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Effects of Muscular Fatigue on Knee Proprioception during Performance and Recovery of the Knee Flexors in Female Physical Education Students

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ABSTRACT

The purpose of this study was to assess the effect of muscular fatigue on the knee proprioception of female's physical education students. Sixteen physical education female students participated in this study from Sport Science College in Mutah University. All students were registered in basketball-2 courses classes during fall semester 2010/2011. Both limbs were used in this study; the dominant limb was used as experimental and non-dominant limb was used as control one. An effect of muscular fatigue on proprioception performance was measured by the method of absolute reproduction angular error (i.e. differences in subject angular reproduction to the angle set by the examiner). The researcher used separate three-factor ANOVAs to calculate the mean and standard deviation for the study; and the goniometer has been used to calculate the differences between the angle set by the examiner and the angle reproduction by the subject. The results indicated that there was no significant difference been the dominant and non-dominant limb before fatigue intervention, $p \leq 0.05$. Also, indicted that there was no significant difference between the dominant and non-dominant limb after fatigue intervention, $p \leq 0.05$. Also results indicted that there was a significant difference between the dominant and non- dominant limb after recovery.

In conclusion there was no significant difference of knee joint proprioception after fatigue intervention between the dominant limb, and the control limb, where alpha level set at (0.05) level of significance. However, the details of proprioception are still largely unknown. It is known that proprioception is necessary for normal functional activities in sport event, and loss of proprioception seriously impedes coordination and influence one to have injuries and re-injuries; also, there was a significant difference of knee joint proprioception after fatigue intervention and recovery time between the dominant limb, and the control limb. Therefore, more research is needed to verify the effects of fatigue on proprioception around the knee joint among female's athletes.

Keywords: Female Students, Proprioception, Fatigue, Knee Joint, Reproduced Joint Angle and Injury.

INTRODUCTION

During the past 20 years, there has been significantly growth in participating of organized sports. One of the most dangerous parts of sport is sport injuries which trigger the concern of science and research for possible prevention during different times (pre-season, on-season and off-season) of sport performance at all skill levels. Today more than ever before it is necessary and important for all parties involved in sports (coaches, physical educator's trainer and fitness instructors) to regard and consider the prominent role of science and research in functioning as a successful measure of sport injuries. These injuries result in time lost from competition, economic coast of treatment and pose mental and social problems to athletes and can seriously affect their sports careers (Panics et al., 2008; Boden et al., 2000). For example a prospective study of 302 adolescent players in three ball games (Basketball, handball and soccer), 119 incurred injuries. The injury incidence (number of injuries per 1000 playing hours) was in 3.0 in basketball, 4.1 in handball and 5.4 in soccer). Many injuries in handball and basketball were often caused by ball contact and running while injuries occurred during tackling and contact with an opposing player (Yde and Nileson, 1990); So, basketball and many other sports required players to have well developed physical and physiological capacities to avoid injuries during game times. Sprinting, jumping, throwing speed and flexibility represent physical activities that are

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considered as important parts of the games and contribute to the high performance of the players (Mitchell et al., 2005). During games, such as basketball many movements are characterized as intermittent and change continuously in response to different offensive and defensive conditions (Deng et al., 1990). The movements of offensive and defensive situations among athletes produce physiological changes so called Fatigue. Fatigue is defined as the transient inability to maintain power out put or force during repeated muscle contractions (Hoekstra et al., 2001) and a usual phenomenon in resistance sport, and is a common experience in the daily activities (Silva et al., 2006), which cause muscular fatigue that may lead to reduction in neuromusculer ability to produce strength around the joint during sport activities which may lead to sport injuries.

