Clinical Pain Research

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Determinants of pain occurrence in dance teachers

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Abstract

Objectives: Dance teachers are strongly dependent on their functional body in their professional practice. As yet, it has largely been unclear whether the musculoskeletal system is endangered by a dance teaching activity. Pain can be a warning signal for a health hazard. The aims of the study were (a) to determine the pain prevalence, location and assessment of dance teachers and (b) to identify determinants of pain occurrence over a 3-month period prior to the survey.

Methods: The quantitative, retrospective cohort study was conducted with n=166 dance teachers by an anonymous online survey. The data on the study sample, professional practice and pain prevalence, location and assessment were presented descriptively. A binary logistic regression was used to identify determinants of pain occurrence in the last 3 months from the sample parameters and the data of professional practice.

Results: In the 3-month period n=143 (86.1%) of dance teachers had been in pain, often localized in the lower back and lower extremities. In the binary logistic regression model, the Body mass index (BMI) (odds ratio (OR)=1.15, 95% CI: 0.93–1.42, p=0.18), age (OR=1.03, 95% CI: 0.99–1.08, p=0.11) and the presence of disease (OR=2.81, 95% CI: 0.78–10.15, p=0.12) were identified as determinants of pain occurrence (LR-Chi^2=7.8, $p<0.05$, pseudo R^2=0.06, n=160).

Conclusions: Pain occurs in dance teachers under multifactorial conditions. Pain occurrence seems to be favored by context factors, such as the BMI, age and the presence of diseases. However, none of these factors could be identified as a significant, clear risk factor for the occurrence of pain in this sample. Education and preventive measures, that consider pain as a warning signal, should take effect early in the dance career.

Keywords: dance teachers; health hazards; musculoskeletal system; pain; prevention.

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Introduction

Dance teachers (DT) depend on their body as a working tool in their professional practice – comparable to professional dancers [1–3]. DT can work in the field of dance sports (e.g., standard and Latin) or in artistic dance directions (e.g., ballet, modern/jazz dance, contemporary dance, hip hop) [2]. The work of DT includes not only dance lessons but also the preparation of choreographies and performances [1]. The teaching of dance can be performed in a sitting position, either by indicating the movements or in the form of fully executing the movements [1, 2]. In the subjective perception of DT differences in physical workload between the age group to be taught, the dance level and the dance style emerge [4]. This may be due to different demands on the musculoskeletal system during dance teaching. The physical workload of teaching beginners, where rather full movement demonstrations were necessary, was rated higher by DT than teaching professional dancers [4].

In dance, the musculoskeletal system is heavily strained which can lead to complaints due to over- and/or misload [5–8]. Physically, very high mechanical stimuli are conceivable in dance as well as in dance teaching. High mechanical stimuli can cause pain [9]. Pain is defined as a subjective, unpleasant sensation described in the context of an actual or potential tissue injury [9]. Acute pain can be interpreted as a warning signal of a tissue injury [9, 10]. Chronic pain persists beyond the time of tissue healing [9, 10]. The extent to which pain in dance signals a health hazard depends on various characteristics. In the relevant literature of dance medicine, two constructs of pain assessment from the subjective perception of dancers emerge: “Good” pain, or performance pain, is experienced as a natural consequence of physical exertion and is associated with performance and progress [11–13]. “Bad” pain, or injury pain, is related to acute injuries or chronic pain processes [11–13]; it interferes with dancing and is experienced as uncontrollable or difficult to control [12].

Pain is a common symptom in dance. Various studies show that more than half of the dancers at any point and/or in a 12-month period are affected by pain [11, 14, 15]. There are only few studies of complaints, such as pain and injuries, in DT. In the study by Lampe et al. [16] almost 80% of female DT reported pain during their professional practice or within 24 h after in a 12-month period. In the study by Wanke et al. [1], 78.2% of DT reported at least one necessary work interruption due to injuries or chronic complaints.

DT have, so far, hardly been the focus of medical research. There is currently no clear evidence whether a dance teaching activity promotes or damages the health of the musculoskeletal system [1, 4]. Hincapié et al. [6] report on factors influencing the prevalence of musculoskeletal injuries and pain in dance such as age, gender, previous injuries, the number of years of dance experience and training hours in their review. It is not clear whether these factors are also relevant in the occurrence of pain in DT. In any case, there are hardly any studies with multivariate analyses of risk factors of pain and injuries in dance. In a recent systematic review on low back pain and injury in dance by Swain et al. [17] only two studies could be identified that examined the risk of low back pain using a comprehensive analysis. Most analyses were univariate [17]. To our knowledge there are currently no studies investigating the risks of pain in dance teachers.

