Relationship among Anthropometric Indices & Motor Nerve Conduction Velocity of Radial & Ulnar Nerves in Aerobic Trained Athletes

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Abstract

The purpose of this study was to investigate the relationship among anthropometric indices (upper extremity lengths and circumferences) and motor nerve conduction velocity (MNCV) of radial & ulnar nerve (bilateral side) in aerobic trained athletes (long distance runners & cyclists). A total of 50 male long distance runners & cyclists with an average age, height and weight of 23±2 years, 172.8±5.8 cm and 70.05±4.2 Kg respectively, volunteered to participate in this study. Each subject's MNCV was measured with the help of computerized equipment called "NEUROPERFECT" (Medicaid Systems, India) and the data was analyzed using Mean ±SD and Pearson correlation. Results shows that MNCV of right radial and left radial was negatively and significantly related with right upper arm length ($r=0.-40$ $p < 0.01$) and left upper arm length ($r=0.-37$ $p < 0.05$). But a positive and significant relationship of MNCV of right ulnar and left ulnar was found between right upper arm circumference ($r=0.33$ $p < 0.05$) and left upper arm circumference ($r=0.36$ $p < 0.05$). Thus, it is concluded that the positive relationship of MNCV of radial and ulnar nerve in aerobic trained athletes may be the result of their long term training adaptations which may be further related to their pattern of movement requirement.

Key Words: **Long Distance Runners, Cyclists**

Introduction

Theorists have pointed to the contribution of neurological system to the performance of the athletes of different sports due to the requirement of different motor actions *(Payne & Morrow, 1993)*. The findings of nerve conduction velocity may give explanations for poor performance of the athletes due to poor muscle coordination and/or weakness of muscle actions *(Wilbourn, 1990).* It is more meaningful and interesting to observe the relationship of anthropometric indices and motor nerve conduction velocity in upper extremities of aerobic trained athlete like long distance runners & cyclists, who need to control their movement patterns accurately and maintained pace or speed during the performance and this requires neural adaptation in them. In theory, changes in MNCV may be an indicator of improved neural adaptations in athletes due to their exercise training program. *Halar et al (1985)* pointed out that the influence of physical activity is not the same for all types of exercise and that not all nerves may be affected in the same way. *Campbell et al (1981)* reported that the motor nerve conduction velocity is also influenced by other variables like body segment lengths/breadths and circumferences/girths. Longer nerves generally conduct more slowly than shorter nerves (*Campbell et al, 1981*). Thus, the purpose of this study was to investigate the relationship among anthropometric indices and motor nerve conduction velocity (MNCV) of radial & ulnar nerve (bilateral side) in aerobic trained athletes (long distance runners & cyclists) and to understand whether their neural specification would change from long term training.

Material and Methods

Fifty aerobic trained athletes (25 long distance runners & 25 cyclists) in the age range of 18-25 years were voluntarily recruited as subjects in the present study on the basis of their predominant energy system i.e. aerobic. An informed consent was obtained from all the subjects. Motor Nerve Conduction Velocity (MNCV) was assessed with the help of computerized equipment called "Neuroperfect" (Medicaid Systems, India) by using the standard technique *(Smorto & Basmajian, 1979).* The subject lay supine on a wooden table with the straight arm as radial and ulnar motor nerve conduction velocity was tested. The differences in the mean values and relationship among anthropometric indices and MNCV was identified using Pearson correlation with a significance level of $p < 0.05$ by statistical software 'SPSS' version 10.

Results & Discussion

The mean age, body height and body weight of the subjects were 23±2 years, 172.8±5.8 cm and 70.5±4.2 kg respectively. The means of right and left upper arm length & lower arm length were 13.7 cm, 13.4 cm, 11.1 cm and 10.9 cm respectively. The means of right and left hand length and hand breadth were 8.1 cm, 7.9 cm, 9.2 cm and 9.1 cm respectively. The means of right and left upper arm, fore arm and wrist circumferences were 10.2 cm, 9.9 cm, 9.5 cm, 8.9 cm, 7.0 cm and 6.7 cm respectively. The mean of motor nerve conduction velocity of right and left radial nerve and ulnar nerve were 42.4 m/s, 42.6 m/s, 41.7 m/s and 41.4 m/s respectively (Table 1).

Table 1: Mean ±SD of Anthropometric indices & MNCV of aerobic trained athletes

Variables	Mean±SD
Age (years)	23±2
Body Height (cm)	172.8±5.8
Body Weight (Kg)	70.5±4.2
Right Upperarm length (cm)	13.7±0.9
Left Upperarm length (cm)	13.4±0.8
Right Lower arm length (cm)	11.1±0.8
Left Lower arm length (cm)	10.9±0.9
Right Hand length (cm)	8.1±1.8
Left Hand length (cm)	7.9±1.9
Right Hand breadth (cm)	9.2±3.2
Left Hand breadth (cm)	9.1±3.0
Right Upper arm circumference (cm)	10.2±1.4
Left Upper arm circumference (cm)	9.9±1.2
Right Fore arm Circumference (cm)	9.5±1.1
Left Fore arm Circumference (cm)	8.9±1.3
Right Wrist circumference (cm)	7.0±0.7
Left Wrist circumference (cm)	6.7±1.1
MNCV of right radial (m/s)	42.4± 6.9
MNCV of left radial (m/s)	42.6± 7.3
MNCV of right ulnar (m/s)	41.7± 6.1
MNCV of left ulnar (m/s)	41.4± 6.5

The mean value of motor nerve conduction velocity (MNCV) of right and left radial and ulnar nerve was comparable. Further, the mean of motor nerve conduction velocity (MNCV) of radial nerve (both right & left) was greater than ulnar nerve. Further, the differences in the bilateral mean values of anthropometric indices and motor nerve conduction velocity of radial and ulnar nerve were not statistical significant (Table 1).

