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# INJURIES IN PROFESSIONAL DANCERS: A SYSTEMATIC REVIEW

LESÕES EM BAILARINOS PROFISSIONAIS: UMA REVISÃO SISTEMÁTICA

LESIONES EN LOS BAILARINES PROFESIONALES: UNA REVISIÓN SISTEMÁTICA

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## ABSTRACT

Movement is a fundamental element of dance, and the dancer's body is the raw material through which the art of dance is expressed; for this, it demands the utmost discipline in the pursuit of technical and artistic excellence. To meet the professional demands, dancers are subjected to strenuous training routines, which can lead to the development of injuries in this environment. The objective was to examine the etiology, main affected segments, prevalence, and instruments used to evaluate the lesions in studies with professional dancers and/or in comparison with similar populations. We selected articles published in the last decade in the databases BIREME, LILACS, MEDLINE EBSCO, WEB OF SCIENCE, SCOPUS (Elsevier), and PubMed, with cross-sectional, observational cohort and case control design published in Portuguese, English, or Spanish. Systematic reviews, case studies, dissertations, theses, book chapters, cross-referenced articles, and studies published outside of the last decade were not included. The search used combinations of the terms "dancing\*" and athletic injuries\* and musculoskeletal\* and pain\*. A principal investigator and two reviewers conducted the survey and analyzed all the potentially relevant articles, initially by the abstract and title. Twelve articles were included, with 1,149 participants (965 professional dancers of classical ballet, modern dance, contemporary dance, and breakdance, 104 amateur dancers, and 80 elite athletes). Nine studies found simultaneous lesions with emphasis on the foot and ankle (n=4), upper and lower limbs lesions (n=4) and lower and upper limb joints (n=1). Other studies have found lesions in the anterior cruciate ligament (n=3). There was no agreement regarding the instruments for detecting lesions in professional, pre-professional, and amateur dancers. There was a prevalence of studies aimed at classical ballet modality, evidencing a higher frequency of lower limb involvement in professional dancers.

**Keywords:** dancing; athletes/injuries; movement.

## RESUMO

A dança tem o movimento como elemento fundamental e o corpo do bailarino como matéria-prima para expressar sua arte; para isso, exige a máxima disciplina na busca da excelência técnica e artística. Para atender às demandas profissionais, os bailarinos são submetidos a extenuantes rotinas de treinamento, que favorecem o desenvolvimento de lesões nesse meio. Objetivou-se examinar etiologia, principais segmentos acometidos, prevalência e instrumentos usados para avaliar as lesões em estudos com dançarinos profissionais e/ou em comparação com populações similares. Foram selecionados artigos completos publicados na última década nas bases de dados BIREME, LILACS, MEDLINE EBSCO, WEB OF SCIENCE, SCOPUS (Elsevier) e PubMed, com desenho de coorte observacional, transversal e controle de casos, publicados em português, inglês ou espanhol. Não foram incluídas revisões sistemáticas, estudos de caso, dissertações, teses, capítulos de livros, artigos com referências cruzadas e estudos publicados fora da última década. A busca usou combinações dos termos "dancing\*" and athletic injuries\* and musculoskeletal\* and pain\*. Um pesquisador principal e dois revisores realizaram a pesquisa e analisaram todos os artigos com relevância em potencial, inicialmente por resumo e título. Um total de 12 artigos foi incluído, com 1.149 participantes (965 dançarinos profissionais de balé clássico, dança moderna, dança contemporânea e breakdance, 104 dançarinos amadores e 80 atletas de elite). Nove estudos encontraram lesões simultâneas com ênfase no pé e tornozelo (n = 4), lesões dos membros superiores e inferiores (n = 4) e nas articulações de membros inferiores e superiores (n = 1). Outros estudos encontraram lesões no ligamento cruzado anterior (n = 3). Não houve consenso quanto aos instrumentos para identificação de lesões em bailarinos profissionais, pré-profissionais e amadores. Houve prevalência de estudos destinados à modalidade de balé clássico, evidenciando maior frequência de acometimento dos membros inferiores em bailarinos profissionais.

