ORIGINAL ARTICLE

Development, validation, and reliability of athletes' resilience index

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim: The ability to turn back from stressful experiences quickly and efficiently is essential for any athlete who performs in high-level competition. Measuring the degree to which athletes deal with adversity, setbacks, and failure has become the area of concern in the field of resilience. The main aim of the study was to develop, validate and test the reliability of a new index of measurement that can evaluate the level of athletes' resilience.

Material and Methods: The first phase of the study is developing 37 items of the Athletes Resilience Index (ARI-37) based on previous qualitative data. Meanwhile, in the second phase, the study focused on establishing the Confirmatory Factor Analysis, convergent validity, and construct reliability of the index. The sample consisted of 351 Performance Development athletes who represent the state of Perak, Malaysia in the Malaysian Games (SUKMA) 2022.

Results: Confirmatory Factor Analysis retained five risk issues in sports setting including performance, change, behavioral, psychological, and interpersonal. However, instead of 37 items, the Confirmatory Factor Analysis confirmed 26 items only. Most of the factors in ARI-26 yielded a high coefficient value of convergent validity (>0.5). Construct reliability of the index was also sufficient (0.44 to 0.62).

Conclusions: The development of ARI-26 will allow researchers to better capture the unique aspects of resilience in the sports context. Thus, the Athletes' Resilience Index (ARI-26) is revealed to be a reliable instrument for the assessment of resilience levels in high-level athletes.

Keywords: resilience, athletes' resilience index, performance development, sports adversity, confirmatory factor analysis

Introduction

Resilience means turning back from stressful experiences quickly and efficiently [1] and achieving a balanced performance status [2]. It is the ability of an individual to lead a life towards more sustainable well-being [3]. Resilience is the role of psychology in promoting personal assets that can protect individuals from distress factors [4]. Studies on resilience want to understand why some individuals are able to survive in stressful situations, and even bounce back and become better than before [5]. Although there are different definitions and concepts related to resilience, in general, resilience is a person's ability to cope and deal with adversity effectively and positively, thus improving the person's well-being [6]. This explains why the concept of resilience is more geared towards the success of individuals adapting and rebounding in difficult situations [7].

The concept of resilience is very important for individuals in various fields, including sports. Studies show that various sources of stress are experienced by athletes in competitions, while psychological characteristics help athletes adapt to the difficulties experienced during the involvement [8, 9]. Moreover, the environmental factors can cause athletes to face significant stress processes such as effort, struggle, sacrifice, overcoming challenges, rivalry, evaluation, risk of injury, assimilation of defeat, and facing and overcoming numerous adverse and stressful situations [10]. In addition, studies show injury factors, relationship factors, organisational demand, and mental health problems are a source of stress for athletes [11-14]. For this reason, resilience has been identified as a relevant variable in the context of sports and training, arousing a growing interest as an object of research over the last decades [5, 10, 15]. Thus, emphasis should be given to the extent to which athletes respond to difficulties encountered in maintaining performance. This is because only athletes who are able to recover from the impact of stress are considered resilient [16].

Over the past decades, the resilience paradigm has evolved from a stable, trait-oriented approach to an outcome-oriented approach [17]. In sports, due to the nature of athletes, they are expected to achieve long-lasting victories. Therefore, resilience is a critical attribute for them. Because of this, organizational stress continues to generate interest and research attention in sports psychology. This is largely because research evidence continues to highlight that the organizational environment is a breeding ground of stressors for athletes. For example, studies on the effects of organizational stress on well-being in competitive sports found positive relationships between both goals and

doi:10.15561/26649837.2022.0307

development stressors (duration and intensity) and team and culture stressors (frequency and intensity) on negative affect [18]. Meanwhile, the study found that athletes generally respond to organizational stressors with a wide range of emotions, attitudes, and behaviors such as anger, anxiety, disappointment, distress, happiness, hope, relief, reproach, and resentment [19].

Concerning the effect of organizational stress on athletes' performance, transactional theories of stress have been considered to conceptualize stress in sport [20, 21]. Stress transactions appear to include stressors, appraisals, coping, and emotions, and they do, in fact, determine the level of adaptation and resilience. In sports situations, athletes who perform at a high competition level need to perform ideally under many stressors with their own appraisal. This is mentioned in the Integrative Model of Athletic Performance (IMAP), which highlights the three interactive phases that athletes can attain and then maintain optimal performance states [22]. Based on IMAP, individual dispositional characteristics become the most important protective factor for individuals as they respond to external demands and environmental stimuli during their preparation phase. Those potential stressors, such as personal and professional relationships, demand and organizational realities, physical and psychological needs in training and competition, financial stress, injuries and physical barriers, experience outside of sports, and life changes and transitions, become challenges for the athlete to pursue their next performance phase where they need to blend interactively in terms of affective, physiological, and behavioral processes to produce the outcome. The outcome of resilience should have resembled what it was during the post-performance phase in which athletes were either involved in sustaining involvement, re-engaging after a brief dysfunctional period, or disengaging from the activity [22]. In the long run, IMAP suggests the importance of ideal performance for the athlete is to have good protective factors in order to achieve equilibrium and adaptation.

