anthropometric characteristics. Handgrip strength, VO2 max, Inter-college volleyball players.

Introduction
Volleyball is a traditional outdoor game played with minor variations in all regions of India - in fact, in most parts of Asia. Volleyball requires tremendous physical stamina, fagility, individual proficiency, neuromuscular coordination, lung capacity, quick reflexes, intelligence and presence of mind on the part of both attackers and defenders.

Nutrition has a major influence on them magnitude of adaptation to training. Proper food intake and sound nutritional strategies will result in strength and muscular endurance improvements, and will facilitate athletic performance. Nutritional needs are influenced by the metabolism of energy providing nutrients (that is, mobilisation, utilisation, and storage of energy substrates) at rest and during exercise.

The power of handgrip is the forceful flexion of all finger joints with the maximum voluntary force that the subject is able to exert under normal biokinetic conditions (Richards *et al.* 1996, Bohannon 1997) [31, 4] uses several muscles in the hand and the forearm (Bassey and Harrie 1993) [1]. Grip strength is often used as an indicator of overall physical strength (Massey-Westrop *et al.* 2004, Foo 2007) [24, 13], hand and forearm muscles performances (Nwuga 1975) [26] and as a functional index of nutritional status (Chilima and Ismail 2001, Pieterse *et al.* 2002) [7, 28] and physical performance (Samson *et al.* 2000, Onder *et al.* 2002) [33, 27].

Handgrip strength is a physiological variable that is affected by a number of factors including age, body size and gender. Strong correlations between grip strength and various anthropometric parameters, (weight, height, BMI etc.) were reported earlier (Malina *et al.* 1987, Ross and Rösblad 2002, Singh *et al.* 2009, Koley and Yadav 2009, Koley and Singh 2009, Koley *et al.* 2009, Jurimae *et al.* 2009, Kaur 2009) [23, 32, 18, 35, 19, 16, 17].

Several studies have examined the relationships between anthropometric and physiological characteristics of volleyball players (Fleck *et al.* 1985, Fry *et al.* 1991) [12, 14]. But information related to the correlations of handgrip strength and anthropometric characteristics in volleyball players are limited, especially in Indian context. So the present study was planned.

Materials and Methodology

Participants

The present cross-sectional study is based on randomly selected 40 inter-collage volleyball players (40 males) aged 18–25 years (mean 19.05 years, ± 1.40) from Vidyasagar University, Paschim Midnapora, West Bengal, india. An adequate number of controls (n = 40, males mean age 21.60 years, ± 2.13) with no particular athletic background were also collected from the same place for comparisons. The age of the subjects were recorded from the date of birth registered in their respective institutes. A written consent was obtained from the subjects. The data were collected under natural environmental conditions in morning (between 8 AM. to 12 noon). The study was approved by the local ethics committee.

Measurements and calculations

Three anthropometric variables, viz. height (HT), weight (WT) and BMI, Two body composition parameters, viz. percent body fat (%BF), percent lean body mass (%LBM), two physical parameters, viz. right and left hand grip strength (RHGS and LHGS respectively) and two physiological variables, viz. heart rate (HR) and VO2 max (VO2M) were measured on each subject. Anthropometric variables of the subjects were measured using the techniques provided by Lohmann *et al.* (1988) [22] and were measured in triplicate with the median value used as the criterion. Dominant hand grip strength: Koley & Singh (2012) [20] pp 41-50 The height was recorded during inspiration using a stadiometer (Holtain Ltd., Crymych, Dyfed, UK) to the nearest 0.1 cm, and weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. BMI was then calculated using the formula weight (kg)/height $(m)^2$. Percent body fat was assessed using skinfold measurements taken from four sites, viz. biceps, triceps, subscapular and suprailiac using Harpenden skinfold caliper (Holtain Ltd, Crosswell, Crymych, UK) to the nearest 0.2 mm, and using the Durnin and Womersley (1974) skinfold equation. Percent lean body mass was calculated subtracting percent body fat from 100. Heart rate was estimated manually immediately after step test. VO2 max was estimated by Queen's College Step Test (McArdle *et al.* 1972) [25].

