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Original Research

Dance exposure, general health, sleep and injury in elite adolescent Irish dancers: A prospective study

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ABSTRACT

Objectives: To investigate dance exposure, sleep, general health and injury in elite adolescent Irish dancers.
Design: Prospective study.
Setting: Six Irish dance schools in Ireland.
Participants: Thirty-seven elite Irish dancers, aged 13-17, competing at the highest championship level for at least the previous year.
Main Outcome Measures: Self-reported weekly hours of dance, general health, sleep quality, monthly and annual height and weight, injury incidence.
Results: Overall injury incidence (time-loss plus non-time-loss) and time-loss only injury incidence were 9.3 injuries, and 4.5 injuries, per 1000 hours of dance respectively. At least one injury was incurred by 86.5% of participants, with the foot/ankle most commonly affected. There were no statistically significant associations ($p>0.05$) between injury and sleep quality, or annual change in height/weight. There was some evidence of a statistically significant association between injury and health quality, with poorer health associated with increased levels of injury. There was no evidence of a statistically significant association between the probability of injury over time and sleep quality one week earlier, health quality one week earlier, or training load one and two weeks earlier.
Conclusions: The incidence of injury in elite adolescent Irish dance is considerable with many dancers continuing to dance when injured. Increased dance exposure is associated with new injury.

1. Introduction

Dance is a popular physical activity practiced by youths internationally (Australian Bureau of Statistics, 2012; Canadian Youth Sports Report, 2014). Irish dancing (ID) has become increasingly popular, with schools in over 40 countries worldwide (An Coimisiun le Rinci Gaelacha, 2018). The relatively recent professionalisation of ID following the international success of productions including "Riverdance" has precipitated competitiveness at the amateur level, resulting in increasingly complex, demanding choreography. Compared with other genres, there are no conservatoires where young Irish dancers can pursue both dance and academic studies simultaneously. ID classes happen outside of school hours with elite dancers likely attending several weekly classes, and practicing at home on days when not at class. ID is overwhelmingly focussed on competition, with dancers tiered according to ability (Noon, Hoch, McNamara, & Schimke, 2010). The most accomplished dancers compete at "open" or championship level, at national and international events. The pinnacle event is the annual World Irish Dancing Championship, which requires qualification via a regional or national event.

The biopsychosocial benefits of dance for adolescents are roundly acknowledged and may include improved body image, self-confidence, cardiovascular health, and fitness (Burgess, Grogan, & Burwitz, 2006; Connolly, Quin, & Redding, 2011). However, high rates of injury and disablement compared to other

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performer cohorts have been reported in young elite dancers across multiple genres (White, Hoch, & Hoch, 2018). Studies of adolescent ballet dancers have reported an association between increasing age and injury incidence, particularly during puberty (Bowerman, Whatman, Harris, Bradshaw, & Karin, 2014; Leanderson et al., 2011). However, factors affecting well-being in adolescent ID are poorly understood, with limited investigations to date. Previous studies are largely retrospective, reporting primarily on the injury epidemiology (Noon et al., 2010; Stein et al., 2013). Furthermore, these studies have included participants who were recreational dancers, and/or were not limited to adolescent cohorts. A prospective investigation in elite adult ID has identified a plethora of risk factors for injury including poor sleep, multiple painful bodily sites and higher levels of anger/hostility (Cahalan et al., 2016). However, immature skeletal and neuromuscular structures (Stracciolini, Hanson, Kiefer, Myer, & Faigenbaum, 2016) coupled with tumultuous psychological change (Rowan & Wilson, 2017) all distinguish adolescence as a period of immense challenge for the young dancer. Findings in adult cohorts may therefore not be applicable to younger ID participants.

