Cross-Cultural Adaptation of the Urdu Version of Rosenbaum Concussion Knowledge and Attitude Survey—Student Version in Pakistan

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Evaluating athletes’ knowledge of and attitudes toward sports-related concussions is important. However, there is limited research involving South Asian athletes, partly due to the lack of a valid and reliable tool. This study, therefore, aimed to translate and validate the Rosenbaum Concussion Knowledge and Attitude Survey—Student Version, an established tool used to measure knowledge and attitude toward concussion, into Urdu. Rosenbaum Concussion Knowledge and Attitude Survey—Student Version was translated into Urdu using the standard guidelines and then completed by 369 athletes participating in contact sports at different universities in Pakistan. Confirmatory factor analysis was performed on the Concussion Attitude Index items to examine the underlying factorial structure. Construct validity of Concussion Attitude Index factors was also investigated using convergent and discriminant validity. The results showed that the Urdu version of the Rosenbaum Concussion Knowledge and Attitude Survey—Student Version has good psychometric properties and is a valid and reliable tool for evaluating Urdu-speaking athletes’ knowledge of and attitudes toward concussions.

Keywords: sports-related concussions, confirmatory factor analysis, cultural adaptation, Pakistani athletes, Indian athletes

In recent years, sports-related concussions (SRCs) have received increasing attention and are now recognized as a major health concern for athletes participating in contact or collision sports (McCrory et al., 2017; Rivara & Graham, 2014). Broadly, a concussion is defined as a traumatic brain injury induced by biomechanical forces caused by a direct blow to the head, face, neck, or elsewhere on the body with an impulsive force transmitted to the head, often resulting in rapid but transient impairments of neurological functions (McCrory et al., 2017).

SRCs can result in serious short- and long-term consequences (Daneshvar et al., 2011). In the short term, concussions leave an athlete’s brain in a vulnerable state, making it more susceptible to subsequent concussions and musculoskeletal
injuries (Kerr, 2014). Subsequent or additional concussions can result in a longer time for full neurologic recovery, permanent cognitive deficits, and even death (Boden et al., 2007; Majerske et al., 2008; Prins et al., 2013). The long-term consequences of concussions on an athlete’s mental, behavioral, and neurological health are particularly alarming. Athletes who experience multiple concussions are more likely to develop long-term memory problems, mental health issues, and neurodegenerative diseases such as chronic traumatic encephalopathy (Baugh et al., 2014; Gardner et al., 2014; Kerr et al., 2012). Furthermore, SRCs are also linked to reduced health-related quality of life (Houston et al., 2016; Weber et al., 2019).

Timely identification and appropriate medical attention are essential for reducing the negative effects of concussions (Okonkwo et al., 2014). However, as concussions are often an “invisible injury” (Echlin, 2010), identification and diagnosis can be challenging. While certain symptoms are easily observable, such as loss of consciousness, many other concussion symptoms are difficult to identify (Moreau et al., 2014). As a result, many concussions experienced by athletes go unnoticed and untreated (Harmon et al., 2019; King et al., 2014). The burden of identifying and reporting any possible concussion symptoms, thus, usually falls on the athletes themselves. However, several studies have found that insufficient knowledge and understanding of concussions and poor attitudes toward SRC reporting among athletes result in a high number of unidentified, unreported, and untreated cases (Bramley et al., 2012; Davies & Bird, 2015; Delaney et al., 2015; Kroshus et al., 2014). Thus, evaluating athletes’ knowledge of and attitudes toward SRCs becomes critical.

