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RESEARCH ARTICLE

STANDARDIZATION OF LOWER LIMB'S RANGE OF MOTION FOR HEALTHY EGYPTIAN SUBJECTS

Reham M. Abd Elrahim[1,*], Mohammad F. Ali[2], Yomna Farag Ahmed[1] and Reda kotb[3]

[1]Department of Physical Therapy for basic science ,Faculty of Physical Therapy, Modern University for Technology and Information, Cairo, Egypt

[2]Department of Physical Therapy for orthopaedics, Faculty of Physical Therapy, Beni-Seuf Uneversity, Beni-Seuf, Egypt

[3]Department of Physical Therapy for orthopaedics, Faculty of Physical Therapy, Banha University, Banha, Egypt

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ABSTRACT

Background: In the last years there were a huge differences in the ADL life style within Egyptian citizens by using transportation rather than walking, preferring to resting rather than moving and making sport. These changes in life style may reflect on the lower limb range of motion. **Purpose:**To have a standard normal value for lower limb's range of motion for Egyptian subjects. **Materials and methods:** 1000 normal Egyptian male and female subjects aged between 21 and 50 years, free from any conditions cause limitation joint mobility, enrolled in the study. Three licensed physical therapists measured Lower limb joints ROM using digital goniometer to determine active joint motion of the lower limb bilaterally. **Results**: Range of motion average values for all joints decreased for both right and left side. The results were significantly different than most commonly used normative values. **Conclusion** This study showed a new data for lower limb joints ROM measurements in Egyptian subjects.

INTRODUCTION

The hip's unique anatomy enables it to be both extremely strong and amazingly flexible, so it can bear weight and allow for a wide range of movement. The hip joint is a large ball and socket synovial joint between the head of thefemurand the acetabulum of thepelvis. It is structured in such a way that enables movement in all axes, and providing stability for the body during movement.[1] The knee is a hinge joint that is responsible for weight-bearing and movement. It designed to achieve various functions: Support the body in an upright position without the muscles being required to work, helps lower and uplift the body, brings stability, does act as a shock absorber and allows leg twisting. [2] The ankle jointfunctionally, is a hinge type joint, permitting dorsiflexion and plantarflexion of the foot. It is comprised of the lower leg and the foot and forms the kinetic linkage allowing the lower limb to interact with the ground.[3] Active range of motion (AROM) assessment is therefore often used as an indicator for lower extremity function[4]. In clinical practice, (AROM) assessment represents a quantitative method to evaluate movement and functional status of an impaired lower extremity[5]**.** Itis a primary reference tool in assessing the integrity of the lower limb joints.[6]

Corresponding author:** ***Reham M. Abd Elrahim,
Department of Physical Therapy for basic science ,Faculty of Physical Therapy, Modern University for Technology and Information, Cairo, Egypt.

According to the Guide to Physical Therapist Practice, the examination of joint integrity and mobility is necessary to select appropriate interventions. Therefore measurement of ROM essential to both the clinician and researcher desiring to objectively monitor disease progression, outcomes, and mobility impairments. [7] Articular range of motion (ROM) is one of the measured during physical assessment. Goniometry is employed to measure and to register ROM available in a joint; however, it is necessary Joint range of motion that it supplies reliable and standardized measures.[6] Normal reference values are needed to determine extent of impairment to assess and monitor joint motion. Standardization is the process of developing and implementing technical standards[8]. Although there is variability among individuals, so there is a need to make standardization of lower limb ROM among Egyptian peoples. There is very little published data describing normal joint range of motion (ROM) for healthy individuals across a wide span of ages all over the world.

MATERIALS AND METHODS

Ethics: The study was ethically approved by the Institutional Ethical Committee of the Faculty of Physical Therapy, Cairo University, Egypt (No: P.T.REC/012/002307). All patients read and signed two copies of a consent form before the beginning of data collection.

Study Design: Study design is a cross-sectional observational study.

Subject selection: 1000 healthy subjects (280 male and 720 female) were participated in the study. They were selected by using random sampling technique using folded paper from variety of settings such as community gatherings, schools, scientific meetings and workplaces in Egypt. Subjects were included if their age ranged between 21 and 50 and Their BMI ranged from 18 to 25 kg/m^2.The exclusion criteria for participants were We excluded participants with any musculoskeletal disorders, congenital anomalies, complain from chronic pain before.

