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Original Research Article

An Observational Investigation to Evaluate the Fine Motor Abilities and Hand Grip Strength of both Competent and Unskilled Individuals

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Abstract

Aim: The aim of the present study was to assess the hand grip strength & fine motor skills in skilled & non skilled persons.

Methods: The current investigation was carried out in the Department of Physiology. We enrolled a cohort of 200 physically fit individuals between the ages of 20 and 40 who shown no difficulty in complying with the researcher's instructions, possessed enough muscular strength to do the assigned activity, and exhibited no restrictions in joint mobility.

Results: There were no statistically significant differences between the groups in terms of general characteristics ($p > 0.05$). There were no notable differences between the groups in the time it took to complete the CMT assessment before and after the intervention. There were no notable differences between the experimental and control groups in terms of the duration of the pre-intervention PPT time and post-intervention PPT time (experimental group: 52.80 ±6.31 s; control group: [missing value]).

Conclusion: When opposed to those who are not competent, skillful individuals have a decrease in their muscular strength, which results in an improvement in fine motor skills such as FT and PDT.

Keywords: hand grip strength, fine motor skills, skilled persons, non-skilled persons

Introduction

The condition of the body that should stay free of physical and mental stress at the time of work is referred to as occupational health. This state of the body should be maintained not only for the purpose of achieving maximum productivity but also for the purpose of reducing the likelihood of accidents and injuries. [1] The amount of labor load that is forced on a person, either as a result of industrial need or as a result of postural discomfort, is the primary source of health dangers that are present in the working environment. [2] The evaluation of an individual's dietary pattern and health state may be accomplished via the use of anthropometric measures and body composition, both of which are essential techniques. [2-4] Furthermore, different components of body composition not only represent diverse energy balances in respect to the functional and metabolic characteristics of the subject, but they also have a strong correlation with the cardiorespiratory fitness of the individual. [4-7] Nutrition and an individual's level of cardiorespiratory fitness both have an impact on the function of skeletal muscles. [8] and hand grip strength (HGS) testing is used to quantify the motor fitness or skill-related fitness of the complete skeletal musculature of the arm. [9] A loss in hand function may also be the consequence of changes in the peripheral nervous system. These changes may include a decrease in nerve conduction velocity, sensory perception, or the excitation–contraction coupling of motor units. [10,11] It has been hypothesized that alterations in both the central nervous system and the muscles are connected with a poorer tolerance to muscular fatigue in older people. This hypothesis has been supported by several studies. [12] In addition, it is believed that a problem with sensory perception is the cause of a decrease in sensorimotor performance. [13] In all, the complex changes that occur as a result of aging in the physiology of the human brain and the whole central nervous system are characterized by a decline in perception and cognitive capacity, a slowing of motor activity, and a loss of a variety of motor abilities. [14] Additionally, the capacity to repeat motions at a high frequency is primarily reliant on the manner in which the central nervous system governs antagonistic muscle groups as well as the method of muscle activation and inhibition. The aging process is another factor that might have an effect on these elements; once again, it has been noticed that older people experience weariness faster than younger people. The elderly have been shown to employ a substantially larger number of motor units than younger persons, even

while engaging in tasks that require very little muscle. [15] In this particular research, the objective was to evaluate the hand grip strength and fine motor abilities of individuals who were either competent or not skilled.

Materials and Methods

The present study was conducted in the Department of Physiology, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India for one year . We recruited 200 healthy adults aged 20–40 years who had no difficulties in following the researcher's instructions, who had sufficient muscle strength to conduct the given task, and who were without limitations in the range of motion of the joints.

Inclusion Criteria

- Males & Females
- Subjects aged 20 – 40 yrs
- Computer operators
- No History of systemic disorders
- No History of medication

Exclusion Criteria

- Subjects aged < 18 and > 40 yrs
- Non computer operators
- Other systemic disorders
- History of medication
- Parameters recorded

Height & Weight

- recorded by using Stadiometer & Digital weighing balance.

- Body Mass Index

- calculated by using a formula Weight in Kgs / Height in meter square.

- Maximum Voluntary Contraction

- recorded by using Hand grip dynamometer.

- Finger Tapping

- recorded by using Computerized finger tap recorder.

- Pin Dexterity Test

- recorded by using Modified O'Connor dexterity apparatus (in house built and calibrated).

Data Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows version 20.0. Statistical significance was set at < 0.05.