Outcome measures play an important role in identifying knowledge gaps and attitudes toward a behavior (Boateng et al., 2018; Shaneyfelt et al., 2006). Various outcome measures exist to assess athletes’ knowledge and attitudes toward concussions. Sye et al. (2006) designed a tool to measure concussion knowledge and attitudes among school students, while Cusimano et al. (2009) developed a scale for players, coaches, and parents. Although both instruments identified concussion knowledge gaps and attitudes, psychometric analysis of the instruments was not reported—the psychometric analysis ensures outcome measures’ reliability and validity (Furr, 2011). The Knowledge and Attitudes about Sports Concussion Questionnaire-24 by Simonds (2004) and the College Football Head Injury Survey by Sefton (2003) are also limited by the lack of adequate sample size and psychometric analysis. Similarly, Chrisman et al. (2011) developed an outcome measure to determine concussion knowledge but did not report its psychometric properties. Thus, these measures do not provide sufficient reliability and validity to measure concussion knowledge and attitudes among athletes.

In contrast, the Rosenbaum Concussion Knowledge and Attitudes Survey—Student Version (RoCKAS-ST), a popular tool developed by Rosenbaum and Arnett (Rosenbaum & Arnett, 2010), has undergone extensive psychometric evaluation and is a valid and reliable tool for assessing knowledge of and attitudes toward SRCs. The knowledge section evaluates participants’ awareness of the causes, sequelae, and common symptoms of concussions, and the attitude section assesses participants’ views toward SRC reporting and return to play protocol as well as their views about SRC management by their coaches and athletic trainers, who play a significant role in the education about, and recognition and management of SRCs. It also assesses team norms by eliciting participants’ perceptions...
of how their teammates will behave in specific situations. An advantage of the RoCKAS-ST over other available measures is that its attitude section has been examined for social desirability bias, and shown to be unaffected by underreporting or attitude diminution, indicating that it is an adequate measure of attitudes toward SRCs. Although initially developed for high school students, RoCKAS-ST has been used in different populations—including college athletes and players of various sports (e.g., rugby, American football, judo, and soccer)—and has successfully identified knowledge gaps and attitudes toward SRCs (Chinn & Porter, 2016; Kraak et al., 2019; Manasse-Cohick & Shapley, 2014; Viljoen et al., 2017; Williams et al., 2016). In a recent systematic review of 25 SRC educational interventions (Conaghan et al., 2021), the RoCKAS-ST was identified as the most frequently used instrument.

Each year, up to 3.8 million sports-related concussive events occur in the United States alone (Kay et al., 2015). In South Asian countries, including Pakistan and India, contact sports with high rates of SRCs, such as football (soccer) and field hockey, are popular among youth (Haider, 2016; Sisodia et al., 2015). Rugby, the sport with the highest incidence of SRCs, is also gaining popularity in these countries (Chadwick et al., 2010). Moreover, cricket, the most popular sport in India and Pakistan (Bandyopadhyay, 2021), has been linked to cases of SRCs (Hill et al., 2019; Whitehouse et al., 2021), and a high incidence of SRCs has also been reported for kabaddi, a traditional South Asian sport (Sen, 2004). Studies of neurotrauma in Pakistan have identified numerous SRC cases (Junaid et al., 2016; Mushtaq et al., 2013). Similarly, studies investigating sporting injuries in India have reported several cases of SRCs (Adkitte et al., 2016; Sipra, 2013). The actual number of SRCs in these countries is thought to be even higher due to athletes’ nonreporting (Adamson et al., 2020; Dave et al., 2019; Haider, 2016; Harmon et al., 2019). This nonreporting may occur because of athletes’ lack of knowledge about the potential consequences of SRCs or unsafe attitudes toward injury reporting (Adamson et al., 2020; Davies & Bird, 2015; Harmon et al., 2019). An extensive literature review failed to find any prior studies regarding the level of concussion knowledge and attitudes among athletes in South Asian countries, such as Pakistan and India. This warrants research on the current status of these athletes’ SRC knowledge and attitudes.

Before this research gap can be filled, a valid and reliable measure is needed to collect accurate data on knowledge and attitudes toward concussions. Although the RoCKAS-ST is a valid and reliable tool in English-speaking communities, it has not been culturally and linguistically adapted for use in Urdu-speaking countries. Therefore, this study aims to translate the RoCKAS-ST into Urdu and examine the reliability and validity of the translated version among Pakistani university student-athletes.

