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Evaluation of Prevalence, Location and Pattern of Musculoskeletal Pain and Discomfort among Dancers

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Abstract

Professional dancers are contemplated as athletes as it is involving repetitive and rhythmic movement. These strenuous activities are the negative stressors and reason for overuse injuries leading to discomfort and pain. This pain and discomfort results in some major issues in the future and it can affect their professional performance or career. This study aimed to exploring the prevalence, common region involved and relation of course of pain in different regions of the body in dancers. A total of 110 dancers, both male and female, participated in this cross-sectional study using the Nordic MSD questionnaire tool. The mean and standard deviation for age (years), height (cm), weight (kg), BMI (kg/cm^2), experience (years), and weekly practice hours were calculated as follows: for women, 21.87±4.47, 165.57±9.89, 60.98±17.85, 22.20±5.93, 8.05±5.47, and 8.98±6.93, and for men, 21.83±6.59, 173.73±7.34, 70.41±11.43, 23.23±3.24, 7.84±5.55, and 9.36±6.95. The result findings revealed, 30.8% participants had pain in the low back region that in last 7 days, followed by shoulder 27.3% and ankle 25.5%. In last 12 months 51% participants reported pain, discomfort and numbness in the lower back region followed by ankle/ foot and knee (31%). In response towards the restriction in the ADL, lower back pain cases (30%) were highest followed by knee (23.6%). The results also revealed that neck pain is strongly and positively associated with upper back pain(r=.601) and moderately related to shoulder pain (r=.467). The study concludes that the lower back region is more prevalent area for pain following the ankle and knee among dancers.

Keywords: *biomechanics, dancing, foot, ankle, injury, prevalence, epidemiology*

Introduction

Dancers are considered as athletes, using artistic statement with athletic skills performing a series of rhythmic body movements to the beats of music (Costa et al., 2016). Dance is an art involving motor activities with expression to interact with society (Aweto et al., 2014). In the past, dancing was considered to have cultural links, but nowadays it is also opted as a profession and forms the statement of social style rather than cultural links. Professional dancing requires hard training and more practice hours. The movement patterns in dancing involve transitions from one position to another that can be challenging and strenuous at the same time. This places a high physical and physiological demand on all the body's musculoskeletal systems (Motta-Valencia, 2006). This makes them more susceptible to musculoskeletal injuries, pain and discomfort, affecting their performance level and career (Russell, 2013). Myriads factors involve in different dancing activities, placing dancers at the risk of injuries resulting in pain and discomfort (Campoy et al., 2011). The factors are biomechanical faults, and mal-alignment caused over time due to different body movements, lack of flexibility and strength because of non-involvement in exercise regime before dancing (Huang et al., 2022).

Evidences underscore the pivotal role of biomechanical analysis in dance, emphasizing its significance in understand-

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ing movement patterns, skill enhancement, and injury prevention (Koutedakis et al., 2008; Sadhu et al., 2021). While existing research has delved into aspects such as prevalence rates ranging from 26% to 84%, commonly injured lower limb body parts, and preventive measures (Anand Prakash et al., 2023; Gopi & Shah, 2022; Uršej & Zaletel, 2020; Vassallo et al., 2019), there remains a notable gap in tracking the development and progression of pain over time. Moreover, the interconnected biomechanical impacts have not received adequate exploration. Comprehensive data on the overall pain patterns experienced by dancers, including which body parts are affected together, are lacking. Therefore, our study aims to fill this gap by investigating the pain patterns across different anatomical sites. By doing so, we seek to inform the implementation of appropriate preventive measures in advance. Our study encompasses the determination of the incidence rate of musculoskeletal pain, identification of the most common regions for experiencing pain among dancers, and analysis of sex differences within the sample. Through these undertakings, we aim to contribute to the enhancement of dancer well-being and performance.

Material and methods

Study design and participants

A cross-sectional study with a convenient sampling method was conducted from September 2023 to December 2023 among the dancer population of India. The study was conducted by using both online and offline platforms. The participants from different parts of India was approached, and a questionnaire was shared with them via the google form and personally. All form of male and female dancers within the age group of 18-45 years, willing to participate voluntarily and ready to provide signed consent, without any diagnosed psychological issues and resident of India were included in this study. This cross-sectional study was carried out according to established criteria included in Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) (Cuschieri, 2019).

