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Chronotype and Self-Reported Perception of Sleep Quality in Relation to Psychological Inflexibility in Dance Students

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Abstract: Dance, as a performance activity, is associated with various problems. Among these challenges, sleep disturbances are notably prevalent. This study aimed to explore the potential relationship between sleep characteristics—specifically chronotype and subjective sleep quality—and psychological inflexibility in dance students. This research adopted a cross-sectional design using non-probabilistic sampling. One hundred and fourteen dance students, with a mean age of 23.87 years, participated in the study. Assessment tools included the Acceptance and Action Questionnaire-II, Pittsburgh Sleep Quality Index, and the Composite Scale of Morningness. The results revealed no gender differences in psychological inflexibility or chronotype, although women report poorer sleep quality. Differences emerged in both subjective sleep quality and chronotype when students were grouped according to low, medium, or high levels of psychological inflexibility. Those with low inflexibility, as opposed to those with high inflexibility, report better sleep quality, with no differences observed between medium and high inflexibility groups. Students with high-medium levels of psychological inflexibility showed a higher risk (OR = 6.373 times higher) of experiencing poor sleep quality compared to those with low psychological inflexibility. In terms of chronotype, the low inflexibility group is inclined to be more of a morning type than the medium and high inflexibility groups, with no differences between the latter two groups. Students categorized as having low inflexibility tend to have a longer history of dancing under the guidance of a teacher and dedicate more hours and days per week to rehearsal. The findings are discussed in terms of their educational implications for dance students.

Keywords: dance; psychological inflexibility; sleep; chronotype; student

1. Introduction

Dance, as a performance activity, imposes significant physical and cognitive demands on both students and professionals, making them susceptible to physical fatigue, pain, psychological distress, injury, and school dropout [1]. Dance is associated with various problems, including injuries [2,3], eating behavior disorders [4], and sleep-related problems [5-9], among others.

Sleep has an important relationship with physical activity levels [10,11] and the ability to attain high levels of athletic and cognitive performance [9,12,13]. However, regarding professional dancers, relatively few studies have explored the impact of sleep problems and poor sleep quality on their dance performance, despite the high prevalence of sleep issues among this group. Sources of stress in dance, which can disrupt sleep, vary across different phases, including pre-performance, during performance, and post-performance or rehearsals [7,8,14,15]. Furthermore, for dance students, the academic demands they face can compound their sleep issues, particularly towards the end of the

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semester [16,17]. All these factors contribute to a wide spectrum of emotional intensity levels and characteristics, as found in other performance-based activities [8,18].

While some authors recommend that performance athletes, including dancers, should ideally get between nine and ten hours of sleep per night [19], achieving this level of sleep is atypical [20]. For instance, it has been reported that professional dancers, in the months leading up to a performance premiere, typically sleep an average of between 6.5 and 6.9 hours per night [7]. Dance students tend to average approximately 7.8 ± 0.9 hours, with 58% admitting to sleeping less than 8 hours per night [21].

In terms of sleep-related issues, it has been reported that 35% of dancers attending primary health care centers and mental health services list psychological fatigue and sleep deprivation as their primary reasons for seeking medical assistance [22]. Moreover, some studies indicate that 59.5% of dance students experience poor sleep quality, affecting 62.9% of women and 42.1% of men [5].

It is important to recognize that the demanding nature of training and rehearsals in dance does do not allow for the maintenance of regular chronobiological patterns or a normal sleep-wake rhythm [7,8]. For instance, in the three months lading up to a classical dance performance premiere, dancers reported a significant decrease in sleep duration (from 418+43 min to 391+42 min), sleep efficiency (from 81+4% to 79+5%), and a reduction in the time spent in bed. Additionally, they experienced an increase in sleep disturbances once sleep had begun, although sleep latency did not appear to be affected [7]. However, it is worth noting that the sleep changes observed by actigraphy were not consistently reflected in the subjective data collected in sleep diaries or sleep scores. Approximately half of the professional ballet dancers in the study self-reported PSQI (Pittsburgh Sleep Quality Index) obtained scores higher than five (indicative of poor sleep quality) and 16.7% obtained a mean sleepiness score higher than the normal range. However, a smaller percentage (average = 7.6%) of other professional dance participants in the Fietze et al. [7] study scored higher than five on the PSQI. This research highlights the negative impact of sleep deprivation on the health of ballet dancers during their preparation for a performance, leading to impaired mental acuity, concentration, and speed [7].

