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Multi-factorial profiling of athletes integrating personality, psychological skills, and Psychophysiological performance indicators

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Sports performance is shaped by the interaction of various factors, including the athlete's personality, psychological skills and psychophysiological performance. The aim of this study was to develop a multi-factorial profile of athletes, combining personality traits, psychological skills and psychophysiological performance indicators. An additional aim was to investigate the differences between team and individual sports athletes and at different levels of achievements. A total of 304 (female and male) athletes completed standardized assessments of personality traits, psychological skills and psychophysiological performance, including reaction time, stress tolerance, impulsivity, decisiveness and performance consistency. Multivariate analysis revealed significant differences between athletes taking into account the type of sport (individual vs. team), as well as the level of sport (elite, pre-elite, amateur). Cluster analysis identified four distinct athlete multi-factorial profiles. Qualitative validation by an expert panel confirmed that these profiles reflect recognizable athlete types in real training and competition contexts, providing recommendations for the implementation of practical interventions. Integrating personality, psychological skills, and psychophysiological performance indicators provides a comprehensive understanding of how athletes perform under different performance demands. These four multi-factorial profiles offer a practical framework for individual training, psychological preparation, and identification of potential risks.

Keywords Athlete profiling, Personality, Psychological skills, Psychophysiological performance

The core research problem is that athlete profiling has traditionally been fragmented, with studies often examining personality traits, psychological skills, or physiological factors in isolation. This one-dimensional approach has led to inconsistent and context-dependent findings. Omitting objective psychophysiological metrics leaves critical gaps. There is thus a lack of an empirically grounded, integrated profiling model that combines psychological and physiological dimensions. The present study addresses this gap by developing a multidimensional athlete profile that captures the interplay between personality, psychological skills, and psychophysiological response capabilities in sport.

The role of personality and psychological skills in athletic performance

Personality traits and psychological skills are equally important factors in supporting successful athletic performance. It is important to note that the optimal personality profile may vary across sport disciplines¹. Understanding the interaction of these factors allows athletes and coaches to develop training and competition strategies that support both performance consistency and individual development.

Xu and Hao² found that conscientiousness, extraversion, and lower levels of neuroticism were associated with success and higher performance in sport. The authors identified three mechanisms through which personality

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influences performance: direct neurobiological pathways, including dopaminergic sensitivity and prefrontal regulatory control, particularly in relation to extraversion and conscientiousness; indirect psychological mediation, particularly through motivation and self-regulation, associated with scores on neuroticism and conscientiousness; and contextual moderation, such as sport type, competitive level, and cultural environment. Research indicates that elite athletes typically exhibit greater emotional stability, which supports cognitive clarity and consistent decision-making under pressure. For example, Fabbriatore et al.³ found that top-level swimmers scored significantly lower in neuroticism than non-elite athletes. In turn, Piepiora⁴ found that players of higher-level team sports are distinguished from others by low levels of extraversion and openness to experience. Taken together, these findings suggest that personality–performance relationships are context-dependent and may differ across sport types and performance demands.

These psychological characteristics operate within physiological and situational conditions, meaning that performance depends not only on what athletes think and feel, but also on how effectively they regulate their psychophysiological responses in real time.

Psychophysiological adaptation in sport

The competitive sports environment requires athletes not only to have high psychological readiness, but also to be able to effectively regulate cognitive and physiological responses under pressure. Psychophysiological indicators, such as reaction speed, inhibitory control, and stress tolerance, reflect how effectively athletes process information, maintain attention, and make decisions during competition, where demands change rapidly^{5,6}. These abilities are closely related to performance outcomes, especially in time-constrained or unpredictable environments⁷. It is well known that stress affects athlete performance and results. Exposure to stress simultaneously activates autonomic, cognitive, and emotional systems during performance, requiring athletes to regulate both physiological arousal and cognitive processing^{8,9}. Reaction time and inhibitory control serve as practical indicators of this regulation capacity, reflecting an athlete's ability to suppress impulsive responses and maintain decision accuracy under load^{7,10}.

Sports competitions involve dynamic interactions that affect an athlete's readiness to achieve high results. Psychophysiological performance measurements provide essential insights into how to plan and implement the process of psychological preparation of athletes and beyond. Therefore, to understand performance in sports, psychophysiological functioning must be examined alongside personality traits and psychological skills, not in isolation.

Integrative approaches to athlete profiling

An increasing number of studies in sport science support the usefulness of multidimensional approaches to understanding athletic performance. For example, a study conducted by Vancouver et al.¹¹ demonstrated that even traditionally positive performance-related factors, such as self-efficacy, may under certain conditions have a negative effect on performance. This example illustrates that narrow, single-factor–based assessment approaches can lead to contradictory findings. Therefore, multidisciplinary and integrative research is required to account for the many interrelated variables that influence sport performance¹². Integrating stable personality traits, trainable psychological skills, and psychophysiological performance indicators aligns with the multidimensional paradigm and helps to overcome the limitations of earlier unidimensional approaches.

Performance is multidimensional and dynamic, with psychological, technical–tactical, and physiological variables interacting with each other and fluctuate over time. Personality traits, psychological skills, and physiological capacities each explain different mechanisms of adaptation to physical and psychological load or environmental requirements. Therefore, reliance on a single-dimension metric often leads to misleading conclusions when applied across contexts. Recent research suggests that a multidisciplinary and integrative perspective is required to understand how multiple interacting factors shape athletes' performance¹³. Accordingly, Glazier¹⁴ proposed a Grand Unified Theory, which supports the notion that sports performance is governed by complex interactions across fields. For example, psychology, physiology, and biomechanics. For example, in examining the factors influencing biathlon performance, a biopsychosocial approach was employed, enabling a multidimensional analysis of human functioning by simultaneously considering biological, psychological, and social factors and their dynamic interactions. This integrative approach is particularly well suited to the investigation of complex processes, as it provides a holistic perspective on performance, well-being, and behavior while overcoming the limitations of single-level explanations. The biopsychosocial framework supports interdisciplinary analysis and facilitates theoretically grounded interpretation of empirical data¹⁵. An extensive research analysis conducted by Zentgraf and Raab¹⁶ indicates that individual factors associated with expertise are well discussed. However, most interactions between these key factors have not been investigated together, and it would be premature to draw conclusions about how their combined effects influence expertise development and sport performance.

As noted by Neumann et al.¹³, sports performance is an emergent process governed by individual-specific, interacting biopsychosocial factors. This means that measurements are needed in several domains, and data from different areas must be synthesized to create an integrative view, allowing the athlete's profile to be seen “in one picture.” When developing an individual profile, the specifics of the sport type, the level of athletic performance, and gender differences must be considered, as each of these may create distinct performance demands and require different psychological skills and regulation strategies. The more variables are considered when differentiating sport competence, the more researchers conclude that general models require adaptation to specific sport contexts in order to meaningfully guide practice¹⁷. This leads to the conclusion that a model tailored to sport type, gender, age, and competitive level functions more effectively. In this context, integrating personality traits (stable dispositions), psychological skills (trainable self-regulation strategies), and psychophysiological performance indicators (such as stress-related response efficiency) enables a more

ecologically valid understanding of how athletes functioning under real performance conditions. An integrated athlete profile is needed because performance arises from interactions between variables, not from any single factor alone. By linking psychological and psychophysiological indicators to performance-relevant outcomes, athlete profiling becomes directly applicable to multidisciplinary sports support teams, including coaches, physical trainers, nutritionists, physicians, physiotherapists and sport psychologists.

Current gaps and limitations in athlete typologies

Substantial empirical evidence suggests that athletes from different sport types display distinct personality trait profiles. For example, Shuai et al.¹ showed that team sport athletes tend to score higher on conscientiousness and extraversion, whereas findings for traits such as agreeableness and openness vary across specific sports and competitive contexts. Although some studies have observed differences between individual- and team-sport athletes, the overall evidence remains inconsistent and strongly dependent on methodological and contextual factors.

Several conceptual perspectives have been proposed to explain how personality traits and sport participation may be related. One of the fundamental foundations of the personality perspective in sport is Eysenck's¹⁸ theoretical concept, which states that individuals are naturally drawn to environments, including sport settings, that matches their pre-existing personality traits. Consequently, personality influences sport selection, while participation within a particular sport environment may, over time, further reinforce or shape certain psychological characteristics. Conzelmann et al.¹⁹ suggested that long-term participation in sport may promote gradual personality development over time through socialization processes and learning experiences. Other approaches to the concept of personality emphasize that personality and sport contexts mutually influence each other, which is consistent with broader trait-situation interaction frameworks in personality psychology²⁰.

In addition to personality traits, psychological and psychophysiological factors play a critical role in athletic performance, injury susceptibility, and recovery. Research shows that heightened stress, cognitive interference, and maladaptive coping patterns increase injury risk²¹, while psychological readiness strongly influences return-to-sport outcomes after injury²². Integrating these factors into athlete profiling may therefore enhance early risk detection and support more individualised prevention and rehabilitation strategies.

Despite advances in the field, several key limitations remain. Many existing typologies rely primarily on self-report personality measures, which may oversimplify the psychological foundations of performance and overlook the trainability of psychological skills. There is also a lack of longitudinal research, limiting understanding of how athlete profiles evolve across developmental stages. Additionally, cultural variation, gender differences, and sport-specific demands are often underrepresented, reducing the generalizability of existing models. A further limitation is the frequent absence of objective performance and psychophysiological indicators in athlete profiling. Without integrating behavioral or stress-response data, typologies have limited practical utility for performance planning or intervention design. Therefore, there is a need for empirically grounded, multi-factorial athlete profiles, validated through both quantitative data and qualitative expert evaluation, to ensure relevance and application in real training and competition settings. The present study addresses these gaps by developing an integrated profiling approach that combines personality traits, psychological skills, and psychophysiological performance indicators.

Study aim and hypothesis

The present study aimed to develop a multi-factorial profile of Latvian athletes by integrating measures of personality traits, psychological skills, and psychophysiological performance variables. Specifically, the study sought to (1) identify distinct athlete profiles using multivariate statistical techniques, (2) examine differences across sport types (team vs. individual) and competitive levels (elite, pre-elite, amateur) and explore how personality and psychological skills are associated with psychophysiological performance indicators.

Hypotheses: (1) There are significant multivariate differences in personality, psychological, and psychophysiological performance characteristics between team and individual sport athletes as well as between athletes of different competitive levels. (2) Distinct athlete profiles (clusters) can be identified based on the integration of personality traits, psychological skills, and psychophysiological performance indicators, reflecting different styles of emotional regulation, motivation, and performance efficiency.