For example, Skinner et al. (1986) found a significant reduction in the ability to reproduce joint angles after a series of interval running sprints in which subjects covered a total distance of 3.75 miles. The muscular strength is essential to perform many tasks that are encountered in sport activities; that is importance to prevent sport injuries. Female athletes show less absolute strength than their male counterparts, and suggest a potential link between deficient muscular strength and noncontact ACL injuries in female athletes (Nagai et al., 2013; Shultz et al., 2009; Salci et al., 2004). These changes come out because of fatigue that may occur anywhere along the pathway in muscular contraction within muscles group that can affect the proprioception within knee joint (Lephart and FU, 2000). Proprioception is defined as the perception of limb position in space after mechanical displacement of a joint (Wei-Chun et al., 2005). This includes both the sense of static limb position and the sense of dynamic movement. There are three types of proprioceptors; joint receptors in the joint capsule, ligament and cartilage, and muscle receptors of the muscle spindles and Golgi tendon organ in tendon and skin receptors. These receptors are very important to provide feedback to joint stability during joint movement in sports performance during games time (Wei-Chun at el., 2005). The decrease of joint proprioception may lead to abnormal joint biomechanics during functional activities which may lead to very serious injuries (Nagai et al., 2013; Fernando et al.2007; Lephart and FU., 2000; Skinner., et al 1986). In contrast, Marks and Quinney (1993) found that 20 maximal isokinetic quadriceps contractions used as a fatigue intervention, did not significantly reduce knee proprioception in young women. Previous studies have shown that conflicting results about the effect of muscle fatigue on proprioception function.

Proprioception have been measured in many ways and are used to assess the integrity and the function of conscious proprioception (Nagai et al., 2013), but the most often used methods are based on the ability to detect a passive movement, and the ability to reproduced a knee joint position by active repositioning of the knee joint (Jenson et al., 2002).

In general, few researchers have evaluated the relationship between knee joint proprioception and the effects of a repeated exposure to fatigue intervention on the knee flexor musculature among female players; and a corroding to researcher knowledge, the present study is the first to describe effects of muscular fatigue on knee proprioception during performance and recovery of the knee flexors in physical education female's students. The proprioception performance during reproduction of the knee joint angles by examiner(passive) and subjects (active) in of the flexors muscles has not been yet assessed. Thus, the purpose of this study was to assess the effects of fatigue inducing exercise and the effect of subsequent recovery, on knee joint proprioception among physical education female's student.