The aims of this study were a) to determine the prevalence, location and assessment of pain, the latter in terms of the subjective perception of dance as pain-influencing factor and the subjective evaluation of pain as “performance pain” or “injury pain”, in DT and b) to identify the determinants of pain occurrence during the 3-month period prior to the survey.

Materials and methods

Study design and sample

The present study is a retrospective cohort study. The data were collected anonymously by means of online questionnaires. The following inclusion criteria were defined for participation:

- full-time or part-time dance teaching activity in the semi- or non-professional area,
- age: at least 18 years old.

The study followed ethical research criteria. An ethics approval was obtained by the medical ethics committee of the Goethe-University Frankfurt am Main (No. 25/19). Potential study participants were informed about the purpose and the content of the survey and about the persons and institutions responsible for research in an accompanying letter. The chosen design ensured voluntariness and anonymity.

Content and development of the questionnaire

The pain aspects of the questionnaire were based on the Birbaumer and Schmidt scheme of pain perception and behavior [9]. The pain scheme includes aspects of pain perception, including the sensory and affective component, pain assessment (cognitive component) and pain behavior [9]. The operationalization of the pain aspects was carried out by modifying existing pain measuring instruments, taking into consideration dance-specific characteristics described in dance-specific literature [11–13, 18]. The questionnaire contained closed and partially open questions. The following blocks of questions were considered in the subsequent data analysis:

- (a) pain prevalence,
- (b) pain location,
- (c) pain assessment.

Block (a) contains information on pain during dancing or within 24 h thereafter, taking into account the temporal occurrence of muscle ache [19] during a 3- and 12-month period prior to the survey, respectively. A yes/no selection was used to indicate whether pain occurred in the mentioned time frames during or after dance classes. Only participants who reported pain in the context of dancing during the 3-month period answered the questions on detailed pain aspects, including pain location and assessment. The period was based on the validated pain sensation scale according to Geissner [20].

Block (b) contains information on pain locations in total, including the most severely affected body region, radiating pain (yes/no) and concomitant symptoms on an ordinal 4-point Likert scale from “not” (=0) to “very” (=3) (e.g., “Restricted in mobility” and “Less resilient”). For this research, only the pain locations in total are reported, as the other questions of this block contain information on a specific pain region which is not relevant to the research question of this paper. For this study a validated self-assessment of functional disability due to pain (SEFIP) with 14 body regions to assess pain was used [21]. In order to differentiate specific regions of complaints in dance, the authors listed the locations in more detail and included a right-left distinction for the extremities (Table 1).

Block (c) contained classifications on an ordinal 4-point Likert scale from “does not apply” (=1) to “applies exactly” (=4) on the influence of dancing in pain (caused, improved, aggravated) and on statements as to whether the pain is assessed more as a natural consequence of dancing (performance pain) or as injury pain based on the study by Anderson and Hanrahan [13]. A statistically validated assessment to assess the constructs of “good” and “bad” pain in dance is currently not available.

In addition, information on dance pedagogical activity was requested: employment relationship (part-time or full-time employed,

Table 1: Body regions of dance teachers in pain during the 3-month period (n=143).

Body region		n, %
Head and trunk		
Head		9 (6.3)
Neck/cervical spine		53 (37.1)
Upper back/thoracic spine		34 (23.8)
Breast		2 (1.4)
Lower back/lumbar spine/iliosacral joint		91 (63.6)
Stomach		5 (3.5)
Buttocks/pelvis		42 (29.4)
Upper extremity	**Right**	**Left**
Shoulder	22 (15.4)	23 (16.1)
Upper arm	5 (3.5)	1 (0.7)
Elbow	4 (2.8)	5 (3.5)
Forearm	0	3 (2.1)
Wrist	8 (5.6)	8 (5.6)
Hand	2 (1.4)	4 (2.8)
Lower extremity	**Right**	**Left**
Hip joints	39 (27.3)	34 (23.8)
Groin	26 (18.2)	26 (18.2)
Anterior upper thigh	11 (7.7)	6 (4.2)
Posterior upper thigh	9 (6.3)	13 (9.1)
Knee	56 (39.2)	58 (40.6)
Anterior lower thigh/shinbone	6 (4.2)	5 (3.5)
Posterior lower thigh/calf	14 (9.8)	12 (8.4)
Ankle joint	28 (19.6)	28 (19.6)
Back-/mid-foot	30 (21.0)	25 (17.5)
Forefoot and toes (except big toe)	17 (11.9)	20 (14.0)
Big toe	18 (12.6)	18 (12.6)

n, count; %, percentage.

or freelance), dance style, years of dance and teaching experience, lessons per week, as well as preparations for competitions and performances during the 3-month period (yes/no). Furthermore, typical sample parameters (gender, age, height, weight, injuries (yes/no), diseases (yes/no)) were collected. Injuries and diseases could be named in an open text field.

