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RESEARCH ARTICLE

COMPARISON OF RISK FACTORS FOR ANKLE SPRAINS IN KARATE PLAYERS WITH OR WITHOUT ANKLE SPRAINS.

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Abstract

Aim: The purpose of the study was to compare risk factors of ankle sprains in karate players with and without ankle sprain.

Materials and Method: Community based cross sectional study was conducted on fifty karate players, 25 players with history of ankle sprains and 25 players without history of ankle sprains. The karate players were recruited from various Karate institutes across Mumbai, Maharashtra. The subjects were evaluated and compared for Body Mass Index (BMI), balance using Star Excursion Balance Test (SEBT) , Range of Motion using goniometer, Ankle Strength using Manual Muscle Testing and Ankle joint position sense in players with and without ankle sprains.

Results: The mean values of right ankle range of motion, ankle strength and ankle joint position sense and the normalized reach distance percentages for SEBT showed no significant difference in players with and without ankle sprain. The mean values for left ankle dorsiflexion range of motion showed a significant difference in players with and without ankle sprain where $p<0.05$.

Conclusion: Based on the results of our study it can be concluded that the intrinsic risk factors for ankle sprain considered for this study like impaired balance, reduced ankle strength, reduced range of motion and affected joint position sense were not significantly different in karate players with and without ankle sprain and dorsiflexion range of motion in left leg was significantly different among the karate players with and without ankle sprain.

Introduction:-

Karate is a Japanese martial art. The word karate has been derived from modern-day Japanese and means "empty hand". Karate signifies that your main weapon is your body. Instead of an arsenal of swords or guns, karateka (person preforming karate) cultivates a personal arsenal of punches, kicks and deflection techniques [4]. It has become popular not only for learning self-defense but also as a sport to improve cardiovascular fitness and

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flexibility [1]. It has thus been promoted as an excellent activity for maintaining good health and fitness [2]. Karate seeks defensive and counteractive body movements.

One crucial element of karate is focusing the energy of punch or kick into a relatively small point of contact. These points of contact are wrist, knife hand, back of fist, spear hand, ball of foot and instep [4]. Injuries in high contact sports are unavoidable [5]. Karate fighting is considered a high intensity event. Injuries occur to three main areas: the head and neck, the abdominal organs, and the limbs [3]. Injuries in karate range from minor to severe and most common injuries in lower limb include plantar fasciitis, ankle sprains, hematomas, dislocated joints, fractures of lower limb, etc. The foot and ankle account for at least 10 percent of total injuries sustained in martial arts [2]. A study carried out by Maghsoud Peeri et al [5] suggested that the rate of muscular injuries in karate players are higher than other types of injury and trauma (58.7%) and muscle tear (6.7%) comprised the most and least frequent type of muscular injury respectively. The injuries frequently occurred due to punching, kicking, blocking actions in karate. In the article' Injuries in karate', S Sterkowicz et al [6] concluded that trunk injuries in karate players ranged from 4%-31.8%, upper limbs ranged from 10.1%-17.2% and lower limbs ranged from 3.4%-55.2%. According to this article, the most frequent mechanism leading to injuries in lower limb occurred during kicks almost 33.3%[6]. When the karateka performs kicks, turns and throws or shuffles and lunges, they are at a risk of injuring the weight-bearing limb. Students advance from learning basic kicks and punching moves to more difficult techniques. Attempting a more difficult technique without appropriate training often predisposes them to injury. The ability to deliver an appropriate kick or punch depends on the player's flexibility and balance. Lack of balance while preforming any moves, will cause the weight bearing foot to be loaded without stability further leading to strains or sprains of ankle and foot. Strength and speed of the moves also play a very important role in karate. If the players lack strength and speed, the opponent can execute countermeasures, which may throw the player off balance, further leading to injury [2].

World Karate Federation is the largest international governing body of this sport with over 130 member countries and has more than 10 million members. With this high number of karate practitioners, it seems very important to prevent injuries [6]. Treating sports injuries is very difficult and time consuming. Understanding the causes and effects of injuries is very important in planning prevention and treatment of these injuries.

To prevent an injury, there must be a clear understanding of the etiology. This includes information on why a particular athlete may be at risk in a given situation (risk factors) or how injuries happen (injury mechanism) [7]. Sports injuries have two types of risk factors, intrinsic (person related) and extrinsic (environment related) risk factors [8]. A number of studies have suggested several possible intrinsic risk factors leading to ankle sprains. These variables range from diminished ankle muscle strength diminished [7], [11], postural control [7], [8], diminished proprioception [7], [8] and overweight or obese individual [7], [9].

The review of literature has revealed that no study has been conducted to compare the risk factors for ankle sprains in Indian karate players with and without ankle sprains. Several studies have been conducted on injuries in karate players [1], [2], [5] [6] but none of them compared the risk factors between karate players with and without ankle sprains. Several other studies have been conducted in foreign countries to compare the risk factors for ankle sprains in players with and without ankle sprain [7], [9], [11], [15], [17]. However, these studies were undertaken in sports other than karate; and lack consensus with respect to their relationship. The current study therefore aims to compare the intrinsic risk factors for ankle sprains in karate players with and without ankle sprain.