Greater dance exposure has been linked to an increased injury vulnerability in young talented dancers (Steinberg, Aujla, Zeev, & Redding, 2014). The impact of dance exposure on dancer well-being is a developing area of dance science (Lee, Reid, Cadwell, & Palmer, 2017) but has not previously been investigated in adolescent ID. Furthermore, despite the acknowledged importance of non-physical risk factors for dancer well-being (Molnar & Esterson, 1997) these factors are under-investigated across all genres. The aim of the current study was to establish the rates of time-loss and non-time-loss injury in this cohort. Furthermore, to explore the impact of dance exposure (hours of dance activity), cross−training, sleep, general health and physical growth on injury in elite adolescent ID participants.

2. Methods

2.1. Participants

A sample of convenience of thirty-seven elite Irish dancers (four male, 33 female) aged 13 to 17 were recruited by the main author who is a physiotherapist, ID teacher and former professional Irish dancer. The female/male ratio y reflects participation by the sexes within competitive ID at this age. Participants were recruited from six ID schools in Ireland and were required to be actively competing at open (elite) level for a period of at least twelve months. Written informed consent was obtained from participants and their parents/guardians.

2.2. Data collection

Data was collected at baseline using an online self-report questionnaire to establish demographic, injury and dance history data (Cahalan, Bargary, & O'Sullivan, 2018). Participants then completed a brief online questionnaire each week for one year (Cahalan et al., 2018a,b). The questionnaire was based on previous research in other ID cohorts (Cahalan et al., 2016), as well as considering emerging research highlighting the role of injury definition (Kenny, Palacios-Derflingher, Whittaker, & Emery, 2017) and the impact of load on injury (Lee et al., 2017). This detailed the number of weekly hours of dance activity and cross-training undertaken. Weekly general health and sleep quality were measured on a Likert scale from 1 to 5 (1 = Very good; 5 = very poor) (Cahalan et al., 2016, 2018a,b). Participants reported the weekly details of any injury sustained, body part involved, perceived cause, diagnosis where known, duration of the injury (number of days affected), and impact upon their ability to dance (fully able, partially able, or completely unable to dance that week). Where participants could dance partially, the percentage of normal dancing activity undertaken was reported. Injury was defined as "any pain or injury that impacted upon your ability to dance". This definition reflects the inadequacy of time-loss definitions to fully record all episodes of pain, discomfort and/or injury experienced (Kenny, Palacios-Derflingher, Whittaker, & Emery, 2018). Injuries to the same anatomical site and side of the body on consecutive weeks were considered to be the same injury. A minimum of a four-week injury-free gap between reports of injury to the same anatomical location was required before the second injury was recorded as a new injury (Cahalan et al., 2018a,b). Participants were advised to disregard any illness such as head colds. For uninjured dancers, the weekly survey took less than 1 min to complete. For injured dancers, the questionnaire required approximately 3 min to complete. Weekly email reminders were sent to encourage compliance. The weight and height of participants were also recorded at baseline and each month. Initial measures were taken by the investigators with dance teachers responsible for collecting the remaining monthly measures.

2.3. Statistical analyses

Descriptive analysis of the data was performed to establish the injury prevalence, defined as the total number of injuries reported over the study period, across the cohort. The injury incidence rate over the year was calculated as the number of injuries per 1000 h dance exposure. The injury incidence rate was calculated separately for all injuries, and time-loss injuries only. Descriptive statistics are reported as the mean and standard deviation (SD) for symmetrically distributed variables, the median and interquartile range (IQR) for skewed variables, and relative frequencies (in %) for categorical variables. Graphical representations of the data (histograms, boxplots, violin plots, QQ-plots) were used to assess the distributions of the continuous variables. A Poisson regression model was fitted to investigate the joint impact of the potential risk factors; change in weight, growth, number of weeks of poor sleep, number of weeks of poor health and the average number of hours danced per week, on the total number of injuries (Y_1). A negative-binomial regression model was fitted to investigate the impact of these risk factors on the total number of weeks injured (Y_2), since there was evidence of over-dispersion. To assess the joint impact of training load and other risk factors on the probability of being injured each week, a mixed effects logistic regression model was used to appropriately account for the correlation between measurements made on the same dancer over time. All analyses were carried out using the R statistical software package (Team R Development, 2017). The significance level was set at $\alpha = 0.05$, with Bonferroni adjustments applied where necessary to adjust for multiple testing.

