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Subjective Sleep Awareness Scale for Athletes: A Validity and Reliability Study

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Abstract: The aim of this study is to develop a valid and reliable measurement instrument capable of assessing athletes' subjective evaluations of their sleep patterns, sleep quality, and sleep perceptions. The qualitative phase of the development process included the application of the Lawshe Technique. Quantitative procedures comprised assumption testing followed by factor analyses, as well as the assessment of convergent and discriminant validity and composite reliability analyses. The dataset for the Exploratory Factor Analysis (EFA) consisted of 597 active athletes, while a second group of 578 active athletes was used for the Confirmatory Factor Analysis (CFA). The construct validity of the scale was established. Based on the literature review, the final instrument consists of 17 items across three factors: Social and Environmental Factors (Cronbach's α = 0.85, 7 items), Performance Anxiety and Stress (Cronbach's α = 0.89, 5 items), and Physiological and Biological Factors (Cronbach's α = 0.78, 5 items). The items were rated on a 7-point Likert scale. The total variance explained by the factors was 59.446%. The goodness-of-fit indices supported the model structure (χ^2/df = 4.68, RMSEA = 0.08, SRMR = 0.07, NFI = 0.95, CFI = 0.96, GFI = 0.90, and AGFI = 0.86). Considering that subjective sleep awareness is an important determinant of performance in athletes and that there is a limited number of measurement tools in this field, the newly developed "Subjective Sleep Awareness Scale for Athletes" makes a significant contribution to the existing literature.
Keywords: Subjective sleep awareness, athletes, validity, reliability

Sporcularda Öznel Uyku Farkındalığı Ölçeği: Geçerlik ve Güvenirlik Çalışması

Öz: Bu çalışmanın amacı, sporcuların uyku düzenleri, uyku kaliteleri ve uyku algılarına ilişkin öznel değerlendirmelerini ölçebilecek geçerli ve güvenilir bir ölçüm aracı geliştirmektir. Geliştirme sürecinin nitel aşamasında Lawshe Tekniği uygulaması yer almıştır. Nicel prosedürler, varsayım testlerini takiben faktör analizleri ile yakınsak ve ayırıcı geçerlilik değerlendirmeleri ve bileşik güvenilirlik analizlerini kapsamaktadır. AFA için gözlem seti 597 aktif sporcudan oluşurken, DFA için 578 aktif sporcudan oluşan ikinci bir grup kullanılmıştır. Ölçeğin yapı geçerliliği tespit edilmiştir. Literatür taramasına dayalı olarak, nihai araç üç faktörde 17 maddeden oluşmaktadır: Sosyal ve Çevresel Faktörler (Cronbach's α=0.85, 7 madde), Performans Kaygısı ve Stres (Cronbach's α=0.89, 5 madde) ve Fizyolojik ve Biyolojik Faktörler (Cronbach's α=0.78, 5 madde). Maddeler 7'li derecelendirilmiştir. Faktörler tarafından açıklanan toplam varyans %59,446'dır. Uyum iyiliği indeksleri model yapısını desteklemiştir: χ^2/df=4.68, RMSEA=0.08, SRMR=0.07, NFI=0.95, CFI=0.96, GFI=0.90 ve AGFI=0.86. Sporcularda öznel uyku farkındalığının performansla ilgili önemli bir belirleyici olduğu ve bu alandaki ölçüm araçlarının azlığı göz önüne alındığında, yeni geliştirilen 'Sporcular için Öznel Uyku Farkındalığı Ölçeği' mevcut literatüre önemli bir katkı sağlamaktadır.
Anahtar Kelimeler: Öznel uyku farkındalığı, sporcular, geçerlilik, güvenilirlik

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Introduction

Sleep represents a foundational biological necessity critical for optimal functioning across physical, neurological, and affective domains. From a physiological perspective, sleep serves as a restorative state that facilitates the regeneration of mental and physical capacities while supporting essential growth and repair processes (Walker, 2017; Zhdanova, 2005). Regular, high-quality sleep positively influences immune system resilience and cognitive performance, whereas disrupted sleep patterns compromise these vital functions. The implications of chronic sleep disruption extend beyond immediate performance decrements to encompass significant long-term health risks, including increased susceptibility to cardiovascular disease, metabolic disorders such as obesity and diabetes, and various neurological conditions (Walker, 2017). Maintaining consistent, efficient sleep architecture is therefore recognized as a fundamental preventive health measure, as research consistently demonstrates that compromised sleep quality and irregular sleep patterns negatively impact performance capabilities, daily functioning, and energy regulation systems (Çölbay et al., 2007).

Sleep duration alone inadequately captures the complex nature of restorative sleep. Quality sleep is distinctively characterized by post-awakening refreshment, uninterrupted continuity, and subjective satisfaction with the overall sleep experience (Ohayon & Zulley, 2001). The multidimensional determinants of sleep quality encompass sleep onset latency, perceived sleep sufficiency, sleep continuity, and sleep depth (Hirshkowitz et al., 2015). This evidence underscores that optimal sleep derives not merely from temporal duration but from its continuity, depth, and restorative capacity (Luyster et al., 2012). High-quality sleep facilitates comprehensive restoration across cognitive, physical, and psychological domains. Should this restorative process be compromised, cascading effects emerge—impairing daily functioning, degrading social interactions, and undermining occupational performance. Sleep insufficiency manifests through increased fatigue and diminished cognitive alertness, potentially triggering maladaptive behavioral responses including heightened aggression. Such outcomes can significantly impair interpersonal relationship maintenance, demonstrating how sleep disruption in one domain precipitates systemic consequences across multiple life dimensions. For athletic populations specifically, sleep quality represents a critical performance determinant. The qualitative and quantitative aspects of athletes' sleep directly influence their performance capabilities, team dynamics, and recovery processes. Within the specialized context of athletic achievement, sleep emerges as a foundational element affecting technical execution, interpersonal relationships with teammates and coaching staff, and the physiological and psychological recovery mechanisms essential for sustained competitive excellence.

Athletes depend on numerous physiological and psychological processes for optimal performance—processes fundamentally influenced by their sleep quality, duration, and consistency. The sleep experienced by athletes plays a critical role in physical recovery, cognitive function, emotional regulation, immune system maintenance, performance capacity, and injury prevention (Vorster et al., 2024; Swinbourne et al., 2016; Nobari et al., 2023). Sleep deficiencies correlate with elevated injury susceptibility that can undermine training effectiveness and competitive outcomes, while simultaneously compromising muscle recovery and cognitive focus (Vorster et al., 2024; Cho & Im, 2024). Beyond objective sleep metrics, athletes' subjective awareness of their sleep quality holds equal importance to sleep regularity itself. The systematic monitoring, evaluation, and adjustment of training and recovery protocols based on individual sleep patterns—accomplished through collaboration between athletes, coaches, and support personnel—enables athletes to maximize performance potential (Doherty et al., 2021; Knufinke et al., 2018). With contemporary advancements in both subjective assessment tools and objective monitoring technologies, sports organizations can now identify sleep disturbances before they potentially compromise training adaptations or increase injury vulnerability (Najafabadi et al., 2024). Such monitoring approach, when paired with targeted interventions, contributes significantly to sustaining athlete health by minimizing cumulative sleep debt and reducing overtraining syndrome risk (Venter, 2012; Cho & Im, 2024). The integration of sleep awareness into athletic cultures fosters improved adherence to recovery strategies, thereby enhancing performance outcomes throughout competitive seasons (Venter, 2012). Athletic activities, which intensively engage physical, emotional, and cognitive systems, typically involve demanding training protocols (Hoffman, 2014). The sporting environment inherently encompasses a broad spectrum of intense emotional experiences—excitement, competitiveness, achievement motivation, frustration, anger, and performance anxiety (Weinberg & Gould, 2019). Within this challenging athletic context, characterized by rigorous training demands and heightened emotional states, athletes' sleep architecture, quality parameters, and sleep onset latency can be significantly impacted.