**Descritores:** dança; atletas/lesões; movimento.

## RESUMEN

La danza tiene el movimiento como elemento fundamental y el cuerpo del bailarín como materia prima para expresar su arte; para ello, exige la máxima disciplina en la búsqueda de la excelencia técnica y artística. Para atender las demandas profesionales, los bailarines son sometidos a extenuantes rutinas de entrenamiento, que favorecen el desarrollo de lesiones en ese medio. El objetivo fue examinar etiología, principales segmentos acometidos, prevalencia e instrumentos usados para evaluar las lesiones en estudios con bailarines profesionales y/o en comparación con poblaciones similares. Se seleccionaron artículos completos publicados en la última década en las bases de datos BIREME, LILACS, MEDLINE EBSCO, WEB OF SCIENCE, SCOPUS (Elsevier) y PubMed, con diseño de cohorte observacional,

transversal y control de casos, publicados en portugués, inglés o español. No se incluyeron revisiones sistemáticas, estudios de caso, disertaciones, tesis, capítulos de libros, artículos con referencias cruzadas y estudios publicados fuera de la última década. La búsqueda utilizó combinaciones de los términos "dancing\* and athletic injuries\* and musculoskeletal\* and pain\*": Un investigador principal y dos revisores realizaron la investigación y analizaron todos los artículos con relevancia potencial, inicialmente por resumen y título. Un total de 12 artículos fueron incluidos, con 1.149 participantes (965 bailarines profesionales de ballet clásico, danza moderna, danza contemporánea y breakdance, 104 bailarines aficionados y 80 atletas de elite). Nueve estudios encontraron lesiones simultáneas con énfasis en el pie y el tobillo (n = 4), lesiones de las extremidades superiores e inferiores (n = 4) y en las articulaciones de extremidades inferiores y superiores (n = 1). Otros estudios encontraron lesiones en el ligamento cruzado anterior (n = 3). No hubo consenso en cuanto a los instrumentos para identificación de lesiones en bailarines profesionales, pre-profesionales y aficionados. Se observó una prevalencia de estudios destinados a la modalidad de ballet clásico, evidenciando mayor frecuencia de afectación de las extremidades inferiores en bailarines profesionales.

**Descriptor:** baile; atletas/lesiones; movimiento.

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## INTRODUCTION

Dance has the movement as fundamental element of its art, and the body as raw material, requiring discipline, develops and enhances it, in order to reach all the magnificence, line purity and possible expressions of the worked technics<sup>1</sup>. Dancers in different dance categories, are considered as much athletes as artists, because, their routine needs either an excellent physical condition and high efficiency, as the visual beauty assigned to the choreography movements<sup>2,3</sup>.

To fill all the athletic demands that dance as professional activity requires, these dancers are submitted to stressful charges in order to reach an excellent physical aptitude, and for that they need great levels of aerobic resistance, neuromuscular coordination, power, based muscular resistance, agility also flexibility and stretching<sup>4,7</sup>.

As much as athletes, professional dancers are susceptible to a constant injury risk. Factor often justified, by the exhausting training routine and the mistakes made due this routine<sup>7</sup>. The athletic life routine of these dancers starts from an early age, enabling them to become professionals near 15 years old<sup>8</sup>. Since then these dancers are subjected to heavy loads of training, regardless their musculoskeletal structures be ready, raising the occurrence of acute injuries and granting the occurrence of chronic injuries<sup>7,9</sup>.

The incidence of injuries in dancers varies from 40% to 84% according Jacobs, Hincapie, and Cassidy<sup>10</sup>, these being mostly caused by low cardiovascular conditioning, articular hyper mobility, postural deviation, alteration in the body's center of balance, among others<sup>2,9-11</sup>. A Study realized with amateurs dancers, shows that for each 1000 hours of training, the injuries incidence diagnosed was from 0.62 to 5.6 injuries per dancers<sup>2</sup>. Bearing in mind that the technical demand for a professional dancers is even higher, is considered that this number increases drastically into the professional contest.