2.4. Ethical considerations

Ethical approval was granted by the ethics committee of the local University.

3. Results

Follow-up survey completion rates over the one-year period varied from 67.6% (25/37) to 100% (37/37) per week. The average weekly completion rate was 93.2%, which was facilitated by dancing teachers and parents who encouraged adherence by participants. Once a month, questionnaires also included measurement of weight and height. Where participants did not complete the weight/height component, they were unable to progress

through to the end of the questionnaire, thus the questionnaires featuring weight/height questions were completed less frequently. Two participants were lost to the study during the final 2 months as they ceased dancing.

3.1. Injury

There were 130 reported injuries involving 32 dancers (86.5%) over the study period (Table 1). Five dancers (13.5%) were uninjured, with four dancers (10.8%) reporting only one injury over the year. Eighteen participants (48.6%) reported between two and four injuries, while the remaining ten participants (27.1%) reported between five and eleven injuries over the study period. The median number of reported injuries per dancer over the year was 3 (IQR = 2, 5). The median number of weeks injured over the year was 6 (IQR = 2, 13). Regarding severity as defined by days of dancing affected by injury (Ojofeitimi, Bronner, & Woo, 2012), 90 (69.2%) injuries were mild in nature and resolved within one week, while 24 (18.5%) injuries were moderate and had resolved within four weeks. The remaining sixteen injuries (12.3%) were severe, requiring longer than four weeks to resolve. The median duration for an injury was 1 (IQR = 1, 2) week.

The 130 reported injuries resulted in a total of 863 days of being unable to dance, and an additional 169 days of reduced ability to dance. Participants continued to dance fully while injured on 136 days. The median number of days fully lost to injury was 11.5 (IQR = 6.5, 36.75). The median number of days partially lost to injury was 3 (IQR = 1.5, 6). The median percentage of normal dancing activity when partially dancing on days when injured was 70% (IQR = 50, 80%). Sixty three of the 130 injuries (48.5%) were time-loss injuries, indicating that dancers still danced either partially or fully while injured in over 50% of cases. The overall injury incidence rate for all injuries was 9.3 injuries per 1000 h danced (defined as the total number of injuries/total number of hours danced). The injury incidence rate for time-loss injuries only was 4.5 injuries per 1000 h danced (defined as the total number of time-loss injuries/total number of hours danced).

The anatomical site most affected was the foot/ankle region (n = 45, 34.6%). (Table 2). Participants perceived that overuse/excessive dancing accounted for 42.9% of all episodes of injury, with accident (11.5%), growth (8.4%) and choreography/technique (8.1%) also identified as common factors. Twelve injuries (9.2%) had multiple diagnoses recorded and three injuries had no diagnosis recorded. Of the remaining 115 injuries, the majority (58.3%) had an unclear/unknown diagnosis, while a further 20.9% were muscular in nature. Joint pathology (7.8%), tendinopathy (6.1%) and shin splints (2.6%) were also reported. The remaining injuries included fracture (1.7%), inflammation (1.7%) and infection (0.9%).

Table 1
Frequency distribution for the number of injuries reported by participants.

Number of injuries	Number of participants	Percentage of overall injuries
0	5	13.5
1	4	10.8
2	8	21.8
3	6	16.2
4	4	10.8
5	3	8.1
6	3	8.1
7	0	0
8	0	0
9	0	0
10	1	2.6
11	3	8.1
n = 130	**n = 37**	**100%**

Table 2
Frequency distribution of body part injured for each reported injury.

