European Journal of Contemporary Education

ELECTRONIC JOURNAL

Adaptation of Psychological Performance Inventory for Sport Schools' Students

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Abstract

Recently, there has been an increasing need to develop mental toughness of students who participate in sport, in order to improve their adaptation not only during sporting activities but also in other contexts. Developing mental toughness skills among sport school students is one of the main ways to ensure their psychological well-being, and therefore research in this area is of great importance. However, there is currently a lack of adapted validity measures that consider socio-cultural factors to assess their psychological skills, namely mental toughness. For this purpose, it is necessary to adapt and validate a modern, useful measure of psychological resilience skills. Therefore, the aim of this paper is to conduct an adaptation of the Psychological Performance Inventory-Alternative (PPI-A) for sport school students. The participants of the study were 378 basketball sport school students aged 15-18 years from different Lithuanian basketball sport schools. Confirmatory factor analysis (CFA) was conducted using Jamovi software. Pearson correlation coefficients and average variance extracted were calculated using Jamovi software and Excel program. These indicators were used to check the convergent and discriminant validity of the questionnaire. Reliability of the questionnaire was checked using Cronbach's alpha and McDonald's omega. Structural equation modelling showed an acceptable fit of the four-factor PPI-A model. Validity and reliability analyses revealed a good level of internal consistency between the factors. Given the appropriate psychometric properties, the Lithuanian version of the Psychological Performance Inventory-Alternative (PPI-A) can be used in studies aimed at better understanding of mental toughness among sport school students. Further research on the structure of the instrument is also warranted in order to validate the questionnaire for other samples.

Keywords: mental toughness, psychological performance, validation, adaptation, sport schools, students.

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1. Introduction

Researchers have long discussed the issues of examining the education of sport school students in sport activities (Jankauskas, 2016; Opstoel et al., 2020). A systematic review of the literature (Opstoel et al., 2020) revealed that in the last 10 years, only 26 studies have focused on the personal and social development of students through physical activity and sport. Hardman et al. (2014) encouraged researchers to keep in mind that personal and social development is one of the main and most frequently cited objectives of European education through sport. This undoubtedly demonstrates the relevance of research in this area and that there is scope for further development and expansion of the research related to the personal, social, and psychological education of students in sport schools. According to the results of the systematic review of the literature (Opstoel et al., 2020), personal, social, and psychological education (the development of personal, social, and psychological skills) was the most frequently studied phenomenon. Through sport, pupils learn to behave correctly, to show empathy and respect, to resolve conflicts, and to cooperate with team members (Warburton et al., 2020).

One of the more important psychological skills is mental toughness (the personal ability to consistently achieve high levels of personal goals or top performance despite daily challenges, stressors, and the ability to ignore overwhelming odds) (Gucciardi et al., 2015). In the sports community, there is a widespread belief that an athlete possessing mental toughness is more inclined to attain success in their sporting endeavors (Crust, Clough, 2011). The importance of mental toughness has increased even more in the Covid pandemic and post-pandemic period (Shepherd et al., 2021). In addition, mental toughness has been most often studied in the context of sport, but the importance of mental toughness skills has recently been recognized in other domains (Liew et al., 2019). It has been suggested that mentally tough individuals are likely to be social and to be sociable, as they are able to remain calm and relaxed, and are competitive in many situations, but at the same time, in these situations, they have lower levels of anxiety than others (Guszkowska, Wójcik, 2021). Such individuals have high self-confidence and believe that they are in control of their own destiny as they are not affected by competitive environments (Guszkowska, Wójcik, 2021). Therefore, it is indisputable that mental toughness skills are important not only in the context of sport. Despite its growing popularity, it is important to acknowledge that mental toughness skills are a relatively new area of research for the scientific community (Brace et al., 2020).