Finally, it is important to consider that the social pressure resulting from variable training schedules introduces variations in the timing of environmental factors (e.g., light exposure) and behavioral patterns. This interaction between environmental factors and behavior has a distinctive and complex impact on sleep patterns [8].

One construct that can help understand the development and persistence of various issues, including sleep problems [23-25] is psychological flexibility/inflexibility. Psychological flexibility refers to the ability to fully accept unpleasant private events in the present without attempting to modify them. Rather, the individual is encouraged to stop struggling with discomfort and fully feel, engage, and see these events for what they are, rather than for what they are said to be, as a method of serving one's values [26,27]. The psychological flexibility model, which is fundamental to Acceptance and Commitment Therapy (ACT), promotes adaptive coping through six processes: skills-acceptance, cognitive defusion, awareness of the present moment, ability to see oneself in context, values, and committed action [26,28,29].

Psychological inflexibility shows a strong and positive correlation with various psychopathologies, such as anxiety, depression, and sleep disorders [23,25,30-35]. In contrast, it is negatively associated with quality of life, perceived health, and positive emotional experiences [26]. Furthermore, evidence from non-clinical samples suggests that psychological inflexibility and experiential avoidance (the unwillingness to acknowledge and thus avoid internal states such as unpleasant thoughts, feelings, and sensations) play a key role in the relationship between negative emotional states and the occurrence of a wide range of problems [24,31,33,36].

The ACT model posits that sleep problems can be mitigated by reducing psychological inflexibility [26]. Mindfulness and acceptance, based processes, which serve to decrease psychological inflexibility while enhancing psychological flexibility, have been suggested to address the cognitive mechanisms underlying the development and persistence of sleep problems [37,38]. According to Lundh [37], certain sleep problems result from the interaction between processes that

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trigger arousal and dysfunctional processes related to the perception of sleep. The processes that interfere with sleep refer to stressful events such as trauma, emotional conflicts, depression, worries, negative conditioning, and other factors, which lead to emotional or cognitive arousal during sleep. On the other hand, sleep-related cognitive processes include various standards, perceptions, personal beliefs, and fears that can influence how an individual interprets the modulation, problems, and consequences of not getting enough sleep [39]. In this regard, mindfulness and acceptance techniques can be instrumental in improving sleep perception processes (such as beliefs, expectations, and attributions).

Ong et al. [38] proposed a two-level model of cognitive arousal, consisting of primary and secondary elements, which involves four components: attention and emotional bias toward sleep-seeking or sleep-averse thoughts and behaviors, rigidity in sleep-related behaviors and beliefs, attachment to sleep-related needs and expectations, and absorption in solving sleep problems. These elements can potentially be transformed into adaptive processes through mindfulness and acceptance-based interventions.

An increasing body of research is demonstrating the effectiveness of treatments based on the processes underlying psychological inflexibility in addressing sleep-related problems [40-44]. Consequently, higher levels of psychological inflexibility are associated with increased sleep-related symptoms and problems.

In this context, it is important to note that dancers, particularly dance students, represent a group facing significant challenges associated with their activity. However, little attention has been paid to this group, with relatively few studies focusing on sleep quality and the potential performance-related issues in dance. Thus, the present study aims to advance our understanding of the relationships between the construct of psychological inflexibility and sleep characteristics, evaluating the subjective and reported sleep quality and chronotype in dance students participating in a highly demanding performance activity. To our knowledge, no previous research has investigated the potential role of psychological inflexibility in the lives of dance students or professionals and how it influences their sleep characteristics or their perceptions of these sleep patterns. However, building on the findings on studies conducted with other population groups, three key hypotheses were proposed. The first hypothesis predicts a positive relationship between psychological inflexibility and poor sleep quality. The second hypothesis predicts that psychological inflexibility will be positively associated with a tendency toward an evening chronotype, which has been linked to a variety of issues. Finally, the third hypothesis suggests that certain training-related characteristics (number of years with a dance teacher, number of days per week spent dancing, hours per week dedicated to dancing) will show negative relationships with the scores in psychological inflexibility obtained by dance students.