Body part	n (%)
Foot/ankle	45 (34.6)
Thigh	16 (12.3)
Lower back	15 (11.4)
Groin	14 (10.8)
Knee	14 (10.8)
Calf	10 (7.7)
Shin	7 (5.4)
Buttocks	6 (4.6)
Ribs	1 (0.8)
Shoulders	1 (0.8)
Upper back	1 (0.8)
	130 (100)

3.2. Dance exposure and cross-training

The mean weekly dance exposure over the year was 7.9 h, ranging from 4 to 12 h per week. There was variability week-to-week in dance exposure with peaks and dips evident (Fig. 1). From the Poisson model, there was no evidence of a statistically significant relationship between the total number of injuries (Y_1) and the average number of hours danced per week ($p = 0.11$, exp(B) = 0.91, 95% CI for exp(B):[0.82, 1.02] (exp(B) reflects risk ratio). However, from the negative-binomial model there was some evidence of a statistically significant relationship between the total number of weeks injured (Y_2) and the average number of hours danced per week ($p = 0.001$, exp(B) = 0.80, 95% CI for exp(B):[0.69, 0.92]). For every additional hour danced per week, the total number of weeks injured decreased by a factor of 0.8. The median number of hours of cross-training remained reasonably constant throughout the year at two (IQR 1, 3) hours per week. No data were collected on the nature of cross-training activities.

3.3. Annual weight and height changes

The mean weight gain over the study period was 3.7 (SD = 3.3) kg. The median growth in height was 3 (IQR = 2, 7) cm. From the Poisson regression model, there was no evidence of a statistically significant relationship between total number of injuries (Y_1) and change in weight ($p = 0.19$, exp(B) = 0.94, 95% CI for exp(B): [0.87, 1.03]) or height ($p = 0.13$, exp(B) = 1.06, 95% CI for exp(B): [0.98, 1.14]). From the negative-binomial model, there was no evidence of a statistically significant relationship between the total number of weeks injured (Y_2) and the change in weight ($p = 0.30$, exp(B) = 0.95, 95% CI for exp(B): [0.86, 1.04]) or height ($p = 0.22$, exp(B) = 0.1.06, 95% CI for exp(B): [0.97, 1.18]).

3.4. Sleep and general health

Most participants reported their general health and sleep as being very good or good for most of the year. Only three participants regularly reported having poor or very poor health (between 23.1% and 34.4% of the study period) with three participants regularly reporting poor or very poor sleep (between 31.4% and 44.2% of the study period). From the Poisson regression model there was a statistically significant association between the total number of injuries (Y_1) and number of weeks participants reported poor/very poor general health ($p < 0.001$, exp(B) = 1.17, 95% CI for exp(B):[1.10, 1.25]), where for each additional week of poor health, the number of injuries increased by a factor of 1.17. There was no evidence of a statistically significant relationship between the total number of injuries (Y_1) and the number of week participants

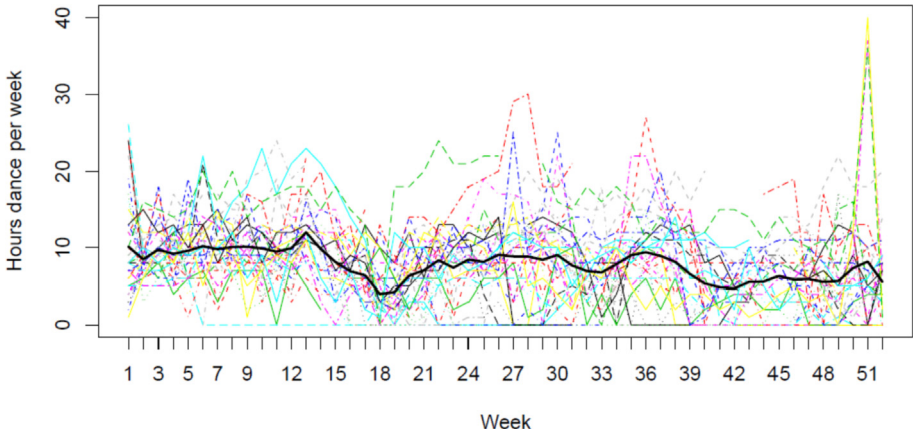

Fig. 1. Dance exposure: Variability across the year by individual dancers. The solid black line is the mean number of hours danced per week over all participants.

reported poor/very poor sleep ($p = 0.11$, exp(B) = 0.96, 95% CI for exp(B):[0.91, 1.01]).