Exposure to one or more of these stressor events does not always dictate the occurrence of negative outcomes [23]. No matter how many stressors they face, they still manage to maintain good coping behavior and adapt successfully in the face of adversity, thereby maintaining or regaining normal levels of functioning. Based on Clinical Sport Psychology, Performance Development (PD) functioning athletes are classified as those who tend to improve sports performance and are not affected by any psychological well-being issues, whereby no factors such as development, transition, behavior, interpersonal, or intrapersonal can affect their performance or require the attention of sports psychologists [22]. This classification is based on the model of the Multilevel Classification System for Sport Psychology (MCS-SP), which provides interview administration guidelines to obtain athlete performance function information. Case formulation resulting from these interviews can provide information related to risk factors and protective factors that can determine the overall athlete resilience index. There are eight elements of case formulation based on the MCS-SP model to understand athletes' risk factors and protective factors underlying performance issues, such as contextual performance needs, athlete performance level, relevant situation needs, athlete psychological characteristics, behavioral response, self-regulatory profile, willingness to change, and reactance level [24].

In Malaysia, Malaysian Game or SUKMA is a national event organized by the National Sports Council of Malaysia and State Sports Councils as well as the Malaysian Schools Sports Council (MSSM), Malaysian University Sports Council (MASUM), and the Malaysian Royal Police Sports Council. It is a 'multi-sports competition' with the concept of 'Mini Olympic Games' in Malaysia which involves young athletes. Since SUKMA is held bi-annually and alternates with the SEA Games, the focus on the development and athletes' preparation is very much emphasized. Athletes who participate in SUKMA are usually high-performing athletes and have bright hopes of producing success for their respective states. Accordingly, athletes have to undergo a rigorous training program that has been arranged by the State Sports Councils. However, the level of athlete satisfaction and the extent of athlete resilience to adversity and all forms of expectation and pressure on competition are still unclear as no empirical data has been found on this matter. Therefore, it is important for sports organizations to ensure that athletes who are preparing for high-level competitions are not only classified as Performance Development (PD) but also resilience.

Examining the interplay between stressors and protective factors is essential since it focuses on the process of adaptation in which resilience occurs. Thus, before developing sport-specific measures of resilience, the pivotal resilience-related areas of stressors and protective factors should be taken into consideration [5]. Based on our previous qualitative study, we had already explored the aspects of resilience among Performance Development (PD) athletes using semi-structured interviews based on the Multilevel Classification System for Sport Psychology (MCS-SP) [24]. The results of the study found five themes related to risk factors faced by PD athletes in maintaining developing performance, such as performance, change, behavior, psychology, and interpersonal issues. Therefore, in this study, we discuss the process of developing, validity, and reliability of the Athletes Resilience Index as

sport-specific measures of resilience among PD athletes. The objective of developing the index is to determine the extent to which athletes' performance is affected due to the presence of risk factors, with the belief that resilience occurs when athletes are buffered from the risk factors throughout their involvement in sport. It was hypothesized that the Athletes' Resilience Index would provide a reliable and valid measure of resilience index for athletes. It was further hypothesized that the index would also reveal a five-factor model, reflecting performance, change, behavior, psychology, and interpersonal issues as risk factors for PD athletes.

Material and methods

Participants

A pilot study was carried out to test the validity and reliability of Athletes Resilience Index (ARI-37). There were 351 athletes under the Performance Development (PD) category who represent the state of Perak in Malaysian Games (SUKMA) 2022 involved in this study. Among the participants, there were male (n=185, 58.7%) and female (n=130, 41.3%) athletes. The participants also represented individual sports (n=171, 54.3%) and team sports (n=144, 45.7%). Participants >200 are considered a large sample size for the factor analysis procedure [28].

Adherence to Ethical Standard

All procedure performed in this study were in accordance with ethical standard of the institutional Research Ethics Committee. Informed consent was obtained from all participants involved in this study.

