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ARAŞTIRMA / RESEARCH

Test-retest reliability of muscle strength evaluations in healthy ballet students

Sağlıklı bale öğrencilerinde kas kuvvet değerlendirmelerinin test-retest güvenirliği

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Abstract

Purpose: The aim of this study is to investigate the test-retest reliability of muscles strength measurements performed with Nicholas Manual Muscle Tester (NMMT) in healthy ballet subjects.

Materials and Methods: The study group consisted of 10 healthy ballet students aged between 10-11 years. Muscle strength evaluations of lower extremity were made to determine the physical performance level using NMMT. Moreover, every measurements were performed three times with NMMT.

Results: NMMT measurements were found as reliable for lower extremity muscle strength in clinical measurements. These reliability of NMMT scores were found as between 0.634 and 0.991.

Conclusion: In this paper, we think that NMMT measurements for lower extremity muscles can be used as reliable in clinical measurements and the identification of problems including lower extremity, evaluation of the training and treatment effectiveness of ballet students.

Key words: Ballet students, reliability of Nicholas Manual Muscle Tester (NMMT), Muscle strength

Öz

Amaç: Bu çalışmanın amacı sağlıklı bale öğrencilerinde Nicholas Manual Muscle Test (NMMT) aleti ile yapılan kas kuvvet ölçümlerinin test-retest güvenilirliğini araştırmaktır.

Gereç ve Yöntem: Çalışma grubu 10-11 yaş arası 10 sağlıklı bale öğrencilerinden oluşmaktadır. Alt ekstremitenin kas kuvvet değerlendirmeleri NMMT aleti kullanılarak fiziksel performans düzeyini belirlemek için yapıldı. Ayrıca, her ölçüm 3'er defa NMMT aleti ile yapıldı.

Bulgular: NMMT alet ölçümleri alt ekstremite kas kuvvet ölçümleri için klinik ölçümlerde güvenilir bulundu. NMMT aletinin güven aralığı 0.634 ile 0.991 olarak bulundu.

Sonuç: Bu çalışmada, alt ekstremite kasları için NMMT aletinin bale öğrencilerinin tedavi etkinliğinin ve eğitimin değerlendirilmesinde, alt ekstremiteyi içeren problemlerin belirlenmesinde ve klinik ölçümlerde güvenilir olarak kullanılabileceğini düşünmekteyiz.

Anahtar kelimeler: Bale öğrencileri, Nicholas Manual Kas Kuvvet aletinin (NMMT) güvenirliği, Kas kuvveti.

INTRODUCTION

Classical ballet is an branch of art that necessitates artistic talent, excellent physical fitness, strength and flexibility. The bodies of ballet dancers often turn into the difficult positions which are not similar to the anatomical position and physiological characteristics so as to achieve superior properties for technical ballet requirements[1]. Moreover, It is determined that success in ballet dancer requires both flexibility and strength[2]. Furthermore, the one of the critical positions is the turn-out. There are five fundamental positions in ballet training which based on turnout. Turnout degree is designated with like features muscle strength or skeletal anatomy[2]. Additionally, lower extremity strength is important for the explosive manoeuvres performance, supporting balance and postural control[2].

Manual muscle force measurements were rated from 0 until 5 in clinic practice. Muscle force is defined as the spent power againts to resistance of muscle or muscles groups with maximal effort[3]. However, this method is not precise and it can be changed from

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researcher to other researcher[4]. So, we think that reliable muscle force evaluation methods need to be used in determining of the ballet treatment approach. Because, ballet requires athletic ability too much due to the excessively physical demands. Since, ballet dancers are at risk for injuries[5]. Moreover, the one study is stated that there are very few muscle strength measurement data of ballet dancers[2]. Ballet training necessiate suitable muscle strength. Lower extremity strength is important for jumps, balance and postural control in several ballet motions like arabesque and attitude[2].

There is no muscle strength evaluations performed with NMMT in ballet selection. So, we think that muscle strength measurements can be performed in ballet selection, ballet injuries and these measurements can be applied after any injury or in physical therapy or evaluation and plan of rehabilitation program. So, muscle strength measurements can considerate training progress of ballet students. The purpose of this study was to investigate the test-retest reliability of muscles strength measurements performed with NMMT in healthy ballet students. The other aim was to evaluate the lower extremity muscle strength of healthy ballet students.

MATERIALS AND METHODS

The study was approved by our institutional review board and ethics committee approval also was obtained. Bilateral lower extremity muscles force measurements were taken from 10 ballet students aged between 10 and 11 years. Moreover, measurements were performed three times using NMMT. All measurements were performed by only one researcher in morning hours. Second and third measurements were done every other week. Furthermore, each subject was asked to gently place her/his lower extremity to suitable position for muscle test.

Inclusion criteria were ballet students who have taken the same programme. This training programme were applied by the same ballet master for six years. Other criteria was ballet students who have been trained in Cukurova University State Conservatory.

In addition, portable hand-held dynamometers which allows isometric assessment opportunity have been seen as a suitable option because of the ease of application, the lack of expensive equipment and being portable[6]. There has been studies in the literature about the reliability of the NMMT tool which is a portable dynamometer[6,7]. NMMT tool allows to objective results between 0 and 136 kg[4]. These muscle test measurements are often used in physical therapy, rehabilitation and sport sciences[8].

These measurements were as follows; hip flexion, extension, isolated hip extension muscle test (gluteus maximus muscle), external rotation, internal rotation, abduction, adduction, ankle dorsiflexion, plantar flexion and eversion[3].

Statistical analysis

After these calculations, the statistical analysis was performed with SPSS 21.0. From these measurements, means and standard deviations values were evaluated.