Methods

Study Design

This study was carried out in two phases. In the first phase, RoCKAS-ST was translated and adapted into Urdu. In the second phase, the validity and reliability of the Urdu version were assessed. Ethical approval to conduct this study was obtained from the relevant research ethics committee (UM.TNC2/UMREC-630).
Rosenbaum Concussion Knowledge and Attitudes Survey—Student Version

The original RoCKAS-ST (Rosenbaum & Arnett, 2010) comprises 55 items divided into three subscales: the Concussion Knowledge Index (CKI), the Concussion Attitude Index (CAI), and the validity index.

The CKI measures concussion knowledge via 25 dichotomous (true/false) questions. The use of dichotomous items as knowledge quizzes is common among researchers, as it assists in identifying existing knowledge or knowledge gaps (Hoppe et al., 2018). In addition, dichotomous items are user-friendly, reduce respondents’ boredom and fatigue, and are time efficient (Dolnicar & Grün, 2007; Dolnicar & Leisch, 2012). Each CKI item covers a different area of concussion knowledge. Each correct answer is scored one point, resulting in a maximum of 25 points, with higher scores reflecting greater concussion knowledge. The CKI items demonstrated adequate test–retest reliability (intraclass correlation coefficient = .67, \( p < .001 \)), and cluster analysis of these items demonstrated three discrete groups based on the level of difficulty (Rosenbaum & Arnett, 2010).

The CAI measures attitudes toward concussions and comprises 15 questions answered using a five-point Likert scale (strongly agree to strongly disagree). Answers reflecting safer attitudes toward concussion are scored four to five points, while unsafe responses are scored one to two points. The maximum score is 75 points, with a higher score reflecting safer attitudes toward concussions. Thirteen CAI items measure personal and others’ attitudes toward concussions and behavior regarding coaches’ and athletic trainers’ concussion management. An additional two items measure general attitudes toward concussions. Rosenbaum and Arnett (2010) reported that the CAI items were nonsignificantly correlated with the Marlowe–Crowne Social Desirability Scale (\( r = -.09, n = 367, p > .05, d = 0.008 \)) and demonstrated adequate test–retest reliability (intraclass correlation coefficient = .79, \( p < .001 \)), internal consistency (Cronbach’s \( \alpha = .76 \)), and goodness of fit (goodness-of-fit index = .94, consistent Akaike information criterion = 407.37, and root mean square error of approximation = .07). The validity index comprises three questions and serves as an internal validity index: Respondents who score less than two correct responses are disqualified.

Phase 1: Translation and Adaptation

Following the guidelines by Gjersing et al. (2010) and Sousa and Rojjanasrirat (2011), a collaborative and rigorous approach was adopted to translate the original RoCKAS-ST questionnaire into Urdu. The following steps were taken to ensure that the Urdu version was semantically, conceptually, and operationally equivalent to the original questionnaire and was culturally appropriate.

Step 1: Committee Formation

A committee was formed comprising four members (i.e., a psychology Ph.D. student with previous experience in questionnaire translation, a qualified soccer coach, a sports director of a Pakistani university, and the main researcher). All committee members were fluent in Urdu and English and held postgraduate degrees in psychology or sports sciences. The committee evaluated the conceptual
equivalence of the RoCKAS-ST in both the original and target cultures and confirmed its appropriateness for use in Pakistan. In addition, the committee assessed the RoCKAS-ST items and deemed them relevant and acceptable to the target population.

**Step 2: Forward and Backward Translation**

Two translators (i.e., a medical doctor and an English lecturer) with previous experience in questionnaire translation were recruited. They were instructed to forward-translate the questionnaire into Urdu independently on the principle of retaining meaning rather than word-to-word translation. The committee discussed the received drafts with one of the translators, and a preliminary translated draft was synthesized. Two expert translators were then asked to blindly translate the preliminary draft into English. Upon receiving the back translations, the committee discussed them and agreed on a prefinal version.