2. Materials and Methods

2.1. Participants

The sample comprised 114 dance students (87.7% female). The students had a mean age of 23.87 years (SD = 5.47). According to dance specialty, 7% of the sample were studying classical dance, 43.9% flamenco, 13.2% contemporary dance, 20.2% Spanish dance, 11.4% urban dance, and 4.4% other dances. The study sample was recruited through non-probabilistic sampling to select participants who met the inclusion criteria. These criteria were: to be of legal age, to have been studying dance for at least three years and always with a teacher (thus excluding self-taught dancers), to be enrolled in a conservatory course (elementary, intermediate, or professional level) or dance school-academy, and to sign the informed consent form.

2.2. Instruments

Through an ad hoc interview, information was collected on sociodemographic and educational characteristics (gender, year of birth, weight, height, and level of studies), and on dance characteristics. Thus, data were gathered on the number of years dancing under the direction of a

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teacher, days and hours per week spent dancing-training, place of study (conservatory, academy, or both) stage at which they were studying (elementary, intermediate, higher, or in school), and dance specialty (classical, flamenco, contemporary, Spanish, urban, or other).

We assessed participants' subjective perceptions of their sleep quality using the Pittsburgh Sleep Quality Index (PSQI) [45] in the version adapted to Spanish by Macías & Royuela, [46]. Buysse et al. [45] also demonstrated this instrument's predictive validity in that a cut-off point of a PSQI score >5 showed 89.6% sensitivity and 86.5% specificity for identifying poor sleep quality. The 19 items within this instrument pertain to different determinants of sleep quality and are grouped into seven components: (a) subjective sleep quality, (b) sleep latency (the reported time taken to fall asleep), (c) sleep duration (the reported number of hours slept or a score on the duration scale), (d) sleep efficiency (the percentage of time slept relative to time in bed or a score on the scale), (e) sleep disturbances (the number of times the participant admits to having had problems falling sleep for various reasons), (f) use of sleeping medications, and (g) daily dysfunction due to sleep (drowsiness, etc.). Responses to the PSQI yield seven component scores from 0 to 3, and the total PSQI score (the sum of the seven component scores) ranges from 0 to 21 points, with higher scores suggestive of poorer sleep quality. In this work, acceptable internal consistency was obtained for the Total (α=.812)

Chronotype was evaluated using The Composite Scale of Morningness (CSM) [47,48], in its Spanish version by Díaz-Morales & Sánchez-López [49]. It consists of 13 items that measure the time at which individuals wake up and go to bed, the preferred times for physical and mental activity, and subjective alertness. These data are then used to generate a total score (CSM-Total), (Min: 13, Max: 55) with a lower score being taken to indicate an evening chronotype, a general morning factor (CSM-General) and an alert factor (CSM-Alert). In this work, acceptable internal consistency was obtained for the CSM-Total (α=.862), the CSM-General (α=.853) and the CSM-Alert (α=.715).

The Acceptance and Action Questionnaire (AAQ-II) [50], in its Spanish adaptation by Ruiz et al. [51] was used to assess Psychological Inflexibility. This instrument provides a general measure of psychological flexibility-inflexibility consisting of a 7-item questionnaire concerned with how the individual relates to their private events (e.g., thoughts, feelings, emotions, and memories) and to what extent they perceive these events as an obstacle to leading the life they wish. Participants respond on a Likert-type scale (1: never, to 7: always) to indicate the extent they believe the statements to be true. Low scores on the questionnaire indicate greater psychological flexibility, while high scores indicate greater inflexibility. The test used in this study has shown high internal consistency (Cronbach's α = .930). To determine the relationship between the level of flexibility and the rest of the variables, the participants were categorized according to tercile distributions of the total AAQ-II score [52]. Thus, three levels were established: High Inflexibility (> 34 points), Medium Inflexibility (21-33 points), and Low Inflexibility (< 20 points).

2.3. Procedure

The data were collected in paper format by visiting public conservatories and private academies, and online after contacting the management of public conservatories and dance academies nationwide. After agreeing to collaborate, the management disseminated the study through social networks and emails to students. The online and paper questionnaires provided information about the study's objectives, legal terms, and informed consent to participate in the research. Data were collected from October 10, 2022, to January 20, 2023.

2.4. Statistical Analysis

An a priori power analysis was conducted using G*Power-3 [53] to determine the minimum sample size required to test the study hypothesis. The results indicated that the sample size required to achieve 95% power to detect a mean effect, with a significance criterion of α = 0.05, was N = 117 for Student's t-test for independent groups. Therefore, the obtained sample size of N = 117 is adequate to test the study hypothesis.

