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The Perceived Concentration Level in Athletes Scale (PCLAS): A Validity and Reliability Study

Nuriye Şeyma KARA[1], Mehmet KARA[2]

[1]Hatay Mustafa Kemal University, Faculty of Sports Sciences, Hatay, Türkiye
[2]Mersin University, Faculty of Sports Sciences, Mersin, Türkiye

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Abstract

This study aimed to develop a valid and reliable measurement tool specific to the sports context to measure the concentration levels perceived by athletes during training and competition. Qualitative and quantitative methods were combined in the scale development process. The qualitative stage involved focus group interviews, compositions written by the target audience, and content validity analyses via the lawshe technique. The quantitative stage applied assumption analyses, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), convergent-divergent validity, and composite reliability analyses. The scaling study was conducted through two independent samples. EFA was performed with data from 735 athletes, while CFA included 681 athletes. Factor analyses yielded a final scale form of 27 items with a 7-point Likert type. It consists of two factors: Focusing and maintaining attention (α=.97, ω=.92, n=11) and attentional control under pressure (α=.98, ω=.94, n=16). The two-factor structure explains 71.11% of the total variance. CFA results indicated that the model provided an acceptable level of fit (χ^2/df=4.46; RMSEA=.080; SRMR=.023; CFI=.99). Convergent validity criteria were met. Composite reliability and omega coefficients revealed that the scale possesses a high level of internal consistency. The findings show that the Perceived Concentration Level in Athletes Scale (PCLAS) is a valid and reliable measurement tool suitable for use in the field of sports psychology.

Keywords: Attention focusing, attentional control under pressure, perceived concentration, scale development, sports psychology

Correspondence: Nuriye Şeyma KARA, **E-mail:** nseymasar@gmail.com

INTRODUCTION

The ability to execute a specific purpose or behavior is thought to depend not only on an individual's level of performance but also on their level of concentration. Rice et al., (2016) described concentration as the capacity to channel limited cognitive resources toward relevant stimuli in pursuit of a specific task or goal. In a similar fashion, Nideffer and Sagal (1993) defined it as directing attention toward performance-related stimuli and bringing distracting elements under control. Such perspectives suggest that concentration is not merely a matter of objective attentional processes. It also encompasses subjective evaluations regarding the extent to which an individual can control their own attention. Perceived concentration includes subjective judgments about one's ability to direct attention to the target during performance, to sustain this focus, and to maintain cognitive control against distracting stimuli (Gardner & Moore, 2004; Eysenck et al., 2007; Wilson et al., 2009). It can be viewed as a vital concept for interpreting how athletes experience their performance and manage attentional processes, particularly within training and competitive environments. At this point, it is important to conceptually distinguish perceived concentration from related constructs such as attention and attentional focus. Attention generally refers to the cognitive mechanism that selects and processes relevant stimuli from the environment (Abernethy, 2001; Moran, 2016). Attentional focus, on the other hand, concerns the direction of attention (e.g., internal vs. external focus) and its breadth (broad vs. narrow), as conceptualized in attentional style models such as the test of attentional and ınterpersonal style (Nideffer, 1976) and further elaborated in attentional focus research distinguishing internal and external focus of attention (Wulf, 2013). These frameworks primarily describe objective attentional tendencies or styles. In contrast, perceived concentration refers to the athlete's subjective evaluation of their ability to effectively direct, sustain, and regulate attention within sport-specific performance contexts. Thus, perceived concentration is not merely an attentional style or direction, but a self-assessed cognitive control capacity experienced during performance. In addition to attentional control frameworks, perceived concentration should also be clearly distinguished from related constructs frequently examined in sport psychology, such as mindfulness in sport, flow experience, and mental toughness. Mindfulness in sport emphasizes present-moment awareness and non-judgmental acceptance of internal experiences (Birrer et al., 2012), whereas flow reflects an optimal experiential state characterized by deep absorption and intrinsic enjoyment (Csikszentmihalyi, 1990). Mental toughness represents a broader dispositional capacity to maintain performance under stress and adversity (Gucciardi et al., 2009a). Unlike these constructs, perceived concentration specifically refers to athletes' self-evaluative appraisal of their ability to direct, sustain, and regulate attention during sport-specific performance tasks. Therefore, the PCLAS targets a domain-specific cognitive control perception rather than global psychological resilience, experiential states, or trait-based personality characteristics.

The competitive sports environment is a performance domain containing high cognitive demands (Vickers, 2007). It forces the athlete to constantly reorganize their resources of attention. In contexts where competition is felt intensely, athletes are compelled to manage their attentional processes effectively. They face time pressure, environmental stimuli, and performance expectations (Abernethy, 2001). Directing attention to a target and maintaining it plays a significant role in the execution of motor behavior, effective decision-making, and the stability of performance (Vickers, 2007). Yet, how athletes experience these processes and how they evaluate their own concentration levels can determine the result. For this reason, examining the level of perceived concentration in athletes is seen as a necessity for understanding the cognitive dimensions of performance (Jackson & Csikszentmihalyi, 1999; Beilock & Carr, 2001).

The literature evaluates concentration in athletes through two main concepts. The first concerns the directing and sustaining of attention toward a goal. Focusing and maintaining attention means the athlete turns selectively to elements related to performance and keeps this focus over time (Abernethy, 2001; Vickers, 2007; Moran, 2016). In sports requiring technical skill, the continuity of focus is vital. It plays a major role in movement accuracy, timing, and performance consistency (Vickers, 2007). Rice et al., (2016) states that the ability to sustain focus allows the athlete to use cognitive resources efficiently during performance. In this regard, focusing and maintaining attention may be stated as one of the building blocks of concentration in athletes.

The second important building block of concentration is seen as attentional control under pressure. In competitive sports environments, athletes frequently encounter situations creating stress, anxiety, and performance pressure. These situations can lead attention toward elements unrelated to performance. According to attentional control theory, as pressure and anxiety rise, the individual’s cognitive control mechanisms weaken and attentional processes may fail (Eysenck et al., 2007). On the other hand, some athletes regulate their attention even under crushing conditions and continue to focus on performance goals. This shows that attentional control under pressure must be evaluated as an individual skill (Wilson et al., 2009). Research on choking under pressure further demonstrates that heightened performance anxiety can disrupt attentional regulation and impair skilled performance (Mesagno & Hill, 2013), highlighting the importance of athletes’ perceived capacity to maintain attentional control under competitive demands.