**Step 3: Expert Review**

The prefinal version and original English questionnaire were sent to six experts from sports sciences, medical sciences, psychology, and languages (Urdu and English). They were each asked to assess the conceptual and semantic equivalence of the Urdu version and evaluate its appropriateness for Urdu culture. The experts recommended some grammatical and semantic changes. All of their recommendations and comments were taken into account.

**Step 4: Pretesting**

After the expert review, 30 students from the psychology, English, and sports sciences departments of a university were asked to read the Urdu and English versions and rate the Urdu version items as clear or unclear. They were also asked to mark any ambiguous words or phrases. No statements or words were highlighted as unclear or vague by more than 20% of the participants.

**Step 5: Interviews**

Eight participants who pretested the questionnaire were invited to a focus group with the researcher to assess their understanding of the items. Participants were asked to paraphrase each sentence in the questionnaire. The participants suggested a change to the sentence structure of one item, which the committee considered and agreed to.

**Cultural Adaptation**

The committee could not find any suitable translation for the term “concussion” in Urdu. After consultation with medical experts, it was decided to retain the English word “concussion” rather than translate it into an Urdu proxy. This is similar to other English medical terms lexically borrowed into Urdu, such as “doctor,” “nurse,” and “cancer” (Shaukat & Talaat, 2021). Several other English words were retained in the Urdu version, such as “match,” “practice,” “team,” “final,” “semifinal,” “season,” and “weightlifting,” since diffusion of English is common in Urdu (Qadir et al., 2018; Sipra, 2013).
The participants were asked two questions about their views on athletic trainers’ concussion management (Section 4, Questions 7 and 8). However, athletic trainers are not used in Pakistan. Hence, the term was changed to physiotherapist to make it culturally relevant. A similar approach was used by Williams (2013) and Williams et al. (2016) in South Africa and the United Kingdom, respectively. Another item (Section 1, Question 15) asked for views about college and high school students’ ages. To make this item operationally equivalent, “college” was changed to “university.” In the United States, college starts after 12 years of education; however, in Pakistan, college begins after 10 years of schooling.

After taking these steps, the Urdu version was finalized and deemed suitable for use in Pakistan and other Urdu-speaking cultures. The full Urdu version of the questionnaire is presented in Supplementary Material (available online).

Phase 2: Validity and Reliability

This phase aimed to investigate the psychometric properties of the Urdu version of the questionnaire to confirm its validity and reliability. Confirmatory factor analysis (CFA) was performed on the CAI items to confirm the underlying factor structure. A hierarchical cluster analysis was conducted to examine CKI construct validity.

Participants

For CFA, the recommended sample size is 10–20 cases per measured variable (Bentler & Chou, 1987). Unfortunately, no specific recommendations are available for cluster analysis regarding the sample size; however, a large sample size is recommended (Siddiqui, 2013). A sample size of 350 participants was deemed adequate. The selection criteria for the participants were as follows: athletes (a) who play contact or collision sports, (b) represent their universities or their departments’ teams within their universities, and (c) are aged 18 years or older. The Urdu version of RoCKAS-ST was administered to 400 athletes. Participants also reported their demographic variables (age and gender), the main sports played, and their previous exposure to concussion knowledge. Responses from 31 participants were excluded because they did not satisfactorily complete the questionnaire. Thus, the final analysis included 369 participants (224 men and 145 women) aged 18–27 years ($M = 19.95, SD = 1.75$). A total of 156 participants, constituting 42.3% of the sample, reported playing football (soccer) as their main sport, while 49 (13.3%), 38 (10.3%), and 31 (8.4%) participants reported hockey, basketball, or rugby as their main sport, respectively. Of the participants included in the analysis, 88.6% ($n = 327$) reported receiving no prior formal concussion education.

