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EFFECTS OF MILD, MODERATE AND INTENSE PHYSICAL ACTIVITY ON KNEE JOINT PROPRIOCEPTION IN HEALTHY YOUNG ADULTS

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ABSTRACT

Background of the Study: To evaluate the immediate effects of various activity levels on knee joint position sense.

Methodology: Sixty males aged between 19 and 24 years, without any complains of discomfort or pain in the knee joint were selected from Bakhtawar Amin Hospital, Multan using convenience sampling, between April 2nd, 2019 to July 28th, 2019. Group A participants walked on the treadmill at a speed of 4 km/h for 5 min (n = 20). Group B participants ran on a treadmill at 6.4 km per hour for five minutes (n = 20). Group C participants sprinted on a treadmill at 8.5 km per hour for five minutes (n = 20).

Results: Mean age of the subjects was 21.18±1.77. In the moderate physical activity group, the difference in the means in passive reproduction of the knee flexion angle of 20° observed was 1.40±2.39, (p-value 0.013), and similarly in intense physical activity was 1.75±3.58 (p-value 0.020). For the knee flexion angle of 40°, the difference in the means for moderate was 1.35±1.84 (p=0.002), and for the intense activity was 2.35±2.27 (p=0.012). However, in the group with mild physical activity, the difference in the means was statistically insignificant.

Conclusion: The study indicated that physical activities of moderate level and intense level decrease the joint position sense appreciation at the knee joint in less active healthy individuals.

Keywords*: Continuous Passive, Exercise, Exercise Movement Techniques, Motion Therapy, Position Sense, Proprioception.*

Introduction

The physical well-being of healthy young adults is important not only for themselves but also to the community[1]. Routine physical exercise is important for the mental and physical health of individuals. Because of its well established benefits, physical activity is expected to be an integral part of one's life[2].The ability to recognize the body positions and its movements is Proprioception is an integral part of kinesthesia. It is important not only in preventing trauma but also in enhancing the performance of highly complex movements. The power and strength in muscles is of slightest value if the muscles fail to activate on time, as this timely activation is

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important in protecting the muscles themselves, joints and even other muscle groups[4]. A large number of studies have shown that the performance of sensory organs can be influenced depending on the kind of activity undertaken, joint laxity, vibration of tendons, swelling in and around the joints, gender, any disease affecting joints, muscles or tendons, neuromuscular insufficiency and muscle fatigue[5,9]. A study[10] was conducted to analyze the influence of specific proprioceptive training on knee proprioception among professional female handball players. It was concluded that specific proprioceptive training enhances the knee joint proprioception among such players. Another reseach concluded that the swelling and effusion around knee joint causes a decline in proprioception and recognition of passive and active joint position sense in osteoarthritic joints[11]. Muscle fatigue is generally followed by the failure of a muscular tendon to sustain the contraction. Similarly, fatigue may also be described as the powerlessness of a muscle to sustain a certain load and incapability of controlling the activity at a particular level[11]. Recent research has concluded that a decline in proprioceptive sensations in response to decreased joint[12] and muscle's receptors function might appear with the occurrence of fatigue. It is suggested that this decline in joint position sense might result in increased joint and musculotendinous injuries[13,14]. In comparison of the recommendations, suggesting that proprioception is affected by fatigue, another study concluded that there was not any significant decline in knee joint proprioception after performing 20 maximal isokinetic contractions of quadriceps in sedentary females[15]. Alternatively, other studies have concluded that isokinetic exercise till fatigue affects joint position sense considerably[16,18]. Furthermore, it was determined that sub-maximal intensity physical work to fatigue diminishes the awareness of proprioception, that in turn can cause altered motor coordination and joint position sense. Therefore, the objective of current study is to evaluate the effects of different levels of activities on the reproduction of proprioception sensing on the knee joint.