Materials and methods

Participants

In this cross-sectional study, data were collected from a purposive sample of 304 active competitive Latvian athletes both males ($n=183$, 60.2%) and females ($n=121$, 39.8%), recruited through sport federations, sport schools, and national teams across multiple regions. Inclusion criteria were: (a) active participation in organised competitive sport, (b) a minimum of three years of sport-specific training experience, and (c) regular training at least three times per week. Athletes were excluded if they reported current injury, acute illness, or neurological or psychological conditions that could affect psychophysiological testing. All assessments were conducted individually under controlled laboratory conditions. The mean age of the sample was 19.63 years ($SD=3.64$), with an average training load of 6.06 h per week ($SD=2.89$) and 9.22 years ($SD=4.18$) of sport-specific experience. A total of 177 athletes (58.2%) represented team sports: basketball ($n=86$); football ($n=26$); volleyball ($n=19$); hockey ($n=18$); handball ($n=16$); rugby ($n=10$); floorball ($n=2$) and 123 athletes (40.5%) represented individual sports: athletics ($n=15$), luge ($n=14$), orienteering ($n=11$), cycling ($n=9$), skeleton ($n=9$), fitness ($n=8$), tennis ($n=7$), climbing sports including bouldering ($n=6$), sport dancing and dance disciplines ($n=5$), judo ($n=4$), table tennis ($n=4$), alpine skiing ($n=4$), figure skating ($n=4$), running ($n=3$), kickboxing ($n=3$), equestrian sports ($n=3$), cross-country skiing ($n=2$), gymnastics ($n=2$), boxing ($n=1$), fencing ($n=1$), wushu

($n = 1$), bowling ($n = 1$), golf ($n = 1$), triathlon ($n = 1$), javelin throw ($n = 1$), inline skating ($n = 1$), canoeing ($n = 1$), and motocross ($n = 1$).

Athletes were classified into three competitive levels based on objective performance criteria. The classification was determined by combining training load, competition level, and years of experience, ensuring that the grouping reflected actual performance demands rather than self-reported status. Elite athletes were those engaged in a professional or semi-professional training regime, participating in ≥ 8 training sessions or ≥ 12 h per week, with at least five years of structured sport experience. In addition, they were required to have achieved high-level competitive results, such as being finalists or medallists in National Championships (adult higher leagues) or having participated in international competitions, including European Championships, World Cups, World Championships (junior or senior), or the Olympic Games.

Pre-elite athletes trained at ≥ 5 sessions or ≥ 7.5 h per week and were active in national championship competition (junior or adult divisions) or regional and university-level leagues. These athletes were typically situated in high-performance development environments (such as national youth teams, sport academy or sport school programs) but had not yet consistently competed at senior international level.

Amateur athletes participated in ≥ 2 training sessions or ≥ 4 h per week and competed primarily in regional, local, or lower-division national competitions, without national team selection or professional status. This tiered system aligns with contemporary athlete development models distinguishing elite, developmental, and participation-level performers, and enables meaningful comparison of psychological preparedness across competitive standards.

Based on competitive achievement level, athletes were classified as: (1) Elite ($n = 54$, 17.8%; Mage = 19.27, SD = 0.42; training load = 8.46 h/week, SD = 0.40; experience = 9.00 years, SD = 0.52); (2) Pre-elite ($n = 160$, 53.6%; Mage = 18.93, SD = 0.27; training load = 6.24 h/week, SD = 0.19; experience = 9.84 years, SD = 0.32) and (3) Amateur ($n = 87$, 28.6%; Mage = 20.61, SD = 0.50; training load = 4.24 h/week, SD = 0.27; experience = 8.26 years, SD = 0.49). At the time of data collection, 54 athletes (17.8%) held an active professional sport contract.

To qualitatively validate the athlete profiles obtained from the cluster analysis, a panel of nine applied sport psychology experts was convened. The panel included practicing sport psychologists ($n = 6$) who were actively providing psychological support to athletes and were registered with the national Sport Psychology Association, as well as senior coaches specializing in psychological preparation ($n = 3$). Their professional experience in working directly with competitive athletes ranged from 3 to 30 years ($M = 15.5$, $SD = 8.44$), providing a diverse and well-informed expert perspective for the validation process.

Measures

Personality

To assess athletes' personality traits, the Latvian Personality Inventory (LPI-v3)²³ was used, specifically the sports-validated version (LPI-v3s)²⁴. The original LPI-v3 is a widely used in Latvia, which is also clinically validated multidimensional personality assessment instrument, applied in both clinical practice and psychological research, ensuring strong psychometric reliability and construct validity. The LPI-v3s is an adaptation developed for performance and sport contexts, maintaining the same theoretical factor structure while refining item interpretation and normative ranges for athletic populations. The inventory assesses five personality domains: (1) Neuroticism, (2) Conscientiousness, (3) Extraversion, (4) Agreeableness, and (5) Openness to Experience and includes an additional response validity scale (Lie scale) to detect inconsistent or socially desirable responding. It consists of 57 items rated on a 5-point Likert scale (1 = does not match; 5 = matches). Internal consistency values in the present sample ranged from $\alpha = 0.58$ to 0.79, consistent with prior validation studies.

Psychological skills

To assess athletes' psychological skills, the Psychological Skills Inventory for Sport (PSIS-R5)²⁵ was used in its Latvian language adaptation (PSIS-R5-L)²⁶. The PSIS-R5 is one of the most widely used standardized instruments for evaluating psychological performance attributes in competitive sport contexts and has been validated across multiple athletic populations. The Latvian adaptation preserves the theoretical factor structure and scoring system of the original scale while ensuring linguistic and cultural equivalence for local sport settings. The PSIS-R5-L consists of four subscales: (1) Self-Confidence (belief in one's ability to perform successfully), (2) Motivation (persistence, striving, and task engagement), (3) Team Emphasis (cooperation and interpersonal functioning in team contexts), and (4) Visualization (use of imagery and mental rehearsal strategies). The inventory contains 17 items, each rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree), with higher scores reflecting stronger psychological skill development. Internal consistency reliability coefficients in present athletic samples range from $\alpha = 0.43$ to 0.75, and in the current sample coefficients fell within this expected range.

Psychophysiological performance measures

In this study, psychophysiological performance measures were obtained using the Vienna Test System (VTS)²⁷, a computerized and standardized assessment platform widely used in performance psychology and neurocognitive evaluation. All testing was conducted individually under controlled laboratory conditions to ensure consistency and to avoid external environmental interference. The test battery included three VTS modules relevant to cognitive-motor performance in sport: the Determination Test (DT), the Reaction Test (RT), and the Attitude towards Work (AHA).

The DT test assesses the ability to respond rapidly and accurately to multiple simultaneously presented visual and auditory stimuli, requiring fast and flexible choice reactions. Within the framework of the Cattell-Horn-Carroll (CHC) model of cognitive abilities²⁸, this ability is associated with the broad factor of processing speed and the more specific component of reaction and decision speed. The test also indexes reactive stress tolerance, which reflects the capacity to maintain performance under time pressure and increasing task demands. In

the present context, reactive stress tolerance is operationalized as the stability, precision, and persistence of responses during high-speed stimulus discrimination and motor execution. This construct is particularly relevant in competitive sport, where athletes must sustain decision-making accuracy under rapidly changing and physiologically arousing conditions. To complete the DT test, it takes approximately 8 min.

The study applied the AHA test battery to assess performance-related behavioural tendencies. The AHA provides indicators that describe how individuals plan, sustain, and regulate task performance under varying cognitive demands. The constructions assessed are closely related to performance consistency in sport, particularly in situations requiring precision, decision-making, and the management of errors. The AHA battery includes the following variables: (1) Exactitude, reflecting precision and accuracy in task execution; (2) Decisiveness, indicating the ability to make timely decisions even under uncertainty; (3) Impulsiveness vs. Reflexivity, distinguishing between rapid, instinctive responding and more deliberate, controlled responding; (4) Performance Level, assessing sustained concentration and productivity; (5) Aspiration Level, reflecting the realism of self-set performance goals; (6) Frustration Tolerance, denoting the ability to maintain performance following errors or negative feedback; and (7) Target Discrepancy, indicating the consistency between predicted and actual performance outcomes. Together, these indices provide a multi-factorial profile of performance regulation processes that are directly relevant to athletic training and competitive settings. AHA test takes approximately 15 min to complete. In the AHA impulsivity vs. reflectivity index, higher scores indicate greater inhibitory control and reflective responding, whereas lower scores indicate faster, more impulsive and less controlled responding.

The Reaction (RT) test from the VTS was used to assess psychomotor response speed. Two test forms were administered: S1, which measures simple reaction time, and S5, which measures choice reaction time. Both tests record latent (perceptual) reaction time, reflecting how quickly the athlete detects and processes a stimulus, as well as motor reaction time, indicating the speed of the physical response. The combination of S1 and S5 therefore provides an index of both fundamental sensorimotor responsiveness and rapid decision-making efficiency under choice conditions. The total testing time for both forms was approximately 6 min.

All tests were completed individually in consecutive order, following standardized administration procedures. Before each test, athletes received on-screen instructions and completed a trial phase to ensure full task comprehension. Only after successful completion of the practice phase did the formal testing begin. All tasks were non-verbal, minimizing language-based performance effects. Administration strictly adhered to standardized procedures to maintain administrative reliability, ensuring that all athletes received identical instructions, timing, and testing conditions. For the purposes of statistical analysis and cluster modelling, the following performance indices were used from the VTS battery: stress tolerance score (mean accuracy under high time pressure), exactitude, decisiveness, impulsiveness vs. reflexivity, frustration tolerance, and performance level, latent and motor reaction time, and latent and motor choice reaction time. These variables were selected as theoretically relevant indicators of cognitive-motor efficiency and performance regulation in sport. The test sequence was structured to account for evidence indicating that cognitively demanding tasks can induce mental fatigue, which negatively affects subsequent psychomotor performance. To reduce potential fatigue-related confounding, tasks with higher attentional and executive demands were administered prior to simple reaction tasks^{29,30}. All VTS test results are presented in standardized scoring protocols, which include raw scores, T-scores ($M = 50$, $SD = 10$) and percentile ranks. For the purposes of this study, statistical analyses and interpretation were conducted using T-scores, as they allow comparability across tests and individuals irrespective of age or sport type. All variables listed above were included in the multivariate analyses and subsequent cluster modelling.

Qualitative validation of athlete multi-factorial profiles (Expert Panel)

To evaluate the ecological validity of the athlete profiles derived from the cluster analysis, a panel of nine applied sport psychology experts was engaged. Experts participated in a structured open-ended questionnaire designed to evaluate: (1) the perceived real-world relevance and recognizability of each athlete profile (Q1), (2) typical behavioural patterns and stress responses in training and competition (Q2), and (3) appropriate psychological intervention and skill-development priorities for each profile (Q3). Each expert reviewed short narrative descriptions of the four profiles (summarising personality, psychological skills, and psychophysiological performance characteristics) and answered three open-ended questions: (1) Do these profiles reflect real athlete types you encounter in practice? (2) What typical behaviours or situational reactions correspond to each profile in training and competition? (3) What psychological interventions or skill-development directions would you recommend for each type?

