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The Role of Sleep Quality and Exercise Delay on Perceived Improvement in Tennis Players

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Abstract

This study examined bedtime procrastination, exercise procrastination, and perceived psychological recovery among tennis players, while also considering variations according to demographic and training characteristics. A quantitative, cross-sectional correlational survey was conducted with 214 volunteer licensed tennis players aged 18–35 years who had at least one year of sporting experience. Data were obtained using an exercise procrastination measure, a bedtime procrastination measure, and a psychological recovery measure, together with a demographic questionnaire. Descriptive statistics, independent-samples *t* tests, one-way analyses of variance, Tukey post-hoc comparisons, and Pearson correlations were reported. The findings showed no statistically significant differences by gender on the measured scale scores. Age-group comparisons indicated differences in exercise procrastination and its time, motivation, and anxiety components, whereas bedtime procrastination and perceived psychological recovery did not significantly differ by age. Athletes with doctoral qualifications reported higher psychological recovery scores than participants with asso-

ciate or bachelor's degrees, although these results were based on a small doctoral subgroup. Athletes training only once a week recorded higher exercise procrastination scores than those training more frequently; perceived recovery and bedtime procrastination did not significantly differ according to training frequency. The reported correlation between exercise procrastination and bedtime procrastination was positive and strong ($r = 0.88$), although the manuscript does not provide the associated significance test or the complete correlation matrix. Overall, the study identified associations between exercise procrastination and demographic or training characteristics, together with a notable reported association between exercise and bedtime procrastination. Because the design was cross-sectional and based on self-report, causal effects and changes in objective sleep quality or athletic performance cannot be inferred. The findings may inform further studies of self-regulation and recovery-related perceptions among tennis players.

Keywords: tennis; bedtime procrastination; exercise procrastination; perceived psychological recovery

1. INTRODUCTION

Sustained athletic performance depends not only on the appropriate prescription of training loads but also on adequate recovery and the management of physical and psychological stress [1–3]. Recovery is a multidimensional process encompassing physiological restoration, neuromuscular readiness, psychological adjustment, and the re-establishment of the capacity to meet subsequent training demands. Athletes exposed to intensive or repetitive training may experience persistent fatigue, reduced preparedness, and a greater likelihood of underrecovery when the balance between exertion and restoration is disrupted [2, 4]. Accordingly, recovery-related behavior is relevant to both the quality of training and the sustainability of sports participation. A comprehensive assessment should consider not only the quantity of exercise performed but also the everyday practices through which athletes regulate their health and training commitments.

Sleep is among the principal recovery-related behaviors because its duration, continuity, and timing support cognitive function, emotional regulation, and physical restoration. Research on athletes links inadequate sleep with impaired attention, decision-making, perceived vigor, and several aspects of physical performance [5–8]. Tennis presents particularly demanding conditions because players must combine rapid directional movements, repeated high-intensity efforts, technical accuracy, and sustained concentration. Competition, travel, scheduling demands, and psychological pressure may complicate athletes' rest routines. Evidence from tennis research also indicates the relevance of sleep–wake patterns to match performance, although the reported relationships vary by outcome and study population [9, 10]. These observations provide a rationale for examining sleep-related behavior alongside exercise habits in tennis players.

An important distinction is required between sleep quality and bedtime procrastination. Sleep quality refers to characteristics such as perceived restfulness, sleep continuity, and sleep disturbance, whereas bedtime procrastination refers to voluntarily going to bed later than intended without an external reason preventing an earlier bedtime [11]. Bedtime procrastination may be related to inadequate sleep, but a bedtime procrastination questionnaire does not, on its own, directly measure sleep quality. The present investigation administered a bedtime procrastination scale and therefore reports this behavior rather than an objective or comprehensive assessment of sleep quality. Maintaining this distinction is necessary when describing the study variables and interpreting their relationship with perceived recovery.