Review of Literature

Basketball is one of the most popular sport thoughtout the world. Million of people participate in the sport at all levels whether competitively or recreationally. Contribution in any sport activities; however, is able to potential lead to injury. Basketball injuries can be divided into two general categories: overuse and traumatic injuries. Overuse injuries caused by stressing an area over and over until is damaged and being to hurt, an example of this is patellar tendonitis; whereas traumatic injuries are those caused by a sudden forceful injury an example of this is knee sprain. An example of knee sprain is the anterior cruciate ligament (ACL). The ACL is one of the more commonly torn ligaments in the knee joint. Many factors are contributed to ACL injury in the knee joint during all season such as inadequate conditioning, experience, muscle recruitment pattern, proprioception and most important is muscle fatigue. Fatigue is defined as any reduction in the neuromuscular ability to produce strength (Silva et al., 2006); and is a common on resistance and experience in daily activities. For example, a study by Greig and Siegler (2009) to evaluate the influence the soccer-specific fatigue on peak eccentric torque of the knee flexor muscles. Ten male professional soccer players completed an intermittent treadmill protocol replicating the activity profile of soccer match play, with a passive halftime interval. Before exercise and at 15 minute intervals, each player completed isokinetic dynamometer trials. The peak eccentric knee flexor torque was quantified at isokinetic speeds of (180, 300 and 60) degree per seconds, with 5 repetition at each speed. The result showed that the peak eccentric knee flexor torque at the end of the experiment (T 300eccH105=127± 25 Nm) and at the end of the passive halftime interval (T 300eccH60=133± 32 Nm) was reduced to T 300eccH00=167± 35 Nm, P < 0.01) and T 300eccH105=161± 35 Nm, P=0.02); in addition to, Hewett, (2009) show that the ACL injury were higher in female compared to male athletes. During the year of 2000, there were more than 2.5 million girls competing in high school sports and an other 145.000 in college sports in the U.S.A a lone .Additionally, women participation in professional sports is emerging in many countries in basketball, soccer and ice hockey. This exposes female athletes to knee injuries and then ACL injuries, which estimated about 30000 injuries yearly. The National Collegiate Athletic Association (NCAA) reported that between 2002 and 2003 for women's soccer shows an ACL injury rate of 0.15/1000 athlete exposures in practice and 0.84/1000 athlete exposures in games. In women's basket ball the ACL injury rates were 0.15 and 0.16, respectively. Furthermore, many studies have shown that fatiguing diminishing the knee proprioception around the knee joint (Skinner et al, .1986; Fernando et al, .2007; Lin et al, .2008). Proprioception includes the senses of joint position and joint motion. The important of sensory information, central processing and in integration, and neuromusculer control to achieve a stable knee joint (Nagai et al., 2013); therefore any proprioceptive deficit may lead to an alteration in joint stability and control of joint motion and may lead to the knee injury (Lattanzio et al., 1997). Several researchers study the proprioception in joint and muscle in relation to joint position sense and their determination. For example, Lattanzio et al. (1997) evaluated the effect of fatigue on knee proprioception in sixteen (eight men and eight women) healthy volunteers age 19-27 years. Three separate fatigue protocols:[ram test (RM), continuous test (CT) and interval test (IT)];were executed. All tests consisted of lower limb cycling on a computer-driven cycle ergometer (Lobe). The RT was used to calculate the maximal aerobic power (VO2 max) and determine the work rate for the CT and IT. Work rate for the RT increased 20/25 W/min to maximal exhaustion. CT consisted of cycling at 80% VO2 max until maximal exhaustion. The IT consisted of cycling alternatively at 120% VO2 max and at 40% VO2 max for 30s each to the point of maximal exhaustion. The result show that a statistically significant increase in the absolute angular error (AAE) after the RT (1.0±0.66, P< 0.01); C.T (0.70 ±0.66, P≤ 0.03) and IT (10.24±0.79, P< 0.01 for male subjects and CT (0.73 ±0.73 P≤ 0.03) and IT (1.1±0.89, P< 0.01) for female subjects. Anther study by Changela, and Ramaprabhu (2012) evaluated the effect of fatigue on knee joint proprioception and balance in healthy individuals; was conducted on 30 healthy subject(age 18-30) from Srinivas college of physiotherapy. Fatigue was induced in the subjects by cycling up to level of exceeding 60% of predicted HR max (14-17 PRE). The result revealed that significant reproduction error was found for perception of joint position sense (t =3.103) with significant changes were founded in AP (t- 3.997), Lateral of center of pressure (CoP) excursion (t=10.949) and stability score (t= 11.785) at p> 0.05. furthermore, Marks and Quinney (1993) studied the active reproduction of the knee joint angles in a group of 8 young, sedentary women. The fatigue was induced by performance of 20 consecutive maximum voluntary concentric and eccentric contractions of the quadriceps at 180^0 per second. Neuromusculer fatigue was confirmed by documenting a 16-23 % fatigue index. The study showed that no significant difference in joint position sense between the experimental and control group at baseline and immediately following exercise.

Moreover, there are many studies attempted with regard to verifying the relationship between proprioceptive fatigue and athletic injuries such as Chappell et al.,2005; Lin et al.,2008;Tiggelen et al.,2007; Greig and Siegler (2009); Lattanzio et al. (1997) and Marks and Quinney (1993); however they show a conflicting results regarding the effects of fatigue on proprioception of knee joint. Therefore, much more research is needed to determine the effects of fatigue on knee proprioception and subsequently on ACL injury, especially female athletes. This will help to plan and re-plan training strategies to better manage the possible effects of fatigue on knee joint proprioception. Further more, this will help to maintain the best protection level and decrease the risk of injury among many athletes especially females athletes.

METHODS

PARTICIPANTS

Community of the study: sixty students who registered in basket ball (2), during fall semester 2011/2012 in Sport Science College, Mutah University.