Despite having a training as intense as the elite athletes, the professional dancers do not get the same assistance concerning to the injuries prevention, technical preparation and physiotherapeutic of others modalities, especially in the appearance and treatment of lesions<sup>9</sup>. The lack of national and international researches having the dance as object of study is evident in different areas, mainly with the injuries, once that one is yet very discussed in classical ballet, leaving others dance styles aside; and sometimes it makes impossible the relation between the lack produced material with more precise conclusions, in order to expose these to the scientific society<sup>7,10</sup>. The *International Association for Dance Medicine and Science* (IADMS) has been trying to organize some methodologic and scientific questions of the research involving the

dance, suggesting some directives, and, allowing that future studies can be done with bigger background and credibility<sup>12,13</sup>.

Above all this study seeks alerting the dancers involved of the possible risks involved in inadequate practices, stimulating preventative and conscious attitudes in the professional dance context. For that, just few researches were made in way to investigate the epidemiology of the injuries in professional dancers, demystifying cause, places, occurrence and most frequent injuries in that group<sup>8</sup>. In face of that, the objective of this systematic review was to examine the etiology, main affected segments, prevalence and instruments used to evaluate the lesions in studies with professional dancers and/or compared to similar populations.

## MATERIAL AND METHODS

Article selection and identification

This systematic review was registered at PROSPERO (*International Prospective Register Of Systematic Reviews*) under the number CRD42016036529, and follows the recommendations of PRISMA (*Preferred Reporting Items for Systematic Review and Meta-analyses*)<sup>14</sup>. For that were added complete articles, observational cohort type, transversal and control-case, that investigate injuries in professional dancers, published in Portuguese, English or Spanish in the last decade.

### Search strategy

To search strategy were used the database BIREME, LILACS, MEDLINE EBSCO, WEB OF SCIENCE, SCOPUS (*Elsevier*) and PubMed. The used descriptors were "dancing\* and athletic injuries\* and musculoskeletal\* and pain\*": The search was made in February 2016. Articles that brought the cited descriptors and evaluated professional dancers comparing them with similar populations as pre-professional dancers, amateur dancers and athletes were also included in the search.

### Study selection and data extraction

To study selection and data extraction, one main researcher and two reviewers realized the search and analyzed all the potentially relevant articles, initially by the abstract and title. In cases of divergences between the articles selected by the reviewers, all repeated the procedures until the divergences were corrected.

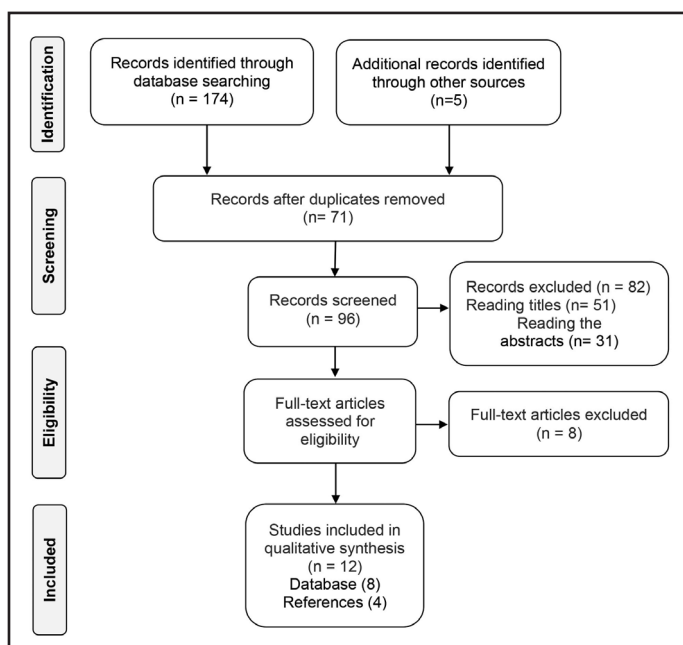
The articles were accessed integrally on-line, available in Portuguese, English or Spanish, published in the last 10 years. Were also part, articles identified by the way of manual search of references of the included articles. Were not included systematic reviews, case studies, dissertations, theses, book chapters, identified articles as crossed reference and published studies out time and languages established previously.

