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RESEARCH ARTICLE

DIFFERENCES IN QUADRICEPS AND HAMSTRING STRENGTH AMONG COLLEGE STUDENTS

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ABSTRACT

Introduction: Strength of the quadriceps and hamstring of a person is determined by individual gender, age and individuals physical activity. There seems to be a difference in strength of quadriceps and hamstring in male and female but no study has been done to study the same. Hence this study Aims to find out the difference between strength of quadriceps and hamstring Muscle among college students. ***Methodology:*** 120 Individuals both male and female between the age group of 18-25 who actively consented to participate and had no history of disease or difficulty with walking or musculoskeletal disorder were taken from Padmashree Institute of Physiotherapy. Quadriceps and Hamstring strength was measured by using FET2 dynamometer. ***Results:*** The demographic characteristics were tabulated and the difference between the strength of male and female in hamstrings and quadriceps muscles were calculated in the form of Mean ±SD. ***Conclusion:*** From our study we conclude that quadriceps strength was higher than hamstring strength. Also while considering the gender males were seen to have higher quadriceps and hamstring strength compared to female. This could have been because men has more of type II muscle fibers while women has more of type I muscle fibers.

INTRODUCTION

The quadriceps muscle is located in the anterior compartment of the thigh. The Quadriceps femoris is the most voluminous muscle of the human body. The quadriceps femoris is a hip flexor and a knee extensor. They form the main bulk of the thigh, and collectively are one of the most powerful muscles in the body (Standring, 2021). It is composed of 4 muscle bellies: the rectus femoris, which lies in the anterior portion of thethigh; the vastus medialis and vastus lateralis on the inner and outer portions, respectively; and the vastus intermediuswhich is located posteriorly. The vastus muscles originate from the anterior, medial,and lateral aspects of the femur. The rectus femoris originates from the anterior inferior iliac spine, and it has three proximal tendons: the straight or direct tendon, which arises from the anterior inferior iliac spine; the indirect tendon that inserts into the superolateral rim of the acetabulum; and a small reflected tendon that inserts into the anterior capsule of the hip joint (Pasta, 2010). The quadriceps all work to extend (straighten) the knee. The rectus femoris also flexes the hip, The vastus medialis adducts the thigh and also extends and externally rotates the thigh and stabilizes the kneecap. The quadriceps are primarily active in kicking, jumping, cycling and running example sports like basketball that requires jumps (Kary, 2010). In everyday life, they help you get up from a chair, walk, climb stairs and squat. They are used in walking and running at the onset of a stride and get used significantly when going downhill. The quadriceps is essential for daily activities, such as climbing stairs or getting up from the chair (Garrett, 1984). The biceps femoris, semitendinosus, and semimembranosus muscles comprise the hamstring muscle group, which is primarily composed of type II muscle fibers. The hamstrings are a group of three muscles which predominantly act to flex the knee. The muscles cross two joints and have long proximal and distal tendons with resultant long muscle tendon junctions (MTJ). MTJs extend into the muscle bellies, overlap within the muscle belly, facilitate transmission and dissipate forces across the MTJ while muscle contraction and relaxation. The origin of the biceps femoris muscle on the femur is used as a consistent landmark in differentiating proximal from distal hamstring injuries (De Smet, 2000). Recent studies suggest that impaired muscle strength is a risk factor for recurrent falls' and hip fracture (Whipple, 1987). In addition, adequate walking speed, which is vital for normal activities, also correlated with muscle strength. Muscle strength has also been shown to correlate with functional capacity in several other important activities such as standing ability (Buchner, 1990). Because of the potentially important role of muscle strength in the subsequent development of functional disability in older individuals, there is a great need for measurement of quantitative muscle strength that could be used for population-based studies. One option is through the use of a hand-held iso- metric dynamometer. These instruments are portable and can rapidly provide information about muscle strength in several muscle groups.