From the negative-binomial model, there was some evidence of a statistically significant association between total number of weeks injured (Y_2) and number of weeks participants reported poor/very poor general health ($p = 0.01$, exp(B = 1.15, 95% CI for exp(B):1.04, 1.29]), indicating that those with better general health had fewer weeks of injury. For every additional week of poor health, the total number of weeks injured increased by a factor of 1.15. There was no evidence of a statistically significant relationship between the total number of weeks injured (Y_2) and the number of weeks participants reporting poor/very poor sleep ($p = 0.21$, exp(B) = 0.95, 95% CI for exp(B):[0.89, 1.03]).

3.5. Probability of injury over time

A mixed effects logistic regression model was fitted to model the probability of being injured each week using the following risk factors; general health quality one week previous, sleep quality one week previous, and the number of hours danced (i.e. training load) one and two weeks previous. A random effect for participant (random intercept) was included in the model to account for correlation between measurements made on the same participant. There was no statistically significant relationship between injury and any of these factors (Table 3).

4. Discussion

This is the first prospective study of elite adolescent Irish dancers investigating dance exposure, sleep, general health, and injury. Injury rates were substantial, predominantly affecting the lower limb, with participants frequently dancing while injured. Most participants reported good general health and sleep quality. An increased risk of injury was associated with poorer general health and reduced dance exposure, but not with sleep quality or change in weight or height.

Table 3
Odds ratio estimate, 95% confidence intervals and p-values for the mixed effects logistic regression model.

Risk factor	Odds Ratio	95% CI for Odds Ratio	p-value
Hrs dance (1 week before)	1.02	[0.98, 1.05]	0.33
Hrs dance (2 weeks before)	0.98	[0.94, 1.01]	0.20
Sleep (1 week before)			
Good/very good vs neither	0.99	[0.64, 1.58]	0.98
Poor/very poor vs neither	1.08	[0.53, 2.11]	0.83
Health (1 week before)			
Good/very good vs neither	0.83	[0.52, 1.35]	0.43
Poor/very poor vs neither	0.62	[0.27, 1.32]	0.23

4.1. Injury

Findings regarding anatomical location of injury (Bowerman, Whatman, Harris, & Bradshaw, 2015), perceived causes (Bowerman et al., 2014; Ekegren, Quested, & Brodrick, 2014) and diagnoses (Yin, Sugimoto, Martin, & Stracciolini, 2016) are in consistent with research in cross-genre adolescent elite dancers. In this study, 86.5% of participants reported at least one injury over the year, consisting with previous research in ID cohorts (McGuinness & Doody, 2006; Cahalan, Bargary, et al., 2018). In comparison, a five-year study of young ballet dancers found that between 32% and 51% of participants were injured annually (Gamboa, Roberts, Maring, & Fergus, 2008) and a large study of 1,336 adolescent dancers from a variety of genres reported that 42.6% of participants reported an injury during the screening period (Steinberg et al., 2011). The injury rate in the current study (9.3 injuries per 1000 h danced for all injuries, and 4.5 injuries per 1000 h danced) compares to injury rates of 4.7 and 1.38 per 1000 h of dance in two study cohorts of pre-pre-professional adolescent ballet students (Ekegren et al., 2014). Comparing the level of injury in dance is hampered by inconsistency in the definition of injury, with a single time-loss definition frequently understating the injury incidence (Kenny et al., 2017). However, these preliminary results would suggest a high instance of injury in ID when compared to elite adolescents from other genres.