Exercise procrastination is another self-regulation-related behavior and refers to intentionally postponing planned exercise despite previously intending to undertake it [12, 13]. Such postponement can interfere with training consistency and may reflect difficulties involving competing demands, time management, motivation, and anxiety. The relationship between procrastination and physical activity has been investigated in community and university samples, including research addressing the roles of time-management dispositions and exercise motivation [14, 15]. The Procrastination in Exercise Scale and its Turkish-language adaptation provide measurement approaches for this behavior [13, 16]. Nevertheless, these findings should not be presumed to establish the direction of an association in every athletic setting, particularly when data are collected at a single time point.

The possible co-occurrence of delayed bedtimes and postponed exercise is theoretically relevant because both behaviors involve decisions about when to undertake an intended activity. Shared self-regulatory demands, social commitments, and training schedules may contribute to associations between them. At the same time, perceived psychological recovery is a distinct construct: an athlete may report feeling recovered without necessarily following an ideal sleep schedule, and an athlete who trains frequently may still experience substantial fatigue. Consequently, correlations between behavioral scales and recovery scores require cautious interpretation and do not, by themselves, demonstrate a reciprocal causal process [7, 8, 17].

Although athletic recovery, sleep, and exercise behavior have each received substantial attention, their combined description in adult recreational and licensed tennis populations remains useful. This study examined exercise procrastination, bedtime procrastination, and perceived psychological recovery among licensed tennis players aged 18–35 years. It also explored differences in scores according to age, gender, education level, and weekly training frequency. By distinguishing measured behaviors from broader outcomes such as sleep quality or physiological recovery, the analysis seeks to provide a more precise account of the associations present in this study sample and to identify questions for future longitudinal or intervention-based research.

The following hypotheses guided the analysis:

H1: Exercise procrastination scores differ significantly across the age groups of tennis players.

H2: Tennis players who train more frequently report lower exercise procrastination scores.

H3: Bedtime procrastination is associated with perceived psychological recovery among tennis players.

2. METHOD

The study used a quantitative, cross-sectional correlational survey design to examine exercise procrastination, bedtime procrastination, and perceived psychological recovery among tennis players. This design enabled comparisons of self-reported scale scores across participant groups and the examination of associations between measured variables. Because

all measures were collected within the same survey, the analysis was descriptive and associational rather than experimental; it did not provide evidence that one behavior caused a change in another.

The study population comprised licensed tennis players actively participating in the sport in Karabük, Siirt, and Şırnak provinces of Türkiye during 2025. A convenience sampling approach yielded 214 volunteers, aged 18–35 years, with at least one year of licensed tennis participation and ongoing training. The demographic table records 96 men and 118 women, corresponding to 44.9% and 55.1% of the sample, respectively (Table 2). Participants were eligible if they met the experience and age criteria and agreed voluntarily to complete the questionnaire. Exclusion criteria comprised serious musculoskeletal injury during the previous six months, a chronic sleep disorder, a diagnosed psychiatric disorder, regular medication use, or incomplete questionnaire responses. These restrictions defined the analytic sample but also limit generalization to tennis players who do not meet these conditions.

Data collection included a personal information form and three self-report scales. The personal information form recorded participant characteristics and training frequency, thereby allowing comparisons between age, gender, and education groups. The Exercise Procrastination Scale (EPS), developed by Kelly and Walton [13], was used to assess intentional postponement of exercise. The original six-item instrument uses five response options; higher scale scores represent a greater tendency to delay planned exercise. The development publication reported high internal consistency, and a subsequent Turkish adaptation examined the scale's reliability and psychometric characteristics in Turkish-speaking samples [16]. The present manuscript does not supply a separate reliability coefficient for the current 214 participants, so the published reliability estimates should not be treated as sample-specific findings.

Bedtime procrastination was assessed using the nine-item Bedtime Procrastination Scale originally developed by Kroese, de Ridder, Evers, and Adriaanse [11]. This instrument addresses going to bed later than planned despite having an intention to retire earlier. It uses a five-point response format, with higher scores indicating greater bedtime procrastination after the relevant items have been coded appropriately. The Turkish adaptation reported by Yılmaz Dinç, Koçhan, and Zat [18] has also been cited in the study. The reported internal consistency coefficient for that adaptation was 0.71. It is important to note that this tool does not directly quantify sleep duration, sleep efficiency, or overall sleep quality; its results are therefore described here as bedtime procrastination scores.