Ethical consideration

Ethical approval was acquired on 20 April 2023 from the Genebandhu Independent Ethics Committee under Ref-ECG005/2023. The study's objectives were mentioned and explained to the participants before filling out the questionnaire. The signed consent was obtained from the respondents before filling out the questionnaire. The moral principles of ethics were considered as per the Helsinki declaration, and privacy were maintained.

Data collection tool

The Nordic MSD Questionnaire was used for to analysing the pain and discomfort. This questionnaire has three sections with questions of pain or discomfort in the last seven days and other two sections having questions about pain, discomfort and problems faced in performing household or other activities in the last 12 months (Crawford, 2007).

Procedure

After obtaining the ethical approval a well-structured data collection form was constructed including three sections: Section 1: It includes the title of the study with all the objectives and procedure disclosed followed by the consent form for the participant. Section 2: This section includes the general information related questions of the participants (name, age, height, weight, BMI, dance form, dance type, dance practicing hours per week/day, number of years practicing dance). Section 3: This section includes the Nordic musculoskeletal questionnaire for pain and discomfort assessment.

The platform used for this study was both online and offline. After considering inclusion and exclusion criteria, the dancers were approached individually telephonically and on a one-on-one basis. A total of 110 responses were received. The participant responses were evaluated properly for any missing numbers and data analyses were carried out by using software IBM SPSS Statistics 22 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp) and MS Excel 2016 (Microsoft Excel 2016 is developed by Microsoft Corporation, headquartered in Redmond, Washington, USA.) (Abbott, 2011) .

Statistical analysis

The data's normality was tested by using Shapiro-Wills and data was normally distributed. Descriptive statistics were used to calculate the samples' mean ± SD and median (range); the confidence interval was 95%. Independent t test was used to evaluate any gender difference ($p<0.05$). Pearson's correlation coefficient was utilized to detect the relationships among the variables.

Results

Descriptive statistical analysis was used to define the variables and characters. Frequency distribution tables were used to explain the results more clearly.

Socio-demographic and clinical information

A total of 110 dancers (71 females and 39 males) participated in the study, with the mean and standard deviation for various attributes such as age, height, weight, BMI, experience, and weekly practice hours were calculated as for females 21.87±4.47, 165.57±9.89, 60.98±17.85, 22.20±5.93, 8.05±5.47, and 8.98±6.93, and for male 21.83±4.59, 165.89±9.53, 61.26±18.19, 22.19±5.96, 7.84±5.55, and 9.36±6.95 respectively. In our investigation, 45% (49) of the dancers practiced traditional dance form, while 27% (30) were engaged in Non-traditional dance, and 28% (31) participated in both forms. Subsequent analysis revealed that 23% (25) dancers practiced all types of dance forms, 24% (26) focused on Western type, 8% (9) specialized in Bharatanatyam classical dance, 15% (17) in Bhangra dance, 10% (11), 6% (7) in Kathak dance, 5% (6) in Kuchipudi dance, 4% (4) in Rajasthani folk, and 5% (5) in Bihu folk dance.

Nordic musculoskeletal assessment questionnaire

In our investigation, subsequent to inquiring about the pain status over the previous seven-day period as depicted in Table 1, it was observed that the highest number of cases reported was related to low back pain (30.8%), followed by shoulder (27.3%) and ankle (25.5%). In light of the limitations in the performance of daily activities, as depicted in Table 2, instances of lower back pain (30%) were predominant, followed by knee (23.6%) and then neck (21.8%). The findings of our study demonstrate that, during the past 12 months, as illustrated in Table 3, 51% of the participants encountered pain, discomfort, and numbness in the lower back area, followed by the ankle/ foot and knee regions (31%).

Gender difference

On comparing the mean difference between the genders, there was no significant difference between male and female except pain/discomfort in the neck region in last seven days (0.017) and Hip pain/discomfort in last 12 months (0.044) as illustrated in Table 1,2, and 3.