The questionnaire was created online via the survey server SoSci Survey. The practicability and quality of the questionnaire were checked in advance by representatives of the target population in a pretest. In the pretest, the pages of the questionnaire could be commented in a comment field. Additional questions were asked to determine the reasonableness of the questions and their order, the reasonableness of the processing effort and possible answer tendencies.

Data collection

The data collection took place over a period of 3 months between March and May, 2017. A non-probabilistic method was used in the sampling, which means that a non-randomly, convenience sample was generated [22]. The acquisition of participants was carried out through various associations with broad networks and numerous members in the dance community in Germany (Tanzmedizin Deutschland e. V. (tamed), German Professional Association for Dance Education e.V. (DBfT), Deutscher Tanzsportverband (DTV), Royal Academy of Dance (RAD), Dachverband Tanz), via e-mails to individual dance and ballet schools and via social networks on the Internet.

Data analysis

The statistical evaluation was carried out with Stata/IC 14.2. The descriptive statistics of the study sample and the variables collected were based on frequency, position and dispersion measures. Median ($\tilde{X}$) and interquartile distance (I_{50}) were given for non-normal distributed metric variables (age, weight, body mass index, year of dance teaching, hours per week). A binary logistic regression model was used to determine the most influential determinants of binary scaled pain occurrence within the 3-month period. The most influential determinants were determined from the sample parameters and the data on dance pedagogical activity. To reduce the number of possible determinants, variables with missing values of more than 20% were excluded as independent variables (e.g., "preparation for competitions"). In the next step, differences between DT with pain and DT without pain were statistically tested (Chi^2 test, Fisher exact test, Mann-Whitney-U test, t-Test in independent samples). Since there were no significant differences ($p<0.05$), the authors chose a higher limit of the p-value for the purpose of pre-selecting determinants for the regression: Only variables with a p-value <0.5 were included in further analysis. For the identified metric variables, pairwise Pearson correlations were performed. For correlations $r \geq 0.5$ [23], one of the two variables was eliminated. In binary logistic regression analysis, categorial variables were dummy-coded. In order to determine a meaningful regression model with as few variables as possible, a complete model with all preselected independent variables was tested against a reduced model omitting the variable with the highest p-value. The model was selected using pseudo R^2 (McFadden's), Akaike's information criteria (AIC) and Bayesian information criterion (BIC) [24, 25]. The larger the pseudo R^2, the better the quality of the model fitting results [25], whereas, the lower the AIC and BIC, the better the model matching is achieved [24]. The evidence for the superiority of a model is divided into weak (0–2), positive (2–6), strong (6–10) and very strong (>10) [24] according to the absolute difference between the BIC and AIC. For the final binary logistic regression model, the statistical parameters were determined. In order to quantify the influence of the determinants, both the odds ratios and the predicted probabilities (average marginal effects (AME)) with 95% confidence intervals were determined [25].

Results

Study sample

A total of n=166 DT (female: n=151; male: n=15) participated in the study. The participants were a median 45.0 (I_{50}=18.0) years old. The average height was 167.8 (sd=6.3) cm and the median weight was 60.0 (I_{50}=10.5) kg. The BMI (kg/m^2) was $\tilde{X}$=21.1 (I_{50}=3.2). According to the BMI, n=10 (6.0%) were underweight (BMI<18.5), n=134 (80.7%) were normal weight (BMI 18.5–24.9), n=15 (9.0%) were pre-obese (BMI 25.0–29.9) and n=3 (1.8%) participants had obesity (BMI>30). 122 (73.5%) of the DT were full-time employed (including n=106 self-employed or freelance and n=15 employed). 31 (18.7%) worked part-time as DT (including n=23 self-employed or freelance and n=8 employed). Most of the DT were active in artistic dance directions including ballet, modern/jazz dance, contemporary dance, hip hop. Only n=3 (1.8%) were dance sport teachers. On average, the DT had danced for 32.5 (sd=12.4) years. The median teaching experience was 18.0 (I_{50}=17.0) years. In the median, the DT taught 15.0 (I_{50}=12.0) hours per week. In the 3-month period, n=108 (65.1%) of the DT had prepared performances and n=19 (11.5%) had entered competitions.