Material and Methods:-

The study was a community based cross sectional study which was conducted on 50 karate players, 25 players with history of ankle sprains in past 10 years and 25 players without the history of ankle. The subjects were in the age group of 18 years to 45 years. Study subjects were recruited from various karate institutes across Mumbai. Subjects unwilling to participate in the study, those with recent ankle or foot injuries and those with underlying respiratory, cardiovascular and neurological problems with excluded from the study. The study took place for duration of 6 months.

Plan of Study:

The study was initiated after obtaining approval from Institutional Ethics and Research Committee at D. Y. Patil University of Physiotherapy. All the players participating in the study willingly gave a written consent for participation. The confidentiality of the data was ensured. A proforma including details such as name, gender,

weight, height, etc. was prepared. Permission was taken from coaches of different karate institutes before initiating the study. After a baseline screening to determine the suitability for inclusion, the following assessment was carried out.

BMI-
height was measured using the measuring tape in centimeters and weight using calibrated weighing scale in kilograms.
BMI=M/(H x H), where M = body mass in kilograms and H = height in meters.

Star Excursion Balance Test (SEBT) is a measure of dynamic balance with good to excellent test-reset reliability (Munro & Herrington, 2010). It is inexpensive, quick method of measuring balance with good reliability [13]. The test involves a star shaped grid which is used to measure the foot excursion in the anterior, posterior, medial, lateral, antero-lateral, antero-medial, postero-lateral, postero-medial directions.

Procedure:
The participants were required to balance on their stance leg and reach as far as possible with the contralateral leg in the direction being assessed whilst keeping their hands on their hips. When using the right foot as the reaching foot, and the left leg to balance, the athlete should complete the circuit in a clockwise fashion. When balancing on the right leg, the athlete should perform the circuit in an anti-clockwise fashion. With a chalk pen, the spot was marked at which the athlete touched the line with their toe. This can then be measured from the center spot after the test to calculate the reach distance of each reach direction. This was repeated with the same foot for all the remaining directions before changing the foot. Participants were given three practice trials before any measures were recorded (Robinson & Gribble, 2008). Three reach distances in each direction were averaged and normalized to individual's leg length. Leg length was measured as the distance from anterior superior iliac spine to distal point of medial malleolus on same leg (Gribble & Hertel, 2003). The star excursion test was conducted bilaterally.

Range of Motion (ROM):
Ranges of motion at the ankle, both active and passive ranges were assessed using goniometer. According to AASO normal ROM for ankle dorsiflexion is 20 degrees, plantar flexion is 50 degrees, inversion is 35 degrees and eversion is 15 degrees. [23]

Dorsiflexion:
The subjects were made to sit with knees flexed to 90 degrees. The foot was kept in 0 degrees of inversion and eversion. Center fulcrum of goniometer was kept over lateral aspect of lateral malleolus, proximal arm was aligned with lateral midline of fibula and distal arm was aligned parallel to lateral aspect of fifth metatarsal. The subjects were then asked to dorsiflex the foot and readings were noted.

Plantarflexion:
The subjects were made to sit with knees flexed to 90 degrees. The foot was kept in 0 degrees of inversion and eversion. Center fulcrum of goniometer was kept over lateral aspect of lateral malleolus, proximal arm was aligned with lateral midline of fibula and distal arm was aligned parallel to lateral aspect of fifth metatarsal. The subject then plantarflexed the foot and readings were noted.

Inversion:
The subjects were made to sit with knees flexed to 90 degrees and lower leg over the edge of supporting surface. Hip was positioned in 0 degrees of rotation, adduction and abduction. Center fulcrum of goniometer was kept over the anterior aspect of ankle midway between the malleoli. Proximal arm of goniometer was aligned with anterior midline of lower leg. Distal arm was aligned with anterior midline of second metatarsal. The subjects were then asked to invert the foot and readings were noted.

Eversion:
The subjects were made to sit with knees flexed to 90 degrees and lower leg over the edge of supporting surface. Hip was positioned in 0 degrees of rotation, adduction and abduction. Center fulcrum of goniometer was kept over the anterior aspect of ankle midway between the malleoli. Proximal arm of goniometer was aligned with anterior midline of lower leg. Align distal arm with anterior midline of second metatarsal. The subjects were then asked to evert the foot and readings noted.

Manual muscle testing (MMT):
Strength of ankle in karate players was assessed using MMT method devised by Kendall.

Dorsiflexors:
The subjects were made to sit with knees flexed to 90 degrees and lower leg over the edge of supporting surface and were asked to resist the dorsiflexion motion against therapist's hand, which was kept over the dorsal surface of the foot. The strength was then graded according to MMT grades.

Plantarflexors:
The subjects were made to lie in prone on a mat with knees flexed at 90 degrees and were asked to resist the plantar-flexion motion against therapist's hand which was kept over the plantar aspect of foot. The strength was then graded according to MMT grades.

Invertors:
The subjects were made to lie supine on a mat with knees extended and were asked to resist inversion motion at the ankle against therapist's hand which was kept over the medial side, dorsal surface of the foot. The strength was then graded according to MMT grades.

Evertors:
The subjects were made to lie supine on a mat with knees extended and were asked to resist eversion motion at the ankle against therapist's hand which was kept over the lateral side, dorsal surface of the foot. The strength was then graded according to MMT grades.