Determining the levels of subjective sleep awareness among athletes and categorizing the influencing factors are considered important undertakings. Social and environmental factors potentially impacting sleep quality may encompass the coach-athlete relationship, the performance level of competitors, and interactions with other relevant stakeholders. Factors related to performance anxiety and stress levels include athletes' expectations for success and the perceived importance of competitions. Prominent physiological and biological factors include nutritional habits, training load intensity, and the characteristics of the sleep environment. Beyond these categories, other elements such as hormone intake, dietary supplementation, training intensity, intercity or international travel, psychological well-being, performance outcomes, and underlying physiological conditions can also influence athletes' sleep patterns and quality. Grandner (2017) highlighted the close association between healthy sleep and dimensions of cognitive performance, physical health, and mental health. Cognitive performance encompasses aspects such as learning, memory, decision-making, and attention; physical health relates to factors including weight management, muscle accretion, metabolism, and post-exercise recovery; and mental health involves components like anxiety, depression, and emotional regulation (Scullin & Bliwise, 2015; Grandner, 2017). Although sleep has been widely recognized as a key factor influencing athletic performance, existing research largely focuses on objective indicators or general sleep quality measures, leaving a significant gap in the assessment of athletes' subjective sleep awareness through a valid and sport-specific multidimensional instrument.

Given that such elements may offer insights into athletes' sleep awareness, the primary objective of the present study is to develop a valid and reliable measurement instrument designed to help athletes enhance their subjective sleep awareness. The significance of this newly developed instrument lies in its potential to provide coaches, athletes, sports psychologists, and other sports science professionals with valuable insights into specific areas of concern regarding sleep. This, in turn, enables these stakeholders to design targeted training programs and implement appropriate psychological, physiological, or recovery-based interventions to address identified issues.

Methods

Research Design

The primary objective of this study was to develop a psychometrically sound instrument for measuring athletes' subjective evaluations of their sleep patterns, quality, and overall sleep perceptions. To achieve this goal, we implemented a scale development approach utilizing summated ratings, which enables evidence-based inferences from athlete responses. Ethics approval for this study was obtained from the Mersin University Sports Sciences Ethics Committee on September 22, 2025 (Decision No: 2025-074). This methodological framework permits systematic analysis through cumulative scoring processes—an approach widely employed in psychometric research to quantify perceptions of underlying constructs.

The summated ratings method facilitates rigorous analysis of subjective assessments by examining response patterns across items throughout the study sample and target population (Stevens, 2017; DeVellis, 2021; Boateng et al., 2018). This approach operates on the fundamental psychometric principle that individuals obtaining higher aggregate scores possess greater magnitudes of the measured trait (Torgerson, 1958). By applying summated ratings in developing the Subjective Sleep Awareness Scale for Athletes (SSASA), we established a framework for objective measurement and evaluation of sleep perceptions among athletic populations.

This methodological approach represents a robust analytical technique that supports the construct validity assessment of scale items while determining individual awareness levels. Consistent with established psychometric practices, we captured athlete perspectives using summated ratings derived from participant responses, employing a respondent-centered scaling approach as the methodological standard (Crocker, 2012). This approach ensures that the resulting instrument effectively quantifies the multidimensional nature of sleep awareness among athletes while maintaining psychometric integrity.

Research Group

Two independent samples of active athletes participated in this investigation to establish the psychometric properties of the instrument. For the initial Exploratory Factor Analysis (EFA), which aimed to identify the underlying factor structure of the proposed measurement model, data were collected from 651 volunteer athletes between September 23–30, 2025. Following rigorous preliminary data screening and assumption testing, 54 cases were identified as outliers and subsequently removed, yielding a final analytical sample of 597 participants for the EFA.

To further substantiate the construct validity of the instrument, a separate sample was recruited for Confirmatory Factor Analysis (CFA) and subsequent convergent and discriminant validity assessments. This second data collection phase involved 604 active athletes who participated between October 1–7, 2025. Consistent with methodological best practices, comprehensive data screening and assumption verification procedures were again implemented, resulting in the exclusion of 26 responses that violated statistical assumptions. The remaining 578 participants constituted the final sample for the confirmatory analyses. The definitive version of the scale was established following the systematic completion of these sequential analytical procedures, ensuring robust psychometric properties across independent samples.

The sample sizes for the EFA and CFA were determined based on commonly accepted guidelines in scale development studies. In the literature, it is generally recommended that the sample size for factor analysis should be at least 5–10 times the number of items, with larger samples (e.g., N > 500) considered highly adequate for stable factor solutions (Hair et al., 2019; Kyriazos, 2018). In the present study, independent samples were collected for EFA and CFA to ensure methodological rigor and to avoid sample-specific bias. The data for EFA and CFA were not obtained by splitting a single dataset; rather, two separate data collection processes were conducted to provide stronger evidence for the construct validity of the scale.

Scale Development Process

The development of the Scale (SSASA) followed a systematic, multi-stage process combining qualitative and quantitative methodologies. This section details the sequential procedures employed to ensure content validity, reliability, and construct validity of the final instrument.

Stage 1 – Focus Groups and Initial Item Generation: Using convenience sampling, a qualitative research approach that selects participants based on accessibility (Andrade, 2021; Büyüköztürk et al., 2015), we conducted focus group interviews with 3 academics and 12 athletes between January 15-20, 2025. These sessions established the foundational scope and content parameters for the item pool and determined the most appropriate rating scale format.

Stage 2 – Narrative Collection from Target Population: To enrich the content of the item pool and enhance its prospective reliability and validity, 20 active athletes provided written narratives describing their sleep awareness experiences, including potential insomnia causes and related perceptions. These narratives were systematically transformed into candidate scale items and subsequently reviewed for linguistic clarity and relevance.

Stage 3 – Literature Review: National and international sleep awareness research was extensively examined. The item pool was enriched with insights from studies including Şenol et al. (2012) on sleep quality determinants, Öz & Miniksar (2023) on digital technology's impact on sleep quality, and various established insomnia assessment instruments. Information gathered through these qualitative investigations was synthesized and refined into appropriately structured scale items.