Methods: Digital Goniometer powered by one 9V battery, power coated steel with inch/cm marks printed onto arms, 2 Stainless steel rules with 7" and 4" blades with photo etched graduations in mm, 1/16", 1/32" and 1/64" with large clear LCD display Resolution: 0.05 degree (that's $5/100^{th}$ of a degree!), Accuracy: +/- 0.2 degree, Repeatability: 0.05 degree, Battery: 3V CR2032 with life of approximately 1 year and comes with an extra battery[6].

Procedures of the study: The study was conducted between 15 March 2019 to 20 November 2019 on MTI university.Participants were asked to wear light clothing to allow for better identification of the bony landmarks and to avoid motion restrictions. Before recording any measurement, the tested movements were practiced three times bilaterally to familiarize the participants with the procedure and the motions being measured.Three licensed physical therapists measured lower limb joints ROM using digital goniometer. Before measuring the motion, Digital goniometer calibrated to zero prior to each participant being measured, a pen marker was used to draw cross marks on preselected anatomical landmarks on the tested lower limb. Using these marks, we quantified the following lower limb movements that each participant performed at a maximum (end-range) joint movement at each participant's own pace: Hip Flexion, extension AROM: a cross mark was placed on the greater trochanter (fulcrum). One cross mark was placed along the lateral midline of pelvis; one additional cross mark was placed along the lateral midline of femur toward lateral epicondyle[9]. Flexion-AROM was assessed with the participant in supine position on a standard plinth. The thigh was actively elevated with knee 90° flexion into flexion. While in prone position. The thigh was actively move backward with knee extension into extension. Hip Abduction-AROM: a cross mark was placed on the ipsilateral ASIS (fulcrum). One cross mark was placed along the opposite ASIS; one additional cross mark was placed along the anterior midline of femur[9]. Abduction AROM was assessed with the participant in supine position on a standard plinth. The thigh was actively move out of blinth with knee extended. Hip ER and IR AROM: a cross mark was placed on the anterior patella (bisect femoral condyles) (fulcrum). One cross mark was placed perpendicular to floor; one additional cross mark was placed along the anterior midline of tibia (toward center point between malleoli)[9]. AROM was assessed with the participant in seated position with hip and knee 90° flexion. The leg was actively move inward in ER and move outward in IR. Knee Flexion, Extension AROM: a cross mark was placed on the lateral epicondyle of femur(fulcrum). One cross mark was placed along the Lateral midline of femur toward greater trochanter; one additional cross mark was placed along the lateral midline of fibula toward lateral malleolus[9]. AROM was assessed with the participant in supine position on a standard plinth. Ankle slide on the plinth toward thebody into flexion and away from the body into extension. Ankle dorsiflexion, planterflexion AROM: a cross mark was placed distal to but in line with the lateral malleolus (fulcrum). One cross mark was placed Lateral midline of fibula toward fibular head; one additional cross mark was placed along the parallel to lateral aspect of the 5th metatarsal[9]. AROM was assessed with the participant in seated position with hip and knee 90° flexion. The foot was actively move upward in dorsiflexion and move downward in planterflexion.

Data analysis: Statistical analysis was conducted using SPSS for windows, version 25 (SPSS, Inc., Chicago, IL). The current test involved ROM of Hip movements (flexion, extension, abduction, adduction, internal rotation and external rotation), knee flexion and extension, ankle dorsiflexion& planterflexion) dependent variables.

Date where collected from 1000 subjects 720 females and 280 males: As The study was performed on a random sample of 1000 subjects 720 (72%) females and 280 (28%) females, Their ages mean value was (30.36± 6.941), the Max. value was (50) and Min. value was (21) years. study. The mean height±SD and the mean weight±SD was 68.9±7.2 kg. Descriptive statistics used are minimum, maximum, mean±SD, median and inter quartile range (IQR).Farther more, 10%, 25% (1^{st} quartile), 50 (median) 75%(3^{rd}quartile) and 90% percentile rankings for ROM scores in all subjects are shown in table (1). If a person had a score at the 25th percentile, 25 percent of the population scored lower than him/her and so on. These tables allow readers to see the distribution of data and, and how other participants compare to this sample of participants as a stander value. Prior to final analysis, data were screened for normality assumption. Kolmogorov-Smirnov test for normality showed that data is not normally distributed, so nonparametric test where used for comparison. Wilcoxon Signed Ranks Test used for related sample comparison between right and left side in the same subject, and Mann-Whitney U test used for comparison between independent sample, male and female values. Intestinal alpha level was 0.05 for all tests.