RESULTS

The records of 10 ballet students were assessed. While the demographic data (age, height, weight and body mass index-BMI) of participants were shown in Table 1. Moreover, the muscle strength intraclass coefficient correlation (ICC) measurement results of classical ballet training in hip joint were indicated in Table 2. The three measurements results performed with NMMT were demonstrated in Table 3.

Table 1. Demographic data of ballet students

Demographic data	Mean	Standard Deviation (SD)
Age (year)	10.60	0.52
Height (m)	1.49	0.78
Weight (kg)	38.91	7.63
Body Mass Index (kg/m^2)	17.50	2.16

DISCUSSION

Classical ballet necessitates artistic talent, excellent physical fitness, strength and flexibility. The ballet dancers often turn into the difficult positions which are not similar to the anatomical position and physiological characteristics so as to achieve superior properties[1]. The features which is important for ballet training are established as heart, respiration endurance, the external rotation ability of

hip joint, the flexibility of ankle and foot, range of motion, aesthetic appearance, coordination and flexibility, agility and balance[9-15]. The injuries are seen due to overuse. The 20% of injuries are occurred in lower extremity, whereas 30% of injuries in ankle and foot region[16-18]. In ballet art ballet dancers have to be aesthetic, elegant and slimmer.

Table 2. The muscle strength intraclass coefficient correlation (ICC) measurement of classical ballet training in hip joint.

Muscle test values (Ibs)	ICC value
Hip flexion (right)	0.925/p<0.001
Hip flexion (left)	0.837/p=0.003
Hip extension (right)	0.842/p=0.002
Hip extension (left)	0.783/p=0.007
Hip external rotation (right)	0.773/p=0.009
Hip external rotation (left)	0.676/p=0.032
M.gluteus maximus (right)	0.765/p=0.010
M.gluteus maximus (left)	0.828/p=0.003
Hip internal rotation (right)	0.977/p<0.001
Hip internal rotation (left)	0.990/p<0.001
Dorsiflexion (right)	0.821/p=0.004
Dorsiflexion (left)	0.919/p<0.001
Plantar flexion (right)	0.773/p=0.009
Plantar flexion (left)	0.893/p=0.001
Eversion (right)	0.877/p=0.001
Eversion (left)	0.784/p=0.007

Table 3. The three measurement results of ballet dancers

Muscle test values (Ibs)	Mean±SD First measurement	Mean±SD Second measurement	Mean±SD Third measurement
Hip flexion (right)	32.47±5.42	33.66±5.83	32.07±4.70
Hip flexion (left)	29.52±4.13	30.43±3.81	31.27±5.42
Hip extension (right)	32.61±5.42	34.68±4.57	32.94±4.84
Hip extension (left)	31.15±5.30	32.34±5.85	33.31±5.83
Hip external rotation (right)	21.94±2.49	22.08±2.18	21.53±2.67
Hip external rotation (left)	21.78±3.28	20.92±2.93	21.08±2.73
M.gluteus maximus (right)	31.80±4.15	31.56±4.03	32.06±3.31
M.gluteus maximus (left)	33.53±3.15	33.74±4.54	34.23±4.51
Hip internal rotation (right)	21.40±6.65	21.72±7.36	21.51±6.45
Hip internal rotation (left)	21.05±5.41	22.57±8.42	21.79±6.88
Dorsiflexion (right)	27.54±4.95	29.86±2.02	28.37±2.15
Dorsiflexion (left)	29.72±1.87	29.87±3.42	28.80±3.07
Plantar flexion (right)	36.00±4.73	36.61±4.46	36.47±4.14
Plantar flexion (left)	36.80±4.66	37.37±4.44	36.74±4.98
Eversion (right)	21.13±2.72	21.08±2.95	20.29±2.86
Eversion (left)	21.43±3.34	21.88±2.53	21.82±2.67

Fat and energy percentage of ballet dancers decrease because of poor nutrition result. So, injuries happen[19]. Bennel et al declared in Australian girls aged between 8-11 years, the mean values of the body mass index, weight and height as 16.30 kg/m2, 30.50 kg and 1.36 m[20]. Blaes et al established the body mass index values as 17.1 kg/m2 in childrens aged between as 6-12 years[21]. Whereas knowing the suitable body mass index as 18.5 – 24.96 kg/m2, in our study the same value was calculated as 17.50 kg/m2 in our study. The mean values of weight and height were found as 1.49m and 38.91 kg. In a study, If the ratio of external rotation muscle force to internal rotation muscle force is higher, this condition protects athletes from some injuries[7]. In our study, the ratio of external rotation muscle force

to internal rotation muscle force is higher in right side, whereas, in left side the corresponding value is lower than in left side. But, in our study ballet dancers don't suffer from injuries.

The values obtained in these study could not be compared with literature. The NMMT is an ergonomic, reliable, accurate hand-held device used for objectively quantifying muscle strength22. Because, there is no enough data which are obtained and performed with NMMT in healthy same age population. However, when it is looked at the other studies performed with NMMT, there are few studies about the reliability of this tool[6,23,24]. It is determined that NMMT tool reliability was analyzed and it was found as between 0.870 and 0.930[23]. When we evaluated with this score, it presents an excellent result. Whereas Krause et al were found NMMT intrarater reliability as between 0.820 and 0.9706. Moreover, NMMT's reliability was established as 0.96024. Furthermore, literature showed that these dynamometers could be used as reliable in clinic and exercise practices to determine hip and knee isometric muscle force[6].

We believe that our data will give substantial information. Because, there is not enough study about NMMT using in literature. Moreover, we think that this obtained data will help for evaluation of the treatment effects, determination therapeutic approaches and rehabilitation clinics. Furthermore, this study showed that NMMT can be used as reliable in muscle force measurements.

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