Handgrip strength measurement

The grip strength of both right and left hands was measured using a standard adjustable digital handgrip dynamometer (Takei Scientific Instruments Co., LTD, Japan) at standing position with shoulder adducted and neutrally rotated and elbow in full extension. The dynamometer was held freely without support, not touching the subject's trunk. The position of the hand remained constant without the downward direction. The subjects were asked to put maximum force on the dynamometer thrice from both sides of the hands. The maximum value was recorded in kilograms. Anthropometric equipment and handgrip dynamometer were calibrated before each assessment. All subjects were tested after 3 minutes of independent warm-up. Thirty seconds time interval was maintained between each handgrip strength testing.

Statistical analysis

Standard descriptive statistics (mean ± standard deviation) were determined for directly measured and derived variables. One way analysis of variance was tested for the comparisons of data among inter-university volleyball players and controls, followed by post hoc Bonferroni test. Pearson's correlation coefficients were applied to establish the relationships among the variables measured. Data were analyzed using SPSS (Statistical Package for Social Science) version 17.0. A 5% level of probability was used to indicate statistical significance.

Results

Descriptive statistics of selected anthropometric, body compositional, physical and physiological characteristics in inter-college volleyball players and controls were shown in following Table. Volleyball players were compared with their control groups, statistically significant differences ($p \leq 0.05$ - 0.01) were found in all the variables studied.

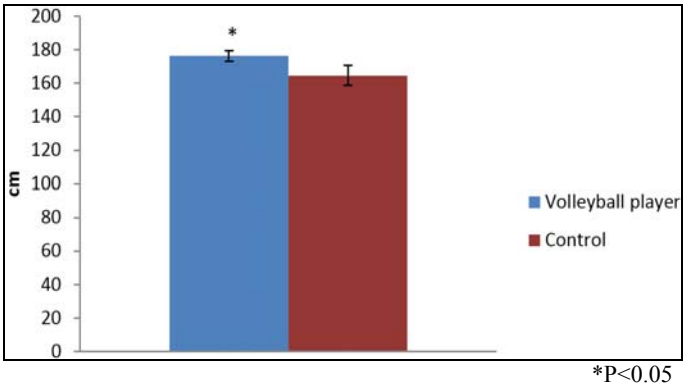
Right handgrip strength of volley ball player and control group is (41.55 ± 6.21 and 35.34±4.35)Kg also left handgrip strength of volley ball player and control group is (40.26 ± 2.65 and 33.56±3.48)Kg had significantly increased ($P \leq 0.05$ and $p \leq 0.01$ respectively) in volleyball players in compared with their control group. Among the other variables, height (176.34 ± 3.54 and 164.64±6.54) cm, weight(65.07 ± 9.82 and 56.63±5.23)Kg and BMI(36.09 ± 3.54 and 34.39±1.04) Kg/m^2 in volleyball player and control group respectively had significantly increased ($p \leq 0.05$) in volleyball players compared with their control group. Percent body fat (12.45 ± 2.38 and 21.52±3.28)% and percent Lean body mass(87.55 ± 2.38 and 78.48±5.28)% in volleyball player and control group respectively had significantly decreased and Increased respectively ($p \leq 0.01$) in volleyball players compared with their control group. On the other hand, VO2 max(70.28± 4.27 and 61.85±6.46) ml/kg/min in volleyball player and control group respectively had significantly increased ($p \leq 0.01$) and heart rate(86.06± 2.68 and 116.28 ±12.38) beats/min in volleyball player and control group respectively had significantly decreased ($p \leq 0.05$) in volleyball players compared with their control group.

Table 1: Height (cm) of inter-college volleyball player and with Control group.