These approaches show that concentration in athletes cannot be explained by objective attentional processes alone; the athletes' own perceptions regarding these processes are also a key component. Especially in sports environments containing high pressure and stress, the perception of one's ability to manage attention directly affects how the performance is experienced and sustained (Jones, 2003; Gucciardi et al., 2009b). Evaluating concentration through the dimensions of directing and sustaining attention, alongside attentional control under pressure, allows for a more holistic explanation of performance processes (Badau, 2024). In this regard, a need arises for measurement tools that evaluate attentional processes not only by objective indicators but through the athletes' perceptions of their own experience. Although several instruments have been developed to assess attention and attentional style in sport settings-such as the test of attentional and ınterpersonal style (Nideffer, 1976) and various attentional focus scales-most of these tools primarily measure stable attentional preferences, attentional direction, or style characteristics. They tend to focus on trait-like cognitive tendencies rather than the athlete’s situational and subjective evaluation of their concentration capacity during actual training or competition. Moreover, existing instruments often assess general attentional processes without sufficiently incorporating sport-specific stressors such as scoreboard pressure, referee decisions, crowd effects, or performance-critical moments. The present scale differs by directly measuring athletes' perceived concentration within performance environments and by integrating both sustained focus and attentional control under pressure into a unified, sport-specific framework. Therefore, the conceptual boundary of the PCLAS lies in assessing how athletes perceive and evaluate their own attentional functioning in context-dependent performance situations. Unlike traditional attentional style measures, the PCLAS is designed to capture the experiential and self-regulatory dimension of concentration as it unfolds under competitive demands. However, these instruments do not directly assess athletes' subjective appraisal of their concentration capacity within performance contexts, nor do they integrate sustained attention and pressure-based attentional control into a unified sport-specific construct, which constitutes the primary contribution of the PCLAS.

The purpose of the research was therefore to develop a valid and reliable measurement tool for use in the field of sports psychology that would enable measuring concentration levels perceived by athletes during training and competition, covering the dimensions of focusing and maintaining attention, and attentional control under pressure.

METHOD

Research Model

This study constitutes a scale development investigation aimed at assessing the perceived concentration levels of athletes affiliated with various sports federations in Türkiye. Conducted within the framework of basic research, the scale development process was based on the summated ratings method, one of the respondent-based scaling approaches, whereby measurement scores are derived from participants' responses (DeVellis, 2021).

Research Group and Ethical Approval

The research was conducted in accordance with the principles of the Declaration of Helsinki. It was approved by the Hatay Mustafa Kemal University Social and Humanities Ethics Committee with the decision dated 07 November 2025, session number 13, and decision number 42. The research was carried out with two independent study groups to determine the perceived concentration levels of the athletes. In scale development studies, the primary aim is not to estimate population parameters or test causal hypotheses, but to examine the psychometric structure of the measurement instrument (Worthington & Whittaker, 2006; DeVellis, 2021). For this reason, the term "study group" is preferred instead of "sample," as the focus lies on obtaining sufficiently large and heterogeneous participant groups to evaluate factor structure rather than representing a specific statistical population. Accordingly, participants were recruited from licensed athletes affiliated with various sport federations in Türkiye. A non-probability sampling approach was adopted. Participants were reached through online data collection using federation networks and direct contact with different sport clubs. To minimize overlap between the two datasets, separate clubs were intentionally contacted for the exploratory and confirmatory phases. Recruitment relied on voluntary participation and coach-mediated distribution of the online questionnaire.

Exploratory factor analysis (EFA) was applied to reveal factors based on the relationships between variables and to determine the exploration aimed at generating theory. Data were collected from the target audience of athletes between 08 November 2025 and 15 November 2025, within the scope of the EFA. Data were collected exclusively through online Google Forms. Distribution was conducted via official federation contacts and through coaches who shared the survey link with their athletes. Due to the broad sport network accessed and the use of online distribution channels, a high number of responses were obtained within a relatively short period. During this process, a total of 851 observations were obtained from individuals aged 18 and over who actively participated in licensed sports. After the EFA assumptions were met, the analyses continued with 735 valid observations. Descriptive information for the EFA is presented in Table 1.

Table 1. Descriptive characteristics of the exploratory (EFA) and confirmatory (CFA) samples

		EFA		CFA	
Variables	**Groups**	**n**	**%**	**n**	**%**
Gender	Female	329	44.8	282	41.4
	Male	406	55.2	399	58.6
Sport Category	Individual	443	60.3	294	43.2
	Team	292	39.3	387	56.8
Years of Experience in Sports	1-3 Years	370	50.3	243	35.7
	4-6 Years	164	22.3	226	33.2
	7-9 Years	90	12.4	108	15.9
	10 Years and Above	110	15.0	104	15.3
	Total	735	100	681	100

EFA=Exploratory Factor Analysis; CFA=Confirmatory Factor Analysis. As shown in Table 1, the distribution patterns across the exploratory and confirmatory samples were comparable.

A total of 735 athletes were included in the research during the EFA process. Of the participants, 329 (44.8%) were female and 406 (55.2%) were male. An examination of age distribution shows that the majority of athletes fell within the 18-25 age range (n = 561, 76.3%). Those in the 26-45 age range numbered 174 (23.7%). Regarding the distribution of experience, 370 participants (50.3%) had 1-3 years, 164 (22.3%) had 4-6 years, 91 (12.4%) had 7-9 years, and 110 (15.0%) had 10 years or more of sporting experience. In terms of sport category, 443 participants (60.3%) were engaged in individual sports, while 292 (39.7%) were involved in team sports.