Stage 4 – Content Validity Assessment: The preliminary item pool underwent two-phase content validation: Initially, items were read aloud to 25 athletes in individual sessions to assess interpretation and conceptual alignment. Subsequently, the refined item pool was submitted for expert review between January 20-30, 2025, involving 8 academics specializing in scale development and 3 elite athletes (N=11 experts). Reviewers evaluated each item's representativeness of the theoretical construct and linguistic clarity using a standardized form based on the Lawshe Technique (3=Good, 2=Needs Improvement, 1=Poor). The Content Validity Ratio (CVR) is expected to yield a value between -1 (indicating absolute rejection) and +1 (indicating absolute agreement). The standard formula for this calculation is presented in Equation 1:

$$CVR = Nu/(N/2) - 1 \quad \text{(Equation 1)}$$

In Equation 1, Nu represents the number of experts rating an item as "good", and N represents the total number of experts providing feedback on that item. A CVR of 1 means all experts rated the item as good; a CVR of 0 means only half rated it as good; and a CVR of -1 results if no experts rated it as good. Items with a CVR of 0 or a negative value are considered lacking content validity and should be removed from the measurement instrument (Ayre & Scally, 2014; Lawshe, 1975; Wilson et al., 2012). For this study, with 11 experts (8 academics, 3 athletes) and a significance level of $\alpha=0.05$, the critical CVR threshold was established at 0.712 (Lawshe, 1975). Based on this criterion and overall expert feedback, it was decided that 9 items failed to meet the content validity threshold and were eliminated. Two additional items were removed based on specific expert recommendations, while 3 new items were added, transforming the initial 33-item pool into a 25-item trial form. Expert consensus also determined that a 7-point Likert-type scale (ranging from 7=Totally Describes Me to 1=Does Not Describe Me At All) was optimal for response anchoring.

Stage 5 – Trial Administration: The 25-item preliminary instrument with the 7-point rating scale was administered online to 651 active athletes between September 23–30, 2025. Observations obtained from these volunteer participants constituted the dataset for subsequent EFA.

Stage 6 - Factor Analyses (EFA-CFA): Prior to conducting EFA, the initial dataset underwent rigorous assumption testing, including assessments of sample adequacy, outlier identification, multicollinearity evaluation, factorability examination of the correlation matrix, and verification of normality and linearity assumptions. Following the removal of outliers, the EFA proceeded with a finalized sample of 597 participants.

For Confirmatory Factor Analysis (CFA), a separate data collection was conducted between October 1–7, 2025, yielding 604 responses from active athletes. Following identical assumption testing procedures, 26 observations were excluded, resulting in a finalized sample of 578 participants for confirmatory analysis. The definitive version of the SSASA was established following the systematic completion of these analytical procedures.

Data Analysis Techniques

Factor analyses (EFA and CFA) served as the primary quantitative methodological framework for assessing subjective sleep awareness among active athletes. To establish instrument reliability, we calculated Cronbach's alpha internal consistency coefficients for both the comprehensive scale and its constituent subscales, supplemented by composite reliability values. Additionally, we computed the underlying factor structures and their corresponding factor loadings to confirm the scale's dimensionality.

EFA was employed to uncover the latent structures within the measurement model (Hayton et al., 2004) by clustering observed variables into a more parsimonious set of core factors through correlation and covariance analysis, thereby simplifying the conceptual structure (Watkins, 2018). In the EFA, Principal Axis Factoring (PAF) was used as the extraction method, as it is recommended for identifying underlying latent constructs rather than merely reducing data (Fabrigar et al., 1999). Additionally, Varimax rotation was applied to obtain a simpler and more interpretable factor structure by maximizing the variance of factor loadings across factors. This orthogonal rotation method was preferred because it facilitates clearer interpretation when factors are assumed to be relatively independent.

For the EFA procedure, we collected an initial dataset of 651 observations. While methodological perspectives on required sample size for factor analysis vary considerably in the literature—with some researchers advocating a minimum participant-to-item ratio of 5:1 (Cheong et al., 2017; Krichbaum et al., 2011) and others suggesting that samples exceeding 500 participants constitute "very good" conditions for EFA (Echeverri et al., 2019)—our sample size substantially exceeded these thresholds. The assumption of data normality was supported by the close proximity of arithmetic mean, mode, and median values across scale items.

An outlier analysis was conducted on the initial 651 observations following a multi-stage process. First, preliminary screening identified and excluded 15 observations, yielding 636 cases for subsequent examination using Mahalanobis distance and standardized Z-scores. The Z-score analysis resulted in the removal of 4 additional observations with absolute values exceeding 3.0, with all remaining Z-scores contained within the range of -2.92 to 2.99. Referencing Tabachnick and Fidell's (2015) criterion threshold of ±4.0, no significant univariate outliers remained in the dataset. It should be noted that the acceptable Z-score range can be extended to ±4.0 when evaluating variance-explaining patterns and factors within scale items (Vannatta, 2005).

To identify multivariate outliers, we examined Mahalanobis distances using the critical value from the Chi-square distribution ($\chi^2(25, p=0.001) = 52.620$). This analysis identified 35 observations exceeding this threshold, which were subsequently removed. Following this exclusion, the range of Mahalanobis distances for retained cases spanned from 2.27 to 52.50. In total, 54 observations were removed from the initial sample (15 + 4 + 35 = 54), resulting in a final analytical sample of 597 participants for the EFA procedure.

Acknowledging the view that achieving perfect linearity between two variables is nearly impossible (Field, 2024), the assumption checks continued with normality testing. For the 25 items in the measurement instrument, skewness coefficients ranged from 1.124 to -0.885, and kurtosis coefficients ranged from 0.205 to -1.083. According to established guidelines (e.g., Bernstein, 2000, suggesting acceptable ranges of ±3.3 for skewness and ±7 for kurtosis), these results indicate that the normality assumption was adequately met for the dataset.

Variance Inflation Factor (VIF) and Tolerance values were examined to assess potential multicollinearity issues. For the 25 scale items, VIF values ranged from 4.24 to 1.14, and Tolerance values ranged from 0.873 to 0.235. Since all Tolerance values were greater than 0.20 and all VIF values were less than 5, these results confirm the absence of significant multicollinearity among the items in the dataset (Singh et al., 2023; Miles, 2005). Additionally, the Durbin-Watson (D-W) statistic was calculated as 2.06, indicating independence of errors (i.e., absence of significant autocorrelation) (Kalaycı, 2010).

As part of the EFA prerequisite checks, the factorability of the correlation matrix (R) was assessed using the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The calculated KMO value was 0.915, indicating an 'excellent' level of sampling adequacy for factor analysis. Dağlı (2015) suggests that KMO values between 0.8 and 0.9 are 'very good', while values of 0.9 and above are 'excellent'. Furthermore, Bartlett's Test of Sphericity was statistically significant ($\chi^2 = 5143.637$, $p < 0.05$), leading to the rejection of the null hypothesis that the correlation matrix is an identity matrix. This result confirms that the inter-item correlations were sufficiently large and that the data structure was suitable for factor analysis (Gürbüz & Şahin, 2014).

Table 1.