## Methodology evaluation

The quality of the data was evaluated independently by the reviewers based in the criteria of Downs e Black<sup>15</sup>, which consist in 27 questions that cover communication methodological aspects, inner and outer validity and statistic power. To the appreciation of the studies that do not included interventions, were considered just 15 questions, excluding 4, 8, 13-15, 17, 19, 21- 24 e 26 questions. To each question was applied the score zero (0), if the article wasn't pertinent to what was being evaluated, e the score one (1) when observed positive answer to the requisite, observing that only the question 5 has maximum score 2. With that the maximum score to each article was 16 points. To analyze the quality of the data of the included studies, descriptive statistic was used (mean score).

## RESULTS

Initially 174 articles were identified. After the withdraw of the duplicate and executed the title triage phase, abstracts and complete texts, was reach the number of 16 articles, among these, 8 satisfied the eligibility criteria. After the manual evaluation of these articles bibliography references, 4 more were added, totaling 12 potentially relevant articles to the qualitative evaluation (Figure 1).



**Figure 1.** Review included studies fluxogram.

As the obtained score by the way of the Downs and Black<sup>15</sup> methodological Scale, the articles achieve 11.61 of average considering maximum score of 16 points. Among the methodological criteria that presented more failures are: the non-description of the individuals lost during the study characteristics; the lack of result basis definition (non-detailing of the main confusion factors) and the related aspects to the internal studies validity. The studies with best evaluation obtained score 14 of 16<sup>13,16-18</sup>. And the studies with worst evaluation get 11 points<sup>4,19-21</sup>.

The methodological evaluation shows that any article reach maximum values, making clear that some methodological failures in the execution of these researches. However, none of them got values under 11, what may determine the sample as “good” according to the qualitative rating of Downs e Black<sup>15</sup>.

The main characteristics of the studies included in the review are presented in Table 1. The presented review is formed by 12 articles, 11 published in English between 2007 and 2014, where the year of 2008

obtained the greater number of publications, totaling 4 articles, presented in the supplements. The total sample of this review was composed by 1149 participants, where 325 men and 427 women, which 965 professional dancers of the classical ballet, modern dance, contemporary dance and break dance modalities, 104 amateur dancers and 80 elite athletes. As the etiology of the related lesions, stand out the floor surface, the inappropriate technic and the lack of stability in some moves the overload of activities, the excessive effort in the training routine, the muscular fatigue, the biomechanical stress and the lack of proper equipment.