Group	Height(cm)
Volleyball players (n=40)	176.34 ± 3.54*
Controls (n=40)	164.64±6.54

*P<0.05

Value shows: Mean ± S.E



*P<0.05

Value shows: Mean ± S.E

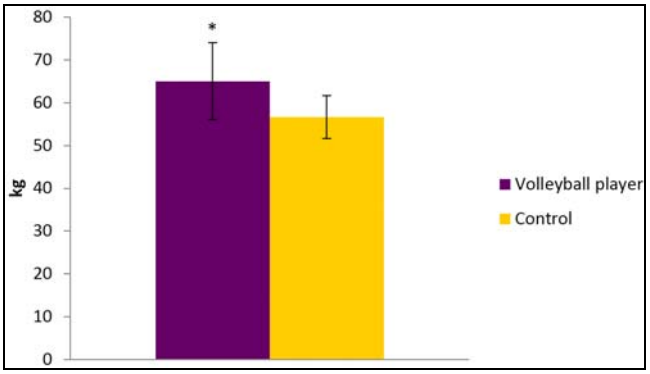
Fig 1: Height (cm) of inter-college volleyball player and with Control group.

Table 2: Weight (Kg) of inter-college volleyball player and with Control group.

Group	Weight(Kg)
Volleyball players (n=40)	65.07 ± 9.82*
Controls (n=40)	56.63±5.23

*p<0.05

Value shows: Mean ± S.E



*p<0.05

Value shows: Mean ± S.E

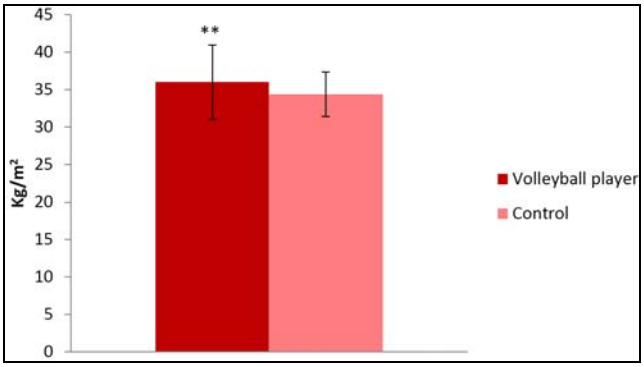
Fig 2: Weight (Kg) of inter-college volleyball player and with Control group.

Table 3: BMI (Kg/m^2) of inter-college volleyball player and with Control group.

Group	BMI (Kg/m^2)
Volleyball players (n=40)	36.09 ± 3.54*
Controls (n=40)	34.39±1.04

**P<0.05

Value shows: Mean ± S.E



**P<0.01

Value shows: Mean ± S.E

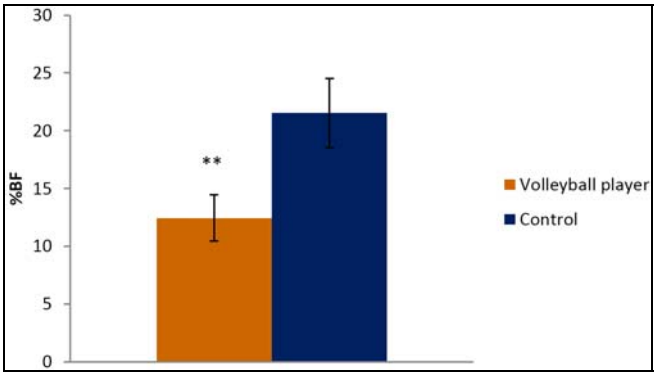
Fig 3: BMI (Kg/m^2) of inter-college volleyball player and with Control group.

Table 4: Body Fat Percentage (%BF) of inter-college volleyball player and with Control group.

Group	. % BF
Volleyball players (n=40)	12.45 ± 2.38*
Controls (n=40)	21.52±3.28

**P<0.01

Value shows: Mean ± S.E



Value shows: Mean ± S.E

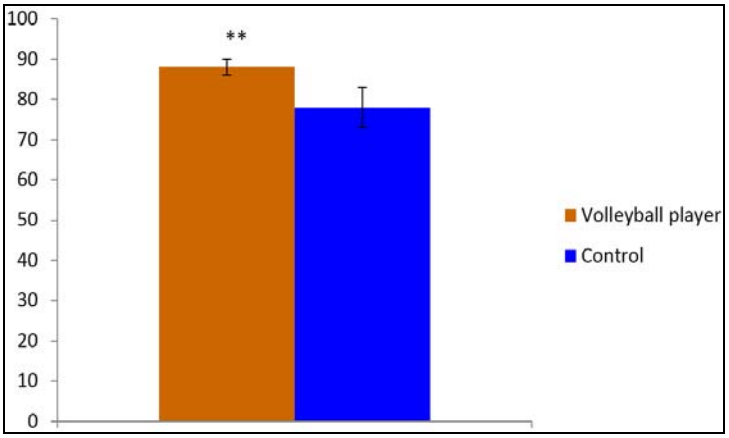
Fig 4: Body Fat Percentage (%BF) of inter-college volleyball player and with Control group.