Research Design

Phase 1: Item Development

Based on previous study, the Athlete Resilience Index (ARI) was developed into 37-items of self-assessment (ARI-37) to quantify an athlete's resilience index [24]. The term index is used as it reflected the characteristics of index variables [25]. First, an index is derived from multiple items that have been combined and converted into a single measurement or scale. Secondly, the individual items that form the basis of the index, measure something that is underlying, quantitative, and on a measurement continuum. Thirdly, an index variable constitutes a scale measurement that is indicative of some hypothetical construct, therefore the higher index values might indicate 'more off' and lower values 'less off', with neither being 'right' or 'wrong'.

In developing the ARI-37, five main issues were identified during the qualitative study [24]. Item analysis was performed on the responses obtained in the focus group discussion. A total of 37 items were found related to the athletes' agreement that several issues were identified as risk factors in their preparation for competition. Thus, the ARI-37 is considered as a comprehensive instrument composed of five sub-scales, which reflect five major issues or risk factors for the athletes. All the items were rated on a 5-point Likert scale as follows: 1 (strongly disagree), 2 (somewhat disagree), 3 (neither disagree nor agree), 4 (somewhat agree), and 5 (strongly agree). The sub-scales consisted of performance issues (6 items), change issues (11 items), behavioral issues (9 items), psychological issues (8 items), and interpersonal issues (4 items). The high score on the index meant high resilience.

The initial pool of items has been submitted to expert review for face and content validity. Two linguists and three psychologists were appointed for the review process. The results of the coefficient value for face validity found that all experts agreed that the language used in the instrument is simple (0.88), the language used is easy to understand (0.84), the terms used are correct (0.84), the grammar used is correct (0.80), the content of the questionnaire is well understood (0.88), and the entire questionnaire is suitable for use in the context of testing (0.92). Meanwhile, in terms of the coefficient value for content validity, all experts agree that the content of the instrument meets the target population (0.90), the instrument implementation situation is appropriate (100.0), the time allocated to answer is sufficient (0.85), the instrument successfully measures the content it should measure (0.75), and the instrument can help individuals assess their behavior (0.85). A validity coefficient value of 0.70 is considered high, indicating that all aspects of the face and content validity are acceptable [26, 27].

Phase 2: Establishing Psychometric Analysis of Athlete Resilience Scale (ARI-37)

Procedure

This study was conducted during the Covid-19 pandemic phase in July 2021. Therefore ARI-37 was transferred in google form to facilitate the distribution process to the participants. Prior to that, a briefing session by google meet was held between researchers and participants to explain the method of answering the questionnaire. Participants were given two weeks to submit the form to the researcher.

Statistical Analysis

Psychometric characteristics of the original ARI-37 were analyzed using Structural Equation Modeling (SEM) and Moment Structure (AMOS) software (SPSS Version 26). Confirmatory Factor Analysis (CFA) was used as it is a multivariate statistical procedure to test how well the measured variables represent the number of constructs in the ARI-37. Through the CFA method, researchers will be able to test for model fit, convergent validity, and also construct reliability. Assessment of model fit is based on fit indices which suggests three to four fit indices to establish model fit [29]. The recommended fit indices include Relative Chi

Square (χ2), Goodness-of-fit statistic (GFI), adjusted goodness-of-fit statistic (AGFI), Comparative fit index (CFI), Normed-fit index (NFI), Tucker-Lewis Index (TLI), and Root mean square error of approximation (RMSEA). The criteria for fit indices are shown in Table 1. In terms of the factor loading, all standardized factor loadings must be more than 0.5 [29, 30], positive, and not more than 1.0 (as > 1.0 is considered an offending estimate). Deleting indicators should be done for those who do not meet the above requirements. Using AMOS, the identification of a potential indicator to be deleted can be obtained from Modification Indices (MI).

Table 1. The criteria for Fit Indices

Fit Indices	Recommended Value
CMIN (χ^2)	Report if n between 100 200 [31]
CMIN/DF (Relative χ^2)	< 5.0 [32] < 5.0 [33] Report if n > 200 [33]
GFI	> .90 [34] > .90 [35]
CFI	> .90 [33] > .90 [36]
NFI	> .90 [37]
RMSEA	< .08 [30] < .05 [38]
SRMR	< .08 [29] < .05 [30]

Note: GFI - goodness-of-fit statistic; AGFI - adjusted goodness-of-fit statistic; CFI - comparative fit index; NFI - normed-fit index; TLI - Tucker-Lewis Index; RMSEA - root mean square error of approximation.