There are various research tools, which could be used to measure mental toughness. Typically, these instruments are designed with a specific number of items to assess various aspects of mental toughness. For instance, Psychological Performance Inventory – PPI (Loehr, 1986) contains 42 items constituting seven scales: self-confidence, negative thoughts control, positive thoughts control, attention, control, visualization, performance imagery control, attitude. Psychological Performance Inventory-Alternative – PPI-A (Golby et al., 2007)) is an inventory containing four scales: determination, self-belief, visualization, positive cognition. It contains 14 statements. The MeBTough (Mental, Emotional, and Bodily Toughness Inventory), developed by Mack and Ragan in 2008, is a scale designed to diagnose the psychological, physical, and emotional components of mental toughness. It is composed of 43 statements. Mental Toughness Questionnaire – MTQ48 (Clough et al., 2002) is made up of four main scales and two subscales: commitment, challenge, confidence: belief in one's own skills, self-confidence in interpersonal contacts, emotional control, life control. It contains 48 items. Psychological Performance Inventory-Alternative – PPI-A was chosen for adaptation, as the students who participate in sports do not tend to get used to long questionnaires (with more than forty items) and want to answer the questions as quickly as possible.

For school sports students, mental toughness skills can help them cope with unexpected physical and emotional stresses, such as high levels of fatigue, pain, and intense experiences, during physical activity or sports training (Bird et al., 2021). Performance sport requires exceptional skill and effort, and the high demands placed on young athletes and the challenges of the competitive environment require athletes to have perseverance, self-belief, and positive cognition. Although the actions of sport school students during sporting activities are motivated, they sometimes lack the mental toughness to complete their actions and achieve their goals. Therefore, researchers stress the importance of developing mental toughness and responsibility when facing the challenges of competitive activities (Malinauskas, Juodsnukis, 2017).

The adaptation of the Psychological Performance Inventory-Alternative (PPI-A) for sport school students is essential as it can significantly increase the effectiveness and relevance of psychological assessment in the context of sporting activity. Sport school students have unique psychological needs

and challenges compared to the general student population (Romanová, 2021). A tailored psychological inventory can be adapted to address specific psychological factors that are critical for success in sport, such as the mental toughness, competitive mindset and goal setting of competitive sport students.

To be able to have an instrument to determine how a student would react to different external (e.g. competition) and internal (e.g. fatigue, stress) factors, it is necessary to carry out an adaptation and validation of the inventory. As young athletes are often faced with stressors specific to their sporting environment, including performance pressure, competition anxiety and injury concerns, the statements in the adapted inventory are important in assessing how well the students are coping with these sport-specific stressors, thus providing valuable insights for both the students and their coaches (Wu et al., 2021). The aim of sports schools is to develop not only academic but also sporting excellence (Romanová, 2021). A specialised adapted psychological performance inventory can help to identify athletes' and sport schools' students' psychological skills that need to be improved. The development of an adapted and validated instrument can lead to targeted interventions to improve students' athletic performance and enhance their psychological strength (mental toughness).

Adaptation and validation of this research instrument is needed as the Psychological Performance Inventory-Alternative (PPI-A) for Sport Schools is in line with the principles of evidence-based practice. This ensures that the assessment tools used are valid and reliable in the specific context, which increases the accuracy of the results and the usefulness of the information gathered for decision-making (Behnke et al., 2019).

Study hypothesis – we hypothesize that Lithuanian version of the Psychological Performance Inventory (PPI-A; Golby et al., 2007) has good psychometric properties. Our hypotheses are based on a previous study (Pocius, Malinauskas, 2023), where a mathematical model of instrument's exploratory factor analysis was used to find that the instrument is suitable for factor analysis, furthermore, four factors explaining 67.03 % of the total number of factors in the factor analysis were identified. The extracted factors and their constituent items were in perfect agreement with the items extracted by the authors (Golby et al., 2007), and the internal consistency of all subscales was considered good.

However, there is currently a lack of adapted validity measures that consider socio-cultural factors to assess psychological skills among sport schools' students, namely mental toughness. For this reason, it is necessary to adapt and validate a contemporary useful instrument for mental toughness skills. Therefore, the aim of this paper is to conduct an adaptation of the Psychological Performance Inventory (PPI-A) for sport school students and describe its psychometric properties.

2. Methods

The participants of the study were 378 basketball sport schools' students aged 15-18 years from different Lithuanian basketball sport schools. The selection of basketball sport schools was conducted by randomization software. Then students were randomly selected from roosters of chosen basketball sport schools.

