ISSN 0973-2020

Journal of Exercise Science and Physiotherapy (JESP)

An official Peer Reviewed Journal of Exercise Fitness & Health Alliance, EFHA
(Published biannually in June & December)

Volume 5, No. 1: 2009

Contents

Editor's Page

Journal of Exercise Science and Physiotherapy
Volume 5, No.1: 2009

An official Publication of
Exercise Fitness and Health Alliance
www.efha-in.org
www.efha.in

Editor-in-Chief: Prof. (Dr.) S.K. Verma
Email: satishsk1@rediffmail.com

Welcome to the new issue of the journal.

First, goal of EFHA in the year of its inception i.e 2005 was to have the journal on a regular publication schedule. I am pleased to inform you that the editorial team of JESP has been successfully executing this job without any problem. Keeping in view the request and pressing demand of the readers to bring out two issues of the journal per year, second, goal was set before EFHA in the year 2007. Although this was a great challenge before the organisation which it accepted with humility and I am pleased to say that it is the fifth consecutive year that the issues of JESP are coming out in time and with great credibility. This one represents the first issue for 2009. Next issue is already full and will be coming out in November or shortly thereafter. With the active support and help from the Editorial Board, this goal has been attained. I invite you to look at JESP regularly, and offer suggestions for articles and features to the journal. I welcome your input and contribution on my email address.

This issue of JESP contains twelve articles on different aspects of exercise science. **Nande et al from Nagpur** studied Micronutrient Status of Male & Female Players Engaged in Different Sports Disciplines and interestingly observed that irrespective of sex & sports, mean intakes of thiamine, riboflavin, folic acid, calcium & phosphorus were found to be less than their respective recommended dietary allowances. **Taylor and Psycharakis from UK** studied muscle activation patterns during the take off and landing phases of single and double revolution jumps in figure skating using EMG. They observed that activation of each muscle varied with the type of jump and the number of revolutions, suggesting that figure skaters might alter the muscles' EMG activity and, thus, the technique of the jump according to the number of revolutions required.

Chaudhary et al from Dehradun report in their study that the left handers are better in performing memory and attention tasks as compared to the right handers. Majority of left handers have auditory learning style while majority of right handers have visual learning styles. Another study by **Dhavalikar et al from Dehradun** reported significant variation in nerve conduction velocity with variation in skin temperature and established the validity of temperature correction formula. **Kulandaivelan et al from Hissar** studied Test-Retest reproducibility of a Hand-Held Lactate Analyzer in Healthy Men. Their results support the use of the hand-held device in healthy human beings. **Sharma et al from Punjab** studied the relationship between Muscle Tendon Ratio, Muscle Morphology and Isokinetic Strength of Anterior Group of Forearm Muscles and concluded that as muscle length is related to the isokinetic strength, isokinetic strength of flexor carpi ulnaris is more than flexor carpi radialis. **Sandhu et al from Punjab** investigated Personality Hardiness of Indian Coaches in Relation to their Age and Coaching Experience. They observed significant differences on commitment and control dimensions and not on challenge and total hardiness on the basis of age level; whereas coaches above the age of 45 years are more committed and have better control. **Kaur & Kalra** in their study on Life Style and Nutritional Profile of Non-Insulin Dependent Diabetes Mellitus (NIDDM) Patients **r**eported that by modifying diet and life style one can maintain fair control over diabetes.

Muktamath et al from Karnataka observed that pain due to acute supraspinatus tendinitis was found to be relieved earlier by the phonophoresis in adducted & internally rotated than phonophoresis in abducted position. **Bharti & Nanda Kumar** compared Two Methods of Moving A Manual Wheelchair Short Distances on Leveled and Inclined Surfaces and concluded that moving the wheelchair on four wheels over the two surfaces is faster, easier, efficient and more comfortable for the back than on rear wheels. **Singh from Punjab** studied Kinanthropometric Measurements in Players of Athletics and Boxing and showed that Boxers in general possess more deposition of subcutaneous fat in the regions of triceps and calf than the athletic group. Lastly **Silawat et al from Gujarat** evaluated the Impact of Age on Physiological Variables, Body Composition and Blood Cholesterol in Selected Physical Education Professionals. The results warn of a significant negative impact of aging on the body composition of these subjects.

S.K. Verma

Micronutrient Status of Male & Female Players Engaged in Different Sports Disciplines

Nande[1], P., Mudafale, V. & Vali[2], S.

[1]Lecturer, Post Graduate Teaching Department of Home Science, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur, Maharashtra. Email: prajaktanande@yahoo.co.in

[2]Professor & Head, Post Graduate Teaching Department of Home-Science, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur, Maharashtra.

Abstract

The present study was undertaken to assess micronutrient status of female & male players engaged in different sports disciplines. For this purpose, university & / state level players aged 19 – 22 years were selected. Total 13 females & 46 males were chosen. 24 hour's dietary recall method was used to collect information on food habits, meal timings & dietary pattern of subjects. Biochemical parameters such as hemoglobin %, blood pressure & pulse rate were examined. The results revealed that irrespective of sex & sports, mean intakes of thiamine, riboflavin, folic acid, calcium & phosphorus were found to be less than their respective recommended dietary allowances (RDAS). In contrast, mean daily intakes of carotene & vitamin c among players were found to be significantly exceeding the rdas ($p<0.01$). Players met only 50 % of their requirements for iron. Poor micro nutrient intake could possibly be attributed to the skipping of meals & training & college schedule of players. Mean hemoglobin % of majority groups of players were found to be exceeding the cut off level given by world health organization (who). Systolic blood pressure & diastolic blood pressure values were recorded to be closer to the normal values. Majority of groups of players showed mean pulse rate insignificantly above the normal value of 70 beats / minute ($p>0.05$).

Key words: Micronutrient Status, Thiamine, Riboflavin, Calcium, Phosphorus, Iron, Carotene, Vitamin C, RDA, WHO

Introduction

Nutrition not only plays a role in performance, but it also helps to prevent injuries, enhance recovery from exercise, help maintain body weight, & improve overall health. It is important for all sports persons to have a good working knowledge, understanding of exercise science & sports nutrition so that these can help in their own performance potential *(Bakulin & Efimo, 1996)*.

The B vitamins are of special interest to athletes and exercisers because they govern the energy producing reactions of metabolism. Need for these vitamins increase proportionally with energy expenditure. To meet growth needs, athletes require higher intakes of some vitamins than those for non athletes. The need for riboflavin is higher because of increased energy intake, but intake is frequently low in teens, especially in girls. Folate and vitamin B_{12} needs are increased because of the high rates of growth. Vitamin B_6 is essential for the protein synthesis that occurs during rapid growth. *(Smolin and Grosvenor, 1997, Houtkooper et al., 1998).*

According to *Manore (2002),* the athletes most likely to have insufficient vitamin intake are those with low calorie intakes or whose diets consist of highly processed convenience foods that are high in fat and /or sugar. Inadequate vitamin consumption will lead to suboptimal health and, ultimately, poor athletic performance. If athletes are limiting food

intake to maintain a lean build or a low body weight, they should supplement their diets with vitamins and minerals. The specific supplements will depend on their total energy intakes, the foods they typically eat, and their sports. If diet is the problem, then the solution should also be from the diet. There are many ways to achieve a balanced intake of vitamins, minerals, and energy substrates.

The needs for calcium, iron, and zinc increase substantially during the adolescent growth spurt. All three of these minerals are frequently deficient in the adolescent athlete's diet. The need for micro minerals should not be ignored *(Boyle, 2000).*

Rowland (2001) points out that calcium and iron are the two minerals that are worth watching in the athlete's diet. Generous intakes of calcium along with physical activity during growth are thought to contribute to maximizing peak bone mass. Achieving optimal bone mineralization may reduce athletes' risk of stress fractures during their athletic careers and help minimize the adverse consequences of bone loss later in life. Poor iron status among female athletes is a consequence of menstrual losses in girls and inadequate dietary intake.

To meet growth needs, athletes require higher intakes of some vitamins & minerals than those for non athletes. The B vitamins are of special interest to athletes and exercisers because they govern the energy producing reactions of metabolism. Need for these vitamins increase proportionally with energy expenditure. It has usually been assumed that if athlete meets requirements for increased energy, the vitamin & mineral requirements will also be satisfied. Vitamins play a very important role in nutrition for sportspersons. Vitamin deficiency leads to specific violation of metabolism and to diseases. Majority of hypovitaminosis causes lowering of work ability. Deficiency leads to lowering of training efficiency, and may cause training staleness. Minerals such as sodium, potassium, calcium, phosphorus & iron play an important role in achieving the winning edge for athletes *(Smolin and Grosvenor, 1997, Boyle, 2000).*

Present study was undertaken to assess the micronutrient & biochemical status of male & female players engaged in different sports disciplines.

Material and Methods

Table 1: Data on Meritorious Achievements of Female & Male Players classified Game-Wise

Sports Disciplines	University Level		State Level		National Level	
	N	%	N	%	N	%
FEMALES [N = 13]						
Half Marathon (n=3)	3	100.00	3	100.00	0	0
Hurdle Racing (n=2)	2	100.00	2	100.00	0	0
Athletics (n=4)	3	75.00	3	75.00	0	0
Badminton (n=4)	2	50.00	2	50.00	0	0
MALES [N = 46]						
Athletics (n=7)	4	57.14	4	57.14	1	14.3
Badminton (n=4)	3	75.00	3	75.00	1	25
Cricket (n=6)	5	83.33	5	83.33	0	0
Judo (n=5)	4	80.00	4	80.00	0	0
Judo & Gymnastics (n=6)	4	66.66	4	66.66	0	0
Volleyball (n=14)	11	78.57	11	78.57	0	0
Weight Lifting (n=4)	2	50.00	2	50.00	0	0

For the present study, both males & female players engaged in regular practice & participated in professional sport tournaments were taken as a sample. The athletes were young players from different sports disciplines such as athletics, volleyball, cricket, judo, gymnastics, weight lifting, hurdle racing,

half marathon, badminton, cross country etc. The subjects aged between 18-22 years were taken from a well known Physical Education Institution of Vidarbha, Maharashtra.. Players who were participating in regular practice schedules & in many sports events from the past few years [players were in the field from last 3 – 7 years] were mainly of choice, data of which is shown in Table 1.

Major areas of the study protocol were as follows: -

- General Information
- Data on Sports
- Dietary Information
- Recording body weight & height of players
- Energy Expenditure (through Daily Activity Schedule)
- Statistical Analysis

A total of 13 females & 46 males from various sports disciplines were chosen & surveyed. Game wise classification of subjects is shown in Table 2.

Table 2: Game-Wise Classification of Subjects

Sr. No.	Sports Disciplines	No. of Subjects	Age (yrs) Mean ± SD
FEMALES [N = 13]			
1	Half Marathon	3	19.89 ± 0.95
2	Hurdle Racing	2	20.13 ± 1.62
3	Athletics	4	19.27 ± 1.00
4	Badminton	4	20.45 ± 1.00
MALES [N = 46]			
1	Athletics	7	20.52 ±1.30
2	Badminton	4	21.87 ±0.50
3	Cricket	6	20.98 ±1.40
4	Judo	5	21.02 ±1.70
5	Judo / Gymnastics	6	21.00 ±1.20
6	Volleyball	14	20.39 ±1.50
7	Weight Lifting	4	21.08 ±0.50

For collecting information, an interview schedule was designed to elicit information from all players on their socioeconomic background, sport profile (information regarding time & duration of subject's engagement in the chosen sport/s, their daily routine, hours of practicing a game, their meritorious achievements etc.), dietary profile, anthropometric measurements such as body weight & height & energy expenditure pattern.

Players were nutritionally assessed as follows -

Precise information on food consumption pattern of subjects was gathered through three day dietary recall method. The intake of macro nutrients viz., carbohydrate, protein & fat was computed using the values given in the Nutritive Value of the Indian Foods *(Gopalan et. al., 2004).* Energy intake was computed for all players. Means were derived & nutrient intakes were compared with their respective RDAs *(Satyanarayana, 1991).*

Biochemical Data:

Under this section, hemoglobin level was estimated. Pulse rate & blood pressure were recorded. For this purpose, subjects were asked to come in decided time schedule to the pathology laboratory. The hemoglobin level was estimated by a trained pathologist using Sahli's Haemometer. Sphygmomanometer was used to measure the blood pressure of subjects. Pulse rate, which is simply the number of times the heart contracts each minutes was measured accordingly. Three readings were taken, of which average was considered a standard.

Data was collected, tabulated & grouped. Means & standard deviation values were calculated. Minimum, maximum, range values & percentages

were taken out. Comparisons were made with the available standards. Student's't' test was applied to see the differences. The difference was tested at both 1% (0.01) & 5% (0.05) levels of significance.

Results and Discussion

FIGURE 1 . DATA ON APPROXIMATE MONTHLY MEAN TOTAL INCOME & RANGE FOR FEMALE PLAYERS

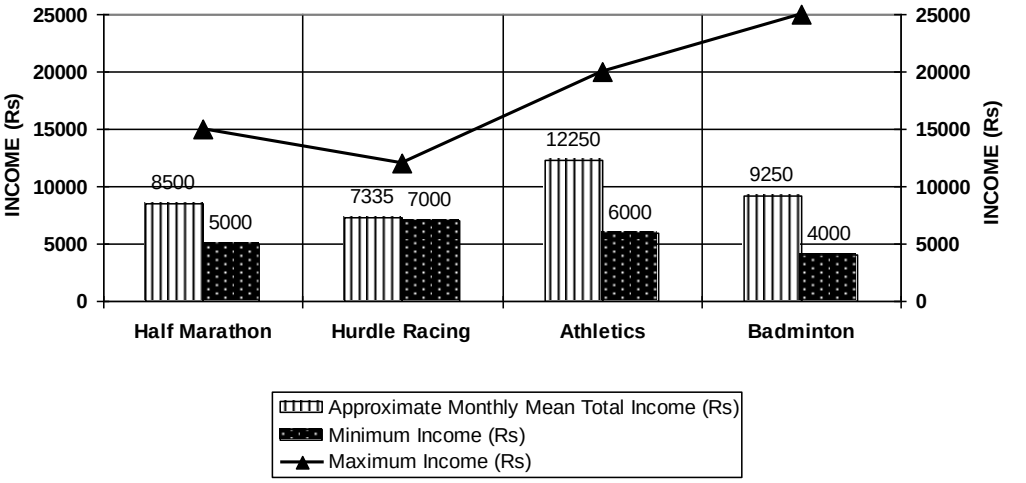
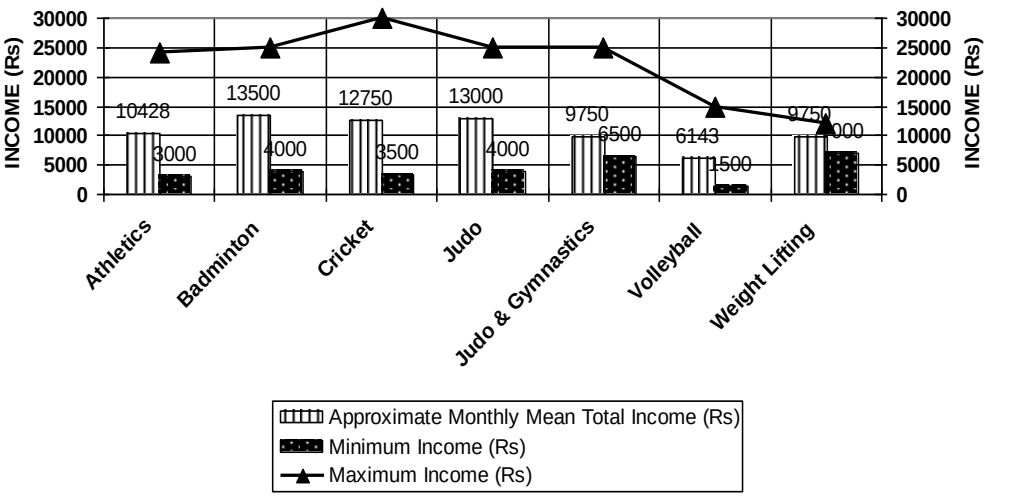


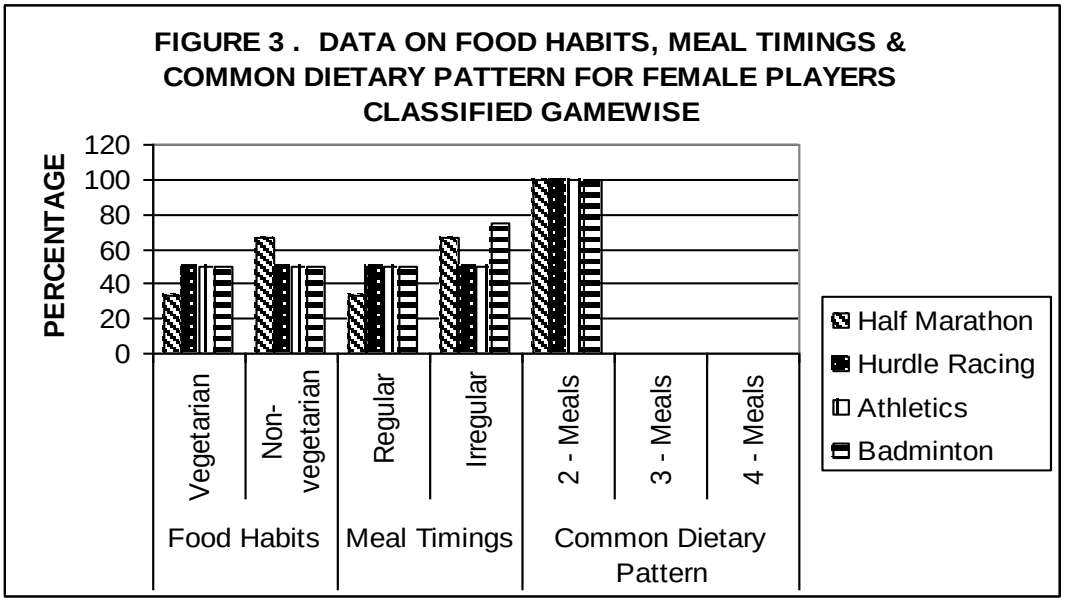
FIGURE 2 . DATA ON APPROXIMATE MONTHLY MEAN TOTAL INCOME & RANGE FOR MALE PLAYERS

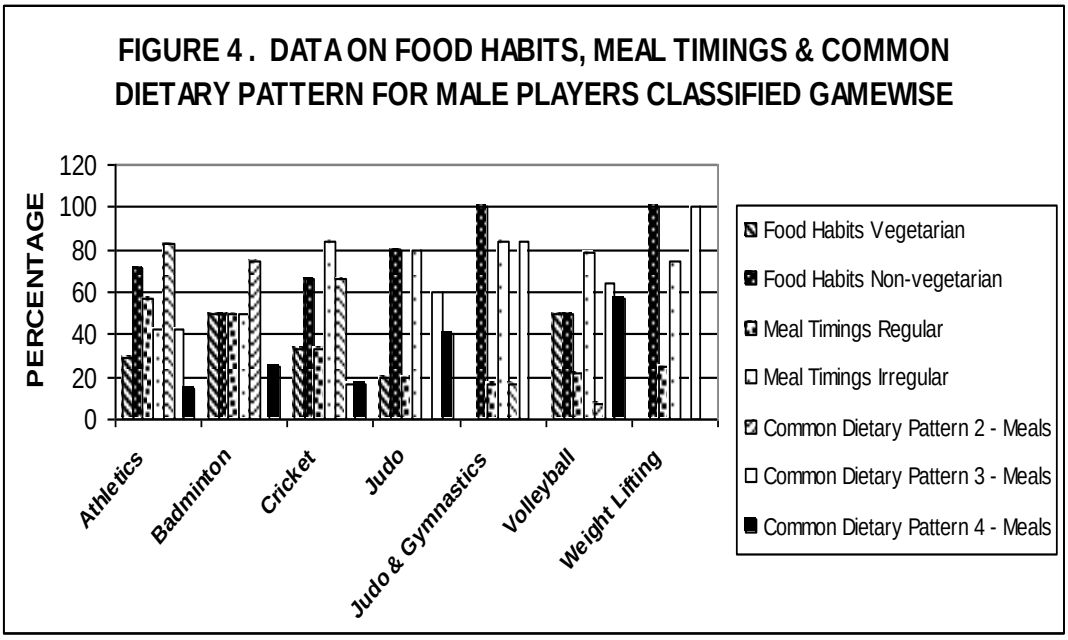


Figures 1 & 2 present data on approximately mean monthly family income for female & male players' classified game wise. Variability in range values can be seen for monthly family income for players. For females a minimum of Rs.4000 /- & a maximum of Rs. 25000 /- monthly income was found out. For male players, minimum monthly

income was recorded as Rs. 1500 /- & that of maximum as Rs. 30000 /-.

Food Intake:





Figures 3 & 4 show data on food habits, meal timings & common dietary pattern for subjects. Among female players, majority of players were found to be vegetarian, % of non vegetarian was more for half marathon group. The intake of meat, chicken & egg was found to be occasional – either fortnightly or monthly.

Majority of female players were consuming meals irregularly, all of them were found to be following a dietary pattern of two meals.

In contrast, majority of male players were found to be non vegetarians, with three & / four meals dietary pattern. They were accustomed to skipping meals. This could be attributed to the college timings & practice schedules. It is speculated that because of training & work schedules, athletes seldom eat three balanced meals, but they rely heavily on snacking to maintain their energy levels, & these snacks may be less nutrient dense than the meals they replace. The poor nutritional status of some athletes may be due to their training & work schedules. Some athletes have low energy intakes because of concerns about body weight & appearance, which makes the likelihood of them having inadequate intakes of vitamins & minerals even greater ***(Bishop, 1989)***.

Micro Nutrient Intake:

Nutrient intake of elite athletes is a critical determinant of their performance & ability to compete *(Kelkar et al. 2006).* Tables 3 & 5 show mean daily intakes of vitamins for female & male players respectively. Tables 5 & 6 show mean daily intakes of minerals for female & male players respectively.

Table 3. Mean Daily Intake of Vitamins for Female Players Classified Game-Wise

Sports Disciplines	Thiamine (mg)		Riboflavin (mg)		Folic Acid (µg)		Carotene (µg)		Vitamin C (mg)	
	M ± SD	RDA	M ± SD	RDA	M ± SD	RDA	M ± SD	RDA	M ± SD	RDA
Half Marathon (n=3)	1.3±0.2 (0.9–1.5)	3.18	1.2 ± 0.3 (0.9 – 1.5)	3.18	196.8 ± 53.4 (129.5 – 260.2)	300	6859.0 ± 523.4 (6216 - 7498)	3262	164.0 ± 27.09 (126.0 – 187.5)	102
Hurdle Racing (n=2)	1.9 ± 0.03 (0.6 – 12.2)	3.68	0.9 ± 0.1 (0.8 – 1.0)	3.68	242.8 ± 4.2 (238.7 – 246.9)	300	6114.0 ± 504 (5610 - 6618)	3385	166.4 ± 48.04 (118.4 – 214.5)	106
Athletics (n=4)	1.8 ± 0.2 (0.4 – 8.7)	2.08	0.9 ± 0.08 (0.8 – 1.0)	2.08	214.0 ± 56.5 (128.4 – 284.7)	300	5462.5 ±710.1 (4432 - 5482)	2545	144.7 ± 24.9 (103.6 – 168.5)	80
Badminton (n=4)	2.0 ± 0.4 (0.4 – 10.8)	3.03	1.4 ± 0.5 (1.0 – 1.9)	3.03	218.0 ± 34.5 (146.5 – 260.5)	300	5590.3 ± 934.9 (4224 - 6865)	3059	129.6 ± 24.0 (103.7 – 168.5)	95

RDA's referred from **Satyanarayana (1991),** Figures in parenthesis indicate range.

Table 4: Average daily excess/deficit intake of vitamins in females classified gamewise

Sports Disciplines	Thiamine (mg)	Riboflavin (mg)	Folic Acid (µg)	Carotene (µg)	Vitamin C (mg)
	% Excess or Deficit	% Excess or Deficit	% Excess or Deficit	% Excess or Deficit	% Excess or Deficit
Half Marathon (n=3)	-37.74	-59.11	-34.4	110.26	60.78
Hurdle Racing (n=2)	-75.54	-48.36	-19.06	80.62	56.98
Athletics (n=4)	-56.74	-13.46	-28.66	114.63	80.87
Badminton (n=4)	-53.79	-33.99	-27.33	82.74	36.42

Vitamin Intake:

Table 3 depicts mean daily intake of vitamins for female players. Irrespective of sports disciplines, mean intakes of thiamine, riboflavin & folic acid among females were found to be less than their respective recommended dietary allowances (RDAs). When student's't' test was applied to draw the significance of difference, it was found that the differences were significant at

0.01 level for folic acid (t=11.19, p<0.01); insignificant for thiamine (t=1.55, p>0.05) & significant at 0.05 but insignificant at 0.01 level for riboflavin (t=3.26, 0.01<p<0.05). Percent deficit was found to be highest for thiamine in half marathon (-59.11%), for riboflavin in hurdle racing (- 75.54 %) & for folic acid in athletics (- 28.66 %).