A total of 681 athletes were included in the research during the CFA process. Of the participants, 282 (41.4%) were female and 399 (58.6%) were male. Regarding sporting experience, 243 athletes (35.7%) had 1-3 years of experience, 226 (33.2%) had 4-6 years, 108 (15.9%) had 7-9 years, and 104 (15.3%) had 10 years or more of experience. In terms of sport category, 294 participants (43.2%) were engaged in individual sports, while 387 (56.8%) were involved in team sports. Confirmatory factor analysis (CFA) was conducted to evaluate the construct validity, convergent validity, and divergent validity of the final form obtained after the EFA. Data were collected a second time for the purpose of the CFA from 823 licensed and active athletes who volunteered for the research between 20 November 2025 and 25 November 2025. These data were subjected to assumption analyses. Following the analyses, the CFA was performed on the 681 valid observations that remained. Although the time interval between the two data collection phases was relatively short, deliberate efforts were made to ensure independence between the datasets. Different sport clubs were contacted for the exploratory and confirmatory phases, and separate distribution networks were used to minimize potential overlap. No personal identifiers (e.g., name, email, ID number) were collected due to ethical considerations; therefore, absolute verification of non-duplication was not possible. However, participants were clearly instructed to complete the questionnaire only once. Considering the distinct recruitment channels and the large and diverse sport environment in Türkiye, the likelihood of substantial overlap between the two datasets is considered minimal.

Phases of Developing the Candidate Scale Form

Focus Group Interview: Interviews were conducted to generate the item pool. Eight national athletes-four from team sports and four from individual disciplines-along with four academic experts participated. Participants were selected via a convenient sampling approach within the study group. This qualitative method targets easily accessible subjects and is preferred when time and resources are limited (Yıldırım & Şimşek, 1999).

Writing Composition for the Target Audience: To further develop the item pool, active licensed athletes aged 18 and over were consulted. A total of 62 students from the Faculties of Sports Sciences at Hatay Mustafa Kemal University, Mersin University, Osmaniye Korkut Ata University, Çukurova University, and universities in surrounding provinces participated. They were asked to express their views and experiences regarding perceived concentration levels in writing through open-ended questions.

Literature Review: We examined various scale items addressing concentration and related concepts in the literature, and these items contributed to the process of creating the item pool. Within the framework of attentional control theory, item writing was supported to reflect athletes' abilities to direct attention and sustain it under pressure (Eysenck et al., 2007).

Content Validity (CVI) Analysis: Following the completion of the above-given stages, the item pool was formed and the candidate scale form took shape. The candidate form was read aloud to six active athletes. Their views and feedback regarding the clarity of the items were obtained. Necessary adjustments were made based on this feedback, and a pilot scale form consisting of 40 items was prepared. The pilot form was structured based on the lawshe technique and sent to field experts via e-mail for evaluation. They assessed the items based on representativeness and clarity criteria. The critical content validity ratio (CVR) value for 12 experts at the alpha=.05 significance level was taken as .56 (Lawshe, 1975). Ten items did not meet the content validity criterion. Three items were removed based on expert suggestions. Expert opinions and validity analyses resulted in the removal of 13 items total. A pilot scale form consisting of 28 items remained. Experts also evaluated the rating structure. A 7-point Likert-type rating (1=does not describe me at All, 7=completely describes me) was deemed appropriate based on the feedback.

Application of the Pilot Scale Form: Following the content validity evaluations, a pilot scale form consisting of 28 items with a 7-point Likert-type rating structure was finalized. This form was administered to licensed and active athletes for the exploratory factor analysis phase. Data were collected exclusively through an online google forms platform. The survey link was distributed via sport federation networks and through direct contact with coaches from different sport clubs. Coaches were asked to share the questionnaire with their athletes on a voluntary basis. A total of 851 responses were initially obtained. Prior to conducting the exploratory factor analysis, the dataset was screened for missing data, outliers, normality, linearity, and multicollinearity assumptions. After necessary data cleaning procedures, analyses were conducted on 735 valid observations.

Data Analysis

Preparation for EFA and Testing Statistical Assumptions: EFA and CFA were performed during the statistical analysis process to determine the perceived concentration levels of athletes. Cronbach's α internal consistency coefficients and composite reliability values were calculated to examine the reliability of the scale. Various assumption tests were performed to evaluate the suitability of the data before proceeding to factor analyses. For the exploratory factor analysis (EFA), a total of 851 observations were initially examined for missing data, sample adequacy, outliers, multicollinearity, factorability of the correlation (R) matrix, and assumptions of normality and linearity. Following data screening procedures, analyses proceeded with 735 valid observations. For the confirmatory factor analysis (CFA), 823 observations were initially evaluated using the same data screening procedures. After removing cases that violated statistical assumptions, CFA was conducted on 681 valid observations.

EFA is a statistical technique aimed at revealing the latent structures underlying a group of variables (Tabachnick et al., 2007). Sample size in EFA is critical for the stability of the obtained factor structure and valid interpretation of results. Krichbaum et al., (1994) stated that at least 125 participants would be sufficient for a 25-item scale, though this varies in the literature depending on the number of items. Comrey and Lee (2013) define a sample size of 500 and above as "very good." In this direction, the data obtained from 851 participants included in the current research exceed the recommended sample size criteria for EFA. Furthermore, recommendations in scale development research emphasize achieving large participant-to-item ratios (at least 10:1) to ensure stable factor solutions (Worthington & Whittaker, 2006). The present study exceeded these recommendations substantially. The results of the factor analysis can be evaluated reliably.

The median, mode, and arithmetic mean values of the scale items were found to be relatively close to each other, suggesting a symmetrical distribution pattern. In conjunction with skewness and kurtosis values, this pattern provides preliminary evidence of approximate normality (Tabachnick & Fidell, 2013; Field, 2024). According to established guidelines in multivariate statistics, the combined evaluation of central tendency measures and distributional shape indicators is recommended when assessing normality assumptions prior to factor analysis. Outlier analysis was performed on a total of 851 observations. Four observations were removed from the data set as a result. The sample size dropped to 847 before analysis.

Z-scores were calculated to identify potential univariate outliers. Observations falling outside the ±3 standard deviation range were considered extreme values in accordance with commonly accepted criteria in multivariate statistical analysis (Tabachnick & Fidell, 2013; Field, 2024). This threshold is widely used in factor analytic studies to ensure stability of parameter estimates and prevent distortion of the covariance matrix. Eight observations falling outside this range were excluded from the analysis. The Z-values of the remaining observations were found to be between -2.971 and 2.905. Mahalanobis distances were examined to determine multiple outliers. One hundred and four observations remaining above the threshold value determined according to the Chi-square distribution ($\chi^2(27, .001)=55.476$) were removed from the data set. EFA was carried out based on 735 valid observations following all preliminary procedures and assumption checks.

