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RESEARCH ARTICLE

Electromyogram, hand grip strength and time to fatigue in matched samples of vegetarians and non-vegetarians

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ABSTRACT

Background: Nutritional content of diet of vegetarian (V) and non-vegetarian (NV) differs in terms of food composition, and vegetarian diets are often low in protein, probably causing a difference in body composition, structure and strength characteristics. **Aims and Objectives:** To compare the electromyogram (EMG), hand grip strength (HGS) and time to fatigue in matched groups V and NV. **Materials and Methods:** Anthropometrically matched 50 V and 50 NV males in the age group 17-19 were recruited for the study. HGS and EMG were recorded with the help of grip force transducer and EMG electrodes using Power lab 8/30 series with dual bioamplifier (AD Instruments Australia, Model No. ML870). Student's *t*-test (two-tailed, independent) was used to find the significance of study parameters between two groups. **Results:** There was no statistically significant difference in HGS, time to fatigue and EMG when compared between matched NV and V. **Conclusion:** HGS, time to fatigue and EMG where comparable for V and NV.

KEY WORDS: Electromyogram; Hand Grip Strength; Time to Fatigue; Vegetarians; Non-vegetarian

INTRODUCTION

Hand grip strength (HGS) is a measure of the strength of several muscles in the hand and the forearm.[1] It is measured in either kilograms or Newtons by squeezing a HGS dynamometer with one's maximum strength. The estimation of HGS is of immense importance in determining the efficacy of different treatment strategies of hand and in hand rehabilitation. The hand muscles play a vital role in the performance of daily activities of normal life such as using tools or transferring from one position to another, such as rising from a chair.[2] The relationship between HGS and several variables including morbidity, mortality, the risk of falling, anthropometric traits, and nutritional status has been reported.[3-5] An electromyogram (EMG) is a record of the electrical activity of muscles. This current is usually proportional to the level of the muscle activity. EMG can be recorded by two methods: Intramuscular electrodes or surface electrodes. Surface electromyography is widely used in many applications, such as physical rehabilitation (physical therapy/physiotherapy and orthopedics), urology (treatment of incontinence), biomechanics (sports training, motion analysis, and research), and ergonomics (studies in the workplace, job risk analysis, product design, and certification).[6] Epidemiological studies on vegetarians show that appropriately planned vegetarian diets are healthy and nutritionally adequate.[7-11] Compared to non-vegetarian (NV) diets, V diets can provide several health benefits.[12-15] However, these health benefits in vegetarians may be influenced by other non-dietary practices. Regular physical activity and the avoidance of harmful practices such

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as smoking and excessive alcohol and being more "health conscious" in general are influencing factors.[16] As per some studies, there is little evidence that athletic performance differs much between V and NV if the diet is nutritionally adequate.[17] Some other studies have shown that HGS and endurance are significantly higher in NV compared to V.[18] In most of these studies NV and V are not anthropometrically matched, that is most studies compared a self-selected vegetarian group with standard population references. To truly attribute the health benefits associated with a vegetarian lifestyle, it is necessary to compare the vegetarian subjects with an adequate reference sample.[19,20] In such a design the vegetarians are compared with a comparable NV sample to exclude possible confounding factors. Moreover, none of the studies in India have been used EMG to measure the influence of the type of diet practice on muscle performance. The purpose of this study is to compare EMG, (HGS) and time to fatigue in matched groups of V and NV.

MATERIALS AND METHODS

About 50 V and 50 NV healthy, non-athlete males in the age group 17-19 years were recruited as subjects. Subjects were classified as NV if foods of plant and animal origin, including meat, fowl, eggs, milk and other dairy products, and fish were included in their diet and vegetarians if foods of plant and dairy products were included in their diet. Subjects with joint problems of hand, wrist and elbow, history of fracture, neurological condition, and any deformities of the upper limb were excluded from the study.

Human ethical clearance certificate was obtained from the Institute Human Ethical Clearance Committee. Written informed consent was taken from each subject after explaining the procedure.

Body Mass Index (BMI)

The height was recorded during inspiration using a stadiometer to the nearest 0.1 cm, and weight was measured by digital standing scales to the nearest 0.1 kg with the subjects wearing light indoor clothes and without shoes. BMI was then calculated using the formula weight (in kg)/height $(m)^2$.