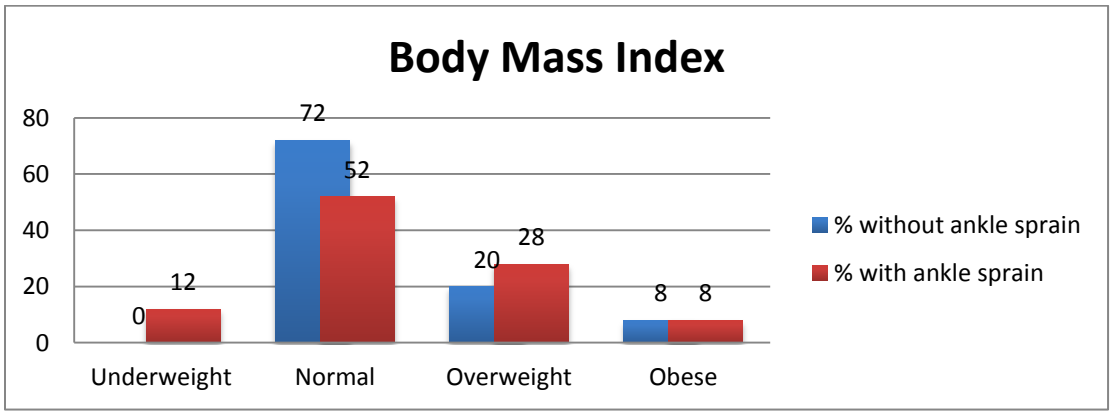
Ankle Joint Position Sense (JPS):
For lower extremity, JPS testing was done at the metatarsophalangeal joint of great toe, with patients eyes closed. Subjects were made to lie supine on a mat and the subject's relaxed digit was held from side, parallel to plane of movement. The part was then passively moved up or down, and the patient was instructed to indicate the direction of movement from last position. Healthy young individuals can detect great toe movements of about 1mm, or 2 to 3 degrees. This was performed on both limbs for comparison. [24]

Data analysis:-

Distribution of karate players according to Body Mass Index:

Table 1:-

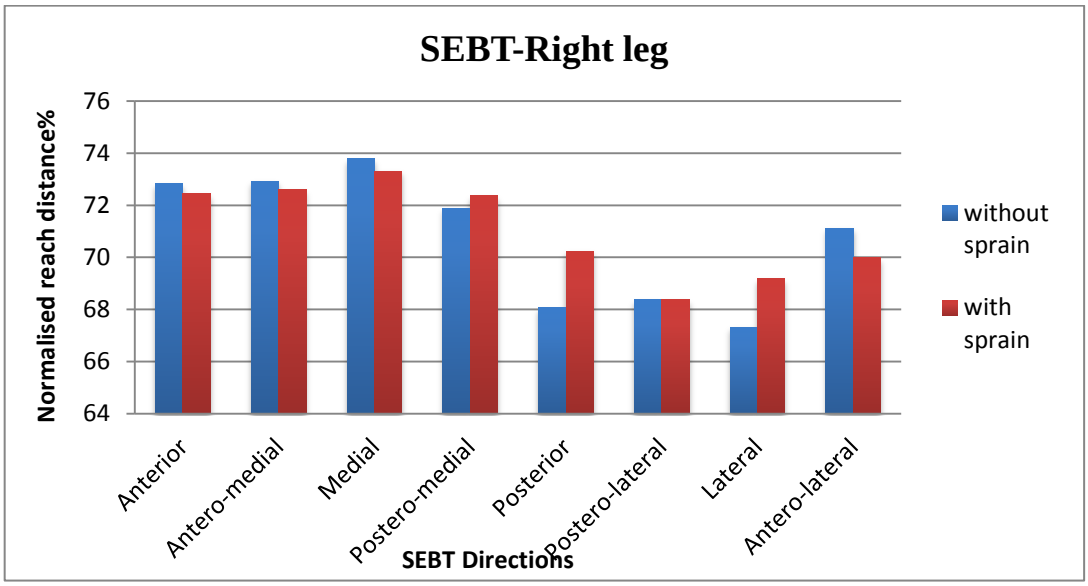
	% without ankle sprain	% with ankle sprain
Underweight	-	12
Normal	72	52
Overweight	20	28
Obese	8	8
Total	100	100



Graph 1:-Distribution according to Body Mass Index (BMI)

Inference:
As per the graph, in players without ankle sprain (group 1): 72% were of normal BMI, 20 % were overweight and 8% were obese. In players with ankle sprain (group 2): 12% were underweight, 52% were of normal BMI, 28% were overweight and 8% were obese. The BMI showed no significant difference in the two groups. (p>0.05)

Distribution of karate players according to SEBT:

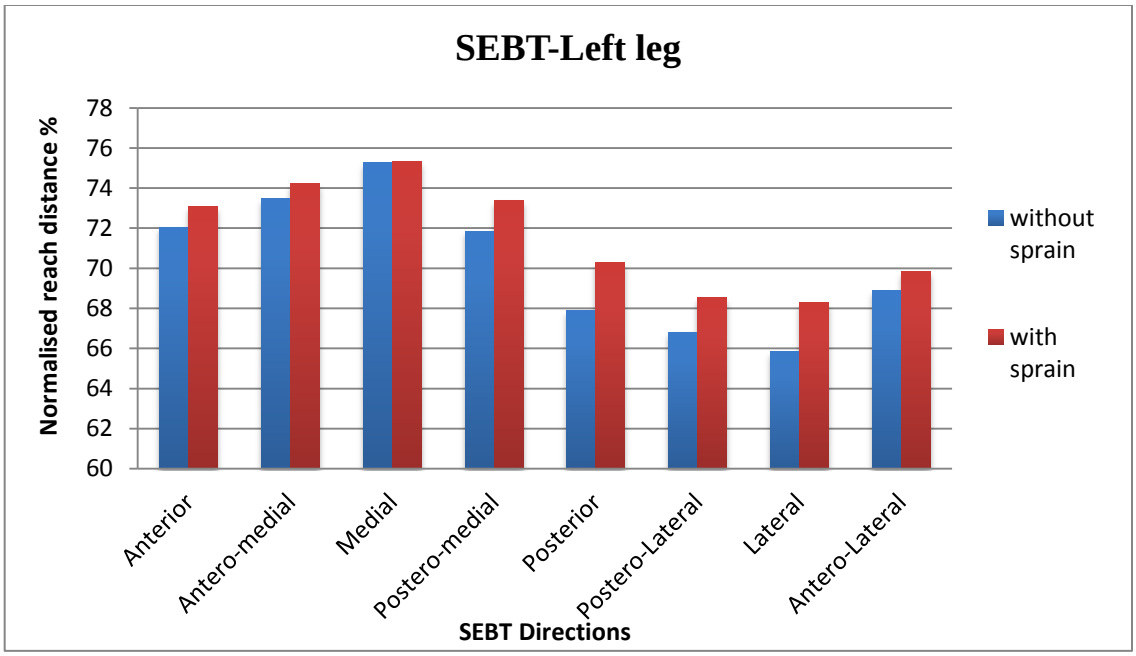


Graph 2:-SEBT for right leg

Table 2:-

SEBT For Right leg	Players without ankle sprain			Players with ankle sprain			P value
	Normalised reach distance %	SD	Std error	Normalised reach distance %	SD	Std error	
Anterior	72.82	11.26	2.25	72.46	9.28	1.85	.88
Antero-medial	72.92	10.81	2.16	72.61	9.66	1.93	.89
Medial	73.80	9.56	1.91	73.31	8.83	1.76	.83
Postero-medial	71.89	8.65	1.73	72.37	9.61	1.92	.83
Posterior	68.07	9.16	1.83	70.23	11.95	2.39	.46
Postero-lateral	68.37	8.11	1.62	68.37	8.11	2.47	.32
Lateral	67.32	10.14	2.02	69.18	11.80	2.36	.50
Antero-lateral	71.12	12.18	2.43	69.99	12.31	2.46	.71

Inference:
The percentage normalized reach distance values of karate players without and with ankle sprain were compared for SEBT of right leg. Since the data passed the normality test, paired t test (parametric) was used. Normalized reach distance percentages for right leg SEBT showed no significant difference in players with and without ankle sprains.