Analyses in this study were conducted based on the assumption that existing relationships are linear, considering the view of Kara et al., (2023) that relationships between variables may not always be fully linear. Each item was examined individually to evaluate the normality assumption. Skewness and kurtosis coefficients were analyzed alongside measures of central tendency. The closeness of the obtained values indicates that univariate normality was achieved (Can, 2018). Skewness and kurtosis values were evaluated to assess univariate normality. According to widely accepted guidelines in multivariate analysis, skewness values within ±3 and kurtosis values within ±10 are generally considered acceptable for structural equation modeling and factor analysis (Kline, 2015; Hair et al., 2019). The obtained values fell within these acceptable thresholds, indicating no serious deviation from normality. a skewness coefficient between -3.3 and +3.3 and a kurtosis coefficient between -7 and +7 are sufficient for normality. The data met the normality assumption according to these criteria. Tolerance and Variance Inflation Factor (VIF) values were examined to evaluate the risk of multicollinearity. Tolerance values ranged from .205 to .395, and VIF values ranged from 2.534 to 4.887. All Tolerance values being above .20 and VIF values being below 5 indicates no multicollinearity problem in the data set (Tabachnick & Fidell, 2013).

The presence of relationships between error terms occurring at different time periods, namely autocorrelation, was also evaluated within the scope of the model, as it could increase the risk of Type I error (Field, 2024). The durbin-watson test result was calculated as 1.789. This result shows that error terms are independent of each other and there is no autocorrelation problem (Kalaycı, 2010).

The factorability of the R matrix, one of the fundamental assumptions of factor analysis, was evaluated via the kaiser-meyer-olkin (KMO) sample adequacy test and bartlett's test of sphericity. The KMO coefficient was determined to be .985. This value shows that the sample is highly suitable and excellent for factor analysis. KMO values above .90 indicate excellent adequacy according to criteria suggested by (Sofroniou & Hutcheson, 1999; Dağlı, 2015). Bartlett's test of sphericity results revealed that the correlation matrix differed significantly from the identity matrix ($\chi^2=20516.734$; $p<.05$). These findings show that significant relationships exist between items and the data set meets the necessary conditions for factor analysis (Gürbüz & Şahin, 2014).

Preparation for CFA and Testing Statistical Assumptions: The final scale at this stage consisted of 27 items. It was re-administered to active athletes prior to CFA. This yielded 823 raw observations. Analyses of missing data, normality, linearity, sample adequacy, and multicollinearity were conducted in order. This determined if necessary assumptions for CFA were met. Mode, median, and arithmetic mean values were compared within the scope of the normality assumption. The closeness of these values indicated that univariate normality was achieved (Tabachnick & Fidell, 2013). Five observations located at the lower and upper limits of the distribution were removed from the data set following outlier examination. Sample size dropped to 818. Skewness and kurtosis coefficients were examined. Skewness values varied between -.922 and -.440. Kurtosis values ranged from .118 to -.553. These values show the distribution of variables is symmetric. They indicate strong compliance with normal distribution. Literature states that a skewness coefficient within the ±1 range is sufficient. Limits of ±3.3 are also acceptable for normality (Tabachnick & Fidell, 2013; Kline, 2015). The findings led to the conclusion that the univariate normality assumption was met.

Z-scores and mahalanobis distance analyses were conducted to determine univariate and multivariate outliers. Z-values were evaluated based on ±3 limits. Five more observations falling outside these limits were excluded. Mahalanobis distances calculated for multivariate outlier detection were examined. One hundred and thirty-two observations remaining above the threshold value of $\chi^2(27;\ .001)=54.476$ were removed from the data set. Thus, CFA analyses were conducted on 681 observations. VIF and Tolerance values were examined to evaluate the multicollinearity assumption. VIF values ranged from 3.246 to 4.396. Tolerance values were between .223 and .308. All VIF values being below 5 and Tolerance values above .20 indicates no multicollinearity problem in the data set (Tabachnick & Fidell, 2013). Conducting CFA with 681 observations was deemed appropriate based on these assumptions. Standardized factor loadings, error variances, and model fit indices were considered during the analysis process.

RESULT

EFA results: Initial data collection yielded 851 observations for the exploratory factor analysis. However, analyses proceeded with 735 observations following assumption checks. Communality values indicate the extent to which the factor structure explains the items. These values ranged from .568 to .776. Literature suggests that values falling below .10 present a problem (Büyüköztürk, 2022). Yet, relying solely on this criterion is insufficient for a decision. Additional methods were included in the analysis to clearly evaluate item contribution. These included the "scree plot," "percentage of total variance," "kaiser criterion," and "explained variance criterion." according to Cattell (1966), the plateau observed in the scree plot marks the beginning of a new factor. The number of factors is determined via these break points. The scree plot obtained during analysis (Figure 1) aided the visual determination of the factor count.