The majority of DT reported neither to have suffered from diseases (n=116, 69.9%) nor from injuries (n=92, 55.4%). Of the n=49 DT with diseases, musculoskeletal findings, such as osteoarthritis (n=9), hip dysplasia (n=3) or scoliosis (n=2), as well as internal diseases, such as hypothyroidism (n=4), hypertension (n=3), diabetes (n=2), asthma (n=2) or rheumatism (n=2), were frequently mentioned. Occasionally, there were also psychological (depression, n=2), neurological (multiple sclerosis, stroke, n=2) or oncological (breast cancer, n=2) findings. Among the n=73 injured DT, ligament and tendon lesions (n=15), meniscus damage (n=14), disc protrusions (n=10) and muscle injuries (n=6) were common.

Pain prevalence

75.3% (n=125) of the DT reported pain while teaching in the past 12-month and 78.9% (n=131) reporting pain within 24 h thereafter. 70.5% (n=117) had been in pain while teaching in the past 3- month, with 78.3% (n=130) being in pain within 24 h thereafter. In total, 86.1% (n=143) of the DT reported pain within the 3-month period.

Pain locations

The total pain locations of the 3-month period of n=143 DT are shown in Table 1. The three most common pain locations included the area of the lower back, the neck or cervical spine and the knees.

Pain assessment

Table 2 shows the pain ratings of n=143 DT. Most DT (n=91, 63.6%) believed that dance contributed to their pain to some extent. A comparable number of DT stated that their pain was worsened by dancing to some extent (n=83, 58.0%). In each case 9.8% (n=14) were in complete agreement that dance was the exact cause of their pain and that pain was worsened by dancing. In contrast, only 41.3% (n=59) believed that dance offered a relief to their pain.

14% (n=20) were convinced that their pain had been induced by an injury and for 31.5% (n=45) this is in part true. In the belief of pain as a possible warning signal of an injury, a relatively even distribution of responses at the extremes and in the partial agreements is shown. 75.5% (n=108) agreed with the statement in parts or exactly. Only about half of the DT (n=65, 45.5%) assessed the pain as partially harmless.

Determinants of pain occurrence

Possible determinants of the occurrence of pain were age, BMI, the presence of diseases, employment (self-employed

Table 2: Pain assessment on a four-level scale of dance teachers in pain during the 3-month period (n=143).

	Does not apply (=1) n, %	Applies a little (=2) n, %	Applies largely (=3) n, %	Applies exactly (=4) n, %	Missing n, %
Influence of dancing on pain					
Cause of pain	20 (14.0)	48 (33.6)	43 (30.1)	14 (9.8)	18 (12.6)
Relief of pain	60 (42.0)	38 (26.6)	16 (11.2)	5 (3.5)	24 (16.8)
Worsening of pain	21 (14.7)	37 (25.9)	46 (32.2)	14 (9.8)	25 (17.5)
Performance and injury pain					
Pain is harmless and belongs to dancing as a natural consequence.	64 (44.8)	35 (24.5)	30 (21.0)	1 (0.7)	13 (9.1)
Pain is alarming and could be a warning signal of an injury.	22 (15.4)	39 (27.3)	44 (30.8)	25 (17.5)	13 (9.1)
Pain is induced by an injury.	57 (39.9)	22 (15.4)	23 (16.1)	20 (14.0)	21 (14.7)

n, count; %, percentage.

or freelance/employed) and the number of years of dance teaching experience (see Table 3). The years of teaching experience were not taken into account in the further analysis as there was a very strong correlation with age ($r=0.82$, $p<0.001$). There was no correlation between age and BMI ($r=-0.01$, $p=0.895$).

Only for 146 of the DT were the data sets of the possible determinants complete. When comparing the full model with the reduced model, the reduced model with the determinants age, BMI and diseases (pseudo $R^2=0.05$, AIC: 111.4, BIC: 123.4, n=146) proved to be more suitable than the full model with all variables (pseudo $R^2=0.05$, AIC: 113.1, BIC: 128.0, n=146). The evidence for this was "weak" according to the AIC (absolute difference=1.7) and "positive" according to the BIC (absolute difference=4.6). Using pseudo R^2 there no differences were observed.