Results

Table 1: Demographics

Characteristics	Skilled persons N=100	Non-skilled persons N=100	P Value
Gender			
Male	60	56	0.852
Female	40	44	
Age (years)	29.91 ±4.08	32.36 ±4.06	0.654
Height (cm)	168.82± 9.71	169.00 ±7.63	0.610
Weight (kg)	67.28 ±12.88	66.98 ±14.35	0.760
Dominant hand (L/R)	4/96	6/94	0.316

There were no significant between-group differences in the general characteristics (p > 0.05).

Table 2: Coordination

Characteristics	Skilled persons N=100	Non-skilled persons N=100	P Value
Pre	58.64 ±14.04	62.92 ±16.15	0.420
Post	52.68 ±9.71	51.32 ±16.54	0.825
t	3.541	5.346	
p	0.001	<0.001	

There were no significant between-group differences in the pre-intervention CMT time and post-intervention CMT time.

Table 3: Dexterity

Characteristics	Skilled persons N=50	Non-skilled persons N=50	P Value
Pre	58.13 ±10.86	58.30 ±7.80	0.900
Post	52.80 ±6.31	54.58 ±6.23	0.160
t	5.616	4.500	
p	<0.001	<0.001	

There were no significant between-group differences in the pre-intervention PPT time and post-intervention PPT time.

Discussion

Most people primarily use one hand in their everyday activities, which defines whether they are right- or left-handed. The asymmetrical use of the dominant hand compared to the non-dominant hand reduces the skill and strength of the muscles in the non-dominant hand, as well as the level of brain activity in the non-dominant motor cortex. Additionally, Sperry [17] proposed that using the dominant hand more than the non-dominant hand leads to an uneven distribution of various cognitive functions in the left and right brain hemispheres. Utilizing both the dominant and non-dominant hands enables the balanced activation of various brain areas. Researchers from several disciplines have used hand anthropometry to improve their work in areas such as sports, glove production, and the development of grips, keyboards, and computer mice with precise technical requirements. [18] These measures are crucial in identifying the most appropriate models that enhance optimum performance with least effort and constant effectiveness.

There were no statistically significant differences between the groups in terms of general characteristics (p > 0.05). There were no notable variations between the groups in terms of the time it took for the CMT measurement before and after the intervention. There were no notable differences between the groups in the time it took to complete the PPT task before and after the intervention. Matsuo et al. [19] examined the hemodynamics of individuals as they self-fed using chopsticks with their dominant and non-dominant hands, using near-infrared spectroscopy. When using chopsticks with the hand that is stronger or more skilled, there was a noticeable increase in the clarity and intensity of the mental images of the motor actions compared to using the less dominant hand. This indicates that the motor imagery task requiring competent control of chopsticks resulted in a higher level of vividness compared to the task requiring unskilled control. Additionally, it had an impact on the haemodynamic response. More precisely, this indicates that the work enhances brain function. Many research have examined the use of mental imagery in basic tasks. However, the use of mental imagery in complicated tasks, such as self-feeding with chopsticks, in everyday activities that have practical significance for patients is still not well understood. This implies that there is a theoretical basis for the observed enhancement in coordination and dexterity of the non-dominant hand. It also highlights the importance of our results in a therapeutic context. Our research included two groups: an experimental group and a control group. The experimental group performed hand motions that were known to them using their dominant hand, whereas the control group did the same actions using their non-dominant hand. Kirby and colleagues [20] undertook a functional magnetic resonance imaging (fMRI) investigation to assess the level of brain activity between the dominant and non-dominant hands in a group of healthy persons. The researchers discovered that the group using their non-dominant hand engaged more areas of the brain related to vision and movement compared to the group using their dominant hand while doing a task using a joystick. Furthermore, training the non-dominant hand resulted in higher levels of brain activity compared to training the dominant hand. In contrast, training the dominant hand resulted in bilateral stimulation, long-term persistence, and after-effects.

Munn et al [21] found that cross-training one limb had an impact on the other extremity or other non-exercising body areas, resulting in increased muscle activation. In addition, Carson[22] observed an augmentation in the excitability of the motor domain in the corresponding cerebral hemisphere when the dominant upper extremity was used for training, leading to enhanced function. Carroll et al[23] shown that this process is organized in a hierarchical and flexible way within a widespread network spread over the frontal lobe of the cerebral cortex. This network is responsible for the planning and execution of independent movement. Moreover, they demonstrated that one-sided motor learning is linked to the brainstem via the corpus callosum connecting motor regions, hence influencing motor learning on the opposite side. Collectively, mirror training may result in similar outcomes as cross-training for the dominant hand, by enhancing the activity of the opposite side of the brain. As a result, this had an impact on the stimulation of the non-dominant hand and enhanced coordination and dexterity.

Conclusion

The improvement of fine motor skills like FT and PDT results from the reduction of muscular strength in competent individuals as opposed to non-skilled individuals.

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