

Exploratory Factor Analysis of Psychological Skills Inventory for Sports in Indonesian National Athletes

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Abstract The Psychological Skills Inventory for Sports (PSIS-R5) that stands for Psychological Skills Inventory for Sports is one of instruments in measuring six psychological aspects of an athlete in sports settings. Such instrument has been used differently with inconsistent findings, items used, target subjects, etc. This study aims to reveal the extent of factor analysis of this instrument when it applies to different subgroups of 295 Indonesian national athletes. It also intends to ensure which statements are consistent with the psychological aspects measured through assessing reliability and validity. The collected data were quantitatively analyzed to obtain information about construct validity and reliability. After data collection through the PSIS-R5 instrument, they were then analysed both qualitatively and quantitatively. Descriptive statistics, including means, and standard deviations were initially calculated and subsequently identified the extent of psychometric characteristics of the instruments studied and the application of Alpha Structured formula, KMO and Bartlett's Test. Results showed the PSIS-R5 instrument to be composed of five factors with values of 45.325%; to be in the reliable category of Cronbach's alpha reliability coefficient for self-management, motivation, and psychic readiness factors. However, it was not in the reliable category for failure/defeat thought and team management, but the good category in the stratified alpha reliability.

Keywords Exploratory Factor Analysis, Athletes, PSIS-R5, Reliability, Construct Validity

1. Introduction

In a broad sense especially in recent times, to be a good performer in sport, athletes have to bear not only the psychological well-being but also the incorporation of it with several other things deemed useful to contribute to the improvement of the performance itself thereby psychological factor [1], [2]. By that, several studies conducted revealed psychological factors (skills) such as cognition, self-confidence, anxiety control, mental preparation, and team emphasis to be closely related to the success of elite soccer players [3], [4]. However, on the other hand, psychological factors anxiety, poor concentration, self-doubt, stress, tension, and aggression, were observed to have a potentially negative effect on athlete's performance [2], [5], [6]. Although the field of applied sport psychology has rapidly grown in these recent decades, the development of assessment instruments specific to sport has been disrupted anyway [7], [8]. Traditionally, instruments of psychological functioning or personality inventories for some have been adapted and employed in sports settings. In order to compare successful and unsuccessful athletes, mental skills are relevant for sport performance purposes. Therefore, a valid and reliable instrument is needed.

The Minnesota Multiphasic Personality Index (MMPI)

for instance is one of them that has been used to identify personality differences between athletes at different skill levels. In tandem, instruments such as the Competitive State Anxiety Inventory-2, the Sport Anxiety Scale, the Sport Competition Anxiety Test are other few instruments designed and developed to assess Psychological skills specific to sport [9]. The psychological Skills Inventory for Sports, shortened as PSIS is another instrument developed by Mahoney et al. according to Yang [10] for the same purpose but with several opinions about its background. In this context Tenenbaum et al. [11] states that this piece of protocol was developed due to the failure of personality test to associate specific characteristics with sports performance, and its tendency to ignore psychological skills. In the thesis work of Wheaton [12] entitled *A Psychological Skills Inventory for Sport*, it is mentioned that this instrument (PSIS) was developed due to the need for instrument assessment of psychological skills possessed by athletes toward the cognitive strategies to distinguish the successful from the less successful. For the quality improvement and the well-being of sports athletes in terms of performance, we have realized that multiple other instruments are being invented, innovated, developed or even combined. Then based on what is audited above along with literature that exists so far, one may wonder which instrument is more accurate, practical, reliable, valid to measure psychological skills in sports performance.

In a study of Sindik et al. [13], it is mentioned that, PSIS was found to be the most useful instrument in assessing athletes' psychological skills. Some of these skills were distributed into five subscales (aspects) (R5) such as anxiety, concentration, self-confidence, team emphasis, and mental preparation even though later on some changes were made by swapping from PSIS to PSIS-R5 due to items reduction [14]. As far as PSIP-R5 instrument is concerned, six psychological sub-scales (aspect) encompassing motivation, confidence, anxiety control, mental preparation, team emphasis, and concentration was formed [15], [16].