The method of CFA will also test the convergent validity of the instrument. Convergent validity refers to a set of indicators that are presumed to measure a construct [28]. Convergent validity is the internal consistency of a set of items or indicators [38]. It represents the strength of relationships between items that are predicted to represent a single latent construct. Therefore, to confirm that the instrument highly meets the criteria of convergent validity, the items must be strongly related to each other and represent only one factor. Convergent validity can be tested using factor loading or Average Variance Extracted (AVE). High factor loadings (0.5) on a factor indicate high convergent validity [29, 30], whereas the average variance extracted (AVE) for each construct should be at least 0.50 (> 0.5), indicating high convergent validity [39]. Construct Reliability (CR) is another criterion to be tested in CFA. It is a measure of internal consistency in scale items, much like Cronbach's alpha [40]. An instrument with CR > .70 is considered reliable [29].

Results

A screening procedure of the data has been done in order to make sure that the data meet the appropriate assumption for factor analysis. A sample of 351 is acceptable as a minimum of five subjects per variable is required for factor analysis. The absolute values of skewness and kurtosis did not indicate a violation of the normality assumption. In terms of factorability of the correlation matrix, the result of Barlet field test value χ2: 8221.555 was found as significant with a value of p<.05. In addition, it was observed that the common factor variance (Communalities) of examined items ranged between 0.475 – 0.715, meanwhile, the Kiser-Meyer-Olkin value that measure of sampling adequacy is far greater than 0.6. From this result, it is confirmed that the data is suitable for factor analysis.

Confirmatory Factor Analysis for Performance Issues

The construct of performance issues consists of five indicators. Based on observation, all the factor loading values are positive and meet the criteria of > 0.5. However, as it can be seen from Figure 1, the results of initial confirmatory factor analysis (CFA) yielded rather unacceptable model fit [$\chi2$ (5) = 28.376, p < 0.05, CFI = 0.942, RMSEA = 0.122]. Therefore, based on modification indices, the highest MI of item b3 should be deleted. After deleting b3, the model should fit well. Instead of five items, the construct of performance issues only has four items to be used, and those are b1, b3, b4, and b5.

Confirmatory Factor Analysis for Change Issues

The initial construct of change issues consists of 11 indicators. Based on observation on Fit Indices, all the criterion were not achieved [$\chi2$ (44) = 316.929, p < 0.05, CFI = 0.840, RMSEA = 0.141]. However, all factors loading values are positive and more than 0.5. Modification Indices (MI) suggested a few possibilities of the item to be deleted that is b7, b11, and b15. After deleting the items, the model fits the indices well. Instead of 11 items, the construct of change issues has eight items to be used (b6, b8. B9. B10, b12, b13, b14, and b16). The model tested shown in Figure 2.

Confirmatory Factor Analysis for Behavioural Issues

The construct of behavioral issues consists of nine initial indicators. Based on the test for Model Fit in Figure 3, the Fit Indices are not acceptable [$\chi2$ (27) = 536.364, p < 0.05, CFI = 0.704, RMSEA = 0.245]. Several factor loading values are also less than 0.5. Thus, the first action was taken to delete unfit factor loading for items b17, b18, b19, b20, and b21 as being suggested by Modification Indices. This has resulted in an appropriate loading factor (> 0.50). Instead of nine items, the construct of behavioral issues has four items to be used that is b22, b23, b24, and b25.