The sport school students completed the Psychological Performance Inventory-Alternative (PPI-A) questionnaire (Golby et al., 2007). Each questionnaire item is scored on a 5-point Likert scale. The questionnaire consists of 4 subscales: determination, visualisation, positive cognition, self-belief. We decided to analyse data with subscales not only by summing the item scores of each subscale but also by averaging the summed scores.

The Psychological Performance Inventory-Alternative (PPI-A, Appendix 1) was forward-translated into the Lithuanian language and back-translated into English following the methodological considerations for double translation and reconciliation. During the translation and adaptation processes linguistic and psychological differences in the Lithuanian population and peculiarities in sport practices were considered through the choice of experts with relevant expertise, e.g., knowledge of sport, knowledge of sport psychology, and proficiency in Lithuanian language. The confidentiality and anonymity of the data was ensured during the study.

A pilot study involving 203 sport schools' students was previous undertaken, during which participants were asked to provide feedback on the clarity of individual items and the rating system (Pocius, Malinauskas, 2023). A mathematical model of exploratory factor analysis of PPI-A was performed to extract the factors and to assess whether they correspond to those extracted by the authors (Golby et al., 2007) of the instruments (Pocius, Malinauskas, 2023). Principal component analysis and orthogonal Varimax rotation were applied in the pilot study, uncovering four factors that accounted for 67.03 % of the total variance. The factors and the items associated with them, as identified in the pilot study, were found to align completely with those identified by the creators of

the instrument (Pocius, Malinauskas, 2023). Therefore, the present study only conducts a confirmatory factor analysis with another sample of participants (378 sport school students), as is required by the methodological standards for instrument validation.

Confirmatory factor analysis (CFA) was conducted using Jamovi software (The jamovi project, 2022). To evaluate model fit, χ^2 statistics, comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), Akaike information criterion (AIC), Bayesian information criterion (BIC) were calculated. Pearson correlation coefficients and average variance extracted (AVE) were calculated using Jamovi software and Excel program. These indicators were used to check the convergent and discriminant validity of the instrument.

Discriminant validity was assessed by examining the square root of the AVE. When this value of each measure variable is greater than the correlation coefficient between the variables, it indicates that discriminant validity is established (Hair et al., 2013).

The internal consistency of the questionnaire was assessed by Cronbach's alpha coefficients. Reliability of the instrument was checked using McDonald's omega coefficients. To confirm the normal distribution of the data, the normality of the data was assessed by asymmetry (skewness) coefficient and by measure of the tailedness of a distribution (kurtosis). Skewness and kurtosis coefficients were between +1 and -1, and is possible to conclude that the distribution of all variables does not significantly differ from the normal distribution. Statistical significance was set at $p < .05$ for all tests.

The study was approved by the Committee for Social Sciences Research Ethics of Lithuanian Sport University. The research was conducted in accordance with ethical guidelines and the legal code of the country in which the study was conducted. The researcher obtained approval from the coaches at sports schools to administer a face-to-face questionnaire to the students.

3. Results
Confirmatory Factor Analysis
Using confirmatory factor analysis (CFA), we wanted to see how well a pre-specified model, which was tested in a pilot study, is confirmed by the observed data from this study. The results obtained from the CFA, using the Psychological Performance Inventory (PPI-A) are summarised in Table 1. As illustrated in Table 1, all standardized estimate values are greater than 0.50 and statistically significant, what, according to Chin (1998), proves that all variables with loadings higher than 0.50 are acceptable for the predefined (four-factor PPI-A) model.