Broadly speaking, motivation is defined by Elmagd et al. [17] as the foundation for all endeavours and achievements of athletes because it reflects the needs or desires energizing and directing their behaviour toward a goal [18]. So, in order to become an accomplished athlete, motivation is needed to maximize every potential skill. Confidence is another indispensable aspect simply interpreted as the inner knowledge of conviction needed by athletes to achieve a goal, with "guts" through equate self-confidence [19]. Furthermore, several sports psychology studies have concluded that athletes with high levels of self-confidence have better levels of performance in different sports than those without [20], [21]. In the same vein, it is agreed that athletes with lower confidence feel more anxious about competition and results because of their unpreparedness for all possible consequences. It is then agreed that anxiety is negatively related to self-confidence as the third aspect of psychological skills needed during sports performance [22]. As a banal example, both Hanin [23] and Craft et al. [24]

reported that most athletes find anxiety to weaken and reduce their performance. Mental preparation is another aspect described by Jonker et al. [25] as readiness or ability of athletes to compete in big matches, stay focused, and show high talent and skills in every competitive situation. Overall, the lack of mental preparation in competition leads to poor performance in different sports. This latter opinion is corroborated by the results of Perry et al. [26], and Rupprecht et al. [27] that the last not least, the team emphasis and concentration are another type of subscale individuals players required to use as a coherent unit to form a team synergy. For example, in soccer, it is important to understand the impact of a player on the team as well as those of the team on the player [28]. Concentration of players has been observed and valued to be an important element for successful performance in sports [29].

The use of PSIS-R5 instrument has been observed to have good psychometric characteristics [30]. However, the determination of such goodness in characteristics depends on the assessment of measurement properties namely validity and reliability [31]. They are important in describing the effect of measurement errors on the theoretical relations measured [32]. Kuzmanić [33] suggested validity represents the truth of the findings while reliability refers to its stability. Through the use of different analytical methods, Michael et al. [34] proved the construct validity through the Confirmatory Factor Analysis and found the structure of psychological factors not to be consistent with the constructs compiled. Meanwhile, regarding the reliability estimation of PSIS-R5 instrument, Mahoney et al. [35] reported an internal consistency and split-half reliability in a fairly low category of 0.636 for Cronbach's alpha reliability and 0.567 for split-half reliability. In line with this, Chartrand et al. [9] also surprisingly found the mental preparation subtest had a negative alpha Cronbach reliability of -0.34 while other aspects except for self-confidence with $\alpha = 0.85$, have low reliability, control anxiety = 0.59, concentration = 0.52, motivation = 0.62, and importance of team = 0.53.

Therefore, based on these inconsistent findings, items used, further research is particularly needed on the psychometric characteristics instrument with different samples to assess the reliability and validity when applied to different subgroups of athletes. This study is conducted to reveal the extent of factor analysis of this instrument and to ensure its statements are consistent with the psychological aspects measured.

2. Materials and Methods

2.1. Participants

The participants were 295 sports performers, consisting of 95 females (32.2 %) and 200 males or (67.7 %) recruited randomly from 27 sports clubs officially recognized and listed on the National Sports Committee of Indonesia. The

data distribution of athletes' sports is presented in the table below:

Table 1. Data distribution of athletes' sports used in this study

No.	Sports	Number of athletes
1	Athletics hurdles and competitions	1
2	Middle-distance Running Athletics	1
3	Sprint Athletics	4
4	Long-distance Running Athletics	4
5	Long Jump Athletics	2
6	Water ski	10
7	Tennis Court	6
8	Water polo	25
9	Synchronous swimming	10
10	Bowling	12
11	Billiards	8
12	Archery	11
13	Martial arts	22
14	Boxing	11
15	Karate	16
16	Wushu	11
17	Taekwondo	17
18	Triathlon	8
19	Weightlifting	9
20	Squash	12
21	Judo	20
22	Paddle	22
23	Table tennis	8
24	Road Race Bike Race	11
25	Swimming	16
26	Bike Track Racing	12
27	Golf	6
	Total	295

Participants in this study were randomly recruited via personal communication, WhatsApp, and email invitations representing a wide variety of elite and non-elite Indonesian athletes. The chronological ages of the participants ranged between 22 and 33 years old.

2.2. Instruments

The instrument used was the Psychological Skills Inventory for Sports (PSIS-R5) compiled by [35]. It is a

questionnaire with 45 items distributed in six psychological aspects aiming to measure psychometric characteristics. Data were collected by means of a questionnaire adopting a 5-point Likert scale. Therefore, the subjects just simply provided a response by choosing one of the five alternative answers. The specification of the PSIS-R5 instrument is presented in Table 2.

