Comparison of H-Reflex Response of Sprinters & Non-Athletes

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Abstract

The aim of this study was to investigate the effects of training type (anaerobic) on Hoffmann reflex (H- reflex) response parameters in sprinters & non-athletes. For this purpose, 10 male Sprinters (Group 1) and 10 male non-athletes (Group 2) were involved in this study in which the amplitude and latency values of H- reflex were measured with the help of an equipment called "Neuroperfect" (Medicaid Systems, India). Statistical analysis was performed by using statistical software 'SPSS,' means ± SD and student's *t* test was used. The mean age and body height of group 1 & 2 were 23.93 ± 2.65 years & 173.12±6.40 cm and 24.28 ± 2.45 years & 168.80±3.25 cm respectively. The H-reflex amplitude and latency values found in groups 1 & 2 were 3.13±0.22 mV & 22.77±2.82 ms and 6.19±0.44 mV & 26.79±1.85 ms respectively. There was no statistically significant difference between the groups with respect to latencies of H- reflex. In the test group (sprinters), the amplitude of the H-reflex was significantly smaller than the non-athlete group ($p<0.05$). The results of this study suggest that training of skeletal muscles affect the H- reflex response parameters.

Key words: Sprinters, H- reflex, Amplitude, Latency, Training

Introduction

The H-reflex is an estimate of alpha motoneuron (αMN) excitability when presynaptic inhibition *(Zehr, 2002)* and intrinsic excitability *(Capaday, 1997)* of the αMNs remain constant. This measurement can be used to assess the response of the nervous system to different neurologic conditions, *(Fisher, 1992)* musculoskeletal injuries, *(Hopkins & Palmieri, 2004)* application of therapeutic modalities, *(Krause et al, 2000)* pain, *(Leroux, 1995)* exercise training, *(Earles et al, 2002)* and performance of motor tasks *(Capaday, 1997)*. It is known that a number of factors affect the normal value of H-reflex amplitude and latency *(Simonsen and Dyhre-Poulsen, 1999)*. While age, body height and extremity length reveal direct correlation with the latency value of the H-reflex, its amplitude is associated with contraction of muscle, intensity of stimulus, vestibular stimulation, movements of head and neck, and temperature *(Oh, 1993)*. The type and training level of skeletal muscle also affects H-reflex amplitude *(Casabona et al, 1990)*. The aim of this study was to determine the effects of the type of training on H-reflex response parameters like amplitude and latency in sprinters and non trained individuals.

Materials & Methods

All subjects involved in this study were closely matched with respect to their age and height. A total of 20 male subjects were included in this study. They comprised of ten sprinters (Group 1) and ten non-athlete subjects (Group 2, control). The group 1 sprinters were engaged in specific power training program and group 2 that is untrained control group consisted of 10 healthy subjects who did not carry out any kind of sports, were not engaged in any regular training program professionally for recreational physical activity. All subjects were non smokers, non alcoholic, none had any medical problem and they were not under any prescription drugs. The H-reflex response was recorded on the right and left extremity of each subject involved in this study were measured with the help of computerized equipment called “Neuroperfect” (Medicaid Systems, India).The subject lay comfortably in the prone position on a wooden table. Their skin was degreased, conducting paste was applied before recording and stimulating electrodes were placed. The skin temperature was kept above 31 °C over the recording area. The recording electrode was positioned over the medial gastrocnemius muscle halfway between the midpoint of the popliteal fossa and upper border of the medial malleolus. The reference electrode was also positioned in the same line 5 cm distal to the active electrode, and the ground electrode was placed between the tendon and reference electrode. An approx. 15 cm thick support was placed under the ankle to ensure 90 degrees of flexion and 0.5 ms pulses of constant voltage were applied to the tibial nerve in the popliteal fossa. The time base was adjusted to 10 ms, sensitivity to 0.5-5 mV and filters to 10-500 Hz. The intensity of the stimulus was increased by 0.5 mA until maximum H-reflex amplitude and minimum motor response was obtained and then 5 maximum H-reflex responses were recorded. The maximum peak to peak amplitude and latency values were used for assessment. The reflex response with smallest distal latency was used for statistical analysis. A peak to peak interval (inter peak) was regarded as the amplitude.

Statistical analysis was performed by using statistical software ‘SPSS-16 free trial version’ for windows, means ± SD and student’s *t* test was used. $p<0.05$ was considered to be statistically significant.