Descriptive Statistics of EFA Sample by Demographic and Athletic Characteristics

Characteristic	*Category*		*%*
Gender	Female	325	54.4
	Male	272	45.6
Sport Category	Individual	308	51.6
	Team	289	48.4
Athletic Experience	1-3 Years	237	39.7
	4-6 Years	127	21.3
	7-10 Years	116	19.4
	10 Years or More	117	19.6
Age	18 years or younger	192	32.2
	19-25 years	336	56.3
	26 years or older	69	11.6
Total		597	100

Descriptive statistics for the observations included in the EFA, conducted to determine the subjective sleep awareness of active athletes, are presented in Table 1. To establish the construct validity of the measurement instrument, data were collected anew, yielding 604 observations. Prior to calculating error variances, standardized factor loadings, and goodness-of-fit indices for the 17-item, 3-factor structure obtained from the EFA, assumption testing was performed again on this second dataset. Accordingly, the data related to the 17 items were examined for linearity, normality, sample size adequacy, and multicollinearity.

Skewness values were found to be generally negative, ranging between -0.879 and 0.813, while kurtosis values were also predominantly negative, ranging from -0.958 to 0.059. Within the context of univariate normality assessment, it is noted that all these values fall within the ±1 range, satisfying a strict criterion for the normality assumption (Bernstein, 2000). Regarding outlier analysis for the CFA dataset, the 10 most extreme observations were initially removed. Subsequently, Mahalanobis distances (for multivariate outliers) and Z-scores (for univariate outliers) were examined on the remaining data. Based on the critical value for Mahalanobis distance with 17 degrees of freedom ($\chi^2(17, p=0.001) = 40.790$), 10 observations exceeding this value were removed. Furthermore, 6 observations with absolute Z-scores greater than 3 were excluded. After these exclusions, all remaining Mahalanobis distances fell within the range of 40.10 to 1.58, and all Z-scores were within the range of 2.94 to -2.82.

To prevent difficulties in interpreting the effects of variables within the model and to ensure reliable predictions when applied to new data, the potential for multicollinearity was assessed. Variance Inflation Factor (VIF) and Tolerance values were examined for this purpose. The VIF values for the 17 items ranged from 4.836 to 1.320, and the Tolerance values ranged from 0.757 to 0.207. As all Tolerance values exceeded 0.20 and all VIF values were below 5, these results indicate the absence of significant multicollinearity (Luo et al., 2019; Oh, 2023). The Durbin-Watson (D-W) value was calculated as 2.036, suggesting independence of errors. Consequently, a total of 26 observations were removed from the initial 604 collected for the second phase (10 initial + 10 Mahalanobis + 6 Z-score = 26). The CFA was therefore conducted using the final 17-item model on the remaining 578 observations.

Findings

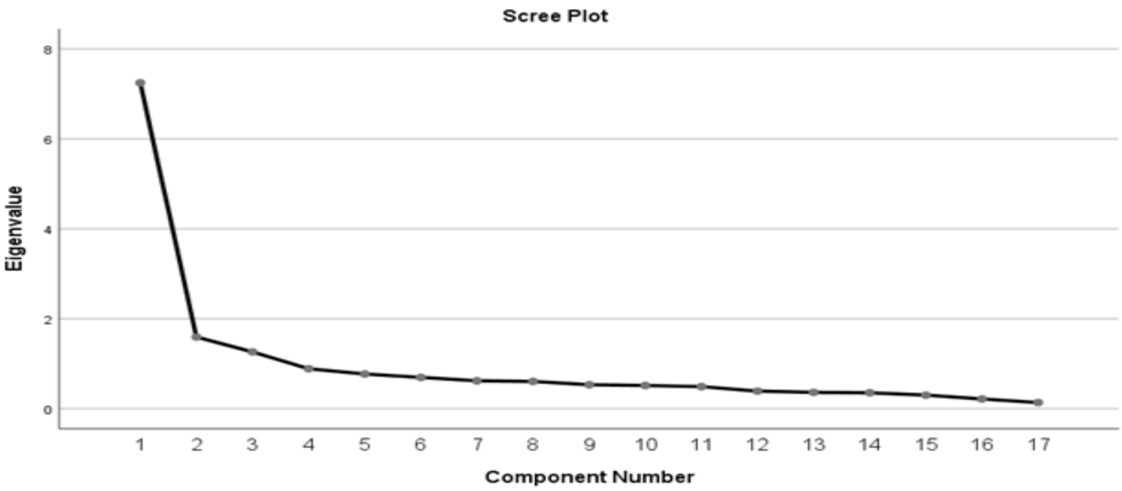
Validity Findings

EFA Results

Data were initially collected from 651 participants. Following assumption checks, 54 observations were excluded from the analysis. Consequently, Exploratory Factor Analysis (EFA) was performed on the remaining 597 observations. Additionally, explained variance values were calculated to ascertain the contribution of each item to its respective factor, as explained variance is a statistical method indicating the relationship between an item and its factor (Hair et al., 2019). Within this study, these values were found to range from 0.397 to 0.780.

In scale development studies, several methods are typically employed to determine the relationship between the items retained in the final form post-analysis and their respective factors, and to provide additional evidence for the factor structure. Accordingly, the application of the "Scree Plot", "Percentage of Total Variance Explained Method", "Kaiser Criterion" (Kaiser's Rule), and "Variance Explained Criteria" was deemed appropriate (Çokluk et al., 2012). The scree plot generated from the analysis is presented in Figure 1.

Figure 1.
Scree Plot



As shown in the figure, a plateau appears to form after the 4th point. According to the Kaiser Criterion, which identifies the main inflection points (the 'elbow'), a three-factor structure is indicated before this plateau. This finding is consistent with the criterion of retaining factors with eigenvalues greater than 1.

The percentage of total variance explained method (Field, 2024) allows for the identification of variance within the dataset and quantifies the contribution of each factor, potentially representing incremental contributions. A common heuristic suggests that the point at which the additional variance explained by subsequent factors drops below a certain threshold (e.g., 5%) can indicate the maximum number of factors to retain (Kalaycı, 2010). Based on these criteria, the results presented in Table 2 support the existence of a three-factor structure.

Table 2.
Total Variance Explained

Component	*Initial Eigenvalues*			*Extraction Sums of Squared Loadings*		
	Total	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*
1	7.247	42.629	42.629	3.647	21.455	21.455
2	1.595	9.384	52.014	3.468	20.400	41.855
3	1.263	7.432	59.446	2.990	17.591	59.446
14	.137	.806	100.000			

Considering that the generally accepted range for explained variance in the social sciences is between 40% and 60% (Çokluk et al., 2012), and sometimes even below 30% (Tabachnick & Fidell, 2015), the 59.446% of total variance explained in the current study can be considered quite satisfactory. In addition to these indicators, results from Horn's (1965) parallel analysis were compared with the obtained eigenvalues, providing further evidence for a three-factor structure featuring eigenvalues greater than 1 and accounting for approximately 60% of the total variance. As detailed in Table 2, the first factor explains 21.455% of the total variance, the second factor explains 20.400%, and the third factor explains 17.591%. The 8 items excluded during the exploratory factor analysis and the justifications for their removal are presented in Table 3.