Table 1. Indicators of the confirmatory factor analysis (CFA)

Factor	Item	Estimate	SE	Lower	Upper	Z	p	Stand. Estimate
				95 % Confidence Interval				
Factor 1	P1	0.736	0.0394	0.659	0.814	18.69	< .001	0.820
	P2	0.678	0.0435	0.593	0.763	15.60	< .001	0.726
	P3	0.786	0.038	0.711	0.860	20.56	< .001	0.875
Factor 2	P4	0,654	0,064	0,528	0,780	10,15	< .001	0.537
	P5	0.558	0.040	0.480	0.637	13.96	< .001	0.682
	P6	0.772	0.0424	0.689	0.856	18.21	< .001	0.853
	P7	0.583	0,063	0,458	0,709	9,14	< .001	0.501
Factor 3	P8	0.453	0.0401	0.374	0.531	11.30	< .001	0.575
	P9	0.576	0.0396	0.498	0.653	14.56	< .001	0.702
	P10	0.648	0.0425	0.565	0.732	15.26	< .001	0.731
	P11	0.473	0.0379	0.399	0.547	12.50	< .001	0.618
Factor 4	P12	0.713	0.048	0.619	0.807	14.84	< .001	0.720
	P13	0.817	0.046	0.727	0.907	17.74	< .001	0.830

P14	0.762	0.045	0.673	0.851	16.76	< .001	0.792

Notes: Items (P1–P14) of Psychological Performance Inventory-Alternative (PPI-A) are described in Appendix 1. Factor 1 – Determination; Factor 2 – Visualization; Factor 3 – Positive Cognition; Factor 4 – Self-belief.

The results of the CFA showed that all indices (Chi-Square Fit Index [$\chi^2(70)$ = 203.0, p < 0.001]; CFI = 0.95; TLI = 0.93, SRMR = 0.047, RMSEA= 0.070 (RMSEA 90 % CI 0.06–0.08)) were adequate and suggested data fit to the 14-item instrument PPI-A structure (Table 2). There is no need to evaluate AIC and BIC as the pre-specified (four-factor PPI-A) model of instrument created by the authors Golby, Sheard and VanWersch (2007) is model fit and no modified models have been developed and analyzed.

Table 2. Model goodness of fit criteria of the confirmatory factor analysis for the Psychological Performance Inventory (PPI-A)

χ^2	df	p	CFI	TLI	SRMR	RMSEA	RMSEA 90 % CI		AIC	BIC
							Lower	Upper		
203	70	< .001	0.945	0.928	0.047	0.070	0.0598	0.0825	11976	12169

Notes: df – degree of freedom. CFI – Comparative Fit Index; TLI – Tucker Lewis index; SRMR – Standardized Root Mean Square Residual; RMSEA – Root Mean Square Error of Approximation; AIC – Akaike Information Criterion; BIC – Bayesian Information Criterion.

The estimated factorial loadings (standardized estimates) above the arrows are displayed in Figure 1. As already mentioned, all the items with factorial loadings higher than 0.50 are acceptable for the predefined model.
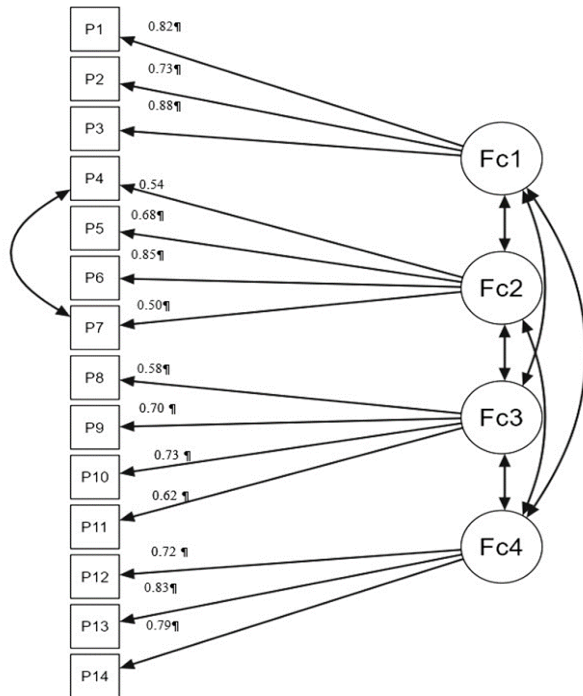
Fig. 1. Path Diagram
Notes: Items (P1–P14) of Psychological Performance Inventory-Alternative (PPI-A) are described in Appendix 1. Factors: Fc1 – Determination; Fc2 – Visualization; Fc3 – Positive Cognition; Fc4 – Self-belief. The factorial loading of P7 is 0.501.