Table 1. Pain/discomfort in a particular body region at any time during the last seven days

Region	Total (110)	Males (39)	Females (71)	P value
Neck	22 (20%)	3	19	.017
Upper back	26 (23.64%)	7	19	.302
Lower back	34 (30.90%)	10	24	.380
Shoulder	30 (27.27%)	9	21	.469
Elbow	11 (10%)	4	7	.948
Wrist/hand	15 (13.64%)	6	9	.695
Hip	11 (10%)	5	6	.469
Knee	18 (16.36%)	6	12	.839
Ankle/foot	28 (25.45%)	7	21	.184

Table 2. Prevented from doing your normal work due to pain in a particular body region for the last 12 months

Region	Total	Males	Females	P value
Neck	24 (21.82%)	6	18	.230
Upper back	18 (16.36%)	7	11	.742
Lower back	33 (30%)	15	18	.154
Shoulder	18 (16.36%)	7	11	.742
Elbow	15 (13.64%)	5	10	.855
Wrist/hand	13 (11.82%)	4	9	.710
Hip	10 (9.09%)	6	4	.090
Knee	26 (23.64%)	8	18	.572
Ankle/foot	21 (19.09%)	8	13	.781

Table 3. Trouble (such as pain, ache, discomfort, numbness) in particular body region in last 12 months

Region	Total	Males	Females	P value
Neck	23 (20.91%)	7	16	.620
Upper back	26 (23.64%)	11	15	.408
Lower back	56 (50.91%)	21	35	.651
Shoulder	24 (21.82%)	9	15	.815
Elbow	13 (11.82%)	4	9	.710
Wrist/hand	12 (10.91%)	5	7	.637
Hip	20 (18.18%)	11	9	.044
Knee	35 (31.82%)	11	24	.551
Ankle/foot	35 (31.82%)	12	23	.863

Correlation between the socio-demographic characteristics and pain/discomfort history of different regions

To assess the relationship between gender, age, height, weight, BMI, dancing experience, and daily practice hours, Pearson's correlation statistical test was used (refer to Table 4). The findings demonstrated a significant inverse correlation between gender and neck pain experienced within the last seven days (-.228), as well as a significant positive correlation with hip pain or discomfort encountered within the past 12 months (.193). Age exhibited a positive correlation with neck pain experienced within the past seven days (.259), neck pain experienced within the past 12 months (.215), and wrist pain that hindered work within the past 12 months. Furthermore, age displayed a negative correlation with wrist pain experienced within the last seven days (-.190). Height manifested both positive and negative correlations with neck pain experienced within the past seven days and hip pain experienced within the past 12 months (-.238, .245). Practice hours were significantly and positively associated with lower back pain experienced within the past seven days and 12 months, as well as hip pain experienced within the past 12 months (.318, .279, .285). Additionally, practice hours exhibited a negative association with pain in the elbow and ankle that impeded work (-.198, -.190).

Table 4. Correlation between socio-demographic characteristics and pain/discomfort history of different regions

Variable	Hours	Years	BMI	Height	Weight	Age	Gender
Neck1	-.061	.029	.063	-.238*	-.038	.259**	-.228*
Neck2	-.075	.076	.053	-.186	-.023	.173	-.115
Neck3	-.001	.048	.068	-.149	.010	.215*	-.048
Upperback1	-.141	-.016	.031	-.176	-.043	.083	-.099
Upperback2	-.010	-.098	.045	.008	.050	.134	.032
Upperback3	.005	-.119	.041	-.021	.032	.112	.080
Lowerback1	-.012	.114	.099	-.127	.045	.125	-.084
Lowerback2	.318**	.104	-.066	.089	-.021	.063	.137
Lowerback3	.279**	.090	-.155	.065	-.113	-.024	.044
Shoulder1	.025	.006	-.112	-.168	-.164	.045	-.070
Shoulder2	-.088	.091	.135	-.070	.094	.079	.032
Shoulder3	.129	.008	-.106	-.062	-.122	-.109	.023
Elbow1	-.175	.053	-.028	.084	.000	.064	.006
Elbow2	-.198*	.089	.045	-.019	.033	.005	-.018
Elbow3	-.093	.157	.042	.043	.051	.099	-.036
Wrist1	-.172	.021	.002	-.012	-.003	.190*	.038
Wrist2	-.207*	.028	.050	-.071	.021	.245*	-.036
Wrist3	.098	-.024	.086	-.053	.056	.141	.045
Hip1	-.082	-.125	-.038	-.015	-.042	.057	.070
Hip2	.161	.003	.025	.079	.052	.080	.162
Hip3	.285**	-.071	-.102	.245**	.008	.013	.193*
Knee1	.023	.127	.043	.095	.071	.173	-.020
Knee2	.005	.046	.012	-.033	-.003	.011	-.054
Knee3	.180	.111	-.069	.029	-.053	-.086	-.057
Ankle1	-.056	-.032	-.018	-.110	-.052	.007	-.128
Ankle2	-.190*	.030	.074	-.035	.053	.154	.027
Ankle3	-.004	-.031	-.086	.032	-.065	.055	-.017