Confirmatory Factor Analysis for Psychological

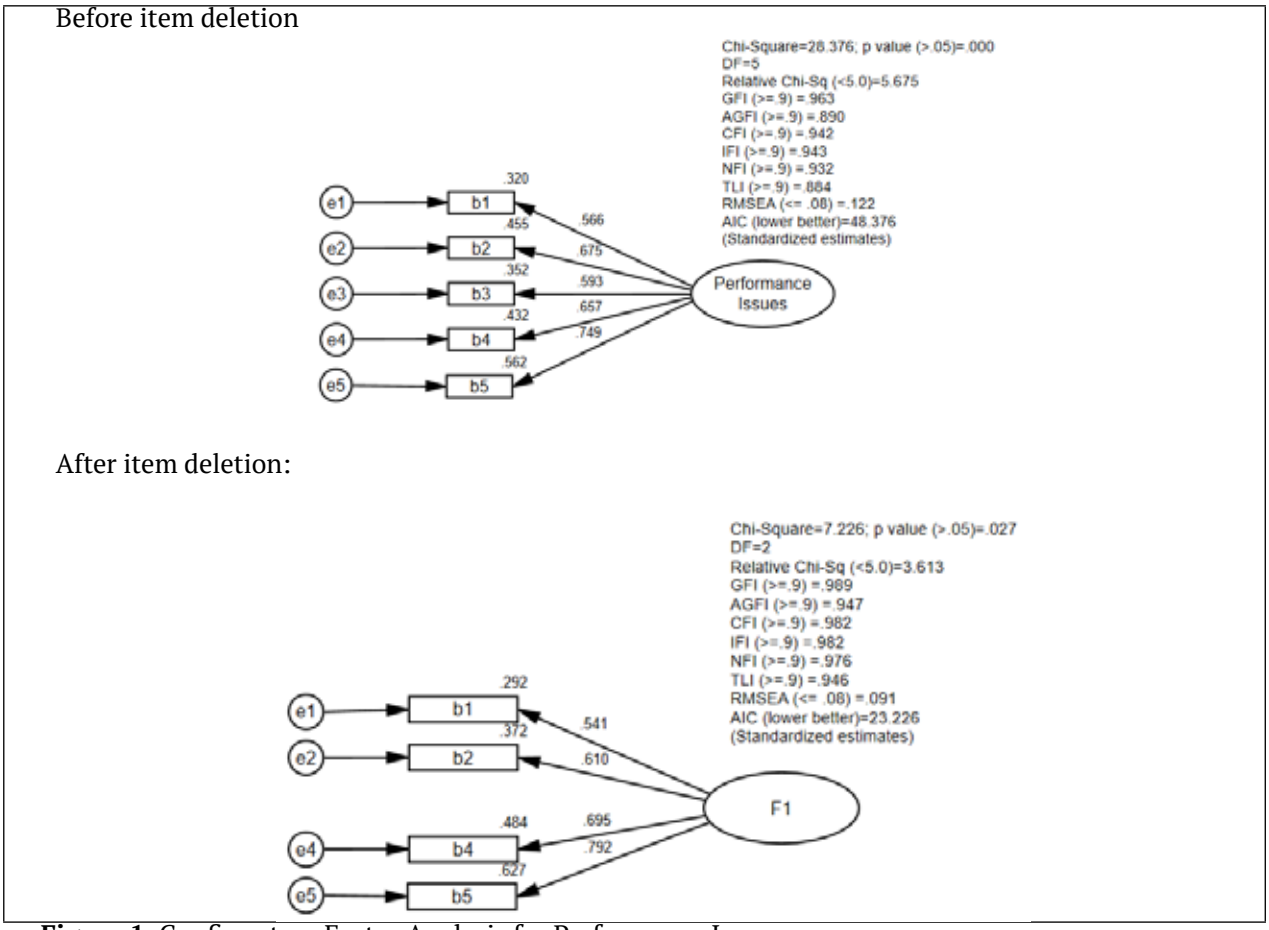

Figure 1. Confirmatory Factor Analysis for Performance Issues

Issues

Initially, the construct of psychological issues consists of eight indicators. Based on the test for Model Fit in Figure 4, all factor loading has met the criterion of > 0.5. However, the results of initial confirmatory factor analysis (CFA) yielded rather unacceptable model fit [$\chi 2$ (20) = 76.588, $p < 0.05$, CFI = 0.955, RMSEA = 0.095]. Thus, Modification Indices suggested items b29 and b32 be deleted. The construct of psychological issues has now consisted of b26, b28, b29, b31, b32, b33.

Confirmatory Factor Analysis for Interpersonal Issues

The construct of interpersonal issues consists of four initial indicators. Based on the test for Model Fit, all factor loading has met the criterion of > 0.5 as shown in Figure 5. The results of initial confirmatory factor analysis (CFA) yielded rather acceptable model fit [$\chi 2$ (20) = 11.475, $p < 0.05$, CFI = 0.985, RMSEA = 0.123]. Therefore, the number of interpersonal issue items remained the same as before.

Convergent Validity and Construct Reliability of the Instrument

In this study, the factorial validity and construct reliability of the instrument were analyzed. As shown in Table 2, all factors have yielded a high coefficient value of convergent validity (> 0.5). However, only one factor considered adequate validity weight that is performance issues. In terms of construct reliability, internal consistency reliability with Cronbach's alpha has been used to analyze the construct reliability of each factor. Results showed that all five factors exhibited a satisfactory level.

Discussion

Researchers who wish to study sports resilience in the future should think carefully about how they operationalize the construct [16]. Therefore, this study shows that athletes' resilience can be defined operationally by the degree of athletes agreed on the extent of how far the risk issue may affect their performance. The less the index indicates the higher level of resilience while the more the index indicates the lower resilience. Resilience is unique because it explains the state of adversity and positive adaptation.