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These types of instruments have demonstrated adequate test-retest reliability and in-terrater reliability (Bohannon, 1986; Stuberg, 1988)

METHODOLOGY

120 Individuals both male and female between the age group of 18-25 who actively consented to participate and had no history of disease or difficulty with walking or musculoskeletal disorder were taken from Padmashree Institute of Physiotherapy. Quadriceps and Hamstring strength was measured by using FET2 dynamometer. Currently, the gold standard method to quantify quadriceps strength utilizes an isokinetic dynamometer. However, this option lacks clinically applicability due to cost and sizeA hand-held dynamometer (HHD) provides a valid and reliable testing alternative. Hence in our study micro FET2 dynamometer was used.

Procedure: Subjects were screened for inclusion and exclusion criteria and those who fulfilled the criteria were included in the study. The data was collected by measuring the quadriceps and hamstring strength.

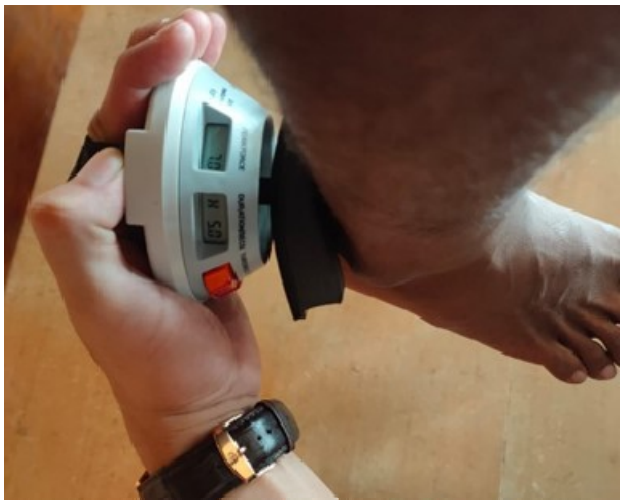

Fig1.a Position of Hoggan micro FET2 hand held dynamometer for isometric hamstring

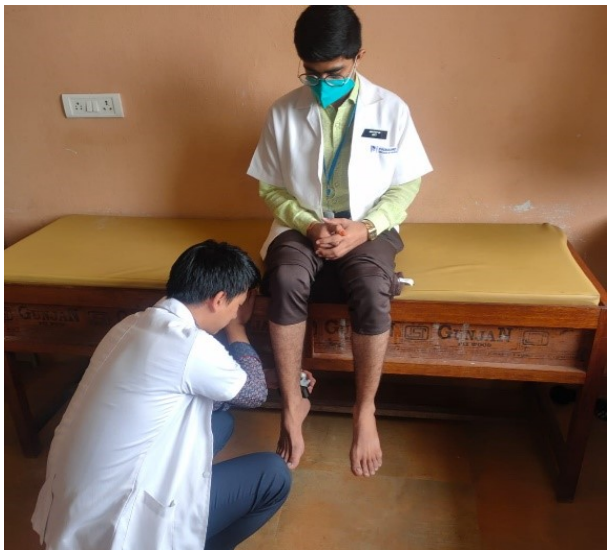

Fig. 1.b Testing positing for isometric hamstring strength

The participants were instructed to be in comfortable clothing and in a comfortable sitting position. The participant will be seated with hip knee flexed at 90 degree. Then, the dynamometer was used or placed on their anterior aspect of the shank, proximal to the ankle joint. Test involved maximal voluntary isometric contraction. Three trials will be recorded for extensor muscle group and average of three were taken. The participants were asked to straighten or extend their knee as much as possible and hold that contraction until they were told relax. Then the dynamometer was placed behind the Achilles tendon, the participants were asked to flex their knees as much as possible and hold the contraction until the command relax. Each test lasted between three to five seconds and ended after a steady maximal force that was produced by the participants. Then the dynamometer reading was observed and recorded.

Outcome measure: Outcome hand-held dynamometry demonstrated good to excellent intra and inter- rater reliability for the assessment of isometric lower limb muscle strength and power in a healthy population. Comparisons of the HHDs to a laboratory-based dynamometer showed moderate to excellent concurrent validity for both measures of isometric lower limb strength and power. To the authors knowledge, this is the first study to evaluate the intra and inter-rater reliability and validity of HHDs for assessing muscle strength in all major muscles of the lower limbs with greater than poor sample size based on the COSMIN checklist (Mentiplay et al., 2015). A hand-held dynamometer could be of potential interest in clinical practice because of its simplicity, objectivity and responsiveness in measuring muscle strength. Maximal isometric voluntary contraction was measured with a MicroFET2 hand-held dynamometer (Hoggan Industries, Inc., West Jordan, UT, USA). It is a battery-operated, load cell system with a digital reading of peak force expressed in newton (N). The device offers a choice a high or low threshold for the minimal force to start the test (Gadwal Afriduddin, 2022).