**Table 1.** Main characteristics of the studies included in the review.

N	Reference	Study location	Population	Gender (M/F)	Modality	Lesion etiology
1	Hopper LS, et al. <sup>19</sup>	United Kingdom	52-58*	25-29/ 27-29	Classical <b>ballet</b>	Floor surface
2	Orishimo KF, et al. <sup>16</sup>	United States	80 (40 PD; 40 athletes)	40/40	Classical <b>ballet</b> and modern dance	Inappropriate jump landing technic
3	Liederbach M, et al. <sup>25</sup>	United States	80 (40 PD; 40 athletes)	40/40	Classical <b>ballet</b> and modern dance	Muscular Fatigue
4	Allen N, et al. <sup>3</sup>	United Kingdom	52	25/27	Classical <b>ballet</b>	Excessive movement repetition and activities overload
5	Rein S, et al. <sup>22</sup>	Germany	30	10/20	**	Lack of stability
6	Kauther MD, et al. <sup>17</sup>	Germany	144 (40 PD; 104 amateurs)	NI	<b>Breakdance;</b>	Excessive movement repetition and lack of safety gear
7	Bronner S, et al. <sup>4</sup>	United States	1	0/1	Modern dance	Non-retreat of activities after a home accident
8	Elias I, et al. <sup>20</sup>	United States	11	5/6	Classical <b>ballet</b>	Biomechanical stress and excessive repetition
9	Liederbach M, et al. <sup>18</sup>	United States	298	115/183	Classical <b>ballet</b> and modern dance	Overload and Fatigue
10	Meuffels DE, et al. <sup>23</sup>	Holland	253	NI	Classical <b>ballet</b> e contemporary	Biomechanical stress
11	Dore BF, et al. <sup>24</sup>	Brazil	141	61/80	**	Excessive strain
12	Lo S, et al. <sup>21</sup>	United States	1	0/1	Classical <b>ballet</b>	Activities overload

PD: Professional Dancers; NI: non-informed; \*To this article was adopted the sample max value; \*\* the study population was described as professional dancers, but not specifying the practiced modality. **Source:** Made by author.

The selected studies main objectives description, as the main discoveries and the classification of the methodological evaluation are presented in Table 2. Is observed that the studies have characteristics, objectives and different forms; where the most common objectives the etiology survey, incidence and lesions characteristics, as well the comparison between the biomechanical execution of movement in dancers and other modalities athletes.

As the used instruments to the lesions evaluation in professional dancers, pre-professionals and amateurs, was verified the absence of an agreement about the use of these. For evaluation of the lesions were used ways of direct evaluation, as magnetic resonance, X-Ray and electromyography<sup>20-22</sup>; multisensorial platforms to biomechanical analysis of

the activity<sup>16,22</sup>; physics tests<sup>22,23</sup> and clinical<sup>4</sup>. Besides the indirect measures, as the questionnaires<sup>3,4,17,22,24</sup>. Just two of the used questionnaires were pointed specifically to dancers, among them one non-validated questionnaire to personal identification, dance experience and lesion history<sup>17</sup> and the *Dance Functional Outcome System Questionnaire*<sup>4</sup>.