Table 3.
Item Exclusions in Exploratory Factor Analysis and Justifications

Items with Communalities < 0.30	*Items with Factor Loadings < 0.40*	*Cross-loading Items(Difference between highest two loadings < 0.10)*	*Rational Reasons (Factor Naming,Phrasing/Clarit)*

22	5	2-20-21-23	3-4

Items 3 and 4 were excluded for rational reasons, as they were determined not to align semantically with their intended factors. Item 22 was removed because its communality value was below the threshold of 0.30, and item 5 was removed because its factor loading was below the 0.40 criterion. Furthermore, items 2, 20, 21, and 23 were excluded due to significant cross-loadings, specifically exhibiting a difference of less than 0.10 between their highest two factor loadings. Thus, 8 items were removed from the initial 25-item trial version of the scale during the EFA process. This resulted in a final 17-item instrument with a three-factor structure that explains approximately 60% of the total variance. The communality values for the retained items in the measurement instrument are presented in Table 4.

Table 4.
Item Communalities, Factor Loadings, and Factor Assignments

No	*Item*	*Factor 1*	*Factor 2*	*Factor 3*	*Common Factor Variance (h2)*
16	My competitors' success disrupts my sleep.	.775			.645
18	My relationship with my coach influences my sleep pattern.	.771			.638
15	Poor relationships with other athletes negatively affect my sleep.	.702			.642
17	I find it difficult to fall asleep on days without physical training.	.690			.546
24	Consuming large amounts of fluids disrupts my sleep.	.564			.427
8	The training environment influences my sleep pattern.	.554			.494
19	My social interactions influence my sleep pattern.	.513			.462
9	Feelings of failure disrupt my sleep.		.816		.768
10	The pressure to succeed disrupts my sleep.		.808		.780
7	I find it difficult to sleep when experiencing competition-related stress.		.722		.641
13	Overthinking my performance disrupts my sleep.		.700		.683
25	I have difficulty falling asleep before important competitions.		.694		.613
12	Training intensity affects my sleep.			.817	.762
11	A high training pace affects my sleep.			.800	.722
14	Sleeping in different places affects my sleep quality.			.575	.439
6	My meal timing affects my sleep pattern.			.573	.446
1	My psychological state affects my sleep quality.			.531	.397
	Explained Variance Values (%)	21.455	20.400	17.591	59.446
	Cronbach's Alpha Values	.85	.89	.78	.91

Table 4 presents the items included in the measurement instrument, detailing their communalities, factor loadings, and factor assignments. The total variance explained by the factors is approximately 60%. Cronbach's alpha coefficients, indicating internal consistency reliability, were calculated as follows: .85 for Factor 1, .89 for Factor 2, .78 for Factor 3, and .91 for the overall scale. The assignment of items to factors, along with their phrasing and semantic content, were considered in conjunction with a review of the relevant literature to guide factor naming. Accordingly, the designated factor names, the number of items per factor, and the reliability coefficients for each factor are presented in Table 5.

Table 5.
Factor Names and Reliability Coefficients

Factor	*Factor Name*	*Number of Items*	*Cronbach's Alpha*
Factor 1	Social and Environmental Factors	7	.85
Factor 2	Performance Anxiety and Stress	5	.89
Factor 3	Physiological and Biological Factors	5	.78
Overall Scale / Total		17	.91

Based on this review process, Factor 1 was labeled "Social and Environmental Factors," Factor 2 "Performance Anxiety and Stress," and Factor 3 "Physiological and Biological Factors." All factors exceeded the commonly accepted criterion for reliability coefficients ($\alpha > 0.60$) (Hair et al., 2019), indicating that the measurement instrument yields reliable scores for each subscale and overall.

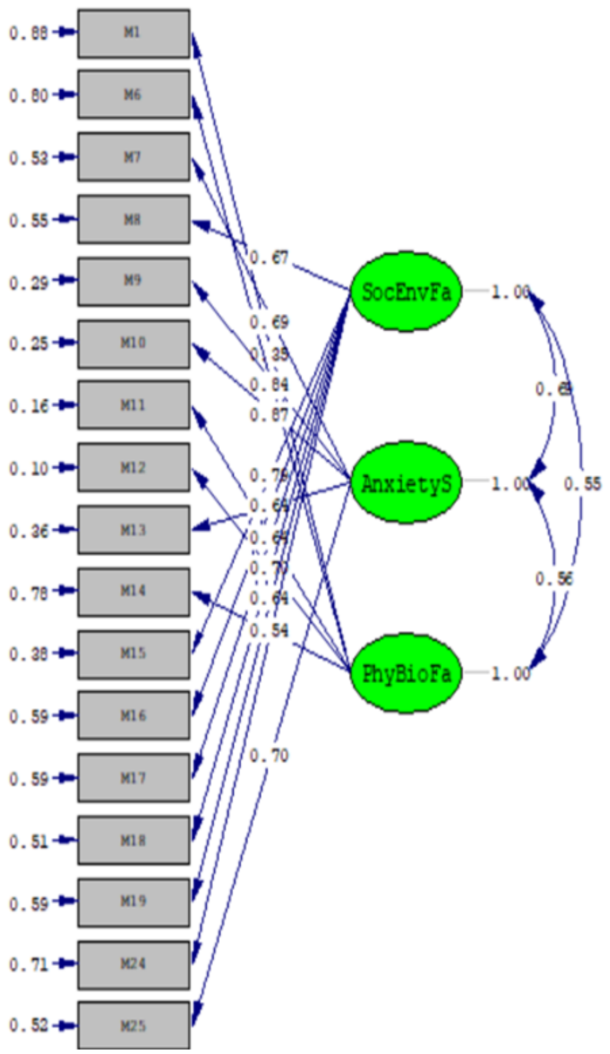
The naming of the factors was based on both the content of the items and the relevant theoretical framework in the literature. Specifically, items loading on each factor were examined in terms of their conceptual similarity and underlying meaning, and the factor labels were guided by existing research in sleep, sport psychology, and performance domains. Therefore, the factor names reflect not only empirical findings but also a theoretically grounded interpretation of athletes' subjective sleep awareness.

CFA Results

The Confirmatory Factor Analysis (CFA) revealed meaningful patterns across the three identified factors. The "Social and Environmental Factors" dimension exhibited standardized factor loadings ranging from 0.513 to 0.775, with item 16 demonstrating the strongest association with this construct. For the "Performance Anxiety and Stress" factor, standardized loadings varied from 0.694 to 0.816, with item 19 emerging as the most strongly correlated indicator. The "Physiological and Biological Factors" dimension showed standardized loadings between 0.531 and 0.817, with item 12 displaying the highest loading value. Statistical significance of these factor loadings was assessed through t-values, which are generally considered significant when they fall outside the -1.96 to +1.96 range ($p < .05$), as suggested in the methodological literature (Byrne, 2013; Brown, 2015). All items in the present analysis satisfied this criterion for statistical significance. The complete standardized factor loadings are detailed in Figure 2, while their corresponding t-values appear in Figure 3.