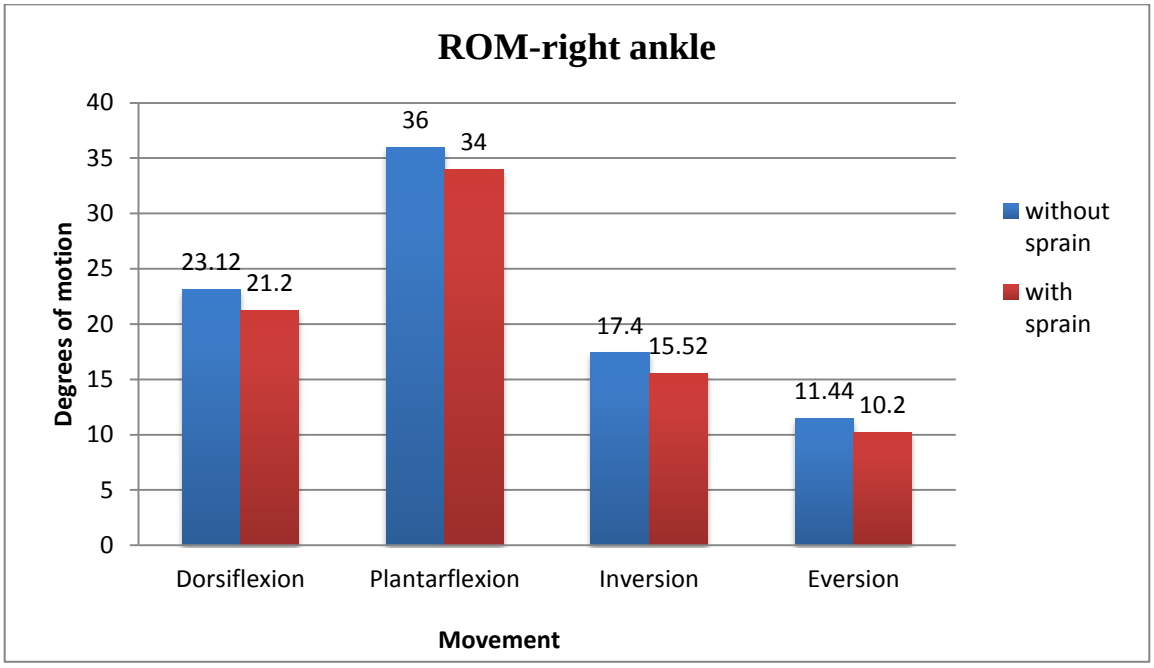
Graph 3:-SEBT for left leg

Table 3:-

SEBT for left leg	Players without ankle sprain			Players with ankle sprain			P value
	Normalised reach distance %	SD	Std error	Normalised reach distance %	SD	Std error	
Anterior	72.05	10.16	2.03	73.09	10.78	2.15	.68
Antero-medial	73.46	10.79	2.15	74.23	10.95	2.19	.76
Medial	75.26	10.47	2.09	75.32	11.18	2.23	.97
Postero-medial	71.86	8.49	1.69	73.37	12.41	2.48	.50
Posterior	67.90	8.77	1.75	70.29	12.78	2.55	.39
Postero-lateral	66.82	10.69	2.13	68.54	13.50	2.70	.60
Lateral	65.86	10.24	2.04	68.29	15.13	3.02	.45
Antero-lateral	68.89	11.63	2.37	69.86	12.37	2.52	.73

Inference:
The normalized reach distance values in percentage of karate players without and with ankle sprain were compared for SEBT of left leg. Since the data passed the normality test, paired t test (parametric) was used. Normalized reach distance percentages for left leg SEBT showed no significant difference in players with and without ankle sprains.

Distribution of karate players according to ROM:

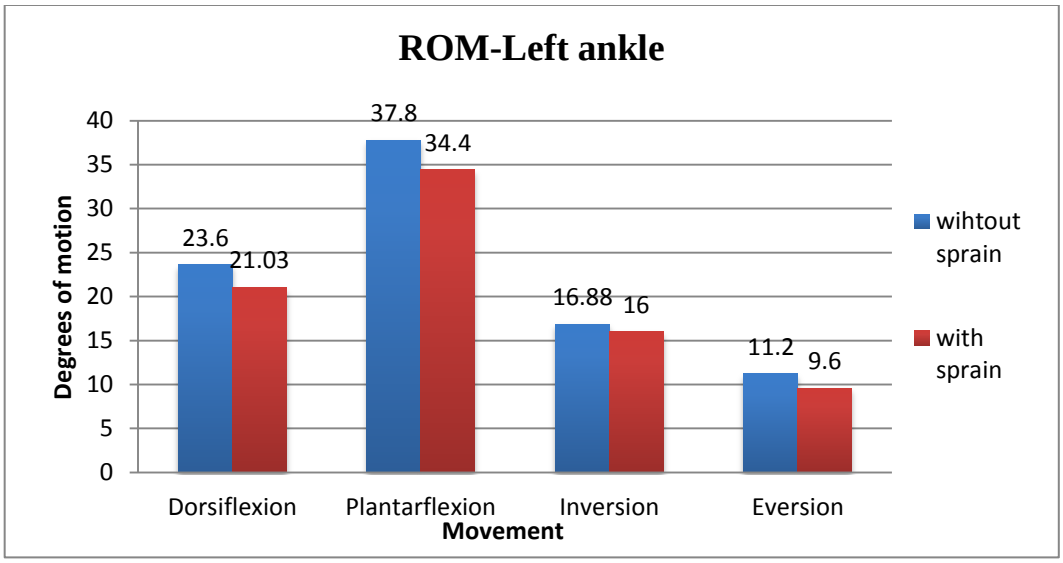


Graph 4:-Range of Motion for Right ankle

Table 4:-

Right ankle					
	Without sprain		With sprain		P value
	Mean	SD	Mean	SD	
Dorsiflexion	23.12	4.61	21.2	4.39	.14
Plantarflexion	36	7.35	34	8.29	.27
Inversion	17.4	6.47	15.52	5.95	.49
Eversion	11.44	4.21	10.2	3.94	.19

Inference:
The mean values of karate players without and with ankle sprain were compared for Range of motion. Since the data passed the normality test, paired t test (parametric) was used. The mean values for right ankle ROM showed no significant difference in players with and without ankle sprains.



Graph 5:-Range of Motion for Left ankle

Left ankle					
	Without sprain		With sprain		P value
	Mean	SD	Mean	SD	
Dorsiflexion	23.6	4.93	21.03	3.81	.04
Plantarflexion	37.8	7.91	34.4	7.26	.14
Inversion	16.88	5.81	16	5.23	.49
Eversion	11.2	3.61	9.6	3.79	.07