Table 5: Lean Body Mass Percentage (%LBM) of inter-college volleyball player and with Control group.

Group	. % LBM
Volleyball players (n=40)	87.55 ± 2.38**
Controls (n=40)	78.48±5.28

**p<0.01

Value shows: Mean ± S.E



**p<0.01

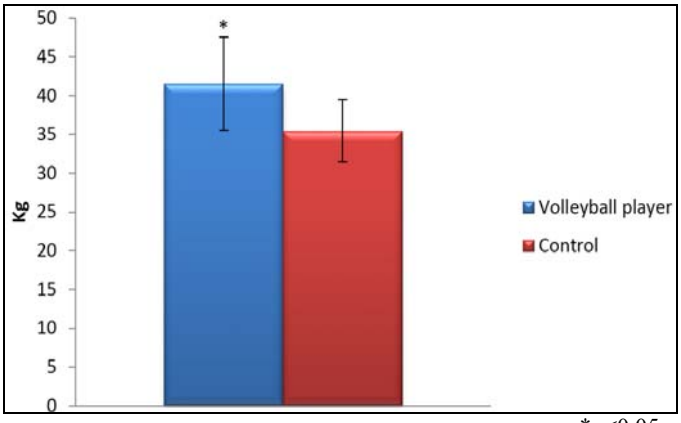
Fig 5: Lean Body Mass Percentage (%LBM) of inter-college volleyball player and with Control group.

Table 6: Right Handgrip Strength (Kg) of inter-college volleyball player and with Control group.

Group	RHGS(Kg)
Volleyball players (n=40)	41.55 ± 6.21*
Controls (n=40)	35.34±4.35

*p<0.05

Value shows: Mean ± S.E



*p<0.05

Value shows: Mean ± S.E

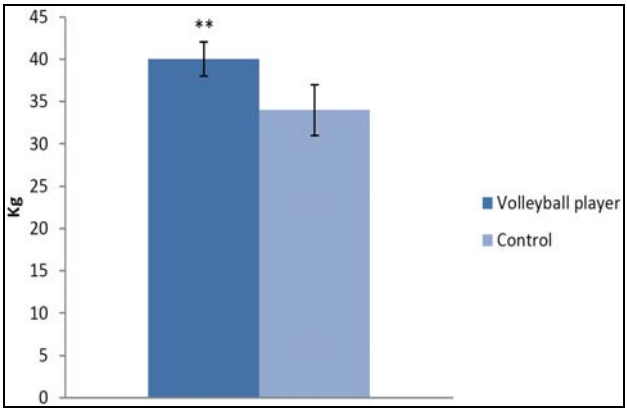
Fig 6: Right Handgrip Strength (Kg) of inter-college volleyball player and with Control group.

Table 7: Left Handgrip Strength (Kg) of inter-college volleyball player and Control group.

Group	LHGS(Kg)
Volleyball players (n=40)	40.26 ± 2.65**
Controls (n=40)	33.56±3.48

**p<0.01

Value shows: Mean ± S.E



**p<0.01

Value shows: Mean ± S.E

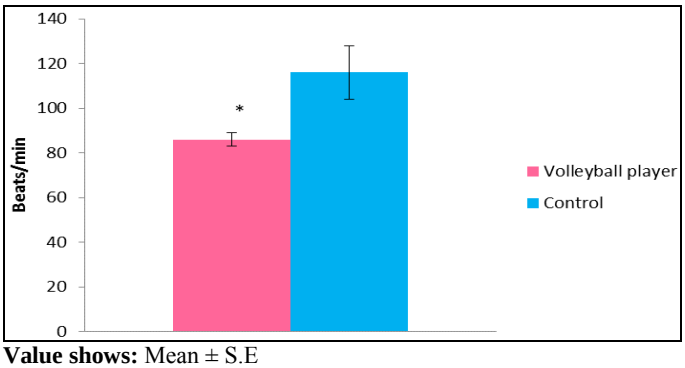
Fig 7: Left Handgrip Strength (Kg) of inter-college volleyball player and Control group.