Table 2. Distribution of factors and items number per factor of the PSIS inventory

Factor	Number of items	Item Number
Motivation	8	1, 2, 3, 4, 5, 6, 7, 8
Self-confidence	8	9, 10, 11, 12, 13, 14, 15, 16
Anxiety Control	8	17, 18, 19, 20, 21, 22, 23, 24
Mental preparation	7	25, 26, 27, 28, 29, 30, 31
Team Emphasis	7	32, 33, 34, 35, 36, 37, 38
Concentration	7	39, 40, 41, 42, 43, 44, 45

Before completion of the questionnaire informed consent and ethical procedures conforming to standards set by the British Psychological Society were adhered to throughout the research process. The participants were requested to complete the inventory in their respective spare times. Average completion time was less than 20 minutes. For just the record, no participants denied to complete the questionnaire administered.

2.3. Descriptive Statistics

Table 3 below shows the descriptive statistics including the mean, standard deviation, minimum score, and maximum score for the six psychological aspects measured through the PSIS-R5 instrument. The table shows the motivation aspect has the highest average score (35.956), while concentration has the lowest one (25.220).

Table 3. Descriptive statistics profile of Research data

Aspect	Minimum	Maximum	Average	Standard Deviation
Motivation	26	40	35.956	2.684
Confidence	22	40	31.725	3.541
Anxiety Control	10	40	28.227	5.037
Mental preparation	14	35	26.108	4.098
Team Emphasis	18	34	25.414	2.803
Concentration	13	35	25.220	4.215

2.4. Exploratory Factor Analysis

The exploratory factor analysis was conducted empirically to obtain the PSIS-R5 factor structure. Initially,

the data were examined by the KMO-MSA [34] and [36] and Bartlett's tests [36] to check a significant relationship [37] and results are presented in Table 4. The Kaiser Meyer Olkin Measure of Sampling Adequacy (KMO-MSA) is an adequacy measure of sampling that evaluates how strongly an item correlates with others in the EFA correlation matrix [38]. The value of KMO is close to 1. However, the value is considered sufficient when it is above 0.5 [39]. The value of KMO-MSA obtained in this research was 0.829. According to Hair et al. [39], this value is classified as a meritorious or good category.

Table 4. KMO and Bartlett's Test Analysis Results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.829
Bartlett's Test of Sphericity	Approx. Chi-Square	7.001E3
	Df	990
	Sig.	.000

Meanwhile, the Bartlett Test provided a chi-square output aimed at determining whether there is a relationship between variables in the multivariate cases. However, the significant results ($p < 0.05$) in this test indicate the data is not an identity matrix. And this makes it suitable for exploratory factor analysis [40]. Moreover, the results of the analysis showed the significance of Bartlett's Test of Sphericity to be 0,000 and since this value was less than the required 0.05, factor analysis was conducted.

In the exploratory factor analysis, a factor extraction was conducted using the Principal Component Analysis method (PCA) with Varimax as a factor rotation method in which several outputs were highlighted. First, the Anti-Image Matrices output contained the measure of sampling adequacy (MSA) for each variable whose criteria are the same as those of the KMO which are greater than 0.5 as shown in Table 5 [40].

2.5. Statistical Analysis

After data collection through the PSIS-R5 instrument, they were then analysed both qualitatively (by expert judgements decision) to view the consistency/validity of the items and quantitatively as well. Descriptive statistics (means \pm SD) were initially calculated and subsequently identified the extent of psychometric characteristics of the instruments studied through the use of the SPSS program (26th edition). These involved the construct validity through the Exploratory Factor Analysis and the internal consistency reliability estimation through Cronbach's Alpha formula to check the reliability of each psychological aspect.

3. Result of Research

To begin with, we portray the summary of loading factors analysis of PSIS-R5 data. The following data would help us to clearly comprehend the state of results we found.