The following was carried out descriptive analyses (frequencies, percentages, means, and standard deviation) were conducted to characterize the main research variables. The reliability of the

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tests was calculated using Cronbach's alpha (α). The comparison of quantitative variables was carried out using the Student's t-test for independent groups. The effect size was estimated using Cohen's d (d < 0.2 - small effect size; d = 0.2 to 0.8 - medium effect size and d > 0.8 - large effect size). In the case of quantitative variables with more than two categories, an ANOVA test was conducted, with Snedecor's F statistic and Bonferroni's post hoc tests. The effect size was calculated using Eta Squared η^2, where the ŋ² effect size coefficients were evaluated as follows: 0.01 ≤ η^2 < 0.06 = a small effect size, 0.06 ≤ η^2 < 0.14 = a medium effect size, and η^2 ≥ 0.14 = a large effect size. In the case of categorical variables, the Chi-Square test (χ^2) was used, Odds Ratio. For categorical variables, Cramer's V was used to estimate the effect size (< 0.2 - small effect size; between 0.2 and 0.6 - moderate effect size and > 0.6 - large effect size). Analyses were conducted using the SPSS statistical package (IBM version 25.0, SPSS Inc Armonk, NY, USA).

3. Results

The results revealed the typical height and weight differences observed between men and women, with men generally being heavier and taller than women. However, no significant age differences were observed between the genders, although there is a tendency for women to be younger than men in the present sample (Table 1). Differences in educational level were also observed, where women tend to have higher education levels (having completed university studies) compared to men, who appear to have a medium education level (Cramer's V = 0.242).

Table 1. Physical and educational characteristics of the sample according to gender.

	TOTAL n = 114	Men 14(12.3)	Women 100(87.7)	$t_{(df=112)}$	p
Age	23.87 (5.47)	28.29 (8.84)	23.25 (4.56)	2.094	.055
Weight (Kg)	59.45 (9.61)	70.64 (8.83)	57.88 (8.65)	5.157	<.001
Height (cm)	163.18 (16.56)	175.64 (4.27)	161.43 (16.90)	3.121	.002
Educational level				$\chi^2_{(2,114)}$ = 6.667	.036
Basic	2 (1.8)	1 (7.1)	1 (1.0)		
Medium	48 (42.1)	9 (64.3)	39 (39.0)		
University	64 (56.1)	4 (28.6)	60 (60.0)		

Note: - For quantitative variables M(SD) and categorical variables N(%).

Concerning the characteristics related to dance studies, there were no notable differences between men and women in terms of the number of years they have been studying dance with a teacher, the frequency of rehearsals per week (number of days), or the hours dedicated to dance per week (Table 2). However, women tended to study in conservatories while men were more likely to attend dance schools (Cramer's V = 0.241). Moreover, women tend to be in higher levels of training (Cramer's V = 0.259), and men tend to specialize in urban dance whereas women tend to specialize in Spanish dance (Cramer's V = 0.340).

Table 2. Training-related characteristics of the sample of dance students according to gender.

	TOTAL n = 114	Men 14(12.3)	Women 100(87.7)	$t_{(df=12)}$	p
Years with teacher	12.99 (5.30)	14.64 (8.98)	12.76 (4.59)	0.771	.454
Days/week dancing	4.72 (1.22)	5.00 (1.11)	4.68 (1.23)	0.992	.359
Hours/week dancing	20.31 (11.73)	21.57 (13.41)	20.13 (11.53)	0.429	.669
Place of study				$\chi^2_{(2,114)}$ = 6.608	.037
Conservatory	68 (59.6)	4 (28.6)	64 (64.0)		
Dance school	30 (26.3)	7 (50.0)	23 (23.0)		
Both	16 (14.0)	3 (21.4)	13 (13.0)		

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Stage of training				$\chi^2_{(2,114)} = 7.627$	.022
Elementary-intermediate	53 (46.5)	8 (57.1)	45 (45.0)		
Higher	34 (29.8)	0 (0.0)	34 (34.0)		
School	27 (23.7)	6 (42.9)	21 (21.0)		
Dance Specialty				$\chi^2_{(2,114)} = 13.149$	.022
Classical	8 (7.0)	1 (7.1)	7 (7.0)		
Flamenco	50 (43.9)	7 (50.0)	43 (43.0)		
Contemporary	15 (13.2)	0 (0.0)	15 (15.0)		
Spanish	23 (20.2)	0 (0.0)	23 (23.0)		
Urban	13 (11.4)	4 (28.6)	9 (9.0)		
Another	5 (4.4)	2 (14.3)	3 (3.0)		

Note: - For quantitative variables M(SD) and categorical variables N(%).

