Original Article

Comparison of Back Muscle Strength and Physical Performance Test in Rickshawpullers Residing at the Northern Part of Dhaka Metropolitan City

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Abstract

Context: *Strength is the quality or state of being physically strong and the ability to resist being moved or broken by a force. Muscular strength is a component of both health-related and sport-related physical fitness. Performance is an assessment of how well a task is executed and the success of a training program is largely dependent upon satisfying the performance aims associated with it. Physical performance testing is completed with subjects in order to collect data and make observations regarding the overall function of the limb integrated into the entire functional unit of the body. This is useful for assessing the true return of function and the individual's risk for potential future injury. The present study aimed at comparing the back muscle strength and physical performance test: vertical jump test, broad jump test, flexibility test between the rickshaw-pullers of Northern Dhaka and sedentary workers of same region. The result might be used as a base-line for other professions as well for further research in our country.*

Materials & Methods: *A cross-sectional analytical type of study was conducted in the department of Anatomy, Dhaka Medical College, Dhaka, from January 2015 to December 2015. The study was conducted on 100 adult Bangladeshi male rickshawpullers (Case group) and 100 adult Bangladeshi male sedentary workers (Control group) -both the groups residing at the Northern part of Dhaka metropolitan city.*

Results: *The results of the present study demonstrate that significant difference of mean back muscle strength and physical performance test: vertical jump test, broad jump test, flexibility test were observed between control and case groups where the mean back muscle strength and physical performance test: vertical jump test, flexibility test were greater in the case group than in the control group. The study findings suggest that work load have influence over back muscle strength and physical performance test: vertical jump test, broad jump test, flexibility test.*

Conclusion: *Back muscle strength and physical performance test: vertical jump test, flexibility test of the case group was significantly higher than the control. The study findings suggest that work load have influence over back muscle strength and physical performance test: vertical jump test, broad jump test, flexibility test.*

Key words: *Back muscle strength, physical performance test, vertical jump test, flexibility test, rickshawpuller, sedentary worker, discriminant analysis technique.*

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Introduction

Strength is the quality or state of being physically strong and the ability to resist being moved or broken by a force [1]. Muscular strength is a component of both health-related and sport-related physical fitness. It is defined as the ability of a muscle group to develop maximal contractile force against a resistance in a single contraction and is either static or isometric, which involves no change in muscle length, and dynamic, which involves either eccentric or concentric action. A normal level of strength is necessary for normal healthy living, while muscle weakness might impair normal functional movement [2]. Strength of muscle can be obtainable after certain period, it depends on types of physical activities, e.g. water polo players need at least 3 years strength training to get their desired strength [3]., judo athletes need at least 7 years strength training to get their desired strength [4].

Back muscle strength is the ability of a muscle or muscle groups of back to exert force to overcome the most resistance in one effort. The muscles of the back may be divided into three groups: the superficial, intermediate muscles which are extrinsic muscles and the deep muscles or postvertebral muscles belonging to the vertebral column. Muscles of the deep group such as erector spinae, transversospinalis, interspinales, intertransversarii are intrinsic muscles. The intrinsic or deep back muscles include muscles that specifically act on the vertebral column, producing its movements and maintaining posture [5]. The deep muscles of the back form a broad, thick column of muscle tissue, which occupies the hollow on each side of the spinous processes of the vertebral column. This complicated muscle mass is composed of many separate muscles of varying length. Because the origins and insertions of the different groups of muscles overlap, entire regions of the vertebral column can be made to move smoothly. The muscles of longest length lie superficially and run vertically from the sacrum to the rib angles, the transverse processes and the upper vertebral spines. The muscles of intermediate length run obliquely from the transverse processes to the spines. The shortest and deepest muscle fibers run between the spines and between the transverse processes of adjacent vertebrae[6].

