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Epidemiology of musculoskeletal injuries in Indian classical dancers: A systematic review

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Abstract
Background: Movement could be a basic component of dance, and a dancer's body is the material through which the art of dance is expressed; for this it demands the utmost discipline within the pursuit of technical and artistic excellence. To meet the professional demands dancers are subjected to strenuous training routine which can lead to development of injuries in this environment.
Aim: To review the epidemiology of musculoskeletal injuries in Indian classical dancers.
Objective: Objective of the study was to explore what the research suggests on the concept of prevalence of musculoskeletal injuries in Indian classical dancers.
Eligibility criteria: Relevant studies from the period of 2010 to 2021 via PubMed, Cochrane and Google scholar. Studies were reviewed as eligible for inclusion in the systematic review if they met the subsequent criteria; full text articles which were published in last 10 years, systematic reviews, cross sectional studies, observational studies, randomized control trials, population included both the genders with age group 18-40 years. In total 50 articles were selected in which 23 were eligible as per inclusion criteria for the systematic review. Most of the injuries occurred in lower limb. Most prevalent site for injury was back (42.5%) followed by knee (28.30%) and ankle (18.64%) in Bharatanatyam dancers whereas in Kathak dancers it was 47% back injuries 16% knee injuries and 20% ankle injuries. Among all the injuries occurring in dancers 60; 80% injuries are of low back pain, 17% - 30% injuries are of spine, upper back injuries are 38%. Complaints related to hips was 54%, complaints for the thighs and knees were 48% whereas complaints for ankle and feet were 45%.
Conclusion: After analyzing the studies it was evident that Lower extremity is the most commonly involved segment in all the dance forms. Incidence of injuries is greater in back followed by knee and ankle in all the Indian classical dance forms. However, there was a difficulty in identifying the etiology of this injuries as for as the modality Bharatanatyam was the most prevalent.

Keywords: musculoskeletal injuries, Indian classical dancers, Kathak, Bharatanatyam, foot posture

Introduction
Dance is outlined as a performing art comprising of purposefully elite sequences of human movement [10]. It is a type of expressions and social interactions [2]. It involves flexibility and body movement [2]. Globally there are a unit completely different sorts of dances like the line dance, salsa, ballet, break dance, bboying, Kathak, ballet dance, Yanko dance, tap dance, hip hop dance.
Indian classical dances are dances of mind and souls and are extremely traditional in nature. Indian classical dances have glorious ancient history which is aimed at betterment of health of dancers. In Indian tradition most popular dances which are evolved in India are Kathak, Bharatanatyam, Kuchipudi, Manipuri, Kathakali, Odissi, mohiniattam [3]. They involve amalgamation of body movements, gestures, facial expressions to portray certain emotions and feelings.
Katthak dance demands repetitive placing of ankle in an instable position [1]. Risk for musculoskeletal injuries is due to the demand placed on dancer's lower extremity. Rare foot and forefoot deformities, excessive ankle and great toe range of motion, pes cavus and pes planus all contribute to the injuries at the foot and ankle in kathak dancers. When dancer is turning and landing from a jump these dysfunctions come into play.
Bhratnatyam dance form strengthens hamstring muscles including semitendinosus, semimembranosus and biceps femoris.

In Bharatanatyam dancers knee joint is the most common site for injuries. The sheer quantity of force passing through the lower extremities might contribute to the injuries [20]. Continuous practice for hours leads to the lower extremity injuries due to high intensity of foot tapping along with vigorous upper extremity movements [11].

Kuchipudi dance form demands proper body balance. Grace and fluid movements of this dance form make it unique and breath-taking. Strong effect of some muscles including rectus abdominis, abdominal external oblique, latissimus dorsi, gluteus maximus are showed by dancers in a survey [11].

Manipuri dance form known by its movements of body, feet and facial expressions. In this dance form dancer never strikes ground hard during dancing. This benefits them not to be injured during long practices. Dancers build rounded movements avoiding any jerks, form edges or line. It offers them undulating and soft look, correct body management and peace of mind [11].

Kathakali dance kind needs much strength and it is typically performed by male. It is characterized by jumps, leaps and sweaps. Dancers shift their weight from one foot to another with leg extension. They also perform elaborate facial expressions at the same time. In this dance form more emphasis is given on muscles [11].

In Odissi dance human body is divided into equal halves carrying equal distribution of weight. Various types sitting, leaping and elevations are included in it. Long time of practice provides good body shape with thin waist and tender loo to female [11].

Mohiniattam dance form is characterized by swaying of broad hips and also the light movements of erect body from side to side is the main feature of this dance kind. Mohiniattam dancers have sensible strength and management over different muscles like adductor muscles, quadriceps femoris, soleus, tibialis posterior, peroneus longus and so on [11].

World health organization outlined dance injuries as "a physical condition that causes pain and discomfort leading to limitation, restriction or halt in participation in dance." Inherent biomechanical factors, environmental and coaching problem in addition as techniques competency square measure inflicting factors for dance related injuries. Foot, ankle, lower leg (calves), low back are most common locations for injuries. They are typically caused by overuse, muscle strains and sprains in Indian classical dancers [2].

Need of study

Indian classical dance forms are the popular dance forms across the globe. The revival movement of Indian classical dances are developed from an ancient dance form and has great historical importance [9].

In recent years more focus has been given to dance related injuries which can be attributed to the type of movement, incidence of participation and intensity of dance.

Studies focused on several Indian classical dancers have reported increase in prevalence of musculoskeletal injuries Which has impact on their performance.

