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Gadwal Afriduddin
MPT, Padmashree Institute of Physiotherapy, Kommaghatta, Bangalore, Karnataka, India

Diker Dev Joshi
Assistant Professor, Padmashree Institute of Physiotherapy, Kommaghatta, Bangalore, Karnataka, India

Corresponding Author:
Gadwal Afriduddin
MPT, Padmashree Institute of Physiotherapy, Kommaghatta, Bangalore, Karnataka, India

Quadriceps muscle strength in healthy individuals of different age groups: A cross sectional study

Gadwal Afriduddin and Diker Dev Joshi

Abstract
Objective: During young adulthood (20-35) years of age, both biological function and physical performance reach their peak. The degeneration of muscle strength with aging is due to the overall decrease in muscle mass, especially the type II muscle fibres. And the lower extremity is more affected by aging than the upper extremity due to less use of lower limbs than upper limbs in daily activity. Thus, this study wanted to find out the quadriceps muscle strength among healthy individuals of different age groups.
Methodology: A cross sectional Study was conducted on 120 healthy individuals. Subjects were selected based on the inclusion criteria. (I) Four equal sized groups, 20–25, 25–30, 30-35, 35-40 years of age, without any neurological and orthopaedic disorders Persons with diabetes/thyroid and lower limb injuries, with concurrent Musculoskeletal, Neurological, Cardiovascular disorders. Were excluded. Quadriceps muscle strength were assessed by using micro FET2 Dynamometer.
Results: By Applying ANOVA significant difference was found in quadriceps strength among different age groups (p-value is < 00001.)
Conclusion: This study concluded that quadriceps muscle strength varies among different age groups of healthy individuals.

Keywords: Quadriceps strength, FET2 dynamometer, healthy individuals, cross-sectional study

Introduction
Young adulthood typically covers the period from 20-35 years of age, when both biological function and physical performance reach their peak. During young middle age (35-45 years), physical activity usually wanes with a 5-10Kg accumulation of body fat. Active pursuits may be shared with a growing family, but it becomes less important to impress either an employer or persons of the opposite sex with physical appearance and performance. During later middle age (45-65 years), women reach the menopause and men also substantially reduce their output of sex hormones. And 65 above the degeneration of muscle strength with aging is due to the overall decrease in muscle mass, especially the type II muscle fibers [1]. Furthermore, the muscle strengths of the lower extremity are more affected by aging than the upper extremity due to less use of lower limbs than upper limbs in daily activity in the elderly population. However, it is noted that the muscles of the lower limb are necessary to perform functional activities in the elderly population to maintain independent living and to participate in community activities. Therefore, greater attention should be directed to the effect of aging on the muscle strength, especially the lower extremity, and functional activities to improve the quality of life [2].
One of the most striking effects of age is the involuntary loss of muscle mass, strength, and function, termed sarcopenia. Muscle mass decreases approximately 3–8% per decade after the age of 30 and this rate of decline is even higher after the age of 60. This involuntary loss of muscle mass, strength, and function is a fundamental cause of and contributor to disability in older people. This is because sarcopenia increases the risks of falls and vulnerability to injury and, consequently, can lead to functional dependence and disability. A decrease in muscle mass is also accompanied by a progressive increase in fat mass and consequently changes in body composition, and is associated with an increased incidence of insulin resistance in the elderly [3]. The muscle strength depends on a variety of factors: biochemical, histological, biological, anatomical kinematics, etc. Anatomical factors relate to the structure, cross-sectional area and muscle architecture.

This study wanted to find out the quadriceps muscle strength among healthy individuals of different age group.

The quadriceps femoris is the most voluminous muscle of the human body and it is essential for daily activities, such as climbing stairs or getting up from the chair. The quadriceps femoris muscle is part of the anterior muscles of the thigh, along with the sartorius muscle. It is composed of 5 muscle bellies.

It consists of the rectus femoris (RS) that originates from the anterior inferior iliac spine with the direct tendon, and the upper rim of the acetabulum with the indirect tendon. With a third and small tendon (reflected tendon), it attaches to the hip joint capsule anteriorly. The first 2 RS tendons continue downward with two aponeurotic laminae, up to two thirds of the rectus femoris. The direct tendon will become the superficial lamina while the indirect tendon continues as a central sagittal lamina [4].

The vastus lateralis (VL) that originates from the lateral face of the great trochanter, from the gluteal tuberosity and the lateral lip of the linea aspera. The vastus medialis (VM) that takes an attack from the anatomical neck of the femur and the medial lip of the linea aspera. The vastus medialis is deeply inserted in the aponeurosis of the vastus intermedius, while the tensor of the vastus intermedius is inserted in the same aponeurosis, more superficial. The vastus intermedius (VI) originates from the proximal three fourths of the anterior and lateral faces of the femoral body, and from the lateral lip of the linea aspera. Some bundles of the vastus intermedius are inserted in the upper recess of the supra-patellar bursae, making up the articular muscle of the knee [4].

Isometric hand-held dynamometers (HHD) have been developed to aid therapists in clinics. HHDs are generally small and portable, and measure strength objectively in kilograms, pounds or newtons. The clinician holds the HHD between his or her force-applying hand and the patient's limb segment. The clinician stabilizes the limb segment while encouraging the patient to exert as much force against the device as possible and the maximum force is recorded by the HHD. Such devices have been proven to have good to excellent reliability. In a single test, however, they can assess the strength of a patient at only one joint angle, rather than through the patient's entire ROM. Although this technique provides a crucial tool for clinical quantification of joint strength at a fixed static position (isometric), it cannot measure properties from dynamic muscle performance assessments [5].