Perceived recovery was assessed using the Psychological Recovery in Sport Scale, developed by Kaygusuz and Karagözoğlu [19]. The scale contains 20 items across four components: mental recovery, vitality and energy, psychological detachment, and return to well-being. Responses are recorded on a ten-point scale. The original development study reported that exploratory factor analysis accounted for 69.88% of the variance. The published Cronbach's alpha coefficients were 0.81 for mental recovery, 0.94 for vitality and energy, 0.83 for psychological detachment, and 0.93 for return to well-being. These figures support the published scale-development work but do not replace a reliability analysis for the present study sample. Throughout this manuscript, scores from the recovery instrument are interpreted as perceived psychological recovery rather than as direct measurements of physiological recovery.

The survey was administered online using Google Forms. Participants received information about the study purpose and the voluntary nature of participation before completing the questionnaires. Responses were collected anonymously and handled according to the stated confidentiality procedures. The supplied manuscript does not identify an institutional ethics approval reference, which should be supplied by the authors if approval was required and obtained under the relevant institutional procedures.

Table 1. Normality analysis of scales and subdimensions

Scales / Sub-Dimensions	Min.	Max.	Mean	SD	Skewness	Kurtosis
Time	1.00	4.00	1.96	0.68	0.625	0.166
Motivation	1.00	4.00	1.42	0.55	1.497	2.334
Anxiety	1.00	4.50	1.83	0.77	0.886	0.162
Exercise Procrastination Scale (EPS)	1.00	3.30	1.75	0.55	0.765	0.202
Sleep Delay Scale	1.44	5.00	3.35	0.72	−0.283	0.085
Psychological Recovery in Sports Scale (PTSS)	1.00	10.00	6.18	2.00	−0.371	0.166

Statistical analysis was performed using SPSS. Frequencies and percentages summarized categorical variables, while means and standard deviations described continuous scale scores. The distributions of scale scores were screened using skewness and kurtosis, as shown in Table 1. The independent-samples *t* test was employed for two-group comparisons, and one-way analysis of variance (ANOVA) was used for comparisons involving three or more groups. The reported Tukey post-hoc test was used after relevant ANOVA results, and effect sizes were presented as Cohen's *d* or eta-squared (η^2), where available. Pearson correlation coefficients were used to summarize associations between variables. A nominal significance threshold of $p < 0.05$ was specified. The supplied tables do not include all correlation-test *p* values, nor a breakdown of sports-experience length, so these analyses cannot be completely independently checked from the manuscript alone. In addition, the time, motivation, and anxiety scores are presented separately in the results tables, but their item

composition and scoring procedure are not described; they should not automatically be treated as validated EPS subscales because the Turkish adaptation describes a unidimensional measure.

3. RESULTS

As summarized in Table 2, the study included 214 tennis players, comprising 96 men (44.9%) and 118 women (55.1%). The age distribution covered five categories between 18 and 35 years. Most participants held bachelor's degrees (77.1%), followed by master's degrees (10.7%), associate degrees (7.5%), and doctoral qualifications (4.7%). In terms of training frequency, two sessions per week constituted the largest category (41.1%), followed by three sessions (29.9%). Fewer participants trained four days (8.9%) or five or more days per week (8.4%). These frequencies describe the sample composition and do not independently establish the representativeness of the participants relative to all licensed tennis players in the study regions.