Responses were analyzed using a hybrid inductive-deductive thematic content approach. Coding first followed predefined conceptual categories aligned with the profile structure, and additional emergent themes were identified inductively. Convergence and divergence across expert perspectives were then synthesized into profile-level summaries. The thematic results are presented in narrative form (see Appendix A).

Design and data collection procedure

This study employed a mixed-methods sequential explanatory design, in which quantitative athlete profiling was followed by qualitative expert validation to evaluate the ecological applicability of the identified profiles. The quantitative phase consisted of standardized laboratory-based assessments of: (1) personality traits, (2) psychological skills, and (3) psychophysiological performance indices. Data collection took place over approximately 18 months, between May 2024 and November 2025. Athletes were recruited through sport federations, sport schools, national teams, and professional coaches, using purposive selection to ensure inclusion of active competitive athletes across sport types and performance levels. Each participant attended the research laboratory individually, where all assessments were conducted under controlled, quiet, distraction-free conditions. The full testing session lasted approximately 1.5–2 h per athlete (see Fig. 1).

Prior to participation, each athlete received a standardized explanation of the study purpose, procedures, data use, and confidentiality safeguards. Written informed consent was obtained from all participants. Athletes then completed the assessments in a uniform standardized order. Participants first completed the LPI-v3s and PSIS-R5-L inventories, along with a demographic and sport-related background form (sport type, years of experience, training load, competition level, highest achievements, and whether a valid professional contract was held). After the questionnaires, athletes completed the VTS batteries in the following fixed sequence: (1) DT, (2) AHA and (3) RT: forms S1 and S5. This order was selected to maintain progression from higher cognitive-attentional load tasks (DT, AHA) toward more automated sensorimotor response tasks (RT), minimizing fatigue-related confounding. At the end of testing, participants could receive individual feedback on their results, provided upon request in a standardized interpretation protocol.

Following quantitative data analysis, a k-means cluster analysis was performed, resulting in four distinct athletes' multi-factorial profiles, representing patterns across personality, psychological skills, and psychophysiological performance variables. These profile descriptions (without raw data or scoring details) were provided only to the expert validation panel.

In the qualitative phase, sport psychology experts (registered psychologists who practice in field of sport and senior psychological preparation coaches) evaluated the real-world relevance of each profile. Experts responded to three structured open-ended questions. Their responses were analyzed using inductive–deductive thematic coding, allowing both data-driven interpretation and alignment with the theoretical constructs underlying the profiles. The mixed-methods structure allowed quantitative profile identification and qualitative confirmation that these profiles correspond to recognizable athlete types in applied sport contexts.

The study protocol received approval from the Ethics Committee of the Latvian Academy of Sport Education (Protocol No. 8, Statement No. 1, April 19, 2024) and was conducted in accordance with the Declaration of Helsinki. All data were anonymized, encrypted, and stored on secure institutional servers accessible only to the research team. Data protection procedures followed the registered ARGOS Data Management Plan (OpenAIRE). Participation was voluntary, and athletes retained the right to withdraw at any point without explanation or negative consequences.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics Version 28.0 for Windows. Initially, data were collected from 317 athletes. Following data cleaning procedures, 13 cases were excluded due to incomplete test sessions or invalid response patterns, resulting in a final analytic sample of $n = 304$ athletes.

Descriptive statistics (means, standard deviations, skewness, kurtosis) were computed for all study variables. Data normality was evaluated based on skewness and kurtosis values, with distributions considered acceptable if values fell within ± 1 . Internal consistency of the LPI-v3s and PSIS-R5-L subscales was examined using Cronbach's α . Subscales with $\alpha \geq 0.50$ were retained, consistent with prior validation studies of multidimensional constructs in sport psychology. The Agreeableness scale was excluded from further analyses due to insufficient reliability.

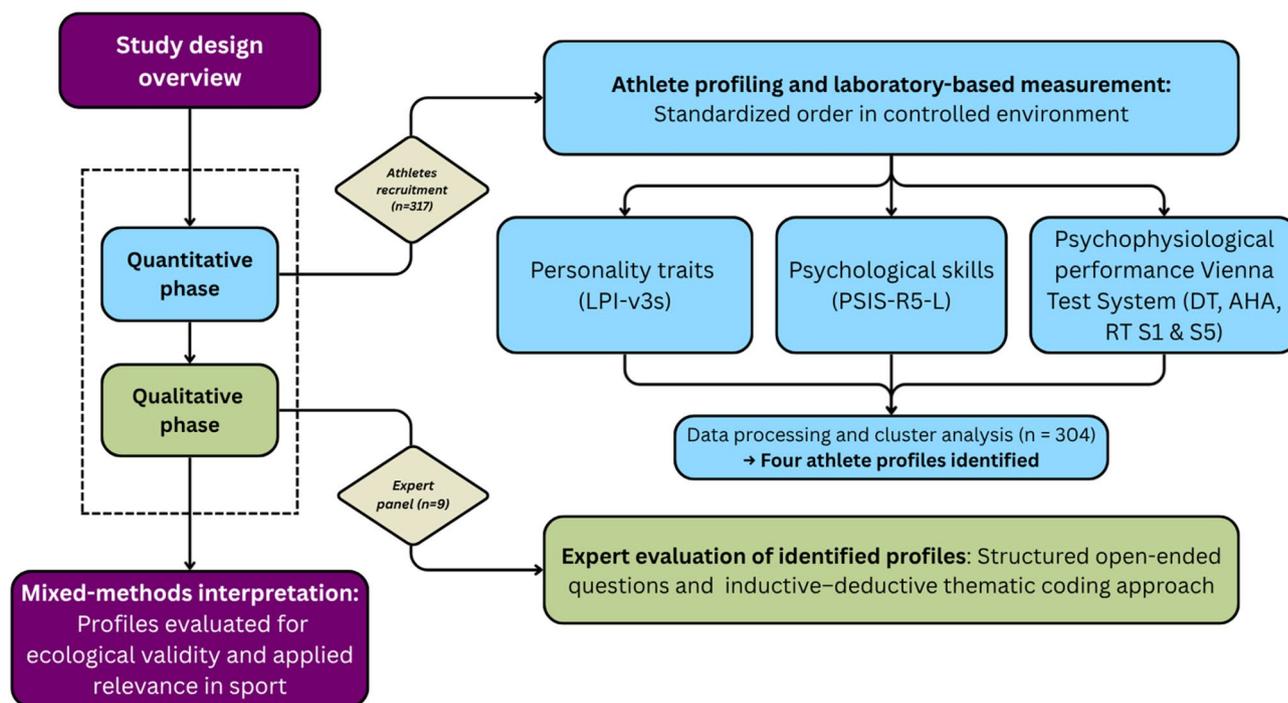


Fig. 1. Study Protocol Overview.

Pearson's bivariate correlation analyses were conducted to examine associations between personality, psychological skills and psychophysiological performance variables and demographic factors (age, gender, training load, sport experience). Differences in indicators across sport type (team vs. individual) and competitive level (elite, pre-elite, amateur) were examined using Multivariate Analysis of Covariance (MANCOVA). Sport type and competitive level were entered as fixed factors, while gender, age, sport experience, and training load were entered as covariates. Significant multivariate effects were followed by univariate tests and interpreted using partial eta squared (η^2) as an index of effect size. Effect sizes were interpreted via partial eta squared (η^2), where values of 0.01, 0.06, and 0.14 indicated small, medium, and large effects, respectively.

For comparability across indicators, T-scores ($M = 50$, $SD = 10$) provided by the VTS were used in all analyses. Alternative cluster solutions (2–5 clusters) were compared using Elbow and Silhouette criteria, interpretability of cluster centroids, and balance in group sizes. A four-cluster solution was selected based on optimal separation of personality, psychological skills and psychophysiological patterns and theoretical coherence. The solution's classification stability was evaluated using Discriminant Function Analysis (DFA), which tested how accurately cluster membership could be predicted based on the final model variables. Cross-validated classification accuracy exceeding 80% was considered evidence of strong cluster discrimination.

The significance level for all statistical tests was set at $p \leq 0.05$. To determine the adequacy of the sample size, a priori power analysis was conducted using G*Power 3.1. For the planned MANCOVA with three achievement-level groups, medium effect size ($f = 0.25$), $\alpha = 0.05$, and power ($1 - \beta$) = 0.80 indicated a required minimum sample of $N = 159$. The final sample of 304 therefore exceeded the required threshold, ensuring sufficient power for group comparisons and supporting stable cluster estimation.

Following the quantitative phase, the qualitative expert validation was analyzed using an inductive–deductive thematic coding approach, allowing integration of expert-derived themes with predefined conceptual dimensions of the athlete profiles. Coding and theme development were conducted in Microsoft Excel, and themes were aggregated across experts to determine areas of consensus and divergence.

Results

Descriptive statistics

In Appendix B, Table S1 summarises the means, standard deviations, skewness, and kurtosis for 23 variables representing personality, psychological skills, and psychophysiological performance factors among competitive athletes ($n = 304$). Data reliability was assessed for the self-report scales of personality and psychological skills using Cronbach's alpha coefficients. The results indicated adequate internal consistency for most scales, with α values ranging from 0.53 to 0.79. The lowest reliability was observed for Agreeableness ($\alpha = 0.38$) and Visualization ($\alpha = 0.43$), which is considered marginal but acceptable given the short scale length and exploratory nature of the study.

The Agreeableness scale was excluded from further analyses due to its low internal consistency and limited theoretical relevance to performance characteristics in the current sample. In contrast, the Visualization scale, while showing a lower alpha ($\alpha = 0.43$), was retained. This decision was theoretically justified, as visualization is a key psychological skill closely linked to mental rehearsal, concentration, and performance optimization in athletes. Furthermore, its reliability falls within the moderate range (0.50–0.80) suggested by Salvucci et al.³¹, and the relatively small number of items (four) likely attenuated the alpha value, as Cronbach's alpha is sensitive to item count³². Therefore, the Visualization scale was retained to preserve the conceptual completeness of the multi-factorial profile.

The lowest mean scores in the athlete sample were on Neuroticism ($M = 28.12$, $SD = 4.43$) and Openness ($M = 29.47$, $SD = 5.49$), suggesting relatively greater emotional stability and a lower tendency toward anxiety or mood fluctuations but also reduced openness to novel experiences. In contrast, Conscientiousness ($M = 33.39$, $SD = 6.48$), Extraversion ($M = 33.28$, $SD = 6.49$), and Adventurism ($M = 34.48$, $SD = 8.37$) were moderately high, reflecting discipline, sociability, and curiosity or a preference for challenge.