Table 5:-

Inference:
The mean values of karate players without and with ankle sprain were compared for Range of motion. Since the data passed the normality test, paired t test (parametric) was used. The mean values for left ankle ROM showed no significant difference in players with and without ankle sprains except for dorsiflexion ROM where the $p<0.05$.
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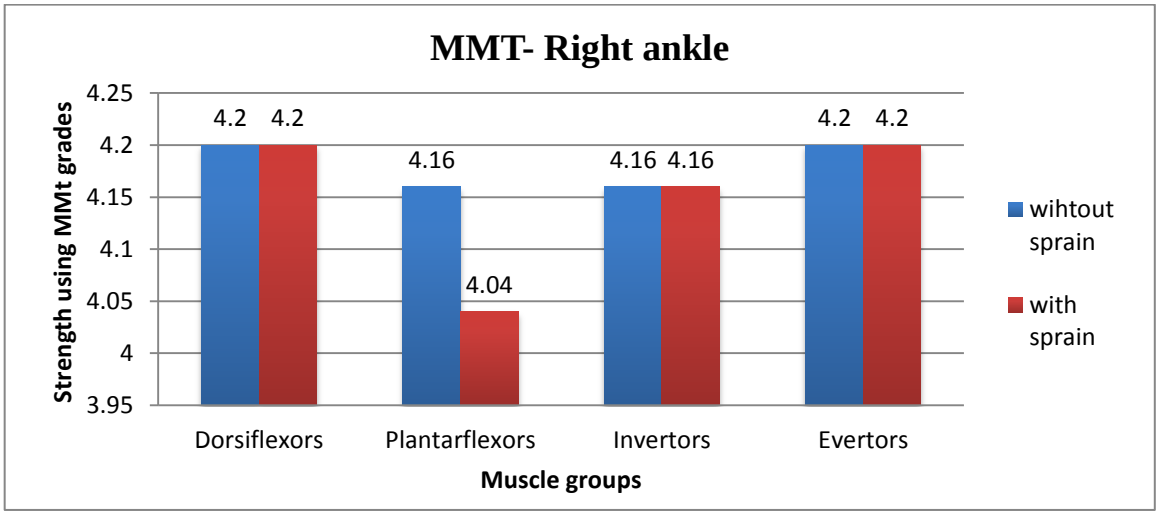
Distribution of karate players according to Manual Muscle Testing:

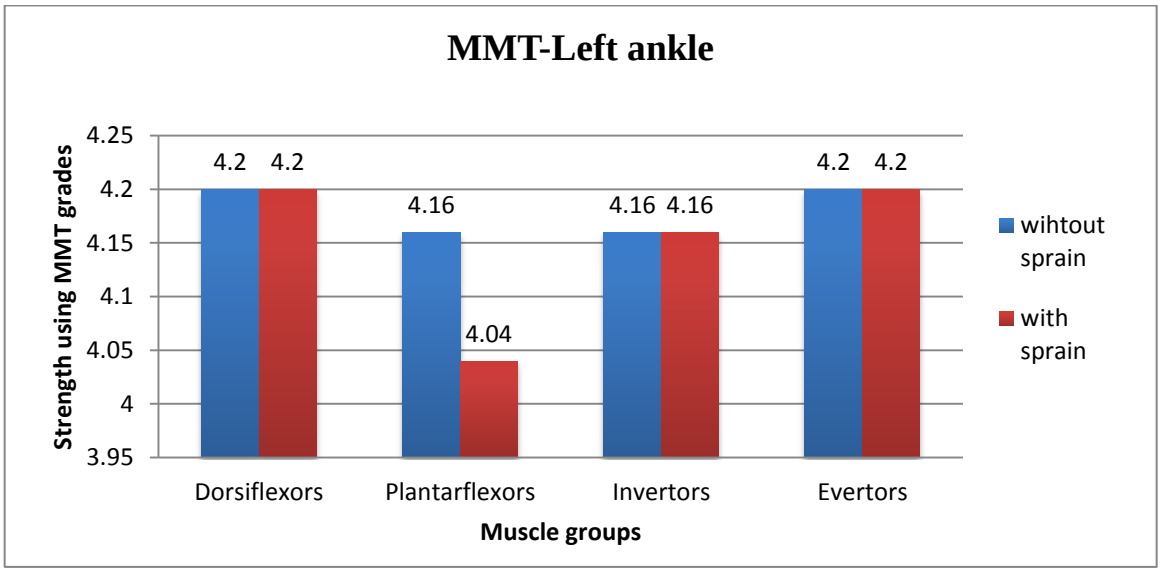


Graph 6:-MMT for Right ankle

Table 6:-

Manual Muscle testing for Right ankle					
	Without ankle sprain		With ankle Sprain		P value
	Mean	SD	Mean	SD	
Dorsiflexors	4.2	0.40	4.2	0.5	1
Plantarflexors	4.16	0.37	4.04	0.61	.41
Invertors	4.16	0.37	4.16	0.47	1
Evertors	4.2	0.40	4.2	0.40	1

Inference: The mean values of karate players without and with ankle sprain were compared for Manual Muscle Testing (MMT). Since the data passed the normality test, paired t test (parametric) was used. The mean values for right ankle MMT showed no significant difference in players with and without ankle sprain