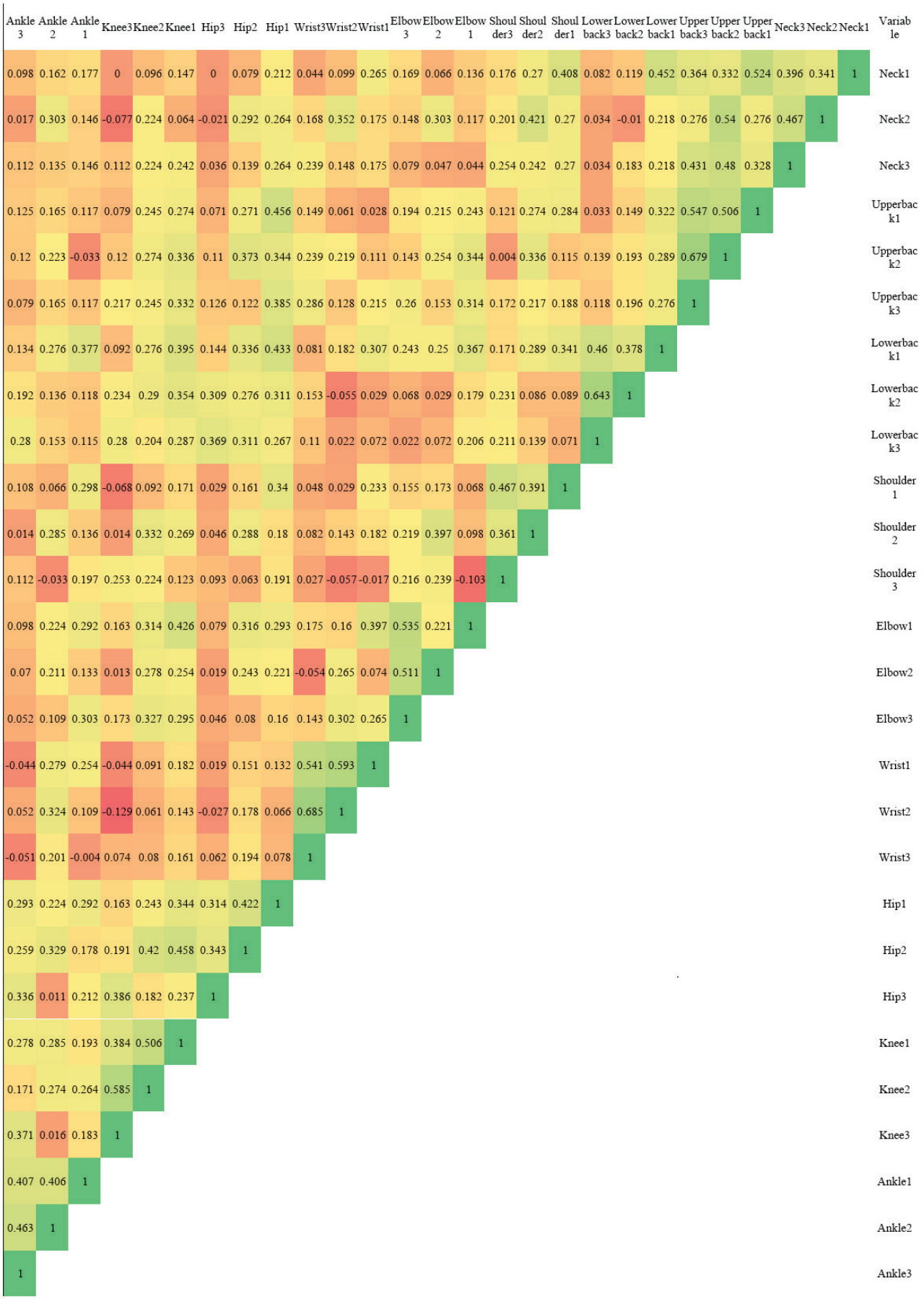
Note: 1= Trouble in a particular body region at any time during the last 7 days, 2= Prevented from doing your normal work due to pain in a particular body region last 12 months, 3= Trouble (such as pain, ache, discomfort, numbness) in particular body region in last 12 months.