Table 5:. Mean Daily Intake of Vitamins for Male Players Classified Game-Wise

Sports Disciplines	Thiamine (mg)		Riboflavin (mg)		Folic Acid (µg)		Carotene (µg)		Vitamin C (mg)	
	M ± SD	RDA	M ± SD	RDA	M ± SD	RDA	M ± SD	RDA	M ± SD	RDA
Athletics (n=7)	2.6 ± 0.5 (2.02 – 3.2)	3.87	2.3 ± 0.9 (0.9 – 3.7)	3.87	226.5 ± 66.4 (125.0 – 346.3)	300	6751.6 ± 1087.9 (5426 - 8421)	3403	195.5 ± 44.3 (143.5 – 262.3)	106
Badminton (n=4)	2.5 ± 0.3 (2.09 – 2.8)	3.87	1.7 ± 0.6 (1.0 – 2.7)	3.87	258.4 ± 63.6 (187.9 – 354.7)	300	6613.5 ± 1064.8 (5578 - 8362)	3403	183.2 ± 55.4 (123.4 – 273.6)	106
Cricket (n=6)	2.2 ± 0.1 (2.0 – 2.3)	-	2.4 ± 0.4 (1.9 – 2.7)	-	228.2 ± 57.9 (152.6 – 314.3)	-	7154.2 ± 1387.6 (4782 - 8436)	-	180.6 ± 39.2 (137.5 – 255.0)	-
Judo (n=5)	2.2 ± 0.2 (2.03 – 2.4)	3.16	1.5 ± 0.7 (0.9 – 2.6)	3.16	223.6 ± 36.3 (158.4 – 269.5)	300	6719.4 ± 1370.7 (4782 - 8761)	3237	166.7 ± 20.9 (137.5 – 196.8)	101
Judo & Gymnastics (n=6)	2.4 ± 0.4 (1.9 – 2.9)	3.68	2.0 ± 4.0 (1.8 – 2.5)	3.68	253.9 ± 44.6 (194.8 – 325.4)	300	6530.9 ± 826.4 (5426 - 7384)	3237	204.6 ± 53.7 (148.4 – 293.0)	101
Volleyball (n=14)	2.06 ± 0.3 (1.9 – 2.7)	4.06	1.8 ± 0.6 (1.0 – 2.6)	4.06	201.9 ± 58.5 (125.5 – 345.7)	300	6885.5 ± 1246.8 (4782 - 8761)	3570	164.9 ± 38.3 (123.4 – 264.5)	112
Weight Lifting (n=4)	2.5 ± 0.3 (2.2 – 2.8)	4.06	2.6 ± 0.2 (2.5 – 2.8)	4.06	222.7 ± 35.5 (163.8 – 253.2)	300	7088.0 ± 886.9 (5832 - 8261)	3570	186.05 ± 4.6 (127.7 – 275.7)	112

Table 6. Mean Daily Intake (excess or deficit) of Vitamins for Male Players Classified Game-Wise

Sports Disciplines	Thiamine (mg)	Riboflavin (mg)	Folic Acid (µg)	Carotene (µg)	Vitamin C (mg)
	% Excess or Deficit	% Excess or Deficit	% Excess or Deficit	% Excess or Deficit	% Excess or Deficit
Athletics (n=7)	-32.81	-40.56	-24.4	98.41	84.44
Badminton (n=4)	-35.4	-56.07	-13.86	94.35	72.84
Judo (n=5)	-30.37	-52.53	-25.46	107.59	65.05
Judo & Gymnastics (n=6)	-34.78	-45.65	-15.36	101.76	102.57
Volleyball (n=14)	-49.26	-55.66	-32.7	92.88	47.24
Weight Lifting (n=4)	-38.42	-35.96	-25.76	98.55	66.12

Similar results were obtained for male players engaged in different sports disciplines (Table 5). Intakes of folic acid were found to be significantly less than the respective RDAs (t = 14.43, p<0.01). Insignificant differences were noticed between intakes & RDAs for thiamine & riboflavin (t = 0.57 & 0.48 respectively, p>0.05). Male athletics players showed highest mean intake of thiamine (2.6 ± 0.5 mg), that of weight lifters for riboflavin (2.6 ± 0.2 mg) & that of badminton group for folic acid (258.4 ± 63.6 µg). Percent deficit was found to be highest in volleyballers for thiamine & folic acid (-49.26 & - 32.7 % respectively) & in

badminton players for riboflavin (- 56.07 %). *Manore (2000)* studied the effect of physical activity on thiamine, riboflavin & vitamin B-6 requirements. Because exercise stresses metabolic pathways that depend on thiamine, riboflavin, & vitamin B-6 the requirements for these vitamins may be increased in athletes & active individuals. Active individuals who restrict their energy intake or make poor dietary choices are at greatest risk for poor thiamine, riboflavin, & vitamin B_6 status.

The antioxidant vitamins – such as vitamin A, C & beta-carotene– play an important role in protecting the cell membrane from oxidative damage. Exercise can increase the oxidative processes in the muscle, leading to increased generation of lipid peroxides & free radicals *(Keith, 1994)*. In the present study, irrespective of sex & sport, mean daily intakes of carotene & vitamin C were found to be highly exceeding their respective RDAs. Differences were highly significant at 0.01 level for both these vitamins ($t = 8.19$ & 6.89 for carotene & vitamin C respectively, $p<0.01$). Intakes were found to be almost double the requirements which could be attributed to inclusion of higher amount of seasonal fruits & vegetables rich in carotene & vitamin C. Among female players, mean intakes of carotene & vitamin C were recorded to be highest in half marathon & hurdle racing respectively (6859 ± 523.4 µg & 166.4 ± 48.04 mg respectively). Among male players, cricket & weight lifting groups showed extremely high intakes of carotene (7154.2 & 7088 µg respectively). Differences were found to be highly significant at 0.01 level ($t = 5.26$, $p<0.01$). Judo & gymnastics group showed 102 % excess mean intake of vitamin C (204.6 mg) followed by athletics with 84.44 % excess intake of vitamin C (195.5 mg). It is evident from Tables 3 & 5 that for all groups of female & male players, minimum values of carotene & vitamin C intakes were also exceeding the RDAs. The effect of vitamin C supplementation on performance has received considerable attention, mainly because athletes consume Vitamin C in large quantities, often because of the volume of food they consume. In studies where athletes were deficient in vitamin C, supplementation improved physical performance, but a thorough analysis of these studies supports the general conclusion that vitamin supplementation does not increase physical performance capacity in subjects with normal body levels of vitamin C *(Keith, 1994)*. On the other hand, because exercise is a stressor to the body, some nutritionists recommended that the active individual may need slightly more vitamin C than the RDA.

Mineral Intake:

Tables 7 & 9 demonstrate mean daily intakes of minerals for female & male players respectively. Mean iron intakes for both female & male players engaged in different sports disciplines were found to be significantly less than their respective standards ($t = 7.44$, $p<0.01$ for females & $t = 4.4$, $0.01<p<0.05$ for males). Players met nearly 50 % of their requirements for iron. Among female players, mean iron intake was found to range between 25.4 to 32.8 mg (the minimum value is for athletics & the maximum value is for hurdle racing). Among male players, highest mean intake of iron was recorded by judo & gymnastics (37.04 mg) & that of lowest both by athletics & volleyball groups (28.8 mg). A combination of factors

increases athlete's chances of depleting his or her iron stores. Inadequate dietary intakes of iron-rich foods combined with iron losses aggravated by physical activity compromise iron status. Physical activity may cause increased iron losses in sweat, feces and urine, plus increased destruction of red blood cells that occurs during exercise *(Boyle, 2000)*. Typical endurance athlete's diet contains about 6 mg iron per 1,000 calories. And recent studies of iron deficient female athletes reported iron intakes of only 13.6 mg / day. *(Clement & Asmundson, 1982)*.

Table 7: Mean Daily Intake of Minerals for Female Players Classified Game-Wise

Sports Disciplines	Iron (mg)		Calcium (mg)		Phosphorous (mg)		Potassium (mg)	Sodium
	M ± SD	RDA	M ± SD	RDA	M ± SD	RDA	M ± SD	M ± SD
Half Marathon (n=3)	27.07 ± 2.05 (24.2 - 28.6)	61	1004 ± 191.2 (832.4 – 1270.7)	2038	1783.9 ± 164.8 (1580.6 – 1984.4)	2038	2633 ± 85.0 (2529.0 – 2738.0)	2027.7 ± 58.4 (1985.5 – 2110.2)
Hurdle Racing (n=2)	32.3 ± 6.7 (26.2 - 38.5)	63	749 ±61.6 (687.4 – 810.6)	2115	1873 ± 35.0 (1838.0 – 1908.0)	2115	2687.5 ± 138.5 (2549.0 – 2826.0)	1777.3 ± 95.0 (1682.2 – 1872.6)
Athletics (n=4)	25.4± 0.1 (24.4 - 26.5)	48	854.5 ± 279.9 (608.8 – 130.8)	1590	1852.5 ± 231.6 (1510.7 – 2164.0)	1590	2643 ± 117.7 2548.0 – 2842.0()	1945.6 ± 138.3 (1775.2 – 2154.3)

Table 8: Mean Daily Intake (excess or deficit) of Vitamins for female Players Classified Game-Wise

Sports Disciplines	Iron (mg)	Calcium (mg)	Phosphorous (mg)
	% Excess or Deficit	% Excess or Deficit	% Excess or Deficit
Half Marathon (n=3)	-55.62	-50.73	-33.72
Hurdle Racing (n=2)	-48.73	-64.58	-44.53
Athletics (n=4)	-47.08	-46.25	-38.51
Badminton (n=4)	-42.45	-52.89	-37.24

Intakes of both calcium & phosphorus in female & male players were observed to be less than their respective RDAs ($t = 4.4$, $0.01<p<0.05$ & $t = 7.63$, $p<0.01$ for females; $t = 3.05$, $p>0.05$ & $t = 2.25$, $p>0.05$, respectively). Players were able to meet only 50 % of their requirements of calcium. % deficit was found to range between – 46.25 to – 64.58 % for females & - 35.47 to – 63.78 % for males. Highest mean calcium intake was recorded for half marathon among females (1004 ± 192.2 mg) & judo among males (1305.4 ± 333.5 mg) whereas the lowest mean intake of calcium was recorded for hurdle racing among females (749 ± 61.6 mg) & badminton among males (804 ± 107.2 mg).

Mean phosphorus intake among female players ranged between 1749.8 to 1873 mg while that in male players it was found to range between 1761.8 to 1849 mg.

Calcium/phosphorus ratio was derived & a range of 0.4 to 0.6 among females & 0.44 to 0.74 among males was noticed.

Mean daily total sodium & potassium intakes among females & males were found to be in the range of 2633 to 2687.5 mg & 1777.3 to 2166.1 mg and 2543.5 to 2713 mg & 1921 to 2166.5 mg respectively **(Table 7 & 9).** Total sodium indicates sodium from food stuffs & sodium from salt.

Table 9: Mean Daily Intake of Minerals for Male Players Classified Game-Wise

Sports Disciplines	Thiamine (mg)		Riboflavin (mg)		Folic Acid (µg)		Carotene (µg)	Vitamin C (mg)
	M ± SD	RDA	M ± SD	RDA	M ± SD	RDA	M ± SD	M ± SD
Athletics (n=7)	28.8 ± 4.0 (22.0 – 35.8)	64	869.3 ± 193.05 (654.0 – 1236.0)	2127	1820 ± 213.3 (1583.0 – 2183.0)	2127	2574.7 ± 98.8 (2442.0 – 2738.0)	1921± 195.9 (1682.0 – 2262.0)
Badminton (n=4)	32.2 ± 5.0 (27.3 – 40.4)	64	804 ± 107.2 (688.0 – 979.0)	2127	1849 ± 139.6 1552.0 – 2076.0()	2127	2713 ± 106.1 (2623.0 – 2884.0)	1945.2 ± 253.8 (1722.0 – 2383.0)
Cricket (n=6)	34.8 ± 5.0 (28.8 – 42.9)	-	962 ± 181.3 (674.0 – 1272.0)	-	1818 ± 190.1 (1572.0 – 2152.0)	-	2711.1± 221.8 (2471.0 – 2832.0)	1967 ± 155.0 (1710.0 – 2189.0)
Judo (n=5)	33.5 ± 4.7 (29.5 – 42.3)	61	1305.4 ± 333.5 (865.0 – 1823.0)	2023	1766.8 ± 108.3 (1664.0 – 1923.0)	2023	2631.6 ± 129.9 (2442.0 – 2819.0)	2118.6 ±174.1 (1889.0 – 2361.0)
Judo & Gymnastics (n=6)	37.04 ± 4.7 (30.3 – 42.6)	61	892.7 ± 359.3 (539.0 – 1542.0)	2023	1761.8 ± 193.1 (1514.0 – 1987.0)	2023	2602.8 ± 91.05 (2515.0 – 2786.0)	1970.5 ± 161.5 (1737.0 – 2213.0)
Volleyball (n=14)	28.8 ± 3.0 (24.4 – 32.7)	67	808.0 ± 140.9 (557.0 – 1323.0)	2231	1834.7 ± 211.6 (1531.0 – 2183.0)	2231	2672.2 ± 124.4 (2486.0 – 2892.0)	2014.9 ± 209.2 (1711.0 – 2345.0)
Weight Lifting (n=4)	33.8 ± 4.6 (29.9 – 41.3)	67	961±152.7 (729.0 – 1138.0)	2231	1816.5 ± 136.3 (1663.0 – 2031.0)	2231	2543.5 ± 103.1 (2392.0 – 2683.0)	2166.5 ± 156.3 (2392.0 – 2683.0)

Table 10: Mean Daily Intake of Minerals (excess or deficit) for Male Players Classified Game-Wise

Sports Disciplines	Iron (mg)	Calcium (mg)	Phosphorous (mg)
	% Excess or Deficit	% Excess or Deficit	% Excess or Deficit
Athletics (n=7)	-55.00	-59.13	-33.23
Badminton (n=4)	-49.69	-62.2	-40.07
Judo (n=5)	-45.08	-35.47	-30.45
Judo & Gymnastics (n=6)	-39.27	-55.87	-36.8
Volleyball (n=14)	-57.01	-63.78	-44.33
Weight Lifting (n=4)	-49.55	-56.92	-39.86

To know consumption of electrolytes especially sodium & potassium & vitamin C through any sport drink, information on quantity & type of fluids consumed by players was gathered. It was noticed that players were relying mainly on plain water to fulfill their thirst.

Table 11 depicts approximate mean daily intake of water by players. Female players drank approximately 6.3 ± 1.09 to 8.7 ± 0.5 glasses of water daily whereas male players drank approximately 9.4 ± 1.6 to 12.7 ± 1.8 glasses of water daily.

Water is the nutrient most critical to athletic performance. Without adequate water, performance can suffer in less than an hour. Water is necessary for the body's cooling system. It also transports nutrients throughout the tissues and maintains adequate blood volume.

During exercise there is always the risk of becoming dehydrated (fluid volume deficit), especially when the temperature is hot. When athletes sweat, they lose water *(Williams, 1990; Grodner et al., 1996).*

Table 11: Mean Approximate Daily Intake of Water by Female & Male Players Classified Game-Wise

Sr. No.	Sports Disciplines	Approximate Intake Of Water (glasses)	
		Mean	Range
	FEMALES [N = 13]		
1	Half Marathon (n=3)	8.7 ± 0.5	8.0-9.0
2	Hurdle Racing (n=2)	7.6 ± 0.6	7.0-8.0
3	Athletics (n=4)	8.6 ± 0.9	8.0-10.0
4	Badminton (n=4)	6.3 ± 1.09	5.0-8.0
	MALES [N = 46]		
1	Athletics (n=7)	11.5 ± 1.7	10 -15
2	Badminton (n=4)	10.0 ± 2.0	8.0-12
3	Cricket (n=6)	12.7 ± 1.8	10 -15
4	Judo (n=5)	9.7 ± 1.9	8.0-13
5	Judo & Gymnastics (n=6)	9.4 ± 1.6	7.0-12
6	Volleyball (n=14)	10.8 ± 3.3	8.0-15
7	Weight Lifting (n=4)	11.0 ± 1.3	9.0-12

Table 12: Mean of Hemoglobin, Blood Pressure & Pulse Rate Values for Male & Female Players Classified Game Wise

Sports Disciplines	Hemoglobin % (g / dl)			Blood Pressure (mm / Hg)						Pulse Rate (beats / minutes)		
				Systolic Blood Pressure			Diastolic Blood Pressure					
	Mean	Range	* C.O.L	Mean	** Std	Range	Mean	** Std	Range	Mean	** Std	Range
	FEMALES [N = 13]											
Half Marathon (n=3)	12.5 ± 0	12.5-12.5	12	120 ± 0	120	120-120	80 ± 0	80	80-80	73 ± 3.8	70	69-78
Hurdle Racing (n=2)	12 ± 0.5	11.5-12.5	12	117 ± 4.3	120	114-120	81 ± 1.5	80	80-82	73 ± 3.0	70	70-76
Athletics (n=4)	12.1 ± 1.9	9-13.8	12	115 ± 5.3	120	110-120	75 ± 6	80	68-80	71 ± 7.3	70	62-82
Badminton (n=4)	11.1 ± 1.8	9-13	12	116 ± 4.9	120	110-120	82 ± 5.5	80	78-90	76 ± 2.5	70	74-80
	MALES [N = 46]											
Athletics (n=7)	13.4 ± 2.4	11.5-13.8	12	116.3 ± 4.7	120	110-120	78.9 ± 4	80	72-82	71 ± 4.9	70	68-82
Badminton (n=4)	11.2 ± 1.4	9-12.5	12	116.5 ± 4.2	120	112-120	74 ± 7	80	68-80	69 ± 2.4	70	67-73
Cricket (n=6)	12 ± 1.4	9-13	12	119.4 ± 1.7	120	116-120	80 ± 0	80	80-80	72 ± 5.03	70	65-78
Judo (n=5)	12.5 ± 1.5	10-13.5	12	122 ± 1.6	120	120-124	80 ± 0	80	80-80	76 ± 4.6	70	68-82
Judo & Gymnastics (n=6)	11.8 ± 1.8	8.5-13.5	12	119.7 ± 0.9	120	118-120	80 ± 0.9	80	78-80	68 ± 5.5	70	69-75
Volleyball (n=14)	11.6 ± 1.5	9-13.5	12	120 ± 5.9	120	110-126	79 ± 3.9	80	68-80	74 ± 4.99	70	65-84
Weight Lifting (n=4)	12.5 ± 1.6	10-14	12	117.5 ± 5	120	110-120	78 ± 4	80	72-80	73 ± 2.2	70	70-76

Std – Standard, * C.O.L – Cut Of Level by world health organization (WHO) (referred from **Bamji et al., 2005)**
** - Referred from **"Nutrition"** - Quarterly Publication (NIN, 2000). Vol. 34(4):15

Biochemical Status: Information on biochemical data of players is presented in Table 12.

Among female players, highest value of mean hemoglobin was recorded for half marathon group (12.5 g / dl) & that of lowest for badminton group (11.1 g / dl). Among males, athletics group showed highest mean hemoglobin % (13.4 g / dl) & badminton group showed lowest mean hemoglobin % (11.2 g / dl). Mean hemoglobin levels of majority groups were found to be exceeding the cut off level given by world health organization *(Bamji et al, 2005)*. However, the differences were found to be insignificant ($t = 1.01$ for females & $t = 0.06$ for males, $p>0.05$). Among groups of players such as female athletics & badminton & male badminton, cricket, judo & judo & gymnastics & weight lifting, minimum hemoglobin values show prevalence of anemia (values were found to be less than 10 g / dl). A reduced hemoglobin level in an athlete's blood means reduced oxygen carrying capacity, with obvious implications for aerobic capacity & ability to sustain an exercise workload. Another factor in athlete's low – normal hemoglobin levels may be hemodilution. Strenuous training leads to an increase in plasma volume & absolute quantity of hemoglobin, the increases may not be proportional plasma volume increases more than does the hemoglobin level. Hemodilution with increased iron loss & increased red blood cell turnover may account for the prevalence of low – normal values among athletes. Obviously this situation is complicated if the diet is inadequate in bioavailable iron, as is sometimes found *(Williams, 1990)*.

Blood pressure values reflect a mean of systolic blood pressure (SBP) ranging between 115 to 120 mm/Hg for females & 116.3 to 122 mm / Hg for males. Mean diastolic blood pressure (DBP) values were found to range between 75 to 82 mm / Hg for females & 74 to 80 mm / Hg for males. These values were found to be closer to the normal values of SBP (120 mm / Hg) & DBP (80 mm / Hg) ($t = 1.48$ & 1.07 for females & males respectively, $p>0.05$).

Highest value of pulse rate among female players was recorded for badminton (76 ± 2.5 beats / minute) & that among male players for judo (76 ± 4.6 beats / minute). With the exception of male players involved in badminton and judo & gymnastics, rest of the groups of players showed mean pulse rate insignificantly above the normal value of 70 beats / minute ($t = 1.48$ & 1.07 for females & males respectively, $p>0.05$). The mean heart rate & blood pressure of the selected athletes studied by *Chandrashekhar et al., (1988)* was found to be less than the normal values of 72 beats / min & 120 / 80 mmHg respectively.

Summary & Conclusion

Present study revealed that female & male players were accustomed to skipping meals which lead to inadequate intakes of vital micronutrients such as iron, calcium, phosphorus, thiamine & riboflavin. Varied dietary practices & consumption of imbalanced diets or failure to consume right diets hampered the micro nutrient status of players. Hemoglobin % in some players indicates a need for scientifically planned balanced diets by expert nutritionists.

The idea that specific nutrients might enhance athletic performance and confer athletic prowess is not new. For competitive athletes, the diet must therefore provide the optimal mixture of macro & micro nutrients to fuel their special needs & enhance performance.

References

Bakulin, V. Efimo, V. 1996. *Nutrition for Sports*. Sports Authority of India, XLV II, pp: 1- 4.

Bamji, Mahtab. S. Rao, N. P. Reddy, Vinodini. 2005. *Textbook of Human Nutrition*. 2nd edition, Oxford & IBH publishing Company Privet Ltd. (New Delhi), pp: 148-152, 264.

Bishop, N. C. 1989. Nutritional Aspects of Immuno-suppression In Athletes. *Sports Medicine*, **28(3):**151.

Boyel, M. 2000. *Personal Nutrition.* 4th edition, Wadswarth Publication, pp: 286,300-302.

Chandrashekhar, Usha. Bhargava, Geeta. 1988, Nutritional Status of Athletes & the Impact of Dietary Modification on Their Athletic Performance. *Indian Journal of Nutrition & Dietetics*, **25:** 176 – 184.

Clement, D. B. Asmundson, R. C. 1982. Nutritional Intake & Hematological Parameters in Endurance Runners. *Physician Sports Medicine*, **10:** 37-43.

Gopalan C, Ramasastri, B. V. & Balsubramanian, S. C. 2004. *Nutritive Value of Indian Foods*. NIN Publication, ICMR, Hyderabad, pg. 3, 47-80.

Grodner, Michel. Anderson, Sara, Long. Deyoung, Sandra. 1996. *Foundation & Clinical Application of Nutrition.* Mosby Publication, pp: 228-233.

Houtkooper, L. B., Mullins, V.A., Taylox. A., Poole, C. 1998. Nutritional Status of U.S. Elite Heptathletes. http://nutrition.arizona.edu/new/files/99heptrpt.pdf.

Keith, R. E. 1994. Vitamins & Physical Activity. In: *Nutrition in Exercise & Sport*. Ed: Wolinsky, I. and Hickson, J. F. Boca Raton CRC Press, Mahan, L. K. Escott – Stumps. Krause's Food, Nutrition & Diet Therapy. 11th edition, W.B. Saunders Company, 2004, pp: 617-637.

Kelkar, Geetanjali, K., Subhadra. Rana, K.C. 2006. Nutrition Knowledge, Attitude & Practices of Competitive Indian Sportsmen. *The Indian Journal of Nutrition & Dietetics*, **43:** 294-303.

Manore, Melinda. M. 2000. Effect of Physical Activity on Thiamine, Riboflavin & Vitamin B_6 requirements. *The American Journal of Clinical Nutrition*, **72(2):** 598 – 606.

Manore, Melinda. M. 2002. Dietary Recommendations & Athletic Menstrual Dysfunction. *Sports Medicine*, **32(14):** 887 – 901.

Nutrition - Quarterly Publication (NIN, 2000). 34(4):15.

Rowland, Tom. 2001. Youth in Sport: Nutritional Needs. c.f: Esmarck and Coworkers - Frontera & Welle et al., 8(4) In Sports Science Exchange, 2002, 79(13): 4.

Satyanarayana, Kakarla. (1991), "Sports Nutrition: Put Back the Pep", Nutrition (April), NIN / ICMR, Hyderabad, pp: 5 & 8.

Smolin. Grosvenor. (1997). Nutrition - Science & Application.2nd edition, Saunders College Publication, pp: 375-377.

Williams, S. R. 1990. *Essentials of Nutrition & Diet Therapy*. 6th edition, Mosby publication, pp: 275, 338, 309-311.