Methodology

The primary data were collected from around Bengaluru. The subjects included were as follows: (i) Person who is willing to participate. (ii) Both genders (iii), 20–25, 25–30, 30-35, 35-40 years of age [6]. The exclusion criteria were as follows: (i Four equal sized groups) Persons with diabetes/thyroid (ii) Person's with H/O of lower limb injuries, Musculoskeletal disorder, Neurological disorders, Cardiovascular disorders [7].

120 healthy individual in Bangalore were selected through Convenience sampling for a period of 1 month and quadriceps strength was measured among them.

Procedure

Subjects were screened for inclusion and exclusion criteria and those who fulfill the criteria were included in the study. Informed consent was taken from the patients before intervention.120 subjects were included in the study. Quadriceps muscle strength were measure by using dynamometer.

Fig 1: Testing position for isometric quadriceps strength

Fig 2: Testing position for isometric quadriceps strength

Testing position for knee extensors: Assessment of isometric muscle strength and power will be performed with the participants in sitting position. Knee extensors with the participant will be seated and hip and knees flexed at 90°. Dynamometer will be placed on the anterior aspect of the shank, proximal to the ankle joint. Test involved maximal voluntary isometric contractions. Two trials will be recorded for extensor muscle group. Instructions will be provided to participants for all trials were 'at the count of three, push/pull as hard and as fast as you can and hold that contraction until I say relax'. Each test will be lasted between three to five seconds and ended after a steady maximal force will be produced by the participant [8].

Outcome Measure

Muscle strength is considered to be an important determinant of physical performance, activity of daily living, and work or sport performance. Muscle strength can be precisely quantified by several instruments (e.g. isokinetic device). Unfortunately, some of these tools are not hand-held and, consequently, their use is limited to specific conditions (e.g. in nursing homes). Hence, it is of importance, especially in the elderly, of being able to

measure muscle strength using a portable device. 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 newtons (N). The device offers a choice a high or low threshold for the minimal force to start the test [9].

Fig 3: Hoggan micro FET 2 hand held dynamometer for muscle strength testing

Fig 4: Hoggan micro FET 2 hand held dynamometer for muscle strength testing.

Result

Table (1) shows Mean and Standard deviation of age and distribution of gender.

Table (2) shows Quadriceps strength in Right and Left lower limbs on basis of age groups.

Table 1: Demographic Characteristics according to different age groups

Characteristics	Age 20-25(Mean±SD)	Age 26-30(Mean±SD)	Age 31-35(Mean±SD)	Age 35-40(Mean±SD)
Age (Mean±SD)	23.6 ±1.08	27.46±1.17	32.8±1.37	38.16±1.55
Gender (Male/Female)	25/5	26/4	28/2	27/3/

Table 2: Quadriceps strength according to age groups

Age Group (Yrs.)	Quadriceps Strength (Mean±SD) (R)	Quadriceps Strength (Mean±SD) (L)
20-25	15.04 ± 4.43	13.70 ± 3.54
26-30	16.88 ± 1.97	16.41 ± 2.01
31-35	20.6 ± 1.80	20.6 ±6.25
36-40	20.2 ±1.84	19.2 ±1.55

Discussion

The purpose of this study is to find out the Quadriceps muscle strength among healthy individuals of different age groups. Here examined 135 subjects, out of 135 subjects 15 were excluded and selected 120 subjects. then divided in to 4 age groups, in each group 30 subjects were included (20-25,26-30,31-35,36-40), there by measured quadriceps strength using Micro Fet2 Hand-held dynamometer in duration of one month. Mean and standard deviation of quadriceps muscle strength b/w (a). 20-25 age group, right lower limb (15.04 ± 4.43) and left lower limb (13.70 ± 3.54), (b). 26-30 age group right lower limb (16.88 ± 1.97) and left lower limb (16.41 ± 2.01) (c). 31-35 age group, right (20.6 ± 1.80) and left (20.6 ±6.25) (d). 36-40 age group right (20.2 ±1.84) and (19.2 ±1.55). In our study, we observed increase in quadriceps muscle strength b/w 20-36 age group, one of the reasons behind that, these age group people usually go for gym or fitness centers and also observed there was a slight decrease in muscle strength among 36-40 age group. Some studies reported that Androgens are complex steroid-derived hormones that contribute to many aspects of growth in youth, which continues with maintenance of muscle mass and other tissues, including bone, in more mature individuals. Type I fibers are small, slow-contracting, low-tension output fibers with many mitochondria and aerobic enzymes for energy production. These fibers are highly resistant to fatigue and are capable of metabolizing fat for energy expenditure. Type II fibers are much larger and faster contracting fibers that produce large tension output but fatigue quickly. While there is no consensus as to the exact numbers, it is clear that aging leads to an increasing percentage of type I fibers compared to type II. Androgen levels decline with age in both men and women. Beginning around the age of 35 years, testosterone levels in men decrease by 1% to 3% per year, while women experience the greatest drop in hormone levels with menopause [10]. Some other studies have shown that muscular strength is improved or maintained until approximately 40 years and also showed increases in isometric and dynamic strength up to the end of the third decade, with strength maintained thereafter until the sixth decade in the quadriceps muscle [11].

Conclusion

This study concluded that quadriceps muscle strength varies among different age groups of healthy individuals. So, muscle strength increases from 20-36 years of age group people and there is a decline in muscle strength > 36 years of age.

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