Hence it is imperative to study about the epidemiology of musculoskeletal injuries in Indian classical dancers.

Aim

To review the epidemiology of musculoskeletal injuries in Indian classical dancers.

Objectives

To explore what the research suggests on the concept of prevalence of musculoskeletal injuries in Indian classical dancers.

Methodology

Literature review

Articles are gathered from the sources of information

1. PubMed
2. Medline
3. Google scholar
4. British journal of sports medicine

And studies are addressing the epidemiology of musculoskeletal injuries in Kathak dancers.

Study design

Systematic review.

Type of study

Descriptive

Data extraction

Articles searched from eligible search engine.

Inclusion criteria

- Full text articles
- Articles which are referred from last 10 years
- Cross sectional study and observational study.
- Systematic review
- Indian classical dancer of age group between 18-40 years.
- Population includes population of all genders.

Exclusion criteria

- Duplicate articles
- Articles with mixed dance forms
- Case reports
- Articles with only abstract
- Statistics which did not present specific % of injuries

Table 1: Studies of Prevalence and Associated Factors of Musculoskeletal Injuries

Sr. No.	Name of the author	Title	Name of the journal	Year of publication	Sample size	Age/ gender	Outcome measure	Conclusion
1	Shweta Chandan [1] Savita Tamaria [2] Davinder Gaur [2] Charu Chadha	Cross-Sectional Study of Foot Posture Index, Navicular Drop and Arch Index in Kathak Dancers	International journal of research and review	2018	100	18-25 years/ both male and female	Foot posture index, navicular drop and arch index.	Kathak dancers have deviation in the foot posture i.e. pronated foot posture which may indicate towards predisposition of foot, knee and back related problems.
2	Dr. Shefali Milind Naik. Dr. praveen ranade.	Proportion of low back pain in kathak dancers in pune – A cross-sectional	Indian journal of applied research	2019	88	15-30 years/ both male and female	1) Stationary 2) Nordic questionnaire sheet	A 59% occurrence of low back pain in Kathak dancers among the Pune population. Out of the Kathak dancers suffering from low back

		observational study					3) Modified Oswestry Questionnaire sheet	pain, 94.31% of dancers have minimal disability while 5.68% of dancers have moderate disability
3	Shruti Prabhakaran Nair, Shruti Kotian Claire Hiller, and Rajani Mullerpatan	Survey of Musculoskeletal Disorders Among Indian Dancers in Mumbai and Mangalore	Journal of Dance Medicine	2018	215	any age group/ both male and female	pain sensitivity questionnaire	Despite differences in dance styles, a similar pattern of musculoskeletal pain and injury was demonstrated between young traditional and Western dancers in India.
4	Dr. Nilesh Andhare [1], Dr. Ujwal Yeole [2], Ms. Madhuri Tannu [3]	Effect of Intrinsic Muscle Training on Balance in Bharatanatyam Dancers: Randomized Control Trial	International Journal of Science and Healthcare Research	2018	60	10-18 years/ both male and females	Berg balance scale, Foot posture index	Intrinsic muscle training for foot musculature improves balance in Bharatnatyam dancers.
5	Craig L. Jacobs, D.C., M.Sc., F.C.C.S.(C.), Cesar A. Hincapié, D.C., M.H.Sc., and J. David Cassidy, Ph.D., Dr. Med. Sci	Musculoskeletal Injuries and Pain in Dancers A Systematic Review Update	Journal of Dance Medicine	2016	875	17-27 years/ both male and female	4 clinical examinations at 2, 10, 21 and 42 days post-injury. Hip flexibility with flexometer; pain with Borg CR-10 scale; knee flexion strength with dynamometer. Perform at pre-injury level.	A large prospective international study of dance injuries could shed light on the issue of long term effects of injury on dancers' careers and quality of life, identify risk factors for injury, and explore the effect of national or cultural variables such as access to health insurance or healthcare. The issue of fatigue and its relationship to injury in dancers needs further exploration.
6	Padmaja Guruprasad [1], Mrudula Sangaokar [2], Tushar Palekar	Prevalence of Myofascial Trigger Points of Gastrocnemius in Dancers	International Journal of Scientific Research in Science and Technology	2019	100	18-40 years/ both male and female	Trigger point present in no. of dancers, pain on VAS.	52% of dancers have presence of trigger point. Amongst which Bharatanatyam dancers showed increase prevalence of trigger point in gastrocnemius.
7	Roopika Sabharwal, Sonia Singh	Prevalence of ankle instabilities and disabilities among female Kathak dancers	The Journal of Indian Association of Physiotherapists	2017	40	18-35 years/ females	Foot and ankle instability index (FADI), cumberlands ankle instability tool (CAIT)	Kathak dancers become prone to develop functional disability and instabilities at ankle joint.
8	N. Roussel, M. De Kooning, A. Schutt, S. Mottram, S. Truijen, J. Nijs, L. Daenen	Motor Control and Low Back Pain in Dancers	Internation-al Journal of Sports Medicine	2013	40	17-26 years/ both male and female	Short Form 36-questionnaire (SF-36), the Tampa Scale for Kinesiophobia (TSK) and a self-established medical questionnaire. The visual analogue scale (VAS – 100 mm)	Strength, extensibility, endurance and motor control are required to perform dance choreographies. The repetition of movements to extreme positions can contribute to pain. Dancers with a history of LBP do not demonstrate increased muscle extensibility or joint hypermobility, but show altered motor control of the lumbopelvic region, when compared to dancers without a history of LBP. Sacroiliac joint pain appears to be unrelated to the LBP in dancers
9	Jeffrey A. Russell	Acute Ankle Sprain in Dancers	Journal of Dance Medicine	2010			Range of motion, manual muscle testing, joint stability, neurologic examination, accessory motions, and functional performance	This article reviewed acute injuries to the ankle and highlighted methods that are useful for evaluation, treatment, and rehabilitation of dancers who suffer such an injury. Ankle sprains are a common dance injury, and certain features of these injuries may become problematic. Early intervention offers the best opportunity for optimum management and successful, safe return to dance.
10	Benjamin R. Kivlan,	Comparison of range of motion,	International Journal of	2016	15	18-21 years/	Hip range of motion, hip	Dancers with FAI have less strength of the hip extensors and