Measurement of Quadriceps strength

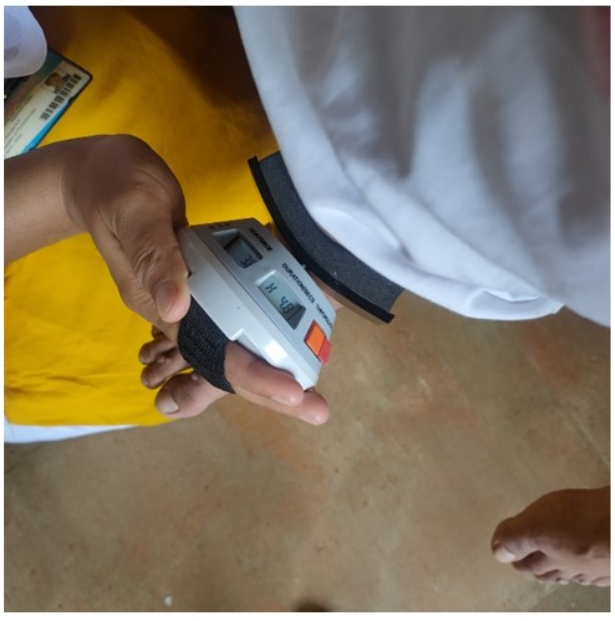

Fig. 2.a. Position of Hoggan micro FET2 hand held dynamometer for isometric quadriceps

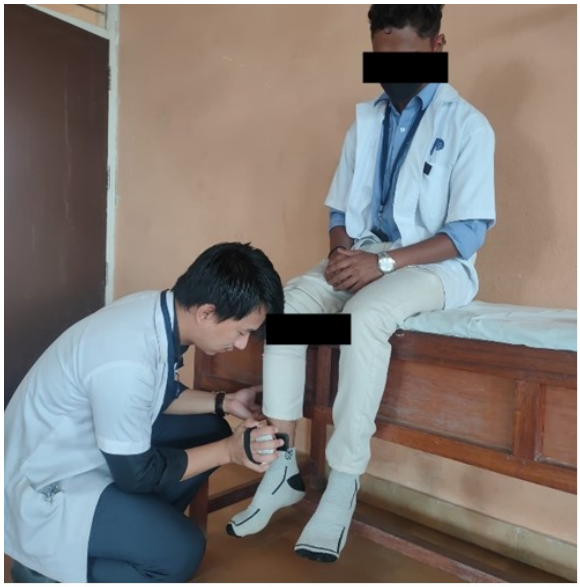

Fig. 2.b. Testing positing for isometric quadriceps strength

RESULTS

Hundred twenty (n=120) individuals both male and female were assessed for compatibility with the eligibility criteria. The flow of the participants is shown in Table1 Table 1 shows demographic characteristics of subjects. Table 2 shows comparison of quadriceps strength and hamstring strength scores outcomes measured Table3 Shows comparison of quadriceps and hamstring strength score with respect to the gender.

Table 1. Demographic characteristics of subjects

Characteristics	Value
Age(Mean±SD)	21.13 ± 1.55
Male/Female	52/68
BMI(Mean±SD)	21.85 ± 3.62

BMI: Body Mass Index, SD: Standard Deviation

Table 2. Values for outcome measures

Characteristics	Value(Mean±SD)
Quadriceps Strength	12.49 ± 6.37
Hamstring strength	8.98 ± 5.45

Table 3. Comparison of Quadriceps strength and Hamstring strength scores with respect to gender

Characteristics	Value (Mean±SD) [Male]	Value (Mean±SD) [Female]
Quadriceps Strength	16.26 ± 6.9	9.61 ± 4.06
Hamstring strength	11.64 ± 6.19	6.95 ± 3.73

DISCUSSION

The purpose of this study is to find out the difference in quadriceps and hamstring strength among college individuals here examined 120 individuals both male and female between the age group of 18 to 25 who actively consent to participated and no history of disease or difficulty with walking or musculoskeletal disorder were taken from Padmashree Institute of physiotherapy, Quadriceps and Hamstring strengthening was measured by using FET2 Dynamometer.