Table 2. Descriptive analysis of participant characteristics

Variables	Category	n	%
Gender	Male	96	44.9
	Female	118	55.1
Age	18–21 years	33	15.4
	22–25 years	47	22.0
	26–29 years	45	21.0
	30–32 years	46	21.5
	33–35 years	43	20.1
Education Level	Associate Degree	16	7.5
	Undergraduate	165	77.1
	Master's Degree	23	10.7
	Doctorate	10	4.7
Weekly Training Frequency	1 day	25	11.7
	2 days	88	41.1
	3 days	64	29.9
	4 days	19	8.9
	5 days and more	18	8.4

Table 3 shows the independent-samples comparisons by gender. No statistically significant differences were observed between men and women in the reported scores for time, motivation, anxiety, exercise procrastination, bedtime procrastination, or perceived psychological recovery (all reported p values exceed 0.05). The mean scores for the two groups were generally similar. These comparisons indicate an absence of statistically significant gender-group differences in this sample; they do not establish that gender has no possible association with these constructs in other populations or in longitudinal settings.

Table 3. Independent-samples t -test analysis by gender

Scale	Gender	n	Mean	SD	t	Sig
Time	Male	96	1.95	0.69	-0.34	0.737
	Female	118	1.98	0.68		
Motivation	Male	96	1.48	0.62	1.27	0.205
	Female	118	1.38	0.49		
Anxiety	Male	96	1.78	0.77	-0.87	0.385
	Female	118	1.87	0.78		
Exercise Procrastination Scale (EPS)	Male	96	1.74	0.58	-0.23	0.818
	Female	118	1.76	0.52		
Sleep Delay Scale	Male	96	3.35	0.72	0.04	0.970
	Female	118	3.34	0.72		
Psychological Recovery in Sports Scale (PTSS)	Male	96	6.12	1.98	-0.38	0.707
	Female	118	6.23	2.03		

* $p < 0.05$

As presented in Table 4, age-group comparisons yielded reported statistically significant differences in the reported time, motivation, and anxiety scores and in the total Exercise Procrastination Scale score. Bedtime procrastination and perceived psychological recovery did not differ significantly across the five age groups according to the reported ANOVA results. The descriptive means generally indicate greater exercise procrastination in the oldest group than in several younger categories. Nevertheless, some Tukey comparison labels printed in Table 4 contradict the direction of the listed group means; these comparisons require verification against the original SPSS post-hoc output before individual pairwise

differences are interpreted as confirmed. Thus, the overall age-related findings should be considered preliminary at the level of specific group comparisons.

Table 4. Analysis of variance by age group

Scale	Age	n	Mean	SD	F	Sig	η^2	Tukey
Time	18-21 years (a)	33	1.89	0.58	2.41	0.04	0.044	c>e
	22-25 years (b)	47	1.90	0.70				
	26-29 years (c)	45	2.05	0.71				
	30-32 years (d)	46	1.94	0.69				
	33-35 years (e)	43	1.71	0.59				
Motivation	18-21 years (a)	33	1.55	0.66	3.99	0.00	0.071	c>d,e
	22-25 years (b)	47	1.39	0.48				
	26-29 years (c)	45	1.38	0.48				
	30-32 years (d)	46	1.45	0.57				
	33-35 years (e)	43	1.72	0.63				
Anxiety	18-21 years (a)	33	2.01	0.88	4.08	0.00	0.072	c>e
	22-25 years (b)	47	1.70	0.71				
	26-29 years (c)	45	1.73	0.74				
	30-32 years (d)	46	1.86	0.75				
	33-35 years (e)	43	2.17	0.81				
Exercise Procrastination Scale (EPS)	18-21 years (a)	33	1.83	0.57	4.74	0.00	0.083	b,c >e
	22-25 years (b)	47	1.67	0.47				
	26-29 years (c)	45	1.65	0.49				
	30-32 years (d)	46	1.77	0.60				
	33-35 years (e)	43	2.04	0.54				
Sleep Delay Scale	18-21 years (a)	33	3.10	0.76	1.71	0.14	0.032	-
	22-25 years (b)	47	3.29	0.67				
	26-29 years (c)	45	3.41	0.71				
	30-32 years (d)	46	3.40	0.75				
	33-35 years (e)	43	3.18	0.71				
Psychological Recovery in Sports Scale (PTSS)	18-21 years (a)	33	5.85	1.91	0.85	0.49	0.016	-
	22-25 years (b)	47	5.87	2.02				
	26-29 years (c)	45	6.38	2.00				
	30-32 years (d)	46	6.15	2.07				
	33-35 years (e)	43	6.35	1.96				