Table 8: Heart rate (beats/min) of inter-college volleyball player and Control group.

Group	HR(beats/min)
Volleyball players (n=40)	86.06± 2.68*
Controls (n=40)	116.28 ±12.38

*p<0.05

Value shows: Mean ± S.E



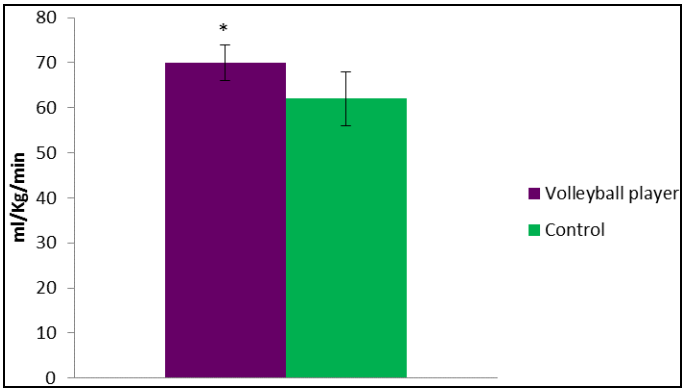
Value shows: Mean ± S.E

Fig 8: Heart rate (beats/min) of inter-college volleyball player and Control group.

Table 9: VO2 max (ml/kg/min) of inter-college volleyball players and Control groups.

Group	VO2 max (ml/kg/min)
Volleyball players (n=40)	70.28± 4.27*
Controls (n=40)	61.85±6.46

Value shows: Mean ± S.E



*p<0.01

Value shows: Mean ± S.E

Fig 9: VO2 max (ml/kg/min) of inter-college volleyball players and Control groups.

Discussion

Volleyball is an intermittent sport. It requires players to participate in frequent short bouts of high-intensity exercise, followed by periods of low-intensity activity (Kunstlinger *et al.* 1987, Viitasalo *et al.* 1987) [21, 38]. The high intensity bouts of exercise, coupled with the total duration of the match requires players to have well-developed aerobic and anaerobic a lactic (ATP-CP) energy systems (Polglaze and Dawson 1992, Viitasalo *et al.* 1987) [29, 38]. As a result, volleyball players require well-developed speed, fragility, upper-body and lower body muscular power, and maximal aerobic power (VO2 max).

In volleyball, teams compete by manicures handling the ball above the head, height is considered to be the most important physical attribute. In the present study, the mean height of the male players (176.34 cm, ± 3.54) was significantly greater than the control group. It is previously reported by Bandyopadhyay that the height of the West Bengal volleyball players (173.10 cm ± 4.19) in (2007). In the study, significantly greater body weight among volleyball players might be disadvantageous for them in attaining a good jumping height as they have to lift a greater weight.

In case of relationships of handgrip strength, a physical performance indicator, with stature, weight, BMI, it was found that volleyball players attained greater values for those anthropometric variables and also had greater handgrip strength values their control counterparts also reported by the different study (Benefice and Malina 1996, Koley *et al.* 2009, 2010) [2, 18, 19, 35]. The findings of the present study followed the same line showing strong positive correlations with dominant right handgrip strength and all the variables studied.

Body composition greatly affects the energy-related physical strength and skill in various sports (Kitagawa *et al.* 1974). In volleyball players, the estimated % body fat was lower and % LBM was reported to be higher than controls, and followed the findings of Tsunawake *et al.* (1995) [36] and Filaire *et al.* (1998) [11]. These differences between players and controls in the variables studied might be due to regular physical exercise and prolonged training effect. Handgrip strength is found to be a significant determinant of bone mineral content and bone area at the forearm sites and has a positive relation with lean body mass and physical activity. The findings of the present study also showed very strong positive relations between dominant handgrip strength and VO2 max, establishing close association between physical and physiological characteristics in volleyball players. The results followed the findings of Beunen *et al.* (1992) [3].