The reasons underlying the considerable rate of injury in ID remain unclear; however, there are several plausible hypotheses. ID in comparison to other more established genres of dance, lacks guidelines for dancer progression, such as readiness for pointe work in ballet (Hewitt, Mangum, Tyo, & Nicks, 2016). In ID, dancers can progress to more complex movements when aged 12 years. This may mean that dancers are being progressed prematurely, when not physically prepared for more advanced choreography. Regarding choreography, ID requires that the hands are held by the side of the torso, and the genre eschews the plié on landing from jumps, favouring landing on a plantar-flexed foot and extended knee. These and other genre–specific requirements increase the proprioceptive demands on, and ground reaction forces experienced by, the dancer (Trégouët & Merland, 2013). Finally, ongoing participation in a year-long competitive calendar, such as that available in ID, may cause physical and psychological burnout in adolescent athletes (DiFiori et al., 2014). This is possibly

exacerbated given the variability in dance exposure evident in this study.

Due to the expanded definition of injury used in this study, it is evident that participants frequently continued to dance, either partially or fully, when injured. This may indicate that the level of discomfort suffered by the participants was minimal and did not impede their dancing. Alternatively it may suggest a subculture of injury concealment, reflected in the adage that "the show must go on" (McEwen & Young, 2011). Continuing to dance when injured may indicate a maladaptive passion for dance, previously linked to a reticence to seek appropriate medical care, and injury chronicity (Rip, Fortin, & Vallerand, 2006). There was a high proportion of injuries in this study with unclear/unknown diagnoses, which may again indicate a culture of subterfuge, where dancers are unwilling to reveal their injuries. Alternatively, it may suggest that the injuries were minor, and participants felt confident to manage them themselves. Dance educators and clinicians must therefore be mindful of the implications of potential strategies employed by dancers regarding injury.

4.2. Dance exposure and cross-training

In this cohort, weekly dance exposure was relatively low (mean = 7.9 h/week), but with much variability over the course of the year. This compares to 30.3 h per week of dance undertaken by adolescent students of pre-professional ballet over their academic year (Ekegren et al., 2014). This may reflect that ID is undertaken in addition to school and other activities, unlike dancers attending dance-specific educational establishments. Also, ID is a particularly high intensity and ballistic activity, and long hours of practise may be less sustainable than in other genres. The impact of dance exposure is a relatively under-investigated phenomenon in dance, but findings in pre-professional ballet and modern dance students suggest a significant association between greater dance exposure and injury ($B = 0.003$, 95% CI 0.001–0.006, $p = 0.016$) (Lee et al., 2017).

The potential benefits of periodisation in dance are known (Wyon, 2010), and research in several sports have found an association between acute training exposure and injury (Windt & Gabbett, 2017). In the current study, increased weekly hours of dance training were associated with a decreased total number of weeks injured. This may suggest the training paradox described in sporting literature where increased load is protective up to a point, at which excess load can render the athlete more susceptible to injury (Gabbett, 2016). Education for clinicians and dance practitioners on load monitoring, periodisation and tapering is recommended, with avoidance of sudden peaks in training load to ameliorate injury risk.

ID is practiced outside of academic hours, thereby often conflicting with mealtimes, homework and social commitments. This demanding timetable frequently leads to specialisation in ID prior to puberty, which has been linked to increased injury rates in other athletic groups (Jayanthi, Pinkham, Dugas, Patrick, & LaBella, 2013). The minimal level of cross-training undertaken may suggest such specialisation in this cohort. The benefits of cross-training in dance include improved aerobic capacity and preparation for a professional career (Bronner, Codman, Hash-Campbell, & Ojofeitimi, 2016). Appropriate cross-training may be even more important in ID, which stylistically has a comparatively limited repertoire of movement, with a concomitant over-reliance on a smaller number of muscle groups. Additionally, technique classes, which feature prominently in ballet and contemporary dance, are uncommon in ID. Guidelines from the International Association of Dance Medicine and Science recommend multiple weekly sessions of supplementary training to address various facets of anaerobic and aerobic fitness, power, endurance, strength, flexibility, neuromuscular control and body composition in dancers (IADMS, 2011). Further research is required to evaluate the efficacy of such cross-training on injury and performance in ID, but there is scope for clinicians and trainers to address these deficits to build a more robust dancer.