Sample of the study: Sixteen healthy physical education female students (age 20.75 ±0.86 years; height 1.72±5.07 m; weight 64.50±6.58 kg [mean ± SD]) from the community of the study agreed to participate in this study; and were informed a bout the aims and procedures of the study. None of them had any musculoskeletal injuries particularly lower extremity injuries or history of neuromuscular disorder. Subjects were instructed not to participate in any heavy exercise 24 h before testing and to maintain constant exercise level during the experimental period. The same test administrator takes all measurements.

Table (1)
Physical characteristics of the participants (mean± SD)

Group	Age	Height	weight
Subjects	20.88 ±1.26 years	1.58±3.62 m	53.38±5.64 kg

Protocol

Familiarization of subjects to testing procedure and testing environment was carried out in the first meeting. Following familiarization to procedure, each subject completed a standardized warm-up which consisted of 5 minutes exercise on a cycle ergometer and an additional 5 minutes of static stretching of the involved muscle. During the test day, subjects were positioned in a prone position on a medical bed at the exercise physiology laboratory at the Sport Science College, with both lower limbs individually were strained from movements by straps over the thigh and the pelvic. The lateral femoral epicondyle was used as a bony marker for the axis of rotation at the knee joint. The foot was fixed to a ladder placed into the wall after a knee flexion angle of 25º. This angle was maintained for both knees during testing procedures. The 25º angle was chosen to position the ligament in similar situation as presented during real life spots events. In addition, previous research showed that this angle is the most related to sports injuries because of the great mechanical strain (Beynnon and Johnson, 1996). The dominant limb (experimental limb) is the limb which is mostly used to kick the soccer ball during match. All subjects were given verbal encouragement, by the examiner during testing. After verbal signal [such as 3, 2,1, go] to the subject, the subjects start to flex the knee joint (experimental limb) as rapidly and forcefully as possible against the immovable ladder (design especially for this study). This position was maintained for 30 seconds. Following another signal by the examiner (i.e. stop), the subject relaxed the contracted muscle immediately. The data was recorded by the examiner within 10 second. This procedure was repeated for two more times (5 second rest and 5 seconds contractions) and every time the data were recorded by the examiner. Repeated events of maximal exercise stress were examined to mimic the physiology loading characteristic of a basketball game. The 40 second bout of maximal volitional activation of the knee flexors was applied to represent the event during basketball game (Gleeson et al.1998).

A gonimeter was positioned midway between the lateral condyle of the tibia and the lateral epicondyle of the femur consistent with the anatomical axis of the knee joint. The goniometer was zero (angle) before tests in each position. Each participant was given two trials to become familiar with the procedure.

Data was collected using the most common procedure which is based on the ability of the subjects to reproduce actively the angle set by the examiner. This procedure was described by Pancics et al.,(2008) as follow: From 25º of knee flexion (middle range of the test position, this position thought to be mechanical threat to the knee stability), the examiner passively move the limb to different angles range from 10º to 80º degrees. After holding the limb in this position approximately 2 seconds, the limb was returned to the starting position and the subject asked to return the limb to the position at which it had originally been placed by the examiner. To eliminate a learning effect, participants were blindfold to prevent visualisation of the leg and did not receive any feedback on the accuracy of their estimates. The difference between the angle set by the examiner and the angle into which the participant put his limb was calculated.

Each subject completed 7 assessment sessions each day for each session; the control limb with no exercise (pre (zero time) , post control (30 seconds), post control (35 seconds), post control (40 seconds), and recovery at 60, 180 and 360 seconds post control 40 seconds); and the experimental limb with exercise(pre (zero time), post fatigue (30 seconds), post fatigue (35), post fatigue (40), and recovery at 60, 180 and 360 seconds post fatigue (40 seconds). The control and experimental limb trials were separated by standardized rest time of 30 minutes to avoid carry over effects. This protocol was repeated on two more days, separated by a three days resting period to avoid the interference of fatigue. The order of testing of subjects and angles order was performed randomly. In addition to, no verbal feedback was given to the subject throughout the testing. Furthermore, the sample was adjusted by statistically which compare the control and experimental limbs before fatigue intervention. The result shows that there was no significant difference between the control and experimental limbs before fatigue intervention.

