



International Journal of Medical and Exercise Science

(Multidisciplinary, Peer Reviewed and Indexed Journal)

ORIGINAL ARTICLE

INTER-RATER AND INTRA-RATER RELIABILITY BETWEEN EXPERIENCE AND NON-EXPERIENCED EXAMINERS ON 90-90 ACTIVE KNEE EXTENSION TEST USING GONIOMETER AMONG HEALTHY COLLEGE STUDENTS

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ABSTRACT

Purpose: Intra-rater reliability refers to the consistency of measurements demonstrated in similar assessment situation at two different times by the same examiner which also refers to test-retest. Inter-rater reliability test denotes the consistency of assessments performed by two different examiners. The objective of the study was to determine the inter-rater and intra-rater reliability between experienced and non-experienced physiotherapist on 90-90 active knee extension test using goniometer among healthy college students. **Methodology:** This study method is a reliability design in determining hamstring flexibility among 42 young healthy college students of School of Physiotherapy, KPJ Healthcare University College, Nilai, Malaysia. The 90-90 active knee extension was performed using goniometry. Four physiotherapists involved in the study consist of two non-experienced physiotherapist and two experienced physiotherapists. **Results:** The mean and standard deviation of active knee extension 90-90 Active Knee extension test among two experienced physiotherapist were 19.83⁰(SD= 10.21) and 43.14 (SD= 47.05). Mean and standard deviation for two non-experienced physiotherapist value were 21.21(SD 11.14) and 42.55 (47.66). **Conclusion:** The conclusion of the inter-rater and intra-rater evaluation between experienced and non- experienced physiotherapist showed that goniometer is a reliable tool to evaluate hamstring flexibility among healthy college students.

Keywords: Experienced, Non-Experienced, Physiotherapist, Goniometer, AKE, Inter-rater, Intra-rater

Received on 3rd July 2019, Revised on 6th August 2019, Accepted on 16th August 2019

INTRODUCTION

Hamstring injuries are most common in nowadays lifestyle. It is also the most common injuries to athletes in dancing, sprinting, martial arts, hockey and kicking sports (Hui Liu, 2012). At the same time, it is also can be occur to older adults and young people. Hamstring muscle injury is the most prevalent muscular damage presented in sports activity. Flexibility is a crucial factor in various athletic performances as well as in carrying out the activities of daily life. There is increasing evidence about associated benefits of flexibility, such as enhanced athletic performance, improved co-ordination, reduced injury risk and post-exercise soreness^{1,2}.

In clinical practice, the measurement of hamstring flexibility is very crucial. Several methods of assessing flexibility available such as 90-90 Active Knee extension, sit and reach test and passive straight leg raise. However, 90-90 active knee extension test is commonly used in clinical practice as the test using instruments which are available in most clinical set up and having high specificity (Neto T et al., 2014).

90-90 active knee extension test most commonly used for hamstring flexibility assessment. The active knee extension consists in an active extension movement at the knee joint with the hip flexed is 90⁰ in which the subject is instructed to stop when he feels strong resistance to the movement and also this test is most consider safe at the end point of the movement^{3,4}.

Intra-rater reliability refers to the consistency of measurements demonstrated in similar assessment situation at two different times by the same examiner which also refers to test-retest. On the other hand, inter-rater reliability

test denotes the consistency of assessments performed by two different examiners (Camassutti, 2015).

The objective of this study was to determine the inter-rater and intra-rater reliability within between experience and non-experienced examiners on 90-90 active knee extension test using goniometry among healthy college students^{5,6}.

METHODOLOGY

Research Design: This is a coparitive study to find the inter-intra reliability on goniometric measurement to determining hamstring flexibility among young healthy college students.

Study Population: The study included two experienced (more than two years) and two non-experienced physiotherapist to find the inter and intra rater reliability on goniometric evaluation of hamstring flexibility among 42 healthy college students (male and female) from School of Physiotherapy, KPJ Healthcare University College, Nilai, Malaysia was recruited for the study.

Sampling Method: Purposive sampling method used to select the subjects for this study. Hamstring flexibility was evaluated using goniometer by experienced and non-experienced physiotherapist.