Since the selected 3 determinants (diseases, age, BMI) were completely available in the total sample (n=160), this sample was used for further calculations. According to the calculations, the probability that the DT had been in pain during the 3-month period was significantly influenced by the variables included in the model (LR-$Chi^2=7.8$, $p<0.05$, pseudo $R^2=0.06$, n=160). The estimates of odds ratios (OR), their 95% confidence interval (CI) and changes in OR as a function of changes in determinants are presented in Table 4. The independent variables were not statistically significant ($p>0.05$) individually when the other variables were kept within their mean. It was found that the higher the characteristic values of the determinants were, the higher were the odds of pain occurrence during the 3-month period. The strongest increase in odds was observed in the presence of a disease. Here the odds increased by a factor of 2.8 (CI: 0.78–10.15) or by 180.8% in cases where a disease was present in comparison to the DT where no disease was present. However, the lower limits of the 95% CI of OR of the identified variables are below 1, which means that an increase in odds of pain occurrence is not clearly determined by the variables.

Figure 1 shows the odds ratios (OR) and the predicative average marginal effect (AME) with the 95% CI of the three determinants. The AME of the probability of pain occurrence in the presence of a disease was 0.098 (CI: −0.001–0.197); i.e., in the case of disease, the probability of pain occurrence increased, on average, by 9.8 percentage points compared to the non-existence of disease. The AME of age was 0.004 (CI: −0.0008–0.008) and the AME of BMI was 0.016 (CI: −0.008–0.0399).

The predictive marginal effects with 95% CI in the presence of disease, age and BMI are shown in Figure 2. If no disease was present, the probability of pain was 83.5%

Table 3: Sample parameters and information on dance teaching of DT with pain (n=143) and without pain (n=23) during the 3-month period.

	DT in pain	DT not in pain	Missing n (%)	p-Value
Gender female (f)/male (m)				
M (VR)	f (0.09)	f (0.09)	–	1.0[b]
Age, years*				
$\tilde{X}$ (I_{50})	45.0 (18.0)	38.0 (24.0)	1 (0.6)	0.09[c]
Body mass index, kg/m² *				
$\tilde{X}$ (I_{50})	21.3 (3.1)	20.2 (3.1)	4 (2.4)	0.09[c]
Diseases yes/no*				
M (VR)	no (0.32)	no (0.13)	1 (0.6)	0.06[a]
Injuries yes/no				
M (VR)	no (0.45)	no (0.39)	1 (0.6)	0.595[a]
Employment relationship				
full-time (ft)/part-time (pt)	ft (0.20)	ft (0.20)	13 (7.8)	1.0[b]
self-employed or freelance (se)/employed (e) *	se (0.14)	se (0.21)		0.49[b]
M (VR)				
Years of dancing				
$\bar{X}$ (sd)	32.7 (12.6)	31.4 (11.1)	4 (2.4)	0.65[d]
Years of dance teaching*				
$\tilde{X}$, (I_{50})	18.0 (16.0)	15.0 (15.0)	2 (1.2)	0.15[c]
Hours per week				
$\tilde{X}$ (I_{50})	15.0 (10.0)	18.0 (12.0)	4 (2.4)	0.87[c]
Performances yes/no				
M (VR)	yes (0.33)	yes (0.35)	3 (1.8)	0.91[a]

$\tilde{X}$, median; I_{50}, interquartile range; $\bar{X}$, mean; sd, standard deviation; M, mode; VR, variation ratio.
[a]Chi^2-Test, [b]Exakter Test after Fisher, [c]Mann-Whitney-U-Test, [d]t-Test.
*p<0.5, difference between both groups as preselection criterion for the regression.

Table 4: Estimates of the odds ratios of determinants using binary logistic regression of pain during the 3-month period in DT (n=160).

	Odds ratio (95% CI)	Change in odds for unit increase in the determinant in %	Change in odds for sd increase in % (sd of the determinant)	p-Value
Diseases, yes	2.81 (0.78–10.15)	180.8	–	0.12
Age	1.03 (0.99–1.08)	3.3	47.0 (sd=11.8)	0.11
Body mass index, BMI	1.15 (0.93–1.42)	15.4	48.5 (sd=2.8)	0.18