Among psychological skills, the highest mean scores were found for Self-confidence ($M = 19.12$, $SD = 6.32$) and Motivation ($M = 14.91$, $SD = 3.63$), suggesting a well-developed psychological readiness for performance. The lowest mean score was observed for Team emphasis ($M = 12.99$, $SD = 2.22$), which may reflect the inclusion of both team and individual sport athletes in the sample.

In the psychophysiological performance domain, athletes showed high performance indicators, particularly in Choice reaction speed ($M = 67.02$, $SD = 9.78$), Choice motor speed ($M = 65.65$, $SD = 8.41$), and Motor speed ($M = 62.38$, $SD = 8.69$), suggesting above-average psychomotor efficiency and response accuracy. Stress tolerance ($M = 54.32$, $SD = 7.61$) and Aspiration ($M = 56.58$, $SD = 7.62$) were also above normative averages, indicating strong coping resources and achievement orientation.

The skewness and kurtosis values fell within acceptable limits ($-1 < Sk < 1$; $-1 < Ku < 1$), confirming that the data distributions did not significantly deviate from normality and were suitable for further multivariate analyses.

Pearson correlation analysis

The Pearson correlation results are presented in Appendix C, Table S1. The correlation result analysis revealed several significant associations among demographic, personality, psychological and psychophysiological performance variables. Pearson's correlation coefficients were interpreted following guidelines established for the social sciences (Cohen, 1988), where correlations of $r \geq 0.10$ are considered weak, $r \geq 0.30$ medium, and $r \geq 0.50$ strong.

Sport type was positively associated with personality variables Openness ($r = 0.16$, $p < 0.01$) and Adventurism ($r = 0.20$, $p < 0.01$), indicating greater openness to experience and novelty-seeking among athletes competing in individual sports. Conversely, negative correlations were found with psychophysiological performance and psychological skills variables such as Aspiration ($r = -0.12$, $p < 0.05$), Team emphasis ($r = -0.23$, $p < 0.01$), and

Motivation ($r = -0.25, p < 0.01$), suggesting that team sport athletes were more cooperative, and motivated. All correlation is evaluated as small to moderate. Sport level correlated positively with personality and psychological skills variables Neuroticism ($r = 0.14, p < 0.05$) and Confidence ($r = 0.13, p < 0.05$), while showing negative associations with Motivation ($r = -0.27, p < 0.01$), Exactitude ($r = -0.11, p < 0.05$), Motor speed ($r = -0.22, p < 0.01$), Choice reaction speed ($r = -0.14, p < 0.05$), and Choice motor speed ($r = -0.22, p < 0.01$). This indicates that athletes at higher competitive levels (elite and pre-elite) exhibited greater emotional reactivity and self-confidence, while their psychomotor performance tended to stabilize rather than increase further.

Gender correlated negatively with personality and psychophysiological performance variables Neuroticism ($r = -0.32, p < 0.01$) and positively with Conscientiousness ($r = 0.17, p < 0.01$), Reaction speed ($r = 0.11, p < 0.05$), Motor speed ($r = 0.32, p < 0.01$), Choice reaction speed ($r = 0.14, p < 0.05$), and Choice motor speed ($r = 0.37, p < 0.01$), indicating lower emotional instability and faster psychomotor performance among men compared to women.

Age and experience both were positively related to Confidence ($r = 0.15, p < 0.01$), while negatively related to Motivation ($r = -0.35, p < 0.01$) and Team emphasis ($r = -0.20, p < 0.01$). By which it can be concluded that older and more experienced athletes demonstrated greater self-confidence but slightly reduced motivational drive and team-oriented attitudes.

Regarding interrelations among personality and psychological variables, Confidence was strongly negatively correlated with Neuroticism ($r = -0.65, p < 0.01$), and Motivation was negatively associated with both Neuroticism ($r = -0.11, p < 0.05$) and Modesty ($r = -0.22, p < 0.01$). Conscientiousness correlated positively with Team emphasis ($r = 0.14, p < 0.05$), Motivation ($r = 0.12, p < 0.05$), and Visualization ($r = 0.25, p < 0.01$).

Among psychophysiological performance indicators, strong positive associations were observed between Motor speed and Choice reaction speed ($r = 0.58, p < 0.01$), Motor speed and Choice motor speed ($r = 0.75, p < 0.01$), as well as Reaction speed and Choice motor speed ($r = 0.39, p < 0.01$), confirming high internal coherence among psychomotor performance measures.

Results suggest systematic patterns linking demographic and psychological characteristics to psychophysiological performance. Team sport athletes tended to be more emotionally stable and socially oriented, while individual sport athletes were more open and novelty-seeking. Male and older athletes showed higher psychomotor efficiency, and personality traits such as conscientiousness, confidence, and low neuroticism were associated with better control and performance consistency.

Multivariate analysis of covariance (MANCOVA)

Two MANCOVAs were conducted to examine differences in athletes' personality traits, psychological skills, and psychophysiological performance factors based on (1) sport type (team vs. individual) and (2) performance level (elite, pre-elite, amateur). Table 1 presents the results of the MANCOVA for sport type. The multivariate test using Pillai's Trace revealed a statistically significant overall effect of sport type on the combined dependent variables, $V = 0.168, F(23, 272) = 2.382, p < 0.001, \eta^2 = 0.168$. This indicates that athletes participating in team and individual sports differ significantly across the set of measured psychological and psychophysiological performance characteristics. The sample consisted of 58.16% ($n = 177$) team sport athletes and 40.46% ($n = 123$) individual sport athletes.

Follow-up univariate analyses (Table 1) identified significant group differences across several variables. Team sport athletes scored lower on Neuroticism ($F(1, 294) = 6.85, p < 0.05, \eta^2 = 0.104$), Adventurism ($F(1, 294) = 4.70, p < 0.05, \eta^2 = 0.074$), and Modesty ($F(1, 294) = 3.53, p < 0.05, \eta^2 = 0.057$), but higher on Openness ($F(1, 294) = 2.38, p < 0.05, \eta^2 = 0.039$).

In terms of psychological skills, individual sport athletes showed significantly higher Confidence ($F(1, 294) = 8.12, p < 0.05, \eta^2 = 0.121$), while team sport athletes reported higher Motivation ($F(1, 294) = 17.84, p < 0.001, \eta^2 = 0.233$) and Team emphasis ($F(1, 294) = 8.99, p < 0.05, \eta^2 = 0.133$).

Among psychophysiological performance variables, team athletes outperformed individual athletes on Motor speed ($F(1, 294) = 8.7, p < 0.01, \eta^2 = 0.129$), Choice motor speed ($F(1, 294) = 11.16, p < 0.01, \eta^2 = 0.16$), and Aspiration ($F(1, 294) = 4.41, p < 0.05, \eta^2 = 0.07$). These results suggest that team sport athletes tend to exhibit faster psychomotor responses and greater achievement orientation, whereas individual sport athletes show higher confidence and openness. Gender, training load, experience, and age were included as covariates in the model.

A second MANCOVA was conducted to examine differences in personality, psychological skills, and psychophysiological performance factors across athletes' performance levels (elite, pre-elite, and amateur). Gender, training load, experience, and age were included as covariates in the model.

The multivariate test using Pillai's Trace indicated that the combined dependent variables differed significantly across performance levels, $V = 0.239, F(46, 542) = 1.60, p < 0.05, \eta^2 = 0.18$. Although the overall multivariate effect was statistically significant but small in magnitude, several univariate effects reached statistical significance, suggesting level-specific variations in select psychological and psychophysiological performance indicators (Table 2). The sample consisted of 17.8% ($n = 54$) elite level athletes, 53.6% ($n = 163$) pre-elite level athletes and 28.6% ($n = 87$) amateur level athletes.

Specifically, significant differences emerged for Confidence ($F(2, 294) = 4.43, p < 0.05, \eta^2 = 0.031$) and Motivation ($F(2, 294) = 3.89, p < 0.05, \eta^2 = 0.028$), indicating that elite athletes reported higher self-confidence and intrinsic motivation compared to pre-elite and amateur athletes. In the psychophysiological performance domain, Decisiveness ($F(2, 294) = 4.21, p < 0.05, \eta^2 = 0.03$) and Aspiration ($F(2, 294) = 3.14, p < 0.05, \eta^2 = 0.022$) also differed significantly, with elite athletes again showing higher mean scores than other groups. These findings suggest that while personality traits and general psychophysiological capacities were relatively stable across levels, psychological readiness and decision-making efficiency distinguish higher-performing athletes from

Factor	Team (<i>n</i> = 177)	Individual (<i>n</i> = 123)	F	η^2
<i>Personality factors</i>				
F1: Neuroticism	27.82 (0.33)	28.58 (0.4)	6.85*	0.104
F2: Conscientiousness	33.87 (0.45)	32.8 (0.64)	0.77	0.013
F3: Extraversion	33.47 (0.48)	32.87 (0.59)	0.56	0.009
F4: Adventurism	33.11 (0.62)	36.56 (0.74)	4.70*	0.074
F5: Openness	28.71 (0.38)	30.46 (0.54)	2.38*	0.039
F6: Modesty	30.55 (0.63)	31.14 (0.86)	3.53*	0.057
<i>Psychological skills factors</i>				
F7: Confidence	18.52 (6.24)	20.00 (6.35)	8.12*	0.121
F8: Motivation	15.67 (3.45)	13.85 (3.65)	17.84*	0.233
F9: Team emphasis	13.41 (2.08)	12.39 (2.26)	8.99*	0.133
F10: Visualization	9.72 (2.47)	10.15 (2.42)	2.04	0.034
<i>Psychophysiological performance factors</i>				
F11: Stress tolerance	53.86 (7.60)	54.94 (7.65)	2.38*	0.039
F12: Exactitude	49.11 (7.21)	50.24 (6.87)	2.05	0.034
F13: Decisiveness	61.97 (8.94)	62.28 (7.35)	2.67*	0.043
F14: Impulsivity	41.31 (9.85)	42.48 (9.41)	1.77	0.029
F15: Performance	61.55 (6.03)	61.53 (6.10)	0.61	0.01
F16: Aspiration	57.37 (7.50)	55.49 (7.75)	4.41*	0.07
F17: Frustration tolerance	45.15 (5.93)	44.53 (6.13)	2.08	0.034
F18: Target discrepancy	49.89 (0.66)	49.45 (0.82)	1.03	0.017
F19: Reaction speed	61.78 (9.16)	60.64 (8.65)	2.61*	0.042
F20: Motor speed	62.81 (8.46)	61.78 (8.85)	8.7*	0.129
F21: Choice reaction speed	68.20 (9.63)	67.09 (9.72)	3.88*	0.062
F22: Choice motor speed	66.48 (8.07)	64.63 (8.07)	11.16*	0.016

Table 1. MANCOVA results comparing Personality, psychological Skills, and Psychophysiological performance factors between team and individual sport Athletes. Pillai's Trace = 0.168, $F(23, 272) = 2.382$, $p < 0.001$, $\eta^2 = 0.168$. $p < 0.05$. Athletes' gender, training load, experience and age are included as covariates; *Significant at the 0.05 level (two – tailed).

their less experienced counterparts. The combination of elevated confidence, motivation, and aspiration reflects a more advanced performance mindset, aligning with theoretical models of elite psychological functioning.