Data Analysis

Descriptive statistics (Mean ± SD) were used to describe the indices of proprioception performance of the absolute error (AE) differences between the angles sit by the examiner and subjects. Separate three-factor ANOVAs: condition [control; fatigue] by time: [pre {both limbs with no exercise}; post {without and with} fatigue 30s; post {without and with} fatigue 35s; post {without and with fatigue} 40s] and by days [1, 2, and 3] with repeated measures were used to analysis the effects of fatiguing exercise intervention for each dependent variable.

Similarly, separate three-factor ANOVAs: condition [Control; recovery] by time: post {without and with} fatigue 40s;{ recovery 60 s; recovery 180 s; recovery 360s} and by days [1; 2; 3] with repeated measures were used to analysis the recovery responses in performance following the cessation of fatiguing exercise. SPSS (V 19) was used to perform all statistical procedures. A *p*-value below 0.05 levels was considered significant.

Results

There was no significant difference between the control and experimental limbs before fatigue intervention. Separate three-factor with repeated measures ANOVA: condition [control; fatigue] by time [zero seconds; post 30 seconds; post 35 seconds; post 40 seconds] and by days [1;2;3] revealed that a significant main effect for condition over time $P<0.001$.Also, result show that a significant main effect for time (1) over time (2,3,4) $P<0.05$; please see table (4).Furthermore, There was no significant main effect between days.

The result revealed that no significant differences between conditions over times between days (table 2) P> 05. This suggests that fatigue was preserved during both control and fatigue trials a cross all time periods in the preferred limb; also, separate three-factor ANOVAs: condition[control; recovery] by time: post [without and with] fatigue 40s;[recovery 60s;recovery 180s; recovery 360s]; and by days[1,2,3] revealed that a significant main effect for condition over time $P<0.008$. Also the result indicated that there was a significant difference (interaction) between conditions over times between days for recovery (table 3) $P<0.046$. This suggests that there was such a change in fatigue of statistical value a cross the four different time periods.

Table (2)

Groups mean (± SD) of control and experimental limb at pre fatigue (time 1); post fatigue 30s (time 2); post fatigue 35s (time 3); post fatigue 40s (time 4) for reproduced joint angle error (degree)

condition	Time	days	Mean ± SD	condition	time	days	Mean ± SD
Control	1	1	2.31± 0.22	Experimental	1	1	2.31± 0.22
		2	2.63± 0.27			2	3.00± 0.30
		3	2.13±0.13			3	2.43± 0.20
	2	1	2.13± 0.26		2	1	3.31± 0.27
		2	2.75± 0.26			2	3.44± 0.27
		3	2.50± 0.20			3	3.50± 0.26
	3	1	2.38± 0.26		3	1	3.69± 0.33

condition	Time	days	Mean ± SD	condition	time	days	Mean ± SD
		2	2.12± 0.21			2	3.50± 0.29
		3	2.67± 0.27			3	3.69± 0.22
	4	1	2.38± 0.27		4	1	4.06± 0.30
		2	2.63± 0.26			2	4.06± 0.19
		3	2.75± 0.23			3	3.50± 0.27

Table (3)

Groups mean (± SD) of control and recovery post fatigue 40s (time 1); 60s (time 2); 180s (time 3) and 360; (time 4) for reproduced joint angle error (degree)

condition	Time	days	Mean ± SD	condition	time	days	Mean ± SD
Control	1	1	2.38± 0.27	Recovery	1	1	4.63± 0.12
		2	2.63± 0.27			2	4.06± 0.19
		3	2.75± 0.23			3	3.50± 0.27
	2	1	2.25± 0.33		2	1	2.75± 0.25
		2	2.75± 0.27			2	3.50± 0.26
		3	2.63± 0.27			3	3.31± 0.20
	3	1	2.06± 0.21		3	1	1.88± 0.20
		2	2.44± 0.22			2	3.25± 0.21
		3	2.25± 0.19			3	3.31± 0.27
	4	1	2.00± 0.18		4	1	2.13± 0.24
		2	2.63± 0.22			2	2.81± 0.23
		3	2.31± 0.15			3	2.56± 0.30