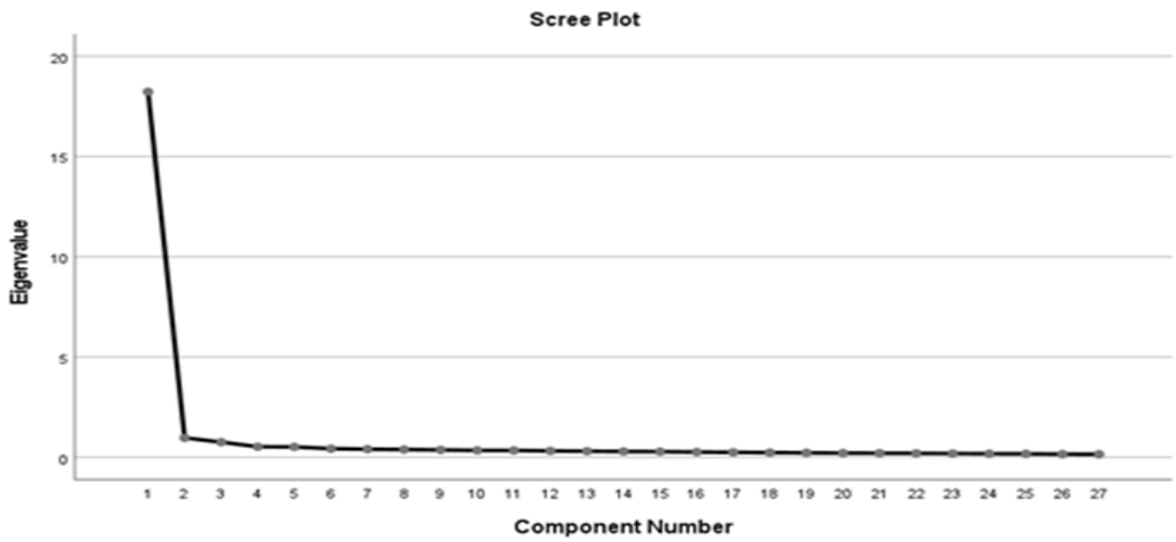


Figure 1. Scree plot

Examination of the scree plot reveals a distinct break-or elbow point-after the first and second factors. The eigenvalue curve begins to follow a horizontal course particularly after the second factor. This indicates that a two-factor structure is appropriate for the scale. According to the scree test proposed by Cattell (1966), the number of factors where the elbow forms shows the number of meaningful dimensions underlying the scale. In this direction, the current scale possesses a two-factor structure. Kaiser's (1960) criterion suggests including factors with eigenvalues very close to 1. Only the first two factors meet this condition. The eigenvalues for the third and subsequent factors drop below 1. This shows their explanatory power is limited. These findings, when evaluated with the scree plot results, support the two-factor structure as appropriate both statistically and theoretically.

However, relying solely on the scree plot to determine the number of factors is not seen as sufficient. The table of explained variance is also considered to base evaluations on more objective grounds. The percentage of total variance method reveals the contribution of each factor to the total variance in the data set. It is a widely used approach in determining factor count (Kalaycı, 2010). According to this method, if the contribution of factors added to the model falls below 5% of the total variance, the appropriate number of factors has been reached. examination of Table 2 shows that the obtained findings support the two-factor structure of the scale.

Table 2. Total variance explained

Component	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	18.228	67.512	67.512	10.426	38.615	38.615
2	.972	3.600	71.112	8.774	32.497	71.112
27	.156	.579	100.000			

The two factors with eigenvalues very close to 1 explain 71.112% of the total variance (Table 2). The first factor explains 38.615% and the second factor explains 32.497%. Components from the third onward have eigenvalues below 1. Therefore, they were not evaluated in line with the Kaiser criterion. Although the eigenvalue of the second factor (.972) was slightly below the traditional Kaiser criterion of 1.00, multiple decision criteria were considered in determining the factor structure. The scree plot clearly indicated a two-factor solution, and the second factor contributed substantially to the total explained variance (32.497%). Although parallel analysis is frequently recommended as an additional technique for determining the number of factors to retain, the present study adopted a multi-criteria decision approach rather than relying on a single statistical rule. In addition to scree plot inspection, the second factor accounted for a substantial proportion of variance (32.497%) and demonstrated clear theoretical interpretability based on item content. Moreover, the dimensional structure identified in the exploratory phase was independent. Moreover, theoretical considerations and the interpretability of the factor solution supported the retention of the second factor. Relying solely on the kaiser criterion is widely discouraged in contemporary psychometric research; therefore, the final decision was based on a combination of statistical and theoretical evidence (Fabrigar et al., 1999; Worthington & Whittaker, 2006). Büyüköztürk (2022) states that a total explained variance ratio over 50% is sufficient. The two-factor structure explaining 71.112% of the total variance is considered a value above the accepted limits in social sciences and indicates that the two-factor structure of the scale is valid and strong (Tabachnick & Fidell, 2013). The balanced contribution of the first and second factors to the variance increases the interpretability of the factor structure. It supports the construct validity of the scale. Communalities regarding the items, factor loadings, and the factors under which they cluster are shown in Table 3 to allow for a more detailed examination of the obtained factor structure.

Table 3. Item communalities, factor loadings, and factor distribution

No	Item	Factor 2	Factor 1	Community h^2
M24	I can maintain my focus during decisive scoring moments.	.781		.774
M25	I can maintain my attention while the opponent is leading.	.760		.738
M22	I maintain my focus during pressure created by the opponent.	.756		.738
M23	I can maintain my focus when physically strained.	.752		.722
M20	I do not lose my focus even in the final moments of performance.	.749		.768
M26	I can direct my attention to performance when I make mistakes.	.738		.720
M17	I can quickly recover my attention in unexpected situations like score changes.	.735		.735
M21	I maintain my focus even when holding the score advantage.	.700		.721
M18	The opponent's technical superiority does not affect my focus.	.693		.702
M19	I warn myself to "recover" when I make a mistake.	.691		.608
M27	I focus only on that moment during performance.	.689		.699
M16	I can focus on my task even in noisy environments.	.683		.672
M13	The opponent's negative attitudes do not affect my focus.	.683		.663
M15	I can maintain my focus even when there are distracting factors in the environment.	.657		.765
M14	I can maintain my focus during referee decisions against me.	.622		.568
M12	Spectator/Audience pressure does not distract me.	.607		.631
M4	When I need to focus, I only think about the task I need to do.		.788	.746
M5	I maintain my attention in long-duration performances.		.777	.776
M2	I can stay in the game without getting distracted.		.764	.759
M3	I can maintain the same level of attention from the beginning to the end of performance.		.746	.732
M9	I direct my focus only to the performance I will display.		.717	.743
M1	I can direct my attention to the target.		.704	.648
M6	I do not struggle to maintain my attention even if conditions change.		.691	.712
M7	My attention does not get distracted easily.		.677	.693

M11	I succeed in focusing only on my performance.		.667	.768
M8	Even if my attention is distracted, I recover it in a short time.		.660	.703
M10	I remove distracting thoughts from my mind.		.606	.696
	Explained Variance (%)	38.615	32.497	71.112
	Cronbach's alpha	.98	.97	.99