Correlation between pain/discomfort history of different regions

Our study findings demonstrate a strong association between various factors, revealing patterns of pain/discomfort. The heat map correlation table (Figure 1) and Figure 2 visually represent these associations through color coding. At a significance level of P≤0.01, we observed a positive correlation among variables related to neck pain. Individuals experiencing neck pain in the past seven days were likely to have also experienced it in the past 12 months (r=.341) and reported activity limitations due to pain (r=.412). Dancers with recent neck pain also frequently reported upper back pain, showing a moderate association (r=.524, .332, .364), as well as shoulder pain (r=.408, .270). Moreover, dancers reporting upper back pain in the past year displayed a strong association with activity restrictions due to upper back pain (r=.506, .322). Those with recent lower back pain showed a significant and positive association with lower back pain in the past 12 months and activity limitations due to pain. Furthermore, dancers with activity restrictions due to low back pain exhibited positive and significant relationships with hip (r=.267, .311, .369), knee (r=.287, .280), and ankle (r=.280) pain.

Discussion

In our study, 110 dancers participated, in these participants only 17.27% (n=19) participants did not report any pain or discomfort but 82.73% (n=91) reported pain at least at one site of the body. These results agree with the two studies conducted in Nigeria and New Zealand among professional dancers and pre-professional dancers. This study concluded the results with a prevalence rate approximately 86%. (Anulika Aweto, 2014; Lee et al., 2017) Similar findings were found in