Results & Discussion

The mean age and body height of group 1 and 2 were 23.93 ± 2.65 years & 173.12±6.40 cm and 24.28 ± 2.45 years and 168.80 ± 3.25 cm (Table 1).

Table 1 Mean ± SD of age & body weight of sprinters & non-athletes

	Group 1 (Sprinters)	**Group 2** (Non-athletes)
Age (years)	23.93 ± 2.65	24.28 ± 2.45
Body Height (cm)	173.12±6.40	168.80±3.25

It was found that there was not statistical significant difference between the age and height of the sprinters and non-athlete subjects.

Table 2 Mean ± SD of H-reflex variables on the right & left side in sprinters

	H-reflex	
Variables	**Latency (ms)**	**Amplitude (mV)**
Right leg	26.80 ± 2.85	3.78 ± 0.20
Left leg	26.95 ± 2.80	3.60 ± 0.25

It was found that there was no significant difference between the latency and amplitude values on the right and left side (Tables 2 & 3) in either group; both values were pooled for statistical evaluation.

Table 3 Mean ± SD of H-reflex variables on the right & left side in non-athletes

	H-reflex	
Variables	**Latency (ms)**	**Amplitude (mV)**
Right leg	**26.09 ±1.80**	**6.21 ± 0.44**
Left leg	**27.50 ± 1.90**	**6.18 ± 0.45**

After pooling of the values on the right and left side, the mean peak amplitude and latency values of H- reflex found in group 1 and 2 were 3.13±0.22 mV & 22.77±2.82 ms and 6.19±0.44 mV & 26.79±1.85 ms, respectively. There was statistical significant difference between group 1 and 2 with respect to the H-reflex peak amplitude. The test group 1 had significantly smaller H-reflex peak amplitude value compared to the non-athlete group ($p<0.001$) but there was no significant difference between the groups with respect to H-reflex latency (Table 4).

Table 4 Comparison of H-reflex variables of sprinters & non-athletes

Variables	H-reflex	
	Latency, ms	Amplitude, mV
Group 1(sprinters)	22.77 ± 2.82	3.13 ± 0.22*
Group 2 (non-athletes)	26.79 ± 1.85	6.19 ± 0.44*

* ($p<0.001$)

It is known that physical exercises can cause structural changes in skeletal muscles as well as an increase in excitability of motor units *(Hoppeler, 1988).* But the effects of the type of exercise on these changes have not been studied in detail. The reflex tests can be used for evaluating of motor unit activities in both sedentary subjects and subjects engaged in active sports *(Perot et al, 1991).* The H-reflex is considered to reflect directly the excitability level of alpha motor neurons in the spinal cord. In H-reflex studies, stimulation is directly applied to the Ia fibers *(Oh, 1993).* The main result of our study concerned the fact that the H-reflex amplitude of trained subjects (sprinters) was significantly smaller than those of the non-athletes (non-trained) subjects. *Casabona et al, (1990)* reported that maximum H response of physically trained subjects was lower than in non-trained subjects and they suggested that this was due to the dominance of synapses between Ia motor neurons and small motor neurons in the ventral horns of the spinal cord. In attempts to characterize muscle fiber differences in trained (athletes) and non trained subjects, marked changes in motor unit morphology and functional aspects were reported *(Tesch & Karlsson, 1985).* Anaerobic exercise with fast contractions causes biochemical changes in motor units *(Hakkinen et al, 1985).* It has been shown that some of the fast contracting motor units that are resistant to fatigue are involved in the H-reflex *(Nardone and Schieppati, 1988).* The number of small motoneurons and interneurons that receive input from Ia afferents is lower in trained subjects than in sedentary subjects. This finding supports the idea that there is a close relation between morphological and functional characteristics of the neuromuscular system and that these can be affected by type and duration of training. However, it is also possible that the presynaptic inhibition is enhanced so that the output from the motor neuron pool in response to Ia afferent input will be decreased and the influence of Ia afferents will be limited. The different muscle fiber types of these subjects could also explain the difference obtained between the H-reflex responses in this study. It is believed that motor neuron excitability is not the only factor in the exercise induced changes of H-reflex parameters, since other parameters may also be involved *(Van Boxtel, 1986). Perot et al (1991)* compared the pre and post exercise H-reflex parameters and found that changes occurred in muscle stretch receptor responses. In conclusion, the results of this study point out that chronic training alters H- reflex amplitude and that the type of training is also important in these reflex changes. These changes may enhance the adaptation ability of athletes to excessive physical activity but the mechanism mediating these changes and the exact role of this modulation remains to be determined.

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