Table 5. Summary of Exploratory Factor Analysis of PSIS-R5 Instruments

	No.	Statement Item	After Exploratory Factor Analysis					Anti-Image	Communalities	
			F1	F2	F3	F4	F5			
Before Exploratory Factor Analysis	M	1	I am very motivated to do well in my sport		.431				.836	.335
		2	I sometimes lack the motivation to train		.483				.890	.468
		3	Winning is very important to me		.513				.842	.50
		4	Right now, the most important thing in my life is to do well in my sport		.426				.718	.473
		5	My sport is my whole life		.349				.749	.402
		6	I want to train hard to belong to the top in my sport		.509				.830	.504
		7	In my sport, I want to bring out the best in myself		.433				.843	.438
		8	I want to succeed in my sport	.435					.910	.291

Table 5 continued

	PD	9	I am the most competitive, I am confident I will do well	.471					.829	.431
		10	It doesn't take much to shake my self-confidence	.447					.710	.945
		11	A minor injury or practice can really shake my self-confidence	.386					.879	.408
		12	I have frequent doubts about my athletic abilities	.507					.901	.442
		13	When I begin to perform poorly, my confidence drops very quickly	.499					.843	.309
		14	I can always be confident about events of one of my poorer performances	.605					.903	.397
		15	My self-confidence jumps all over the place	.720					.915	.578
		16	I have faith in myself		.328				.747	.220
	KK	17	I am tenser before I perform than I am during the performance	.635					.926	.504
		18	I am often panicking before I start my performance	.441					.863	.261
		19	I spent a lot of time trying to stay calm before a meet	.602					.769	.798
		20	I get nervous because I want to start performing	.636					.916	.544
		21	I am anxious to perform in a strange place	.627					.904	.563
		22	Before the meet, I worry if I will do well	.609					.894	.530
		23	Before important meets, I feel intense anxiety	.578					.915	.467
		24	The period right before a performance feels unpleasant	.440					.750	.925
	PM	25	I often dream about competitions			.361			.710	.329
		26	I often "rehearse" my performance in my head before I perform		.464				.819	.473
		27	When I mentally practice my performance, I "see" myself performing-just like		.495				.818	.572
		28	I was watching a videotape			.561			.814	.648
		29	When I'm preparing to perform, I try to imagine what it will feel like in my muscles			.577			.752	.697
		30	When I close my eyes, I can imagine what my muscle feels like			.478			.816	.419
		31	I prepare for a meet by making representations of my performance					.335	.724	.402

Table 5 continued

	PT	32	I get very frustrated when a team-mate is a performance poorly		.276				.741	.226
		33	I concentrate on my own performance for the team	.343					.728	.449
		34	I think team spirit is very important					.286	.646	.212
		35	When my team loses, I feel bad-no matter how well I am as an individual				.387		.607	.526
		36	I think the performance of the team is more important than my individual performance			.467			.693	.532
		37	If my teammates are not exerting themselves to the utmost, I get angry	.451					.862	.890
		38	If I decline the performance level of the team, I have to be replaced		.97				.542	.082
		39	I often have trouble concentrating during my performance	.539					.860	.488
	K	40	I experience frequent "hot streaks" in which my performance is unusually good	.629					.873	.579
		41	When I am performing poorly, I tend to lose my concentration	.492					.809	.604
		42	During my performance, I was invited by comments of people surrounding me	.516					.920	.465
		43	At the beginning of my performance, I had trouble forgetting things I was doing before				.455		.802	.517
		44	During my performance, others distract me	.646					.897	.661
		45	I can concentrate is more difficult to meet than on an easy one	.592					.767	.765
		Eigen Value				8,439	4,559	3,008	2,676	2,051
Variance explained				5,753	4,239	3,712	3,351	3,342		
Variance in%				12,784	9,419	8,248	7,447	7,427		
Cumulative variance in%				12,784	22,203	30,451	37,898	45,325		
<i>M: Motivation. PD: Confident. KK: Anxiety Control. PM: Mental Preparation. PT: Team Emphasis. K: Concentration. F1: Self-management. F2: Motivation. F3: Psychic readiness. F4: Failure/defeat thought. F5: Team Management.</i>										

Constructions after the Exploratory Factor Analysis

Second, the item commonalities were observed to be mathematically equal to the multiples of the squared correlation of the item on general factors. But simply, it showed the percentage variance of the manifest variable explained by the general factors [41]. However, a value of 0.8 or greater has been reported to be in the high category. Although this rarely happens with real data. Generally, it is mostly between 0.40-0.70 but 0.3 is also considered good. Table 5 shows there are only six (6) items including 8, 16, 18, 32, 34 and 38 that do not meet the criteria (<0.30).