	Christopher R. Carcia, John J. Christoforetti RobRoy L. Martin.	strength, and hop test performance of dancers with and without a clinical diagnosis of femoroacetabular impingement	Scientific Research in Science and Technology			females	muscles strength, hop test	perform worse during medial and lateral hop triple tests compared to healthy dancers. Clinicians may use this information to assist in screening of dancers with complaints of hip pain and to measure their progress for return to dance.
11	Dr. Shukra Dhaval Chivate [1], Manali Prasad Kulkarni [2]	Evaluation of Foot Posture, Pain and Ankle Proprioception in Classical and Western Dancers- A Cross Sectional Study	Journal of medical science and clinical research	2017	110	15-25 years/ both male and female	Foot posture index, objective oiny position sense test, visual analouge scale.	The study concludes that there is significant change in foot posture and pain in classical dancers and was more observed in classical dancers when compared with western dancers and there was no adequate loss of proprioception in ankle joint in classical as well as in western dancers.
12	Roopika Sabharwal [1], Sonia Singh [2]	Foot Postural Deviations In Female Kathak Dancers	International journal of physioth-erapy	2017	40	18-35 years/ females	Foot Posture Index. Rear foot angle, Forefoot angle, Navicular Drop and Medial Longitudinal Arch angle	The dancers are susceptible to develop many types of foot problems and injuries. Therefore, the study recommends that the dancers should be educated and trained about the foot problems associated with kathak dance and their prevention. A treatment approach should be formulated and tested specifically for the Kathak dancers according to their profession and lifestyle.
13	Rajani Mullerpatan, A,*Juhi Bharnuke, A & Claire Hiller	Gait Kinematics of Bharatanatyam Dancers with and without Low Back Pain	Physical and rehabilitation medicine	2019	34	20-23 years /both male and female		The long-term training in Bharatanatyam alters the kinematics of the spine, pelvis, and, particularly, the lower-extremity joints during gait performance. Bharatanatyam dancers demonstrated exaggerated spine extension, abduction, and external rotation of the hip together with increased pelvic tilt, obliquity, and rotation during gait performance.
14	Dr. S. R. Pholtan Rajeev	Medical and social aspect of classical dance - Bharatanatyam from Tamil culture of Sri Lanka	European Journal of Biomedical and Pharmaceuti cal sciences	2014	50	11-40 years/ both male and female	Democratic details of Samples, According to Dancers; Dance practicing periods, Diseases, Life Satisfaction.	Any types of negligence or improper body movements may cause the dancer to be injured or it can even become fatal to the dancer.
15	Shruti Jnanesh Shenoy	Ground Reaction Forces During Tatta Adavu of Bharatanatyam	International Society of Biomechanic in Sport Conference, Oxford, OH, United States,	2019	7	18 years and above/fem ale	Peak vertival ground reaction force.	This study revealed that during the foot tapping in Bharatanatyam about 4-5 times the body weight of ground reaction force is experienced by the dancer. These high impact forces could contribute to the injuries.
16	Roshni Prakash	Musculoskeletal effects and injury risk in collegiate Indian classical and ballet dancers	Department of Evolutionary Anthropol-ogy, Duke University	2016	16	18-22 years/ females	Peak vertical forces, knee angles, moment arm, torque, flexibility, training, weight and BMI.	The results demonstrate a significant difference in the acuteness of the knee angle in the full-sitting poses between the Bharatanatyam and ballet dancers.
17	Yaiza Taboada-Iglesias , Rocío Abalo-Núñez RA, Tania García-Remeseiro	Traditional Dances and their Characteristic Injury Profiles. Systematic Review	Faculty of Physical Therapy University of Vigo, Spain.	2020	2038	any age/both male and female	Clinical examinations, magnetic resonance, questionnaires	Traditional dancers present a high incidence of injuries, with differences between dance styles. indicated that in the different dance styles the distribution of pain among dancers was mainly in the back, followed by the ankles and knees, although the Bharatanatyam and traditional