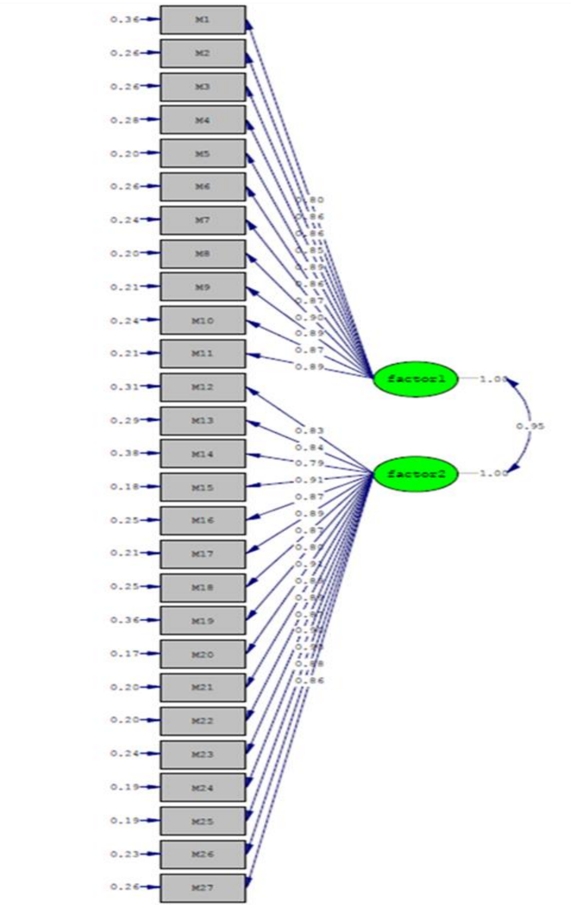
The communality (h2) values of the scale items range from .568 to .776 (Table 3), which indicates that the factor structure sufficiently explains a large portion of the items. Factor loadings range between .606 and .788. All items loaded significantly on their respective factors. Loadings above .40 show that the items possess sufficient power to represent the measured construct (Büyüköztürk, 2022). The findings suggest the scale items exhibit a consistent and theoretically meaningful distribution under the two-factor structure. Factors were named based on the alignment of the structure with the theoretical framework. Reliability coefficients for each sub-dimension are presented in Table 4.

Table 4. Factor names and reliability coefficients

Factor Number	Factor Names	Number of Items	Cronbach's α
Factor 2	Attentional Control Under Pressure	16	.98
Factor 1	Focusing and Maintaining Attention	11	.97
Total Scale			.99

Table 4 shows that the scale consists of two sub-dimensions and each factor possesses high internal consistency. The first factor, focusing and maintaining attention, consists of 11 items. Its Cronbach's α coefficient was calculated as .97. The second factor, attentional control under pressure, consists of 16 items. The Cronbach's α value for this factor is .98. The overall Cronbach's α coefficient is .99. This indicates the scale possesses an extremely high level of reliability as a whole. These values are well above the .70 limit accepted in social sciences. They reveal that the scale offers high internal consistency at both the sub-dimension and total score levels (Kline, 1999; Büyüköztürk, 2022). High reliability coefficients generally reflect strong inter-item correlations and internal consistency, which are expected when items capture theoretically related aspects of the same construct (Hair et al., 2019; DeVellis, 2021). To further evaluate potential item redundancy, mean inter-item correlations were examined. The values fell within the recommended range (.20-.50), indicating adequate homogeneity without excessive overlap (Clark & Watson, 1995). Although very high alpha coefficients may sometimes reflect narrow construct coverage, the present scale items represent distinct but closely related aspects of perceived concentration. Future studies may explore the development of a shorter form; however, the current version prioritizes content coverage and construct comprehensiveness. Nevertheless, although Cronbach's alpha values exceeding .95 may sometimes indicate item redundancy or overly narrow construct coverage (Kline, 2015), several considerations should be noted. Although Cronbach's alpha values exceeding .95 may sometimes indicate item redundancy or overly narrow construct coverage (Kline, 2015), several considerations should be noted. First, alpha coefficients are sensitive to the number of items in a scale; longer scales tend to yield higher alpha values (Tavakol & Dennick, 2011). Second, the two sub-dimensions in the present study represent closely related but theoretically distinct aspects of perceived concentration, which may naturally produce high internal consistency coefficients. Third, item content was carefully examined during the development process to avoid duplication or semantic repetition. The retention of items was based not only on reliability estimates but also on theoretical coherence, content validity, and factor structure evidence. Moreover, composite reliability (CR) and McDonald's omega values were examined and similarly indicated strong but theoretically consistent internal structure.

CFA Results



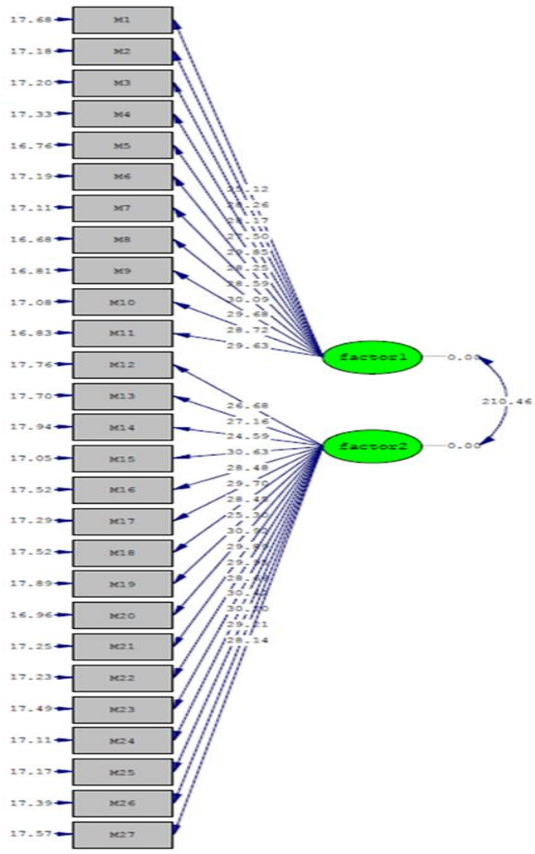


Figure 2. Standardized values **Figure 3.** Significance Levels for t-values (p≤.05)

The CFA model presented in Figure 2 shows that all items forming the scale exhibit significant and theoretically consistent relationships with their factors. The t-values in figure 3 reveals that t-statistics for all items exceed the ±1.96 threshold and are statistically significant. These findings demonstrate that the perceived concentration level in athletes scale possesses sufficient discrimination at the item level and support the construct validity of the measurement model (Hair et al., 2019). The general goodness-of-fit indicators falling within acceptable limits reveal that the proposed factor structure is verified on the research sample.