Procedure

Sports directors of different universities in Pakistan were contacted to obtain their approval to access athletes. Athletes were approached during visits to their respective universities and briefed on the purpose of the study. Informed written consent was obtained from each participant before conducting the research.
Data Analysis

Due to the dichotomized (true/false) nature of the CKI items, which violates the assumptions of normality and variability of factor analysis (Tabachnick et al., 2007), a hierarchical cluster analysis was conducted using squared Euclidean distances to examine CKI construct validity. Cluster analysis is an analytic technique used in exploratory research to classify observations into discrete groups (Finch, 2005). Given the reflective nature of the CAI, covariance-based structural equation modeling was utilized (Reinartz et al., 2009). CFA was conducted using RStudio (RStudio Team, 2020) to investigate whether the CAI items distributed to the same four factors identified by Rosenbaum and Arnett (2010) for the current population. Four indices were used to establish goodness of fit: absolute fit (chi-square goodness of fit [$\chi^2$]), comparative-fit index, standardized root mean square residual, and root mean square error of approximation. Good fit thresholds for these indices should be comparative-fit index $>0.90$, standardized root mean square residual $<0.08$, and root mean square error of approximation $<0.08$ (Brown, 2015). To determine the construct validity of the CAI factors, convergent and discriminant validities were also assessed. Convergent validity was assessed using the composite reliability (CR) and average variance extracted (AVE); a CR value $>0.70$ and an AVE value $>0.50$ indicate good convergent validity (Fornell & Larcker, 1981; Hair et al., 2010). Discriminant validity was evaluated by checking the correlation between the factors. Correlation coefficients between factors should be $<0.85$ or $0.90$ to be considered discriminant (Brown, 2015; Fornell & Larcker, 1981).

Results

CFA of CAI Factors

Before conducting the CFA, the normality of the data was assessed. A normalized estimate of Mardia’s coefficient of 9.21 indicated a non-normal multivariate distribution. Accordingly, maximum likelihood estimation was performed using the Satorra–Bentler scaled chi-square test (Satorra & Bentler, 1988), which is considered the most reliable test statistic in the presence of multivariate non-normality (Chou et al., 1991; Hu et al., 1992). Three different models were examined to determine the best goodness of fit, as presented in Table 1.

Model 1 included all 15 CAI items loaded to a single attitude factor. The unidimensional, one-factor model indicated poor fit across all indices. In Model 2, 13 CAI items were loaded to the four factors identified by Rosenbaum and Arnett (2010). In this model, all four factors were orthogonal and correlated. Model 2 suggested goodness of fit across all indices. All 13 items in this model obtained a satisfactory factor loading of $>0.50$ (Hair et al., 2010). In Model 3 (Figure 1), modification indices were added between Section 3, Question 1 (“Continue playing with a headache”) and Section 3, Question 6 (“Athlete returns to play with symptoms”). The factor loadings for Model 3 are presented in Table 2. The results suggested that Models 2 and 3, which include orthogonal four-factor models, best fit the data; however, Model 3, with modification indices, produced the best fit. The descriptive statistics of the CAI items are presented in Table 3.
Table 1 Summary of the Model Fit Indices

<table>
<thead>
<tr>
<th>Models</th>
<th>Scaled $\chi^2$</th>
<th>df</th>
<th>Robust CFI</th>
<th>Robust RMSEA</th>
<th>SRMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1 (unidimensional)</td>
<td>854.108</td>
<td>90</td>
<td>.644</td>
<td>.161</td>
<td>.115</td>
</tr>
<tr>
<td>Model 2 (four factors/orthogonal, correlated model)</td>
<td>144.120</td>
<td>59</td>
<td>.956</td>
<td>.06</td>
<td>.051</td>
</tr>
<tr>
<td>Model 3 (modification indices)</td>
<td>103.495</td>
<td>58</td>
<td>.977</td>
<td>.048</td>
<td>.046</td>
</tr>
</tbody>
</table>

Note. $N = 369$; maximum likelihood estimation with Satorra–Bentler scaled test statistics; RMSEA = root mean square error of approximation; CFI = comparative-fit index; SRMR = standardized root mean square residual.