								dance styles presented specificities. Moreover, they showed that they do not sustain injuries to the hips, thighs, hands or wrists.
18	Gowari Gopalakrishnan	Kinematics and kinetics assessment of lower limb movements in Bharatanatyam dancers	Original library work declaration	2019	6	23-30 years/both male and female.	Body mass, height, leg length, knee and ankle width, vertical ground reaction force	High percentage of angular increase/reduction especially in frontal plains which involves abd/add especially on ankle or knee. The finding suggests intense dancing activities and wearing dancing bells have the capacity to change the walking pattern of an individual.
19	Monica Sharma, MPT, [1] Shibili Nuhmani, ET AL.	Comparison of Lower Extremity Muscle Flexibility in Amateur and Trained Bharatanatyam Dancers and Non-dancers	Medical Problems of Performing Artists	2018	105	15-18 years/ females	Range of motion of hip, knee, ankle and injury questionnaire	Significant differences in lower limb muscle flexibility between trained and amateur Bharatanatyam dancers and non-dancers. These differences may be due to individual dance postures such as araimandi and muzhumandi.
20	Jyothi S [1],*, Sujaya B	Assessment of Lower Limb Flexibility in Female Bharatanatyam Dancers	International Journal of Clinical and Experimental Physiology	2020	65	18-23 years/ females	Range of motion of hip, knee and ankle	There was no significant difference between the dancers and non-dancers in terms of hip external rotation and knee flexion even though the two commonest poses in bharatanatyam aramandi and muzhumandi involve hip abduction and external rotation and flexion at knee joint.
21	Christopher T.V. Swain, MSc [1] Elizabeth J. Bradshaw	The Epidemiology of Low Back Pain and Injury in Dance: A Systematic Review	Journal of Orthopaedic & sports physical therapy	2019	8919	15-35/ females	Self-report, questionnaires, structured narrative interviews, clinic records, physical records, medical records, work accident reports	Low back pain and injury are common in dance and reflect levels reported in other athletic populations.
22	Vrushali P Panhale, Prachita P Walankar, Aishwarya Sridhar	Analysis of postural risk and pain assessment in Bharatanatyam dancers	Indian journal of occupational and environmental medicine	2020	40	18-30 years/ females	Demographic details, BMI, questionnaires, numerical pain rating scale, rapid entire body assessment tool (REBA)	The point prevalence of pain in female Bharatanatyam dancers is high. Natyarambham posture is considered high risk based on postural assessment.
23	Sonali Manek, Dr. Anjali Puntambekar	A comparative study of foot posture deviations in young female kathak and Bharatnatyam dancers.	International journal of scientific research	2020	132	15-25 years/females	Foot Posture Index – 6 Scale and the Groups Were Compared using Non Parametric ANOVA Test	The foot of Kathak and Bharatnatyam Dancers vary from that of Non Dancers. It has been found that there is no significant difference in the foot posture of Kathak and Bharatnatyam dancers. Suggesting more chances of pronated feet in years to come which could be due to dancing. In long term this could lead to dance related injuries of ankle and foot

Data analysis and Result

After the application of our inclusion criteria to 50 identified abstracts; total 45 studies were screened after removal of duplicate articles, 35 articles were judged to be relevant. Of these, 14 articles were excluded due to repeat publication, unavailable data and other languages. Ultimately 21 articles were accepted as scientifically admissible.

All the features of these studies are included in above table. The dance style with greatest body of research was Bharatanatyam followed by kathak. However, the other dances only obtain one or none result each.

Above graph states that in both genders most common site for pain in Bharatanatyam Dance form across different levels of training was the back (42.5%), followed by the knee (28.3%) and ankle (18.63%). The occurrence of pain was not influenced by the training as the prevalence of pain was similar among trained and recreational groups of female dancers. Dancers had 42.5% of back injuries followed by 28.3% of knee injuries and 18.63% of ankle injuries [11].