Table 3 displays the scores obtained on each of the instruments according to the gender of the dance students. Notably, women obtained higher scores than men on the Self-reported Perception of Sleep Quality, with a medium effect size (Cohen's $d = 0.75$). On the other hand, no gender differences were found for scores on the psychological inflexibility scale, the chronotype scale, or its subscales. However, a residual difference was observed on the CSM-Alert scale, where women obtained a lower score than men, with a medium effect size (Cohen's $d = 0.54$). Interestingly, the sample reported sleeping for a mean of 6.377 hours (SD = 1.31) per night.

Table 3. Self-reported Perception of Sleep Quality and Chronotype and Psychological Inflexibility scores of dance students according to gender**.**

	TOTAL $N = 114$	Men 14 (12.3)	Women 100 (87.7)	$t_{(df=112)}$	p
PSQI	8.80 (3.78)	6.64 (2.68)	9.10 (3.82)	3.028	.006
CSM	31.56 (6.75)	30.36 (5.76)	31.73 (6.89)	0.711	.479
CSM-General	24.96 (5.28)	22.93(4.45)	25.24 (5.79)	1.433	.155
CSM-Alert	6.61 (1.81)	7.43 (1.70)	6.49 (1.81)	1.834	.069
AAQ-II	27.03 (8.50)	26.14 (9.49)	27.15 (8.40)	0.414	.680

Note: For quantitative variables M(SD) and categorical variables N(%). PSQI.- Pittsburgh Sleep Quality Index; CSM.- Composite Scale of Morningness; CSM-General.- General Morning Factor; CSM-Alert.- Alert Factor; AAQ-II.- Psychological Inflexibility.

Scores on the psychological inflexibility scale show significant correlations with subjective sleep quality (r = .336, $p < .001$), the total score on the chronotype scale (r = - .264, $p = .005$), the CSM-General subscale (r = - .212, $p = .001$) and the CSM-Alert subscale (r = - .317, $p = .001$).

When analyzing the sample according to the psychological inflexibility categories (Low, Medium, or High) it was found that 26.3% of the sample fell into the low inflexibility category (21.4% men, 27% women), 52.6% were in the medium inflexibility category (64.3% men, 51% women) and 21.1% were categorized as having high psychological inflexibility (14.3% men, 22% women). No significant differences were observed in the categorization according to gender ($\chi^2_{(2,114)} = 0.904$, $p = .636$).

When the scores obtained on the sleep-related scales are categorized according to psychological inflexibility levels (low, medium, or high), statistically significant differences were observed between the three groups (Table 4). For all comparisons, a medium effect size was observed, as determined by Eta Squared (η^2).

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Table 4. Self-reported Perception of Sleep Quality and Chronotype according to Psychological Inflexibility levels.

	PI-Low (n=30) (a)	PI-Medium (n=60) (b)	PI-High (n=24) (c)	$F_{(2.113)}$	p	η^2
CSM	35.05 (6.17)	30.67 (5.82)	29.46 (8.17)	6.172	.003	0.10
CSM-General	27.47 (4.93)	24.20 (4.97)	23.71 (7.29)	4.277	.016	0.08
CSM-Alert	7.5 (1.59)	6.47 (1.54)	5.75 (2.21)	7.935	.001	0.13
PSQI	7.17 (3.43)	9.07 (3.80)	10.17 (3.56)	4.825	.010	0.08
Categories PSQI				$\chi^2_{(2,114)} = 17.579$	<.001	*Cramer's V* = .393
Poor Quality	17 (56.3)	51 (85)	24 (100)			
Good Quality	13 (43.3)	9 (15)	0 (0)			

Note: For quantitative variables M(SD) and categorical variables N(%). PSQI.- Pittsburgh Sleep Quality Index; Poor Quality.- PSQI score > 5; Good Quality.- PSQI score < 5; CSM.- Composite Scale of Morningness; CSM-General.- General Morning Factor; CSM-Alert.- Alert Factor; PI-High.- High Psychological Inflexibility (> 34 points AAQ-II) PI-Medium.- Medium Psychological Inflexibility (21-33 points AAQ-II); PI-Low.- Low Psychological Inflexibility (< 20 points AAQ-II).