Descriptive, Reliability and Validity Analysis

In order to elaborate on previous results of the present study, the reliability and validity of the model's indicators (factors) were assessed. Table 3 provides the descriptive statistics, the Cronbach's alpha, composite reliability (such as McDonald's ω), and AVE. The internal consistency of all factors was determined to be above 0.70, with values ranging from 0.75 to 0.84, indicating a high level of internal consistency for the measures. The composite reliability values were above 0.70 for all the factors. As the composite reliability of all constructs is well above the recommended level, the internal reliability of the measurement items is considered as good.

AVE was used as a measure to assess convergent validity. According to Psailla and Vagner (2007) AVE values above 0.40 indicate that the convergent validity of the instrument is acceptable. The AVE for all factors ranges from 0.43 to 0.66 (Table 3). This means that the convergent validity criterion is met.

Table 3. Descriptives, reliability and validity analysis indicators

Factors	Mean	SD	Cronbach's α	CR – McDonald's ω	AVE
Factor 1	4.09	0.795	0.844	0.850	0.655
Factor 2	3.68	0.788	0.746	0.745	0.433
Factor 3	3.80	0.618	0.750	0.753	0.435
Factor 4	3.44	0.842	0.822	0.825	0.611

Notes: AVE – Average Variance Extracted. CR – Composite Reliability. Factor 1 – Determination; Factor 2 – Visualization; Factor 3 – Positive Cognition; Factor 4 – Self-belief.

The Fronell-Larcker criterion (Fornell, Larcker, 1981) was used to check the discriminant validity of the model. According to this criterion, the square root of the average variance extracted by a construct must be greater than the correlation between the construct and any other construct. When this assumption is met, discriminant validity is established. The criterion for discriminant validity was satisfied, as the correlations between the PPI-A factors were found to be less than the respective square roots of the AVE values, which were not less than 0.658 (Table 4).

Table 4. Square root of the average variance extracted (AVE) and correlations matrix

Factors		1	2	3	4
1	Factor 1	(0.809)			
2	Factor 2	0.611	(0.658)		
3	Factor 3	0.656	0.552	(0.660)	
4	Factor 4	0.343	0.186	0.432	(0.782)

Notes: Values in parentheses represent the square root of the variance extracted (AVE). Factor 1 – Determination; Factor 2 – Visualization; Factor 3 – Positive Cognition; Factor 4 – Self-belief.

4. Discussion

The cultural context of sports schools in different countries can be unique. Using an instrument adapted and validated in a specific country could ensure that the assessment of psychological well-being is relevant to the experiences of students in sport schools and the learning and sporting environments in that country. That is why this study aimed to conduct an adaptation of the Psychological Performance Inventory-Alternative (PPI-A) for sport school students and describe its psychometric properties.

A review of the national scientific literature on mental toughness suggests that there is still no consensus on a specific single scale that can be used to measure the level of mental toughness of sport school students. Therefore, this study is important to fill this gap in the relevant literature. It can be assumed that this study has established a valid and reliable measure of mental toughness in sport school students. A CFA was carried out to assess whether the data confirmed the theoretically devised model. According to the fit indices obtained, it can be said that the construct validity of the Psychological Performance Inventory-Alternative (PPI-A) has been confirmed (Gucciardi, 2012; Gucciardi et al., 2021) because fit indices were of the four-factor structure were sufficient. The conceptual and psychometric analyses revealed the factors are essential to pre-

specified (four-factor PPI-A) model of instrument created by the authors Golby, Sheard and VanWersch (2007).

The reliability of the measurements obtained from PPI-A instrument was examined by Cronbach's alpha and McDonald's omega reliability methods. We found acceptable Cronbach's alpha coefficients for all four subscales of instrument (ranging from 0.75 to 0.84), which was in line with those seen in a similar study (Gucciardi, 2012). Measurements with a reliability coefficient of 0.70 and above are considered reliable (Sürücü, Maslakci, 2020). The findings suggested that the Lithuanian version exhibited a satisfactory to commendable degree of internal consistency.