Figure 2.
Standardized Estimates for the Tested Model

Figure 3.
T-values for Parameter Estimates (p<=.05)



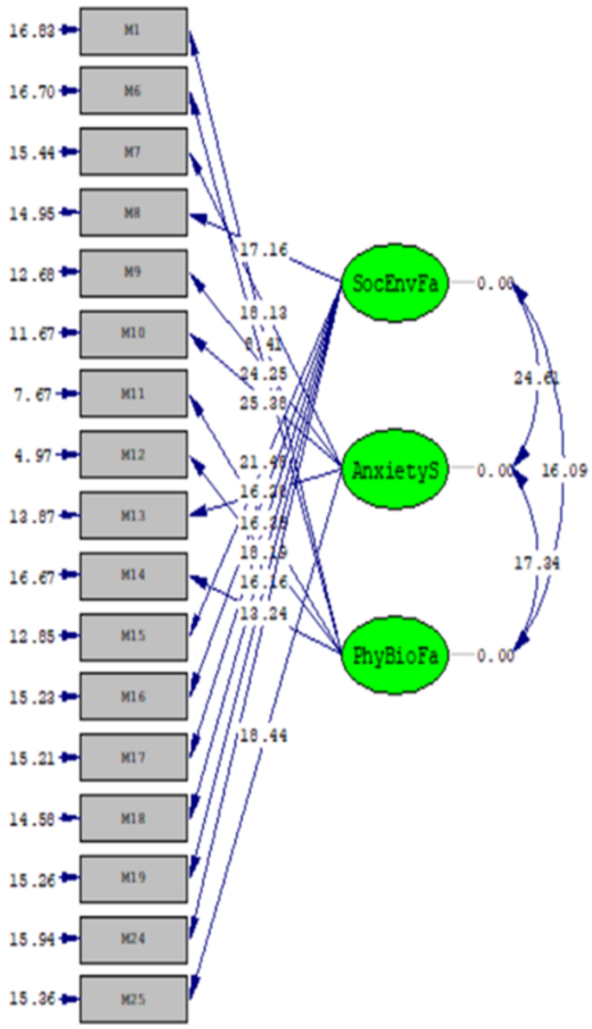


Figure 2 provides the standardized regression weights (factor loadings). As shown in Figure 3, which presents the t-values for these estimates, all item loadings were statistically significant. In addition to these item-level statistics, model goodness-of-fit indices were examined to provide further evidence for the proposed factor structure. These indices clearly indicate that the model provides a good fit to the data obtained from the study sample (Çokluk et al., 2012). The obtained fit indices and their corresponding acceptance criteria are presented in Figure 3.

Table 6.
Goodness-of-Fit Criteria and Obtained Values

Goodness-of-fit index	*Perfect Fit*	*Good or Acceptable Fit*	*Value Achieved*
χ2/df	<2	<5	544/116=4.68
RMSEA	0≤RMSEA≤ .05	.05≤ RMSEA≤ .08	.05≤ .08 ≤ .08
SRMR	0 ≤ SRMR ≤ .05	.05≤ SRMR ≤ .10	.05≤ .07 ≤ .1.0
NFI	.95 ≤ NFI ≤ 1.0	.90 ≤ NFI ≤ .94	.95 ≤ .95≤ 1.0
NNFI	.95 ≤ NNFI ≤ 1.0	.90 ≤ NNFI ≤.94	.95 ≤ .96 ≤ 1.0
CFI	.95 ≤ CFI ≤ 1.0	.90 ≤ CFI ≤ .94	.95 ≤ .96 ≤ 1.0
GFI	.95 ≤ GFI ≤ 1.0	.90 ≤ GFI ≤ .94	.90 ≤ .90 ≤.94
AGFI	.90 ≤ AGFI ≤ 1.0	.85 ≤ AGFI ≤ .91	.85 ≤ .86≤ .90

Sources: (Munro, 2005; Schreiber et al., 2006; Şimşek, 2020; Hooper et al., 2008)

One key fit index presented in Table 6 is the ratio of chi-square to degrees of freedom (χ^2/df). Calculated as 4.68 (χ^2 = 544, df = 116), this value is considered an important indicator of model fit. While a non-significant chi-square test indicates perfect fit, this is rare in practice; the χ^2/df ratio is often preferred, with lower values generally indicating better fit (Kline, 2014; Sümer, 2000). The obtained ratio falls within commonly accepted ranges. Other obtained model fit indices were: Root Mean Square Error of Approximation (RMSEA) = 0.08, Standardized Root Mean Square Residual (SRMR) = 0.07, 1 Normed Fit Index (NFI) = 0.95, Comparative Fit Index (CFI) = 0.96, Goodness of Fit Index (GFI) = 0.90, and Adjusted Goodness of Fit Index (AGFI) = 0.86. As these indices generally fall within accepted thresholds for good model fit, they provide strong evidence that the identified factor structure serves the intended purpose of the measurement instrument (Jöreskog & Sörbom, 1993). In summary, the model fit for the 17-item, 3-factor Likert-type structure of the Subjective Sleep Awareness Scale for Athletes, developed in this research, was confirmed through CFA.

Furthermore, to assess the construct validity (specifically convergent and discriminant validity) of the instrument, several indices were calculated: Average Variance Explained (AVE), Maximum Shared Variance (MSV), Average Shared Variance (ASV), and Composite Reliability (CR). These values are detailed in Table 7.

Table 7.
Convergent and Discriminant Validity and CR Values for the Scale

Factors	*AVE*	*MSV*	*ASV*	*CR*
1	0.54	0.44	0.10	0.85
2	0.57	0.49	0.10	0.89
3	0.50	0.30	0.10	0.78
Index	AVE>.50 CR>AVE	MSV<AVE	ASV<MSV	CR>.70

(Cronbach's alpha for the entire scale: .91)

For establishing convergent validity, AVE values should ideally exceed 0.50, and composite reliability values should be greater than their corresponding AVE values (Yaşlıoğlu, 2017). In this study, the criterion of CR > AVE was met for all three factors. For discriminant validity in multi-factor scales, various criteria exist. The condition that MSV values should be greater than ASV values (ASV < MSV) was also met. Based on these results, the requirements for discriminant validity were satisfied. Finally, all CR values were found to be above the recommended threshold of 0.70.

Conclusion and Recommendations

Sleep is a critical determinant of athletes' daily functioning and performance outcomes. Athletes' subjective awareness of their sleep quality serves as a primary indicator of potential issues that may affect their recovery and performance. By investigating athletes' subjective perceptions of sleep, including their awareness of sleep disturbances and possible causal factors, valuable insights can be generated for athletes, coaches, and sports science professionals. The implementation of reliable and valid measurement instruments to capture these subjective experiences is essential for both practical application and advancing research in this domain. The present study developed the "Subjective Sleep Awareness Scale for Athletes" (SSASA) through rigorous quantitative procedures, including exploratory factor analysis and confirmatory factor analysis, which established the construct validity of the final 17-item scale that employs a 7-point response format and comprises three distinct factors. Based on item content analysis and a comprehensive review of literature on athletes' subjective sleep awareness, these factors were labeled: "Social and Environmental Factors," "Performance Anxiety and Stress," and "Physiological and Biological Factors." The validated instrument provides a foundation for future research and practical interventions addressing sleep quality in athletic populations.