Hand Circumference

Hand circumference was measured at maximum hand width by flexible measuring tape.

Forearm Circumference

Forearm circumference was measured at the midpoint between olecranon process of ulna and styloid process of radius bones by flexible measuring tape.

HGS and EMG were recorded with the help of grip force transducer and EMG electrodes using Power lab 8/30 series with dual bio-amplifier (AD Instruments Australia, Model No. ML870).

HGS of dominant hand was measured using a computerized hand dynamometer with participants seated with their elbow by their side, flexed to right angle and a neutral wrist position.

The maximum voluntary contraction (MVC) task consisted of a gradual increase in force from zero to maximum over 3s, with the maximal force held for 2-3s. Mean of three trials of grip strength for right hand was calculated. Subjects performed sustained submaximal contractions of handgrip at two different intensities: 30%, and 75% of the pretrial MVC.

For the recording of EMG, silver chloride surface electrodes were placed, 3 cm distal to the cubital fossa, over the flexor digitorum profundus. EMG was sampled in 1 s epochs every 15 s during the contractions, and the integrated EMG (IEMG) values were normalized to that of the pretrial MVC by taking the ratios of IEMG at submaximal intensities to that of pretrial MVC. The resultant ratios were expressed in percentage.[21]

Statistical Analysis

Descriptive statistical analysis has been used in this study. Results on continuous measurements were expressed as the mean ± standard deviation (Min-Max). Significance was assessed at 5% level of significance. Student's *t*-test (two-tailed, independent) was used to find the significance of study parameters between two groups. Pearson's correlation coefficient test was applied to study the correlation. The statistical software namely SPSS 17.0 was used for the analysis of the data.

RESULTS

There was no significant difference in mean BMI and forearm circumference between V and NV $P > 0.05$ (Table 1).

Furthermore, there was no significant difference in mean EMG, HGS and time to fatigue between V and NV $P > 0.05$ (Table 2).

Table 1: Comparison of anthropometric parameters

Study characteristics	Mixed vegetarians	Vegetarians	*P* value
Age in years	18.73±1.08	18.68±1.03	>0.05
Forearm circumference in cm	22.06±1.91	21.82±1.73	>0.05
Hand circumference (cm)	21.89±1.10	21.03±0.85	>0.05
BMI (kg/m^2)	21.25±3.08	21.14±3.76	>0.05

BMI: Body mass index

Table 2: Comparison of HGS, time to fatigue and IEMG

Study characteristics	Mixed vegetarians	Vegetarians	*P* value
HGS (MVC in N)	367.97±80.51	360.45±62.27	>0.05
Time to fatigue in seconds at 30% of MVC	175.43±80.31	171.26±62.84	>0.05
Time to fatigue in seconds at 75% of MVC	50.79±11.63	47.96±16.35	>0.05
Normalized IEMG in percentage at 30% of MVC	51.65±24.13	50.80±20.73	>0.05
Normalized IEMG in percentage at 75% of MVC	92.17±26.44	90.87±25.98	>0.05

IEMG: Integrated electromyogram, MVC: Maximum voluntary contraction, HGS: Hand grip strength

DISCUSSION

The main aim of this study was to compare EMG, HGS and time to fatigue between matched groups of V and NV. Western studies have consistently reported that vegetarians have lower BMI than comparable NV and according to them the reasons for this difference may include differences in the composition of the diet such as a higher fiber intake and a lower protein intake.[22] But in our study, we have seen that there was no significant difference in BMI, forearm circumference and hand circumference between V and NV. In one of the studies conducted on Indian female athletes shows that endurance time and recovery was better in NV than V.[18] In our study, we did not find any significant difference in EMG, HGS and time to fatigue between V and NV. All these findings of our study can be attributed to the balanced diet followed by the V.

There was a positive correlation between all anthropometric data (BMI, forearm circumference, and hand circumference) and HGS in both V and NV. The hand circumference had the strongest correlation with HGS in both V and NV. This was in accordance with the earlier study.[23]

CONCLUSION

Appropriately planned and balanced vegetarian diets are healthy and also nutritionally adequate for the muscular performance.

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