The back extensors are essential to lifting and bending activities. These muscles act both to extend the spine and to balance the flexion movement produced by the trunk and weight being lifted [7]. Athletes with poor back muscle strength are prone to injury. It was also reported that reduced back extensor muscle strength might be a major risk factor for non-specific low back pain. Thus, assessment of back strength is one of the important preventive measures for sports persons [8]. In other professionals such as rickshawpuller, cycle van puller, bicycle rider, day labourer etc., as they pull the vehicle and lift heavy load. Their work depend upon back muscle and leg muscle strength. Performance is an assessment of how well a task is executed and the success of a training program is largely dependent upon satisfying the performance aims associated with it. Physical performance testing is completed with subjects in order to collect data and make observations regarding the overall function of the limb integrated into the entire functional unit of the body. This is useful for assessing the true return of function and the individual's risk for potential future injury [9]. It includes vertical jump test, broad jump test, flexibility test etc. Vertical jump is commonly used as an index for the power of the lower limb [10]. Back strength had strong correlations with vertical jump test, broad jump test[8]. Flexibility refers to the absolute range of movement in a joint or series of joints and length in muscles that cross the joints to induce a bending movement or motion. Flexibility varies between individuals, particularly in terms of differences in muscle length of multi-joint muscles. Flexibility in some joints can be increased to a certain degree by exercise. Loss of flexibility can be a predisposing factor for physical issues such as pain syndromes or balance disorders. Individual body flexibility level is measured and calculated by performing a sit and reach test [11].

Cycle, rickshaws are human-powered vehicle driven by pedaling. Rickshaw pulling is labouring task which requires lot of energy, strength and stamina. For their livelihood most of the rickshawpullers in Bangladesh start rickshaw pulling at an earlier stage of their life. They come from different regions of the country to Dhaka city. They have to pull rickshaw on uneven roads and streets. Before being involved in this profession, they are used to do some daily activities such as swimming, walking, running. Because of these activities, their back and leg muscles become strong to some extent. At the first onset of this profession, they do not know how to pull rickshaw effectively and how to maintain proper posture for pedaling. The skill is developed gradually. They are adopted themselves with their new profession. To avoid injuries like back pain, leg pain, joint pain rickshawpullers in Bangladesh

should have knowledge about importance of back muscle and leg muscle strength that can help them to take measures for a healthy and fit professional life.

The muscle strength differs in different population groups. It varies with age, sex, physical activity. The knowledge of muscle strength is important for anatomists, anthropologists, medicine practitioners, physiatrists, neurosurgeons, orthopaedic surgeons and physiotherapists. Enhanced muscular strength can lead to improvement in quality of life by increasing the areas of performance, injury prevention and body composition. A person with a moderate to high level of muscular strength can perform everyday tasks. People with poor muscle strength become fatigue more easily and are less effective in both every day and recreational activities. Increased muscular strength help protect us from injury in two key ways: By enabling us to maintain good posture, by encouraging proper body mechanics during everyday activities such as walking and lifting. Good muscle strength in the back and legs, maintain the vertebral column in proper alignment and help prevent low-back pain, maintain good balance. Increased muscle strength can also help in prevention of fall. Low back pain is one of the most common public health problems in modern industrialized societies. Many lumbar problems are muscular in origin and persons suffering from low back pain often have weak lumbar muscles. Enhanced back muscle strength can aid in the prevention and treatment of low back pain. About 80% of low back pain arises in cyclists because of poor posture. Chronic low back pain in cyclists usually the result of the prolonged flexed position. In cycling, a great amount of strength of the back muscles is required. Increased muscular strength also makes the tendons, ligaments and cartilage cells stronger and less susceptible to injury. Arthritis can be alleviated by strengthening the muscles around the joints that are affected and strength training may be therapeutic for people with chronic pain. The findings of the study might be useful in providing data for the anatomists, nutritionists, orthopaedic surgeons, radiologists, physiatrists and physiotherapists. It is observed by reviewing existing literature that many works have been done on muscle strength in foreign countries. We need our own standard baseline data from which we can compare muscle strength in our own population for future research.

Materials and Methods

100 adult Bangladeshi male rickshawpullers (Case group) and 100 adult Bangladeshi male sedentary workers(Control group) -both the groups residing at the Northern part of Dhaka metropolitan city. Lower limb bones get completely ossified usually by the age of 18 to 23 years. Nearly all bones of body are completely ossified by 25 years of age. So, the lower limb achieves its adult and fixed measurements by 25 years of age [12]. A person should have at least 3 years strength training to get his desired strength [3]. Therefore, continuous 3 years rickshawpulling was one of the prerequisites for the rickshawpullers. Again remarkable changes with aging process take place after 50 years of age. Loss of muscle strength are reported for individuals older than 50 years [13]. Hence the present study was conducted in individual of 28-50 years of age.