DISCUSSION

Having a Standard chart for lower limb ROM in each country is important due to variability between individuals according to their age, sex, culture, job and difference in activity of daily living. To have a standard ROM useful in evaluating the range and patterns of movement is a key concern for a clinician in the diagnostic and functional assessment of patients with musculoskeletal disease[10]. Evaluating the range and patterns of movement is a key concern for a clinician in the diagnostic and functional assessment of patients with musculoskeletal disease[11]. In the present study, normative values for the lower limb range of motion derived from a population of 1000 healthy volunteers are presented. Measuring active lower limb motion. Many studies have quantified motion of the lower limb, they have varied significantly in their choice of tasks and in the methods used to measure joint angles, both in equipment used and in how the segments have been defined. This variation makes direct comparison among studies difficult. In addition, studies have typically focused on assessing a single joint [12-14.]Although there was no researches focused on lower limb range of motion in Egypt.

Table 1. Descriptive statistics of joints ROM in all subjects

ROM	Min	10%	25%	50%(median)	75%	90%	Max	IQR	Mean	SD
Hp. Flex.Rt.	90	100	110	115	120	120	140	10	112.88	8.573
Hp. Flex.Lt.	45	100	110	115	120	120	140	10	112.39	11.097
Hp. Ext.Rt.	10	20	25	30	30	30	60	5	27.37	6.538
Hp. Ext.Lt.	5	20	25	30	30	30	60	5	27	7.037
Hp. Abd.Rt.	25	35	40	41	45	45	50	5	41.635	4.54
Hp. Abd.Lt.	20	35	40	42	45	45	50	5	41.73	4.746
Hp. Int. rot.Rt.	20	35	40	40	45	45	50	5	40.8	4.29
Hp. Int.rot.Lt.	25	35	39.25	40	45	45	50	5.75	40.33	4.833
Hp. Ext.rot.Rt.	25	35	40	40	45	45	50	5	40.88	4.354
Hp. Ext. rot.Lt.	25	35	37	40	45	45	50	8	40.4	4.887
Kn. Flex.Rt.	39	115.5	122	129	132.75	135	140	10.75	126.08	12.234
Kn. Flex.Lt.	95	115	122	129	131.625	135	150	9.625	126.595	9.049
Kn. Ext.Rt.	-5	0	0	0	0	0	110	0	1.2	11.035
Kn. Ext.Lt.	-4	0	0	0	0	0	5	0	0.21	1.175
Ak. Flex.Rt.	10	14	15	19	20	20	150	5	19.13	13.555
Ak. Flex.Lt.	10	14	15	19	20	20	150	5	19.075	13.634
Ak. Ext.Rt.	30	40	40.5	45	50	50	50	9.5	45.33	4.669
Ak. Ext.Lt.	35	40	42	45	50	50	60	8	45.37	4.579

Balance between hip flexion and extension Restoring normal functional patterns of gait will reduce the incidence of low back pain, a widespread complaint among the general population. Any athletic or sport activity requiring running, jumping or pushing off will benefit from improved hip flexion/extensionHip abduction moving the leg away from the body, additionally help turn the leg at the hip joint. That are important for remaining stable when strolling or remaining on one leg[15]. External rotation of the hip is when the thigh and knee rotate outward, away from the body. Actions that use external hip rotation include getting into a car, pitching a baseball, and all other movements that require a person to rotate the pelvis while placing most of the body's weight on one leg[16].

According to ROM Chart 2011[14]. hip flexion ROM was0–120°, hip extension 0–20°, hip abduction0–45°, hip internal rotation and external rotation 0–45°, while in the present study hip flexion was0–140°, hip extension 0–60°, hip abduction0–50°, hip internal rotation and external rotation 0–50°. The knee is a hinge joint with functions that are restricted to raising and extending the leg, linking the broad thigh bone (the femur) to the shin bones (the tibia and fibula)[17-18].According to ROM Chart 2011 [14]. Knee Flexion 0–135°, Extension 0–10°, while in the present studyKnee Flexion 0–140°, Extension 0–5°. Most of daily activities requireankle dorsiflexion and plantar flexion such as:walking, running, swimming, biking, dancing, jumping[19]. In the present study the results was the same as ROM Chart 2011 [14].ankle dorsiflexion 0–50°, planterflexion 0–50°.

LIMITATIONS: With this study are important to address when interpreting the results, the sample size was small.

Conclusion

The result of this study design a recent lower limb ROM chart, which can be used in the physical therapy assessment process.

Recommendations: With this study are important to address the standard lower limb Range of motion in different countries all over Egypt, as a result of variation in habitual daily living & further studies are required to investigate. 1) Make standardization of foot eversion, inversion and toes ROM.

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