Cluster analysis: identification of multi-factorial athlete multi-factorial profiles

A *k* – means cluster analysis was further performed to classify athletes based on their personality traits, psychological skills, and psychophysiological performance factors, considering sport type and performance level. A four – cluster solution was identified as the best fit, considering both the sample size ($n = 304$) and the number of included variables. Alternative cluster solutions (two–, three–, and five– cluster models) did not demonstrate meaningful or statistically distinct group differentiation and were therefore rejected.

All variable scores were standardized into *z* – scores prior to analysis to ensure comparability across different measurement scales. The final cluster solution converged successfully after 9 iterations, confirming model stability. Table S2 in Appendix B presents the descriptive statistics and standardized *z* – scores for each of the four clusters, while Fig. 2 visualizes the cluster profiles across the 22 measured variables. The results revealed clear differentiation among clusters in psychophysiological and psychological performance indicators, with significant between – group differences confirmed by ANOVA (Tukey's HSD, $p < 0.05$).

A one – way ANOVA revealed significant differences across the four clusters in all psychophysiological performance indicators ($p < 0.001$), indicating that the groups were clearly differentiated based on performance – related capacities. Cluster 1 demonstrated the highest stress tolerance, decisiveness, performance, and fast motor and reaction speeds, but also higher impulsivity (lower impulse control), suggesting superior performance efficiency under pressure but a tendency toward rapid, less filtered responding. Cluster 2 showed the highest exactitude but slower response speeds, lower stress tolerance, and lower impulsivity (greater impulse control), suggesting a cautious and controlled performance style that may become strained in demanding conditions. Cluster 3 displayed generally reduced performance, motivation, and decisiveness, combined with slower psychomotor responding, lower stress tolerance, and higher impulsivity, indicating inhibited activation and reduced efficiency in high-pressure situations. Cluster 4 exhibited the fastest reaction and motor speeds and the highest stress tolerance, along with moderate impulsivity and lower decisiveness, reflecting a fast, instinctive, and reactive performance style that prioritizes rapid responding over deliberate decision-making.

Factor	Elite (n = 54)	Pre – elite (n = 163)	Amateur (n = 87)	F	η^2
Personality factors					
F1: Neuroticism	27.07 (0.53)	28.12 (0.35)	28.78 (0.49)	1.23	0.09
F2: Conscientiousness	32.57 (1)	33.53 (0.5)	33.77 (0.69)	1.36	0.01
F3: Extraversion	33.14 (0.91)	33.59 (0.52)	32.6 (0.69)	0.97	0.007
F4: Adventurism	37.45 (1.12)	34.69 (0.63)	32.47 (0.94)	1.18	0.009
F5: Openness	28.75 (0.77)	29.29 (0.44)	30.08 (0.57)	1.01	0.007
F6: Modesty	30.44 (1.11)	30.62 (0.73)	31.31 (0.93)	0.92	0.007
Psychological skill factors					
F7: Confidence	18.5 (0.87)	18.61 (0.52)	20.46 (0.6)	4.43*	0.031
F8: Motivation	16.58 (0.4)	15.1 (0.29)	13.61 (0.37)	3.89*	0.028
F9: Team emphasis	12.90 (0.31)	13.33 (0.15)	12.44 (0.28)	1.09	0.008
F10: Visualization	10.65 (0.39)	9.84 (0.18)	9.55 (0.26)	1.12	0.008
Psychophysiological performance factors					
F11: Stress tolerance	54.29 (0.6)	54.22 (0.78)	50.37 (0.9)	1.02	0.007
F12: Exactitude	50.06 (0.56)	48.21 (0.78)	63 (1)	1.09	0.008
F13: Decisiveness	62.39 (0.65)	62.39 (0.65)	61.03 (1.03)	4.21*	0.03
F14: Impulsivity	41.9 (1.14)	42.14 (0.73)	41.08 (1.12)	0.97	0.006
F15: Performance	61.96 (0.8)	61.9 (0.49)	60.6 (0.64)	1.42	0.01
F16: Aspiration	55.83 (1.07)	56.8 (0.59)	56.68 (0.85)	3.14*	0.022
F17: Frustration tolerance	43.27 (0.87)	44.78 (0.46)	46.13 (0.64)	1.09	0.008
F18: Target discrepancy	49.9 (1.06)	50.03 (0.72)	49 (0.98)	1.12	0.08
F19: Reaction speed	63 (1.13)	61.59 (0.7)	59.8 (0.93)	0.84	0.006
F20: Motor speed	65.9 (1.24)	62.42 (0.66)	60.23 (0.88)	1.01	0.007
F21: Choice reaction speed	67.1 (1.38)	68.52 (0.79)	64.15 (0.93)	0.76	0.005
F22: Choice motor speed	69.75 (1.13)	65.4 (0.66)	63.92 (0.83)	0.82	0.006

Table 2. MANCOVA results for Personality, psychological Skills, and Psychophysiological performance factors across competitive levels (Elite, Pre – elite, Amateur). Pillai’s Trace = 0.239, $F(46, 542) = 1.60$, $p < 0.001$, $\eta^2 = 0.18$. $p < 0.05$. Athletes’ gender, training load, experience and age are included as covariates; *Significant at the 0.05 level (two – tailed).

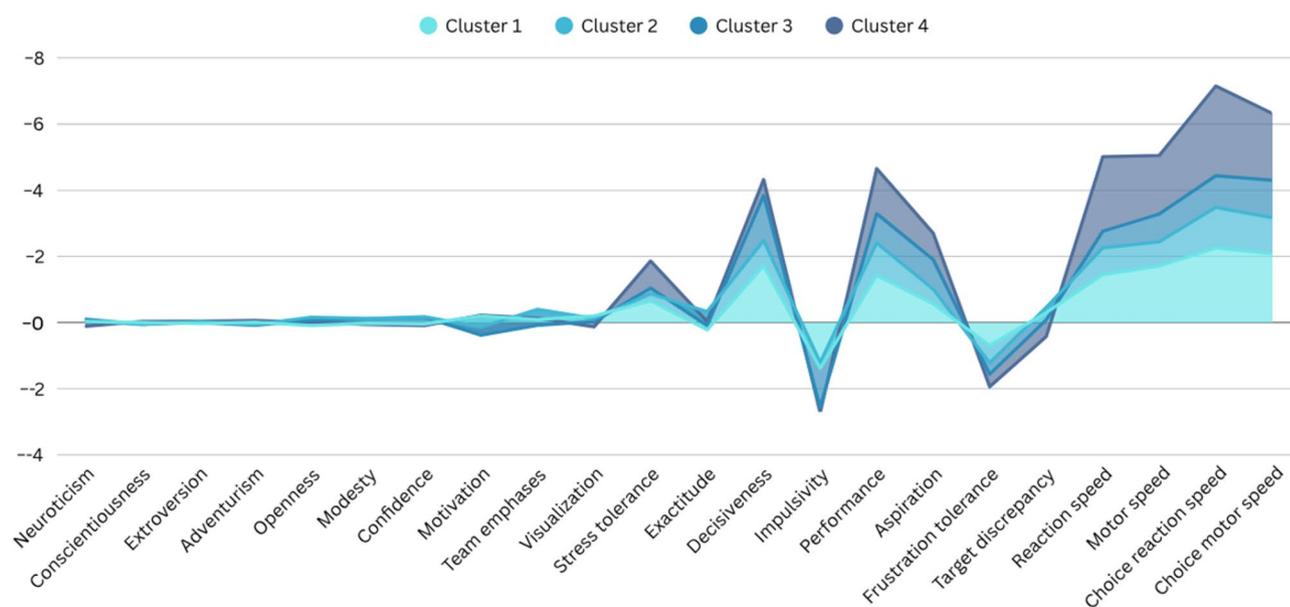


Fig. 2. Profiles of Athletes Based on Standardized Z – Scores Across Personality, Psychological Skills, and Psychophysiological Performance Variables.

Cluster interpretation

The K – means cluster analysis identified four distinct athlete profiles (see Table 3; Fig. 2), each characterized by specific psychological and psychophysiological performance patterns.

Cluster 1 ($n=102$; 33.6%) group demonstrated the most balanced and self-regulated performance profile. Athletes in Cluster 1 scored above the total sample mean on stress tolerance ($M=56.56$, $SD=6.64$), decisiveness ($M=67.22$, $SD=7.14$), performance ($M=64.26$, $SD=6.09$), aspiration ($M=55.72$, $SD=7.83$), and reaction speed ($M=64.45$, $SD=6.97$). Impulsivity was comparatively low ($M=36.25$, $SD=5.97$), indicating faster, more spontaneous/impulsive response style. Personality traits were near the sample average, showing emotional stability and composure (Neuroticism $M=28.03$, $SD=4.55$). Cluster 1 primarily included team-sport athletes ($n=64$; 21.1% of total sample; $\approx 62.7\%$ within cluster), predominantly at the pre-elite (19.1%) and elite (7.6%) levels. These athletes represent emotionally stable, achievement-oriented performers capable of maintaining consistent output under pressure.

Cluster 2 ($n=75$; 24.7%) athletes in this cluster exhibited a controlled and disciplined approach, characterized by high exactitude ($M=55.35$, $SD=6.14$) and conscientiousness ($M=33.07$, $SD=6.20$). They showed moderate stress tolerance ($M=52.07$, $SD=7.02$) and higher impulsivity ($M=51.67$, $SD=7.14$), reflecting strong emotional control and strong inhibitory control and deliberate responding. Performance ($M=59.80$, $SD=6.20$) and decisiveness ($M=57.63$, $SD=7.14$) were slightly above average, consistent with an analytical and strategic style rather than fast, intuitive responding. Motivation ($M=14.81$, $SD=3.66$) and confidence ($M=19.88$, $SD=5.97$) were moderate, aligning with a more reserved personality pattern. Cluster 2 consisted mainly of pre-elite (13.8%) and amateur (7.6%) athletes, with team-sport athletes representing 25.3% of the total sample ($\approx 60\%$ within cluster).