Subjects were selected according to their availability and willingness. They participated in the study neither for payment nor for any other kind of reward. None of their weaknesses were exploited, nor was any undue pressure created to make them participate in the study.

Information regarding inclusion and exclusion criteria of both the sedentary worker and the rickshawpuller were obtained directly by questionnaire and by physical observation as far as possible. Their ages were determined by the national ID cards. Each participant was given an ID number so that repetition could not take place.

The study was carried out on two groups- the sedentary worker and the rickshawpuller. Distribution of study population is given in table I.

Table: I grouping of the study sample

Group	Number
A **Sedentary worker**	100
B **Rickshawpuller**	100

At the beginning of the study, being greeted politely, each subject was informed about the total plan, implication of the study. Written consent was taken from them without exploiting any of their weaknesses or without creating any undue pressure. They enjoyed

the freedom to withdraw themselves from any part of the study.

Procedure of measurement of back muscle strength, vertical jump test, flexibility test was measured by back muscle strength dynamometer [14], steel measuring tape, sit and reach test box [8] respectively.

- **Procedure of measurement of back muscle strength test (Figure: 1a, 1b):**

After 3 minutes of independent warm-up time, the subject was positioned with body erect and knee bent so that the grasping hand rests at about 5-7 cm above the knee. Then he was asked to lift the handle of the dynamometer by straightening the knee. He was also asked to incline his body forward at an angle of 60 degrees. Then the strength of the back muscle was recorded on the dynamometer in kg. The measurement of back muscle strength test was taken at three trial. Each back strength testing was recorded at one minute intervals.

(a) (b)

Figure 1. Photograph showing measurement of back muscle strength (a) Lateral view; (b) Anterior view

- **Procedure of measurement of vertical jump test (Figure: 2): by steel measuring tape [8].**

The subject was asked to stand facing toward the wall. Then he was asked to keep hand straight upwards on the wall as high as possible with the feet flat on the floor. The maximum reach height point of his middle finger at this position was identified and marked by black colour on the wall. When the subject was ready, blue colour was applied on the distal part of his middle finger, then he was asked to jump up as high as possible using both arms and legs to assist in projecting the body upwards, touch and make a point on the wall with his coloured finger, at the highest point of the jump. Then the distance between the first black mark and second blue marked point on the wall was measured in cm.

Figure 2: Photograph showing measurement of vertical jump test

- **Procedure of measurement of flexibility Test (Figure: 3): by sit and reach test box [8].**

The subject was asked to sit on the floor with feet placed firmly against the inner side of the sit and reach box. With one hand over the other, the tips of the two middle fingers on top of one another, the subject was then asked to slowly stretch forward without bouncing or jerking and bending knees. Then he was asked to slide finger tips along the 20-inch scale on the box as far as possible. Maximum reach point was identified and recorded in cm.

Figure 3: Photograph showing measurement of flexibility

All data were checked and edited after collection. Later the data were put into computer and were analyzed with the help of SPSS version 19.0 for windows. Statistical analyses were done by unpaired Student's -'t' test.

Results

The present study was conducted on 100 adult Bangladeshi male sedentary workers (group A) and 100 adult Bangladeshi male rickshawpullers (group B) – both the groups residing at the Northern part of Dhaka Metropolitan City. Participants of sedentary worker included 42 security guards and 58 grocery retailers.

After collection of data, statistical analysis was done by the software, SPSS (Statistical Package for Social Sciences) for Windows, Version 17.0. Results and observations of this study are described below with suitable tables and graphs –

1. Back muscle strength of group A (sedentary worker) and group B (rickshawpuller) (Table II, Fig. 1)

Mean back muscle strength was 121.02 ± 2.36 kg and 146.29 ± 2.62 kg in group A and group B respectively. The back muscle strength was ranged from 118.00 kg to 126.00 kg in group A and 140.00 kg to 152.50 kg in group B.

There was significant difference (P<0.0001) of mean back muscle strength was observed between group A and group B where mean back muscle strength was greater in group B than that of group A.

Table II: Comparison of back muscle strength between group A (sedentary worker) and group B (rickshawpuller)

Group	Strength in kg Back muscle Mean ± SD
A (Sedentary worker) (n=100)	121.02 ± 2.36 (118.00 - 126.00)
B (Rickshaw puller)	146.29 ± 2.62 (140.00 - 152.50)
P value	0.0001***

Figures in parentheses indicate range. Comparison between group was done by unpaired Student's-'t' test, *** = significant at P<0.001.