Ankle 3	Ankle 2	Ankle 1	Knee3	Knee2	Knee1	Hip3	Hip2	Hip1	Wrist3	Wrist2	Wrist1	Elbow 3	Elbow 2	Elbow 1	Shoul der3	Shoul der2	Shoul der1	Lower back3	Lower back2	Lower back1	Upper back3	Upper back2	Upper back1	Neck3	Neck2	Neck1	Variable
0.098	0.162	0.177	0	0.096	0.147	0	0.079	0.212	0.044	0.099	0.265	0.169	0.066	0.136	0.176	0.27	0.408	0.082	0.119	0.452	0.364	0.332	0.524	0.396	0.341	1	Neck1
0.017	0.303	0.146	-0.077	0.224	0.064	-0.021	0.292	0.264	0.168	0.352	0.175	0.148	0.303	0.117	0.201	0.421	0.27	0.034	-0.01	0.218	0.276	0.54	0.276	0.467	1		Neck2
0.112	0.135	0.146	0.112	0.224	0.242	0.036	0.139	0.264	0.239	0.148	0.175	0.079	0.047	0.044	0.254	0.242	0.27	0.034	0.183	0.218	0.431	0.48	0.328	1			Neck3
0.125	0.165	0.117	0.079	0.245	0.274	0.071	0.271	0.456	0.149	0.061	0.028	0.194	0.215	0.243	0.121	0.274	0.284	0.033	0.149	0.322	0.547	0.506	1				Upperback1
0.12	0.223	-0.033	0.12	0.274	0.336	0.11	0.373	0.344	0.239	0.219	0.111	0.143	0.254	0.344	0.004	0.336	0.115	0.139	0.193	0.289	0.679	1					Upperback2
0.079	0.165	0.117	0.217	0.245	0.332	0.126	0.122	0.385	0.286	0.128	0.215	0.26	0.153	0.314	0.172	0.217	0.188	0.118	0.196	0.276	1						Upperback3
0.134	0.276	0.377	0.092	0.276	0.395	0.144	0.336	0.433	0.081	0.182	0.307	0.243	0.25	0.367	0.171	0.289	0.341	0.46	0.378	1							Lowerback1
0.192	0.136	0.118	0.234	0.29	0.354	0.309	0.276	0.311	0.153	-0.055	0.029	0.068	0.029	0.179	0.231	0.086	0.089	0.643	1								Lowerback2
0.28	0.153	0.115	0.28	0.204	0.287	0.369	0.311	0.267	0.11	0.022	0.072	0.022	0.072	0.206	0.211	0.139	0.071	1									Lowerback3
0.108	0.066	0.298	-0.068	0.092	0.171	0.029	0.161	0.34	0.048	0.029	0.233	0.155	0.173	0.068	0.467	0.391	1										Shoulder 1
0.014	0.285	0.136	0.014	0.332	0.269	0.046	0.288	0.18	0.082	0.143	0.182	0.219	0.397	0.098	0.361	1											Shoulder 2
0.112	-0.033	0.197	0.253	0.224	0.123	0.093	0.063	0.191	0.027	-0.057	-0.017	0.216	0.239	-0.103	1												Shoulder 3
0.098	0.224	0.292	0.163	0.314	0.426	0.079	0.316	0.293	0.175	0.16	0.397	0.535	0.221	1													Elbow1
0.07	0.211	0.133	0.013	0.278	0.254	0.019	0.243	0.221	-0.054	0.265	0.074	0.511	1														Elbow2
0.052	0.109	0.303	0.173	0.327	0.295	0.046	0.08	0.16	0.143	0.302	0.265	1															Elbow3
-0.044	0.279	0.254	-0.044	0.091	0.182	0.019	0.151	0.132	0.541	0.593	1																Wrist1
0.052	0.324	0.109	-0.129	0.061	0.143	-0.027	0.178	0.066	0.685	1																	Wrist2
-0.051	0.201	-0.004	0.074	0.08	0.161	0.062	0.194	0.078	1																		Wrist3
0.293	0.224	0.292	0.163	0.243	0.344	0.314	0.422	1																			Hip1
0.259	0.329	0.178	0.191	0.42	0.458	0.343	1																				Hip2
0.336	0.011	0.212	0.386	0.182	0.237	1																					Hip3
0.278	0.285	0.193	0.384	0.506	1																						Knee1
0.171	0.274	0.264	0.585	1																							Knee2
0.371	0.016	0.183	1																								Knee3
0.407	0.406	1																									Ankle1
0.463	1																										Ankle2
1																											Ankle3

FIGURE 1. Heat map Correlation table between the different regions of the body

Note: 1= Trouble in a particular body region at any time during the last 7 days, 2= Prevented from doing your normal work due to pain in a particular body region last 12 months, 3= Trouble (such as pain, ache, discomfort, numbness) in particular body region in the last 12 months

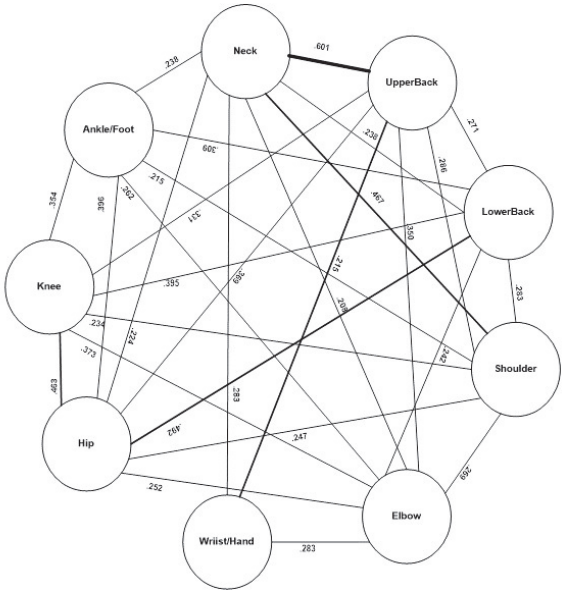


FIGURE 2. Correlation diagram representing association between the different regions of the body with respect to pain and discomfort (association is represented by thickness of lines; thickest line determines strongest correlation)