Methodology

A quasi-experimental study was conducted from April 2nd, 2019 to July 28th, 2019. Sixty participants (N = 20*3 groups) were included in the study. The study setting was Bakhtawar Amin Memorial Trust Hospital, Multan. A convenience sampling technique was used for collection of data. Healthy males were included in the study, aged between 19 and 24 years with Body Mass Index between 18.5 and 25. The subjects without pain and discomfort in knee joint were enrolled in the study. Those having no active participation in regular sports for the last six months and those with no underlying neuromuscular and musculoskeletal pathologies were enrolled. Whereas the individuals with previous knee surgery, gross knee instability, red flags suggesting knee pathologies, cardiopulmonary conditions, tumor, infections, fracture and subjects with a history of soft connective tissue trauma were excluded from the study.Informed consent was taken from the subjects and consequences were also explained and were made to understand. The confidentiality of the data was fully ensured. The willing subjects were interviewed by the professional clinical therapists of Bakhtawar Amin Memorial Trust Hospital, Multan. The subjects were assigned to one of the 3 intervention groups. Group A subjects walked on a treadmill at a speed of 4 km per hour (2.5 miles/h) for five minutes (n = 20). Group B subjects ran on a treadmill at a speed of 6.4 km per hour (4 miles/h) for five minutes (n = 20). Group C subjects ran on a treadmill at a speed of 8.5 km per hour (5.5 miles/h) for five minutes. The joint position sense score was calculated before starting the physical activity, and immediately after ending physical activity by the assistance of Continuous Passive Motion Machine (CPM). The rig of CPM and the seating chair

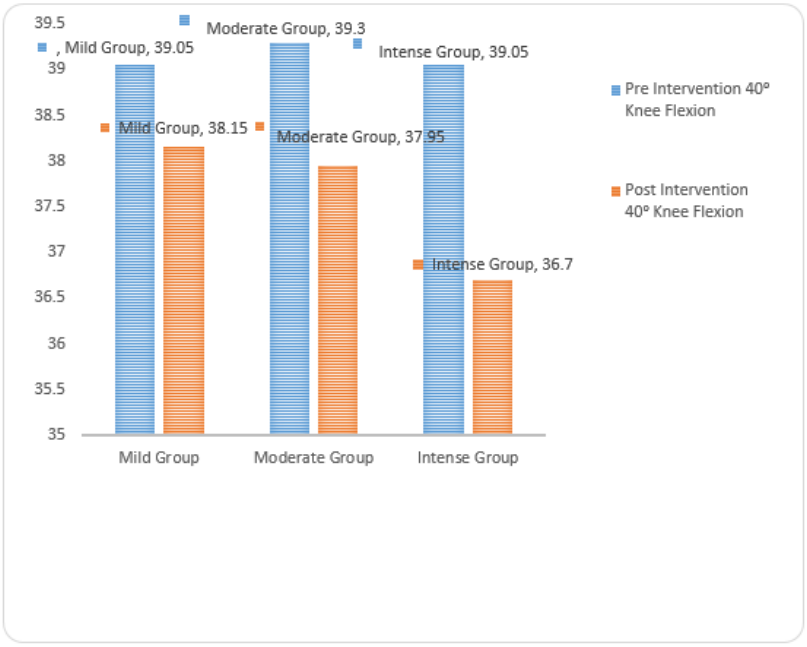
was accurately placed to make the center of rotation of rig becomes equal to the central point of knee joint complex. CPM rotated its arm at the speed of 2 degrees/sec. This speed was used as it was in accordance with the speed used in the prior researches[19]. The basic objective of using the low speed of 2 degrees/sec was to activate the mechanoreceptors located at the joint[20]. Slow and progressive positioning has maximally targeted the stimulation of ligament receptors and the capsules. Unnecessary movements were minimized by the use of straps attached to the chair at the level of the thigh, pelvic area and torso. All the subjects were blind folded while seated and their ear were also closed with cotton gauges. The subjects were asked to move their lower legs from the starting position to the target angle with the use of CPM with the knee flexed to 20 degrees to 40 degrees. The knee joint complex was passively encouraged to move at 2 degrees per second at predetermined target position, and then again reaching the start position. Three familiarizing trails were given beforehand the data were collected. The remote of the CPM machine was handed to the subject, so that he could passively move his knee joint from the starting position to the target position at his own will. The subjects were asked to press the stop button when the target degree movement is achieved. After recording the data, subjects in each of the three groups performed their respective physical activities. The knee joint position sense was again assessed immediately after the prescribed physical activity. The same protocol was followed for measuring joint position sense as was done before the physical activity.Data was analyzed using SPSS 21. The normality of data was checked by Kolmogorov Smirnov test, and the data did not lie normally. So, a non-parametric test was used to compare the means of the data. P value less than 0.05 was taken significant. Comparison of means at different angles of flexion before and after physical activity was depicted through bar charts.