* $p < 0.05$

Table 5 summarizes differences according to educational attainment. Perceived psychological recovery differed significantly across the education groups, whereas the reported time, motivation, anxiety, exercise procrastination, and bedtime procrastination scores did not. In the reported Tukey comparisons, participants with doctoral qualifications had higher perceived recovery scores than those with associate or bachelor's degrees. This finding should be viewed in light of the relatively small doctoral subgroup ($n = 10$), which limits the stability and generalizability of comparisons. The observed differences are associations with educational categories rather than evidence that educational attainment directly improves the recovery process. Other unmeasured training, occupational, and psychosocial factors may contribute to the variation observed.

The findings by weekly training frequency are displayed in Table 6. Statistically significant differences were reported for the reported time, motivation, and anxiety measures and for the total exercise procrastination score. Athletes training one day per week generally had higher scores than those training more frequently. Neither bedtime procrastination nor perceived psychological recovery differed significantly across training-frequency categories in the reported ANOVA tests. Because the analysis was cross-sectional, these associations cannot determine whether more frequent training reduces procrastination or whether athletes who procrastinate less are more likely to maintain frequent training. The Tukey comparisons should also be reviewed alongside the original statistical output because some entries in the supplied table are incomplete or difficult to reconcile with the displayed group means.

The correlation matrix is presented in Figure 1. The reported Pearson correlation between exercise procrastination and bedtime procrastination was strongly positive ($r = 0.88$). Positive correlations were also reported between bedtime procrastination and the reported motivation ($r = 0.74$) and anxiety ($r = 0.72$) scores. Additional correlations were reported between the reported motivation and anxiety scores ($r = 0.38$), motivation and the total exercise procrastination score ($r = 0.45$), and anxiety and the total exercise procrastination score ($r = 0.49$). The relationships involving the reported time score were described as small, ranging approximately from $r = -0.10$ to $r = 0.01$. Perceived psychological

recovery showed smaller reported correlations with other variables (approximately $r = 0.16$ – 0.24 , and $r = 0.03$ with the time component). These values describe the magnitude and direction of the reported associations; the associated p values are not supplied in the text. Accordingly, the manuscript should not claim that every reported coefficient is statistically significant without the corresponding statistical output.

Table 5. Analysis of variance by education level

Scale	Education Level	n	Mean	SD	F	Sig	η^2	Tukey
Time	Associate Degree (a)	16	1.79	0.72	1.421	0.23	0.020	-
	Bachelor's Degree (b)	165	1.95	0.67				
	Master's Degree (c)	23	2.09	0.77				
	Doctorate (d)	10	2.30	0.66				
Motivation	Associate Degree (a)	16	1.54	0.69	0.320	0.81	0.005	-
	Bachelor's Degree (b)	165	1.41	0.57				
	Master's Degree (c)	23	1.45	0.48				
	Doctorate (d)	10	1.37	0.37				
Anxiety	Associate Degree (a)	16	1.69	0.79	0.556	0.64	0.008	-
	Bachelor's Degree (b)	165	1.84	0.78				
	Master's Degree (c)	23	1.90	0.84				
	Doctorate (d)	10	1.60	0.53				
Exercise Procrastination Scale (EPS)	Associate Degree (a)	16	1.68	0.61	0.234	0.87	0.003	-
	Bachelor's Degree (b)	165	1.75	0.55				
	Master's Degree (c)	23	1.82	0.57				
	Doctorate (d)	10	1.74	0.39				
Sleep Delay Scale	Associate Degree (a)	16	3.35	0.80	0.382	0.76	0.005	-
	Bachelor's Degree (b)	165	3.33	0.75				
	Master's Degree (c)	23	3.49	0.55				
	Doctorate (d)	10	3.27	0.48				
Psychological Recovery in Sports Scale (PTSS)	Associate Degree (a)	16	5.06	2.21	4.668	0.00	0.063	d>a,b
	Bachelor's Degree (b)	165	6.16	1.93				
	Master's Degree (c)	23	6.30	2.03				
	Doctorate (d)	10	8.00	1.83				