A Pilot Study on Electromyographic Analysis of Single and Double Revolution Jumps in Figure Skating

Taylor[1], C. L. and Psycharakis[2], S. G.
[1]Research student, Faculty of Sport and Education, Leeds Metropolitan University (UK).
E-mail: *c.taylor5995@student.leedsmet.ac.uk*
[2]School of Life Sciences, Napier University, 10 Colinton Road, Edinburgh, EH10 5DT, UK.
E-mail: *S.Psycharkis@napier.ac.uk*

Abstract

The purpose of this study was to examine the muscle activation patterns during the take off and landing phases of single and double revolution jumps in figure skating. One professional male figure skater performed the following jumps: a single and double toe-loop and; a single and double flip. Using electromyography (EMG) the integrated rectified value (iEMG) was calculated for the following muscles of the take off and landing legs: gastrocnemius medialis, rectus femoris, biceps femoris and adductors. For the take off phase all values were clearly higher in the double revolution jumps for all muscles, while a similar pattern in the landing phase was observed for the adductors only. The activation of each muscle varied with the type of jump and the number of revolutions, suggesting that figure skaters might alter the muscles' EMG activity and, thus, the technique of the jump according to the number of revolutions required.

Keywords: EMG, muscle activation, rotations, skater

Introduction

Figure skating is one of the most complex and intense sports, with the vast amounts of movements made on the ice including among others spins, lifts and more importantly, jumps. Nowadays, competitive figure skaters of an international standard are able to complete up to four rotations within one jump. The successful performance of figure skating jumps is achieved with a combination of several factors, with vertical velocity at take off being one of the main factors identified in previous studies *(King, 2005)*. *King (2005)* stated that despite that vertical velocity at take off appears to be similar among different revolution jumps, when comparing skaters of different abilities, those with higher abilities generate greater vertical velocities at take off for the same type of jump. King suggested that the primary factor in generating vertical velocity is the powerful extension of the legs, implying that the contribution and activation of the lower extremity muscle groups plays a vital role in successful jump performance. Electromyography (EMG) can be a useful tool for the examination of the contribution of different muscle groups during figure skating jumps. However, muscle activation patterns of the lower extremities have not been studied in figure skating.

The execution of a figure skating routine during competition includes a combination of different jumps, with take off from both the dominant (DL) and non-dominant leg (NDL), and the number of rotations in the air varying from one to four. As one would expect, research has shown that the individual jump technique

differs according to the number of rotations performed. For example, *King et al. (2004)* reported differences between three- and four-revolution jumps in a number of kinematic variables measured and for both the take off and landing phases. Given the lack of data with regard to muscle activation patterns for the latter phases and for both the DL and NDL, an EMG analysis of muscles groups of the lower extremity in figure skating jumps would be informative with respect to identifying individual muscle differences in activation patterns between jumps with different number of rotations, as well as the relative contribution of different muscle groups when performing the jumps.

The purpose of the present study was to measure the EMG activity of the main muscle groups of the lower extremity during the take off and landing for one- and two-revolution figure skating jumps, which require take off from both the DL and NDL.

It was hypothesised that the EMG activity would be greater for the two-revolution jumps.

Material & Methods

Participants

One male professional figure skater (age: 28.6 years; body mass: 78.6 kg; height: 180.3 cm) participated in this study. The participant had obtained National Ice Skating Association qualifications and had over 15 years experience in professional figure skating. The testing procedures were approved by the institutional ethics committee and the participant signed an informed consent form before tested.

Selection of figure skating jumps and muscle groups

The 'toe-loop' and the 'flip' jumps were selected. The toe-loop is a jump with a take off from the inside edge of one skate, followed by one or more full rotations in the air, and a landing on the back outside edge of the opposite skate. The flip is a jump with a take off from the outside edge of one skate, followed by one or more full rotations in the air, and a landing on the back outside edge of the same skate. These jumps were selected on the basis that they are simple jumps that are commonly used in figure skating, they are being taught from beginner to advanced level skaters, they can be performed with up to a maximum of four rotations and they require take off from different legs.

Despite the lack of studies in figure skating jumps, the EMG activity of lower extremity muscle groups has been studied for a variety of vertical jumps performed under several conditions and on different surfaces. It has been suggested that the gastrocnemius medialis (GM), the rectus femoris (RF), the biceps femoris (BF) and the adductors (AD) are some of the main muscle groups activated when jumping *(Nagano et al., 2005; Zajac, 2002)*. Thus, these muscle groups were selected for the EMG analysis of this study.

Testing procedure and EMG recordings

Before the test, the muscle bodies of the participant's muscles were identified, shaved and cleaned with alcoholic sterile wipes. Noraxon bipolar passive surface electrodes (Ag-Ag-Cl, diameter 1.0 cm, inter-electrode distance: 2.0 cm) were placed over the GM, RF, BF and AD of both legs. The reference electrode was placed on the anterior bony

side of the knee. All electrodes were safely attached on the participant and any loose wires were securely taped to the legs and protected by the skater's clothing. The electrode placement was checked by movements such as vertical jumps and squats and by manual palpation.

The skater did a personalised warm-up which also included toe loop and flip jumps. Then, for both the toe loop and the flip, the skater performed three jumps with a single and three jumps with a double rotation in the air before landing. For each jump variation the mean values of the three trials were used for the subsequent analyses. The toe-loop required take off from the NDL and the flip from the DL, while the skater landed on the DL in both jumps. For the analysis of the present study, the take off phase was defined as the period between the touch down and the take off of the take off leg before projecting the skater's body in the air. The landing phase was defined as the period between the touch down (following the rotations in the air) and the point of maximum knee flexion of the landing leg. For the identification of these phases, and in addition to the EMG analysis described below, two video cameras (Sony DCR-VX1000E, 50Hz frequency) were fixed on tripods and recorded simultaneously the jumps from the frontal and sagittal plane (90° angle). The space for the jumps was marked and calibrated, and the camera footage was processed with the use of the CODA analysis system (Charnwood Dynamics Ltd, Leicestershire, UK).

EMG was recorded by connecting the electrodes to preamplifier electrode wire which was hardwired to telemetric equipment (TeleMyo2400, Noraxon Inc, Scottsdale, AZ)., with the signal being pre-amplified and transmitted to a computer. The sampling rate was 1500 Hz and the EMG signal was filtered and fully rectified.

Data analysis

The integrated rectified value (iEMG) (μV·s) was calculated for all muscles of the take off and landing legs. The differences between the single and double jumps in iEMG were also calculated as a percentage of the values of the single jumps (subtracting the mean value for the single revolution jumps from the mean value for the double revolution jumps, then dividing by the mean value of the single revolution jump and multiplying by 100). Given that the purpose of the present study was to compare the EMG activity between one and two revolution jumps during take off and landing for a single participant, it was decided to calculate the absolute rather than the normalised values for the EMG signal. This was in line with the recommendations of *Kamen (2004),* who stated that in such investigations reporting the absolute value of the EMG signal is acceptable and can be more meaningful than a relative score derived using normalisation methods.

Results

Toe-Loop

Table 1 shows the iEMG values for all muscles during the take off and landing phases of the single and double toe-loop. The iEMG values at take off increased for all muscles when performing the double revolution jumps. The percentage increase varied among muscles, with the highest increase observed for BF followed by the AD. The landing

patterns were slightly different. AD appeared to be the only muscle with a large increase in iEMG during the double toe-loop. Contrary, iEMG for the other three muscles decreased.

Table 1. iEMG readings of the muscles during the take off and landing phases of the single and double toe-loop.

Muscles	iEMG (μV·s)					
	Toe-Loop Take Off (NDL)			Toe-Loop Landing (DL)		
	Single	Double	%Dif	Single	Double	%Dif
Gastrocnemius Medialis	50.8	65.8	29.5	40.6	27.86	-31.4
Biceps Femoris	36.4	98.3	170.1	64.8	29.75	-54.1
Rectus Femoris	83.7	110.4	31.9	72.9	68.72	-5.7
Adductors	21.4	47.4	121.5	24.3	90.34	271.8

Table 2 shows the iEMG values for all muscles during the take off and landing phases of the single and double flip. Similar to the toe-loop jumps, iEMG at the take off phase of the flips increased for all muscles during the double rotation jump, with the AD being the muscle group with the highest percentage increase. For the landing phase of the flip, the AD was again the muscle with the highest percentage increase. Contrary to the toe-loop, a reduction in muscle activation at the landing of the double flip was observed for one muscle group only (GM).

Finally, the iEMG values of the muscles during the landing phase were higher at the flip than at the toe-loop jumps.

Table 2. iEMG readings of the muscles during the take off and landing phases of the single and double flip.

Muscles	iEMG (μV·s)					
	Flip Take Off (DL)			Flip Landing (DL)		
	Single	Double	%Dif	Single	Double	%Dif
Gastrocnemius Medialis	86.0	104.2	21.2	61.1	31.4	-48.6
Biceps Femoris	98.3	172.0	75.0	73.8	83.4	13.0
Rectus Femoris	118.9	222.9	87.5	76.8	168.4	119.3
Adductors	99.9	236.6	136.8	24.8	68.4	175.8

Discussion

The EMG activity for all the muscles tested in the present study suggested that they made an important contribution during both take off and landing. Some interesting patterns were observed for both phases. With respect to the take off phase, it was shown that regardless of DL or NDL (toe-loop) take off, the activity of all muscles increased when the skater performed the double revolution jumps. This suggests that in order to increase the number of rotations performed for a given jump, a skater must increase the activation of all four muscle groups tested

(BF, RF, GM and AD) for the take off leg. It is also worth noting that the percentage increase for each muscle group varied greatly between jumps and revolutions and ranged from 21.2% to 170.1%. This implies that figure skaters might alter the relative contribution of the muscle groups used for a given jump according to the rotations performed. Such information could have important implications for skaters and coaches, as they could be used for the development of individual programmes for the improvement of the strength and flexibility of particular muscle groups, based on the requirements of the figure skating routines of the athletes.

The EMG activity of the muscles varied with the type of jumps and the revolutions performed in the landing phase also (landing on the DL for both jumps). However, although one could expect for the activity of all muscle groups to increase for the double revolution jumps, this was the case only for AD. Contrary, no consistent pattern was identified for the BF and RF, which decreased in the double toe-loop and increased in the double flip, while the muscle activation of GM decreased during the double revolutions in both jumps. Similar to the observations for the take off phase, these findings suggest that the activation of the muscles and their relative contribution during the landing phase of a figure skating jump might differ depending on the number of revolutions performed. Although not examined in the present study, the above differences between one- and two-revolution jumps might also be attributed to potential differences between the body position (and, thus, the muscle activation requirements) at touch down.

Another interesting finding was that the activation of all muscle groups during the landing phase was higher at the flip than at the toe-loop jumps. This might be related to differences in jump requirements, such as body movement in the air, which might influence the performance characteristics of the jumps. For example, the flight time was generally more for the flip than the toe-loop jumps, something that could partially explain the higher EMG patterns observed at the flip landings. In view of the above findings, it would be of interest in future studies to attempt a detailed analysis of the take off and landing phases of figure skating jumps, and to investigate whether any changes in the EMG activity of the muscle groups are associated with changes in other biomechanical parameters of a figure skater's technique.

Conclusion

The purpose of the present study was to provide a first set of data on the EMG activity of lower extremity muscles during the take off and landing phases of one- and two-revolution jumps of a professional figure skater. It was shown that the EMG activity of GM, BF, RF and AD increased at take off during the double revolution jumps, regardless of DL or NDL take off. No similar pattern was observed for the landing phase (with the exception of AD), while the activation of each muscle varied with the type of jump and the number of revolutions. Finally, all muscles showed higher activation patterns during the flip than the toe-loop landings. Considering the noteworthy EMG patterns recorded, future research should focus on testing a large sample of skaters and expanding the number of revolutions used in each jump, in order to confirm these findings, identify any common

patterns and allow generalisation of the data. Such information can be of great interest to figure skaters and their coaches, as it enables the identification of the main muscles contributing to the projection of the body in the air, as well as the changes in the muscles' activation between jumps with different number of revolutions. Moreover, given that the muscles activated during landing act to improve the stability and balance of the body and to absorb the impact forces, identification of these muscles is also beneficial, for the purposes of designing appropriate personalised training programmes that could lead to performance improvement.

Acknowledgements

The authors would like to thank Abbie Fisher and Matt Greig for their assistance with the data collection for this study.

References

Kamen, G. 2004. Electromyographic Kinesiology. In: *Research Methods in Biomechanics.* Eds: Robertson, D.G.E., Caldwell, G.E., Hamill, J., Kamen. G. and Whittlesey, S.N. Champaign IL: Human Kinetics. 163-182.

King, D. 2005. Performing triple and quadruple figure skating jumps: implications for training, *Canadian Journal of Applied Physiology*, **30**: 743-753.

King, D., Smith, S., Higginson, B., Muncasy, B. and Scheirman G. 2004. Characteristics of triple and quadruple toe-loops performed during the Salt Lake City 2002 Winter Olympics. *Sports Biomechanics*, **3**: 109-123.

Nagano, A., Komura, T., Fukashiro, S. and Himeno, R. 2005. Force, work and power output of lower limb muscles during human maximal-effort countermovement jumping. *Journal of Electromyography and Kinesiology*, **15**: 367-376.

Zajac, F. 2002. Understanding muscle coordination of the human leg with dynamical simulations. *Journal of Biomechanics*, **35**: 1011-1018.

Journal of Exercise Science and Physiotherapy, Vol. 5, No. 1: 20-23, 2009

A Study of Cognition in Relation with Hand Dominance

Chaudhary[1], S., Narkeesh[2], A. and Gupta[3], N.
[1]MPT student, S.B.S.P.G.I., Balawala, Dehradun, Uttaranchal, India
[2]Reader, Department of Physiotherapy, Punjabi University, Patiala-147002, Punjab, India.
[3]Lecturer, Department of Physiotherapy, S.B.S.P.G.I., Balawala, Dehradun, Uttaranchal, India

Abstract

This was an experimental study done on 60 female subjects between the age group of 18-25 years to determine the effect of hand dominance on cognition. The subjects were selected through convenient sampling by using inclusion and exclusion criteria and were divided in two groups viz - Group A (comprising of right handed individuals) and Group-B (comprising of left handed individuals). Both the groups were assessed for their cognitive functions i.e. attention, memory and learning using Trail Making Test, modified MMSE and VAK learning questionnaire. Data was analyzed using independent 't' test and descriptive statistics. The left handers were found to be better in performing memory and attention tasks as compared to the right handers. Majority of left handers were found to have auditory learning style while majority of right handers were found to have visual learning styles.

Keywords: Hand Dominance, Cognitive Functions, Attention, Memory, Learning

Introduction

Cognitive processes are generally defined as the abilities that enable us to "think" which includes the ability to concentrate (pay attention), remember and learn. It is the method used by the central nervous system to process information and includes knowing, understanding and awareness (*Shimoda, 2008).* Assessment of cognition is the important component under physical examination of patient which includes assessment of memory, orientation and ability to assimilate and manipulate information. Because persons with cognitive deficit often cannot recognize their own impairments, cognitive intervention is being increasingly used for the treatment of many neurological conditions like Parkinson's disease, traumatic head injury, and stroke (*Peter & Durding, 1979).* The cognitive intervention focuses on modification of individual thoughts and feelings, through examination of cognition that arises in response to stressors. Complete understanding of cognition is important for planning effective treatment in patients with brain damaged due to various neurological insults like stroke and head injury. Various factors like age, gender, pregnancy, handedness, and systemic diseases like diabetes, hypertension etc are reported to affect patient cognition. *Naugels et al (1998)* stated that left hand dominant individuals are more prevalent among the patients suffering from dementia of Alzheimer disease which begins prior to the age of 65 as compared to right hand dominant individuals. The premotor area of cerebral cortex is involved with the control of hand movements and it is larger in left side of right handed individuals than in the left handed individuals *(Alexander, 1998)*. Studies have found that the left hemisphere is important for language, logical decision making, in performing analytical task, mathematical calculation and performing fine motor skills (*Ferrari,*

2007). Each of the two cerebral hemispheres is responsible for specific functions that are not ordinarily performed by opposite hemisphere. The regional specialization is called as hemispheric lateralization (*Simon, 1988).*

Hand dominance has been a topic of investigation since so many years but the studies showing its influence over cognition are scarce. Thus, this study attempts to find out the effect of hand dominance on components of cognition like learning, attention and memory.

Material and Methods

Four hundred female subjects between the age group of 18-25 years from SBSPGI, Balawala, Dehradun were selected through convenient sampling by using inclusion and exclusion criteria. Experimental design finally consisted of 60 subjects (females) of age group 18 to 25 years and the subjects were allocated in two groups on the basis of their hand dominance for the study. Each group consisted of 30 subjects. Group A comprised of right handed and Group B of left handed subjects.

This study was an experimental study based on the comparison of cognitive functions (learning, attention, memory) in right and left handed individuals who were given Trail Making Test for assessing their attention and VAK (Visual, Auditory, Kinesthetic) learning style questionnaire for assessing their learning style and Modified Mini Mental Status Examination (MMSE) for assessing their memory.

Firstly attention of both groups were assessed by using Trail Making Test and then memory of both groups were assessed by using MMSE scale and lastly learning styles were assessed through VAK learning questionnaire. Time for completing the attention task for Group-A and Group-B were noted. The score and duration of completing memory task were recorded and lastly learning style was assessed on the basis of number of maximum option as a, b, c. The values of both groups were compared through independent sample t test and descriptive statistics.

The data was analyzed by using SPSS version 11 software.

Results & Discussion

Table-1: Mean and SD of Group-A and Group-B for their Trail Making Test

Group	Attention (Trail Making Part-A)		Attention (Trail Making Part-B)	
	Mean	SD	Mean	SD
A	46.20	9.72	91.86	27.89
B	34.56	8.78	73.42	15.33
Unpaired t test	t = 4.87, p = 0.001		t =3.17, p =0.002	

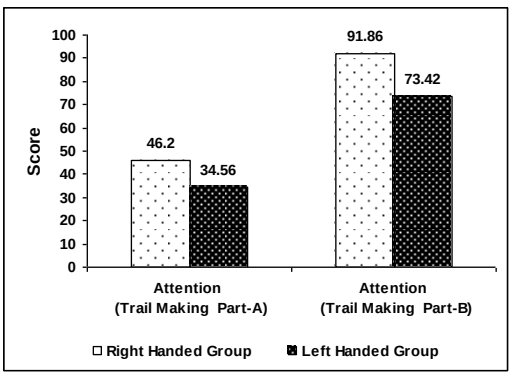


Figure 1: Comparison of Attention task scores between the right and left handed groups

Table 1 & figure 1 compares the mean attention scores among right and left handed groups of females for Trail Making Test. The results showed that left handed individuals (Group B) took less time to complete the trail making test as compared to right handed individuals (Group A) in our study. *Williams et al*

(1985) and *Paolo et al (1998)* revealed in their study that corpus callosum, the main fiber tract connecting the two cerebral hemispheres, was larger by about 0.75 square centimeters, or 11 percent, in left-handed and ambidextrous people than in those with consistent right-handers which he believed played an important role in hemispheric integration. That may be one of the reasons why left handed individuals were found to be more attentive as compared to the right handed counterparts.

Table-2: Mean and SD of Group-A and Group-B for their memory (scores) and duration

Group	Memory Score		Memory - Duration	
	Mean	SD	Mean	SD
A	82.66	8.09	229.66	35.18
B	89.50	5.04	208.66	30.78
Unpaired t test	t = -3.93, p = 0.001		t =2.49, p =0.016	

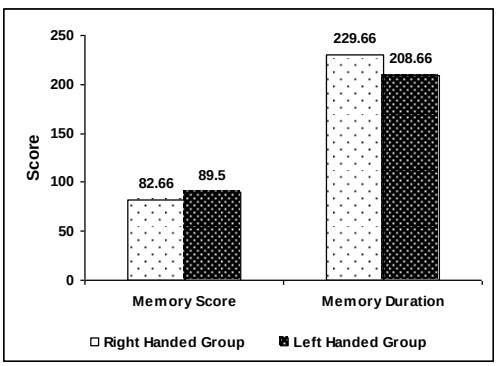


Figure 2: Comparison of Memory scores and Memory Duration between the right and left handed groups

Table 2 & figure 2 compares the mean Memory scores and duration among the right and the left handed groups of females. Left handers scored more in memory scale and they took less time to complete the task as compared to right handers in our study. This is in agreement with the similar findings of the study reported by *Marzi (1988)*. He stated that superior episodic memory is associated with inter-hemispheric processing which is stronger in left handed individuals. These findings were also supported by another study done by T*oga & Thomson (2003)* who stated that the anatomical connectivity of the anterior temporal and inferior frontal lobe is thought to be more highly developed in left handed individuals *Tan (1988)*.

TABLE-3: Comparison of learning styles in both the groups

Groups	Auditory	Visual	Kinesthetic
Group-A	73%	20%	6.7%
Group-B	36.7%	43.3%	20%

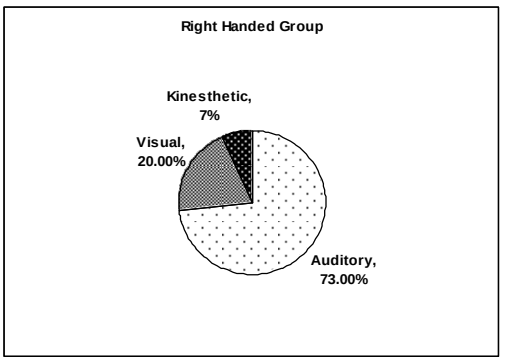


Figure 3: Comparison of learning styles in the right handed group of females

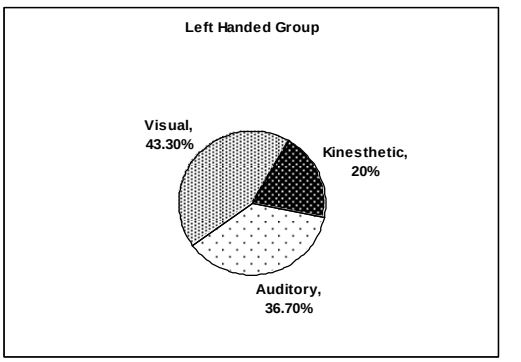


Figure 4: Comparison of learning styles in the left handed group of females

Table 3 and figures 3 & 4 compare the mean scores in the various learning styles among the right and the left handed groups of females. Majority of the right handed individuals were found to

have auditory learning style while majority of the left handed individuals had visual learning style. The physiological reason for the difference in their learning style may be ascribed to the differences in the processing of the information through right and left hemisphere or in combination as reported by *Volkmann et al (1998)* and *Ali (2006)*. They concluded in their studies that learning styles were found to be associated with brain hemi-sphericity.

It was concluded from the present study that the left handers were better in performing attention and memory tasks as compared to the right handed individuals. This finding may be explained by the fact that broader and deeper connections exist between the two hemispheres of the left handlers as compared to the right handlers. Differences in learning styles were also observed among the right and the left handed individuals in the present study.

On the basis of these results, it may be concluded that handedness has an important impact on cognition. The study thus provides an important contributing tool for setting the treatment goal and planning strategies for the treatment of the patients.

References:

Alexander 1998. Hand dominance and motor unit firing behaviour. *Journal of Neurophysiology*. 1373-1382.

Ali, R. M. 2006. *Journal of Neuropsychologia* University Sains Malaysia. **112:** 995-998

Ferrari, M. 2007. Genetic performance and left handedness comparative analysis in adults with seizures, physical, psychological and learning disorder in rehabilitation setting. *Journal of Rehabilitation*. **8(4):** 297-306.

Marzi, C, A. 1988. Left hemisphere superiority for visuospatial functions in left handers. Behaviour and Brain Sciences. **30(2):** 183-192.

Naugles, R.I., Cullum C, Braddom, D. 1998. Handedness and Dementia. School of Medicine, University of California, and Diego. 1145-1152

Paolo, V., Daniela, P., Franco G., Valetino, B., Ferrucio F. 1998. Hemispheric asymmetries and bimanual asynchrony in left and right hander, *Experimental Brain Research*, **120:** 531-53

Peter, M. and Durding, B.M. 1979. Footedness of left and right handers. *American Journal of Psychol*, **92(1):** 133-42

Shimoda 2008. Cerebral laterality differences in handedness: A mental rotation study with NIRS" *Journal of Neurosciences*. **430(1):** 43-7.

Simon J.E. 1988. Hand preference in a normal population. *Cortex*. **24:**157-163

Tan, U. 1988. The relationship between nonverbal intelligence, familial sinstralitry and geshwind score in right handed female subjects. *Neuropsychologia*. **43(3-4):** 177-182

Toga, A. and Thompson, P.M. 2003. Mapping brain asymmetry. *Journal of Neurosciences*. **4:** 37-48.

Volkmann, .J.A., Schnitzler, O. and Witte, W. 1998. Handedness and asymmetry of hand representation in human motor cortex. *Journal of Neurophysiology*. **79(4):** 2149-2154.

William, R., Collis, S. Witelson, F. 1985. The brain connection - the corpus callosum is larger in left handers. *Journal of Neurosciences*. **229:** 665.

Journal of Exercise Science and Physiotherapy, Vol. 5, No. 1: 24-29, 2009

Effect of Skin Temperature on Nerve Conduction Velocity and Reliability of Temperature Correction Formula in Indian Females

Dhavalikar[1], M., Narkeesh[2] A. and Gupta[3], N.
[1]PG Student, SBSPGI, Dehradun, Uttaranchal, India
[2]Reader, Department of Physiotherapy, Punjabi University, Patiala-147002, Punjab, India
[3]Lecturer, SBSPGI, Dehradun, Uttaranchal, India

Abstract

This was an experimental and co relational study done to determine the change in MNCV with variation in skin temperature. It also assessed the reliability of nerve conduction formula in Indian setup. Forty five females between 18-25 years were included in the study. The forearm skin temperatures were varied from 27^0C to 37^0C using hot packs and cold packs and median nerve MNCV was recorded at an interval of 2^0C. The recorded MNCVs were substituted in the temperature correction formula and each of the obtained corrected MNCV was compared with the MNCV recorded at standard temperature of 33^0C. Conclusion: there was a significant variation in MNCV with variation in skin temperature but the temperature correction formula was found to be reliable.