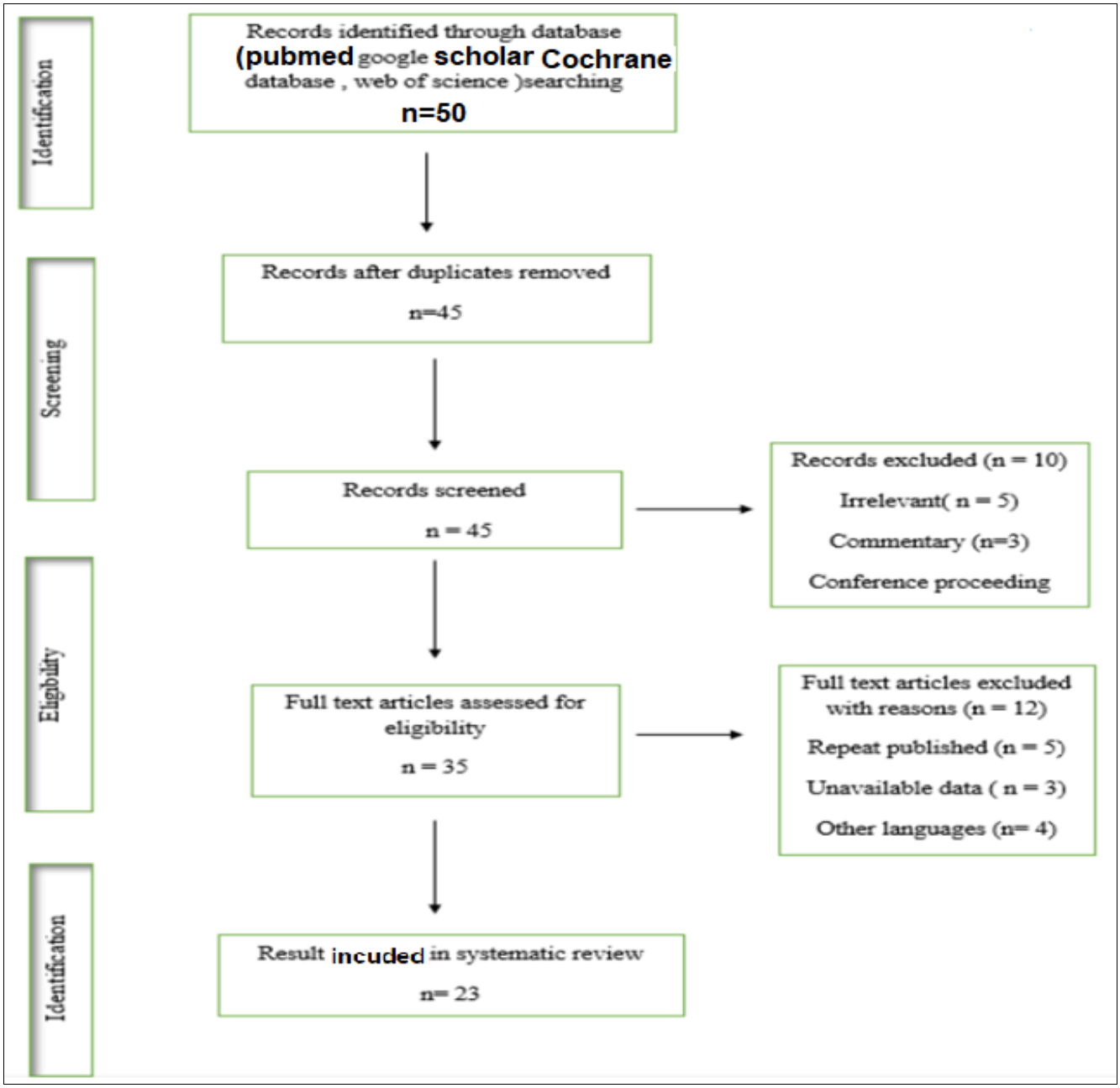

Fig 1: Procedures

In the two systematic reviews they have studied Musculoskeletal Injuries and Pain in Indian classical Dancers and analysed that sprains, strains, and tendinopathies, primarily affecting the lower extremities and back are most prevalent musculoskeletal injuries in dancers. joint injuries of lifetime prevalence were reported at 47% with 20% reported ankle injuries and 16% reported knee injuries which is most important lifetime injury in all females and males respectively 4.

From numerous studies performed on Bharatanatyam dance form. Total three studies have scrutinized that spine and lower extremities are more prone for high incidence of injuries which are constantly reported by the professional dancers.in all the dance injuries almost 60%-80% injuries are of low back pain and 17%-30% injuries are of spine in comparison with general population spinal pathologies such as spondylosis, spondylolisthesis are much more common in dancers. Many other complaints may also arise due to uncontrolled movement of pelvis and lumbar spine. According to one study 60% generalized joint hypermobility was demonstrated by dancers [23]. Incidence of low back pain experienced at least once during previous year was reported 58%. On the other side upper back pain was reported 38%. Complaints related to hips was 54%, complaints for the thighs and knees were 48% whereas complaints for ankle and feet were 45% [23].

Musculoskeletal effects and injury risk in collegiate Indian classical and ballet dancers was studied by Roshani Prakash (2014) analysed that most common type of injuries in Indian classical dancers are knee injuries such as chondromalacia patellae, torn menisci, and other patellar injuries. Because of the specific poses and features of Indian classical dance leads knee to experience torque from a large amount of twisting and rotation, which can cause tenderness and swelling. One of the causing agent for foot, ankle and back pain is bharatnattyam. There was a significant difference between the dance groups for three of the four flexibility measurements [14].

Jeffrey A. Russell (2010) investigated that ankle injuries rates as high as 31% becoming most common acute injury in all the form of the dance.as dance requires extremes of mobility and stability in the foot ankle complex; an ankle sprain is the most commonly reflecting injury in dancers. Another injury

occurring in ankle joint is ligamentous ankle injuries. Usually, ankle gets injured during jump landing in this process most commonly injured region is lateral side of ankle. 1.2%-3% incidence of anterolateral ankle impingement has been reported. The plater flexion inversion mechanism of lateral ankle sprain leads to dancer's fracture. Sprain of the dorsal calcaneocuboid ligament, cuboid subluxation, and tibiofibular syndesmosis injury are associated with the lateral ankle sprain [16].

From many studies performed on kathak dance; two main studies analysed that on the basis of foot posture index 3% of the population with supinated foot, 7% of the population is having normal foot, 25% of the population had pronated foot and 65% of the population is suffering through excessive pronated foot. Considering navicular foot drop as an outcome measure 3% of the population had supinated foot, 48% of the population had normal foot and 49% of the population had pronated foot. Population who had cavus foot, normal foot and planus foot are 5%, 17% and 78% respectively [1]. Whereas another study revealed that that Foot Posture index scores suggested that a large population of kathak dancers (approx. 92.5%) have pronated feet. Increased Rear foot angle was approximately 90%, Forefoot angle was approx. 75% and Navicular drop was seen approximately 97% are showed by most of the kathak dancers and decrease in Medial Longitudinal Arch angle approx. 95% [26].

Subsequently, two studies have scrutinized that 59% occurrence of low back pain in Kathak dancers among the Pune population. Out of the Kathak dancers suffering from low back pain, 94.31% of dancers have minimal disability while 5.68% of dancers have moderate disability. Along with this 47% dancers experienced mild pain whereas 5% of dancers experienced moderate pain. Also, there is significant change in foot posture of classical dancers and pain was more observed in classical dancers than western dancers and there was no adequate loss of proprioception in ankle joint. 70% of dancers suffered from flat arched foot while 20% of dancers had high arched foot with high foot deviations [3].

Prevalence of Myofascial Trigger Points of Gastrocnemius was studied by Padmaja Guruprasad, Mrudula Sangaokar, Tushar Palekar (2019) [2] who surveyed that 52% have trigger point in gastrocnemius and 48% did not have trigger point in gastrocnemius.in comparison with Bharatanatyam dance form kathak has less prevalence of trigger point in gastrocnemius [2].