Table (4)

Significant main effect for time (1) over time (2, 3, 4) of control and experimental limb where as pre fatigue (time 1); post fatigue 30s (time 2); post fatigue 35s (time 3); post fatigue 40s (time 4) for reproduced joint angle error (degree)

Time	Time	Significant difference
1	2	0.025
	3	0.001
	4	0.000
2	1	0.025
	3	0.472
	4	0.113
3	1	0.001
	2	0.472
	4	0.148
4	1	0.000
	2	0.113
	3	o.148

Discussion

A corroding to researcher knowledge, the present study is the first to describe effects of muscular fatigue on knee proprioception during performance and recovery of the knee flexors in physical education female's students. This study was design to analyze the influence of muscular fatigue in knee joint proprioception. The result indicated that there was no significant difference between the dominant (experimental) and non-dominant (control) limb before fatigue intervention. The first finding of this study was the result indicated that there was no significant difference between the dominant (experimental) and non-dominant (control) limb before fatigue intervention; and there was significant main effect between time(1) and time (2,3,4); table (4). The second finding there was a significant interaction between the dominant and non-dominant limb after fatigue (recovery). The fatigue was maintained across both control and serial fatigue intervention during 40 second fatigue task. The researcher finds that the non significant difference between the control and experimental condition may be due to one of the following reasons: overall increase in the observance of the musculotendinous unit (Westgaard and De Luca, 1999) or that motor efferent recruitment patterns are changed in fatigue to prevent metabolic derangement from damaging the muscle fibers (Gleeson et al., 1998). In agreement with the results of the present study, Marks and Quinney (1993) indicated that in their study there was no significant difference in joint position sense between the experimental and control group at baseline and immediately following exercise. Furthermore, this finding is in agreement with study by Silva et al. (2006) who reported that the majority of studies performed show that women have higher resistance to the fatigue during sub maximal contractions. Although, it is unclear how well orderly recruitment is conserved under conditions of fatigue (Enoka, 1995). An unconscious neuromusculer reserve has also been seen during sprinting activities (Key et al., 2001) and may exist in order to protect the human body from fatigue. However, there are many factors to take into consideration when assessing the effects of fatigue on neuromusculer performance such as the specific demands of the exercise, velocity of movement, subject motivation type of muscle action (Gleeson et al., 1998); and may some how effects the intervention of fatigue on proprioception (i.e. neuromuscular and sensorimotor) performance of the knee joint on this particular study. Others studies such as (Sharpe and Miles, 1993) on elbow and (Pedersen et al., 1999) on shoulder joint revealed no such effects.

It was expected that proprioception (i.e. neuromuscular and sensorimotor) performance would be weaken during fatigue conditions (Lattanzio et al., 1997; Changela and Ramaprab, 2012); as no significant interaction was observed for proprioception performance, the researcher finds that certain other factors may in some way have restrained the expected effects of fatigue on proprioception performance within this particular study. It is possible that the intensity of chosen fatigue task may not have been represent of the real life scenario even though the observed of main effect of condition over time (result out come from present study) and thus failed to obtain a significant disruption of proprioception in and around the knee joint. This suggestion may be reinforced by the fact that the stability of sensorimotor performance response was retained during the accumulative effects of fatigue intervention procedure. A significant interaction was shown by this study between post fatigues session (40 seconds) and (180 seconds) recovery time during this time period, pre fatigue values were not re-restored until (180 seconds) following the final fatigue session. This result may be considered by coaches and athletic trainer as it relates to players joint control and protection of general homeostasis. This consisting with a study by the suggestion by Cafarelli (1982), who reported that the effects of fatigue may be counterbalanced by an efficient feedback/ feed forward system of information processing, preventing injury from unexpected situations during sport activities. Furthermore, Silva et al. (2006) reported that the majority of the study performed showed that women have higher resistance to fatigue during sub maximal contractions. Therefore, a suitable neuromuscular training may be an effective method to speed up (i.e. shorten) the recovery period. The effect and duration of a suitable recovery period of proprioception after fatigue exercise has received very limited concern. Therefore, more research is needed determine the different factors affecting the recovery speed of proprioception such as the types of training adaptation (i.e. neuromuscular) and the type of recovery (i.e. active versus passive).