Keywords: MNCV, Temperature Correction Formula, Skin Temperature

Introduction

Nerve conduction studies are being increasingly used in diagnosis and prognosis of various neurological diseases since years. Nerve conduction studies assess the peripheral motor and sensory functions by recording the evoked response to stimulation of peripheral nerves. They have an important role in evaluation of peripheral and entrapment neuropathies by confirming the clinical suspicion of neuropathy. Identifying the predominant pathophysiology such as conduction block, axonal demyelination, and temporal course of the disease i.e. acute, subacute or chronic, the nerve conduction studies provide an objective and qualitative measure of nerve function and also help in predicting the prognosis of neuropathy. With steady improvement of recording apparatus, nerve conduction studies have become a simple and reliable test of peripheral nerve function. *(Aminoff, 1999)*

Another major reason for the increasing value of nerve conduction studies has been the improved quantification of both motor and sensory potentials. Quantification allows precise statements about the severity of the disease process, comparison of findings in patient over time as the disease evolves, and comparison of results obtained by different physicians. Importantly, quantification has demonstrated changes that were not recognized on subjective analysis *(Halar et al, 1981)*

The validity of the calculated nerve conduction velocity depends primarily on the accuracy in determining the latencies and the conduction distances. Several factors may contribute to determination of accurate nerve conduction velocity like age, temperature, height etc. Because of these uncontrolled variables, the calculated values only approximate the true nerve conduction values. Of these, age and temperature have a major influence on nerve conduction studies. Temperature variation

in the tissue surrounding a nerve is an important factor influencing the velocity of the nerve impulse. The distal extremities are constantly exposed to environmental temperature changes and are subjected to significant tissue temperature variation even in healthy subjects *(Halar et al, 1981)*.

Elderly subjects have been found to have reduced ability to respond to cold exposures and are prone to having a lower tissue temperature than younger adults when exposed to same environmental temperatures *(Fox et al, 1973)*. Patients with impaired circulation may have a reduced tissue temperature and additional reduction of nerve conduction velocity. Borderline abnormal nerve conduction velocity values may lead to erroneous diagnosis of peripheral or entrapment neuropathy *(Halar et al, 1981, 1982, 1983)*.

Temperature affects biologic and neurophysiologic processes and is, therefore, always well controlled in vitro experiments. Its role is equally important in the clinical laboratory but has often been neglected. Lower temperature cause slower nerve conduction velocities (NCVs), and increased amplitudes of muscle and nerve potentials *(Dorfman & Bosley, 1994)*. Fibrillations may disappear, and muscle contraction will be slower and weaker and neuromuscular transmission improves. Somatosensory evoked potentials (SEPs) are similarly vulnerable in the peripheral segments, or with changes in central temperature. As a result, abnormalities are artificially created or existing defects are not detected, resulting in false or missed diagnoses. Control of temperature, albeit somewhat time consuming, will result in greater diagnostic accuracy.

Cold temperatures cause slowing of sodium channel opening and also delays its inactivation which probably accounts for the slowing of nerve conduction and the increase in amplitude *(Kimura, 1989)*. With decrease in temperature there is consequent reduction in the sodium permeability of nerve axons during the excitation, resulting in a slower sodium influx and an increased latency (slow neural conduction). Decrease in temperature also increases the resistance to conduction of impulses which increase the latencies and decreases the conduction velocity.

With so much of importance attached to this electro-diagnostic test, the accuracy of results is of extreme importance. A small error like incorrect recording of skin temperature or disregarding it totally can result in disastrous diagnosis. To solve this problem, temperature correction formulae have been devised for various nerves in studies done thence so forth, but clinical imposition of these formulae is not done always.

This study attempts to determine the effect of skin temperature on motor nerve conduction velocity on normal subjects in Indian population and to examine the reliability of temperature correction formulae.

Material & Methods:

Eighty (N=80) girls aged between 18 years to 25 years of Mata Gujri Girls Hostel who fulfilled the inclusion and exclusion criteria constituted the population. The study was conducted in the research laboratory of the Department of Physiotherapy, Sardar Bhagwan Singh Post Graduate Institute of Bio-Medical

Sciences and Research, Balawala, Dehradun.

Forty five (n=45) subjects out of the population were selected for the study on the basis of inclusion and criteria.

Before beginning with the procedure, the subjects who were selected on the basis of inclusion criteria were explained the entire procedure in detail and their consent was taken. They were then assessed according to the assessment chart. The subject was made to sit comfortably on a chair with the right arm supported on the armrest. Metallic ornaments on the limb were removed. The right arm was exposed from mid arm to the hand. The resistance of the skin of forearm was reduced using cotton dipped in alcohol. The recording electrodes were placed in the hand with the cathode placed over the belly of abductor pollicis brevis muscle and the anode on the belly tendon montage. The ground electrode was strapped to the forearm. A point was marked 8 cm proximal to the distal wrist crease. The skin temperature was measured at this point and noted. Cold pack was applied over the forearm for about 5-10 minutes, till the skin temperature reduced to 27^0C. The pack was removed and the area was gently patted dry. Once the required temperature was achieved, the stimulation was given after one minute to allow the skin temperature to stabilize. First, the supramaximal stimulus was given to the median nerve distally at the wrist. The wave and the distal latency were recorded. The second supramaximal stimulus was given to the median nerve proximally at the flexor crease at the elbow. The wave and proximal latency were recorded. The distance between the proximal and the distal stimulating sites was measured using a flexible measuring tape *(Mishra & Kalitha, 2005)*. The MNCV was then calculated as follows:

$$\text{MNCV} = \frac{D}{PL - DL}$$

Where,

D = distance in meters
PL= proximal latency in milliseconds
DL= distal latency in milliseconds

The skin temperature which was measured and the value of MNCV obtained was then put in the temperature correction formula and the temperature corrected MNCV was calculated.

$NCV_{TC} = CF\ (T_{st} - T_m) + \text{obtained NCV}$

NCV_{TC} = Temperature Corrected NCV
CF = correction factor for median nerve = 1.5
T_{st} = standard skin temperature = 33^0C
T_m = measured skin temperature.

The part was then allowed to warm gradually to subsequent temperatures of 29^0C, 31^0C, 33^0C. At each temperature the latency and the MNCV were recorded as described above. The part was then warmed to 35^0C and then to 37^0C by wrapping a hot water bottle around the limb. The hot water bottle was removed and the area was gently patted dry. Again Latencies and MNCVs were calculated at both the temperatures as per the procedure explained above. Temperature corrected MNCV obtained at each temperature was compared with recorded MNCV value obtained at 33^0C.

The data was analyzed, initially using mean and standard deviation to analyze the MNCV at various temperatures (27ºC, 29ºC, 31ºC, 33ºC, 35ºC, 37ºC). Then One Way Anova was applied to analyze the change in MNCV

at various temperatures in different subjects.

Later Karl Pearson Correlation and Paired t-test was used to find out correlation between temperature corrected MNCV at various temperatures with MNCV at standard temperature and reliability of the formula was determined.

The significant value was fixed at $p<0.05$ with confidence interval of 95%.

Results & Discussion

Table 1 describes the mean and standard deviations of all the MNCV's recorded at various skin temperatures from 27^0C to 37^0C. The values indicate a general trend of increase in the conduction velocity of median nerve with increase in the temperature.

Table 1: Mean and Standard deviations of all the MNCV values (meters/sec) recorded at various temperatures.

TEMPERATURE	MEAN	±S.D.
27^0C	54.91	2.94
29^0C	54.39	2.89
31^0C	54.94	2.76
33^0C	55.35	3.08
35^0C	56.42	3.70
37^0C	56.86	3.46

Table 2: ANOVA

Variables	Sum Of Squares	Df	Mean Square	F-Value	Sig
Between groups	206.406	5	41.281	4.159	.001
Within groups	2620.160	264	9.925		

Table 2 describes the values for One Way Anova for the temperatures from 27^0C to 37^0C. The F value of 4.159 was significant at $p<.001$ for within the six different temperatures used.

Having calculated a one-way ANOVA for same subject design on the data and obtained significant results throughout the temperature range ($F=4.159$, $p=.001$), comparisons of the means were performed using the Scheffe' multiple range test. The results indicated that MNCV values observed at 29^0C and 37^0C were significantly different.

Table 3: Correlation between the temperatures corrected MNCV's at various temperatures with the MNCV value recorded at 33 ºC

Variables	r-value	Significance
NCV_{TC} at 27 ºC and NCV at 33 ºC	0.643	.000
NCV_{TC} at 29 ºC and NCV at 33 ºC	0.688	.000
NCV_{TC} at 31 ºC and NCV at 33 ºC	0.716	.000
NCV_{TC} at 35 ºC and NCV at 33 ºC	0.419	.000
NCV_{TC} at 37 ºC and NCV at 33 ºC	0.672	.000

Table 3 shows the correlation between the temperatures corrected MNCV's obtained at various temperatures with the MNCV value recorded at 33 ºC using the Karl Pearson Correlation Formula. Significant correlation was observed.

Discussion

The results of the study reveal that temperature have an effect on the ability of the nerve to conduct impulses and the greatest change in NCV was seen when NCV values were compared at temperatures of 29ºC and 37ºC (Table 1). Similar results have also been reported by *De Jesus et al (1973)* and *Lowitzsch et al (1977)*. The probable explanation for the increase in MNCV with increase in temperature is that on warming of the nerve there is a transient hyper polarization by acceleration of the electrogenic sodium pump (*Stetson et al, 1992)*. Observations of some other investigators show that the conduction velocity increases by approximately 5% per degree Celsius increase in the temperature of the nerve from 29°C to 38°C (*Johnson and Olsen, 1960; De Jesus et al, 1973; Lowitzsch et al, 1977)*. Along with the increase in the NCV, the amplitude of nerve and muscle action potentials have been reported to decrease

(*Bolton et al, 1981 and Lang and Puusa, 1981)*. According to *Downey (2002)*, lowering of the temperature on the other hand prolongs the open time of the voltage gated sodium channel, thereby generating a larger and longer action potential, and reducing the nerve conduction velocity and increasing the latency. A decrease in temperature is found to alter conduction differently in nerves because of the wide variation on fiber diameters. The large-diameter fibers comprising the A group require less of a drop in temperature to produce action potential blockade than in C fibers. As per Downey large fibres are more responsive to cooling. He further is of the view that decreases in temperature increases the skin surface resistance which may also account for an increase in latency and therefore decrease in the conduction velocity. *Halar et al (1982)* in their study obtained a 1.5 m/sec/^{0}C change in median nerve conduction velocity and of 1.4 m/sec/^{0}C change in ulnar nerve conduction velocity. The recordings were done at volar mid wrist region and the standard temperature was taken as 33ºC.

One of the reasons for the lesser variation in MNCV with variation in skin temperature in the present study could be due to difference in the technique used to vary the skin temperature. In the existing study the skin temperature was varied by wrapping hot water bottle and cold pack around the volar aspect of the forearm. Moist packs were not used as it was difficult to obtain a controlled rise in skin temperature at the time of pilot study. In previous studies the skin temperature of the extremity was varied using cold and hot water bath, infra red lamps or hot packs. The hot and cold packs were placed for 10 minutes to get a change in the skin temperature from 33ºC to 37ºC. In the study done by *Halar et al (1982)* it took about 20-25 minutes for the limb temperature to gradually increase from 26ºC to 30ºC, when the limb was allowed to warm normally.

Although skin temperature is a quick and a reliable method of temperature determination in the extremities, it varies with the site of measurement along the same extremity. So to standardize the temperature correction for NCV and DL measurement, in this study the average skin temperature was measured at 8 cm proximal to the distal wrist crease, which was in accordance with the study done by *Halar et al (1982)* who showed that the volar mid-wrist site and the site 8 cm proximal to the wrist crease had the best correlation to NCV. They also suggested that volar mid-wrist be used as the standard site because effects of decreased temperatures are more likely to occur distally. The skin temperature in palms did not fall by the same magnitude as the finger skin temperatures due to better palmer blood supply and better capability to respond to the tissue temperature changes caused by environmental factors. The results support the use of skin temperature correction factors to correct for temperature-induced NCV and DL changes.

The reliability of temperature correction formula in the Indian set up was assessed using Karl Pearson Correlation and Paired t- test. The correlation was performed between each of the temperature corrected MNCV at 27ºC, 29ºC, 31ºC, 35ºC, 37ºC with MNCV recorded at 33ºC. All the values showed significant correlation which showed a strong association. This indicates that each temperature corrected MNCV's did match the recorded MNCV

value at 33ºC. Thus there is significant correlation between the temperature corrected MNCV's and the MNCV value recorded at 33ºC. Results of the present study are in accordance with the study of *Bjorkovist (1977)* who found that preheating the limb to the normal temperature before the NCV measurement did not produce variability in repeated NCV determinations and that preheating of limb appeared to be time consuming and an uncertain method for controlling temperature influence on NCV. Since the length of time varied from patient to patient to achieve the required skin temperature, it was better to use the temperature correction formula for each nerve to get a more consistent response.

Conclusion

The study results indicated variation in MNCV with changes in skin temperature in normal population as shown by One Way ANOVA.

The results of mean and standard deviation indicated that MNCV at 37ºC showed the highest values and the MNCV at 27ºC showed the minimum values which indicate an increase in the MNCV values with increase in temperature.

The study showed that the temperature correction formula is reliable in the Indian context.

References

Aminoff, Michael, J. 1999. *Electrodiagnosis in Clinical Neurology*, 4thedn:Churchill Livingstone, ch 7p 236

Bjorkovist, S.E. 1977. Variability in nerve conduction velocity: using averages reduces it, warming of limb does not. *Electromyog. Clin. Neurophysiol.*, **17:** 21-28.

Bolton, C.F., Sawa, G.M, Carter, K. 1981. The effects of temperature on human compound action potentials. *Journal of Neurology, Neurosurgery and Psychiatry*. **44:** 407-413

De Jesus, P.V., Hausmanowa-Petrusewicz, I., Barchi, R.L. 1973. The effect of cold on nerve conduction of human slow and fast nerve fibers. *Neurology*. **23:** 1182–9.

Dorfman, L.J., Bosley, T.M. 1994. Age related changes in peripheral and central nerve conduction in man. *Neurology*, **29:** 38-44

Downey, D. 2002. *Physiological basis of rehabilitation*. 2nd edition Lippincott and Wilkins.

Fox, R.H., MacGibbon, R., Davies, L., Woodward, P.M. 1973. Problem of the old and cold. *Br. Med. J.*, **1:** 21-24

Halar, E.M., Delisa, J.A., Brozovich, F.V. 1982. Nerve Conduction Velocity: Relationship of skin, subcutaneous and intramuscular temperatures. *Archives of Phys. Med. Rehabil.*, **61:** 199-203

Halar, E.M., Delisa, J.A., Soine, T,L. 1983. Nerve conduction studies in upper extremities: skin temperatures corrections. *Arch. Phys. Med. Rehabil.*, **64:** 412-416.

Halar, E.M., Lisa, De, Brozovich, F.V. 1981. Peroneal Nerve Conduction velocity: The importance of temperature corrections. *Arch. Phys. Med. Rehabil.*, **62:** 239-443

Johnson, E.W., Olsen, K.J. 1960. Clinical value of motor nerve conduction velocity determination. JAMA, **172:** 2030–5.

Kimura, J. Electrodiagnosis in diseases of nerve and muscles - Principles and Practice", 2nd Edition, 1989

Lang, A.H. and Puusa, A. 1981. Dual influence of temperature on compound nerve action potential. J Neurol. Sci., **51:** 81–8.

Lowitzsch, K., Hopf, H.C., Galland, J. 1977. Changes of sensory conduction velocity and refractory periods with decreasing tissue temperature in man. *J. Neurol.*, **216:** 181–8.

Stetson, D.S., Albers, J.W., Silverstein, B.A., Wolfe, R.A. 1992. Effects of age, sex and anthropometric factors on nerve conduction measures. *Muscle Nerve*, **15:** 1095-1104

Mishra, U.K. and Kalitha, J. 2005. Clinical Neurophysiology - Nerve Conduction, Electromyographers and evoked Potential."2nd edition, Elsevier

Journal of Exercise Science and Physiotherapy, Vol. 5, No. 1: 30-33, 2009

Test Retest Reproducibility of a Hand-Held Lactate Analyzer in Healthy Men

Kulandaivelan[1], S., Verma[2], S.K., Mukhopadhyay[3], S., Vignesh[4], N.
[1]Lecturer, Dept. of Physiotherapy, Guru Jambeshwar University, Hisar, Haryana, India
[2]Professor, Dept. of Sports Sciences, Punjabi University, Patiala-147002, Punjab, India, Email: satishsk1@rediffmail.com
[3]Assistant Professor, Industrial Safety & Environment Group, NITIE Campus, Mumbai 400087, Maharahtra, India
[4]Physiotherapist, Railway Hospital, Kolkatta, India

Abstract

The objective of the present study was to evaluate the test-retest reliability and day-to-day precision of a hand-held Blood Lactate Analyzer. Blood lactate levels were evaluated on 12 samples of human beings and blood was collected from both ring and middle finger for test-retest reliability. Day-to-day precision was determined by known concentration of two aqueous lactate control solutions once a day for 10 consecutive days. Results showed high test-retest reliability (r = 0.948; mean 2.41±0.86 in ring and 2.45±0.76 in middle finger) and high day-to-day reliability (r = 0.998; mean 1.1±0.08 in low control and 4.28±0.24 in high control solution). The results were similar to those previously reported. The results of this study support the use of the hand-held device in healthy human beings.

Key Words: Test-Retest, Reliability, Blood Lactate, Portable Analyzer

Introduction

Measurement of blood lactate has many important applications. In clinical setting, it helps to identify the disease severity (*Planche et al., 2001; Saunders et al., 2005; Tennent-Brown et al., 2007; Thorneloe et al., 2007*), prognosis *(Coghe et al., 2000),* and treatment efficacy *(Ivers and Mukherjee, 2006)* in many conditions. In sports settings, it also helps to identify an optimal training intensity *(Bishop, 2001)* and proper recovery to reduce chances of injury occurrence, as the increased lactate level seems to inhibit certain enzymes so as to create fatigue.

Traditionally, measurements of lactate have been made by using large laboratory based analyzers that are expensive and cumbersome – need of lactate transportation, centrifugation, storage in ice (refrigeration) etc, all of which requires higher technical knowledge from user *(Thorneloe et al., 2007).* In sports, ideally the lactate concentrations should be measured during a training session and reported immediately to the athlete to ensure the desired training intensity *(Bishop, 2001).* But the above said limitations of the large laboratory based equipments tend to limit their usage in the field during training. The essential qualities of any tool are that they provide accurate and reliable results in a rapid and simple manner. With the advent of less expensive, rapid hand- held lactate analyzers that have proved accurate in animals *(Coghe et al., 2000; Tennent-Brown et al., 2007; Thorneloe et al., 2007),* critically ill human beings *(Planche et al., 2001; Ivers and Mukherjee, 2006),* even in sportsmen *(Bucklay et al., 2003; Pyne et al, 2005),* lactate measurement is likely to increase in sports community in order to improve performance, facilitate recovery and reduce the chances of injury.

Thus, the purpose of the present study was to see test-retest reliability of Lactate Plus hand held analyzer in healthy

human beings and day-to-day precision of the same in two control solutions.

Material and Methods

Twelve healthy male subjects (age 17-24 yrs, height 163-178 cms and weight 58-75 kgs) were used for the present study.

A hand-held portable lactate analyzer (Lactate Plus, Nova Biomedical, Waltham, MA, USA) was used to determine blood lactate level. It determines plasma lactate levels quantitatively (in mmol/L) on 0.6µl of whole blood by the use of a single use reagent strip of an enzyme-coated electrode and a small meter within 15 sec. The hand-held device's measuring range is between 0.3 and 25.0 mmol/L for human. It has high reliability (test-retest and day-to-day) and validity (as per user's manual).

After getting their informed consent, all the subjects were asked to sit for 30 minutes after washing their hands with soap. Tip of either middle or ring finger was used as a puncture site for the first time. A Lancet BD was used to puncture the site without pain and even awareness of the subject. Then both sides of the puncture sites were pressed gently to develop a drop of blood, care was taken not to squeeze vigorously as it causes wrong lactate value. The first blood drop was wiped off using sterile cotton swab as it may contain interstitial fluid. When the second drop developed, test strip with Lactate Plus meter was touched to the blood drop until it filled up with blood and meter beeped. Plasma blood lactate value was available within next 20 sec. The whole procedure was repeated in the other site again.

Blood lactate measurements were performed on two sites (tip of either middle or ring finger) in twelve healthy human beings and on two control solutions (low and high lactate control solutions, 1.0-1.6 and 4.0-5.6 mmol/L respectively) for ten consecutive days for test-retest reliability, day-to-day precision of Lactate Plus (hand-held) analyzer respectively.

Lactate values obtained from both sites (ring and middle finger) and both control solutions (high and low) were presented by descriptive statistics (mean, standard deviation (SD), standard error of mean (SEM), coefficient of variance (CV)), alpha correlation model using SPSS 10 version.

Results

Descriptive statistics of blood lactate values from two sites is presented in Table 1, where as descriptive statistics of control solutions is presented in Table 2.

Table 1: Descriptive statistics of blood lactate values in mmol/L from two sites using Lactate Plus (hand-held) analyzer (n=12)

	Mean	Median	Range	SD	SEM
Ring	2.41	2.30	1.40-4.50	0.86	0.25
Middle	2.45	2.35	1.60-4.10	0.76	0.22

Table 2: Descriptive statistics of lactate values in mmol/L from two control solutions using Lactate Plus (hand-held) Analyzer (n=10)

	Mean	Median	Range	SD	SEM	CV
Low	1.10	1.10	1.0-1.2	0.08	0.03	7.27
High	4.28	4.30	3.9-4.6	0.24	0.09	5.60

Blood lactate concentrations obtained in healthy human beings ranged from 1.4 to 4.5 mmol/L with mean ± SD values of 2.41 ± 0.86 and 2.45 ± 0.76 mmol/L for ring and middle finger respectively (Table 1). Lactate values with low control solution ranged from 1.0

to 1.2 mmol/L (mean 1.1 mmol/L) and with high control solution ranged between 3.9 - 4.6 mmol/L (mean 4.28 mmol/L).

The Lactate Plus was found to have moderate to high test-retest reliability (r = 0.948; SEM = 0.25 mmol/L) with 95% confidence interval ranging from 0.693 to 0.970 (Table 3). In addition 95% of repeated measurements on the Lactate Plus were within 0.4 mmol/L of the initial measurement. Figure 1 shows the correlation between the two site's lactate values from Lactate Plus (r = 0.908; p < 0.01), with regression line.

Table 3: Test-retest reliability of the Lactate Plus (hand-held) analyzer evaluated on two sites at the same time (n=12)

	Pearson correlation	Alpha model reliability	ICC (Inter class correlation)	95% CI	Error Variance
Middle & Ring	**0.908****	**0.948**	**0.901**	**0.693–0.970**	**6.59**

****-p<0.01-highly significant**

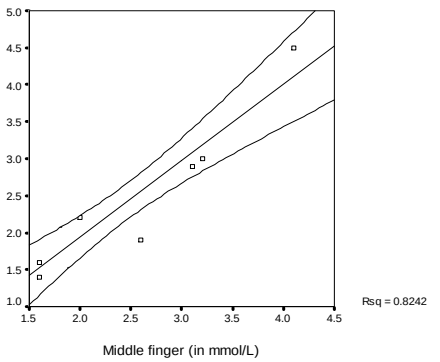


Figure 1:- Correlation between the blood lactate concentrations obtained from two sites

Table 4: Day-to-day precision of the Lactate Plus (hand-held) analyzer evaluated on two control solutions in ten consecutive days (n=10)

	Alpha model	ICC (Inter Class Correlation)	Error Variance (in %)
High & Low	**r = 0.999**	**r = 0.993**	**5.50**

The Lactate Plus was found to have very high day-to-day precision when using the same standard lactate control solutions each day for ten days (r = 0.999; SEM = 0.03 mmol/L for low, 0.09 mmol/L for high control solutions) (Table 4). The differences between two sites lactate values ranged from -0.35 to +0.20. These values along with difference between mean value of each control solution and each day values represented in Figure 2 along with 95% limits of agreement (shown in dotted line).

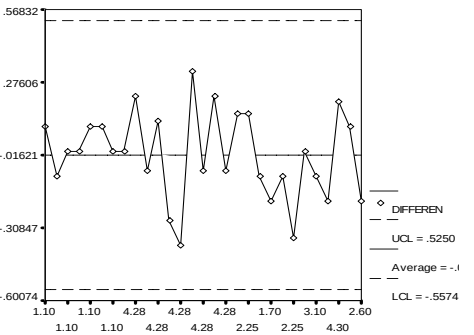


Figure 2:- Bland-Altman plot showing relationship between mean lactate concentration determined at both sites, mean control solution (high & low) (x-axis) and the difference between two sites (ring & middle finger), mean control value and each day value (y-axis) showing the mean bias (solid line) with the 95% limits of agreement (dotted lines) (n=32)

DISCUSSION:

The results of the present study demonstrated moderate to high test-retest reliability in healthy human being's resting blood lactate values and very high day-to-day precision on control solution.