The purpose of a recent study was to develop and test the validity and reliability of the Athletes' Resilience Index (ARI). Therefore, the respondent was selected among Performance Development (PD) athletes who were classified as those who tend to improve sports performance and are not affected by any psychological well-being issues, whereby no factors such as development, transition, behavior, interpersonal, or intrapersonal can affect

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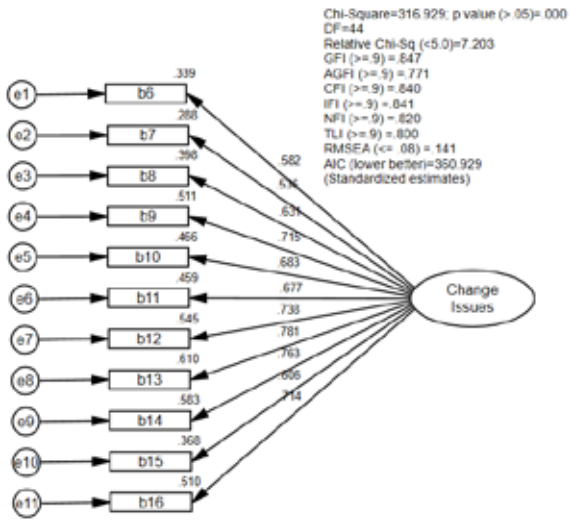

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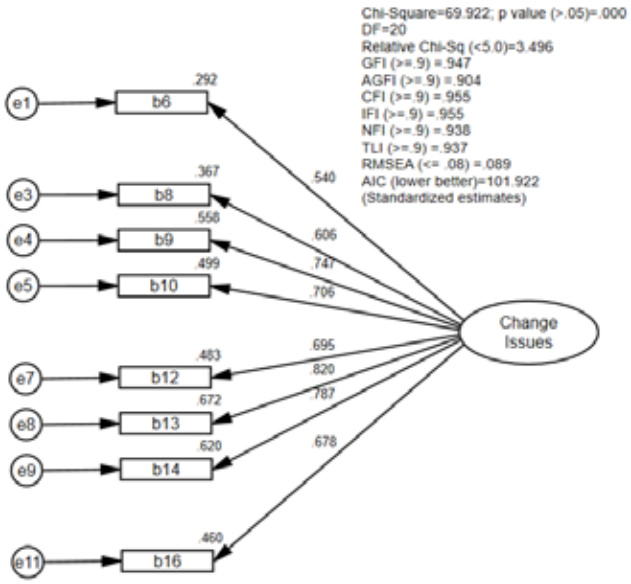

Figure 2. Confirmatory Factor Analysis for Change Issues

Table 2. Average variance Extracted and Construct Reliability of Instrument

Construct	No of Items	AVE	CR
Performance Issues	4	0.440	0.753
Change Issues	8	0.500	0.884
Behavioral Issues	4	0.720	0.897
Psychological Issues	6	0.515	0.863
Interpersonal Issues	4	0.629	0.871

Note: AVE - Average Variance Extracted; CR - Construct Reliability.

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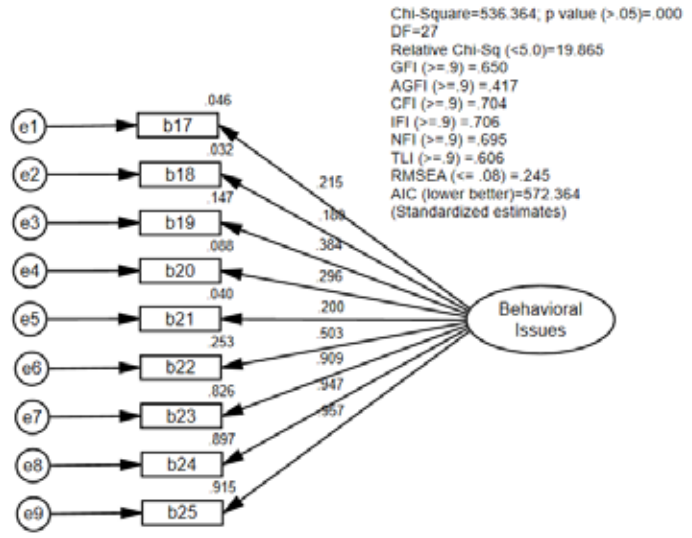