**Table 2.** Study objectives, main results and evaluation Downs & Black.

		OBJECTIVE	MAIN RESULTS	D&B
1	Hopper LS, et al. <sup>19</sup>	Investigate possible lesions risk factors related with the mechanical proprieties of the regular used pavements by professional ballet companies.	96 lesions were register in 18 weeks and after the definition of the right floor, 69 lesions were included in the analysis; the occurrence of the MML and lumbar were responsible for 72% of the total of lesions, where 38 in males and 31 in females; PD can execute classes, rehearsals and shows in inappropriate floor to a safe dance practice.	11
2	Orishimo KF, et al. <sup>16</sup>	Compare the biomechanical landing task of PD and team sports athletes related to typical neuromuscular deficit related to anterior cruciate ligament lesions (ACL) and difference between genders.	PD of both genders shown a better landing mechanic, obtaining lower levels of ACL lesions when compared to female athletes; PD shown better core stability then athletes; Female dancers landed with a inferior lateral body flexion comparing with athletes of both genders, however, male PD land with a straighter posture, because in their technic, they are not always allowed to use swing of their arms to produce a jumping dynamic; the intensive technical training of PD can be partially responsible to the protections biomechanical shown during the jumping lands, favoring the lower rate of ACL lesions.	14
3	Liederbach M, et al. <sup>25</sup>	Compare PD and athletes based in their resistance and fatigue in the biomechanical factors of a jump-landing task, before and after reach the fatigue related to the associated risk variable.	PD take more time to reach the fatigue level when compared to athletes; Even to PD or athletes the landing parameters are changed by the fatigue, helping the knee flexion movements decrease during the jump landing, favoring the ACL lesions.	14
4	Allen N, et al. <sup>3</sup>	Report the incidence, severity and etiology of injuries suffered by a group of PD and analyses the impact of the dance activity and PD classification about the lesions and the differences between genders.	During a year, an average of 6,8 lesions per PD (women 6,3; men 7,3; p>0,05) were register. The average severity of the lesion was significantly higher (p<0,05) in men (9 days) then in women (4 days). The majority of the occurring lesions in women was classified as transitory (94%) followed by light (5%) and moderate (1%). The majority of lesions in male PD was classified as transitory (87%), followed by light (9%) moderate (2%) and severe (2%). Between both genders the number of lesions classified as transitory were significantly higher than (p<0,05) when compared to the light intensity, moderate or severe.	13
5	Rein S, et al. <sup>22</sup>	Compare the postural control and ankle stability among PD, amateurs and a control group.	PD present a better ankle movement amplitude as a better postural control, followed by a specific weight distribution, being significant in the anterolateral region of the foot; however, the articular position sense and the electromyography answer do not present differences between professional and non-professionals.	13
6	Kauther MD, et al. <sup>17</sup>	Investigate the rate of lesions in PD and <i>break-dancing</i> amateurs, excessive use and other medical problems related to this modality.	On the whole 1665 acute lesions were related during the trainings; six of the amateurs breakdancers (4,2%) never had suffer a lesion; Was verified an average of 11,6 (variation, 0-42) lesions per individual; When compared, PD suffered significantly more lesions than amateurs.	14
7	Bronner S, et al. <sup>4</sup>	Report about the repair and rehabilitation of long hallux extensor and tendon lacerations of a PD.	First case of repair and rehabilitation of the short muscular extensor of hallux tendon laceration, long hallux extensor tendon and of the metatarsophalangeal joint; the PD back to normal activities in 17 weeks, after 32 physical therapy sessions	11
8	Elias I, et al. <sup>20</sup>	Examine the pattern of images by magnetic resonance of bone marrow edema (BMO) in ankles of PD to evaluate the clinical relevance of the lesions.	Bone marrow edema in talus was observed in 9 of 12 evaluated ankles, reporting a moderate co-relation between pain and edema in PD, probably related with biomechanical stress reactions, due the unique maneuvers frequently realized; clinically, this condition can indicate a lesion sign by strain on the ankle bone.	11
9	Liederbach M, et al. <sup>18</sup>	Measure the ACL lesion incidence between classical ballet and modern dance PD, and compare the rate among genders and dance groups.	From 298 dancers, 12 had an ACL lesion in a period of 5 years, where the incidence was 0,009 per 1000 exposures. The jump landing in one leg was the mechanism in 92% of the cases. The incidence was not statistically different between gender and dance modality. However, female PD of modern dance obtained from 3 to 5 times more lesion risk when compared to both genders PD of classical ballet.	14
10	Meuffels DE and Verhaar JA <sup>23</sup>	Report the ACL lesion incidence and the clinical care designated to this lesion in PD of classic and contemporary of 3 professional companies.	The classical ballet company shows a grater ACL lesions risk probability when compared to the two investigated contemporary companies; all lesions occur in the jump landing, with prevalence of the left side with hips extroversion, more precisely on "grandjeté" to the dancers; 6 of the PD had some lesion historic with surgical procedure and were followed up by a medical team; after the lesion, all the 6 PD reported unreliability feelings to execute jumps; after return to dance; 3 of the 6 quit dance in order of the lesions.	13
11	Dore BF and Guerra RO <sup>24</sup>	Investigate the prevalence of associate factors to the pain symptomatology in PD.	High levels of tolerance to pain were observed in 70,2% of PD; the lumbar region pain was present in 85,8% of subjects; were verified positive co-relations between the intensity pain level with daily life activities, sleep, humor and personal relationship; Was determine high pain prevalence in PD observing great interference in the pain symptomatology in many personal life activities and professional of this group.	12
12	Lo SL, et al. <sup>21</sup>	Report a strain fracture in the distal phalanx of the first metatarsus with strain lesion in a PD.	Strain fracture of the first metatarsus of the PD's right foot, defined as activities overload lesion.	11