Consistent with a previous study *(Bishop, 2001)*, there was strong correlation (p = 0.908; p < 0.01) between the two sites of measurements. Repeated measurements of lactate concentration with Lactate Plus on two samples drawn at the same time showed high reliability (r = 0.9477, n = 12) and low SEM (0.23) which were similar to previous studies *(Bishop, 2001; Pinnington and Dawson, 2001 and Poscia et al, 2005)*. It was also found to have very high day-to-day reliability when using the same standard

lactate solutions each day for ten days, our value r = 0.998 ± 0.04 (n=10) is in agreement with *Bishop (2001)* that showed r = 0.993 ± 0.4. Low values of coefficients of variance (CV) in low and high control solution in the present study also support the values reported by *Fell et al (1998)*.

Conclusion

Our results support the use of Lactate Plus hand-held device in field environment. Its ease of use and rapid turn around time (15 Sec) allow for prompt decision making in training and recovery adjustments, and relative low cost for sample processing, all of which recommends its use in athletic setting.

References

Bishop, D. 2001. Evaluation of the Accusport Lactate Analyzer. *Int. J. Sports Med*., **22(7):** 525-30.

Bucklay, J.D., Bourdon, P.C., Woolford, S.M. 2003. Effects Of Measuring Blood Lactate Concentrations Using Different Automated Lactate Analyzers On Blood Lactate Transition Thresholds. *J. Sci. Med. Sport*, **6(4):** 408-21.

Coghe, J., Uystepruyst, C.H., Bureau, F., Detilleux, J., Art, T., Lekeux, P. 2000. Validation and Prognostic Value of Plasma Lactate Measurement In Bovine. *Respiratory Disease*, **160(2):** 139-46.

Fell, J.W., Rayfield, J.M., Gulbin, J.P., Gaffney, P.T. 1998. Evaluation of the Accusport Lactate Analyzer. *Int. J. Sports Med.*, **19(3):** 199-204.

Ivers, L.C., Mukherjee, J.S. 2006. Point of Care Testing for Antiviral Therapy Related Lactic Acidosis in Resource Poor Settings. *AIDS*, **20(5):** 779-80.

Pinnington, H., Dawson, B. 2001. Examination of the Validity and Reliability of the Accusport Blood Lactate Analyzer. *J. Sci. Med. Sport*., 4(1): 129-38.

Planche, T., Krishna, S., Kombila., Engel, K., Faucher, J.S., Nau-Milama., Kremsner, P.G. 2001. Comparison of Methods for the Rapid Laboratory Assessment of Children with Malaria. *Am. J. Tro. Med. Hyg.*, **65(5):** 599-602.

Poscia, A., Messer, Moscone, D., Ricci, F., Valgimigli, F. 2005. A Novel Continuous Subcutaneous Lactate Monitoring System. *Biosen. Bioelectron*., **20(11):** 2244-50.

Pyne, D.B., Boston, T., Martin, D.T., Logan, A. 2000. Evaluation of the Lactate Pro Blood Lactate Analyzer. *Eur. J. Appl. Physiol*., **82(1-2):** 112-16.

Saunders, A.C., Feldman, H.A., Correia, C.E., Weinstein, D.A. 2005. Clinical Evaluation of A Portable Lactate Meter in Type I Glycogen Storage Disease. *J. Inh. Met. Dis.*, **28(5):** 695-701.

Tennent-Brown, B.S., Wilkins, P.A., Lindborg, S., Russell, G., Boston, R.S. 2007. Assessment of a Point Of Care Lactate Monitor in Emergency Admissions of Adult Horses to a Referral Hospital. *J. Vet. Intern. Med*., **21(5):** 1090-98.

Thorneloe, C., Bedard, C., Boysen, S. 2007. Evaluation of a Hand-held Lactate Analyzer in Dogs. *Can. Vet. J.*, **48(3):** 283-88.

Journal of Exercise Science and Physiotherapy, Vol. 5, No. 1: 34-37, 2009

A Study of Muscle Muscle Morphology of Anterior Group of Forearm Muscles

Sharma[1], M., Chabbra[2], U., Kaushal[2], S., Patnaik[3], V.V.G., Prashar[2], R.
[1]Deptt. of Anatomy, Gian Sagar Dental College, Rampur, Banur, Punjab, India,
Email: *rprashardr1195@rediffmail.com*
[2]Govt. Medical College, Patiala-147001, Punjab, India.
[3]Maharishi Markendeshwar Institute of Medical Sciences, Mullana-Ambala, Haryana, India.

Abstract

The study was done on 60 upper limbs (56 males and 4 females) of embalmed adult human cadavers obtained from the department of anatomy, govt. Medical college, patiala. The muscle fibre length, tendon length and total muscle length of the anterior group of forearm muscles were measured in all the 60 upper limbs. Amongst wrist flexors Flexor Carpi Ulnaris had the longer muscle belly than Flexor Carpi Radialis. In Flexor Digitorum Superficialis (FDS), FDS-Index had the longest muscle belly. In Flexor Digitorium Profundus (FDP), FDP-Middle had the longest muscle belly. The Pronator Quadratus had the smallest muscle belly with no tendon. Ratio of Muscle Fibre Length and Total Length for Flexor Carpi Ulnaris was more than Flexor Carpi Radialis. In FDS it was maximum for FDS-Index and in FDP it was maximum for FDP-Ring. As muscle length is related to the isokinetic strength, it is believed that the isokinetic strength of FCU is more than FCR and among FDS it is higher for FDS-Index and in FDP for FDP-Ring.

Keywords: Isokinetic Strength, Muscles, Muscle-Fibre-Tendon Ratio, Tendon Compliance

Introduction

Motions are the result of co-ordination by a number of muscles and tendons, some of them causing most of the motion, other deviating the direction of the motion and still other holding back the motion to make it slow and controlled (*Bunnel, 1948*).

The functional effect of a long, compliant tendon in series with muscle fibres was to increase the functional operating range of the muscle- tendon unit. The tendon compliance had its greatest functional effect in muscle- tendon unit with high tendon length/fibre length ratios. Thus in addition to muscle architecture, tendon length and tendon properties can also be considered important design criteria, which should be considered in transfer procedure *(Zajac, 1989)*.

Tendon injuries are one of the most problematic in hand surgery with respect to the restoration of normal function. To deal with these problems adequately, it is also essential to know certain facts about flexor tendon anatomy, function and physiological behaviour (*Kleinert et al, 1986*).

Tendon transfers are used primarily to improve function following damage to major nerve trunks, the brachial plexus or the cord and the brain and to substitute for motion lost through trauma to muscles in the forearm and the hand *(Boyes, 1970)*.

Materials & Methods

The material for this study comprised of 60 upper limbs (56 males and 4 females) of embalmed adult human cadavers obtained from the department of Anatomy, Govt. Medical College, Patiala.

The specimens were dissected to expose the muscles and tendons of flexor compartment of the forearm. The length of the fleshy part of the muscle was measured as the distance from the origin of the most proximal muscle fibres to the insertion of the most distal fibres into the tendon of the muscle. The length of the tendon was taken from the beginning of the tendon from the muscle fibre to its bony insertion and the total length of the muscle was measured from the origin of the most proximal muscle fibres to the bony insertion of tendon.

Unbraided silk thread was placed along the whole length of the fleshy part of the muscle. The most proximal and most distal points were marked with Indian ink. The length was calculated using metal measuring roller. Length of tendon and total length of the muscle was also taken in a similar manner. In case of multiple tendons of a muscle, the length of the longest and shortest tendon was recorded and average tendon length was calculated.

Muscle fibre – tendon ratio was calculated according to the following equation:

$$\text{Muscle Fibre to Tendon Ratio} = \frac{\text{Length of the fleshy part of the muscle}}{\text{Tendon length}}$$

$$\text{Muscle fibre to Total muscle length ratio} = \frac{\text{Length of the fleshy part of the muscle}}{\text{Total Muscle length}}$$

Results & Discussion

Table 1: Average Muscle fibre length, Tendon length and total muscle length

Muscles	MFL (cm)	TDL (cm)	TL (cm)	MFL :TDL	MFL :TL
PT	13.84 ±1.97	6.73 ±1.58	14.78 ±2.18	2.14 ±0.48	0.9 ±0.05
FCR	16.28 ±1.97	18.0 ±3.03	32.31 ±3.15	0.94 ±0.24	0.50 ±0.05
PL	12.40 ±1.75	18.19 ±2.40	28.61 ±3.03	0.63 ±0.25	0.43 ±0.04
FCU	23.69 ±2.50	10.35 ±2.90	31.52 ±3.86	2.50 ±0.87	0.75 ±0.04
FDS-I	22.19 ±2.02	18.37 ±0.37	38.91 ±2.32	1.21 ±0.11	0.57 ±0.03
FDS-M	17.99 ±0.81	21.64 ±2.81	38.21 ±3.03	0.85 ±0.11	0.47 ±0.03
FDS-R	15.65 ±0.43	18.98 ±2.38	33.15 ±1.17	0.81 ±0.04	0.47 ±0.01
FDS-S	10.42 ±0.54	15.28 ±1.04	23.89 ±1.10	0.69 ±0.07	0.44 ±0.02
FPL	15.96 ±1.64	17.49 ±0.84	30.80 ±2.31	0.92 ±0.11	0.52 ±0.02
FDP-I	13.29 ±0.56	29.77 ±2.38	40.60 ±2.30	0.45 ±0.04	0.33 ±0.02
FDP-M	21.48 ±2.96	25.99 ±3.05	43.98 ±4.40	0.84 ±0.18	0.49 ±0.05
FDP-R	20.47 ±0.52	17.72 ±2.05	35.59 ±1.68	1.15 ±0.11	0.58 ±0.03
FDP-S	15.79 ±0.70	16.23 ±1.40	29.36 ±1.59	0.98 ±0.11	0.54 ±0.03
PQ	4.12 ±0.47	-	-	1	-

PT – Pronator teres, FCR – Flexor carpi radialis, PL – Palmaris longus, FCU – Flexor carpi ulnaris, FDS-I – Flexor digitorum superficialis – Index, FDS-M - Flexor digitorum superficialis – middle, FDS-R - Flexor digitorum superficialis – Ring, FDS-S Flexor digitorum superficialis – Small, FPL – Flexor pollicis longus, FDP-I – Flexor digitorum profundus – Index, FDP-M - Flexor digitorum profundus – Middle, FDP-R - Flexor digitorum profundus – Ring, FDP-S - Flexor digitorum profundus – small, PQ – Pronator quadratus, TDL-Tendon length, TL – Total length, MFL – Muscle fibre length.

In the present study, the muscle fibre length, tendon length and total muscle length of the anterior group of forearm muscles were measured in all the 60 upper limbs. Amongst wrist flexors FCU had the longer muscle belly (23.69±2.50 cm) than FCR (16.28±1.97 cm). In flexor digitorum superficialis FDS-I had the longest muscle belly (22.19±2.02cm).

In flexor digitorum profundus FDP-M had the longest muscle belly (21.48±2.96 cm). The PQ had the

smallest muscle belly (4.12±0.47 cm) and there was no tendon for this muscle. The length of the muscle belly of PT was 13.84±1.97 with shortest tendon i.e. 6.73±1.58cm.

Table 2. Comparison between the lengths of anterior group of forearm muscles

MFL(cm) Muscles	*Lieber et al* (1992)	Present study (2003)
PT	13.0 ± 0.47	13.84 ± 1.97
FDS-I	20.7 ± 1.07	22.19 ± 2.02
FDS-M	18.3 ± 1.15	17.99 ± 0.81
FDS-R	15.5 ± 0.77	15.65 ± 0.43
FDS-S	10.3 ± 0.63	10.42 ± 0.54
FDP-I	14.9 ± 0.38	13.29 ± 0.56
FDP-M	20.0 ± 0.82	21.48 ± 2.96
FDP-R	19.4 ± 0.70	20.47 ± 0.52
FDP-S	15.0 ± 0.47	15.79 ± 0.70
FPL	16.8 ± 1.0	15.96 ± 1.64
PQ	3.9 ± 0.23	4.26 ± 0.66

The present findings of the muscle lengths were compared with those of Lieber et al 1992 and were found to be in accordance with there findings (Table 2).

The ratio between muscle fibre length and tendon length (MFL: TDL) and ratio between muscle fiber length and total muscle length (MFL: TL) had been studied and calculated as shown in table-1.

The MFL:TL for FCU (0.75±0.04) was more than FCR (0.50±0.05) and in FDS it was maximum for FDS-I i.e. 0.57±0.03 and in FDP it was maximum for FDP-R i.e. 0.58±0.03

Tendon length was studied because it is one of the important parameter for the selection of muscle during tendon transfer procedure. A tendon transfer is that procedure in which the tendon of insertion or of origin of a functioning muscle is mobilized, detached or divided and reinserted into a bony part or into another tendon to supplement or substitute for the action of the recipient tendon.

A theoretical review by *Zajac (1989)* suggested that functional effect of a long compliant tendon in series with muscle fibres was to increase the functional operating range of the muscle tendon unit. He demonstrated that tendon compliance had its greatest functional effect in muscle tendon unit with high tendon length to fiber length ratio. Thus in addition to muscle architecture, tendon lengths and tendon properties can also be considered important design criteria which should be considered in transfer procedure.

The contractile component seems to determine the strength of a muscle which was also supported by *Behncke (1998)* in his study on human dorsal and plantar flexor muscles that increase in gross muscle length, a muscle tendon ratio indicating a longer muscle length is positively related to maximal isokinetic strength in the lower limb.

Hence the findings in the present study suggest that the isokinetic strength of FCU is more than FCR and among FDS it is maximum for FDS-I and in FDP for FDP-R.

References

Bunnel, S. 1948. Phylogeny and Comparative Anatomy. In: *Surgery of the Hand*. 2nd Edition. J.B. Lippincott Company, 3-29.

Boyes, J.H. 1970. Tendon. In: *Bunnell' Surgery of the hand*. 2nd Edition J.B Lippincott Company, 393-436

Behncke, L. 1998. *Relationship between muscle tendon ratios, muscle morphology,*

isokinetic strength and reactive strength characteristic in human dorsi and plantar flexor muscle. Faccioni Publications, Australia

Kleinert, H.E., Kalisman, M. and Steyers, C.M. 1986. Complications in flexor tendon injuries. In: *Complication in Hand Surgery* by Boswick, J.A. W.B.Saunders Company, 19-22.

Zajac, F.E. 1989. Muscle and tendon properties, models, scaling and application to biomechanics and motor control. *Crate. Rev. Biomed. Eng.* **17:** 359-411.

Lieber, R.L., Jacbson, M.D., Fazeli, B.M. et al. 1992. Architecture of selected muscles of the arms and forearm: Anatomy and implications for tendon transfer. *The Journal of Hand Surgery*, **17A(5):** 787-98.

Journal of Exercise Science and Physiotherapy, Vol. 5, No. 1: 38-41, 2009

Personality Hardiness of Indian Coaches in Relation to their Age and Coaching Experience

Sandhu[1], K.S., Sharma[2], R.K. and Singh[3], A.

[1]Lecturer in Physical Education, Guru Nanak College, Killianwali, District Mukatsar, Punjab, India

[2]Director, Sports, Punjabi University, Patiala-147002, Punjab, India

[3]Deptartment of Psychology, Punjabi University, Patiala-147002, Punjab, India

Abstract

The study was conducted on 400 coaches of different sports disciplines between the age range of 30 to 55 years and having coaching experience of 5 to 25 years. The objectives of the study were to study the three dimensions of personality hardiness i.e. commitment, control and challenge among coaches in respect to their age level and to know the significant differences on three dimensions of personality hardiness among coaches of different levels of coaching experience. The coaches of the present sample were divided into three age groups i.e. coaches up to the age of 35 years (N=41); coaches between 35 to 45 years (N=199) and coaches above 45 years (N=160). The short version of Hardiness scale developed by *Kobasa et al (1982)* was used to assess the hardiness of the subjects. The comparison of the mean scores of three groups of coaches formed on the basis of their age level reveal that as age increases, the commitment of the coaches also go on increasing. The same trend was observed in case of control; the coaches above 45 years in age have better control (M=38.74) as compared to younger coaches up to 35 years (M=36.10) and coaches of 35 to 45 years (M=37.80). In the case of challenge, of course, the same trend is followed, however the results were not found to be significant statistically. Coaches were also compared on the three dimensions of personality hardiness on the basis of experience level of the coaches. Coaches were divided into three groups i.e. coaches having experience up to 10 years (N=36), between 10 to 20 years (N=206) and above 20 years (N=158). Comparison of means scores indicate that as experience of the coaches was increasing, their commitment level was also increasing.

Keywords: Commitment, Control, Challenge, Age level, Coaching experience

Introduction

During the last few years, some personality variables have attracted the attention of researchers in the correlates of job stress and burnout. One of the correlates is Personality hardiness. *Kobasa et al (1982)* explored the concept of personality hardiness as a resistance resource that mediates the negative consequence of high level stress. The concept of hardiness focuses on the person that remains relatively healthy after experiencing high amounts of stressful life events. Psychological hardiness *(Kobasa, 1982)* is conceived of as a personality based tendency to diminish the impact of stressful life events by optimistic cognitive appraisals and decision copying actions. It is defined as a constellation of three dispositions - commitment, control and challenge. These dispositions influence cognitive appraisal and behaviour in response to stressful events.

Shirkan (2000) concluded that there was a significant positive correlation between personality scale of hardiness and perceived stress and psychological symptoms among college, varsity athletes and college non-athletes. According to *Crust (2000)* a few studies had attempted to transfer the concept of hardiness to sports and exercise settings. *Bawa (2005)* concluded in this study that (i) Commitment has been found to have significant relationship with control,

challenge and total scores of hardiness in case of athletic, gymnastic, hockey, wrestling coaches, (ii) there is a positive significant correlation between challenge and control dimension with the total scores of hardiness in case of athletes, gymnastics, boxers, wrestling, football, hockey coaches. Hence it was considered proper to study personality hardiness of the Indian coaches.

The objectives of the present study were: (i) to study the three dimensions of personality hardiness i.e. commitment, control and challenge among coaches in respect of their age level; (ii) know the significant differences on three dimensions of personality hardiness among coaches of different levels of coaching experience. It was hypothesized that significant differences would exist on the three dimensions of personality hardiness among coaches of different age levels and having different levels of coaching experience.

Material & Methods

The sample of the study consisted of 400 coaches of different sports disciplines between the age range of 30 to 55 years and having coaching experience of 5 to 25 years. They belonged to 12 different games like; athletics (40) Badminton (30), boxing (30), cycling (25), gymnastics (40), wrestling (30), basketball (40), football (35), handball (40), hockey (25), kabaddi (35), and volleyball (30).

The short version of Hardiness scale developed by *Kobasa et al (1982)* was used to assess the hardiness of the subjects. This scale contains 36 items in all that assesses the attitude of the subject on the three dimensions such as commitment (12 items), control (16 items) and challenge (8 items). *Kobasa et al (1982)* have shown reliability co-efficient of 0.86. This test was administered to 400 coaches of different games at their places of posting individually as well as in small groups. The scoring of each of the three dimensions of personality hardiness was done as per the directions given in the test manual. The raw scores were statistically analyzed and results were interpreted accordingly.

Results & Discussion

In the present investigation, three dimensions of personality hardiness of coaches were studied on the basis of three age groups and three experience groups of coaches. The coaches of the present sample were divided into three age groups i.e. coaches up to the age of 35 years (N=41); coaches between 35 to 45 years (N=199) and coaches above 45 years (N=160). Their means, SDs and SEs were calculated separately on three dimensions of personality hardiness as well as total hardiness. In order to find out the significant difference on the mean scores of these variables; one way simple ANOVA was applied.

Table-1 Means and SDs of three Components of Personality Hardiness

AGE GROUP	N	Commitment			Control			Challenge			Total		
		M	SD	SE	M	SD	SE	M	SD	SE	M	SD	SE
Up to 35 years	41	20.27	4.32	0.674	36.10	4.36	0.68	19.961	3.11	0.48	57.09	8.88	1.39
Between 35-45 years	199	22.29	5.37	0.38	37.80	5.86	0.41	20.78	3.35	0.23	57.81	11.84	0.84
Above 45 years	160	22.58	4.52	0.36	38.74	6.05	0.48	21.14	4.02	0.32	57.04	13.89	1.09

Table-2: ANOVA of scores of three components of personality hardiness in relation to three age level

Variables Of Personality Hardiness	Source Of Variation	SS	DF	MS	F
Commitment	Between	177.91	2	88.96	3.64
	Within	9696.09	397	24.42	P<.05
Control	Between	244.53	2	122.27	3.63
	Within	13367.46	397	33.67	P<.05
Challenge	Between	47.29	2	23.64	1.83
	Within	5127.15	397	12.915	NS
Total	Between	57.75	2	28.877	0.19
	Within	61572.42	397	155.09	NS.

These results reveal that significant differences were found only in case of commitment (F=3.64, p<0.05) and control (F=3.63, p<0.05) and not in case of challenge (F=1.83, NS) and total hardiness (F=0.19, NS). The comparison of the mean scores of three groups of coaches formed on the basis of their age level reveal that as age increases, the commitment of the coaches also go on increasing; as it is evinced that the mean scores stand contrasted to 20.27, 22.29 and 22.58 for three groups of age levels. The same trend was observed in case of control; the coaches above 45 years in age have better control (M=38.74) as compared to younger coaches up to 35 years (M=36.10) and coaches of 35 to 45 years (M=37.80). In the case of challenge, of course, the same trend is followed, however the results were not found to be significant statistically.

Coaches were also compared on the three dimensions of personality hardiness on the basis of experience level of the coaches. Coaches were divided into three groups i.e. coaches having experience up to 10 years (N=36), between 10 to 20 years (N=206) and above 20 years (N=158). The mean scores, SDs, and SEs were calculated and F values were computed in order to find out the significant differences between the mean scores of the coaches belonging to three different groups formed on the basis of their experience level. The results are given in Table 3 and 4.

Table -3: Means and SDs of three Components of Personality Hardiness on the basis of Experience

EXPERIENCE	N	Commitment			Control			Challenge			Total		
		M	SD	SE	M	SD	SE	M	SD	SE	M	SD	SE
Upto 10 years	36	20.03	4.33	0.72	36.00	4.31	0.72	19.81	3.15	0.52	58.17	8.03	1.34
Between 10-20 years	256	22.23	5.33	0.37	37.78	5.85	0.41	20.73	3.33	0.23	57.58	11.82	0.82
Above 20 years	158	22.65	4.51	0.36	38.76	6.03	0.48	21.21	3.98	0.32	57.08	13.98	1.11

Table-4: ANOVA of three components of Personality Hardiness in relation to three experience levels

Variables Of Personality Hardiness	Source Of Variation	SS	DF	MS	F
Commitment	Between	202.36	2	101.179	4.15
	Within	9671.64	397	24.36	P<.05
Control	Between	245.40	2	122.701	3.64
	Within	13366.59	397	33.67	P<.05
Challenge	Between	63.34	2	31.67	2.46
	Within	5111.10	397	12.87	P<.05
Total	Between	43.832	2	21.92	0.14
	Within	61586.35	397	155.13	N.S.

It was observed from the results that the significant differences existed on three variables of personality hardiness, i.e. commitment (F=4.15, p<0.05), control (F=3.64, p<0.05) and challenge (F=2.46, p<0.05) but not in case of total hardiness. Comparison of means scores indicate that as experience of the coaches was increasing, their commitment level was also increasing as means are 20.03, 22.23 and 22.65. The same trend was observed in case of control as the mean scores were

found to be 36.00, 37.78 and 38.76 for coaches of up to 10 years experience, between 10 to 20 years and above 20 years respectively. It was also observed that in case of challenge; the same trend was noticed as means stand contrasted to 19.81, 20.73 and 21.21 for the coaches of three different experience levels.

The hypothesis of the study that significant differences would exist on the three dimensions of personality hardiness among coaches of different age level and having different levels of coaching experience was partially accepted in case of age groups but fully accepted in the case of experience group.

Conclusions

On the basis of the above findings; the following conclusions can be drawn which may be considered as the highlights of the study:

Significant differences are observed on commitment and control dimensions and not on challenge and total hardiness on the basis of age level; where coaches above the age of 45 years are more committed and have better control.

Coaches on the basis of different levels of experience differ on all the three dimensions of personality hardiness. Coaches with experience of more than 20 years are more committed, better in control and challenge dimensions of hardiness as compared to the coaches with experience of less than 10 years and between 11 to 20 years.

References

Bawa, H. 2005. *Study of Personality Hardiness, Traits Anxiety and Burnout among coaches*, Unpublished Ph.D. thesis Physical Education. Kurukshetra University, Kurukshetra.

Kobasa, S.C. 1982. *The Hardiness Test* (3rd ed.) New York, Hardiness Institute.

Kobasa, S.C., Maddi, S.R., Kahn, S. 1982. Hardiness and health: A Prospective study. *Journal of Personality and Social Psychology*, **42(1):** 168-177.

Crust, L., 2000. *Sports Psychology: Do you have what it takes?* w.w.w.bodybuilding.com.

Shirkan, N. 2000. The relationship of hardiness, sense of coherence, sports participation and gender to perceived stress and psychological symptoms among college students. *Journal of Sports Medicine and Physical Fitness.* **40(1):** 63-70.