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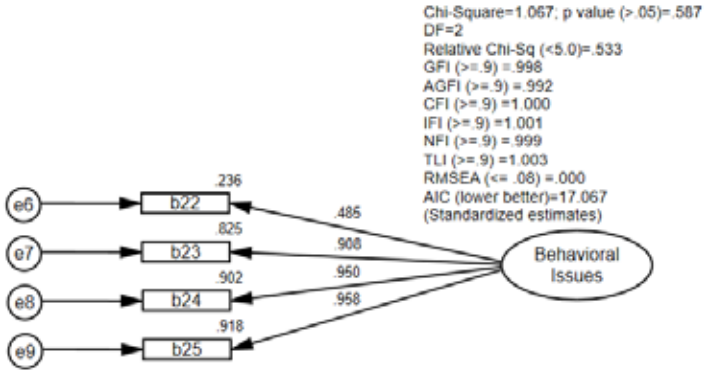

Figure 3. Confirmatory Factor Analysis for Behavioral Issues

their performance or require the attention of sports psychologists [22]. Few studies also use the same respondent with the same criteria but different terminologies such as athletes who won an Olympic gold medal [41], and current and former high-level athletes recommended by others as being resilient athletes [42].

The risk issues covered were achieved through interviews as the primary method of data collection during the previous study [24]. Confirmatory Factor Analysis (CFA) was performed on the original ARI-37 to obtain the result of model fit, convergent validity, and construct reliability. Based on CFA, the results revealed the existence of a new resilience index (ARI-26) which composed of 26 items under five constructs of risk issues, namely performance issues, change issues, behavioral issues, psychological issues, and interpersonal issues. The first construct of performance issues had a special focus on the athlete's view that some risk factors related to their performance may affect them. The distinguishing issue was due to unstable physical performance during training, a mistake while doing warm-up in training, the coach's approach during training, and the static performance shown throughout the training. The second related risk construct that may affect athletes' performance, is the change issue. Change issue composed of athletes' views that their performance may be affected due to changes in body composition, training schedule, training venue, training equipment, organizational management, sports facilities, accommodation facilities at the training venue, the pattern of relationships with family, and socialization. The third construct covers factors related to behavioral issues such as disciplinary problems throughout training, consume illegal substances and alcohol, and smoking habits. The fourth construct is psychological issues which cover the difficulty of overcoming nervousness, impatience to finish training sessions and tournaments, the difficulty of overcoming the feeling of laziness in training, difficulty in coping

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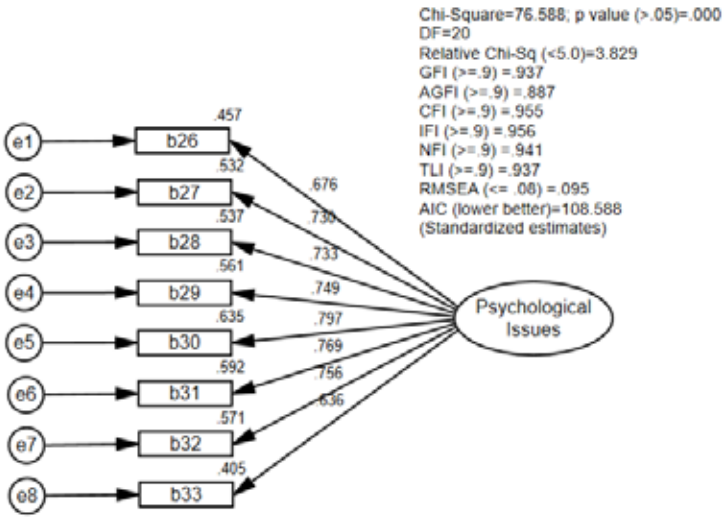

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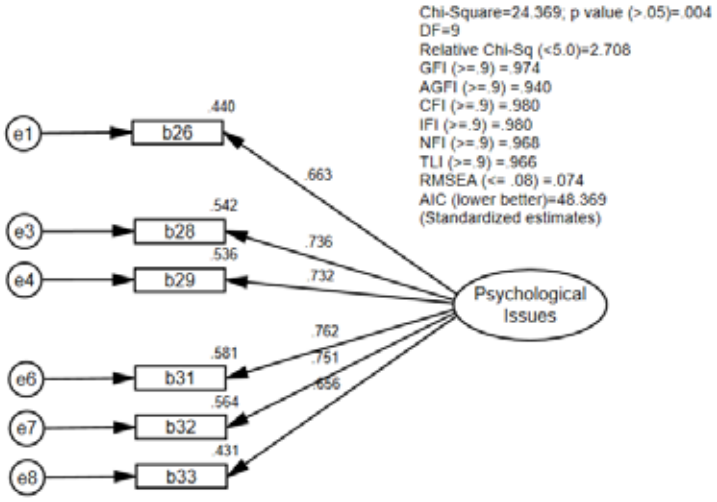

Figure 4. Confirmatory Factor Analysis for Psychological Issues

with stress, difficulty overcoming drowsiness, and difficulty coping with pain from injury. While the fifth construct is related to interpersonal issues such as conflict with the coach, conflicts with teammates, conflict with management, and conflict with family. These constructs resemble the idea that athletes who participate in sport at a high level will likely experience a number of stressors, adversities, and failures [43, 44, 45].