* $p < 0.05$

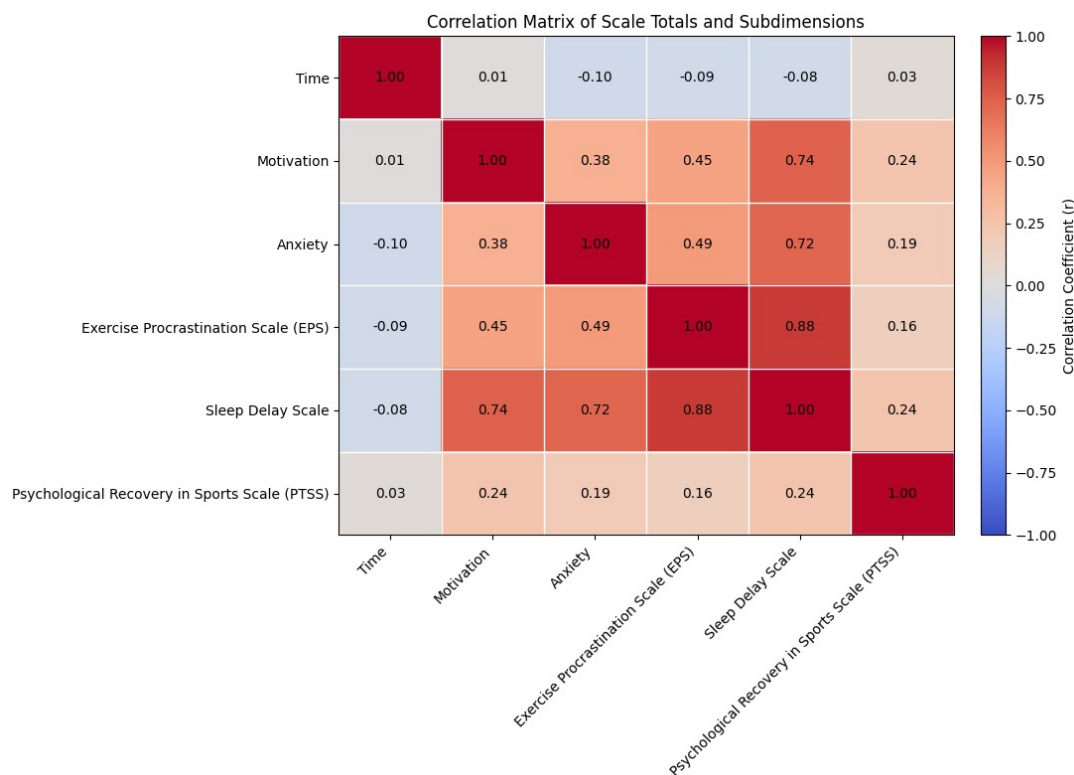


Figure 1. Correlation matrix of scales and subscales

Table 6. Analysis of variance by weekly training frequency

Scale	Weekly training frequency	n	Mean	SD	F	Sig	η^2	Tukey
Time	1 day (a)	25	2.55	0.78	8.763	0.00	0.144	a>b,c,d,eb>e
	2 days (b)	88	2.01	0.61				
	3 days (c)	64	1.90	0.67				
	4 days (d)	19	1.75	0.53				
	5 days or more (e)	18	1.46	0.53				
Motivation	1 day (a)	25	1.76	0.57	2.893	0.02	0.052	a>b,c,d,
	2 days (b)	88	1.41	0.49				
	3 days (c)	64	1.36	0.55				
	4 days (d)	19	1.30	0.74				
	5 days or more (e)	18	1.35	0.52				
Anxiety	1 day (a)	25	2.32	0.88	4.407	0.00	0.078	a>b,,d,e
	2 days (b)	88	1.74	0.73				
	3 days (c)	64	1.91	0.78				
	4 days (d)	19	1.51	0.69				
	5 days or more (e)	18	1.61	0.56				
Exercise Procrastination Scale (EPS)	1 day (a)	25	2.22	0.53	7.321	0.00	0.123	a>b,c,d,e
	2 days (b)	88	1.72	0.50				
	3 days (c)	64	1.74	0.56				
	4 days (d)	19	1.52	0.51				
	5 days or more (e)	18	1.49	0.42				
Sleep Delay Scale	1 day (a)	25	3.16	0.68	1.288	0.27	0.024	-
	2 days (b)	88	3.44	0.65				
	3 days (c)	64	3.26	0.71				
	4 days (d)	19	3.50	0.83				
	5 days or more (e)	18	3.28	0.93				
Psychological Recovery in Sport Scale (PTSS)	1 day (a)	25	5.76	1.51	1.238	0.29	0.023	-
	2 days (b)	88	6.01	1.81				
	3 days (c)	64	6.25	1.97				
	4 days (d)	19	6.84	2.52				
	5 days or more (e)	18	6.67	2.85				

* $p < 0.05$

4. DISCUSSION

This study examined exercise procrastination, bedtime procrastination, and perceived psychological recovery in a sample of 214 licensed tennis players. The findings identify differences in exercise procrastination by age and training frequency and a difference in perceived recovery by educational attainment. No significant gender differences were reported. The correlation analysis also describes a strong positive association between exercise procrastination and bedtime procrastination. These findings are best understood as relationships among self-reported behaviors and perceptions, rather than as evidence of direct influences on sleep quality, physiological recovery, injury rates, or competitive performance.

The absence of statistically significant gender differences in the measured scores suggests that men and women in this sample reported broadly comparable patterns of procrastination and perceived recovery. Research on sleep and athletic performance indicates that individual training demands, sleep schedules, and recovery opportunities may be important across athletic populations [7, 8]. However, the present comparison cannot establish that gender differences are absent generally, since the findings pertain to the participating athletes and the specific questionnaires employed. Moreover, the study did not include objective measurements of sleep duration or sleep quality, which limits comparisons with research using actigraphy, sleep diaries, or sleep-quality instruments.