PD: Professional Dancers; ACL: Anterior Cruciate Ligament; **Source:** Made by the author

Nine studies found simultaneous lesions with emphasis in foot and ankle (n=4)<sup>4,20-22</sup>, upper and lower limbs lesions (n=4)<sup>3,19,24,25</sup> and together lower and upper limbs (n=1)<sup>18</sup>. Other studies found lesions in the anterior cruciate ligament (n=3)<sup>16,23,26</sup>.

In the studies that took part of this systematic review, five related systematic train of 5 to 6 time per week<sup>3,17,19,23,24</sup>, but just four of these informed the amount of rehearsed hours, what results in a 23.17 average of dedicated hours between classes, rehearsals and training<sup>3,17,19,24</sup>, the other studies (n=7) do not informed the amount of rehearsed hours.

## DISCUSSION

According to the results of the 12 included studies in this systematic review, lower limbs, specially foot, ankle and knee seem to be the main affected segment in the dancers population, and the anterior cruciate ligament are the most found lesion. Among the investigated dance modalities, the classical ballet presented a higher prevalence in the lesion occurrence<sup>3,18-21,23</sup>. Results confirmed by Smith et al.<sup>8</sup> that when investigated the prevalence and the profile of musculoskeletal lesions in professional dancers, pre-professionals and amateurs, reinforced in his discoveries a higher prevalence of lesions in lower limbs of professional dancers and pre-professionals dancers.

These data can be explained observing that the dance, regardless the modality, when practiced in a professional level, charges from the dancer an excellence and technical perfection that only can be achieved through straining physical train<sup>27</sup>. The constant repetition of positions and choreographic postures demand too much straining physical charges that sometimes exceed these dancers' physical capacities, facts that, together with the absence of adequate recovery breaks between training, support to the occurrence of lesions<sup>27</sup>. Other support factor with the increase of lesions in professional dancers is the methodological training model. That many times does not respect the principles of sportive training, especially in the matter of preparation and previous conditioning specified to the body and charges that it is submitted. When lesser is the time of this preparation, higher tends to be the lesion rate of these dancers<sup>28</sup>.

The higher incidence of lower limbs lesion is high related with the biomechanical that dance most common postures demand, causing the musculoskeletal system lesions. One of these common biomechanical alterations is the genu recurvatum, which is characterized by the hyperextension and sometimes by hypermobility of the knee. This specific change happens by the posture maintenance that dancers have to adopt during the training and concerts, promoting an over activation of the quadriceps in a way to maintain lower limbs super stretched. This posture is demanded from dancers, for draw a straight line in their lower limbs, mostly achieved when the positions are realized on ballet pointe shoes<sup>29</sup>.

Although of 12 studies being fitted in the results, just one of them has, as objective, investigate the lesions etiology. Just the Allen et al.<sup>3</sup>, that follow during a year season, 52 professional dancers, propose itself to relate the incidence, severity and etiology of the occurring lesions. Relating a frequency of 6.8 lesions per professional dancers in a period of a year, classified as temporary, even for men (87%) as for women (94%), happening mostly in the lower limbs, and with the occurrence prevalence of the same during the company rehearsals. Although not deeply discussed some risk factors were pointed in the studies included in the review, such as, the excessive repetition of movements, the overload of activities, the muscular fatigue and the biomechanical stress<sup>3,17,20,23-25</sup>, the inappropriate technique of jumps landing<sup>16,22</sup>, and also the influence of the mechanical characteristics of the floor<sup>19</sup>.