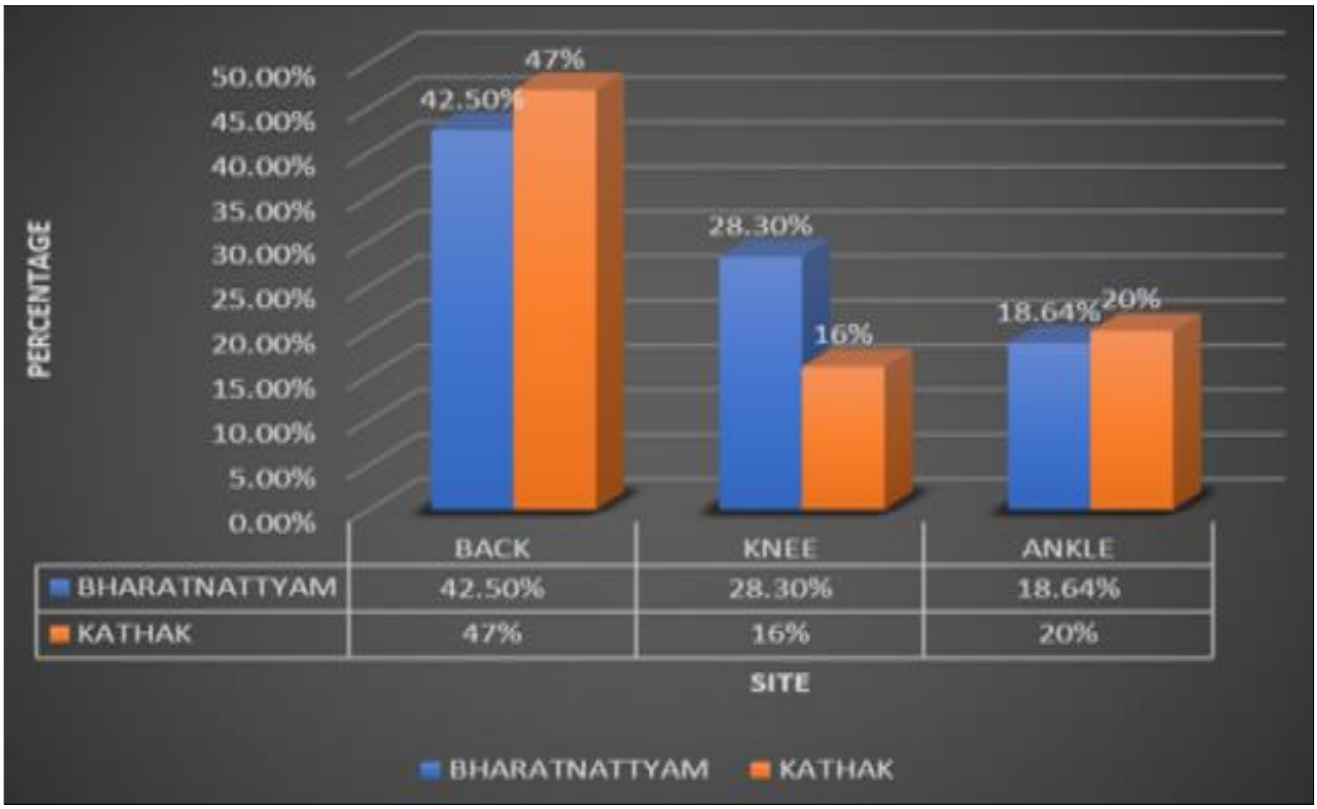

Fig 2: Regional comparative study between Kathak and Bharatnattyam

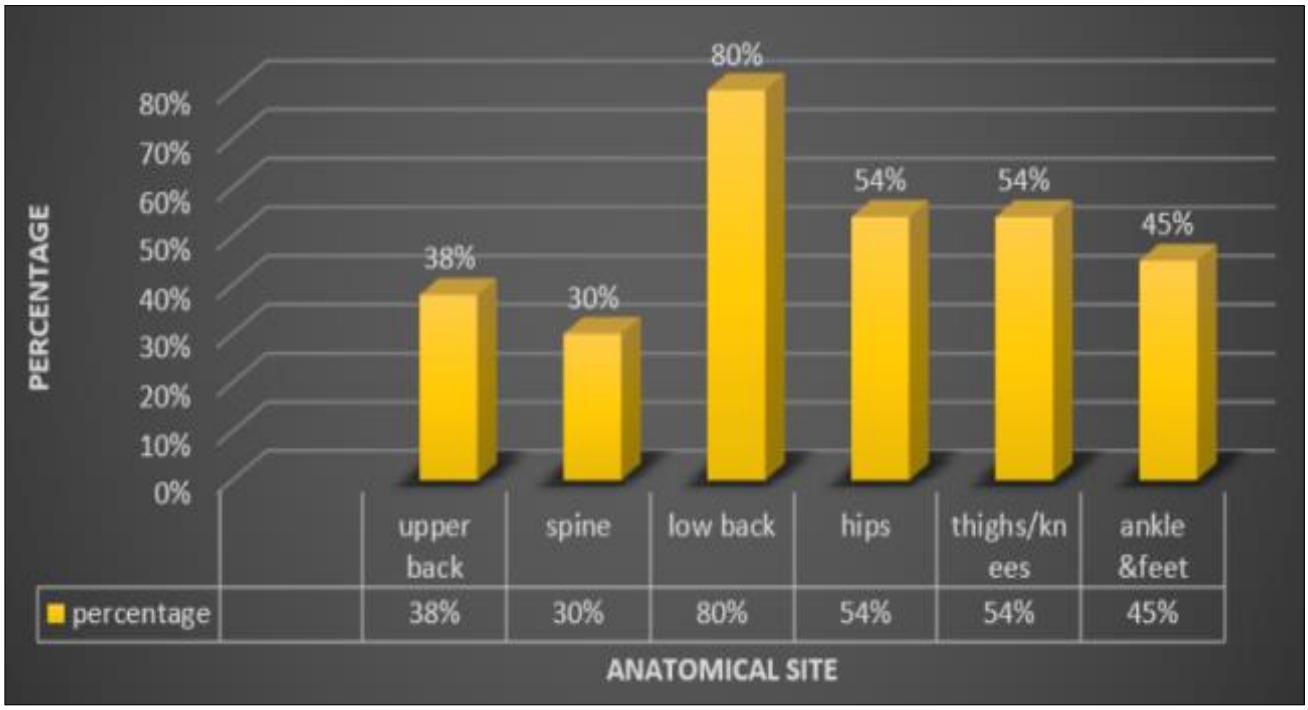

Fig 3: Prevalence of injuries in Bharatnattyam dancers

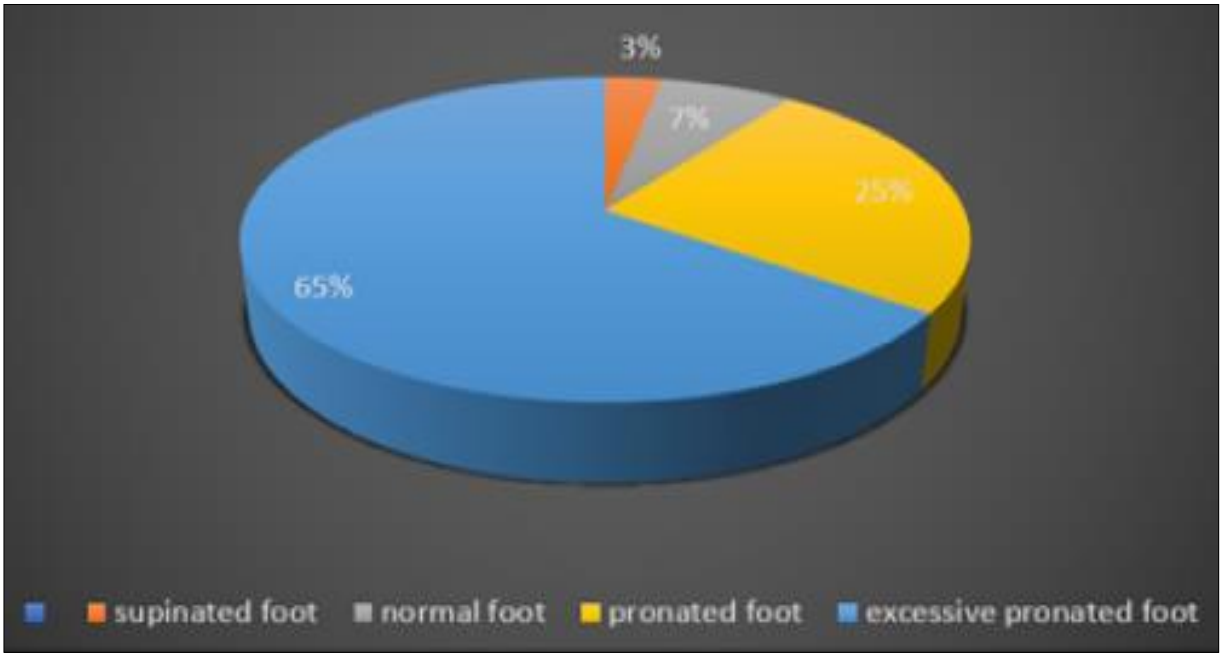

Fig 4: Foot posture deformities in Kathak dancers

Discussion

Few studies suggests that Bharatanatyam dancers have altered gait kinematics as this dance form demands sustained and excessive motion at spine, pelvis and lower extremity joints. According to this study Bharatanatyam dancers are prone to have an excessive lumbar lordosis coupled with anterior pelvic tilt; main cause behind this postural deformity is shortening of hip flexors which pulls the pelvis down causing excessive lumbar lordosis. Various postures in Bharatanatyam dancers along with anterior pelvic tilt leads to shortening of iliopsoases muscle which contribute to various musculoskeletal injuries. Imbalance in muscle activity such as underactivity in abdominals and glutei; and coexistent overactivity and tightness of hip flexors and low back extensors leads to pelvic crossed syndrome [12]. Also it presumes Bharatanatyam dancers are more prone for injuries due to high tightness of hamstring muscles and lack of stretches.one more contributing factors for such injuries are the forces which are faced by the dancers constantly which leads to instability and postural deviations. Bharatanatyam dance form is characterized by various features and postures which leads to the lenghthing of the internal rotators and anterior capsule of hip associated with adaptive shortening of external rotators and posterior capsule causing various postural abnormalities

One of the survey concluded that stress (34.4%) was the major reason for sustaining dance-related musculoskeletal injuries, followed by overwork (24.7%), tiredness (17.2%), and falls (13.5%). While taking off and landing from the jump notable force was transmitted via patella causing load on the patellar tendon ultimately leading to knee pain. Various poses in Bharatanatyam dance leads to patellofemoral joint

syndrome due to weakening of the medial structures and subsequent increased activity of the lateral knee stabilizers.in addition short length of hamstring muscles is the main factor for knee pain. Changes within the traditional mechanics of movements and muscle fatigue area of unit because of the dearth of flexibility of muscle which leads dancer to pain and deformities. Early wear and tear changes in weight bearing joint is because of muscle tightness. Competition among peers, unhealthy eating, irregular sleep patterns, frequent travel, and inadequate rest are the associate factors which are responsible for musculoskeletal injuries among dancers [12].