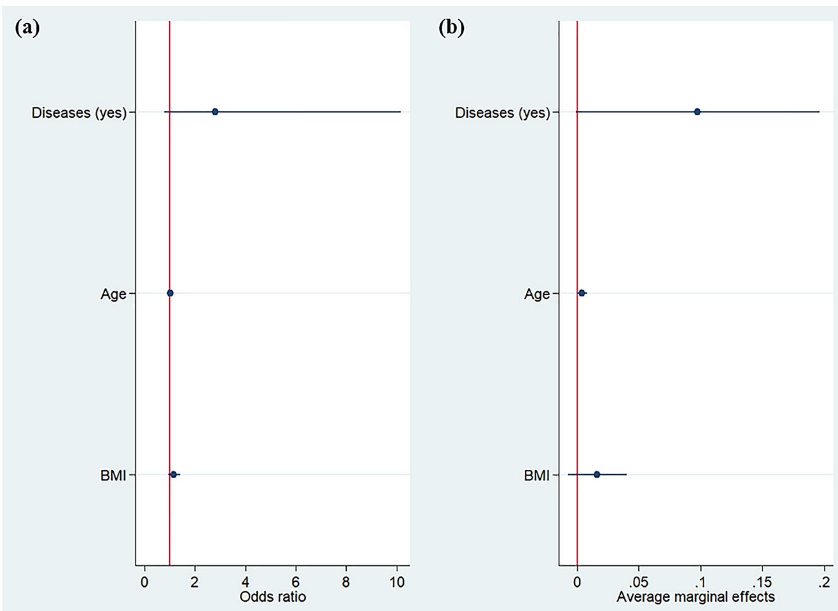

Figure 1: (a) Odds ratios (OR) and (b) average marginal effects (AME) with 95% CIs of pain occurrence in dance teachers for the determinants disease, age and BMI during the three-month period.

(CI: 76.9–90.2). This increased to 93.3% (CI: 85.99–100.6) if a disease was present. At the lowest age of 19 years, the probability was 75.6% (CI: 58.9–92.4) and at the age of 70 years it was 94.0% (CI: 86.8–101.2). At the lowest BMI of 16 kg/m^2, the probability of pain was 75.2% (CI: 54.8–95.5) and at the highest BMI of 35 kg/m^2, it was 97.7% (CI: 91.1–104.3).

Discussion

The 12- and 3-month pain prevalence of DT during and within 24 h after dance classes was very high with over 70% and is comparable to pain prevalence in professional dancers. In the study by Ramel et al. [15], the 12-month pain prevalence of professional ballet dancers was around 90%, although this study did not differentiate between the occurrence of pain during or after dancing. Thomas and Tarr [11] and Dore and Guerra [14] found a point prevalence of 78 and 70.2% respectively for professional dancers.

The pain indicated here is localized in frequent stress and discomfort body regions in dance (lower back and lower extremity) [6, 7]. This leads to the assumption that a long-term activity in dance or in dance mediation may become a possible influencing factor in the occurrence of pain. The DT's subjective pain assessments also support this assumption, as only 14% did not suspect the cause of their pain to be dancing. The certainty that other factors seem to be relevant in the occurrence of pain is shown by the fact that the cause of pain by dancing was only exactly true for about 10% of the DT. A large proportion of the DT assessed the pain neither as harmless, in the sense of a natural consequence of dancing, nor as being directly caused by an injury. The pain assessment suggests that pain occurs in DT under multifactorial conditions.

The best fitting logistic regression model included three possible determinants of the occurrence of pain in DT in the 3-month period: the BMI, age and the presence of a disease. However, none of the variables investigated could be identified as a significant, clear factor for an increase of risk of pain occurrence in this sample of DT as the lower limits of the 95% CI of OR of the identified determinants are below 1. Based on substantive considerations, it is likely that the identified determinants tend to increase the odds of pain