The age-group results suggest that exercise procrastination and some associated barriers vary across the 18–35-year age range. Athletes in the oldest age category had relatively high descriptive scores for several exercise-procrastination measures. Such differences may reflect variation in training schedules, professional commitments, competing responsibilities, or self-regulatory demands. Studies in other populations have linked procrastination to physical activity and time-management processes, providing a relevant theoretical context [14, 15]. Nevertheless, the present data do not identify the causes of the age-group differences. Several pairwise Tukey labels also require correction against the original results because their printed direction conflicts with the corresponding group means. Until those comparisons are verified, it would be inappropriate to attribute the pattern to a specific age transition or a definitive increase in barriers with age.

Educational attainment was associated with perceived psychological recovery, with the doctoral group reporting higher scores than participants with associate or bachelor's degrees. One possible interpretation is that differences in routines,

self-appraisal, or coping resources may correspond to different recovery perceptions. The study, however, did not directly measure those explanatory factors and cannot establish a mechanism. The doctoral group contained only ten participants, making its mean potentially sensitive to individual responses. The finding therefore warrants replication in a larger sample before educational attainment is treated as a stable correlate of perceived recovery or as a basis for intervention planning.

The training-frequency comparisons showed that athletes who trained only once a week generally reported greater exercise procrastination than those with more frequent schedules. This association is consistent with the concept of exercise procrastination as the postponement of intended physical activity [13, 16]. More frequent training may coexist with established routines, but the reverse interpretation is equally possible: people who procrastinate less may be better able to follow the training programs they already intend to complete. Further research using prospective activity records could help distinguish these explanations. The absence of statistically significant training-frequency differences for bedtime procrastination and perceived recovery also cautions against presenting training frequency as a demonstrated determinant of those outcomes.