Figure 1 — Confirmatory factor analysis with four orthogonal factors and modification indices (Model 3). ORTP = views about others’ return to play attitudes; Coach = views about coaches’ concussion management; Physio = views about physiotherapists’ concussion management; PRTP = personal return to play attitudes.
Convergent and Discriminant Validity of CAI Factors

Based on Model 3, the CR, AVE, and correlations between factors were computed. CR values for each factor exceeded the minimum recommended level of 0.70. AVE values for all factors exceeded the suggested level of 0.50, indicating good convergent validity. All correlations between factors were below .85, indicating good discriminant validity (Fornell & Larcker, 1981; Hair et al., 2010). The CR, AVE, and factor correlation values are presented in Table 4.

Cluster Analysis of CKI Items

First, an unconstrained cluster analysis was conducted with all the CKI items, which suggested two to five clusters. Next, a second-order cluster analysis was conducted, constraining data to two to five clusters. A two-cluster solution was identified that demonstrated the most logical relationships within the data. Similar to Rosenbaum and Arnett (2010), there appeared to be no theoretical constructs underlying the clusters; rather, items were distributed based on the percentage of correct responses by the participants (Table 5). Cluster 1 contained 16 items with moderate difficulty (correctly answered by > 50% of participants), and Cluster 2 contained nine high-difficulty items (incorrectly answered by > 55% of participants).

Discussion

This study aimed to examine the translation and adaptation of the RoCKAS-ST from English to Urdu. RoCKAS-ST has undergone extensive psychometric analysis in the
Table 3 Descriptive Statistics of Concussion Attitude Index

<table>
<thead>
<tr>
<th>Concussion Attitude Index</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal return to play attitudes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I feel that an athlete has a responsibility to return to a game even if it means playing while still experiencing symptoms of a concussion.</td>
<td>2.54</td>
<td>1.25</td>
</tr>
<tr>
<td>2. I would continue playing a sport while also having a headache that resulted from a minor concussion.</td>
<td>2.51</td>
<td>1.28</td>
</tr>
<tr>
<td>3. I feel that Athlete M should have returned to play during the first game of the season.</td>
<td>2.33</td>
<td>1.23</td>
</tr>
<tr>
<td>4. I feel that Athlete O should have returned to play during the semifinal playoff game.</td>
<td>2.07</td>
<td>1.15</td>
</tr>
<tr>
<td><strong>Views about others’ return to play attitudes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Most athletes would feel that Coach A made the right decision to keep Player R out of the game.</td>
<td>2.21</td>
<td>1.11</td>
</tr>
<tr>
<td>2. Most athletes would feel that athlete M should have returned to play during the first game of the season.</td>
<td>2.09</td>
<td>1.11</td>
</tr>
<tr>
<td>3. Most athletes would feel that Athlete H should tell his coach about the symptoms.</td>
<td>1.99</td>
<td>1.21</td>
</tr>
<tr>
<td>4. Most athletes feel that Athlete O should have returned to play during the semifinal playoff game.</td>
<td>1.93</td>
<td>1.07</td>
</tr>
<tr>
<td><strong>Views about coaches’ concussion management and precautions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I feel that an athlete who is knocked unconscious should be taken to the emergency room.</td>
<td>3.63</td>
<td>1.17</td>
</tr>
<tr>
<td>2. I feel that coaches need to be extremely cautious when determining whether an athlete should return to play.</td>
<td>3.63</td>
<td>1.00</td>
</tr>
<tr>
<td>3. I feel that Coach A made the right decision to keep Player R out of the game.</td>
<td>3.45</td>
<td>1.12</td>
</tr>
<tr>
<td><strong>Views about physiotherapists’ concussion management</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I feel that the physiotherapist, rather than Athlete R, should make the decision about returning Athlete R to play.</td>
<td>2.62</td>
<td>1.14</td>
</tr>
<tr>
<td>2. Most athletes would feel that the physiotherapist, rather than Athlete R, should make the decision about returning Athlete R to play.</td>
<td>2.14</td>
<td>1.14</td>
</tr>
<tr>
<td><strong>General attitude toward concussion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I feel that concussions are less important than other injuries.</td>
<td>3.08</td>
<td>1.23</td>
</tr>
<tr>
<td>2. I feel that Athlete H should tell his coach about the symptoms.</td>
<td>2.40</td>
<td>1.21</td>
</tr>
</tbody>
</table>