In terms of the mean number of hours slept during the night, no significant differences were observed among the three groups ($F_{(2,113)}$=0.005, p = .995). Notably, 80.7% (n = 92) of the total number of students reported poor sleep quality compared to 19.3% (n = 22) who reported good sleep quality, according to the PSQI. When categorizing the students into low inflexibility and medium-high inflexibility groups, 56.7% of the subjects with low inflexibility reported poor sleep quality, compared to 89.3% of the medium-high inflexibility students. In this regard, students with high-medium psychological inflexibility showed a higher risk (Odds Ratio [OR] = 6.373 times higher) of experiencing poor sleep quality (PSQI score >5) compared to those with low psychological inflexibility, $\chi^2_{(1, 114)}$ = 15.102, p < .001, Phi = .364; 95% CI (2.345-17.318).

Post Hoc Bonferroni test was used to determine the differences among the pairs of groups. This analysis revealed that for the PSQI, the differences were between low and high inflexibility groups (a<c, p = .010), but not between low and medium inflexibility (a=b, p = .066) or medium and high inflexibility groups (b=c, p = .647).

For the total scores on the chronotype test, the low inflexibility group differed from both the medium inflexibility group (a>b, p = .009) and the high inflexibility group (a>c, p = .006), while no differences were found between the medium and high inflexibility groups (b=c, p = .100). Similarly, for the chronotype subscale "CSM-General", the low inflexibility group differed from the medium inflexibility group (a>b, p = .028) and the high inflexibility group (a>c, p = .043), with no differences between the medium and high inflexibility groups (b=c, p = .100). Finally, this same pattern of results was observed for the "CSM-Alert" subscale, where a>b (p = .014), a>c (p = .001). and b=c (p = .257).

Finally, Table 5 displays the mean scores obtained on the three training-related variables (Number of years with a dance teacher, days per week spent dancing, number of hours per week dedicated to dancing) according to levels of psychological inflexibility. Significant differences were observed in the three variables according to levels of psychological inflexibility, with a medium effect size for number of years dancing with a teacher, and a small effect size for the number of days spent dancing per week and the number of hours dedicated to dancing per week.

Table 5. Training-related characteristics according to levels of Psychological Inflexibility.

	PI-Low (n=30) (a)	PI-Medium (n=60) (b)	PI-High (n=24) (c)	$F_{(2.113)}$	p	η^2
Years dancing with a teacher	15.60 (6.61)	12.73 (4.40)	10.38 (4.16)	7.365	.001	0.12
Days/week dancing	5.07 (0.907)	4.77 (1.19)	4.17 (1.44)	3.945	.022	0.07

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Hours/week dancing	24.33 (11.69)	19.77 (11.82)	16.63 (10.43)	3.130	.048	0.06

Note: - For quantitative variables M(SD). PI-High.- High Psychological Inflexibility (> 34 points AAQ-II); PI-Medium.- Medium Psychological Inflexibility (21-33 points AAQ-II); PI-Low.- Low Psychological Inflexibility (< 20 points AAQ-II).

Post-hoc Bonferroni tests revealed that for the number of years dancing with a teacher, the low inflexibility group differed from the medium inflexibility group (a>b, p = .036) and high inflexibility group (a>c, p = .001), while no differences were found between the medium and high inflexibility groups (b=c, p = .164). However, for days per week spent dancing, significant differences only emerged between the low and high inflexibility groups (a>c, p = .020), but not between the low and medium (a=b, p = .780) or between the medium and high inflexibility groups (b=c, p = .115). The same pattern of results was found for the number of hours dedicated to dancing per week, where a>c (p = .048), but a=b (p = .236) and b=c (p = .783).

4. Discussion

The present study aimed to advance our understanding of the potential relationships between the construct of psychological inflexibility and sleep-related characteristics, assessed using reported sleep quality and chronotype, among dance students who engage in a demanding and high-performance activity. The first hypothesis predicted that psychological inflexibility would show a positive relationship with poor sleep quality. The second hypothesis suggested that psychological inflexibility would be positively associated with a tendency towards an evening chronotype. Finally, the third hypothesis considered that psychological inflexibility would show negative relationships with certain training-related characteristics (number of years with a teacher, days per week spent dancing, and hours per week dedicated to dancing) in dance students.