The correlation between exercise procrastination and bedtime procrastination was strong in the supplied results ($r = 0.88$). This association is noteworthy because the instruments concern two distinct planned behaviors: engaging in exercise and retiring to bed at the intended time. Their co-occurrence may reflect shared self-regulation difficulties, but cross-sectional self-report correlations may also be influenced by overlapping response tendencies or unmeasured contextual factors. The study cited literature on bedtime procrastination, which distinguishes delaying bedtime from a full assessment of sleep quality [11]. Consequently, the observed correlation must not be interpreted as direct evidence that poor sleep quality causes exercise procrastination, or that delaying exercise disrupts actual sleep physiology. Likewise, the smaller reported associations involving perceived psychological recovery do not establish a clinical change in recovery capacity.

The limitations of this study are important when placing the findings in a practical context. The survey was observational, the sampling was non-probability based, and measures were completed through an online self-report instrument. The dataset does not include objective sleep measurements or prospective assessments of exercise adherence, and training intensity and competition schedules were not controlled for. The complete statistical output for the correlations and several post-hoc comparisons was not provided with the manuscript. In addition, the description of the study mentions sports-experience duration, but no corresponding results table was included. These constraints limit conclusions concerning causal direction, statistical robustness, and the generalizability of the findings.

From a practical perspective, coaches and sports scientists may consider discussing exercise planning, self-regulation, and bedtime routines with athletes who experience difficulties maintaining consistent schedules. Nevertheless, specific behavioral interventions should be evaluated in prospective or controlled studies before effectiveness is asserted. Future investigations could combine sleep diaries or actigraphy, exercise attendance logs, validated recovery questionnaires, and repeated measurement to clarify how bedtime decisions, training consistency, and perceived recovery change over time. A larger sample would also permit more reliable examination of subgroup differences in age, educational attainment, and weekly training frequency.

5. CONCLUSION

This cross-sectional study identified variation in exercise procrastination among tennis players according to age group and weekly training frequency, as well as differences in perceived psychological recovery according to educational attainment. The participants who trained only once weekly generally reported higher exercise procrastination scores than those training on more days. Athletes holding doctoral qualifications reported relatively high perceived psychological recovery scores, although that subgroup contained only ten participants. The reported association between exercise procrastination and bedtime procrastination was strongly positive, while the associations involving perceived recovery were smaller. These observations demonstrate potentially relevant relationships between scheduling behaviors and recovery-related self-perceptions in the study population.

The study did not establish causal relationships or directly assess overall sleep quality, objective sleep duration, physiological recovery, or competitive tennis performance. The findings should therefore not be interpreted as proof that altering training frequency or bedtime practices will improve recovery. The analysis is also limited by convenience sampling, the use of self-report measures, and the absence of complete post-hoc and correlational significance information. A rigorous interpretation should preserve the distinction between reported associations and experimentally demonstrated effects, while also acknowledging the potential influence of unmeasured training demands and daily responsibilities.

Further research should examine these constructs longitudinally and, where possible, combine validated behavioral questionnaires with objective measurements of sleep and training participation. Improved reporting of scale reliability in the study sample, complete pairwise comparison results, correlation significance levels, and participants' sports-experience characteristics would strengthen the evidence. The present findings provide a preliminary basis for developing research questions related to exercise planning, bedtime procrastination, and perceived psychological recovery among tennis players.

6. RECOMMENDATIONS

Future studies may investigate interventions that address self-regulation, exercise scheduling, and sleep-related routines using controlled and repeated-measure designs. Researchers should distinguish bedtime procrastination from sleep-quality outcomes and evaluate these constructs with suitable, validated instruments. Coaches may use the findings as a starting point for conversations about training consistency and rest-related behavior, while avoiding causal claims unsupported by these data. Replication among athletes from other regions, sporting levels, and age groups would improve understanding of the generalizability of the patterns reported here.

Author contributions

All authors contributed equally to the preparation and revision of the manuscript, according to the submitted authorship declaration.

Conflict of interests

The authors declare that they have no conflicts of interest related to this study.

Data availability

The study involved anonymous questionnaire responses. De-identified data may be requested from the corresponding author, subject to the consent conditions and applicable institutional data-sharing requirements.

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