Table 5. Goodness of fit criteria and obtained values

Fit Measure	Perfect Fit	Good-Acceptable Fit	Value Obtained in Study
χ^2/df	< 2	< 5	4.46
RMSEA	0 ≤ RMSEA ≤ .05	.05 < RMSEA ≤ .08	.080
SRMR	0 ≤ SRMR ≤ .05	.05 < SRMR ≤ .10	.023
NFI	.95 ≤ NFI ≤ 1.00	.90 ≤ NFI < .95	.99
NNFI	.97 ≤ NNFI ≤ 1.00	.95 ≤ NNFI < .97	.99
CFI	.97 ≤ CFI ≤ 1.00	.95 ≤ CFI < .97	.99
IFI	.95 ≤ IFI ≤ 1.00	.90 ≤ IFI < .95	.99
RFI	.95 ≤ RFI ≤ 1.00	.90 ≤ RFI < .95	.99
GFI	.95 ≤ GFI ≤ 1.00	.90 ≤ GFI < .95	.87
AGFI	.90 ≤ AGFI ≤ 1.00	.85 ≤ AGFI < .90	.86

The χ^2/df ratio for the model in Table 5 was calculated as 4.46. Considering the sensitivity of the Chi-square statistic to sample size, this value below 5 falls within acceptable fit limits (Sümer, 2000; Kline, 2015). Examination of other fit indices shows that RMSEA=.080 and SRMR=.023 are at acceptable levels. NFI, NNFI, CFI, IFI, and RFI values of .99 indicate the model fits well. GFI (.87) and AGFI (.86) values remain slightly below the proposed threshold values. However, considering the sensitivity of these indices to sample size alongside the high values of other fit indices, the general fit of the measurement model is acceptable. Overall, the findings show the two-factor measurement model provides sufficient fit with the data (Jöreskog & Sörbom, 1993). A single-item criterion (Item 28: "I have a high level of concentration") reflecting the general concentration levels of athletes was employed to support construct validity. Relationships between this item and the sub-dimensions of the scale were examined. The aim was to obtain additional evidence regarding the criterion-related validity of the developed scale. However, it should be noted that the criterion variable used in the present study was based on a single self-report item, which provides only preliminary evidence of criterion-related validity. Future research should examine the association between PCLAS scores and externally validated indicators, such as objective performance metrics, coach evaluations, anxiety measures, or established attention-related scales, in order to strengthen the construct validity evidence.

Table 6. Correlation results between control ıtem and factors

Variables	M	1	2	3
1. Focusing and Maintaining Attention	5.42	1		
2. Attentional Control Under Pressure	5.40	.93**	1	
3. Item 28	5.37	.820**	.831**	1

Note: Item 28 ("I have a high level of concentration"). **p<.01

As shown in Table 6, a strong positive relationship was observed between the two sub-dimensions (r=.93, p<.01), indicating that they represent closely related yet conceptually distinguishable components of perceived concentration. This finding indicates both sub-dimensions are closely related components of the concentration construct. They remain theoretically distinguishable. This strong relationship points to the holistic nature of concentration. Analyses are reported at the sub-dimension level to maintain distinct interpretability. A higher-order factor model was not tested separately. Correlations between each sub-dimension and the total concentration score (Item 28) are strong and statistically significant (r=.820 and r=.831, respectively, p<.01). These results show the sub-dimensions represent the total score strongly. The holistic structure is consistent. The correlation coefficients demonstrate relationships of the expected direction and magnitude. They present important evidence supporting construct and convergent validity. AVE, MSV, ASV, and CR values are presented in Table 7. They clarify findings regarding convergent and divergent validity levels and composite reliability indicators.

Table 7. Convergent and divergent validities and composite reliability values of the scale

Factors	AVE	MSV	ASV	CR	Omega (ω)
1	.52	.86	.86	.93	.918
2	.51	.86	.86	.96	.941
Criteria	AVE>.50	MSV<AVE	ASV<MSV	CR>.70	
	CR>AVE				

MSV (maximum shared variance) was calculated as the square of the inter-factor correlation (MSV=r^2). Based on the correlation reported in Table 6 (r=.93), MSV was computed as .86. In a two-factor model, ASV is equivalent to r^2, as only one inter-factor correlation exists. Scale development studies evaluate convergent and divergent validity evidence regarding internal factor structures via average variance extracted (AVE), composite reliability (CR), maximum shared variance (MSV), and average shared variance (ASV). AVE values exceeding .50 (AVE>.50) and CR values surpassing AVE values (CR>AVE) indicate convergent validity (Fornell & Larcker, 1981). The current study meets these criteria for both sub-dimensions and offers sufficient evidence regarding the convergent validity of the scale.

MSV and ASV values should ideally remain lower than AVE values for divergent validity. Yet, correlations between factors can be high in two-factor models representing close components of the same theoretical construct. This situation raises MSV values (Kline, 2015; Hair et al., 2019). This indicates limited divergent validity in the classical sense according to the Fornell-Larcker criterion. However, it is theoretically explainable. The two sub-dimensions are closely related components of the same construct. The high inter-factor relationship obtained here shows that perceived concentration in athletes reflects a holistic cognitive control process. Evaluating sub-dimensions within the same construct is theoretically consistent. All CR values exceed .70. McDonald's omega (ω) reliability coefficients are calculated at high levels (ω=.92 for focusing and maintaining attention; ω=.94 for attentional control under pressure), which indicate strong internal consistency and structural reliability. Given the high inter-factor correlation (r=.93), the dimensional structure may also be conceptualized as representing closely related components of a broader higher-order construct. While the two-factor model demonstrated acceptable fit in CFA, future studies may examine alternative structural representations, such as higher-order or bifactor models, to further clarify the hierarchical nature of perceived concentration. In addition, although the Fornell-Larcker criterion was not fully satisfied, contemporary literature notes that this criterion may be overly conservative in models involving highly related subdimensions (Henseler et al., 2015). The strong conceptual coherence between the dimensions supports their distinction within a unified cognitive framework.