Several studies were also keen to work with interview techniques to understand resilience in a sport setting by analyzing the views of risk issues from athletes' perspectives. Thus, the present study gets support and offers some add-on findings related to risk issues other than general stress of training and competition [4], self-identified of most difficult adversity as an athlete [42], injury factor [11, 46], worse-than-expected performance [48, 49], effort, struggle, sacrifice, overcoming challenges, rivalry, evaluation, risk of injury, assimilation of defeat, and facing and overcoming numerous adverse and stressful situations [10], relationship factors [12], organizational demand [13], and mental health problems [14].

Conclusions

In conclusion, the development of such sport-specific measures will allow researchers to better capture the unique aspects of resilience in the sports context. The emergence of ARI-26 had provided the evidence-based measurement to measure resilience among PD athletes. The five-factor model, including performance, change, behavior, psychology, and interpersonal issues as risk factors had also been confirmed by the model fit. Thus, the Athletes' Resilience Index (ARI-26) is revealed to be a reliable

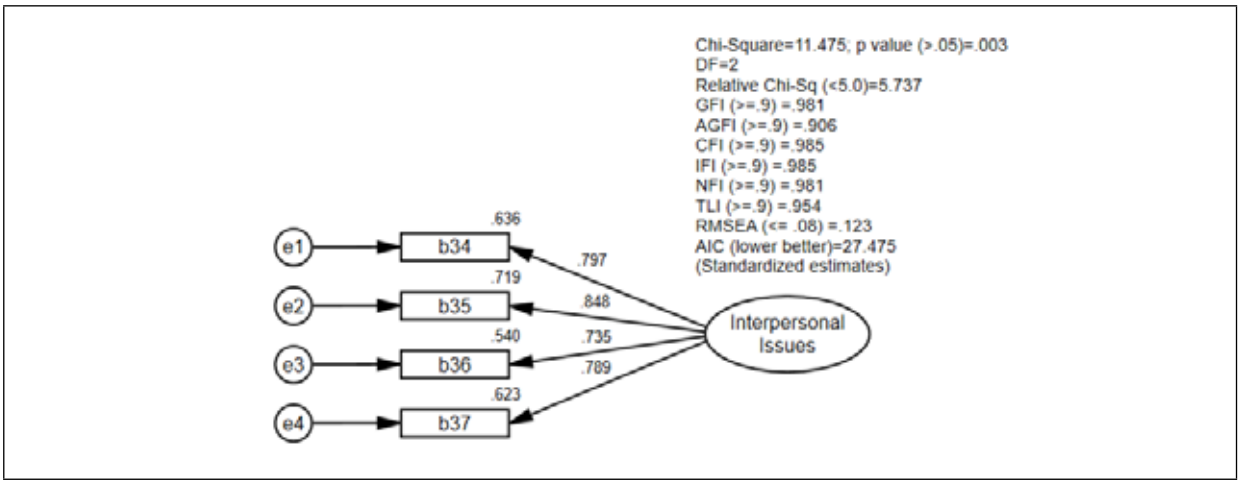

Figure 5. Confirmatory Factor Analysis for Interpersonal Issues

instrument for the assessment of resilience levels in Performance Development athletes. ARI-26 can be used in future research to explore the level of resilience in the context of sports adversities. The data from ARI-26 might provide early warning signals to the athletes and other sports practitioners, therefore prevention action can be taken before breakdowns in performance occur.

Acknowledgment

This paper is based on the research project entitled Construction of Athlete Resilience Index Instrument (ARI) based on the Multi-Level Classification System Model for Sport Psychology. The authors would like to extend their gratitude to Sultan Idris Education University, Malaysia for the University Research Grants (code: 2019-0213-106-01) that helped fund the research.

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Cite this article as:
Khalid NHM, Rasyid NM, Ahmad Y. Development, validation, and reliability of athletes' resilience index. *Pedagogy of Physical Culture and Sports,* 2022;26(3):188–198.
https://doi.org/10.15561/26649837.2022.0307

Received: 14.04.2022
Accepted: 29.05.2022; Published: 30.06.2022