Cluster 3 ($n=85$; 28%) athletes showed lower stress tolerance ($M=51.71$, $SD=8.27$), low impulsivity (indicate reactive responding; $M=36.52$, $SD=5.92$), and slightly below-average performance ($M=58.35$, $SD=8.53$). They also scored lower on aspiration ($M=50.89$, $SD=8.91$) and frustration tolerance ($M=46.63$, $SD=9.35$), indicating difficulty maintaining composure and persistence under pressure. Reaction speed was relatively slow ($M=55.02$, $SD=8.10$), suggesting reduced psychophysiological performance efficiency. Personality profiles revealed slightly elevated neuroticism ($M=28.58$, $SD=4.36$) and average conscientiousness ($M=33.21$, $SD=7.08$), consistent with emotional reactivity and weaker self-regulation. This group included a higher proportion of individual-sport athletes ($n=41$; 13.5% of total sample; $\approx 49\%$ within cluster) and amateurs (12.2%).

Cluster 4 ($n=42$; 13.8%) athletes in this cluster displayed the most distinct psychophysiological performance pattern, characterized by very high stress tolerance ($M=58.19$, $SD=7.02$) and exceptional reaction and motor speeds (Reaction speed $M=72.45$, $SD=7.23$; Motor speed $M=67.86$, $SD=7.85$). They also demonstrated high performance ($M=65.30$, $SD=8.53$) and aspiration ($M=60.90$, $SD=8.53$). Impulsivity was average ($M=48.40$, $SD=5.86$) between cluster, showing that although these athletes are reactive, they maintain good control over emotional responses. Personality traits included low neuroticism ($M=27.47$, $SD=4.38$) and moderately high extraversion ($M=32.30$, $SD=5.30$), reflecting emotional resilience and assertiveness. This cluster included both team-sport athletes ($n=25$; 8.2% of total sample; $\approx 58\%$ within cluster) and individual-sport athletes ($n=17$; 5.6% of total sample; $\approx 40\%$ within cluster), with the highest proportion of elite competitors (11; 3.6%).

Discriminant function analysis: validation of cluster solution

A discriminant function analysis was conducted to determine whether the clusters identified through k – means clustering could be accurately differentiated based on the psychological and psychophysiological performance variables.

The analysis yielded three discriminant functions, of which the first two explained 92.4% of the total between – group variance. Function 1 accounted for 51.5% (canonical correlation = 0.83), and Function 2 accounted for 40.9% (canonical correlation = 0.80).

Wilks' Lambda indicated that all three functions were statistically significant ($\Lambda_{1-3} = 0.086$, $\chi^2(69) = 711.41$, $p < 0.001$), supporting the adequacy of the model in distinguishing among the clusters.

The classification results (Table 4) showed that 80.6% of the cases were correctly classified, indicating good internal consistency and stability of the cluster solution.

	Cluster 1		Cluster 2		Cluster 3		Cluster 4		Total
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Sport type									
Team sports	64	21.1	45	14.8	44	14.5	25	8.2	178
Individual sports	38	12.5	30	9.9	41	13.5	17	5.6	126
Level									
Elite	23	7.6	10	3.3	10	3.3	11	3.6	54
Pre – elite	58	19.1	42	13.8	38	12.5	25	8.2	163
Amateur	21	6.9	23	7.6	37	12.2	6	2	87
Total	102	33.6	75	24.7	84	28	43	13.8	304

Table 3. Distribution of sport type and competitive level within the four athlete Clusters.

Cluster	Predicted group membership				n	%
	1	2	3	4		
Profile 1	97	2	2	1	102	95.1
Profile 2	1	72	1	0	75	96
Profile 3	0	1	83	2	85	97.6
Profile 4	1	0	1	40	42	95.2
Total					304	80.6

Table 4. Classification accuracy of discriminant function analysis for the four athlete Profiles.

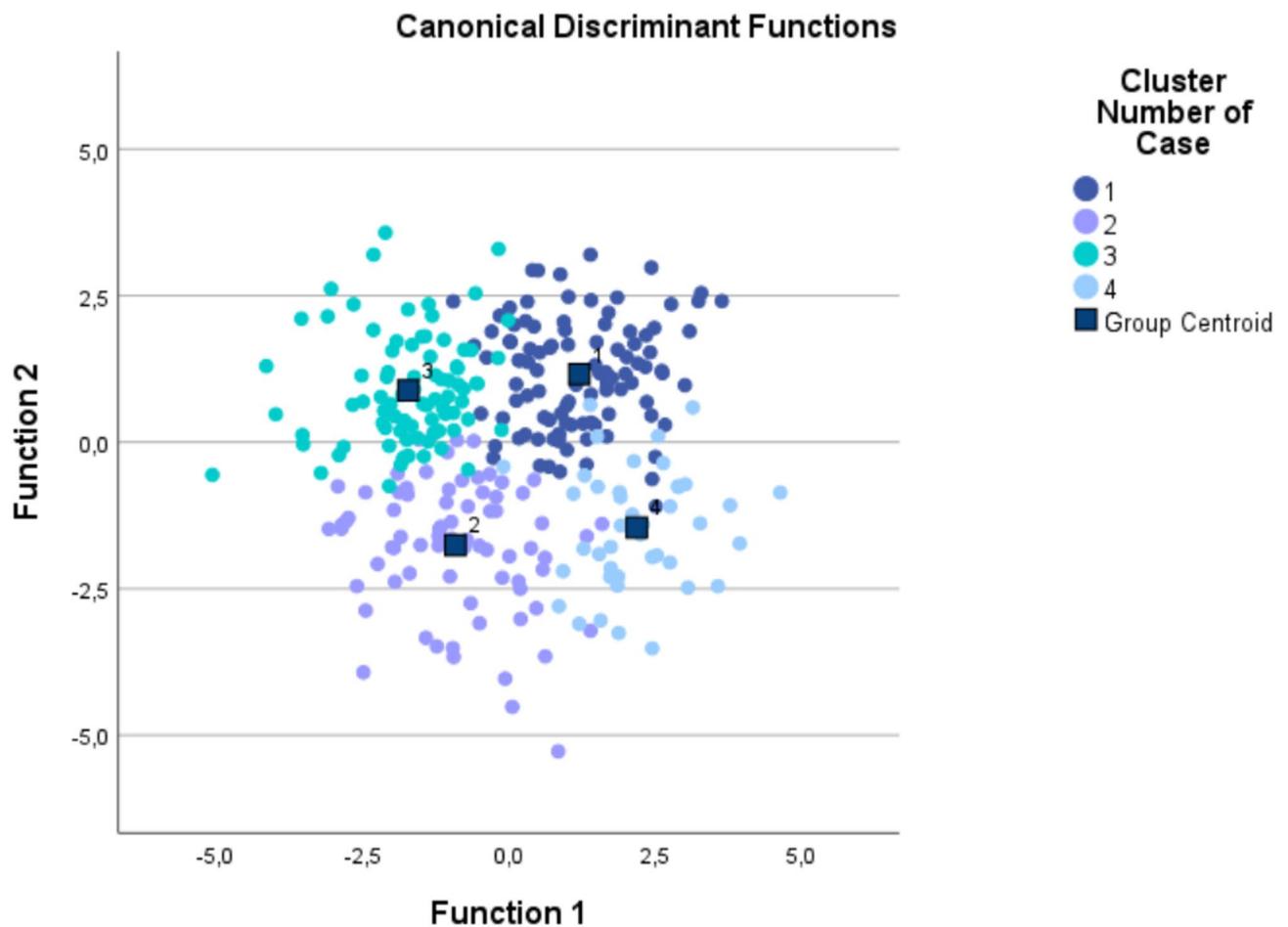


Fig. 3. Scatterplot of Discriminant Function Scores by Cluster Profile. *Note.* Squares represent group centroids (mean scores for each cluster on the discriminant functions).

Cluster-specific classification accuracy was high, ranged from 95.1% to 97.6%, with the highest accuracy observed for Profile 1 and the lowest for Profile 3 (97.6%) and similar high accuracy for the other clusters.

The spatial representation of the discriminant functions is shown in Fig. 2.

The figure illustrates the separation of the four clusters along the first two discriminant dimensions. Cluster centroids were located at (Function 1, Function 2): Cluster 1 = (1.20, 1.16), Cluster 2 = (-0.91, -1.76), Cluster 3 = (-1.72, 0.88), and Cluster 4 = (2.18, -1.46). The first function primarily differentiated clusters based on psychophysiological performance efficiency, whereas the second function reflected differences in impulse control and emotional self-regulation. The first two discriminant functions explained 92.4% of the between-group variance and were therefore used for visualization (Fig. 3). The third function explained only 7.6% and was not plotted due to its limited discriminative contribution.

Based on the results obtained, four distinct athlete profiles were identified, reflecting differences associated with sport type (team vs. individual) and competitive level (elite, pre-elite, amateur). The profiles were derived from the integrated analysis of personality traits, psychological skills, and psychophysiological performance variables, which together represent the core determinants of athletic functioning.

Profile	Theme	Code	Example raw data quotes
Profile 1	Profile validity (Q1)	<i>leadership_stability</i>	"Profile 1 matches high-level players and team leaders; emotionally balanced, self-regulated, focused under pressure." (E1) "Experienced, elite athletes in team and individual sports." (E2) "Future elite talents." (E9)
	Behaviour under stress (Q2)	<i>leadership_support focus_under_pressure</i>	"Confident, inspire younger teammates; stable performance." (E2) "Takes over late-game responsibility; composed; analyses failures for next time." (E4) "After errors they analyse and adapt quickly; keep calm and task-focused under stress." (E1) "Maintain focus in intense situations; planful training; stabilising presence for team." (E7)
	Psychological intervention (Q3)	<i>self_reflection mental_flexibility</i>	"Maintain and improve psychological flexibility between load and recovery; update goal programs; mindfulness, breathing, mental training, imagery, self-talk." (E3) "Maintain optimal motivation; avoid stagnation; develop creativity, flexibility, openness; goal refinement; leadership; adaptability." (E7)
Profile 2	Profile validity (Q1)	<i>precision_overcontrol</i>	"Disciplined, conscientious, well-trainable; strong responsibility; sometimes struggle to adapt to unexpected situations." (E1) "Experienced amateurs/national level." (E2)
	Behaviour under stress (Q2)	<i>cautious_decisions routine_precision</i>	"Diligent, compliant; cautious/avoidant; less effective under stress." (E2) "More introverted; prefer individual training; public aspect hinders performance." (E6) "Repeat drills until fully precise; control holds if plan works; unexpected events can unsettle." (E1) "Checks equipment and routines; inner tension with errors, rarely outward." (E3)
	Psychological intervention (Q3)	<i>reduce_overcontrol relaxation_breathing</i>	"Reduce overcontrol, trust the body, allow flow; relaxation and breathing; cognitive acceptance of mistakes; biofeedback." (E3) "Emotional freedom, spontaneity and self-reliance; reduce anxiety and overthinking; relaxation; cognitive reframing; switch to automatic execution; strengthen self-efficacy." (E7) "Train stress tolerance using breathing and concentration; use positive self-talk; simulate unexpected situations." (E1)
Profile 3	Profile validity (Q1)	<i>emotional_reactivity</i>	"Common among younger athletes; emotional fluctuations and quick frustration after errors." (E1) "Youth or early adult transition." (E2)
	Behaviour under stress (Q2)	<i>emotional_volatility motivation_swings</i>	"May love training but dislike competing." (E5) "Mood-dependent engagement; emotional reactions; need structured self-regulation." (E7)
	Psychological intervention (Q3)	<i>emotional_regulation self_regulation_package</i>	"Develop emotional self-regulation and mindfulness (box breathing, 3-second reset). Reduce fear of mistakes via reflection." (E1) "Emotion regulation and stress-coping skills." (E4) "Strengthen self-regulation and intrinsic motivation; emotion awareness and management; self-esteem; focus on progress; ABC model; routines and attentional focus; self-efficacy." (E3) "Build self-regulation, emotional resilience and concentration; routines, micro-goals, positive self-talk." (E7)
Profile 4	Profile validity (Q1)	<i>reactive_speed</i>	"Energetic, instinctive; speed is a strength; impulsivity may cause emotional outbursts." (E1) "Pre-elite/elite in growth stage." (E2)
	Behaviour under stress (Q2)	<i>quick_decisionmaking high_stress_tolerance</i>	"High stress tolerance." (E2) "Mobilise under stress; resilient until cumulative failures/trauma." (E6)
	Psychological intervention (Q3)	<i>impulse_control visualization</i>	"Impulse control recognises escalation moments and refocus with a brief reset ritual (self-talk, breath, sensory cue)." (E1) "Develop patience, sustained attention, and impulse control; perceptual slowing drills; cognitive control and decision quality under pressure; rhythm and focus training." (E3) "Imagery, self-regulation, routines, self-talk, problem-focused sessions." (E5)