The use of tools such as the PPI-A questionnaire, which provide comprehensive information while minimizing the load on students, is essential in the field of sport education science. This ensures that the assessment does not interfere with the training process. Based on our empirical findings, the adapted version of the PPI-A is an ideal choice for researchers and practitioners seeking to obtain concise data covering key aspects of mental toughness among sport school students (Guszkowska, Wójcik, 2021). There are currently no other instruments available in the country that appear to be a better choice for measuring specific aspects of mental toughness (Pocius, Malinauskas, 2023).

The hypothesis, that Lithuanian version of the Psychological Performance Inventory (PPI-A) has good psychometric properties, has been confirmed. As already mentioned, the results of present study confirmed a four-factor structure, which is consistent with the structure of the original inventory in English language. It should be noted that our data are very close to the original version's factorization rates (Golby et al., 2007; Gucciardi, 2012), whereas latent factors were stable and 'all indexes reaching levels of adequate fit: $\chi^2(70) = 160.14$, $p < .001$, CFI = .907, IFI = .909, SRMR = .060, RMSEA = .060, 90 % CI [.047, .073]' (Gucciardi, 2012: 399).

The significance of research. As the field of sport psychology develops, so the tool for assessing mental toughness among sport school students must also improve. The adaptation of the PPI-A inventory ensures that it is in line with the latest research and best practice, allowing for continuous improvement in the assessment and maintenance of the mental toughness like indicator of psychological well-being of sport school students.

Limitations and future prospects. Our results are limited to 15–18-year-old students from sports schools and the findings are based on cross-sectional and self-report data. This analysis did not cover students of other age, and as a result, the conclusions cover only peculiarities of this age of group students. It would be appropriate to conduct similar study by examining other age groups of students. Future research can also observe gender differences.

5. Conclusion

The Lithuanian version of the Psychological Performance Inventory Alternative (PPI-A) can be used in studies aiming to better understand the mental toughness of sport school students, as this study has shown adequate psychometric properties of this instrument. It must be concluded that it is important to consider research on mental toughness as an essential component of research on the sustainable development of sport school students. Coaches and sports organisations should take a holistic approach to the sustainable development of athletes by integrating the development of mental toughness skills alongside physical education and sport. This may include mental toughness training, such as visualisation exercises, mindfulness practices and techniques to help maintain attention and concentration. The use of a validated instrument (i.e., PPI-A) can help to assess the effectiveness of targeted interventions and the need for support for sport school students.

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Appendix 1

Items of the Psychological Performance Inventory-Alternative (PPI-A) Questionnaire (Golby, Sheard, VanWersch, 2007). (For clarity, items are presented in English)

Item labels	Items	Degree of agreement with the statement				
P1	The goals I've set for myself as a player keep me working hard.	1	2	3	4	5
P2	I don't have to be pushed to play or practise hard. I am my own best igniter.	1	2	3	4	5
P3	I'm willing to give whatever it takes to reach my full potential as a player.	1	2	3	4	5
P4	I lose my confidence very quickly.	1	2	3	4	5
P5	I can keep strong positive emotion flowing during competition.	1	2	3	4	5
P6	I am a positive thinker during competition.	1	2	3	4	5
P7	My self-talk during competition is negative.	1	2	3	4	5
P8	I can clear interfering emotion quickly and regain my focus.	1	2	3	4	5
P9	Playing this sport gives me a genuine sense of joy and fulfilment.	1	2	3	4	5
P10	I can change negative moods into positive ones by controlling my thinking.	1	2	3	4	5
P11	I can turn crisis into opportunity.	1	2	3	4	5
P12	I mentally practice my physical skills.	1	2	3	4	5
P13	Thinking in pictures about my sport comes easy for me.	1	2	3	4	5
P14	I visualize working through tough situations prior to competition.	1	2	3	4	5

Notes: 1 – Almost never ‖ 2 – Rarely ‖ 3 – Sometimes ‖ 4 – Often ‖ 5 – Almost always. Items 1–3 measure Determination; 4–7 measure Self-belief; 8–11 measure Positive Cognition; 12–14 measure Visualization.