*Note. N = 369. SRC = sports-related concussion; responses ranged from one to five, with five indicating the safest attitudes toward SRCs.*

United States and has been determined to be a reliable tool; however, this is the first study examining whether RoCKAS-ST is a valid and reliable tool to assess knowledge and attitudes toward concussion in a non-English-speaking culture such as Pakistan. As demonstrated by the cluster analysis of knowledge index items and the CFA, reliability, and discriminant validity of the attitude index items, the Urdu version of the RoCKAS-ST is a reliable and valid tool for its intended purpose.
Concussion knowledge is vital among athletes, as it supports the timely identification of concussion symptoms (McCrory et al., 2017; Miyashita et al., 2013). RoCKAS-ST CKI was created to determine concussion knowledge gaps and improvements following evidence-based interventions. In the current study, the CKI items were placed into two constructs (moderate difficulty and high difficulty) as compared with the three clusters reported by Rosenbaum and Arnett (2010; i.e., low, moderate, and high difficulties). As none of the CKI items were answered correctly by more than 75% of the participants, the data did not have a low-difficulty construct. Contrary to only three items in the high-difficulty construct found by Rosenbaum and Arnett (2010), nine items were in the high-difficulty construct in the results as more than 55% of respondents answered these items incorrectly. Given that 88.6% of the participants had no previous exposure to concussion awareness programs, the higher number of items under the high-difficulty construct reflects the paucity of SRC knowledge and confirms that the CKI was able to identify the knowledge gap in this population. Based on the results of cluster analysis and experts’ reviews, it is concluded that the CKI is a valid tool for identifying gaps in concussion knowledge among this population.

As this study was based on a hypothetical model of item distribution based on the original study (Rosenbaum & Arnett, 2010), instead of performing exploratory factor analysis before CFA, only CFA was conducted on the Urdu version of CAI items (Byrne, 2010; Mayo, 2015). The CFA results confirmed that the 13 CAI items represented four factors with a desirable goodness of fit for the data collected from this sample of university student-athletes in Pakistan. For Rosenbaum and Arnett (2010), the CAI items did not load well onto a single attitude construct; this suggests that one general factor cannot account for the sample’s total variance and that a multifactorial model best explains the data. Similarly, the data in this study did not load well onto a single construct (Model 1), indicating that a multifactorial model (i.e., the four-factor orthogonal model) best explains the data. Chapman et al. (2018) tested the RoCKAS-ST with the U.S. collegiate students and reported a poor goodness of fit for the CAI items; however, the 13 CAI items loaded well onto the four proposed factors in the current study. Social, psychological, and emotional differences may explain why the CAI produced a good fit in this study. Furthermore, Chapman et al. (2018) identified five factors compared with the four

<table>
<thead>
<tr>
<th>Factor</th>
<th>No. of items</th>
<th>CR</th>
<th>AVE</th>
<th>ORTP</th>
<th>Coach</th>
<th>Physio</th>
<th>PRTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORTP</td>
<td>4</td>
<td>0.839</td>
<td>0.567</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coach</td>
<td>3</td>
<td>0.784</td>
<td>0.548</td>
<td>0.416</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physio</td>
<td>2</td>
<td>0.795</td>
<td>0.663</td>
<td>0.679</td>
<td>0.433</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PRTP</td>
<td>4</td>
<td>0.842</td>
<td>0.575</td>
<td>0.589</td>
<td>0.370</td>
<td>0.376</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. ORTP = views about others’ return to play attitudes; Coach = views about coaches’ concussion management; Physio = views about physiotherapists’ concussion management; PRTP = personal return to play attitudes; CR = composite reliability; AVE = average variance extraction; MSV = maximum shared variance.
### Table 5  Cluster Analysis of CKI