Graph 7:-MMT for Left ankle

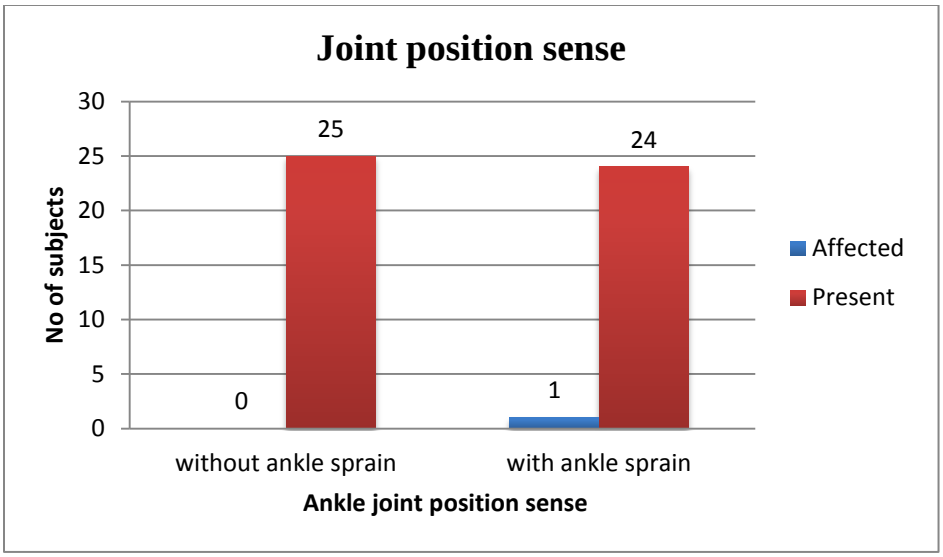
Table 7:-

Manual Muscle Testing for Left ankle					
	Without ankle sprain		With ankle Sprain		P value
	Mean	SD	Mean	SD	
Dorsiflexors	4.2	0.40	4.2	0.5	1
Plantarflexors	4.16	0.37	4.04	0.61	.41
Invertors	4.16	0.37	4.16	0.47	1
Evertors	4.2	0.40	4.2	0.40	1

Inference:
The mean values of karate players without and with ankle sprain were compared for Manual Muscle Testing. Since the data passed the normality test, paired t test (parametric) was used. The mean values for left ankle MMT showed no significant difference in players with and without ankle sprains.

Distribution of karate players according to JPS:
Table 8:-

JPS	without ankle sprain	with ankle sprain	p value
Affected	0	1	0.32
Present	25	24	



Graph 8:-Ankle Joint Position Sense

Inference:
The mean values of karate players without and with ankle sprain were compared for Joint position sense. Since the data passed the normality test, paired t test (parametric) was used. The mean values for joint position sense showed no significant difference in players with and without ankle sprains.

Discussion:-

A comparison of intrinsic risk factors for ankle sprains was conducted in karate players with and without ankle sprains. The players were divided into two groups: an uninjured group who did not have ankle sprain to either leg (group 1) and group with subjects who sustained an ankle sprain in past (group 2) belonging to age group of 18 to 45 years of age. The subjects were taken from various karate institutes in Mumbai, India. All the statistical analysis was done using SPSS version 22.0 for windows. Paired T test was done. A p value of <0.05 was considered statistically significant.

The first objective of our study was to compare BMI between group 1 and group 2. Out of total samples, only 8% players were obese in both groups. There were 20% overweight subjects in group 1 and 28% in group 2. The p value for the difference of both groups for BMI was 0.97, which was considered statistically insignificant.

BMI has been considered as an injury risk factor because an increase in height or weight of an individual can produce a proportional increase in the forces that articular, ligamentous and muscular structures must resist [8]. Timothy F. Tyler et al [9] found that an overweight players who previously had an ankle sprain was 19 times more likely to sustain a non contact ankle sprain than a normal weight player with no previous history of ankle sprain. Our results showed that there was no significant difference in BMI between the two groups. A number of studies found out that there is no association between body size and injury. Baumhauer et al [11] suggested there was no effect of height or weight on incidence on ankle injury among athletes participating in soccer, hockey. A study conducted by Twellaar et al [12] suggested that there were no significant differences in terms of height, weight, or BMI between those who sustained injury and those who did not.

Many of the studies discussed above have used different techniques to represent body size and body composition like skin fold calipers, DEXA respectively making it difficult to compare the findings and conclude the association between body size and injury. Also, BMI can falsely categorize subjects with greater lean body mass as being overweight or obese. One of the drawbacks is that our results include very minimal subjects in overweight and obese categories, making it difficult to compare both the groups. Therefore additional researches that use a common outcome measure to represent body size are needed.

The second objective was to compare balance using star excursion balance test between group 1 and group 2. Subjects in both groups were made to perform SEBT on both legs. Group 1 showed no significant difference in SEBT in all 8 directions when compared to group 2 for both, right and left leg ($p>0.05$).

Balance is a complex motor control task involving detection and integration of sensory information to assess the position and motion of the body in space and execution of appropriate musculoskeletal responses to control body position within the context of environment and task. Balance requires interaction between nervous system and musculoskeletal system. The nervous system provides sensory processing, sensorimotor integration and motor strategies for planning and executing balance. The musculoskeletal system includes postural alignment, ROM, joint integrity, muscle performance and sensation. Perception of one's body position and movement in space requires a combination of information from peripheral receptors in multiple sensory systems, which include visual, somatosensory and vestibular system. When sensory inputs from one system are inaccurate because of environmental factors or injuries that decrease the information-processing rate, the CNS must suppress the inaccurate input and select and combine the appropriate sensory input from other two systems. Most individuals can compensate well if one of the three systems is impaired. [22]

In our results we didn't find any statistical difference between the two groups. It could be possible that in previously injured karate players, if one of the systems maintaining balance were affected, the other systems would have compensated and not affected the player's overall balance.