It is also important to clarify that the two-factor structure was not imposed despite exploratory evidence suggesting unidimensionality. Although the second factor's eigenvalue was marginally below 1.00, multiple criteria were considered in determining the dimensional structure. The scree plot indicated a clear break after the second factor, and the second factor explained a substantial proportion of variance (32.497%), supporting its empirical relevance. Additionally, item loadings clustered into two conceptually meaningful dimensions consistent with attentional theory. The subsequent confirmatory factor analysis further supported the adequacy of the two-factor model. Therefore, the retention of a two-dimensional structure was based on converging statistical indicators and theoretical coherence rather than reliance on a single decision rule. However, because the two sub-dimensions represent closely related components of perceived concentration, the inter-factor correlation was high, resulting in MSV/ASV values exceeding AVE. In two-factor models representing dimensions of a broader construct, strict compliance with the Fornell-Larcker criterion may not always be observed (Henseler et al., 2015). Therefore, discriminant validity was evaluated considering both statistical indices and theoretical distinctiveness.

DISCUSSION AND CONCLUSION

The primary objective of this research was to develop a valid and reliable instrument to evaluate the perceived concentration levels of athletes through a multidimensional framework. The development process followed a systematic trajectory. It progressed through focus group interviews, athlete compositions, a comprehensive literature review, and expert panel evaluations. Exploratory factor analysis, conducted on the pilot form, revealed a distinct two-factor structure. This structure explained a substantial 71.11% of the total variance, indicating a strong representation of the construct. Confirmatory factor analysis subsequently tested this model. The analysis confirmed that the structure fits the data within acceptable limits.

The first factor, focusing and maintaining attention, captures the athlete's capacity to direct cognitive resources toward a target. It reflects the ability to sustain focus despite internal or external distractions. This aligns with the theoretical perspectives of Eysenck et al., (2007) and Moran (2016), who position focus as a fundamental mental skill for performance continuity. The high internal consistency of this dimension (Cronbach's α=.97) confirms that the items consistently measure the core cognitive control processes essential for success.

The second factor, attentional control under pressure, addresses the regulation of attention during high-stress scenarios. It accounts for specific stressors such as spectator noise, scoreboard deficits, and adverse referee decisions. Within the framework of attentional control theory (Eysenck & Derakshan, 2011), this factor measures resilience against anxiety-induced cognitive interference. The robust reliability coefficient (α=.98) suggests the items effectively tap into the athlete's subjective experience of maintaining balance under duress.

Confirmatory factor analysis results further validated the construct. Model fit indices fell generally within acceptable ranges (χ^2/df=4.46; RMSEA=.080; SRMR=.023; CFI=.99). While the Chi-square statistic reflects a known sensitivity to sample size, the combination of high CFI and low SRMR values confirms the model's stability. Nevertheless, some fit indices (e.g., RMSEA and GFI-related values) were observed at borderline levels. Although the overall model fit was considered acceptable based on multiple indices, these results suggest that minor model refinements or alternative structural representations may be explored in future research to further optimize model fit. Moreover, all standardized factor loadings were statistically significant (t>1.96), providing strong evidence for construct validity (Hair et al.,

2019). The overall scale reliability (α=.99) far exceeds the standard .70 threshold accepted in psychometric evaluations. This indicates the tool possesses exceptional internal consistency.
In conclusion, the perceived concentration level in athletes scale (PCLAS) can be considered a scientifically reliable measurement tool. It can allow researchers and practitioners to assess concentration through both steady-state focus and pressure-based control. The PCLAS could fill a gap in the literature by offering a sport-specific instrument that accounts for the dynamic nature of competitive environments.

Recommendations and Limitations

The PCLAS can serve as a valid and reliable tool for evaluating attention focusing and attentional control under pressure. Applying the scale to athletes from diverse sport branches, competition levels, and age groups will contribute to the generalizability of the construct. However, the study relies on a cross-sectional design and data collection via self-reports. These factors limit causal interpretations. Future research should integrate the PCLAS with objective performance metrics and observational criteria. This approach may allow for a more holistic handling of the concentration construct. Retesting the scale on different samples will further strengthen its psychometric properties. In addition, although the sample included both male and female athletes as well as participants from individual and team sports, measurement invariance across these groups was not formally examined. Future research should conduct multi-group confirmatory factor analyses to test configural, metric, and scalar invariance. Establishing invariance across demographic and sport-type groups would further strengthen the structural validity and generalizability of the PCLAS.

Furthermore, temporal stability of the scale was not evaluated through test-retest procedures. Although perceived concentration is conceptualized as a relatively stable cognitive tendency within performance contexts, longitudinal assessment was beyond the scope of the present study. Future research should examine test-retest reliability over appropriate time intervals to provide additional evidence of the scale's stability.

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Contribution Rate	**Contributors**
Idea or Notion	Nuriye Şeyma KARA
Research Design	Mehmet KARA
Literature Review	Nuriye Şeyma KARA, Mehmet KARA
Data Collecting	Nuriye Şeyma KARA, Mehmet KARA
Data Analysis	Mehmet KARA
Discussion and Commentary	Nuriye Şeyma KARA, Mehmet KARA

Statement of Ethics Committee

This research was conducted with the protocol decision dated 07/11/2025 and numbered 42 (Meeting No. 13) of the Social and Human Sciences Scientific Research and Publication Ethics Committee of Hatay Mustafa Kemal University

Statement of Conflict

Researchers do not have any personal or financial conflicts of interest with other people and institutions related to the research.

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Generative AI Use Statement

An artificial intelligence tool was not used for data analysis, interpretation of results, or creation of scientific content.