Table 5. Thematic mapping of validated athlete profiles (Q1–Q3). Note. Q1–Q3 refer to the three open-ended questions provided to experts. Expert responses are coded as E1–E9, representing nine sport psychology professionals (psychologists and psychological preparation coaches) who participated in the qualitative validation survey.

Qualitative validation of athlete Multi-Factorial profiles

Table 5 summarises the qualitative analysis of the three open-ended questions addressed to experts, who were either psychologists who practice in sport or psychological preparation coaches with a minimum of six years of professional experience working with athletes. The experts generally confirmed the ecological validity of the four athlete profiles. A total of nine experts participated in the qualitative validation of developed profiles of athletes. Agreement rates were high for Profile 1 (8/9 experts), Profile 2 (8/9), and Profile 4 (8/9), and moderate for Profile 3 (7/9). One expert (E8) expressed general scepticism, emphasising that athlete typologies are often situationally fluid rather than trait based.

Across responses, common descriptors included stability, precision, emotional lability, and speed/impulsivity, indicating substantial convergence between expert perceptions and the empirically derived athlete profiles.

According to the results of the qualitative validation, it can be concluded that the experts consistently recognized that the four derived athlete profiles reflect real athlete types observed in professional practice, with exception of one expert, who indicated that he had not encountered athletes with such characteristics in his practice. In particular, the thematic analysis of behavioural examples revealed clear and internally consistent patterns. Experts described athletes in Profile 1 as being able to remain calm, focused, and analytical under pressure (*concentration_under_pressure*; $n=4$), especially in high-stress situations such as decisive moments during competition. These athletes were often identified as elite or high-level performers who demonstrate psychological stability and self-regulation.

In their descriptions of Profile 2, experts referred to athletes who are conscientious and precise, with a strong desire to avoid mistakes. This tendency toward accuracy and control, however, frequently leads to delayed decision-making and difficulty adapting to sudden changes (*routine_precision*, *cautious_decisions*; $n=5$). Experts noted that this profile is often observed among pre-elite or amateur athletes who rely heavily on structure and predictability.

Profile 3 was also recognised as common in applied practice and was described as representing emotionally unstable athletes whose performance often declines following mistakes (*emotional_instability*, *motivational_fluctuations*; $n=6$). Such athletes were characterised as inconsistent and reactive, relying on momentary emotions or impulses, which can manifest in explosive responses during competition.

Experts provided highly consistent evaluations of Profile 4, repeatedly noting that these athletes are easily recognisable in practice. They display rapid decision-making and adaptability, yet at times exhibit impulsivity or lapses in sustained attention (quick_decision_making; $n = 5$).

The experts proposed a series of targeted mental-skills interventions tailored to each athlete profile. For Profile 1, the primary focus should be on maintaining long-term motivation and leadership capacity through self-reflection, mindfulness, and empathy training. Profile 2 would benefit from interventions aimed at reducing excessive self-control and promoting flexibility, such as relaxation techniques, cognitive reframing, and spontaneity exercises, to enhance resilience under stress. For Profile 3, experts recommended strengthening emotional regulation, self-efficacy, and structured self-regulation routines to improve performance stability and confidence during competition. Profile 4 should focus on developing impulse control, frustration tolerance, and sustained concentration under prolonged or monotonous pressure. Based on the integration of quantitative cluster characteristics and qualitative expert evaluation, four athlete multi-factorial profiles were identified and labelled as follows: Profile 1: “Stable High-Performance Athletes”, Profile 2: “Controlled Precision Athletes”, Profile 3: “Low-Regulation Reactive Athletes” and Profile 4: “Reactive High-Speed Athletes”.

Across all multi-factorial profiles, experts emphasised biofeedback, visualisation, and psychophysiological readiness training as integrative approaches supporting adaptive functioning and consistent performance. All together, these results demonstrate that the four athlete profiles are both statistically distinct and ecologically recognizable, indicating that integrated psychological and psychophysiological performance factors meaningfully differentiate athletic functioning in applied settings.

Discussion

The aim of the study was to develop a multi-factorial profile of Latvian athletes by integrating measures of personality traits, psychological skills, and psychophysiological performance variables. Based on the results, four athlete multi-factorial profiles were identified and qualitatively validated with the help of experts, demonstrating different models in terms of personality structure, psychological skill development, and psychophysiological functioning. These profiles can be used to plan and implement more targeted and effective interventions, promoting long-term athlete development and improving performance in both training and competition. The findings of this research extend previous athlete profiling research by demonstrating that performance-related patterns emerge when personality, psychological skills, and psychophysiological indicators are examined jointly rather than in isolation.

Interpretation of the identified athlete multi-factorial profiles

The observed differences between team and individual sport athletes, as well as across competitive levels, indicate that performance environments are associated with distinct patterns of emotional regulation, motivation, and psychophysiological efficiency. These differences provide an empirical context for interpreting the cluster-based profiles, suggesting that regulatory demands, motivational structures, and response characteristics vary systematically depending on sport type and developmental stage. Profile 1 (Stable High-Performance Athletes), this profile represents athletes with moderate to high emotional stability, balanced sociability, and sufficient conscientiousness. They demonstrate higher self-confidence, motivation, and focused goal orientation. Their lower impulsivity scale scores indicate a faster, more spontaneous response style, with reduced inhibitory control and less reflective regulation but at the same time they have high decisiveness. These athletes exhibit relatively high stress tolerance (second highest among the profiles) and good reaction and motor speed, enabling them to maintain stable performance under competitive pressure. Profile 1 reflects emotionally stable, self-regulated athletes who maintain performance under pressure, consistent with findings linking psychological resilience to high-level performance^{34,35}. Previous studies have often shown that these aspects are specific and reflect elite-level athletes^{36,37}. The profile demonstrates that elite level athletes functioning is more accurately characterized by the combination of emotional stability, decisiveness, and psychophysiological efficiency under stress. This profile is the most common among team-sport athletes ($\approx 63\%$ within the profile) and included a substantial proportion of pre-elite and elite competitors, suggesting that emotional stability, stress tolerance, and consistent decision-making may be particularly advantageous in cooperative and tactically dynamic sport environments.

Profile 2 (Controlled Precision Athletes) athletes in this are emotionally stable and tend to present as cooperative and socially constructive in team environments, although their extraversion scores did not differ significantly from other profiles. Their interaction style reflects communication discipline rather than sociability level. This profile also displayed notably lower Openness, reflecting a preference for structure, routine and low novelty in training environments. They are conscientious, organized, and disciplined, preferring structured and predictable performance environments. Their impulsivity scale scores are the highest, indicating strong reflective control and deliberate decision-making. They demonstrate the highest precision (exactitude) and consistent execution, while showing relatively slower reaction and motor speed and lower stress tolerance compared to Profiles 1 and 4. This reflects a methodical and planned performance style, where accuracy is prioritized over speed. Such athletes excel in tasks requiring technical consistency and routine adherence, although they may be less adaptable in rapidly changing competitive contexts. This profile helps explain why some highly disciplined athletes show stable performance in structured settings but inconsistent results under unpredictable competitive conditions, a pattern is frequently reported but sometimes is insufficiently explained. This aligns with evidence linking conscientiousness to persistence, task planning, and technical mastery in sport^{38,39}. Profile 2 corresponds to a strategic and deliberate performance style, which is advantageous in technically stable tasks but may require targeted training to improve adaptability under uncertainty. Profile 2 was also more represented in team-sport athletes and occurred primarily among pre-elite and amateur athletes, reflecting a performance style that favours structured training environments, progressive skill development, and stable team roles. The overrepresentation of team-sport athletes in Profiles 1 and 2 is consistent with the broader pattern observed in this sample, where

team-based contexts were more often associated with stronger motivational orientation, greater team focus, and faster psychomotor responding.

Profile 3 (Reactive Low-Regulation Athletes), these athletes show higher neuroticism and the lowest conscientiousness among the profiles, along with greater emotional reactivity and reduced self-esteem. They demonstrate lower motivation, weaker stress-management skills, and lower impulsivity scale scores, which indicates greater spontaneous impulsive responding and inconsistent self-regulation. They exhibit the lowest stress tolerance, slower reaction and motor speed, and reduced performance stability. This pattern corresponds to athletes with underdeveloped emotional regulation strategies, who may experience performance disruption following stress or mistakes^{40,41}. This profile corresponds to developmentally earlier stages of psychological skill acquisition, where athletes may possess physical ability but lack regulatory strategies to manage pressure effectively. This profile was more prevalent among younger athletes, suggesting a developmental pattern rather than a fixed limitation. Strengthening emotional resilience, confidence, and coping resources is therefore crucial for athletes in this group. Profile 3 included a higher proportion of individual-sport athletes, which aligns with the broader pattern in this sample suggesting comparatively higher self-confidence but lower motivational orientation and slower psychomotor responding among individual athletes. While individual sports often demand greater self-reliance and internal confidence, they may provide fewer external regulatory cues, potentially contributing to greater emotional reactivity and variability in stress regulation during performance. This pattern supports previous findings that individual athletes may experience greater psychological load in self-regulated competitive contexts.