The limitations of the study were the less sample size and consideration of players only from inter-college level competitions. In future studies, all these limitations would be taken care.

Conclusions

The data presented in the present study carry immense practical application and should be useful in future investigation on player selection, talent identification in volleyball and training program development.

References

1. Bassey EJ, Harries UJ. Normal values for hand grip strength in 920 men and women aged over 65 years and longitudinal changes over 4 years in 620 survivors. *Clin Sci* 1993; 84:331-337.
2. Benefice E, Malina R. Body size, body composition and motor performances of mild-to-moderately

undernourished Senegalese children. *Ann Hum Bio* 1996; 23:307-321.
3. Beunen GP, Malina RM, Renson R, Simons J, Ostyn M, Lefevre J. Physical activity and growth, maturation and performance: a longitudinal study. Medicine and Science in Sports and Exercise 1992; 24:576-585.
4. Bohannon RW. Reference values for extremity muscle strength obtained by handheld dynamometer from adults aged 20 to 79 years. Arch Phys Med Rehab 1997; 78:26-32.
5. Bandyopadhyay A. Anthropometry and body composition in soccer and volleyball players in West Bengal, India. Journal of Physical Anthropology 2007; 26(4):501-505.
6. Chatterjee S, Chowdhuri BJ. Comparison of grip strength and isometric endurance between the right and left hands of men and their relationship with age and other physical parameters. *J Hum Ergo* 1991; 20:41-50.
7. Chilima DM, Ismail SJ. Nutrition and hand grip strength of older adults in rural Malawi. Public Health Nutr Human Biology Review 1 (1) 2012: Koley & Singh 41-50, 2001; 9:11-17.
8. Duncan MJ, Woodfield L, Al-Nakeeb Y. Anthropometric and Physiological characteristics of junior elite volleyball players. British Journal of Sports Medicine 2006; 40:649-651.
9. Durnin JVGA, Womersley J. Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. British Journal of Nutrition 1974; 32:77-97.
10. Ferris DP, Signorile F, Caruso JF. The relationship between physical and physiological variables and volleyball spiking velocity. Journal of Strength and Conditioning Research 1995; 9(1):32-36.
11. Filaire E, Duche P, Lac G. Effects of training for two balls on the saliva response of adrenocortical hormones to exercise in elite sports women. European Journal of Applied Physiology 1998; 77:452-456.
12. Fleck S, Case S, Puhl J, Van-Handle P. Physical and physiological characteristics of elite women volley ball players. Canadian Journal of Applied Sport Science 1985; 10:122-126.
13. Foo LH. Influence of body composition, muscle strength, diet and physical activity on total body and forearm bone mass in Chinese adolescent girls. *Br J Nutr* 2007; 98:1281-1287.
14. Fry AC, Kraemer WJ, Weseman CA, Conroy BP, Gordon SE, Hoffman JR *et al*. The effects of an off-season strength and conditioning program on starters and non-starters in women's intercollegiate volleyball. Journal of Applied Sport Science Research 1991; 5:174-181.
15. Houtkooper BL, Tomthy GL, Scott BG, Wanda HH. Why bioelectric impedance analysis should be used for estimating adiposity. American Journal of Clinical Nutrition 1996; 64:436-448.
16. Jurimae T, Hurbo J, Jurimae J. Relationship of handgrip strength with anthropometric and body composition variables in prepubertal children. *J Copmar Hum Biol* 2009; 60:225-238.
17. Kaur M. Age-related changes in hand grip strength among rural and urban Haryanvi Jat females. *J Copmar Hum Biol* 2009; 60:441-450.
18. Koley S, Singh AP. An association of dominant hand grip strength with some anthropometric variables in Indian collegiate population. *Anthropol Anz* 2009; 67:21-28.