The study makes a significant contribution to the literature by introducing a multidimensional and sport-specific instrument designed to assess athletes' subjective sleep awareness. Unlike existing approaches that predominantly focus on objective sleep indicators or general sleep quality measures, the SSASA captures the unique contextual factors influencing sleep in athletes. In doing so, it addresses an important gap in the literature by providing a comprehensive and theoretically grounded measurement tool tailored specifically to athletic populations.

From a practical perspective, the scale offers a valuable framework for coaches, sports psychologists, and sport science professionals to identify sleep-related vulnerabilities that may negatively impact performance and recovery. The systematic use of this instrument can support the development of individualized training, recovery, and psychological intervention strategies. Furthermore, the scale can be utilized to monitor changes in sleep awareness over time, enabling more informed decision-making in athlete management and performance optimization.

Recommendations

The newly developed Subjective Sleep Awareness Scale for Athletes (SSASA) offers significant practical applications for various stakeholders in sport settings, including coaches, sports psychologists, and sport science professionals. In applied settings, the scale can be used as a screening and monitoring tool to identify athletes who may be at risk of sleep-related performance decrements. Coaches and sports psychologists can utilize subscale scores to design targeted interventions—for instance, addressing performance anxiety through psychological skills training or modifying environmental conditions that disrupt sleep.

Future research should examine differences in subjective sleep awareness across specific sport types (e.g., individual vs. team sports), performance levels (e.g., elite vs. amateur athletes), and gender. Such analyses would help determine whether certain groups are more vulnerable to specific sleep-related challenges. Additionally, the relationships between the sub-dimensions of the scale—Social and Environmental Factors, Performance Anxiety and Stress, and Physiological and Biological Factors—and performance outcomes should be investigated to better understand how each dimension contributes to athletic success.

Researchers are also encouraged to explore the predictive role of subjective sleep awareness in relation to key performance indicators such as recovery quality, injury risk, and competitive performance. Longitudinal studies may provide valuable insights into how sleep awareness fluctuates across training cycles and competitive seasons. Furthermore, integrating the SSASA with qualitative approaches (e.g., interviews or athlete diaries) could offer a deeper understanding of the contextual factors influencing sleep perceptions in athletes.

Finally, the applicability of the scale should be tested across different cultural contexts and age groups to enhance its generalizability. The use of the SSASA in multidisciplinary settings—where coaches, sports psychologists, and medical staff collaborate—may further contribute to the development of comprehensive, evidence-based athlete monitoring and support systems.

Ethics Committee Approval Information

Ethical approval was obtained from the Mersin University Sports Sciences Ethics Committee on 22 September 2025, with decision no. 074.

Conflict of Interest

There are no conflicts of interest to declare.

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Genişletilmiş Özet

Giriş

Uyku, fiziksel, nörolojik ve duygusal işlevlerin düzenli şekilde sürdürülebilmesi için temel bir biyolojik gereksinimdir. Fizyolojik açıdan bakıldığında uyku; zihinsel ve fiziksel kapasitenin yeniden yapılanmasını sağlayan, onarım süreçlerini destekleyen yenileyici bir durumdur (Walker, 2017; Zhdanova, 2005). Uyku süresinin ötesinde, uykunun kalitesi ve bireyin bu deneyime dair öznel memnuniyeti, sağlıklı işleyişin belirleyici öğeleri arasında yer almaktadır (Ohayon & Zulley, 2001). Uyku kalitesi; uykunun devamlılığı, derinliği ve uyanma sonrası hissedilen dinlenmişlik düzeyiyle ilişkilidir (Luyster et al., 2012; Hirshkowitz et al., 2015).

Sporcular açısından ise uyku, yalnızca bir dinlenme süreci değil; performans kapasitesi, psikolojik dayanıklılık ve iyileşme süreçlerinin merkezi bir bileşenidir (Swinbourne et al., 2016; Nobari et al., 2023; Vorster et al., 2024). Uyku kalitesinde yaşanan bozulmalar, hem bilişsel dikkat hem de fiziksel toparlanma üzerinde olumsuz etkilere yol açabilmektedir (Cho & Im, 2024). Ayrıca, sporcuların yalnızca objektif uyku göstergeleri değil, öznel uyku farkındalık düzeyleri de antrenman planlaması ve psikolojik destek süreçlerinde önemli bir belirleyicidir (Doherty et al., 2021; Knufinke et al., 2018). Bu bağlamda, sporcularda öznel uyku farkındalığını ölçebilecek geçerli ve güvenilir bir ölçme aracına duyulan ihtiyaç dikkat çekicidir. Bu çalışmanın temel amacı, sporcuların uykuya dair öznel farkındalık düzeylerini değerlendirmeye yönelik psikometrik açıdan geçerli ve güvenilir bir ölçek geliştirmektir.

Yöntem

Araştırma, temel psikometrik desen çerçevesinde gerçekleştirilmiş ve ölçek geliştirme süreci DeVellis'in (2021) ilkeleri doğrultusunda yapılandırılmıştır. Öncelikle nitel veri toplama sürecinde 3 akademisyen ve 12 aktif sporcu ile odak grup görüşmeleri yapılmış; ayrıca 20 sporcudan yazılı anlatımlar alınarak madde havuzu oluşturulmuştur. Literatür taramasıyla desteklenen bu süreçte, Şenol vd. (2012), Öz & Miniksar (2023) gibi kaynaklardan elde edilen bilgiler doğrultusunda ilk taslak ölçek 33 maddeden oluşmuştur.

Kapsam geçerliği aşamasında 11 uzmanın değerlendirmeleri alınmış ve Lawshe (1975) yöntemiyle CVR hesaplamaları yapılmıştır. Kritik eşik değeri olan 0.712'yi karşılamayan 9 madde ile uzman önerisiyle elenen 2 madde çıkarılmış; 3 yeni madde eklenmiş ve 25 maddelik pilot form elde edilmiştir. Ölçek 7 dereceli (1- Beni Hiç Tanımlamıyor ile 7- Tamamen Beni Tanımlıyor) bir yapı olarak sunulmuştur.

Keşfedici Faktör Analizi (KFA) için 651 sporcudan veri toplanmış; aykırı ve uygunsuz verilerin elenmesiyle analiz 597 katılımcı üzerinden gerçekleştirilmiştir. KMO değeri .915, Bartlett testi anlamlı bulunmuştur ($\chi^2 = 5143.637$, $p < .001$). Doğrulayıcı Faktör Analizi (DFA) için ise 604 sporcu verisi üzerinden 26 aykırı gözlem elenmiş ve analiz 578 kişi ile yapılmıştır. Faktör analizleri SPSS ve LISREL programları ile yürütülmüştür.