Inclusion Criteria:

- Age between 18 – 26 years old (Atkinson, 1998)
- No current musculoskeletal problems such as back pain (Young, 2002)
- No history of surgery to low back, knees or hip (Bland & Altman, 1986)
- Unilateral (dominant side) 90-90 Active Knee Extension. (Fabunmi & Awakan, 2015)

Exclusion Criteria: Traumatic injury and any kind of musculo-skeletal surgery in the lower limb and spine for the past 6 months (Atkinson, 1998), Postural deformities (Bland, 1986), Neurological deficit (Gajdosik, 2001).

Sample Size Calculation: The number of subjects (42) was adapted based on previous study (Hamid, Ali & Yusof 2013).

Study Instruments: 90-90 active knee extension is one of the commonest musculoskeletal tests for the lower limb flexibility as having high specificity. Goniometer (Plastic 12" Goniometer 360 Degree ISOM - 12") is a device of articular angle measurement which presents reliability for specific joints measurements of the movement in the parts of the body and can be considered as gold standard in ROM measurement⁷.

Procedure: Before obtaining the permission, the study participants were instructed by the researcher regarding the study flow such as objectives of the study, procedures, methods and benefits. The subjects were informed to let the researcher aware if they experienced any pain or discomfort during the test procedure. A written consent form distributed to each subject, in which all the relevant documents requirements of the subjects were listed such as right to withdraw at any time without penalty and the risk participation in the study. The confidentiality was strictly maintained during the process of the study.

The present study, involved 42 subjects were there divided into two groups which each group consist of 21 subjects. The physiotherapist includes two experiences and two non-experienced divided into two groups. Each group involved one experience and one non experienced physiotherapist. The 90-90

active knee extension was performed using inexpensive instruments goniometer. Subjects were instructed to lay supine on the table. The physiotherapist asked the subjects to expose the tested limb and the tested limb actively flexed until, being at 90° with the table.

The contra-lateral limb positioned in fully extended and stabilized in neutral rotation by using strap. With the foot at neutral position and the knee flexed at 90°, a standard universal goniometer was placed over the lateral femoral condyle, with one arm aligned along the thigh in direction to the greater trochanter, and the other arm aligned over the leg in direction to the lateral malleolus. From this position, and without any prior warm-up, subjects were instructed to extend the knee until they felt a strong resistance, holding this final position for 2-3 sec, allowing the goniometric reading.

The result recorded corresponded to the amplitude, in degrees, of the knee extension movement, starting from the initial test position which knee flexed at 90° corresponded to the goniometric fix at 90°.

After the goniometric reading, the tested leg resumed to the resting position for one minute, after which the same procedures were executed for the second trial and third trial (Fig 1 and 2).

At the point of resistance felt during the test, the examiners read the goniometry in degree of motion and score recorded and analyze. (Kendall et al., 1993; Jackson & Baker 1986). The test performed by the two experienced examiners then followed by two non-experienced examiners. The mean of the three trials was recorded by each Physiotherapist.



Figure 1 and 2 : 90-90 Active Knee Extension Test measurement procedure

RESULT

Descriptive Analysis: There were 5 (12%) male subjects and 37 (88%) female subjects are in the study. The participants involve in the study was aged between 19-21 consists of male 4(10%) where as female 28(65%).

However from aged 22-24 the male subjects are only 1(2%), in female subjects 10(23%). In the study the participants are healthy with no lower limb problem.

Parameter		Gender	N (%)
Subjects		Male	5 (12%)
		Female	37(88%)
Age	19-21	Male	4 (10%)
		Female	27(65%)
	22-24	Male	1 (2%)
		Female	10(23%)
Lower limb problem		Male (YES/NO)	YES:0(%) / NO:12%
		Female (YES/NO)	YES:0(%) / NO:88%

Table 1: Demographic details of the study participants

Parameters	Male (n=5) Mean (SD)	Female (n=36) Mean (SD)
Weight (kg)	66.2, (SD 5.495)	55.17 (SD 9.34)
Height (m)	156 (SD 20.8)	156.58 (SD 6.451)
BMI (kg/m ²)	22.544 (SD 3.941)	29.040(SD 11.7)

Data are expressed as mean, standard deviation (SD), BMI=Body Mass Index.