Profile 4 (Reactive High-Speed Athletes) include emotionally stable and moderately extraverted athletes with high motivation and a strong competitive drive. Their impulsivity scale scores are in the mid-range, indicating rapid responding with partial regulatory control. They demonstrate the highest stress tolerance and the fastest reaction and motor speed among all profiles, reflecting a fast, dynamic, reactive performance style. Such athletes are well-suited to intense, rapidly changing competitive environments where quick decision-making and tactical adaptability are critical⁴². This may also increase vulnerability to decision errors under long-lasting cognitive load, highlighting the importance of targeted inhibitory-control training. However, this performance style relies on instinctive rather than reflective control, meaning sustained performance quality may depend on developing better inhibitory control and decision regulation. Recent sport analytics work supports the importance of integrating perceptual-cognitive training to maintain decision accuracy in high-speed performers⁴³. Profile 4 contained the highest proportion of elite-level athletes, and was represented in both team and individual sports, suggesting that the combination of high stress tolerance and rapid psychomotor response speed supports success in high-intensity, time-pressured performance environments.

Integration across profiles and broader theoretical implications

Differences between competitive levels suggest that progression toward elite performance is primarily associated with enhanced psychological readiness rather than broad changes in personality structure. Higher-performing athletes were characterized by stronger confidence, motivation, and decisiveness, indicating that psychological skills and regulatory efficiency may play a more critical role than stable personality traits in distinguishing elite performers from their less experienced counterparts. The four profiles illustrate that psychological performance in sport is not defined by a single optimal pattern, but rather by different combinations of emotional stability, motivational orientation, and psychophysiological regulation. Empirical cluster structure identified in this research demonstrates that no single psychological or psychophysiological variable was sufficient to explain performance differences, reinforcing the necessity of a multi-factorial developmental framework. The profiles identified here closely reflect contemporary models of athlete long term development, which emphasize that athletes progress along different psychological pathways depending on their training history, competitive environment, and regulatory skill acquisition^{44,45}. Athletes' developmental patterns are consistent with dynamic systems perspectives on athlete growth, self-regulation models of performance under stress⁴⁶, and the theory of challenge and threat states in athletes⁴⁷, all of which emphasize that athletes differ in how they adapt to performance demands.

The differentiation observed between the four profiles demonstrates that athletes require different types of psychological and training support depending on their regulatory profile rather than a uniform "one-size-fits-all" approach. Profiling allows coaches and sport psychologists to identify whether an athlete benefits more from stability and composure training (as in Profile 3), adaptability and decision-speed challenges (Profile 2), sustained emotional control under pressure (Profile 1), or inhibitory and tactical regulation during fast-paced performance (Profile 4). In this way, multi-factorial profiling can guide individualized intervention planning, inform role assignment within teams, and support long-term athlete development by aligning training demands with each athlete's current regulatory capacities and developmental strategies. For example, Sanz-Fernandez et al.⁴⁸ demonstrated that athletes display distinct behavioral patterns associated with specific psychological profiles, and that aligning training with these profiles improves performance and intervention effectiveness. Similarly, Shannon et al. [49] reported that athletes belonging to less optimal psychological profiles may particularly benefit from needs-supportive communication and psychological skills training, highlighting the relevance of profiling for both performance enhancement and mental health support in sport environments. This pattern extends earlier athlete typology research by demonstrating that performance readiness emerges from different regulatory configurations rather than a single optimal psychological profile.

Profiles 1 and 4 align more closely with performance-ready psychological functioning, particularly in environments involving rapid tactical decision-making and competitive pressure. Profiles 2 and 3, meanwhile, reflect earlier or more structurally dependent developmental stages, where performance consistency is supported either by external routine (Profile 2) or may be disrupted by emotional stress (Profile 3). This differentiation

supports the practical value of profiling systems for targeted psychological skill intervention and individualized training design.

Practical implications

The practical contribution of this study can be found in its potential to support and improve the work of sport coaches, sport psychologists and sport specialists whose goal is to strengthen athletes' psychological preparation. Multi-factorial profiling enables practitioners to identify both strengths and aspect requiring development in athletes, making an opportunity to more targeted and individually tailored intervention planning. Multi-factorial profiling can function as a practical assessment tool in applied sport settings, especially when it is based on a structured evaluation of key psychological and psychophysiological performance components. Profiling can inform the work of sports medicine professionals by identifying athletes who may be more vulnerable to overtraining, burnout, or injury risk, especially those with low stress tolerance or heightened emotional reactivity (like Profile 3). This information can support preventive strategies, guide return to sport decisions after injury, and assist with individualized load management. For example, athletes characterized by low stress tolerance and high emotional reactivity (such as Profile 3) may require early preventive interventions focused on stress management and emotional regulation, whereas athletes in more performance-ready profiles may benefit from optimization rather than correction strategies.

The differentiated profiles identified in this study indicate that psychological preparation needs vary substantially across athletes and should therefore be systematically integrated into training planning. The psychological preparation of athletes should be considered as a core element of the training process, alongside physical, technical, and tactical preparation. Integrating psychological development into regular training planning contributes not only to improved performance under pressure, but also to the sustainable long-term development of athletes. These findings support a stronger and more systematic emphasis on psychological preparation within the training process. Systematic assessment of psychological functioning allows to determine which psychological skills require strengthening and to select appropriate training methods or interventions for athletes.

Beyond applied use, the findings of this study contribute to sport science by offering a deeper understanding of the psychological characteristics of contemporary athletes. The multi-factorial profiles identified here are based on empirically grounded evidence and provide a framework for interpreting how personality, psychological skills, and psychophysiological readiness shape performance. This knowledge supports the development of evidence-based approaches to psychological preparation and highlights the value of profiling as a tool for individualized athlete development. Unlike previous typologies based primarily on self-report psychological measures, the present profiles integrate objective psychophysiological indicators, enhancing their validity and applied relevance.

Limitations

Despite the practical value of multi-factorial profiling in identifying athletes' strengths, weaknesses, and individual development needs, several limitations of this study should be acknowledged when interpreting the results. First, the timing within the annual training cycle (periodization phase) was not controlled. Athletes were assessed at different points in their season, and certain psychophysiological performance indicators, such as stress tolerance and reaction speed, may vary depending on whether testing occurs during preparatory, competitive, or transition phases. Personality traits are theoretically more stable and therefore less influenced by seasonal fluctuations, but psychophysiological readiness can vary considerably. The cross-sectional design of the study limits causal interpretation of relationships between personality, psychological skills, and psychophysiological performance indicators.

It is also important to note that the sample consisted exclusively of Latvian athletes, which limits the generalizability of the findings to athletes from other countries or sporting cultures, where psychological preparation systems, coaching traditions, and sociocultural norms may differ. While similar patterns could be anticipated in comparable regional contexts, replication in other populations would strengthen the external validity of the profiling model.

Another limitation concerns the composition of the expert panel used for qualitative profile validation. Although the profiles were qualitatively validated by sport psychology experts, the composition of the panel may be expanded in future research. Involving a greater number of experts, including performance coaches and psychological preparation coaches who work daily with athletes in training and competition environments, would enrich the ecological validity of the interpretations and strengthen the practical application of the profiles.

Future research should employ longitudinal designs to track how multi-factorial profiles evolve across training phases, competitive progression, and career stages, and should examine profile differences within specific sport types, as sport-specific demands and performance environments may shape regulatory patterns differently. A more fine-grained sport-specific analysis could reveal additional sub profiles or nuances in regulatory functioning that were not captured in the broader categorization used in the present study. The profiles suggest possible links to burnout or injury risk vulnerability, but these outcomes were not directly measured in this study. Future research should examine how different psychological and psychophysiological patterns are related to burnout trajectories, overtraining, and injury incidence.

Conclusions

This study developed a multi-factorial profile for Latvian athletes, integrating personality traits, psychological skills, and psychophysiological performance indicators. Based on cluster analysis, four athlete profiles were identified. The profiles differed not only in their indicators, but also in different sports (individual vs. team) and competition levels (elite, pre-elite, amateur). Team-sport athletes and higher-performing athletes were

more frequently represented in Profiles 1 and 4, whereas individual-sport and amateur athletes were more commonly observed in Profiles 2 and 3. These findings indicate that athlete development is not uniform and that performance-relevant psychological functioning is shaped by both training demands and competitive environments. Importantly, the results demonstrate that high-level performance emerges through multiple psychological pathways rather than a single optimal developmental path.

From a theoretical perspective, the findings extend previous athlete profiling research by demonstrating that stable personality traits, trainable psychological skills, and objective psychophysiological indicators jointly contribute to performance-relevant functioning. This integrative approach addresses limitations of earlier unidimensional models and supports contemporary frameworks that conceptualize athletic performance as a dynamic, multi-component process.

From an applied perspective, the proposed multi-factorial profiles provide a structured framework to support individualized psychological preparation in sport. Athletes support teams may use these profiles to better identify athletes' strengths, vulnerabilities, and developmental priorities, thereby informing targeted psychological skills training, stress-regulation interventions, and performance optimization strategies. These profiles should be interpreted as dynamic reference frameworks rather than fixed classifications.

The conclusions of this study should be considered in light of its limitations, including the cross-sectional design, the exclusive focus on athletes, and the absence of longitudinal outcome measures. Future research should therefore track profile stability across training phases and competitive progression and examine links between multi-factorial profiles, performance trajectories, injury risk, and burnout. Such work would further strengthen the practical utility of integrated athlete profiling for long-term athlete development.

Data availability

The used datasets can be accessed at Riga Stradiņš University Dataverse repository: Volgemute, Katrina. 2025. "Athletes Personality Traits, Psychological Skills, and Psychophysiological Performance." Rīga Stradiņš University Institutional Repository Dataverse. <https://doi.org/doi:10.48510/FK2/0B871H>. For long-term access or institutional inquiries, data requests may also be directed to the RSU Research Department at research@rsu.lv.

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Author contributions

K.V. conceived the study, developed the methodology, acquired funding, supervised the project, conducted the investigation, curated the data, performed the formal analyses, validated the findings, prepared the visualizations, and wrote the original draft of the manuscript. G.U., A.A., K.A., and R.L. contributed to data curation and participated in the investigation. Z.V. contributed to data curation, formal analysis, and validation, and assisted in writing and reviewing the manuscript. A.K., Z.V., A.A., G.U., and R.L. contributed to reviewing and editing the manuscript. All authors have read and approved the final version of the manuscript.

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Declarations

Competing interests

The authors declare no competing interests.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Latvian Academy of Sport Education (Protocol No. 8, Statement No. 1, April 19, 2024) and adhered to the ethical guidelines outlined in the Declaration of Helsinki. Informed consent was obtained from all participants included in the study and participants were fully informed that their data would be used solely within the framework of this research. Confidentiality was strictly maintained, with all data securely stored to protect participant privacy. Participants were also informed of their right to withdraw from study at any time without penalty.

Additional information

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