Regarding the first hypothesis, the data support and confirm this prediction. A positive and significant correlation was found between psychological inflexibility and poor sleep quality. It should be noted that the dance students categorized as having low psychological inflexibility showed significantly better sleep quality than those in the medium and high inflexibility groups. In this regard, students with medium-high psychological inflexibility showed a higher risk (Odds Ratio [OR] = 6.373 times higher) of experiencing poor sleep quality.

These results support previous research indicating a notably high prevalence of sleep disturbances among dancers [5,7,22]. Moreover, the estimates from this study, which indicate that 80.7% of participants reported poor sleep quality, are significantly higher than previously reported figures, where 35% [22], 50% [7], or 59.5% [5] of dancers reported sleep-related problems or poor sleep quality. Moreover, when considering the average number of hours of sleep per night reported by the students in our sample, it becomes evident that they do not meet the recommended number of hours of sleep for individuals engaged in performance activities [19]. Additionally, their reported average sleep duration falls below that reported by professionals [7] and in other research involving dance students [21].

This work also reinforces the idea that psychological inflexibility is strongly associated with various psychopathologies, and, in this particular case, there is a strong relationship with poor sleep quality or sleep disturbances, consistent with previous findings [23,25,30-35]. An essential aspect worth considering is the events that contribute to or exacerbate both arousal processes and students' perceptions or interpretations of sleep dysfunctions, particularly those interactions that impact sleep quality [37,39]. However, it is worth noting that no observable changes were found when using objective sleep measures, such as actigraphy [7].

In this regard, it is important to consider the suggestion that both psychological inflexibility and experiential avoidance play a crucial role in the manifestation of intense negative emotions and a wide range of problems, even in non-clinical samples [24,31,33,36]. Therefore, interventions based on mindfulness and acceptance techniques, operating within the framework of the ACT model, may be effective in increasing psychological flexibility and mitigate its impact on students' sleep quality [37,38].

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Moreover, the second hypothesis, which suggested a positive association between psychological inflexibility and an evening chronotype, has also been confirmed by the results of this research. A negative relationship was found between the psychological inflexibility scores and the scores obtained on the chronotype scale, indicating that higher psychological inflexibility scores are significantly related to scores that indicate a characterization of the chronotype as an evening type. This relationship has been observed for both the morningness and alertness subscales, with negative relationships being highly significant in both cases. That is, psychological inflexibility is associated with lower scores on the morning chronotype and alertness scales.

The existing literature has consistently emphasized that the training demands and rehearsal requirements of dancers do not facilitate regular chronobiological patterns and normal sleep-wake rhythms [7,8], an observation that has also been supported by the findings from this group of students. Despite the challenges in maintaining healthy chronobiological patterns, it was evident that individuals who scored lower on psychological inflexibility, indicating greater psychological flexibility, reported more morning-orientated and alertness patterns that are typically associated with and characteristic of healthier lifestyles.

Studies on personality and chronotype have suggested that morning types tend to adopt healthier lifestyles compared to evening types [54,55]. It has been observed that morning and evening orientations are linked to how individuals seek, regulate, internalize, and process information about their environment and themselves (thinking styles), how they interact with others socially (behavioral styles), as well as the feelings that motivate them and the cognitions they have formed [56,57]. Similarly, Santhi et al. [58] demonstrated how circadian rhythms differentially affect mental functions according to gender.

More specifically, it is proposed that morning people maintain knowledge of the tangible and concrete, relying on direct experience and observable phenomena (realistic/sensitive). They typically prefer to process information through analysis and logic (guided by thought) and are inclined to adapt new knowledge based on what is known (conservation seeking). In contrast, the thinking style of evening types is based more on symbolic and unknown data than on concrete and observable data (imaginative/intuitive). These individuals tend to show creativity and a willingness to take risks, often seeking to transform and reimagine everything they encounter (innovation-seeking). Their behavior tends to reflect independence and a nonconformist approach [54-56,58,59].