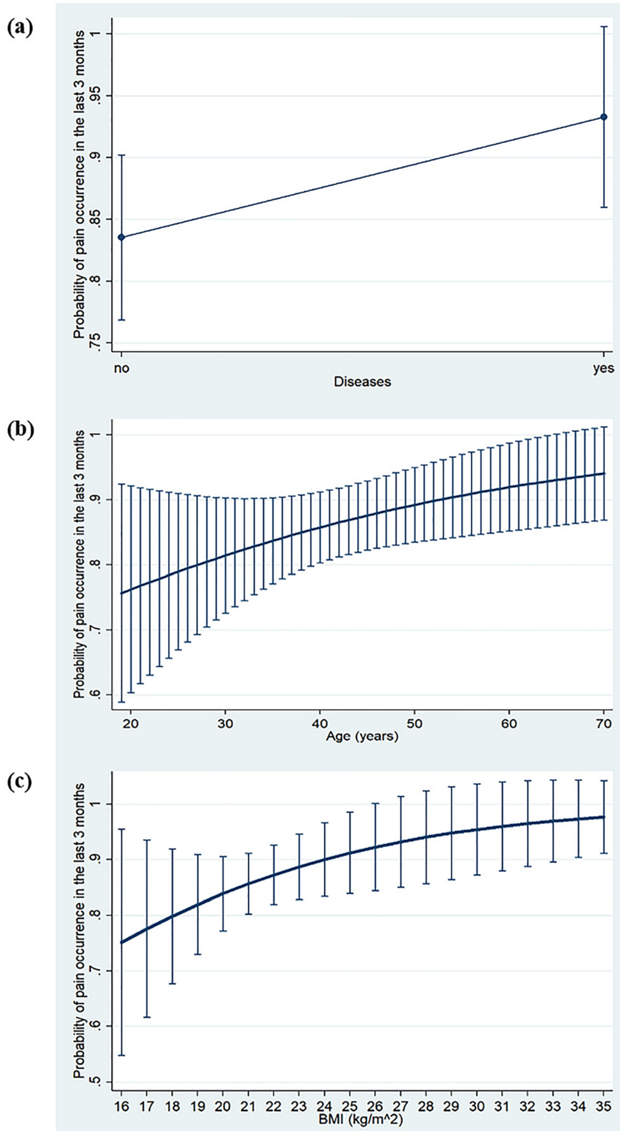

Figure 2: Predictive marginal effects with 95% CIs of the probability of pain occurrence in the three-month period for dance teachers with the determinants (a) disease, (b) age, and (c) BMI.

occurrence in DT, which will be discussed below. Since studies on DT are rare, especially on pain, and there is also little explanatory evidence on pain in dance, the results of this study will be discussed in comparison with studies in a broader context of dance medicine research. It should be considered that a comparison between DT and dancers is only indirectly possible, since the target groups are different.

Height, weight and age may be associated with pain in dance. In the study by Ramel and Moritz [26], univariate static analyses in professional ballet dancers showed significant differences in the prevalence of musculoskeletal complaints in certain body regions with regard to height, weight and age. Dancers with complaints in their knees, ankle joints/feet and wrists/hands were significantly taller, whilst dancers with complaints in their knees were significantly heavier and dancers with complaints in their shoulders and ankle joints/feet were significantly older than those without these complaint regions (p<0.05) [26]. In the multivariate analysis of this study, the BMI (calculated from height and weight) and age were also found to be potential determinants of pain occurrence in DT. However, the comparability of the study of Ramel and Moritz [26] with this study is limited due to the different statistical methods used. It should be noted that most of the participants in this study were of normal weight (according to BMI). Only a few DT were under- or overweight. It should also be considered that the confidence intervals of the predictive marginal effects in low or high BMI are wider than in the normal BMI range. The prediction of the probability of pain occurrence by the logistic regression model is less precise in ranges of the larger confidence intervals.

The age of the teacher, as a determinant, showed a significant, positive correlation with the years of dance teaching experience (r=0.82, p<0.001). DT who experienced pain during the 3-month survey period were a median 7 years older (p=0.09) and were 3 years longer active in their profession (p=0.15). Various studies have shown that the occurrence of musculoskeletal complaints is related to the age and years of dance experience. Mitetic et al. [27] found significantly more pain in the lower back region (p<0.01), shoulders (p<0.05) and hips (p<0.05) of male competition dancers with increasing age. In the study of professional ballet dancers by Dore and Guerra [14], a significant, positive correlation of the intensity of pain in the neck with the age at which they first started dancing was found (r=0.16, p=0.04). Furthermore, Jacobs et al. [28] identified the years of professional dance practice among ballet dancers as a determinant for function-limiting pain on the self-estimated functional inability because of pain (SEFIP) with a score of ≥3. For 9–15.4 years of professional practice (OR=4.00; 95% CI: 1.47–10.91, p=0.007) and for ≥15.5 years of professional practice (OR=4.40; 95% CI=1.58–12.28, p=0.005), the odds ratio for a SEFIP ≥3 increased significantly [28]. In contrast to the studies mentioned above, Swain et al. [29] found no significant correlation between the age or years of dance experience (p>0.05) among pre-professional and professional dancers at any point in their lifetime and the prevalence of low back pain. Dance students from the age of 12 years upwards ($\overline{X}$(sd)=17.8 (2.9)) [29] taking part in this survey were, admittedly, relatively young. Therefore, it cannot be ruled out that the significance of age, as a determinant for the occurrence of complaints, increases with the increasing length of dance practice in the context of prolonged strain in and through dancing as a profession.