Journal of Exercise Science and Physiotherapy, Vol. 5, No. 1: 42-44, 2009

Effects of Phonophoresis on Supraspinatus Tendinitis in Abducted Position and Adducted and Internally Rotated Position of College Men

Muktamath[1], U., Muktamath[2], V. And Maniazhagu[3], D.
[1]Asst. Professor of Physical Education, University of Agricultural Sciences, Dharwad, Karnataka, India
[2]Agricultural Officer, Sirsi, Karnataka, India
[3]Lecturer Department of Physical Education & Health Sciences, Alagappa University, Karaikudi. India

Abstract

The purpose of the study was to analyse the effects of phonophoresis on supraspinatus tendinitis in abducted position and adducted and internally rotated position of college men. Ten college sports men with clinically diagnosed supraspinatus tendinitis in acute state were selected for this study. Their age was between 20 – 25 years and all of them were males. The subjects were randomized into two treatment groups of five each. One of the groups (G1) underwent phonophoresis treatment in abducted position and the other one (G2) underwent phonophoresis treatment in adducted and internally rotated position. Pain due to acute supraspinatus tendinitis was found to be relieved earlier by the phonophoresis in adducted & internally rotated than phonophoresis in abducted position.

Key Words: Phonophoresis, Supraspinatus Tendinitis, Abduction, Adduction, internal rotation

Introduction

Physiotherapy in the sports field has great potential to play a vital role in the prevention of injury, treatment, training and developing a particular skill for an athlete in the specialized field. Proper diagnosis, choosing the appropriate modalities and applying the perfect methods are the pillars of the successful treatment. So choosing the appropriate modality is the key to produce good results.

One of the most common overuse injuries that occur in the upper limb is supraspinatus tendinitis *(Frank, 1986; Ciullo, 1992; David, 1992; Kerstina et al, 1994; Wilder & Sethi, 2004)*. Supraspinatus tendon plays a vital role in all sports and games. Supraspinatus tendinitis is caused by repeated stress or over use injury. In severe cases supraspinatus injury badly hits sports activities and affects the sports men career.

Phonophoresis has been suggested by early studies to enhance the absorption of analgesics and anti-inflammatory agents *(Bare et al, 1996; Kassan et al, 1996)*. *Singh et al (2002)* compared the efficacy of iontophoresis and phonophoresis with diclofenac sodium (1%) in the treatment of shin splints. Evaluation of results showed that both iontophoresis and phonophoresis were effective in introducing the medication deep into the periosteum and adjacent musculo-tendinous structures. More recent, better-controlled studies have consistently failed to demonstrate that phonophoresis increases the rate of absorption or the extent of absorption over placebo. Several reviews stated that more research is needed to ascertain optimal techniques and conditions for safe and efficacious utilization of physical modalities including phonophoresis; and there is a need for additional research to establish clinical effectiveness and determine optimal treatment parameters

for the physical agents (e.g., phonophoresis) used most frequently to alleviate pain. In a review on factors that influence the quality and effectiveness of ultrasound and phonophoresis treatment, *Goraj-Szczypiorowska and colleagues (2007)* noted that although phonophoresis is commonly used among physical therapists, doubts persist as to the relevance and effectiveness of this method. Despite its popularity, the issue of conditions underlying the effectiveness of phonophoresis treatment has still not been adequately addressed.

The present study was conducted to investigate the effects of phonophoresis on supraspinatus tendinitis in abducted position and adducted and internally rotated position of college men.

Material and Methods

Ten college sports men with clinically diagnosed supraspinatus tendinitis in acute state were selected for this study. Their age was between 20 – 25 years. The subjects had symptoms for over various periods ranging between one to two weeks. The subjects were randomized into two treatment groups of five each. First group (G1) underwent phonophoresis treatment in abducted position and the second group (G2) underwent phonophoresis treatment in adducted and internally rotated position. Visual analogue scale was used to assess the progress of the treatment. Visual analogue scale is a widely used subjective evaluation and measurement of intensity of pain. Analysis of covariance was used in the study.

Results and Discussion

Table – 1 illustrates the statistical results of the effects of phonophoresis in abducted and phonophoresis in adducted & internally rotated groups on pain due to acute supraspinatus tendinitis and ordered adjusted means and difference between means of the groups.

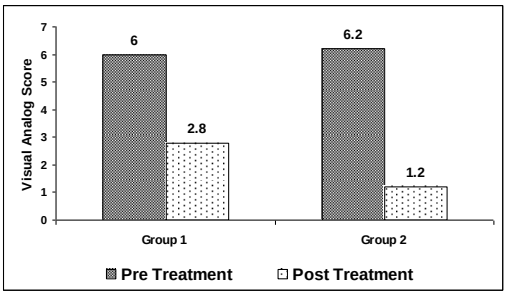
Table: Computation of analysis of covariance of per test, post test and adjusted post test on pain for phonophoresis in abducted position group sand phonophoresis in adducted & internally rotated position groups

Means	G1	G2	Mean Diff	Source of Variance	Sum of Squares	df	Mean Square	F ratio
Pre test means	6	6.2	0.2	B	0.1	1	0.1	0.17
				W	4.8	8	0.6	
Post test means	2.8	1.2	1.6	B	6.4	1	6.4	32
				W	1.6	8	0.2	
Adjusted Post test means	2.84	1.24	1.6	B	14.4	1	14.4	84.7
				W	1.22	7	0.17	
Mean gains	3.2	5	1.8					

G1: Phonophoresis in abducted position group, G2: Phonophoresis in adducted & internally rotated position group
'F' value at 0.05 level for df 1 and 8 is 5.32, for df 1 and 7 is 5.59

The results show the pretest mean of VAS pain score was 6 for phonophoresis in abducted position and 6.2 for phonophoresis in adducted & internally rotated group and the mean difference was 0.2. The obtained F ratio of 0.17 was insignificant at 0.05 level for the degrees of freedom 1 and 8, as the table F ratio was greater than the obtained F ratio. The post test means of the

phonophoresis in abducted group was 2.8 and phonophoresis in adducted and internally rotated group was 1.2 and the mean difference was 1.6. The obtained F ration of 32 was significant at 0.05 level after the degrees of freedom 1 and 8 as the table F ratio was lesser than the obtained F ration.



The adjusted post test means were 2.84 for phonophoresis in abducted group and 1.24 for phonophoresis in adducted and internally rotated group and their mean difference was 1.6. The obtained F ratio of 84.7 was significant at 0.05 level for the degrees of freedom 1 and 7 as the table F ratio was lesser than the obtained F ratio. The mean gain for phonophoresis in abducted group was 3.2 and phonophoresis in adducted and inernally rotated group was 5.

The findings of the study showed that phonophoresis caused significant reduction of pain of acute supraspinatus tendinitis in the Group that underwent phonophoresis treatment in adducted and internally rotated position.

.

Conclusion

Pain due to acute supraspinatus tendinitis was relieved earlier by the phonophoresis in adducted & internally rotated than phonophoresis in abducted position.

References

Bare, A.C., McAnaw, M.B., Pritchard, A.E. et al. 1996. Phonophoretic delivery of 10% hydrocortisone through the epidermis of humans as determined by serum cortisol concentrations. *Phys Ther.*, **76(7):** 738-749.

Ciullo, J. V. 1992. *Shoulder Injuries in Sports Evaluation, Treatment and Rehabilitation*, Human Kinetics: US.

David, R. C. 1992. *Sports Injury Assessment and Rehabilitation*. New York: Churchill Livingstone.

Frank, P. A. 1986. *Upper Extremity Injuries in Athletes*, St. Louis: The C.V. Mosby Company.

Goraj-Szczypiorowska, B., Zajac, L., Skalska-Izdebska, R. 2007. Evaluation of factors influencing the quality and efficacy of ultrasound and phonophoresis treatment. *Ortop. Traumatol. Rehabil.*, **9(5):** 449-458.

Kassan, D.G., Lynch, A.M., Stiller, M.J. 1996. Physical enhancement of dermatologic drug delivery: Iontophoresis and phonophoresis. *J. Am. Acad. Dermatol.*, **34(4):** 657-666.

Kerstina, O., Robyn, G. A., Birgitta, J., Anita, A., Skerfving, S.1994. An assessment of neck and upper extremity disorders by questionnaire and clinical examination. *Ergonomics*, **37(5):** 891 – 897.

Singh A., Sethy G.B., Sandhu J.S. and Sinha A.G.K. 2002. A comparative study of the efficacy of iontophoresis and phonophoresis in the treatment of shin splints. *Physiotherapy*, **1(1):** 17-20.

Wilder, R. and Sethi, S. 2004. Overuse injuries: tendinopathies, stress fractures, compartment syndrome, and shin splints. *Clinics in Sports Medicine*, **23(1):** 55-81.

Life Style and Nutritional Profile of Non-Insulin Dependent Diabetes Mellitus (NIDDM) Patients

Kaur, I. P. and Kalra, R.
Govt. College for Girls, Patiala-147001, Punjab, India

Abstract

The present investigation was undertaken to study the life style and nutritional profile of NIDDM patients. A representative group of 60 respondents belonging to different cities of punjab was selected. General information, dietary information, information about consumption of traditional food adjuncts like bittergourd, jambu and fenugreek seeds, diabetic history and activity pattern was collected. Height, weight and body mass index (BMI) were taken and food intake was recorded by 24 hour recall method. Fasting blood sugar (FBS) levels at the time of diagnosis of disease and prevailing ones at the time of survey were noted from reports of diagnostic laboratories. Observations showed that the majority of respondents were overweight and over 40 years of age with FBS levels of 200-300 mg/dl at the time of diagnosis. All respondents had general awareness regarding control of diabetes. Majority was consulting doctors, dieticians, was regular in walk and other exercises and was consuming glucose lowering food adjuncts. About 50% maintained fair to good control over diabetes. Data showed a definite decrease in their FBS levels. Mean daily intakes of energy and other essential nutrients except iron were adequate. Findings of study indicate that by modifying diet and life style one can maintain fair control over diabetes.

Key Words: Fasting Blood Sugar, BMI, Obese, Traditional Food Adjuncts, Food Habits

Introduction

Diabetes mellitus is one of the most burdensome chronic diseases that are increasing in epidemic proportion throughout the world *(Mageshwari et al, 2004)*. According to *WHO (2000)*, the global prevalence of non-insulin dependent diabetes mellitus (NIDDM) will more than double from 135 million in 1995 to 300 million by 2025.The largest number of diabetic subjects is in India *(Pradeepa et al, 2002)*. Obesity and physical inactivity constitute part of the risk for NIDDM because of their propensity to induce insulin resistance. There is renewed interest in the prevention of insulin resistance and NIDDM through lifestyle interventions like physical activity and nutritional plan with reduced caloric intake *(Kelly, 2003)*. Fiber rich foods and foods known to possess glucose lowering activity may be accorded some preference in the design of diabetic diets. Since food and dietary pattern of an individual have an important role to play in the development, treatment or prevention of NIDDM, the present study focuses attention on food habits, consumption of traditional food adjuncts with glucose lowering activity, activity patterns and nutritional profile of selected NIDDM patients.

Materials and Method

A group of 60 subjects, both male and female above the age of 30 years diagnosed clinically and chemically with NIDDM belonging to different cities of Punjab i.e. Jalandhar, Ludhiana and Patiala was selected. Information regarding the socio-personal and dietary profile of all selected subjects was collected though pre-tested questionnaire cum interview method. The relevant data on diabetic history of the subjects regarding awareness and control of

diabetes, consumption of traditional food adjuncts like bitter gourd, jambu and fenugreek seeds and activity patterns was noted. Anthropometric measurements of height, weight and BMI were taken using standard methods of *Jelliffe (1966)*. Food intake was recorded by "24 hour recall method" for three consecutive days and average daily intake of nutrients was calculated using standard food composition tables *(Gopalan et al, 1989)*. Fasting blood glucose levels at the time of diagnosis of disease and prevailing ones were noted from the reports of clinical and diagnostic laboratories.

Results and Discussion

The results revealed that 60 subjects (40 male and 20 female) selected for this study were in the age group of 30-60 years and majority was over 40 years of age and belonged to nuclear families with monthly income of more than Rs 10000. Food habits revealed that 48 per cent were lacto-vegetarian, 25 per cent ova-vegetarian and 27 per cent were non-vegetarian. None of the female subjects was non-vegetarian. Non-vegetarians consumed fish and chicken once weekly or fortnightly. None of them consumed mutton or pork.

Majority of the subjects had regular meal timings and did not nibble in between meals. Taste and nutrition were the major considerations for selecting food and cost did not matter. Majority did not skip meals or observe fasts and were eating out occasionally. A good number of subjects were consuming whole wheat and mixed flour, pulses, salads, skim milk and avoided sugar, alcohol and smoking. About one-third of the subjects used artificial sweetener in tea/coffee/milk and other sweet preparations like halwas and puddings. Almost all the subjects were consuming Marie biscuits daily. Majority of the subjects (92 per cent) consumed bitter gourd as vegetable, juice or dry powder, 30 per cent consumed fenugreek seeds in different preparations and as such in soaked or powdered form and 20 per cent consumed dry jambu seed powder.

The data showed that all the subjects had general awareness regarding control of diabetes. About 50 per cent cases of diabetes were diagnosed in the age group of 35-45 years. *Sughanthi and Sardha (1991)* and *Snehalatha et al (2003)* have reported that prevalence of diabetes was higher after 40 years of age. Majority of the subjects had fasting blood glucose (FBG) levels in the range of 200-300 mg/dl and a few of them (8 per cent) had FBG level more than 400 mg/dl at the time of diagnosis of disease (Table 1)and all of them were put on medicine.

Table 1: Fasting blood glucose levels at the time of diagnosis

Fasting blood glucose level (mg/dl)	Subjects (n=60)	
	Number	Percentage
<200	18	30
200-300	28	47
300-400	9	15
>400	5	8

A few of them discontinued medicine after sometime and they controlled diabetes by following other practices like walking, yoga and use of traditional food adjuncts while rest of the subjects (77 per cent) continued with oral hypoglycemic drugs. Majority of the subjects (58 per cent) had family history of diabetes with one or more family members suffering from diabetes. 65 per cent of the subjects were not suffering from any other disease whereas 35 per cent had cardiovascular disease. *Magheswari et al (2004)* and *Coulston (2004)* have reported cardiovascular

diseases to be the most prevalent form of complications among diabetics.

Activity patterns showed that all the subjects were leading sedentary lives but majority (72 per cent) were regular in their daily walk and some performed other exercises like yoga, jogging, cycling, swimming etc. A study by *American Diabetic Association (2004)* has demonstrated a consistent beneficial effect of regular physical activity training on carbohydrate metabolism and insulin sensitivity.

The anthropometric data showed that the average weight of both male and female subjects was more than ideal body weight (Table 2).

Table 2: Mean anthropometric measurements of NIDDM subjects

Parameters	Male (n=40)	Female (n=20)
Height (cm)	171.5±5.02	156.7±2.40
Weight (kg)	80.05±7.44	68.9±9.04
Ideal body weight* (kg) (height in cm-100)	72	57

*Calculated using Broka's index

Majority of them fell in overweight/obesity category according to *WHO (2000)* classification of BMI (Table 3). *Vandam and Hujb (2001)* and *Radbard (2002)* have reported obesity to be one of the major risk factors for the development of type II diabetes.

Table 3: Distribution of subjects according to WHO (2000) criteria of BMI

Classification	BMI (kg/m²)	Subjects(n=60)	
		Number	Percentage
Under weight	<18.5	--	--
Normal	18.5-22.9	9	15
Over weight	23.0-24.9	17	28
Obese grade I	25.0-29.9	10	17
Obese grade II	≥30.0	24	40

Table 4 shows data on daily intake of different food groups by NIDDM subjects. Average intake of cereals, milk and milk products, fats and oils was more than the suggested intakes of *Raghuram et al (1993)* for diabetic subjects. Average intake of fruits was just adequate and that of vegetables was less than the suggested intakes. Average intake of pulses was less than the suggested intakes for female subjects. It was more than the suggested intake for both lacto-vegetarian and non-vegetarian male subjects and compensated for lower intake of meat and poultry for non-vegetarians. The consumption of sugar and jaggery was negligible as most of the subjects avoided it after the diagnosis of disease.

Table 4: Daily food intake by NIDDM subjects

Food groups g/day	Female (n=20)			Male (n=40)					
				Lacto-vegetarian (n=9)			Non-vegetarian (n=31)		
	Mean±S.D.	Suggested intake*	Per cent adequacy	Mean±S.D.	Suggested intake*	Per cent adequacy	Mean±S.D.	Suggested intake*	Per cent adequacy
Cereals	193.3±12.2	150	128.8	260.0±18.1	225	115.5	285.0±20.8	250	114.0
Pulses	51.0±8.3	60	85.0	68.0±8.9	60	113.0	32.0±22.2	20	160.0
Green leafy vegetables	143.3±40.2	200	71.7	165.0±28.1	200	82.5	185.0±38.6	200	92.5
Other vegetables	150.4±38.1	200	75.2	175.0±24.5	200	87.5	195.0±28.6	200	97.5
Roots & tubers	110.0±30.0	NA	--	140.0±30.0	NA	--	130.0±14.0	NA	--
Fruits	94.0±8.4	100	94.0	112.5±18.0	100	112.5	98.0±15.1	100	98.0
Milk and milk products	397.5±28.3	300	132.3	485.0±72.4	300	161.0	198.5±34.1	150	132.3
Fats and oils	22.5±4.54	10	225.0	23.5±7.0	15	156.6	32.7±8.4	20	163.5
Meat and poultry	--	--	--	--	--	--	43.8±33.3	70	62.5
Sugar and jaggery	--	--	--	--	NA	--	0.47±1.68	NA	--

* *Raghuram et al (1993)*, NA-Data not available

Table 5 presents data on daily energy and nutrient intake by NIDDM subjects. Mean intakes of energy, carbohydrate, protein, total fat, dietary fibre, ascorbic acid and calcium were observed to be adequate while intakes of riboflavin and niacin were marginally inadequate. Mean intake of iron was inadequate for male subjects and grossly inadequate for female subjects. Higher intake of energy from all the three sources i.e. carbohydrate, fat and protein could be one of the hindering factors in effective management of diabetes as *Sudha et al (2004)* have reported that the most effective dietary management for type II diabetes is caloric restriction for weight reduction.

Table 5: Daily nutrient intake of NIDDM subjects

Nutrient	Female (n=20)			Male (n=40)					
				Lacto-vegetarian (n=9)			Non-vegetarian (n=31)		
	Mean±S.D.	RDA	Per cent adequacy	Mean±S.D.	RDA	Per cent adequacy	Mean±S.D.	RDA	Per cent adequacy
Energy, Kcal	1413.0±74.6	1200*	117.7	1834.4±89.6	1500*	122.2	2020.0±101.2	1500*	134.6
CHO, g	220.0±20.8	189*	116.4	284.0±38.3	236*	120.3	310.0±42.8	236*	131.3
Protein, g	62.0±17.4	48*	129.0	79.8±7.3	58*	137.5	87.0±12.8	58*	150.0
Total fat, g	32.5±10	28*	116.0	41.6±3.7	36*	115.5	48.3±10.4	36*	134.0
Dietary fibre, g	11.9±4.9	10*	119.0	13.8±3.0	10*	138.0	15.6±4.2	10*	156.0
Ascorbic acid, mg	118.0±15.8	40**	295.0	124.0±20.4	40**	310.0	134.8±14.8	40**	335.0
Vitamin A, µg	1188±468.2	600**	198.0	1308.7±425.6	600**	218.1	1514.0±380	600**	252.0
Thiamine, mg	1.1±0.2	0.9**	122.2	1.6±0.3	1.2**	129.1	1.7±0.9	1.2**	141.6
Riboflavin, mg	0.95±0.2	1.1**	86.4	1.2±0.3	1.4**	85.0	1.4±0.3	1.4**	96.4
Niacin, mg	11.09±0.9	12**	92.4	12.8±1.9	16**	80.0	14.2±1.5	16**	88.75
Iron, mg	11.8±2.7	30**	39.3	19.8±2.7	28**	70.7	22.4±3.4	28**	80.0
Calcium, mg	901.2±66.7	400**	225.3	1037.7±88.6	400**	259.4	1198.0±90.8	400**	299.5

* Raghuram et al (1993), ** ICMR (1989)

Table 6 shows that 51 per cent of the subjects were maintaining fair to good control on their fasting blood glucose levels (< 130 mg/dl) while 49 per cent had fasting blood glucose levels higher than 130 mg/dl and had poor control on fasting blood glucose

Table 6: Current fasting blood glucose levels

Fasting blood glucose levels (mg/dl)	Degree of control*	Subjects (n=60)	
		Number	Percentage
<110	Good	11	18
110-130	Fair	20	33
>130	Poor	29	49

**Srilakshmi (2000)*

When compared with fasting blood glucose levels at the time of diagnosis of diabetes (Table 1) data showed a definite decrease in their fasting blood glucose levels.

Conclusion

The study has revealed that rate of prevalence of diabetes is more among overweight/obese people and by modifying diet and lifestyle, doing exercise regularly and by consumption of traditional food adjuncts one can control diabetes without or with minimum dose of medicine. Diabetes is not curable; one has to live with it. Living with diabetes is like living with diabetic lifestyle. There is

urgent need to create awareness amongst the population for prevention of diabetes.

References

American Diabetes Association 2004. Physical Activity/Exercise and Diabetes. Diabetes Care, **27:** S58-S62.

Coulston, A. M. 2004. Cardiovascular disease risk in women with diabetes needs attention. Am. J. Clin. Nutr., **79:** 931-932.

Gopalan, C., Ramasastri, B.V. and Balasubramaniam, S.C. 1989. Nutritive value of Indian foods, NIN, ICMR, Hyderabad.

Jelliffe, D.B. 1986. The assessment of nutrition status of the community. World Health Organization Monograph Series No. 53, Geneva: 50-84.

Kelly, D.E. 2003. Sugars and starch in the nutritional management of diabetes mellitus. Am. J. Clin. Nutr., **78(8):** 58S-64S.

Mageshwari, U., Joseph, S. and Minitha, S. 2004. Pattern of cardiovascular complications among diabetics. Ind. J. Nutr. Dietet., **41:** 507.

Pradeepa, R., Deepa, R. and Mohan, V. 2002. Epidemiology of diabetes in India-current perspective and future projections. J. Indian Med. Assoc. **100:** 144-8.

Radbard 2002. Treatment of type II diabetes. The American Association of Clinical Endocrinologists meeting, May 2002. Diabetes Care., **25:** 1644-1649.

Raghuram, T.C., Pasricha, S. and Sharma, R.D. 1993. Diet and diabetes. NIN, ICMR, Hyderabad.

Snehalatha, C.,Ramchandran, A., Kapur, A. and Vijay, V. 2003. Age-specific prevalence and risk association for impaired glucose tolerance in urban southern India population. J. Assoc. Physicians India,. **51:** 756-7.

Srilakshmi, B. 2000. Dietetics. 3rd edition, New Age International Pvt. Ltd., New Delhi, p 196.

Sudha, V., Radhika, G. and Mohan, V. 2004. Current dietary trends in the management of diabetes. Ind. J. Med. Res., **120:** 4-8.

Suganthi, S. and Sardha, V. 1991. Prevalence of hypertension in diabetes mellitus and impact of diet counseling. Ind. J. Nutr. Dietet., **28:** 238-242.

Vandam, R. M. and Hujb 2001. Diet and risk of type II diabetes: the role of types of fat and carbohydrate. Diabetologia., **44:** 805-817.

WHO (World Health Organization) 2000. The Asia-Pacific perspective redefining obesity and its treatment. International Diabetes Institute. Health Communications Australia Pvt. Ltd. Geneva. levels.

Comparison of Two Methods of Moving A Manual Wheelchair Short Distances on Leveled and Inclined Surfaces

Bharti[1], G. and Nanda Kumar[2], T.R.
[1]Lecturer, St. Soldier College of Physiotherapy & Rehabilitation, Basant Vihar, Vill. Khambra, Nakodar Road, Jalandhar. E-mail: glow_bharti@yahoo.com
[2]Head of Department of Physiotherapy, Dolphin (PG) Institute of Bio-Medical & Natural Sciences, Dehradun.

Abstract

The aim of this study was to determine, which method is more effective while moving a manual wheelchair short distances on four and rear wheels over two surfaces (leveled and inclined) for the attendant or caregiver. It was an observational study design consisting of normal healthy male [N=30] subjects, aged 20-30 yrs. Subjects used both methods i.e. moving a manual wheelchair first on four and then on rear wheels over leveled and inclined surfaces. Distance of 10 m was used. After completion of both trials, subjects used 10 cm Visual Analog Scale (VAS) to quantify, how they perceived, (i) the ease of use (ii) efficiency and (iii) back discomfort. Paired 't' test for all the variables between four and rear wheels over the two surfaces shows significant difference with p- value <0.05. This concludes moving the wheelchair on four wheels over the two surfaces is faster, easier, efficient and more comfortable for the back than on rear wheels.

Key Words: Wheelchair, Leveled Surface, Inclined Surface, Four Wheels, Rear wheels

Introduction

A personal caregiver is an important element for many people with activity restrictions, in the rehabilitation process. Wheelchair users who require assistance most frequently depend on family members. As a result of the burden of providing assistance, some caregivers may neglect themselves and are at a higher risk of physical harm when providing care (*Kirby et al, 2004*). Moving a manual wheelchair is a common task performed by health care workers and caregivers as the wheelchair is among the most common and important of rehabilitation devices (*Woolfrey & Kirby, 1998*). Wheelchairs are an integral component of medical rehabilitation, their use ranges from short-distance propulsion within the home to long-distance marathon racing.