All of these observations are consistent with models that fall within the ACT theoretical framework, suggesting that the interplay between processes generating arousal and the dysfunctional processes involved in interpreting sleep characteristics [7,38,39,60] as a factor that could affect sleep problems. Thus, it can be hypothesized that individuals with an evening chronotype, scoring higher in psychological inflexibility, employ approaches to dealing with reality and the perception of sleep (perceptions, beliefs, personal fears, etc.) that are less grounded in tangible knowledge or direct experience. These individuals may engage in less logical and analytical processing compared to morning types. In this regard, and as Wever [59] had previously suggested regarding the desynchronization of circadian rhythms, the imaginative and innovative thinking style characteristic of evening individuals could be linked to a lack of efficient attention to temporal signals, which could result in the relative discordance between arousal rhythms and the sleep-wake cycle.

Finally, the findings also support our third hypothesis, which posited that psychological inflexibility would show a negative relationship with certain training-related characteristics (years with a dance teacher, days per week spent dancing, hours per week dedicated to dancing) in dance students. In this sense, it has been observed that students who have spent more years learning under the guidance of a dance teacher tend to fall into the low psychological inflexibility category. Additionally, they spend more days rehearsing and dedicate more hours per week to their dance practice.

Given the research design employed, it has not been possible to determine the causal relationship between the variables. However, considering that psychological inflexibility is the tendency to respond to situations in a way that facilitates the attainment of valuable goals [61], it is

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plausible to think that the influence of a dance teacher may be instrumental in shaping such a tendency. In this context, the teacher could potentially influence an individual's capacity to adapt or persist in functional behaviors when doing so aligns with meaningful objectives, while focusing on the specific contexts where flexibility is vital for healthy functioning. This would be particularly relevant in challenging situations that might otherwise disrupt an individual's ability to adapt to the context effectively [26,27], and would, in turn, reduce the interaction between arousal-producing processes and dysfunctional processes associated with the perception of sleep-related characteristics [7,60].

This influence of the teacher can also be observed in other constructs, such as perfectionism. The context of music education, as in dance, involves specific attributes that make the study of perfectionism particularly pertinent. Perfection in these contexts is often linked to the performer's perception of perfection rather than the achievement of an entirely flawless performance [62]. A student's definition of success is often determined by the preferences of the audience, which includes teachers, peers, family members, and others [63]. Research has shown that in students, this perfectionist tendency can also be cultivated under the influence of "other-oriented perfectionism". Similarly, dance teachers often impose the expectation of perfection on their students, both technically and artistically [64].

Thus, psychological flexibility is commonly conceptualized as being developed through six underlying processes, including attempting to accept unwanted feelings and thoughts rather than avoiding, distracting from, or ignoring them (acceptance). This also involves efforts to distance oneself from feelings and thoughts by changing unwanted thoughts and negative internal events (cognitive defusion), as well as striving to cultivate a transcendent sense of self (self as context) [26,28,29]. Therefore, it is reasonable to assume that the teacher, depending on the relational dynamics established with their students, can influence and modify these processes of acceptance, cognitive defusion, or the perception of the problems that dance students must face. In this regard, the teacher could play a role in promoting functional behavioral changes, reducing the interaction between arousal and dysfunctional processes associated with the perception of sleep-related characteristics.

The present research offers valuable insights into the relationships between the construct of psychological inflexibility and the characteristics associated with sleep in dance students. However, in future investigations, it is essential to address some of the limitations of the current work to further refine our understanding of the relationships between the variables analyzed. On limitation concerns the inability to establish causal relationships due to the correlational nature of the study. This makes it impossible to determine whether psychological inflexibility is the cause of sleep problems or whether sleep problems facilitate the use of strategies more closely related to inflexibility. Similarly, it is not possible to determine the directionality of the relationship between teachers and students according to their inflexibility scores or the characteristics of the teacher's relational style. Additionally, it is also necessary to consider expanding the sample, aiming for a more representative selection of students based on their dance specialty, since each type of dance imposes different demands on the student. Finally, an issue that is gaining relevance is the need to critically analyze aspects of the instrument used to assess inflexibility (Acceptance and Action Questionnaire. AAQ-II) since it has been revised, and certain questions could benefit from refinement [61]. However, despite these limitations, two important issues should be emphasized. First, the psychological inflexibility construct is significant due to its influence and potential for modification through intervention and training approaches. Second, it is important to recognize the significance of sleep and sleep-wake cycles in the lives of dancers and the complex relationship between performance activities, emotions, and overall health [6,54-57,59,65,66].

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