Supporting, some studies claim that aerial movements like jumps, its forms and landing time are risk factors to the development of lesions in dance<sup>1,30</sup>. The importance of prevention strategies of the lesions in dancers have becoming more important, as the growing number of practices and the exponential increase of the lesions arising from the training routine of these<sup>8</sup>. Studies realized in pre-professional dancers and amateurs have suggested the importance in a lesion prevention work<sup>2</sup>.

Works like the Gamboa et al.<sup>2</sup> and O'Halloran et al.<sup>30</sup>, show that a proprioception training, associated to an improvement in the postural control and articular stability can potentially contribute to decrease the risk of lesions in semiprofessional dancers. In a way to minimize the lesions risk and improve the functional ankle stability, O'Halloran et al.<sup>30</sup> suggest the addition of proprioceptive activities focusing in the postural control, even for professional dancers as amateurs.

In just 6 of the 12 articles, was verified the participation an involvement of a medical team in the professional companies<sup>3,4,17,19,21,23</sup>. This deficiency can be related to the fact that many companies are afraid of the presence of a medical team interfering directly in the elaboration and execution of their work; what is shown that some characteristics of specific movements, as well the training intensity, the choreographic demands and even the patterns of the body constitution can result in acute traumas and/or chronic in these dancers. Beside this, other complicating would be the high costs of maintaining a multidisciplinary work involving a medical team, as few companies have sponsors or investors<sup>31</sup>.

Other highlighted problem in one of the articles included in the review is the high pain resistance break point that dancers develop<sup>24</sup>. This acquaintance with pain behavior, the not maintenance of physical and mental health harmful conducts goes against to the health precepts that health area professionals safeguard, reason that collaborate to the alienation of these professionals from the high performance companies<sup>32</sup>.

After the analysis of the selected studies is, clear the need of instruments with more specific prognostic characteristics focused in professional dancers lesions prevention. It is perceptible the absence of standardization of specific instruments to lesion evaluation in dancers, what hinders the comparison between studies. The development of criteria and reference values to different dance modalities and levels of action (professional, pre-professional and amateurs) would be more effective in the evaluation of these individuals, preventing the lesion progress in this meantime.

The presence of studies with longitudinal with cohorts was not verified, targeting these professional dancers career follow up. This type of study is highly relevant, according to the variety of relations that can be investigate in the long term, the influence of nutritional aspects, psychological and even physics in the incidence and characteristics of the lesions in the different age-groups, even not being object of this systematic review. This kind of information would allow the development of actions to avoid bad habits in the beginning of the career of these dancers, avoiding damaging behavior during their professional life.

This review becomes effective, because, identify the most recurrent lesions and the main segments affected in professional dancers consists in a needy thematic in actual literature. As studies limitations is highlighted the difficulty of further development about the lesions etiology, this way suggesting that further investigations with a greater number of professional dancers of different dance modalities be developed. Also looking for the creation of prevention programs conducted by capable professionals linked to the health area focused in this population. In order to reduce the incidence and severity of lesions, looking to avoid especially the removal of the professional career by these dancers, and minimizing the psychological impact and the appearance of adverse events that could compromise the health and life qualities of a professional dancers<sup>7</sup>.

## CONCLUSION

After analyzed the studies included in this systematic review, it was evident that the most affected segment was the lower limbs, specially foot, ankle and knee. However, there was a difficulty in identify the etiology of these injuries, as well an appropriated instrument to detect lesions in professional dancers, pre-professionals and amateurs. As for as the modality classical ballet was the most prevalent in the studies.

The impact due these injuries caused by the training routine or the inappropriate execution of movements, influence not just the professional life of a professional dancers, but also its health, even

after the conclusion of its professional career. However, these consequences remain without a proper investigation. In these terms is suggested that more studies be developed with the target population, investigating others modalities of dance in the professional acting context, with gender distinction, and focus in the incidence, severity and injuries etiology often in this in this group. Boosting preventive actions that favor a healthy and safe career to the professionals involved on its practice.

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