However, wheelchairs can be difficult to manage and there is potential for acute or overuse injuries to the wheelchair user and/or the caregiver. Lack of wheelchair skill training may also lead to decreased mobility and reduced community access (*Kirby et al, 2004*). If wheelchair users and their caregivers do not know how to overcome obstacles such as rough ground and curbs safely, they may perform this task in poor posture which may lead to back discomfort.

Most commonly, caregivers propel wheelchair from few to several metres per day. The average time spent working with a bent or twisted position of the back like stooped work posture was found to contribute to the prevalence of back pain or discomfort. The other risk factors include heavy physical work, monotonous tasks, sudden maximal physical effort and forceful movements (*Burdorf et al, 1991*). This strongly suggests that job-related rather than personal characteristics are the major predictors of back injury in health care workers and caregivers (*Venning et al, 1987*).

Activities that are usually done on a flat surface can be made more or less resistive by changing the level of the surface. The standard horizontal work surface itself can be raised to make demands on certain muscle groups or to alter the effect of gravity e.g. in wheelchair mobility, activities usually begin on level surfaces (including floors, doorway and elevators) and progress to up a curb or a ramp, over rough and uneven terrain.

Manual wheelchair propulsion in daily life is increasingly being studied. *Kirby et al (2004)* in their study have concluded that the WSTP (wheelchair skill training programme) is a safe, practical and effective method of improving the wheelchair handling skill of untrained caregivers. Such training could play an important role in the rehabilitation process.

In wheelchair mobility methods, two methods are mainly used. They are, moving a wheelchair on four wheels and moving on rear wheels. Propelling wheelchair on rear wheels help to clear objects on the floor, sidewalk or to manage a step. But much attention is not paid to the effect of changes that occur while propulsion of wheelchair on four wheels and rear wheels over leveled and inclined surface. So, the purpose of the study was to determine, which method is more effective while moving a manual wheelchair short distance on four and rear wheels over two surfaces (leveled and inclined) for the attendant or caregiver. To prevent or minimize back injuries, the health care workers and caregivers should be well trained in performing this task. Caregiver training can improve patient handling and moving skills. This could, in turn, reduce caregiver stress and improve the quality of life for both caregiver and wheelchair user (*Kirby et al, 2004*).

To determine which method is more effective while moving a manual wheelchair short distances on four and rear wheels over two surfaces (leveled and inclined).

Material and Method

Thirty males participated in the study. All the subjects were healthy with mean age of 21.9 yrs. Out of 30 subjects, half of the subjects were hospital workers and half of them were students. The study was carried out at Civil Hospital, Patti, Amritsar. The subjects were alert, co-operative and understood the purpose of the study. An informed consent was taken from all subjects.

Inclusion Criteria :

1. Normal healthy subjects.
2. Age 20-30yrs
3. Height 165-175cms
4. Weight 50-70kgs
5. BMI 18.9-24.9

Exclusion Criteria :

1. Musculoskeletal disorders like problem in the back, upper limb and lower limb.
2. Neurological disorders.
3. Cardiac problems.
4. Respiratory problems.
5. Psychological problems.

Instrumentation :

Wheelchair: The wheelchair selected for the study was of a type commonly used in hospital & home setting. It was a manually propelled wheelchair.

VAS: 10-cm Visual Analog Scale (VAS) was used to quantify the subject's perception of ease of use, efficiency & back discomfort. It is a reliable and valid

method for measuring subjective feelings (*Woolfrey & Kirby, 1998; Price et al., 1983*).

Manual Stopwatch was used to measure the time, taken by the subjects to complete the task.

Measuring tape was used to measure 10m distance on the floor and ramp.

Protocol :

Thirty healthy male subjects were randomly assigned for the study, based on the inclusion and exclusion criteria. Study involves single group of 30 males. All the subjects were instructed to move a manual wheelchair on four and rear wheels over two surfaces (leveled and inclined). 10-cm VAS was used to quantify the subject's perception of ease of use, efficiency and back discomfort. Time taken was measured using manual stopwatch.

Based on the inclusion and exclusion criteria, thirty healthy male subjects were recruited for the study. Before the experiment, all the subjects were explained about the procedure, practice trials were performed. Each subject was instructed to move the wheelchair on leveled (floor) and inclined (ramp up) surfaces with wheelchair on four wheels and then on rear wheels. Instructions were given to propel the wheelchair at normal speed, not considering it a sport. Patient care being must.

The weight of the patient taken for the study was 63 kgs. The distance used was 10m (*Wilkinson & Menz, 1997*). Measuring tape was used to mark the distance on the floor and ramp. Subjects were indicated with the start and finish of the move made by chalk. Subjects performed the task at a speed that was normal for them. Rest break of about 45 sec. was given, however if the subjects reported any sustained discomfort, additional rest time was given (*Olendorf & Drury, 2001*).

Manual stopwatch was used to time the move from start to finish. After completion of both trials, subjects used 10cm Visual Analog Scale (VAS) to quantify, how they perceived,

1. The ease of use.
2. Efficiency and
3. Back discomfort of the two methods.

Data Analysis :

Data was analyzed using SPSS software 12.0 version. Mean & Standard deviation of the physical characteristics i.e. age, height, weight & BMI was calculated for the single group subjects.

Paired t-test was done to analyze all the four variables (ease of use, efficiency, back discomfort and time taken) between four and rear wheels over the two surfaces (leveled and inclined).

The significant level of 0.05 was taken for the study.

Results

The mean and standard deviation of age, height, weight & BMI of 30 subjects who participated in the study was found to be 21.9 ± 2.9 years, 169.7 ± 3.8 cms, 60.2 ± 6.2 kg and 20.8 ± 2.0 respectively as given in Table 1.

Table 1: Demographic data of the subjects

	Age (Years)	Height (cm)	Weight (kg)	BMI
Mean	**21.9**	**169.7**	**60.2**	**20.8**
SD	**2.9**	**3.8**	**6.2**	**2.0**

Table 2–Comparison between four and rear wheels on the two surfaces (leveled and inclined) for ease of use

VARIABLE	Mean	±S.D	t	p-value
Eoulsfw	2.5	1.9		
Eoulsrw	4.7	2.8		
Eoulsfw vs Eoulsrw			5.8	.0001
Eouisfw	4.5	2.0		
Eouisrw	5.7	2.1		
Eouisfw vs Eouisrw			2.8	.009

eou=ease of use, ls=leveled surface, is=inclined surface, fw=four wheels, rw=rear wheels

Table 3-Comparison between four and rear wheels on the two surfaces (leveled and inclined) for efficiency

VARIABLE	Mean	±S.D	t	p-value
Eflsfw	2.4	2.2		
Eflsrw	4.4	2.4		
Eflsfw vs Eflsrw			4.9	.0001
Efisfw	4.2	2.0		
Efisrw	5.4	2.0		
Efisfw vs Efisrw			2.9	.006

Ef= efficiency

Table 4:Comparison between four and rear wheels on the two surfaces (leveled and inclined) for back discomfort

VARIABLE	Mean	±S.D	t	p-value
Bdlsfw	2.5	2.3		
Bdlsrw	4.3	2.8		
Bdlsfw vs Bdlsrw			3.9	.0001
Bdisfw	4.4	2.1		
Bdisrw	5.8	2.2		
Bdisfw vs Bdisrw			3.8	.001

Bd=back discomfort

Paired t-test for all the variables (ease of use, efficiency, back discomfort and time taken) between four and rear wheels over the two surfaces (leveled and inclined) shows significant difference with p-value < 0.05 shown in table 2, 3, 4, 5.

Table 5: Comparison between four and rear wheels on the two surfaces (leveled and inclined) for time taken

VARIABLE	Mean	± S.D	t	p-value
Ttlsfw	11.3	2.3		
Ttlsrw	11.9	3.0		
Ttlsfw vs Ttlsrw			2.5	.018
Ttisfw	9.7	2.2		
Ttisrw	10.9	2.4		
Ttisfw vs Ttisrw			3.6	.001

Tt=Time Taken

This indicates that moving a manual wheelchair on four wheels over the two surfaces (leveled and inclined) is easier, efficient, comfortable and faster method than moving the wheelchair on rear wheels.

Discussion

Many researches have been done on the manual wheelchair propulsion by the patient. Very few researches were done on the ergonomics of the caregiver while propelling the wheelchair. In this study, the ergonomics of the caregiver was taken into account, to reduce the caregiver stress and to improve the quality of life.

Woolfrey & Kirby (1998) in their study used two methods i.e. wheelbarrow method and conventional method. Their results showed that wheelbarrow method was faster, easier, more efficient and more comfortable for the back than the conventional method. The result of present study was somewhat consistent with the study done by *Woolfrey & Kirby (1998)*.

Moving a manual wheelchair over four wheels was easier than moving the wheelchair on rear wheels. In order to move the wheelchair on rear wheels, the caregiver tilts the wheelchair back by

pushing the push handles down and by stepping on the tilt bar raising the casters off the surface. This results in the bending of the back of the caregiver. He then moves the wheelchair while maintaining the above position. The caregiver requires being more careful regarding the balancing of the wheelchair and patient. To the extent that moving a manual wheelchair on four wheels decreases the bending and twisting of the back, its use may also decrease the risk of back injury. This may occur because the forward flexion leads to compression of the inter-vertebral disc anteriorly and stretching of the soft tissues posteriorly. The disc pressure also increases under the flexion moment. Flexion can lead to disc damage under fatigue loads at the low load levels persisting for a long periods of time. The nuclear material displaces posteriorly. Large tensile strains in disc fibres in flexion lead to the vulnerability of lumbar discs to rupture. The anterior portion of the annulus fibrosus get compressed and bulges anteriorly while the posterior portion gets stretched.

As the caregiver was able to move the wheelchair over four wheels more easily and it caused less bending and back discomfort as compared to moving the wheelchair on rear wheels, so moving the wheelchair on four wheels may result in the efficient performance of the caregiver.

Moving a manual wheelchair over the two surfaces (leveled and inclined) on four wheels was found to be a faster method as compared to moving the wheelchair on the rear wheels.

The reason may be that while moving the wheelchair on four wheels, the weight of the patient as well as wheelchair get distributed on all the four wheels. So the overall weight on the wheelchair on four wheels is less as compared to the weight while moving the wheelchair on rear wheels. According to the law of rolling friction, the rolling friction force F is directly proportional to the load L and inversely proportional to the radius of curvature r or $F = \mu r\ L/r$. (*Gomber & Gogia, 2009*). Due to the decrease in the load and large radius of the rear wheels while moving the wheelchair on four wheels, the rolling friction decreases which results in the increase in the speed and less time taken. Further, there may not be any problem with balancing the wheelchair on four wheels, because the caregiver requires force only for the propulsion rather than to balance the wheelchair.

Rolling friction is maximum while moving the wheelchair on rear wheels. This results because of the increased load and difficulty in balancing the wheelchair.

Conclusion

Moving the wheelchair on four wheels over the two surfaces (leveled and inclined) is faster, easier, efficient and more comfortable for the back than moving the wheelchair on rear wheels. Its use may reduce the risk of back injury. Heath care workers should be instructed to use this method while moving the wheelchair.

References

Burdorf, A., Govaert, G. Elders, L., 1991. Postural load and back pain of workers in the manufacturing of prefabricated concrete elements. *Ergonomics, 34(77):* 909-918.

Gomber K.L. and Gogia K.L. 2009. *Pradeep's Fundamental Physics*, 5th edition. New Delhi

Kirby R. L., Mifflen, N.J., Thibault, D.L., Smith, C., Best, K.L., Thompson, K.J., MacLeod, D.A. 2004. The manual wheelchair – handling skills of caregivers and the effect of training. *Arch. Phys. Med. Rehabilitation,* **26:** 2011-2019.

Olendorf, M.R. and Drury, C.G, 2001. Postural discomfort and perceived exertion in standardized box-holding postures. *Ergonomics*, **44(15):** 1341-1367.

Price, D.D., McGrath, P.A., Rafii, A., Buckingham, B. 1983. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. *Pain*, **17:** 45-56.

Ummat, S. and Kirby, L. R. 1994. Nonfatal wheelchair – related accidents reported to the national electronic injury surveillance system. *Am. J. Phys. Med. Rehabilitation*, **73(3):** 163-167.

Venning, P. J. Walter, S.D., Stitt, L.W.1987. Personal and Job-related factors as determinants of incidence of back injuries among nursing personnel. *J. of Occupational Medicine*, **29(10):** 820-825.

Wilkinson, M..J. and Menz, H.B. 1997. Measurement of gait parameters from footprints: a reliability study. *The Foot*, **7:** 19-23.

Woolfrey, P.G.W and Kirby, R. L. 1998. Ergonomics in rehabilitation: A comparison of two methods of moving an empty manual wheelchair short distances. *Arch. Phys. Med. Rehabilitation*, **79:** 955-958.

Kinanthropometric Measurements in Players of Athletics and Boxing - A Comparative Study

Sidhu, J.S.
Lecturer, A.S. College, Samrala Road, Khanna, Punjab.
E-mail: jaskaransidhu@rediffmail.com

Abstract

The study was conducted on 100 boxers and 100 athletes in the age range of 15-25 years to compare their anthropometric characteristics. The subjects were taken from various colleges of Punjab namely Guru Kanshi College, Nehru Memorial College, Mansa, Barjindra Co]lege, Faridkot, Rajindra College, Bhatinda. The results of the study in general reveal that boxers are bulky, taller and heavier than athletes; the significant differences however were noted in chest circumference between the two groups. Boxers in general are found to possess more deposition of subcutaneous fat in the regions of biceps, triceps and calf than the athletic group. However in statistical terms it is significant only in the triceps and calf regions. Comparison has also been made between senior and junior athletes and boxers by dividing the subjects into 15-20 and 20-25 year age groups.

Key Words: Body Weight, Height, Circumferences, Skinfold Thickness

Introduction

In spite of huge population, India has not been able to make much impact in the field of international sports. The poor performance of Indian athletes and boxers at international level has been a matter of great concern, especially to the coaches, sports scientists and sports administrators. Despite the efforts made to improve the standard of sports in the country, little success has been achieved so far. Scientific researches are needed to improve the performance of sports persons. Some reports are available in this context (*Carter, 1970; Drinkwater and Ross, 1978; Mueller et al, 1982; Bharadhwaj et al, 1990; Sodhi and Rajni, 1992; Hortobagni et al 1992; Thorland et al 1993, Sidhu et al, 1996 and Nindl et al 1998*). More studies are required in Indian context. In the present study an attempt has been made to evaluate the Kinanthropometric measurements in the players of athletics and boxing in Punjab.

Material and Method

The sample consisted of randomly selected 100 boxers and 100 athletes aged 15-25 years. The subjects were taken from various colleges of Punjab namely Guru Kanshi College, Nehru Memorial College, Mansa, Barjindra Co]lege, Faridkot, Rajindra College, Bhatinda.

Measurements of body weight, height, chest circumference, upper arm circumference, hip circumference, thigh and calf circumference and skinfold thicknesses from the biceps, triceps, sub-scapular, supra-iliac and calf sites were taken by following standard techniques as described by *Singh & Bhasin (1989).* To account for the large age range, the data has been split into two five yearly age groups namely, the 15-20 and 20-25 years and subsequently comparison has been made between the players of boxing and athletics. The data was statistically analyzed using student 't' test.

Results & Discussion

Table 1 describes the statistical attributes of kinanthropometric data of

players (15-25 years) of athletics and boxing. From the results of the distribution of means and standard deviations of the twelve Kin-anthropometric measurements, significant differences were noted in the chest circumference and biceps skinfold ($p < 0.05$). In the triceps skin fold and calf skin fold highly significant differences ($p < 0.01$) were seen between the boxers and the athletes. In rest of the kin-anthropometric measurements no significant differences were observed.

The results of the study in general reveal that boxers are bulky, taller and heavier than athletes; the significant differences however were noted in chest circumference between the two groups. Boxers in general are found to possess more deposition of subcutaneous fat in the regions of biceps, triceps and calf than the athletics. However in statistical terms it is significant only in the triceps and calf regions.

Table 1: Distribution of Mean Values and Standard Deviation of different Kin-anthropometric Measurements among the Players of Athletics and Boxing (Aged 15-25)

MEASUREMENTS	N	ATHLETICS			N	BOXING			t
		Mean	S.D.	S.E.		Mean	S.D.	S.E.	
Body Weight, kg	100	57.91	8.71	0.87	100	60.34	10.09	1.01	1.77
Height, cm	100	169.90	16.87	1.69	100	171.42	1.016	0.10	0.95
Chest Circumference, cm	100	83.45	5.35	0.53	100	86.10	7.151	0.72	2.59*
Upper Arm Circumference, cm	100	24.65	2.04	0.20	100	25.70	3.I 1	0.31	1.92
Thigh Circumference, cm	100	48.20	3.13	0.31	100	48.43	4.42	0.44	0.32
Calf Circumference, cm	100	33.29	2.24	0.22	100	33.66	2.33	0.23	0.69
Hip Circumference, cm	100	73.98	5.43	0.54	100	74.50	6.36	0.66	0.50
Bicep Skin Fold, mm	100	3.51	0.79	0.08	100	4.24	1.56	0.16	2.14*
Triceps Skin Fold, mm	100	6.95	1.81	0.18	100	8.38	2.77	0.28	2.81**
Calf Skin Fold, mm	100	5.70	1.43	0.14	100	7.04	2.35	0.24	3.01**
Subscapular Skin Fold, mm	100	7.95	2.09	0.21	100	8.36	2.55	0.25	0.79
Suprailiac Skin Fold, mm	100	6.40	1.59	0.16	100	7.16	2.99	0.29	1.53

*Indicates $P < 0.05$, ** Indicates $P < 0.01$ ***Indicates $P < 0.001$

Table 2 compares the kin-anthropometric characteristics along with the statistical correlates of players of boxing and athletics falling in the age range of 15 to 20 years. It is observed from the table that anthropometric features of boxers and athletes of 15-20 years age group exhibit the same trend as was seen in the 15-25 years group. Boxers possess significantly greater deposition of fat in the biceps, triceps and calf regions as compared to the athletic group of comparable age. In the rest of the anthropometric variables no significant differences were found.

Table 2: Distribution of Mean Values and Standard Deviation of different Kin-anthropometric Measurements among the Players of Athletics and Boxing (Aged 15-20)

MEASUREMENTS	N	ATHLETICS			N	BOXING			t
		Mean	S.D.	S.E.		Mean	S.D.	S.E.	
Body Weight, kg	66	55.39	9.07	1.12	66	57.17	10.42	1.1 4	1.12
Height, cm	66	170.00	7.19	0.85	66	168.73	6.72	1.28	1.39
Chest Circumference, cm	66	82.54	5.66	0.70	66	84.20	3.08	0.83	1.53
Upper Arm Circumference, cm	66	24.08	2.00	0.25	66	25.30	4.08	0.38	1.15
Thigh Circumference, cm	66	47.40	3.23	0.39	66	47.55	2.29	0.50	0.23
Calf Circumference, cm	66	32.68	2.20	0.27	66	33.06	6.33	0.27	0.98
Hip Circumference, cm	66	72.45	5.49	0.68	66	73.10	1.66	0.78	0.64
Bicep Skin Fold, mm	66	3.45	0.69	0.09	66	4,23	2.80	0.20	3.53***
Triceps Skin Fold, mm	66	6.91	1.89	0.03	66	8.22	2.57	0.34	3.15**
Calf Skin Fold, mm	66	5.90	1.38	0.17	66	7.33	2.62	0.31	3.97***
Sub scapular Skin Fold, mm	66	7.83	2.18	0.27	66	8.05	2.62	0.32	0.53
Suprailiac Skin Fold, mm	66	6.23	1.75	0.20	66	7.05	3.26	0.40	1.79

*Indicates P < 0.05, ** Indicates P < 0.01 ***Indicates P < 0.001

Distribution of mean values of twelve anthropometric measurements among the players of athletics and boxing aged 20-25 years are shown in Table-3.

Table 3: Different Kin-anthropometric Measurements among the Players of Athletics and Boxing Aged (20-25 Years)

MEASUREMENTS	N	ATHLETICS			N	BOXING			t
		Mean	S.D.	S.E.		Mean	S.D.	S.E.	
Body Weight, kg	34	62.79	5.22	0.89	34	66.5	8.81	1. 51	2.08*
Height, cm	34	168.1	27.04	4.64	34	176.76	7.06	1. 21	3.50***
Chest Circumference, cm	34	85.23	4.15	0.71	34	89.80	6.50	1.11	3.27**
Upper Arm Circumference, cm	34	25.75	1.60	0.27	34	26.50	2 99	0.51	1.02
Thigh Circumference, cm	34	49.60	2.33	0.40	34	50.13	4.54	0.78	0.78
Calf Circumference, cm	34	34.48	I. 78	0.30	34	34.82	2.07	0.35	0.51
Hip Circumference, cm	34	76.96	3.84	0.66	34	77.30	5.44	0.93	0.27
Bicep Skin Fold, mm	34	3.60	0.95	0.16	34	4.26	1 36	0.23	1.41
Triceps Skin Fold, mm	34	7.01	1.65	0.28	34	8.60	2.71	0.46	2. 84**
Calf Skin Fold, mm	34	5.40	1.48	0.25	34	6.49	1.73	0.29	1. 87
Sub scapular Skin Fold, mm	34	8.16	1.86	0.32	34	8.98	2.27	0.39	1.18
Suprailiac Skin Fold, mm	34	6.74	1.15	0.20	34	7.38	2.35	0.40	1.08

*Indicates P < 0.05, ** Indicates P < 0.01 ***Indicates P < 0.001

From the results of the table highly significant differences ($p < 0.001$) were observed in height and statistically significant differences in body weight and chest circumference among the players of athletics and boxing of aged 20-25years ($p < 0.05$ and $p < 0.01$ respectively). Statistically significant differences ($p < 0.01$) were also noted in triceps skin fold among the athletes and boxers of that age group. In rest of the anthropometric variables non significant differences were observed between these two groups of players. From the table it was clear that boxers of age group 20-25 years have higher body weight, height, chest circumference and triceps skin fold values than their athletic counterparts. The athletes of this age group were comparatively leaner and less bulky which is ideal for different athletic events. Tallness is of advantage to the boxers as it helps the boxer to work outside the reach of his opponent as well as enables him to stay just close enough to make contact with his punches. Therefore it can be viewed that a long range boxer should be tall, lanky fighter with long and lean build. The boxers of the present study are far away from the ideal characteristic features possessed by successful boxers as per the requirements of boxing.

Table-4 compares the mean values and standard deviations of twelve anthropometric measurements among the boxers' of age group 15-20 years and 20-25 years.

Table 4: Mean Values and Standard Deviation of different Kin-anthropometric Measurements among the boxers aged 15-20 years and 20-25 years

MEASUREMENTS	N	BOXERS 15-20 YEARS			N	BOXERS 20-25 YEARS			t
		Mean	S.D.	S.E.		Mean	S.D.	S.E.	
Body Weight, kg	66	57.17	9.22	I.14	34	66.5	8.81	I. 5 I	4.41 ***
Height, cm	66	168.7	10.42	1.28	34	176.76	7.05	1.2 I	4.55***
Chest Circumference, cm	66	84.20	6.72	0.83	34	89.80	6 50	1.11	4.03***
Upper Arm Circumference, cm	66	25.30	3.08	0.38	34	26.50	2.99	0.51	1.88
Thigh Circumference, cm	66	47.55	4.08	0.50	34	50.13	4.54	0.78	2.75*'*
Calf Circumference, cm	66	33.06	2.24	0.27	34	34.82	2.07	0'35	3.92***
Hip Circumference, cm	66	73.10	6.33	0.78	34	77.30	5.44	0.93	3.46***
Bicep Skin Fold, mm	66	4.23	1.66	0.20	34	4.26	1.36	0.23	0.10
Triceps Skin Fold, mm	66	8.22	2.80	0.34	34	8.68	2.7 I	0.46	0.79
Calf Skin Fold, mm	66	7.33	2.57	0.31	34	6.49	1.73	0.29	1.90
Sub scapular Skin Fold, mm	66	8.05	2.62	0.32	34	8.98	2.27	0.39	I. 96
Suprailiac Skin Fold, mm	66	7.05	3.26	0.40	34	7.38	2.35	0.40	0.59

*Indicates $P < 0.05$, ** Indicates $P < 0.01$ ***Indicates $P < 0.001$

The results of this table show that boxers of senior age group 20-25 years have higher mean values than their younger counterparts, in all the twelve anthropometric variables highlighting

highly significant differences ($p < 0.001$) in body weight, height, chest, calf and hip circumferences. In rest of the six variables, non-significant differences were noted. Boxers of senior age group in general are taller and heavier having large circumferences. This is understandable because many of the 15-20 year age group boxers comprise of the subjects who are passing through their growth periods and are yet to realize their full physical growth potentials. While in the 20-25 year age group the subjects are fully grown in terms of their physical dimensions and therefore are significantly heavier, taller and possess greater circumferential values than their counterparts belonging to the 15-20 year age group.