Results

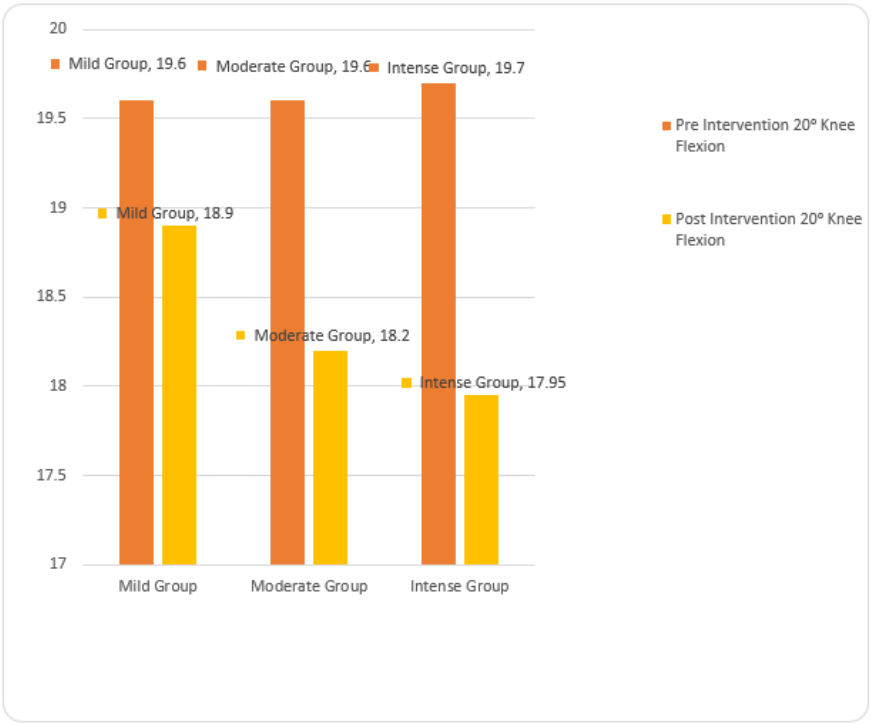
In the moderate physical activity group, the difference of the means in passive reproduction of the knee flexion angle of 40^{o} observed before and after the physical activity was1.35±1.84, it was statistically significantly different (p-value 0.002), and similarly the difference in the means in Intense physical activity was 2.35±2.27 and it was also statistically significantly different (p-value 0.012). In the mild activity group, the difference was not statistically significant (p=0.061).In the moderate physical activity group, the difference in the means in passive reproduction of the knee flexion angle of 20^{O} observed before and after the physical activity was 1.40±2.39, it was statistically significantly different (p-value 0.013) and similarly the difference in the means in Intense physical activity was 1.75±3.58, it was also statistically significantly different (p-value 0.020). In the mild activity group, the difference was not statistically significant (p=0.136) as mentioned in Table 1.

Activity Groups	Angle of Knee Flexion	Mean	N	p-value
The Mild Physical Activity Group	Pre Intervention 40^{O}	39.05±2.28	20	0.061
	Post Intervention 40^{O}	38.15±2.82	20	
	Pre Intervention 20^{O}	19.60±2.21	20	0.136
	Post Intervention 20^{O}	18.90±2.17	20	
A Moderate Physical Activity Group	Pre Intervention 40^{O}	39.30±2.00	20	0.002*
	Post Intervention 40^{O}	37.95±2.95	20	
	Pre Intervention 20^{O}	19.60±2.04	20	0.013*
	Post Intervention 20^{O}	18.20±1.74	20	
The Intense Physical Activity Group	Pre Intervention 40^{O}	39.05±1.91	20	0.012*
	Post Intervention 40^{O}	36.70±4.18	20	
	Pre Intervention 20^{O}	19.70±2.23	20	0.020*
	Post Intervention 20^{O}	17.95±3.30	20	