4.3. General health, growth, sleep and

Previous findings in adult Irish dancers have shown an association between poorer subjective general health and injury (Cahalan, Purtill, O'Sullivan, & O'Sullivan, 2015). Non-injury related illness is rarely studied in dancer cohorts with health promotion emphasising injury prevention and performance (Roussel et al., 2014). However, it has been established that illness is predictive of injury in elite competitive athletes (Timpka et al., 2017) and is an important consideration in dancer well-being. The participants in this study reported largely very good/good health; however, some associations were found between injury and poor general health. Nonetheless, it is acknowledged that general health is multifactorial (Huber et al., 2011) and requires more rigorous exploration than was possible in this study.

Growth-related pain and injury in dancers is a common phenomenon (Yin et al., 2016) with Severs and Osgood-Schlatter's disease particularly prevalent in ID (Beasley, Stracciolini, Tyson, & Stein, 2014; Kadel, 2017). Growth-related changes are associated with epiphyseal traction, impaired proprioception and strength (Arnold, Thigpen, Beattie, Kissenberth, & Shanley, 2017), suggesting a contributory mechanisms for many of the injuries reported by this cohort. However, there was no association in this study found between growth and injury.

Physical growth and repair occurs during sleeping hours in adolescents, with sleep quality also impacting upon psychological well-being (Lo, Leung, Chau, Lam, & Lee, 2017). Although research of sleep in young dancers is lacking, adolescent athletes sleeping less than 8 h nightly have experienced higher rates of injury than their contemporaries (Von Rosen, Frohm, Kottorp, Friden, & Heijne, 2017). Additionally, poor sleep in adult dancers has been linked with deterioration in mental acuity, concentration, and speed, and is an important consideration in dancer health (Fietze et al., 2009). In the current study however, there was no association found between sleep quality and injury with participants largely enjoying good/very good quality sleep.

4.4. Limitations

This study is limited by the small number of participants and for reasons stated may not be generalizable to other genres. The tools used to collect general health and sleep data were relatively crude, and due to limitations around the validity of weekly rate of perceived exertion in adolescent athletes (Phibbs et al., 2017), only an external measure of dance exposure (hours of dance) was collected. This fails to account for variability in the demands of dance sessions. Severity of injury in this study was applied both to days when the participants were unable to dance or only partially dance. This is inconsistent with the referenced definition of severity which applies only to a time-loss definition of injury, and may overstate the actual severity of injury in this cohort. Finally, the choice of a four-week gap to identify an event as a new injury was arbitrarily chosen based on the clinical experience of the researchers, and may be inaccurate in some cases.

Research recommendations: Adolescent growth and development is a key research area in dance, and was possibly over-assessed in this study. Quarterly measures of these variables may be more appropriate and promote compliance with reporting. More detailed study of cross-training undertaken by these dancers would

be helpful, as would more robust explorations of sleep and general health. Although existing tools such as the Athletic Sleep Questionnaire (Samuels, James, Lawson, & Meeuwisse, 2016) may be useful, there is a requirement to develop bespoke tools for dancers.

5. Conclusions

Levels of injury in elite adolescent ID is substantial, with an increased risk of injury associated with poorer general health and reduced dance exposure, but not with sleep quality or change in weight or height. Lower weekly hours of dance practice than other genres with little evidence of periodisation are evident in this cohort. However, increased dance load appears to be protective against injury in these participants. These participants continue to dance when injured, with further research required to establish why this is the case. Appropriate cross-training, which was underutilised by this cohort, may provide an opportunity for enhanced physical fitness and reduction of injury risk.

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Conflicts of interest

The authors have no conflict of interest to declare.

Ethical approval

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