It is believed that a suitable physique is important to achieve success in particular sports therefore judging the performance of the human body by its size, shape and form has been a topic of great exploration. In the present day of tough competition, when scientific principles are applied for training of athletes, the size, the shape and the form of the body together with its efficiency in performance have been the outlook of researchers for identifying, selecting and developing the talent in sports. Stature and body mass have significant impact on elite boxers. Present results of the study that senior boxers possess higher stature, body mass and body fat compared to junior boxers' exhibit important base for formulating training strategies to be adopted for their success in boxing.

Table 5: Distribution of Mean Values and Standard Deviation of different Kin-anthropometric Measurements among the players of athletics aged I 5-20 years and 20-25 years

MEASUREMENTS	N	ATHLETICS 15-20 YEARS			N	ATHLETICS 20-25 YEARS			t
		Mean	S.D.	S.E.		Mean	S.D.	S.E.	
Body Weight, kg	66	55.39	9.07	1.12	34	62.79	5.22	0.89	5.10 ****
Height, cm	66	170.90	7.19	0.85	34	168.10	27.04	4.64	0.59
Chest Circumference, cm	66	82.54	5.66	0.70	34	85.23	4.15	0.71	2.70**
Upper Arm Circumference, cm	66	24.08	2.00	0.25	34	25.75	1.60	0. 27	1.67
Thigh Circumference, cm	66	47.40	3.23	0.39	34	49.60	2.33	0.40	3.9 1***
Calf Circumference, cm	66	32.68	2.20	0.27	34	34·48	1.78	0.30	4.42***
Hip Circumference, cm	66	72.45	5.49	0.68	34	76.96	3.84	0.66	4.79***
Bicep Skin Fold, mm	66	3.45	0.69	0.09	34	3.60	0.95	0.16	0.81
Triceps Skin Fold, mm	66	6.91	1.89	0.03	34	7.01	1.65	0.28	0.27
Calf Skin Fold, mm	66	5.90	I.38	0.17	34	5 40	1.48	0.25	1.97
Sub scapular Skin Fold, mm	66	7.83	2.18	0.27	34	5.16	1.86	0.32	0.79
Suprailiac Skin Fold, mm	66	6.20	1.75	0.20	34	6.74	1.15	0.20	1.73

*Indicates $P < 0.05$, ** Indicates $P < 0.01$ ***Indicates $P < 0.001$

Table-5 highlights distribution of mean values and standard deviations of

twelve anthropometric measurements among the athletes of age group 15-20 and 20-25 years. The results show that the athletes of age group 20-25 years have higher mean values in all the twelve anthropometric variables than their junior counterparts (15-20 years). Highly significant differences ($p < 0.001$) were noted in body weight, thigh, calf and hip circumferences. Statistically significant differences were also observed in the chest circumference among them. In rest of the other seven anthropometric variables non-significant differences were noted among them. This is explicable because a large number of the 15-20 year age group athletes comprise of the subjects who are through their development period and are thus far from realization of their complete physical development potentials. While the 20-25 year age group, comprises of the subjects who are fully grown in terms of their physical size and therefore are significantly heavier, taller and possess greater circumferential values than their counterparts belonging to the 15-20 year age group.

References

Bharadwaj, H., Zachariah, T., Singh, I.P., Krishnan, S., Pramanik, S.N., Kapoor,and Sengupta,. J., 1990. Body composition and body segment volume proportion of Indian athletes and sportsmen. *Ind. J. Sports. Sci. Phy. Edu.*, **2:** 13-23.

Carter, J.E.L. 1970. The Somatotypes of Athletes: A. Review. *Hum. Biol.*, **42:** 553-560

Drinkwater, D.T. and Ross, W.D. 1978. *Anthropometric Fractionation*. lnt. Series Sports Sciences. Vol. 9 Kinanthropomctrery II. University Park Press, Bangalore.

Hortobagni, T.R.G., Israel, L.A., HoumaI'd, K.F.O., Brien, R., Johns, A. and Wells. 1992. Comparison of four methods to asses body composition in black and white athletes. *Inst. J. Port. Nurt.*, **2:** 60-74.

Mueller, W.H., Shoup, R.F., and Malina, R.M. 1982. Fat patterning in athletes in relation to ethnic origin and Sports. *Ann. Hum. Biol.*, **9:** 371-376.

Nindl, B.C., Kraemer, W J., Ermmertt, S.A., Gotshalk, L.A., Patton, J.F. 1998. Comparison of body composition assessment among lean black and white male collegiate athletes. *Med. Sci. Sports. Exer.*, **19:** 769-776 .

Sidhu, L.S., Singh, J., Singh, S.P., and Kaur, G. 1996. Morphological characteristics of sports boys ranging in age 11-19 years. *lnd J. Sports. Sci. Phy. Edu,*. **8:** 37-49.

Singh, I.P. and Bhasin, M.K. 1989. *Anthropometry*. Kamla Raj Enterprises, Delhi.

Sodhi, H.S. and Rajni 1 992. Physical Structure of elite Indian boxers. *Ind. J. Sports. Sci. Phy. Edu.*, **4:** 84-89

Thorland. W.G, Johnson, G.D. and Housh, T.J. 1993. Estimation of body composition in black male athletes *Pediatr. Exerc. Sci.*, 5**:** t16-1240.

Journal of Exercise Science and Physiotherapy, Vol. 5, No. 1: 62-66, 2009

Comparative Study of Impact of Age on Physiological Variables, Body Composition and Blood Cholesterol in Selected Physical Education Professionals

Silawat, N., Savalia, J. K. and Patel, D.
Mahadev Desai Sharirik Shikshan Mahavidyalay, Gujarat Vidyapeeth, Sadra, Dist. Gandhinagar, Gujarat

Abstract

The purpose of the present study was to find out the impact of age on the physiological variables, body composition and blood cholesterol in selected physical education professionals. The study was conducted on 45 physical education professionals who came to attend a National level Workshop on Research Methodology and Statistical Techniques (Funded by Special Assistance Program of UGC) and organized by Mahadev Desai Sharirik Shikshan Mahavidyalay, Gujarat Vidyapeeth, Gujarat. The age of the subjects ranged between 21 to 50 years. The subjects' were selected randomly and divided into three ten yearly age groups. Measured physiological variables included pulse rate (PR), diastolic blood pressure (DBP) and systolic blood pressure (SBP). Body composition was measured by Tonika Body Composition Analyzer and Bio-Chemistry Auto Analyzer was used for the measurement of blood cholesterol. Statistically significant differences were witnessed in the body composition profiles between the three age groups. However no significant differences in PR, SBP, DBP and blood cholesterol were observed.

Keywords: Physical education professionals, Age related changes, Physiological variables, Body composition, Blood cholesterol

Introduction

Aging refers to the normal yet irreversible biological changes that occur throughout a person's lifetime. It is a very complex phenomenon and is influenced by genetic, environmental and life style factors (*Tuomi, et al, 1997; Guo et al, 1999; Brach et al, 2004*). The aging process takes place at all ages, but for those over sixty five; it often becomes more evident with significant changes in quality of life. With aging, there is accumulation of fat and a substantial loss of muscle mass. Comparison between average young and elderly adult suggest a decrease in the fat free mass to the extent of fifteen to thirty percent by age eighty, with the rate and degree of loss varying widely depending on both genetic and life style influences. During middle age there is typically a gain in body fat, and in some individuals, centralization of body fat with its attendant health risk may also occur. In very old age, both fat free and fat mass are lost as body weight declines. Previous studies of the relation between body fat and aging found 1 of 2 patterns: either an increase in body fat until early old age, followed by a decrease, or a pattern of steadily increasing body fat with aging (*Silver et al, 1993 and Going et al, 1995*). Some previous studies of the relation between age and fatness used methods such as measurement of skinfold thicknesses (*Najjar & Rowland, 1987*) or bioimpedance analysis (*Silver et al, 1993*) that had problems with reliability. All the various components of the fat free mass – muscle and bone mineral mass, and total body water are reported to be decreased in older men and women relative to young adults. The decline in resting metabolic rate with advancing age is primarily due to this decline in fat free mass. The importance of the issue become all the more important when the age related

changes of physical education professionals are the focus of the attention as most of these professionals have more opportunity for physical activity. A serious exploration has been made in the literature about the impact of age on physical fitness. Results obtained by *Hawkins et al (2001)* have shown a decrease of 2.4 to 5 percent in VO_2 max in women in the course of a year. *Fitzgerald et al (1997)* also showed a reduction in VO_2 max with increasing age. Similarly *Trappe et al (2006)* reported that the aerobic capacity of exercising individuals decreased by 5 to 7 percent with every 10 years increase in age. Only the study conducted by *Daniel et al (1978)* has reported that cardio-respiratory fitness increased with age in proportion to the increase in weight of subjects. It has been suggested that sample size, limited age ranges and lack of a sedentary control group are responsible for the conflicting results (*Fitzgerald et al, 1997, Hankins et al, 2001*). The review of literature in general indicates that with increase in age there is a decline in cardio-respiratory fitness that is linked to changes in physiological variables, body composition and blood lipids.

Although a number of studies are available in the literature regarding age related changes in different physiological variables, body composition and blood lipids (*Poehlman et al, 1991; Dinenno, et al, 1999; Denti et al, 2000*), no study in this matter with physical education professionals as subjects has been cited.

In view of the importance of the matter with regard to physical education professionals, the present study was aimed to assess the age related changes in selected physiological variables, body composition and blood lipids in physical education professionals in Gujarat.

Material & Method

Forty five male physical education professionals who came to attend a National level workshop on Research Methodology and Statistical Techniques organized by Mahadev Desai Sharirik Shikshan Mahavidyalay, Gujarat Vidyapith, Sadra dist. Gandhinagar, Gujarat were selected for this study. All the important and requisite information about the study was given to participants. Age of the subjects' was checked from their application forms which were filled by participants. All the subjects were screened and homogenized for absence of any diseases related to the cardiovascular, respiratory systems or any other serious disease and then divided into three ten yearly age groups viz young age group (Mean age 23 years), adult young age group (Mean age 34 years) and middle age group (Mean age 44 years). Physiological variables like resting pulse rate, systolic and diastolic blood pressures, and vital capacity were measured using standard techniques. Tonika Body Composition Analyzer was used to measure body mass index, total body water, fat mass and body weight. Hematological variables like hemoglobin, blood cholesterol and fasting blood sugar were also measured by Biochemistry Auto Analyzer.

Statistical Analysis

Statistical analysis of the data was done to study the age related impact on the physiological variables and body composition in the three different age groups. One way analysis of variance (***ANOVA***) and F-test was applied.

Table-1: The Body Compositional, Blood Lipids and Physiological Variables Characteristics of the Physical Education Professionals

VARIABLES	Young Age Group		Young Adult Age Group		Middle Age Group		F- VALUE
	Mean	SD	Mean	SD	Mean	SD	
Total Body Water (TBW), kg	40.64	4.65	44.45	4.81	46.61	3.91	**6.83***
Body Mass Index (BMI)	21.09	2.61	23.24	3.40	24.94	2.33	**7.01***
Body Weight (BW), kg	61.34	8.02	69.56	10.68	74.53	7.45	**8.53***
Fat Mass (FM), kg	5.93	2.78	9.34	4.44	10.95	3.60	**7.29***
Blood Cholesterol, mg%	127.45	29.06	143.35	34.03	145.59	24.74	1.68
Blood Sugar, mg%	95.13	7.11	106.43	19.91	98.27	23.69	1.51
Hemoglobin, gm%	13.76	1.14	14.15	0.75	13.92	0.80	0.72
Pulse Rate, beats/min	73.4	9.26	76.33	5.23	78.93	4.94	0.035
Systolic Blood Pressure, mm Hg	123	10.39	128.4	12.24	132.33	7.52	3.14
Diastolic Blood Pressure, mm Hg	76.8	8.60	78.73	7.95	80.2	5.40	0.029

* $P < 0.05$

Results

The results of the study reveal significant differences between young age group, young adult age group and middle age group in body composition variables like total body water (F = 6.83), body mass index (F = 7.01), body weight *(*F = 8.53) and fat mass (F = 7.29).

Regarding analysis of the results of the age related impact on the physiological variables, it was observed that age was not observed to have significant impact in statistical terms on the resting pulse rate, systolic and diastolic components blood pressure in the three age groups (Table 1).

Comparison of mean values of fasting blood glucose, hemoglobin and cholesterol also reveal a similar picture as is depicted by the physiological variables. In other words no significant impact of age on the blood chemistry has been observed in the three age groups of physical education teachers of the present study.

Discussion

The results of the study suggested that there was significant difference in body composition (*TBW*, *FM*, *BMI* and *BW*) among the young age group, adult young age group and middle age group. In other words, increase in age has significant effect on the body mass index, total body water, fat mass and body weight in different age groups. Study indicated that total body water, body mass index, fat mass and body weight increased with the increase in age.

The obtained results indicate non existence of statistically significant differences in pulse rate, systolic blood pressure, diastolic blood pressure (physiological variables) among the three age groups. This means that increase in

age has no statistically significant effect on the pulse rate, systolic blood pressure and diastolic blood pressure in the physical education teachers of the present study, although the value of pulse rate was lower in the young age group then the other two age groups.

No significant difference has been revealed in the average blood cholesterol, fasting blood sugar and hemoglobin concentration profiles of the three different age groups of physical education teachers in the present study. In general, it can be concluded from the results obtained in the present study that increasing age has no significant impact on most of the variables like blood cholesterol, blood sugar, hemoglobin, pulse rate, systolic blood pressure and diastolic blood pressure.

Although no significant impact of aging has been noticed on some selected physiological and biochemical parameters in the present study on physical education teachers but there is a warning sign in the form of a significant negative impact of aging on the body composition of these subjects'. These changes in overall adiposity and fat appear to be important factors in many common "age-related" disorders such as hypertension, glucose intolerance and diabetes, dyslipidemia, and atherosclerotic cardiovascular disease (*Krotkiewski et al., 1983; Larsson et al., 1984*). In addition, it is possible that the age-associated decrement in muscle mass, and subsequently in strength and endurance, may be a critical determinant for functional loss, dependence, and disability (*Buchner et al., 1992*).

References

Brach, J.S., Simonsick, E.M., Kritchevsky, S., Yaffe, K., Newman, A.B. 2004. The association between physical function and lifestyle activity and exercise in the health, aging and body composition study. *Journal of the American Geriatrics Society*, **52(4):** 502-509.

Buchner, D.M., Beresford, S.A., Larson, E.B., LaCroix, A.Z., Wagner, E.H. 1992. Effects of physical activity on health status in older adults. II. Intervention studies. *Ann. Rev. Public Health*, **13:** 469-488.

Daniel, J., Oldridge, N., Nagle, F. and White, B. 1978. Differences and changes in VO_2 max among young runners 10 to 18 years of age. *Med Sci Sports*, **10(3):** 200-3.

David, C. Nieman. *Fitness and sports medicine a health related approach, physical activity and aging, III edition*, Mayfield publishing company: California, p.429, 436.

Denti, L., Pasolini, G., Sanfelici, L., Benedetti, R., Cecchetti, A., Ceda, G.P., Ablondi, F., Valenti, G. 2000. Aging-Related Decline of Gonadal Function in Healthy Men: Correlation with Body Composition and Lipoproteins. J. Am. Geriatr. Soc., **48:** 1.

Dinenno, F.A., Jones, P.P., Seals, D.R., Tanaka, H. *1999.* Limb blood flow and vascular conductance are reduced with age in healthy humans: relation to elevations in sympathetic nerve activity and declines in oxygen demand. *Circulation*, **100***:* 164–170.

Fitzgerald, M.D., Tanaka, H, Tran, Z. and Seals, D.R. 1997. Age related decline in maximal aerobic capacity in regarding exercising vs sedentary females: a meta analysis. *J. Appl. Physiol.* **83:** 160-165 .

Going, S., Williams, D., Lohman, T. 1995. Aging and body composition: biological changes and methodological issues. *Exerc. Sport Sci. Rev*., **23:** 411–58.

Guo, S.S., Zeller, C., Chumlea, W.C. and Siervogel, R.M. **1999.** Aging, body composition, and lifestyle: the Fels Longitudinal Study. *American Journal of Clinical Nutrition*, 70(3): 405-411. 1999

Hawkins, S.A. Marcell, T..J., Victoria, J.S. and Wiswell, R.A. 2001. A longitudinal assessment of changes in VO_2 max and maximal heart rate in master athletes. Med. Sci. Sports Exerc., **33(10):** 1744-50.

Krotkiewski, M., Bjorntorp, P., Sjostrom, L., Smith, U. 1983. Impact of obesity on metabolism in men and women. Importance of regional adipose distribution. *J. Clin. Invest.*, **72:** 1150-1162.

Larsson, B., Svardsudd, K., Welin, L., Wilhelmsen, L., Bjorntorp, P., Tibblin, G. 1984. Abdominal adipose tissue distribution obesity and risk of cardiovascular disease and death: 13 year follow-up of participants in a study of men born in 1913. *Br. Med. J.*, **288:** 1401-1404.

Najjar, M.F., Rowland, M. 1987Anthropometric reference data and prevalence of overweight, United States, 1976–80. *Vital Health Stat. 11*, **238:** 1–73.

Poehlman, E.T., Melby, C.L., Badylak, S.F. *1991.* Relation of age and physical exercise status on

metabolic rate in younger and older healthy men. *Journal of Gerontology*, **46***:* B54–58.

Silver, A.J., Guillen, C.P., Kahl, M.J., Morley, J.E. 1993. Effect of aging on body fat. J. Am. Geriatr. Soc., **41:** 211–3.

Trappe, T. Trappe, S., Lee, G., Widrick, J., Fitts, R. and Costill, D. 2006. Cardio respiratory responses to physical work during and following 17 days of bed rest and spaceflight. *J. Appl. Physiol.*, **100(3):** 951-7.

Tuomi, K., Ilmarinen, J., Martikainen, R., Aalto, L., Klockars, M. 1997. Aging, work, life-style and work ability among Finnish municipal workers in 1981-1992. *Scand. J. Work Environ. Health*, **23(Suppl 1):** 58-65.

Instructions to Contributors

Journal of Exercise Science and Physiotherapy (JESP) is a scientific peer reviewed journal, publishing research studies and review articles in the field of sports injuries, physiotherapy, exercise physiology, sports rehabilitation, diseases and exercise, sports psychology, nutrition, physical education, sports biomechanics, kinesiology and sports education.

JESP is published annually in June but is planned to be published biannually in the near future. Articles written in English should be sent to the editor of JESP. The research paper for publication in the journal could be sent not only in typed manuscript form but also through the Internet using email attachment. Keeping in view the postal delays, authors, therefore, are encouraged to submit their research material/articles as email directly to ***satishsk1@rediffmail.com*** or ***editor@efha-in.org***

Mission

JESP aims to present easy access to the scientific knowledge for health & sport conscious individuals. The purpose is to minimise the problems like the delays in publishing process of the articles by drawing advantage from electronic medium.

Instructions to Authors

The articles may be submitted to the Editor, JESP (*email: satishsk1@rediffmail.com OR editor@efha-in.org*). Manuscripts are considered if they are submitted only to JESP and therefore should not be under consideration for publication elsewhere, either in part or in whole. Authors are responsible for the scientific context and legal aspects of the articles. Editors may make necessary changes to articles in accordance with "Instructions to Authors". Normally the complete research paper should not exceed 15 typed pages including tables and figures; however under exceptional circumstances this limit can be relaxed. There is no page and reference limitation for the review articles. All files related to manuscripts should be submitted electronically. Internet transmission and e-mail attachments are preferred; CD-ROM is acceptable for large files. Text files should be in Microsoft Word 6.O and later versions. Each figure, table, photograph or other image should be submitted electronically. The manuscripts should be submitted in Times New Roman font, 12-point type, double-spaced with 3 cm margins on all sides. The reference style used by the Journal is the Harvard System of referencing.

Format for Research Article

Include the following sections in research articles without page space:

TITLE: Capital letters.

AUTHORS: Surname followed by initials and institution(s) where the study was conducted.

ABSTRACT Include an abstract of not more than 150 words that includes objectives, methods, results and conclusions.

KEY WORDS*:* To assist in indexing the journal, list up to 6 key words (not from title), which your article could be indexed.

INTRODUCTION

METHODS

RESULTS

DISCUSSION

CONCLUSION

ACKNOWLEDGMENTS: Provide information sufficient to identify sources of support, technical assistance, and intellectual contributions not associated with authorship.

REFERENCES: Each citation in the text must be noted by surname and year in parentheses and must appear in the reference section as an alphabetic order. Example for citation in the text; a) for single author (Gür, 1999), b) for two authors (Gür and Akova, 2001), c) more than two authors (Gür et al., 2000).

Journal Article:

Akova, B., Sürmen-Gür, E., Gür, H., Dirican, M., Sarandöl, E. and Kücükoglu, S. 2001. Exercise-induced oxidative stress and muscular performance in healthy women: role of vitamin E supplementation and endogenous estradiol. *European Journal of Applied Physiology*, **84:** 141-147.

Journal Article, Article not in English:

Seker-Aygül, Z., Akova, B. and Gür, H. 2001. The relationship of stress and stress management factors with injury in soccer players. *Turkish Journal of Sports Medicine*, **36:** 71-80. (In Turkish: English abstract).

Journal Article in press:

Gür, H., Cakin, N., Akova, B., Okay, E. and Kücükoglu, S 2002. Concentric versus combined concentric- eccentric isokinetic training: Effects on functional capacity and symptoms in patients with osteoarthrosis of the knee. *Archives of Physical Medicine and Rehabilitation*, in press.

Journal Article in electronic format:

Weigand, D.A., Carr, S., Petherick, C. and Taylor, A. 2001. Motivational climate in Sport and Physical Education: The role of significant others. *European Journal of Sports Science (serial online)* **1(4**), (13 screens/inclusive page), October. Available from URL: http://www.humankinetics.com/ejss

Book:

Guyton, A.C. and Hall, J.E. 1996. *Textbook of medical physiology*. 9th edition. W. B. Saunders Company, London.

Chapter in edited book:

Wilson, C.H. 1984. Exercise for arthritis. In: *Therapeutic exercise*. Ed: Basmajian, J.V. 4th edition. Baltimore: Williams and Wilkins. 529-545.

Thesis:

Özyener, F. 2000. *Effects of work intensity on dynamics of pulmonary gas exchange during exercise in humans*. Doctoral thesis, University of London, London. 79.

Thesis not in English:

Özer, Ö. 2001. *The effect of muscle exercise to oxygen kinetics in chronic smoker*s. Doctoral thesis, University of Uludag, Bursa. 1-54. (In Turkish: English abstract).

LEGENDS

AUTHOR BIOGRAPHY: Please include a brief biography, approximately 50 words per author, for each author including (1) academic title/degrees, (2) institution affiliation, (3) research focus, (4) post and e-mail addresses.

TABLES, FIGURES, etc.: The location within the article where e.g. figures and tables appear should be indicated in the text. These materials (e.g. table, figure) should be submitted separately from the text document. Each item should be produced in Microsoft Office (Word, Excel, or PowerPoint), GIF or JPEG format. Submit each item separately and number sequentially as (main author) Figure 1.jpg, (main author) Figure2.jpg, and so on, for example, GurFigure1.jpg and GurTable1.doc.

FORMAT FOR REVIEW ARTICLE

Include the following sections in research articles without page space:

TITLE: Capital letters.

AUTHORS: Surname followed by initials and institution(s) where the study was conducted.

ABSTRACT Include an abstract of not more than 300 words.

KEY WORDS: To assist in indexing the journal, list up to 6 key words (not from title), which your article could be indexed

MAIN TEXT

CONCLUSION

ACKNOWLEDGMENT

REFERENCES*:* Each citation in the text must be noted by surname and year in parentheses and must appear in the reference section as an alphabetic order. Example for citation in the text; a) for single author (Gür, 1999), b) for two authors (Gür and Akova, 2001), c) more than two authors (Gür et al., 2000). See the reference section of research article for detail.

LEGENDS

AUTHOR BIOGRAPHY: For detail see the author biography section of research article.

TABLES, FIGURES, etc.: For details see the tables, figures, section of research article.

REVIEW AND PUBLISHING POLICY

Upon receipt of a manuscript the editor will notify the main author that the submission has been received. The manuscript will undergo a blinded review process. Under this process the editor will forward (electronically) the manuscript to two independent reviewers. Normally the review process will take approximately 4 weeks. After the review process has been completed the main author will be notified via E-mail either of acceptance, revision or rejection of the manuscript. If the main author has not been informed of the results of the review process after 8 weeks from the date of confirmation of receipt of the manuscript (by the editor), the author should notify the editor-in-chief directly. If revision was recommended, this should be completed and returned to the editor within 4 weeks; failure to return the revised manuscript within the allotted time span will lead to rejection of the manuscript. When a manuscript has been accepted for publication it will be forwarded to the editor-in-chief for final approval. The editor-in-chief will work with the main author to make necessary revisions in order for the manuscript to appear in the Journal of Exercise Science and Physiotherapy. The final proof of the manuscript will be sent to the main author as an E-mail attachment. If the main author requires any minor changes to the finished work, these should be submitted electronically to the editor-in-chief within one week. Manuscript accepted in the first half of the year will be published not later than the second half of the year.

Checklist for Authors

- Double-space manuscript text and use 3cm margins on all sides, and Times New Roman, 12-point type, English and SI units.
- Include with text a title, abstract, key words, figure and table lists, figure and table legends.
- Submit all materials electronically.
- Include complete author names, addresses, e-mail, phone and fax numbers.
- Include a short (~50 words) author biography for each author.

Editor-in-Chief,
JESP