In dance, symptoms of overload and chronic complaints, especially of the lower back and lower extremities, are frequent [6]. Rietveld [30] refers to older dancers and DT, aged 45 and over, as having predominant problems of degenerative changes, such as arthrosis, which occur primarily in the back and lower extremity body regions. In this study, the presence of a disease was shown to be potential determinant of the occurrence of pain in DT. Among the musculoskeletal findings, arthrosis was mentioned most frequently. With a frequency of 58.8%, arthrosis was also the most frequent orthopedic disease among the DT surveyed in the study by Wanke et al. [1]. Arthrosis is a degenerative process which is associated with pain and loss of function of the affected joint [31]. Biomechanical factors such as joint instability and/or malposition, obesity and increasing age favor the development of osteoarthritis [31]. Thus, the potential determinants identified in this study, in combination with the physical strain of dance teaching, may act as potential triggers for the development of osteoarthritis and associated pain. In addition to musculoskeletal findings, diseases experienced by the DT often included internal diseases and, in some cases, psychological, neurological and oncological diseases. In the context of diseases, apart from the direct symptom of pain in a disease such as arthrosis, an increased vulnerability is also conceivable which may cause pain in ill DT. With regard to the determinant of the diseases, however, it should be borne in mind that the 95% CI of the odds ratio and the predictive marginal effects varied relatively widely.

Limitations and recommendations for future research

The representativeness of the sample may be limited by the non-probabilistic sampling method used [22]. An indication that the sample of this study may be representative of DT in Germany provided by the study by Wanke et al. [1] on the health status of n=165 DT in Germany in 2012. The randomized sample in Wanke et al. [1] shows parallels in terms of gender distribution (female: n=154, male: n=11), weight ($\overline{X}$=59.8 kg), height ($\overline{X}$=167.1 cm), age ($\overline{X}$=46.1) and years of dance teaching activity ($\overline{X}$=17.0) with the sample in this study.

The pain prevalences of this study may be overestimated in so far that the self-selective participation in the study primarily motivated DT with pain to participate. Therefore, there is a potential selection bias and a limited generalizability of results. The number of participants without pain in the 3-month period was very low, therefore, relatively little information on sample parameters and dance pedagogy among DT without pain was included in the analysis. Furthermore, a recall bias is conceivable, as the questionnaire asks for pain during the last 12 or 3-months.

When interpreting the results, it should be taken into account that with a significance level of α=0.05 no significant differences between DT with pain and DT without pain are shown (Table 3). For the pre-selection of the determinants of the regression model, a probability of error to reject the null hypothesis of less than 50% was chosen ($p<0.5$) in order to identify a higher number of potential determinants for the model.

The diseases and injuries in this study were self-reported so there were no uniform definitions. To what extent these were medically diagnosed or, rather, self-diagnosed diseases and injuries remains unclear. In addition, the differentiation between disease and injury does not always seem clear since, in two cases, for example, “arthrosis” was mentioned among the injuries.

Future studies should aim at random sampling to improve the representativeness of the sample and thus the generalizability of results. In order to draw conclusions as to the extent to which professional practice of dance influences the occurrence of pain, it is recommended to compare the study group with a control group without dance history. In view of dance history in DT, the years of dance experience, which were surveyed globally in this study, should be differentiated according to previous non-professional, pre-professional and/or professional dance episodes. The validity of the determinants identified in this study should be further investigated. In addition, the information on dance teaching should include questions on the age and dancing level of the students, as well as on the percentage of the type of dance teaching (e.g., sitting, indicating, full movement demonstration). Furthermore, it should be taken into account that DT can also be active as dancers or have been active as such. This information should also be collected.

Conclusion

In view of the most frequently affected pain locations in DT (lower back and lower extremity), which are commonly affected in dance, and DT’s subjective assessment of pain, dancing activity seems to play a role in pain development. However, it also becomes clear that the occurrence of pain is multifactorial. Thus, pain occurrence in DT seems to be favored by context factors, such as the BMI, age and the presence of diseases. Challenges lie in the aging- and ageappropriate work design of the DT. In order to prevent premature signs of wear and tear, the avoidance of overload and false training is highly relevant throughout the entire (professional) dance career. Furthermore, if a disease is present, a periodization (e.g., the planning of sufficient recovery times) and suitable behavior (e.g., a balanced way of teaching dance – either sitting, or indicating, or by fully demonstrating movements) are sensible strategies in order to avoid further health impairments. As a practical advice, education on pain as a warning signal should take place at an early stage in a dance career.

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