one of the studies conducted in India, stating the 81% of pain prevalence among the dancers (Nair et al., 2018). A study conducted in South Korea among Korean break dancers reported 95.2% of injury prevalence (Cho et al., 2009) and Ruanne et al. reported an injury rate ranging from 67% to 95% pre-professional dancers (Lai et al., 2006). This indicates there is a higher incidence of pain/discomfort among the dancers irrespective of the dance form they are practicing. Every form has a having high injury risk.

The findings of this study are supported by a retrospective cross-sectional study conducted in Germany stating that the lumbar spine is the most affected area (Adam et al., 2004). In our study, in all the three sections, the lower back site was the most affected, area followed by the ankle and knee. Most of the studies related to dancer's injury/pain have reported similar findings. The lower limbs are more affected as compared to the upper limbs, which could be due to the repetitive stamping of limbs on to the ground. The ground reaction force offered by the surface will eventually have an impact on the part, which is in contact. So prevention strategies should be adapted to prevent these issues.

The mean difference between males and females with respect to pain/ discomfort was not significant. This implies both the sexes have equivalent pain and discomfort rates. A similar retrospective study was conducted by Jarneja et al. (2019) with different result findings stating that females had significantly higher incidence rates as compared to males (Premelč et al., 2019).

To estimate the pain pattern relationship between the different anatomical sites, Pearson's correlation coefficient analysis was done, it revealed that neck pain is strongly and positively related to the upper back (r=.601) and moderately to the shoulder (.467). Lower back pain is moderately related to hip, knee and ankle pain (r=.492, .395, .309). Hip pain was associated with knee and ankle pain (r= .463, .396) and knee pain was associated with ankle (r=.354). The study concludes that the pain in the proximal anatomical sites was strongly and significantly related to the pain in the distal anatomical sites. This can give us an idea about the pain pattern and we will be able to stop the course of the pain to further sites. This is the first study to find the correlation of pain/discomfort in different anatomical sites. So there is no literature to support it but one study was conducted among the European population to find the correlation between back and neck as per the working condition and the results supported our study by stating the facts that there was a moderate to strong correlation between the prevalence of back and neck pain (Rizzello et al., 2019).

Thus, the result findings of our study revealed that the lower back is the most common region to get affected in dancer's populations so we should strengthen our core musculature to prevent this pain and our study also shows that pain is not caused randomly in any part. The pain always follows a pattern. If we stop the pattern there is a strong probability that it will not transfer to other parts. The limitation of our study is the small sample size. This study should be done by taking a large sample size so that predictive analysis can be used to prevent the further distribution of the pain.

Conclusion

The findings from the study indicate a significant prevalence of pain among participants, particularly in the lower back region. Specifically, 30.8% of participants reported experiencing lower back pain in the past 7 days, and over the past 12 months, 51% of participants reported pain, discomfort, or numbness in the lower back, followed by 31% experiencing similar issues in the ankle/foot and knee.

When considering the impact of pain on activities of daily living (ADL), lower back pain was the most restrictive, affecting 30% of participants, with knee pain affecting 23.6%. Additionally, the study found a strong positive correlation between neck pain and upper back pain (r=.601), and a moderate correlation between neck pain and shoulder pain (r=.467). It also revealed that Lower back pain is moderately related to the hip (r=.492). Hip pain was associated moderately with the knee pain (r=.463). In conclusion, the study highlights that the lower back is the most prevalent area for pain among dancers, followed by the ankle and knee. This underscores the need for targeted interventions to address and mitigate pain in these regions to improve dancers' health and performance.

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Conflict of interest
The authors declare no conflict of interest

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