The results of correlation showed that motor nerve conduction velocity (MNCV) of right radial and left radial was negatively and significantly related with right upper arm length (r=-0.40) and left upper arm length (r=-0.37) (Table 2).

Table 2: Correlations among segment lengths/breadths & MNCV of radial & ulnar nerve in aerobic trained athletes

Variables	MNCV of Right Radial	MNCVof Left Radial	MNCVof Right Ulnar	MNCVof Left Ulnar
Right Upperarm Length	-.40**	-0.26	-0.02	0.06
Left Upperarm Length	.29	-0.37*	0.03	0.08
Right Lowerarm Length	0.01	0.01	0.09	0.07
Left Lowerarm Length	0.03	0.02	0.05	0.09
Right Hand Length	0.01	-0.12	0.27	0.16
Left Hand Length	0.03	0.17	0.21	0.12
Right Hand Breadth	0.14	0.17	-0.04	0.06
Left Hand Breadth	0.11	0.15	0.06	0.09

**significant at the 0.01 level ; *significant at the 0.05 level

The results of correlation showed that MNCV of right ulnar and left ulnar was positively and significantly related with right upper arm circumference (r=0.33) and left upper arm circumference (r=0.36) (Table 3).

Table 3. Correlations among circumferences/girth & MNCV of radial & ulnar nerve in aerobic trained athletes

Variables	MNCV of Right Radial	MNCV of Left Radial	MNCV of Right Ulnar	MNCV of Left Ulnar
Right Upper arm Circumference	-0.07	0.12	0.33*	0.23
Left Upperarm Circumference	0.09	0.17	0.27	0.36*
Right Forearm Circumference	-0.13	0.01	0.21	0.15
Left Forearm Circumference	0.15	0.03	0.17	0.03
Right Wrist Circumference	-0.01	0.14	-0.11	-0.12
Left Wrist Circumference	0.11	0.09	0.05	0.10

**significant at the 0.01 level ; *significant at the 0.05 level

Discussion

In the presented study, the results showed that aerobic trained athletes had comparable motor nerve conduction velocity of radial and ulanr nerves but the difference between them were statistically nonsignificant. Further, the mean MNCV of radial nerve showed faster motor conduction velocity than the ulnar nerve. The results seem reasonable, since, the goals of long distance runners and cyclists training program are more rapid and coordinated movements in the upper and lower extremities. It may cause physiological adaptations in nerve structure. *Gerchman et al, (1975)* indicated that ventral motoneurons following long term exercise had histochemical changes. The changes in nerve conduction velocity may be indicative of adaptations in the nerve structure such as increased axon diameter and myelination *(Ross et al, 2001)*. It was also observed in the present study that motor nerve conduction velocity of radial and ulnar nerve was significantly and negatively related with upper arm length.

Similar results were also reported by *Falck and Stalberg (1995)*. The MNCV of right ulnar and left ulnar was positively and significantly related with right and left upper arm circumference. When a muscle becomes stronger in response to training, the gain in strength is usually attributed to an improvement in the size or quality of the muscle. Many upswings in strength are actually the result of alterations in the way the muscle is controlled by the nervous system. Specifically, the nervous system can do a better job of recruiting muscle fibres and collections of muscle cells (motor units) within the muscle during an athlete's sporting activity, thus producing more forceful movements *(Christensen & Galbo, 1983)*. In a competitive runner, the nervous system can also learn to activate motor units in a way which will produce not only the desired level of strength and power for a particular sport but also the most energy-efficient production of strength and power. It is presumed that the neural adaptation of muscles in the trained athletes is due to a more active recruitment of motor units and an increase of their firing rates upon maximum voluntary contraction. The recruitments of slow- (type I) and fast twitch (type IIa, b) muscle fibers are in relation to the intensity of effort. For rapid, powerful movements, the fast-twitch fibers are activated *(Edgerton, 1976)*. Further, it is also assumed that the improvement of strength performance may be due to the fact that the athletes can recruit more of type IIa, and especially type IIb, motor units during maximum contraction of the measured muscles, and that they can express their true strength capacity by increasing their capacity to recruit more type II motor units during rapid, powerful movements. This means that trained athletes can more fully activate their prime moving muscles in maximal voluntary contractions *(Sale, 1987)*. Thus, the nervous system plays a critically important role in the development of greater strength, and the nervous system can even learn patterns of muscle coordination and activation which can be utilized by the trained athletes to boost their performance in the sport competitions *(Al-Seffar, 1990)*.

Conclusion

It is concluded that the positive relationship of MNCV of radial and ulnar nerve in aerobic trained athletes may be the result of their long term training adaptations which may be further related to their pattern of movement requirement.

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