Table 2: Descriptive analysis of the subjects

Four physiotherapists involved in the study consist of two non-experienced physiotherapist and two experienced physiotherapists. The mean and standard deviation of active knee extension 90-90 Active Knee extension test among experienced physiotherapist were 19.83^o(SD= 10.21) and 43.14 (SD= 47.05). In addition, the mean and standard deviation for non-experienced physiotherapist value were 21.21(SD 11.14) and 42.55 (47.66) as shown in Table 3.

Examiners	Mean (SD)
NE 1 ^o)	21.21 (11.14)
EX 1 ^o)	19.83 (10.21)
NE 2 ^o)	42.55 (47.66)
EX2 ^o)	43.14 (47.05)

Table 3: 90^o-90 Active Knee Extension (AKE)

Variables	Statistic	Df	p value
EX 1	0.452	21	0.000
NE 1	0.532	21	0.000
EX 2	0.806	21	0.001
NE 2	0.898	21	0.031

Table 4: Normality assumption test for all variables using Shapiro-Wilk test

Normality Test: Assumption of normality was carried out using Shapiro-Wilk test as small number of samples subjects was recruited. The test has comparatively strong power to detect against most alternatives methods which are available in the practice (Ghasemi & Zahediasl, 2012; Kim, 2012). Shapiro-Wilk test indicates that the data for EX1, NE1 and EX2 were not normally distributed with both p values below 5% (0.05) level of significance which showed as (0.000), (0.000) and (0.001).

The NE2 were normally distributed with p value (0.031). The normality test shown in Table 4. The distribution of data was also exhibited using q-q plot presented in table 4.

Intra-Rater and Inter-Rater Reliability Test: Table 5 indicate the result for intra-rater reliability for the physiotherapist performing 90-90 Active knee extension (EX1) Interclass Correlation Class (ICC) suggested excellent reliability (0.968) (0.917-0.988; 95% CI) and SEM (0.176).

For (EX2) having excellent reliability with the ICC value (0.994) (0.987-0.997; 95% CI) and SEM (0.0773). On the other hand, results showed for the (NE 1) excellent reliability ICC value (0.918) (0.841-0.963; 95% CI) and SEM (0.2800). The present study for (NE2) suggested excellent reliability with the ICC value (0.987) (0.972-0.994; 95% CI) and SEM (0.1136).

Physiotherapist	Mean (SD)	ICC (2,1)	95% CI	SEM
EX 1	19.83 (10.21)	0.968	0.917-0.988	0.176
EX2	43.14(47.05)	0.994	0.987-0.963	0.077
NE1	21.21(11.14)	0.918	0.841-0.963	0.280
NE2	42.55(47.66)	0.987	0.972-0.994	0.113

Table 5: Intra-rater reliability of 90-90 Active Knee Extension (AKE) Test

Inter-rater reliability among experienced and non-experienced examiner for the present study showed that experienced (EX1) and non-experienced (NE1) having good reliability with ICC value (0.701) (0.396-0.867; 95% CI) SEM (0.452). On the other hand, experienced (EX2) and non-experienced (NE2) showed excellent reliability with ICC (0.990) (0.974-

0.996; 95% CI) SEM (0.0995). Besides that, the finding for the experienced (EX1 & EX2) showed excellent reliability with ICC value (1.66) (0.288-0.559; 95% CI) SEM (0.259). The analysis between non-experienced (NE1 & NE2) that results showed low reliability with ICC (0.202) (0.253-0.583; 95% CI) SEM (0.299) as shown in Table 6.

Examiners	p value	ICC (2,1)	95% CI	SEM
EX 1 & NE1	< 0.05	0.701	0.396-0.867	0.452
EX 2 & NE2	<0.05	0.990	0.974-0.996	0.0995
EX 1 & EX2	<0.05	1.66	0.288-0.559	0.259
NE1 & NE2	<0.05	0.202	0.253-0.583	0.299

Table 6: Inter-rater reliability between physiotherapists

DISCUSSION

The result of the present study showed that the entire four assessors included two experienced and two non-experienced physiotherapists reading were reliable. Results from ICC and SEM suggest that these flexibility tests have a high degree of reliability in intra-rater and inter-rater reliability.