Third, the extraction of factors is reflected in the Total Variance Explained which contained the number of significant factors in the measurement. Although three parts including Initial Eigenvalues, Extraction Sums of Squared Loadings, and Rotation Sums of Squared Loadings were involved, the Rotation Sums of Squared Loadings were the most useful because it describes the rotated Eigenvalues and variances [42]. Therefore Table 5 shows the PSIS-R5 instrument is composed of five (5) factors with a contribution of 45.325%.

Finally, the factor rotation was conducted to determine how the pattern of factors was initially extracted and converted into a simpler structure. It was necessary because it has the ability to simplify the factor structure of the item groups or in other words, maximize the loading of items into factors through the use of a factor loading score. Based on these criteria, Table 5 shows there are a lot of items moving in the aspects after the factor rotation.

Estimated Reliability of Cronbach's Alpha and Stratified Alpha

Table 6 shows the reliability of Cronbach's alpha for each psychological aspect in the PSIS-R5 instrument. The highest value was found with self-management (.902) while the lowest (.081) was with team management. However, the stratified alpha reliability coefficient was calculated using formula (1), and a value of 0.898 was obtained.

Table 6. Cronbach's Alpha Coefficient for Each Psychological Aspect of the PSIS-R5 Instrument

Aspect	Alpha reliability
Self-management	.902
Motivation	.745
Psychological readiness	.757
Thinking of failure/defeat	.284
Team Management	.081

4. Discussion

Psychological skills or mental training as a series of techniques and strategies (mostly non-physical) used to

optimize athletic performance [43], [44]. In a study by Sindik et al. [13], it is mentioned that Mahoney et al. [35] observed successful athletes to have higher self-confidence than the less successful ones. Control attributes such as passion, confidence, concentration, and mental preparation were also found to have close links with successful athletes and teams. The results showed motivation has the highest average score (35,956) while concentration has the lowest (25,220). This superiority shown by the motivational aspect is because of its influence in developing skills in exercise in addition to the genetic factors and training [18]. It also helps in setting goals as well as in providing and directing energy to achieve the goals [45].

However, the concentration aspect has the lowest average score (25,220) because of the difficulties attached to it. It has been reported that the failure to develop or use concentration skills is one of the factors causing the defeat of many athletes [4], [46]. For example, a gymnast may lose calm and concentration leading to a very bad presentation due to the performance of a competitor. Similarly, during a volleyball match, the visitors may lose concentration seeing the home team set foot on the pitch amidst continuous cheers from their fans. These examples illustrate the potential for interference in a competitive environment with the ability to disrupt concentration. Based on these criteria, the findings of this study indicate only three (3) psychological aspects in the PSIS-R5 instrument with good Alpha Cronbach reliability coefficient; that is self-management, motivation, and psychological readiness. However, it has been found that the values obtained for thought and team management were very low (.081) which makes them unreliable. In multidimensional cases like the measurement of psychological aspects using the PSIS-R5 instrument, composite reliability is required to check the overall reliability of the instrument. However, the only one applied in this study is the Alpha Structured reliability coefficient. The value obtained for Alpha Structured reliability was 0.898 which is classified as in a good category.

Based on the explanation above, the findings were discovered to be different from the initial constructs of Mahoney's PSIS-R5 instrument (1989) which were made of six psychological factors of motivation, confidence, anxiety control, mental preparation, team emphasis, and concentration. Therefore, the findings reinforce previous results indicating psychometric problems in the PSIS-R5 instrument. These problems make it difficult for researchers to ascertain what aspects are actually measured by the instrument. These authors suggested that more psychometric research is needed before the application of the instrument for research or applied purposes. Additionally, the researcher must conduct further item analysis to determine whether the specific items only contribute to the scale measured.

Despite the various research limitations obtained, the PSIS-R5 instrument based on this research can be used by sports psychology researchers, researchers, as well as an

instrument for collecting data on the psychological conditions of athletes and non-athletes. -athletes.

5. Conclusions

The PSIS-R5 instrument measures six psychological aspects, and they include motivation, self-confidence, anxiety control, mental preparation, team emphasis, and concentration. The factor of self-management was found to have the most items because it is a combination of self-confidence, self-control, and concentration. Furthermore, the variance contribution of these factors was discovered with the remaining measuring others. Moreover, the reliability of the overall psychological aspects measured using the PSIS-R5 instrument was found to be in a good category. However, only the aspects of self-management, motivation, and psychological readiness were observed and deemed to be reliable with their coefficients included in the good category among all the aspects studied while failure/defeat thought and team management have a very small coefficient of reliability and this makes them unreliable.

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