19. Koley S, Yadav MK. An association of hand grip strength with some anthropometric variables in Indian cricket players. *FACTA UNIVERSITATIS, Series: Physical Education and Sports* 2009; 7(2):113-123.
20. Dominant hand grip strength: Koley & Singh Koley S, Kaur N, Sandhu JS. 2009. Association of hand grip strength and some anthropometric traits in female labourers of Jalandhar, Punjab, India. *J Life Sci* 2012; 1:57-62, 41-50.
21. Kunstlinger U, Ludwig HG, Stegemann J. Metabolic changes during volleyball matches. *International Journal of Sports Medicine* 1987; 8:315-322.
22. Lohmann TG, Roche AF, Martorell R. *Anthropometric Standardization Reference Manual.* Champaign, IL: Human Kinetics Books, 1988.
23. Malina RM, Zavaleta AN, Little BB. Body size, fatness, and leanness of Mexican American children in Brownsville, Texas: changes between 1972 and 1983. *Am J Public Health* 1987; 77:573-577.
24. Massey-Westrop N, Rankin W, Ahern M, Krishnan J, Hearn TC. Measuring grip strength in normal adult: reference ranges and a comparison of electronic and hydraulic instruments. *J Hand Surg* 2004; 29A:514-519.
25. Mcardle WD, Katch FL, Pechar GS. Reliability and interrelationship between maximal oxygen intake, physical work capacity and step test scores in college women. Med Sci Sports Exerc 1972; 4:182-186.
26. Nwuga V. Grip strength and grip endurance in physical therapy students. *Arch Phys Med Rehab* 1975; 56:296-299.
27. Onder G, Penninx BW, Lapuerta P, Fried LP, Ostir GV, Guralnik JM *et al.* Changes in physical performance over time in older women: the women's Health and Aging Study. J Geronol a Biol Sci Med Sci 2002; 57:M289-M293.
28. Pieterse S, Manandhar M, Ismail S. The association between nutritional status and hand grip strength in older Rwandan refugees. *Eur J Clin Nutr* 2002; 56:933-939.
29. Polglaze T, Dawson B. The physiological requirements of the positions in state league volleyball. *Sports Coach* 1992; 15:32-37.
30. Rashid R, Ahmed SF. Assessment of bone health and body composition in Glasgow school children. European Congress of Endocrinology. Abstract (No. 11), 2006, 35.
31. Richards L, Olson B, Palmiter-Thomas P. How forearm position affects grip strength. *Am J Occup Therap* 1996; 50:133-139.
32. Ross CH, Rösblad B. Norms for grip strength in children aged 4–16 years. *Acta Paediatrica* Human Biology Review 1 (1) 2012: Koley & Singh 41-50, 2002; 91:617-625.
33. Samson MM, Meeuwsen IB, Crowe A, Dessens JA, Duursma SA, Verhaar HJ. Relationships between physical performance measures, age, height and body weight in healthy adults. *Age and Ageing* 2000; 29:235-242.
34. Sartorio A, Lafortuna CL, Pogliaghi S, Trecate L. The impact of gender, body dimension and body composition on hand-grip strength in healthy children.*J Endocrinol Invest* 2002; 25:431-435.
35. Singh AP, Koley S, Sandhu JS. Association of hand grip strength with some anthropometric traits in collegiate population of Amritsar. *Orient Anthropol* 2009; 9:99-110.
36. Tsunawake N, Tahra Y, Yukawa K, Katsura T, Harada H, Kikuchi Y. Characteristics of body shape of female athletes based on factor analysis. *App Human Sci* 1995; 14:55-61.

37. Tsunawake N, Yasuaki T, Kazuhiko M, Satoshi M, Kengo M, Koichi Y. Body Composition and Physical Fitness of Female Volleyball and Basketball Players of the Japan Inter-high School Championship Teams *J Physiol Anthropol Appl Human Sci* 2003; 22(4):195-201.
38. Viitasalo J, Rusko H, Pajala O, Rahkila P, Ahila M, Montonen H. Endurance requirements in volley ball. Canadian Journal of Applied Sports Sciences 1987; 12:194-201.