Table 1: The Wilcoxon Signed Rank Test



Graph 1: Comparison of Means at 40 degrees of Knee Flexion before & after Physical Activity



Graph 2: Comparison of Means at 20 degrees of Knee Flexion before & after Physical Activity

Discussion

This study evaluated the effects of different levels of activities on the reproduction of proprioception sense on the knee joint. The findings of the current study showed that there has been a significant effect on kinesthetic sense due to increased physical activities. The intense physical activity can target the kinesthetic sensation to decrease. The proprioceptive and

kinesthetic sensations on the knee joint are markedly decreased as the intense or moderate levels of activities cause fatigue. A study compared the effectiveness of acupuncture moxibustion versus conventional physical therapy treatment in enhancing the proprioceptive ability among athletes having injured lateral side collateral of the ankle joint. It was deducted about the therapeutic effects of acupuncture-moxibustion that they were superior to the traditional physical therapy treatment in enhancing the proprioceptive ability of the damaged lateral collateral ligament of the ankle[9]. The results of the study were in line with the results of current study.Earlier studies have targeted young and sedentary adults for participation in the study, the subjects have never been involved in any type of sports activity for last years. The neuromuscular coordination of lower extremity is compromised and the stability of the knee joint is also not well established targeting the proprioceptive awareness negative. Fatigue is the main reason for reducing the athlete capabilities and making them prone to injuries[21]. These previous findings have been in accordance with the current study. Previous literature has also quoted decreased joint position sense decreases proprioception and all this is initiated with the onset of fatigue[22, 23]. The methodology section of some previous literature in the terms of instruments and interventional techniques was in accordance with the current study. However, this study investigated the effects of various physical activities classified according to the Metabolic Equivalent Task. The previous literature has not compared these different activity levels in a single study. A study was conducted to evaluate the effects of warm up exercise and fatigue influence on the joint position sense of soccer sports players. The values were assessed at rest, after warm up and finally after a full competition match on the perceived exertion scale. The results of the study showed that joint position sense was markedly improved by warmup exercise immediately before the competition whereas fatigue component after the match decreased the joint position sense. The harmful effects of high intensity activity related fatigue also contribute to the knee instability, trauma and injury[24]. These results agreed with the results of our study, which reported that with the moderate and intense physical activity, joint position appreciation is significantly decreased. Another study evaluated the aging and physical activity effects on knee joint position sense. The study showed that regular physical activity improves the positioning sense in knee joint. However, the aging factor was negatively correlated with the proprioceptive ability of knee[25]. The current study results are dissimilar to the mentioned study, as the current study has targeted the different levels of physical activity on joint position sense. According to our results intense physical activity targets negatively on the joint position sense. Another study evaluated the effects of fatigue on knee joint positioning in sprinters[26]. The results of the study agreed with the current study that showed that high intensity activity causing fatigue effects proprioception of knee joint negatively. It is recommended for future researches to get their focus on an exercise related protocol which produces increasing levels of exertion that most likely replicate sporting activities and athletic actions. Further studies can also compare the physically active individuals with sedentary adults to investigate the relationship between the variables.

Conclusion

The findings of the study concluded that moderate level and intense physical activity decreased joint position sense appreciation (proprioception) at the knee joint in sedentary otherwise healthy young adults.

AUTHORS' CONTRIBUTION:
The following authors have made substantial contributions to the manuscript as under:
Conception or Design: *Hafiz Muhammad Asim ,Iqra Khan*
Acquisition, Analysis or Interpretation of Data: *Ubaid Ullah Akbar*
Manuscript Writing & Approval: *Zahid Mehmood Bhatti*
All authors acknowledge their accountability for all facets of the research, ensuring that any concerns regarding the accuracy or integrity of the work are duly investigated and resolved.

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