In our study, we observed quadriceps muscle strength is more than hamstring strength between 18 to 25 age group. One of the reason behind that " the peak torque for quadriceps and greater than those of the hamstring muscles. This is because anatomically the knee extensors have over twice the cross sectional area of the knee flexors and the knee extensors have a larger force arm distance then the flexors" (Jaiyesimi, 2005). The quadriceps muscle plays an important role in jumping and kicking whilst the hamstring muscle are found to control running activities and stabilize the knee during turns or tackles. The hamstring muscles are involved with concentrically and eccentrically at high speeds, while the quadriceps muscle group appears to be dominant muscle group at lower velocities (Miller, 1999). The ratio of maximal isokinetic hamstring muscle strength relative to maximal isokinetic quadriceps muscle strength (H:Q ratio) is a parameter commonly used to describe the muscle strength properties about the knee joint. The H:Q ratio has conventionally been calculated as maximal knee flexion strength divided by maximal knee extension strength obtained at a given knee angular velocity and contraction mode (isometric, concentric, eccentric) (Willigenburg, 2014). It is well known that chronic forceful muscular contractions will result in an increase in muscle contractile protein and fiber area. The smaller muscle fibers in women may thus be due to an innate biological limitation or to differences in behavioural (physical activity) patterns or to a combination of both. Men are stronger simply because they are typically larger most of the reason for greater strength is larger muscles. According to the American Council on Exercise men have more type II muscle fibers while women have more type I. Type II muscle fibers ensure that men have a greater power output, while women with their predominance of type I fibers have a greater capacity for recovery than men. Men are taller and broader, built to carry and lift, women are more inclined to use muscular strength for tasks related to flexibility, coordination and balance. More women than men take yoga classes and that may be a part of the reason that women who perform stretching exercises along with lower body strengthening exercises have the edge on the balance says the American Heart association (Aagaard, 1998).

Studies indicate that men generally have larger and stronger muscles than women and that differences tend to be more pronounced in muscles of the upper limbs (Levine et al. 1984; Heyward et al. 1986), although considerable overlap has also been shown to exist between the sexes. Factors which affect maximum voluntary strength include cross-sectional area (CSA) of the muscle or muscle groups, specific tension (force per unit CSA, which may be affected by the fiber type distribution and the amount of non-contractile tissue present in the muscle), ability of the subject to fully activate the motor units and possible anatomical differences in mechanical advantage of muscles acting across a joint. Muscle CSA is determined by both the size and number of muscle fibers. While it is generally accepted that untrained women have smaller fiber areas than untrained men in muscles of both upper and lower limbs, as do female athletes and bodybuilders compared to their male counterparts. Moreover, since large inter-individual differences in specific tensions are also found within each gender, the factors responsible for such variability may not be gender specific (Andersen, 2000). It is well known that chronic forceful muscular contractions will result in an increase in muscle contractile protein and fiber area.

The smaller muscle fibers in women may thus be due to an innate biological limitation or to differences in behavioral (physical activity) patterns or to a combination of both. If a significant gender difference in muscle fiber numbers exists, it probably represents a true biological difference, since fiber number is considered to be established at birth. The purpose of the present study was to examine a variety of muscle parameters in lower limbs in a sample of men and women in an attempt to determine whether or not gender differences in muscular strength are more closely linked to differences in physical activity patterns or to innate biological limitations.[17]

CONCLUSION

From our study we conclude that quadriceps strength was higher than hamstring strength. Also while considering the gender males were seen to have higher quadriceps and hamstring strength compared to female. This could have been because of men has more of type II muscle fibers while women has more of type I muscle fiber.

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