The data of the present study suggested 90-90 AKE test produced for (EX1) excellent intra-rater reliability with ICC (0.96; 0.917-0.988 95% CI). It was found that (EX2) having excellent reliability with the ICC value (0.994) (0.987-

0.997; 95% CI) and SEM (0.0773). On the other hand, results showed for the (NE 1) excellent reliability ICC (0.918) (0.841-0.963; 95% CI) and SEM (0.2800). The present study for (NE2) suggested excellent reliability with the ICC value (0.987) (0.972-0.994; 95% CI) and SEM (0.1136). On the other hand, for the inter rater reliability showed that experienced (EX1) and non-experienced (NE1) having good reliability with ICC value (0.701; 0.396-0.867 95% CI) and for experienced (EX2) and non-experienced (NE2) showed excellent reliability with ICC (0.990; 0.974-0.996 95% CI). However, the finding based on the experienced physiotherapist (EX1 & EX2) showed excellent reliability with ICC value (1.66) (0.288-0.559; 95% CI) SEM

(0.259).The analysis between the non-experienced (NE1 &NE2) result showed low reliability with ICC (0.202) (0.253-0.583; 95% CI) SEM (0.299).

The study conducted on intra-rater reliability reported excellent reliability for the 90-90 active knee extension test with an ICC (0.94) with similar number of subjects recruited. However, the study performed on both dominant and non-dominant leg. However, the previous study differs with the present study in term of the objective⁸.

Another study conducted and demonstrated excellent intra-rater reliability between traditional and functional hamstring stretching technique with results ranging from 0.926 to 0.98 for both hamstring muscle length tests. However, the objective of the present study and the previous studies stated above slightly differs where the present study intended to test the reliability of the examiners⁹.

The slight differences in the score between the physiotherapists might be influenced by factors such as the pelvic position as hamstring with low flexibility will cause a posterior pelvic rotation which can increase the variability of the score. From a clinical point of view, the high intra-rater and inter-rater reliability values obtained in this study let believe that the test and the physiotherapist can be with minimal bias¹⁰.

In clinical practice, physiotherapists should be more consistent in the measurement when placing the goniometer that commonly used. Besides that, physiotherapist should ensure that the implementation of the goniometer is standardized in order to gain excellent reliability by single physiotherapist over repeated measurement and between physiotherapists in clinical area¹¹.

Furthermore, neither years of experience of the physiotherapist nor the number of 90-90 AKE test performed, the clinical practice

influenced the reliability of the examiners and the test. The findings from the present study support that the test can be performed with confidence by all qualified physiotherapist regardless of years of clinical experience or familiarity of the test.

CONCLUSION

The inter-rater and intra-rater evaluation between experienced and non-experienced physiotherapist showed that goniometry is a reliable tool to evaluate hamstring flexibility among healthy college students. This reliability study provides information which can help to select the correct tools for assessment and reevaluation purpose, particularly when dealing with individual with hamstring flexibility deficits.

Limitation and Recommendation: This study had some limitations due to methodological constrains that the physiotherapists were unable to blind regarding the study purpose. Besides that, the physiotherapists unable to perform any segment movement during the 90-90 AKE test. Future study should be addressed to the inter-tester reliability for the measurement, in order to increase the value on method for flexibility testing. The future study should have more number of subjects, age group can be wider and the subjects can be from different population such as post injury/surgical conditions.

Ethical Clearance: An initial application was addressed to Research Ethics Committee, School of Health Sciences, KPJ Healthcare University College and approval received for conduct of this study with reference number: KPJUC/SOHS/ECR/07/37 dated 26/10/2016.

Conflict of interest: There was no conflict of interest on conduct of this study.

Fund for the study: It was a self financed study.

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Citation:

Siti Nur Baait Binti Mohd Sokran, Rogini A/P Periasamy, Jibi Paul (2019). Inter-rater and intra-rater reliability between experience and non-experienced examiners on 90-90 active knee extension test using goniometer among healthy college students, *ijmaes*, 5(3), 586-593.