Conclusion

This study documented the effects of repeated bouts of fatigue and recovery on knee joint proprioception (neuromuscular and sensorimotor) performance during reproduction of knee joint angle performance assessment of the knee musculature (preferred limb) and control one in physical education female's students. There was no significant difference of knee joint proprioception after fatigue intervention between the dominant limb, and the control limb, p≤ 0.05. However, the details of proprioception are still largely unknown. It is known that proprioception is necessary for normal functional activities in sport event and loss of proprioception seriously impedes coordination and influence one to injury and re-injury; however, it appears from the result of this study the serial fatigues is not altered the proprioception around the knee joint. Therefore, more research is needed and recommended to verify the effects of fatigue on proprioception around the knee joint among female's athletes. Also, there was a significant difference of knee joint proprioception after fatigue intervention and recovery time between the dominant limb, and the control limb, P< 0.05.

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أثر التعب العضلي على المدركات الحسية لمفصل الركبة خلال الادا في العضلات القابضة وأعاده الاستشفاء لدى لاعبات التربية الرياضية

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ملخص

هدفت هذه الدراسة إلى تعرف أثر التعب العضلي على الركبة بين القدم المهيمنة وغير المهيمنة لدى طالبات التربية الرياضية. شارك في الدراسة ستة عشر لاعبة من كلية علوم الرياضة/ جامعة مؤتة من المسجلات للفصل الدراسي الأول في كرة السلة (2) 2010/2011م.

القدمان استعملتا في هذه الدراسة، القدم اليمنى (المهيمنة) استعملت كتجريبية واليسرى غير المهيمنة كضابطة. المدركات الحسية قيست بواسطة الممتحن (الطريقة السلبية) والايجابية (اللاعب) ومقدرة الطالبات على أعادة أنتاج زاوية المفصل الركبة التي عينت بواسطة الممتحن، استخدم الباحث مقياس الزوايا (goniometer) كأداة للقياس و(three factor ANOVAs) لاحتساب المتوسطات الحسابية والانحراف المعياري.

خلصت الدراسة إلى عدم وجود فروق معنوية ذات دلالة إحصائية ما بين القدم اليمنى (المهيمنة) التجريبية واليسرى غير المهيمنة كضابطة قبل تدخل التعب العضلي عند مستوى α (0.05). كذلك توصلت الدراسة إلى عدم وجود فروق معنوية ذات دلاله احصائيه لتأثير التعب العضلي على المدركات الحسية في مفصل الركبة بين القدم المهيمنة وغير المهيمنة.

في النتيجة خلصت الدراسة إلى عدم وجود تأثير للتعب العضلي على المدركات الحسية في مفصل الركبة بين القدم المهيمنة وغير المهيمنة. في كل الأحوال كثير من تفاصيل المدركات الحسية ليست معروفة ومعروف إن المدركات الحسية في مفصل الركبة مهمة في جميع النشاطات الرياضية، وان إصابة المدركات الحسية توثر في الإصابات واعادة الإصابة في هذا المفصل. كذلك خلصت الدراسة إلى وجود فروق معنوية ذات دلاله احصائيه ما بين القدم اليمنى (المهيمنة) كتجريبه واليسرى وغير المهيمنة كضابطه بعد أعاده الاستشفاء. ولهذا مزيد من الأبحاث عن تأثير التعب العضلي على المدركات الحسية في مفصل الركبة ما بين الطالبات اللاعبات.

الكلمات الدالة: الطالبات اللاعبات، المدركات الحسية، التعب العضلي، مفصل الركبة، زاوية كمفصل الركبة، الإصابة.

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