Roshani Prakash analysed that lack of warm-up routines, overcompensation for inflexibility, hyper lordosis of the back, hyperextension of the knees, or a lack of core strength is the main reason for pain and injuries in Indian classical dancers. many Bharatanatyam poses involve the extension of the knee far beyond the toe, a position that puts an excessive amount of shearing stress on the knee joint is also one of the main reason for injuries. Therefore, any position that command for a protracted time with the knees extended past the toes will place an oversized quantity of stress on the knee joints. flexibility issues in the lower extremities such as iliotibial band muscle tightness, and quadriceps tightness are often demonstrated by Bharatanatyam dancers. one similar article by shruti shenoy states that high impact forces in Bharatanatyam dance could contribute to the lower extremity injuries; it is due to the constant taps performed by the dancers for prolong period of time [20].

Another article has said that regularly performing repetitive extensions. High velocity twisting and bending movement's dancers are at high risk of low back pain. Contributing factors for low back pain are poor techniques; muscle imbalance altered motor control [21].

Kathak Main feature of kathak is that they emphasize on stamping and sharp rhythmic shifts. Katthak dance demands repetitive placing of ankle in an instable position [1]. Risk for musculoskeletal injuries is due to the demand placed on dancer's lower extremity.

Two studies have said that in kathak dancers' foot and ankle instability is standing at the top of all the disabilities.in kathak dance form various foot movements involves extreme dorsiflexion and plantarflexion which leads to putting ligaments of ankle joint under tension. During plantarflexion or dorsiflexion talus is pressed against the lateral malleolus placing considerable stress on ankle mortise putting foot into high risk of instability; forced external rotation and forceful eversion at foot is one of the risk factors for ankle instability. Slackening of the ligaments and strength deficit in muscles results due to these postures performed repetitively in performance [26]. Another article presumed that many dancers start practicing from very young age. This study states that high impact forces during dance leads to change in the anatomical structure of arches of foot. Ankle foot rolling is a result of increase and continuous stress over foot arches [21].

Shweta Chandan, Savita Tamaria *et al.* (2018) said that neurological and rheumatoid diseases are responsible for changes in lower limb motion and muscle activity. Foot and ankle problems are reported frequently due to overuse injuries which leads to pronated foot. It is also studied that dancers have muscle tightness problem leading to various injuries. predisposition of foot, knee, back related problems is due to specific body movements in kathak dancers [1].

In very next year that is in 2019 Dr. Shefali Milind Naik, Dr. Parag Ranade have presumed that without any other form of bodily exercise; long hours of practice at a stretch leads to occurrence of low back pain in these individuals. Arches of feet have shown high impact due to repetitive tapping of feet flat on the ground. This study also shows that in women pronated feet function was associated with the low back pain [3]. Calcaneus everts while the talus adducts and plantarflexes when the foot pronates during early stance phase of gait. Internal rotation of tibia and femur is induced by the inferomedial translation of talus. This increase in the internal rotation of femur leads to anterior pelvic tilt which is a result of tight fibrous connection provided by sacroiliac joint. There is corresponding increase in anterior pelvic tilt when foot is experimentally manipulating in pronated position. In the dancers with extreme foot pronation; Excessive stress on the lumbopelvic region is placed due to compensatory movements of proximal joints 6. In the same year that is in 2019 another article has studied that on statistical analysis overuse injuries are at the top in all dancing injuries. Overuse injury can be caused by the repeated micro trauma rather than a specific or single injury. Research has proved that overuse injury is the main extrinsic risk factor for dancers. Myofascial trigger points are one of the main reasons for calf pain and cramps. They also analysed that in Bharatanatyam dance form main cause behind strain and cramps is constant tapping of feet and continuous pressure on muscles. Whereas in kathak dance form constant tapping of feet for prolonged time leads to stain, pain and cramps [2].

Two systematic reviews and few other studies state that musculoskeletal injuries are the topic of concern for dancers at all skill level. It has also stated that slow stretching at end range activities is responsible for hamstring strain in dancers. Also, in all the classical dance forms most common site for prevalence of injury is back followed by ankle and knee 19. It is due to various features and postures performed in Indian classical dances. Any dancer irrespective of its form must be trained under proper guidance, any kind of carelessness or improper body movements can lead a dancer to injury or it can even become fatal to the dancer [24].

Conclusion

After analyzing the studies included in the systematic review it was evident that Lower extremity is the most commonly involved segment in all the dance forms. All Indian classical dancers present high incidence of injuries with difference between dance styles. All over the India most commonly performed dance style is Bharatanatyam followed by kathak. Incidence of injuries is greater in back followed by knee and ankle in all the Indian classical dance forms. Bharatanatyam is more prone for knee injuries than kathak and on the other hand; in kathak dance form incidence of ankle injuries is higher than that of the Bharatanatyam. Prevalence of upper extremity injuries very minimum in comparison with lower extremity injuries. The impact due to these injuries caused by the training routine or the inappropriate execution of movements, influence not just the professional life of the dancers, but also its health, even after conclusion of its professional career. In these terms is suggested that more studies be developed with target population, investigating other modalities of dance with in professional acting context, with gender distinction, and focus in the incidence, severity and injury etiology often in this group.

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