Bulgular

KFA sonucunda ölçek üç faktörlü bir yapı kazanmıştır: Sosyal ve Çevresel Faktörler (7 madde), Performans Kaygısı ve Stres (5 madde), Fizyolojik ve Biyolojik Faktörler (5 madde). Bu yapı toplam varyansın %59.446'sını açıklamaktadır. Faktör yükleri .513 ile .817 arasında değişmiş; tüm maddelerin madde-toplam korelasyonları ve ortak varyans değerleri anlamlı bulunmuştur.

DFA bulgularına göre modelin uyum iyiliği değerleri kabul edilebilir düzeydedir: $\chi^2/df = 4.68$, RMSEA = 0.08, SRMR = 0.07, CFI = 0.96, GFI = 0.90, AGFI = 0.86. İç tutarlılık katsayıları Sosyal ve Çevresel Faktörler için $\alpha = .85$, Performans Kaygısı ve Stres için $\alpha = .89$, Fizyolojik ve Biyolojik Faktörler için $\alpha = .78$; ölçeğin tamamı için $\alpha = .91$ olarak hesaplanmıştır.

Bileşik güvenirlik (CR) değerleri .78 ile .89 arasında; ortalama açıklanan varyans (AVE) değerleri ise .50'nin üzerindedir. Ayrıca ayırt edici geçerlik ölçütleri olan MSV ve ASV değerleri AVE değerlerinden küçük bulunarak çok faktörlü yapının ayrışabilirliğini desteklemiştir (Yaşlıoğlu, 2017).

Tartışma ve Sonuç

Bu bulgular, geliştirilen "Sporcular İçin Öznel Uyku Farkındalığı Ölçeği"nin yapı geçerliğine ve güvenirliğine sahip özgün bir ölçme aracı olduğunu göstermektedir. Ölçeğin üç faktörlü yapısı; sporcuların hem çevresel etkileşimlerden hem performans temelli kaygılardan hem de biyolojik düzenleyicilerden etkilenen uyku farkındalıklarını çok boyutlu biçimde ortaya koymaktadır.

Spor psikolojisi ve performans alanında bu tür farkındalıkların belirlenmesi, bireyselleştirilmiş antrenman, dinlenme ve psikolojik destek programlarının oluşturulmasında kritik bir öneme sahiptir (Grandner, 2017; Scullin & Bliwise, 2015). SSASA, hem akademik araştırmalar hem de saha uygulamaları için kullanılabilir niteliktedir.

Gelecekte farklı yaş gruplarında, spor türlerinde ve kültürel bağlamlarda yeniden test edilmesi; test-tekrar test güvenirliğinin değerlendirilmesi; ayrıca tükenmişlik, dikkat dağınıklığı, duygudurum bozuklukları gibi değişkenlerle ilişkilerinin incelenmesi önerilmektedir.

Sporcularda Öznel Uyku Farkındalığı Ölçeği ''SÖZUF''

		Sayın Katılımcı; Aşağıda, uyku farkındalık düzeyinizi ölçme amacıyla bir takım sorular yöneltilmiştir. Size sunulan soruların doğruluğu ya da yanlışlığı yoktur, size uygunluğu vardır. Lütfen, ölçekte yer alan ifadeleri, size uygun şekilde ve içtenlikle doldurunuz.	Tamamen Beni Tanımlıyor			Kararsızım			Beni Hiç Tanımlamıyor
Sosyal ve Çevresel Etmenler	1	Antrenörümle olan ilişkim uyku kalitemi etkiler.	7	6	5	4	3	2	1
	2	Uykum, diğer sporcularla olan kötü ilişkimden etkilenir.	7	6	5	4	3	2	1
	3	Rakiplerimin başarısı beni uykusuz bırakır.	7	6	5	4	3	2	1
	4	Fiziksel antrenman yapmadığım günler, uykuya dalmakta zorlanırım.	7	6	5	4	3	2	1
	5	Antrenman yapılan mekân uyku düzenimi etkiler.	7	6	5	4	3	2	1
	6	Sosyal ilişkilerim uyku düzenimi etkiler.	7	6	5	4	3	2	1
	7	Uykum, yoğun sıvı tükettiğimde bölünür.	7	6	5	4	3	2	1
Performans Kaygısı ve Stres	8	Yarışma stresi hissettiğimde uyumakta zorlanırım.	7	6	5	4	3	2	1
	9	Başarısız olma hissi beni uykusuz bırakır.	7	6	5	4	3	2	1
	10	Üzerimdeki başarı beklentisi, uykularımı kaçırır.	7	6	5	4	3	2	1
	11	Performansım üzerine çok düşünmek uykumu kaçırır.	7	6	5	4	3	2	1
	12	Önemli müsabakalar öncesi uykuya dalmakta zorlanırım.	7	6	5	4	3	2	1
Fizyolojik ve Biyolojik Faktörler	13	Psikolojik durumum uyku kalitemi etkiler.	7	6	5	4	3	2	1
	14	Uyku düzenim beslenme zamanlarımdan etkilenir.	7	6	5	4	3	2	1
	15	Yoğun antrenman temposu uykumu etkiler.	7	6	5	4	3	2	1
	16	Antrenman yoğunluğu uykumu etkiler.	7	6	5	4	3	2	1
	17	Farklı yerlerde uyumak uyku kalitemi etkiler.	7	6	5	4	3	2	1

Subjective Sleep Awareness Scale for Athletes

		Dear Participant, Below you will find a series of statements designed to assess your level of sleep awareness. There are no right or wrong answers to these statements; rather, your responses should reflect how accurately each statement describes you. Please read each item carefully and respond sincerely based on your personal experiences.	Completely Describes Me			Undecided			Does Not Describe Me at All
Social and Environmental Factors	1	My relationship with my coach influences my sleep pattern.	7	6	5	4	3	2	1
	2	Poor relationships with other athletes negatively affect my sleep.	7	6	5	4	3	2	1
	3	My competitors' success disrupts my sleep.	7	6	5	4	3	2	1
	4	I find it difficult to fall asleep on days without physical training	7	6	5	4	3	2	1
	5	The training environment influences my sleep pattern.	7	6	5	4	3	2	1
	6	My social interactions influence my sleep pattern.	7	6	5	4	3	2	1
	7	Consuming large amounts of fluids disrupts my sleep.	7	6	5	4	3	2	1
Performance Anxiety and Stress	8	I find it difficult to sleep when experiencing competition-related stress.	7	6	5	4	3	2	1
	9	Feelings of failure disrupt my sleep.	7	6	5	4	3	2	1
	10	The pressure to succeed disrupts my sleep	7	6	5	4	3	2	1
	11	Overthinking my performance disrupts my sleep	7	6	5	4	3	2	1
	12	I have difficulty falling asleep before important competitions.	7	6	5	4	3	2	1
Physiological and Biological Factors	13	My psychological state affects my sleep quality.	7	6	5	4	3	2	1
	14	My meal timing affects my sleep pattern	7	6	5	4	3	2	1
	15	A high training pace affects my sleep.	7	6	5	4	3	2	1
	16	Training intensity affects my sleep.	7	6	5	4	3	2	1
	17	Sleeping in different places affects my sleep quality.	7	6	5	4	3	2	1