A study conducted by Olmsted et al [14] suggested that SEBT has shown sensitivity in screening functional deficits related to musculoskeletal injuries such as chronic ankle instability (CAI). This study also suggested that players with CAI had significantly decreased reach distances compared to uninvolved limb and to reach distances of healthy controls. Our subjects had a history of ankle sprains, not of chronic ankle instability. Therefore our results could differ from the study conducted by Olmsted et al.

McGuine et al [15] used NeuroCom Balance Master to study the relation between balance and ankle injury in basketball players. The study suggested that players with increased postural sway showed seven times increase in ankle sprains compared with those with normal balance. The differences in results could be because of differences in assessment methods. SEBT measures distance whereas NeuroCom Balance Master measures postural sway and the athletes are supposed to balance only for 10 seconds, which may be very less to detect subtle changes [7].

Two studies reported no association between postural stability and injury [7].

Our results were in agreement with Beynnon et al [17] where they evaluated postural stability in collegiate athletes participating in soccer, field hockey, and lacrosse using the NeuroCom Balance Master, and found no difference in balance between those who sustained ankle injury and those who did not.

Hopper et al [16] assessed static balance by measuring the time in seconds that female netball athletes could maintain unilateral balance, both with eyes open and eyes closed. There was no association between the amount of time an athlete could maintain unilateral balance and ankle injury.

The third objective of the study was to compare Range of motion in group 1 and group 2. Active as well as passive range of motion at the ankle was checked using a goniometer.

Our results show that difference between dorsiflexion ROM in two groups in left ankle was found significant ($p<0.05$), there was no significant difference present between the two groups for other range of motions. A study conducted by Tine Willems et al [7] suggested that decreased dorsiflexion range of motion at the ankle could be considered a risk factor for ankle sprains in karate players. Reduced dorsiflexion range could be because of shortened gastrocnemius muscle, which may put the foot in a position of greater plantar flexion, thus increasing risk of ankle sprains. A study conducted by Twellaar et al [12] found no significant difference between the ROM and ankle injuries in soccer players. Also, in a study conducted by Barrett et al [18] suggested that there was no association between plantar and dorsiflexion ROM and ankle injury in basketball players. Since the subjects were from different sport background and different statistical methods were used, getting a direct comparison between studies was difficult.

The fourth objective of the study was to compare strength using Manual Muscle Testing in group 1 and group 2. Our results show that there was so significant difference in strength at ankle when the two groups were compared ($p>0.05$). According to MMT assessment method devised by Kendall, Grade 5 is considered normal where the subject can perform full ROM against gravity when maximum resistance is applied [19].
Our results were not in agreement with Baumhauter et al [11] .In a study of risk factors for ankle sprains in collegiate athletes, they found ankle strength imbalances in athletes who sustained injury compared with those who did not. In a study conducted by Tine Willems et al [7] a biodex system 3-isokinetic dynamometer was used to assess the strength. It was used to determine isokinetic peak torque. It suggested that a decrease in dorsiflexion muscle strength is a risk factor for ankle sprains, as the subjects cannot accurately perform dorsiflexion at their ankle when an inversion action occurs, was not in accordance to our results. In MMT, the grading of muscle strength is more subjective and can vary from person to person but in the dynamometer, no such errors can occur and subtle changes can be measured.

Fifth objective was to compare Joint position sense at ankle in group 1 and group 2. Players without ankle sprain showed no significant difference in Joint position sense when compared to players with ankle sprains ($p>0.05$). Our results were in support to study conducted by Tine Willems et al [7], which suggested that there is no relationship between joint position sense and risk of ankle sprains.

On the contrary, a study made by J Boyle et al [21] demonstrated a measurable deficit in passive joint position sense in individuals with recurrently sprained ankles. This study made use of pedal goniometer where definite measure of joint position sense was possible and also study subjects had recurrent ankle sprains. The probable reasons for difference in results could be differences in assessment method of JPS, and the difference in the baseline status of the study subjects.

Conclusion:-

Based on the results of our study, the following conclusions can be drawn:

1. The intrinsic risk factors for ankle sprain considered for this study like impaired balance, reduced ankle strength, reduced range of motion and affected joint position sense were not significantly different in karate players with and without ankle sprain
2. Dorsiflexion range of motion in left ankle was significantly different among the karate players with and without ankle sprain

Limitations:-

1. Small subject size included in the study challenges the generalizability of the outcome of this study. Thus larger subject size is needed to fully verify results.
2. The subjects who participated were recruited from a specific geographical location; hence results may not be applicable to whole of India.
3. Non-uniform distribution of karate players with respect to their experience as majority subjects were experts.
4. Uneven distribution of BMI as majority subjects belonged to normal body mass index.

Clinical Implications

1. Ankle sprain is one of the common injuries in karate players.
2. Ankle sprains affect the agility of the players. If the players don't take proper precautions they are prone to recurrent sprains, which can further deteriorate their pace and balance and affect their overall career in karate.
3. Therefore it is essential to study the risk factors leading to ankle sprain, so that preventive measures can be implemented.
   The factors commonly considered in literature as risk factors are overweight or obese players, reduced ankle strength, reduced range of motion at ankle, affection of balance and joint position sense. However, the difference between these parameters was found to be statistically non significant in karate players with and without a history of ankle sprains.
4. Therefore further research is required to identify the risk factors for ankle sprain specific to karate players. This may help in specifically targeting the identified impairments, in order to prevent injury.

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