2. Physical performance test: vertical jump test, flexibility test of group A (sedentary worker) and group B (rickshawpuller) (Table III, Fig. 2, 3)

Mean vertical jump test was 37.21 ± 1.18 cm and 45.25 ± 1.22 cm in group A and group B respectively. The vertical jump test was ranged from 34.00 cm to 39.50 cm in group A and 40.00 cm to 50.00 cm in group B.

There was significant difference (P<0.0001) of mean vertical jump test was observed between group A and group B where mean vertical jump test was greater in group B than that of group A.

Mean flexibility test was 10.60 ± 0.52 cm and 17.64 ± 0.63 cm in group A and group B respectively. The flexibility test was ranged from 10.00 cm to 12.50 cm in group A and 16.00 cm to 18.50 cm in group B.

There was significant difference (P<0.0001) of mean flexibility test was observed between group A and group B where mean flexibility test was greater in group B than that of group A.

Table III: Comparison of vertical jump and flexibility test between group A (sedentary worker) and group B (rickshawpuller)

Group	Vertical jump test in cm Mean ± SD	Flexibility test in cm Mean ± SD
A (Sedentary worker) (n=100)	37.21 ± 1.18 (34.00 - 39.50)	10.60 ± 0.52 (10.00 - 12.50)
B (Rickshaw puller) (n=100)	45.25 ± 1.22 (40.00 - 50.00)	17.64 ± 0.63 (16.00 - 18.50)
P value	0.0001***	0.0001***

Discussion

In the present study, the mean back muscle strength of the sedentary worker (group A) and rickshawpuller (group B) was 121.02±2.36 kg and 146.29±2.62 kg respectively. Significant difference (P<0.0001) in all the parameters mentioned above were observed between sedentary worker (group A) and rickshawpuller (group B). Mean back muscle strength were greater in the rickshawpuller (group B) than in the sedentary worker (group A).

Koley, Khajuria and Melton (2010) reported 106.00±23.40 kg mean back muscle strength in cricketers which was significantly lower (P<0.0001) than the present study findings[14].

Koley and Jain (2013) found 147.33±31.99 kg mean back muscle strength in cyclists[8]. There was no significant difference (P=0.82) with the present study findings.

In the present study, the mean vertical jump test of the sedentary worker (group A) and rickshawpuller (group B) was 37.21±1.18 cm and 45.25±1.22 cm respectively and mean flexibility test of the sedentary worker (group A) and rickshawpuller (group B) was 10.60±0.52 cm and 17.64±0.63 cm respectively. Significant difference (P<0.0001) in all the parameters mentioned above were observed between sedentary worker (group A) and rickshawpuller (group B). Mean vertical jump and flexibility test were greater in rickshawpuller (group B) than in sedentary worker (group A).

Koley and Jain (2013) found 46.27±5.50 cm and 18.59±4.66 cm mean vertical jump and flexibility test respectively in cyclists which were significantly higher (P<0.001) than the findings of present study[8].

Koley and Bijwe (2014) reported 51.37±8.39 cm mean vertical jump test in volleyball players which was significantly higher (P<0.0001) than the findings of present study[15].

Another study done by Demirkan (2015) and reported 30.6±6.3 cm mean flexibility test in wrestlers which was significantly higher (P<0.0001) than the present study findings[16].

The present study was conducted on a small sample size. Only 100 rickshawpullers from Northern part of Dhaka Metropolitan City were included in this study. So the result of the study may not be fully representative of whole community of rickshawpuller in Bangladesh.

No published work was available on back muscle strength and physical performance test on professionals, in Bangladesh. So the result of the study

could not be compared with such other studies . Few number of publications by other researchers with similar study were available to compare and correlate with the findings of the present study. Further studies are suggested with larger sample size comprising of male and female workers in various industrial sectors. The more advanced HOGGAN Scientific MicroEFT2 Hand held Dynamometer could be used to get more detailed and accurate information about back muscle strength.

Conclusion

Significant difference of mean back muscle strength and physical performance test: vertical jump test, flexibility test were observed between sedentary worker (group A) and rickshawpuller (group B) where the mean back muscle strength and physical performance test: vertical jump test, flexibility test were greater in the rickshawpuller (group B) than in the sedentary worker (group A).

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