<table>
<thead>
<tr>
<th>Clusters</th>
<th>1: Moderate difficulty</th>
<th>2: High difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Headache (75.3%)</td>
<td>A concussion can only occur if there is a direct hit to the head (41.5%)</td>
</tr>
<tr>
<td>2.</td>
<td>Concussions can sometimes lead to emotional disruptions (68.0%)</td>
<td>Drowsiness (41.5%)</td>
</tr>
<tr>
<td>3.</td>
<td>Symptoms of a concussion can last for several weeks (67.2%)</td>
<td>There is a possible risk of death if a second concussion occurs before the first one has healed (40.7%)</td>
</tr>
<tr>
<td>4.</td>
<td>Even though Player F is still experiencing the effects of the concussion, her performance will be the same as it would be had she not suffered a concussion (62.9%)</td>
<td>It is likely that Player X’s concussion will affect his long-term health and well-being (40.4%)</td>
</tr>
<tr>
<td>5.</td>
<td>After 10 days, symptoms of a concussion are usually completely gone (62.1%)</td>
<td>There is rarely a risk to long-term health and well-being from multiple concussions (40.1%)</td>
</tr>
<tr>
<td>6.</td>
<td>Dizziness (59.3%)</td>
<td>Difficulty concentrating (37.9%)</td>
</tr>
<tr>
<td>7.</td>
<td>If you receive one concussion and you have never had a concussion before, you will become less intelligent (59.6%)</td>
<td>In order to be diagnosed with a concussion, you have to be knocked out (31.7%)</td>
</tr>
<tr>
<td>8.</td>
<td>An athlete who gets knocked out after getting a concussion is experiencing a coma (59.6%)</td>
<td>Sometimes a second concussion can help a person remember things that were forgotten after the first concussion (25.5%)</td>
</tr>
<tr>
<td>9.</td>
<td>After a concussion, people can forget who they are and not recognize others but be perfect in every other way (59.1%)</td>
<td>After a concussion occurs, brain imaging (e.g., CAT scan, MRI, and X-ray,) typically shows visible physical damage (e.g., bruise and blood clot) to the brain (21.7%)</td>
</tr>
<tr>
<td>10.</td>
<td>Being knocked unconscious always causes permanent damage to the brain (57.7%)</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>People who have had one concussion are more likely to have another concussion (56.4%)</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Difficulty remembering (55.8%)</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Feeling in a “fog” (54.2%)</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>It is likely that Player Q’s concussion will affect his long-term health and well-being (53.7%)</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Feeling slowed down (52.6%)</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Sensitivity to light (52.3%)</td>
<td></td>
</tr>
</tbody>
</table>

**Note.** $N = 369$. CKI = Concussion Knowledge Index; CAT = computed tomography; MRI = magnetic resonance imaging. Percentage of participants who answered the CKI items correctly.
factors identified by Rosenbaum and Arnett (2010). Chapman et al. (2018) recruited national collegiate athletic association teams, including noncontact and noncollision sports, whereas only participants from collision or contact sports were recruited in this study. Notably, prior studies have suggested that the type of sports played (Kroshus, Baugh, et al., 2015) and the number of previous concussion experiences (Kroshus, Garnett, et al., 2015) may influence attitudes toward concussions. In addition, Chapman et al. (2018) only collected data from one U.S. collegiate institution, whereas in the current study, participants from several universities were recruited. Hence, it is concluded that the four-factor CAI is a valid and reliable tool for measuring attitudes toward concussions in Urdu-speaking university populations.

Clinical Implications

Adaptation and validation of the RoCKAS-ST into Urdu fill a current gap of available instruments to investigate the understanding of and attitudes toward SRCs in the Urdu-speaking population. Through the Urdu version of the CKI, coaches, managers, and practitioners can evaluate athletes’ knowledge about the causes, course, and sequelae of SRCs and identify the area(s) in need of improvement. With the help of the Urdu version of the CAI, researchers and practitioners can assess participants’ views about SRC reporting and return to play. It will also assist in the investigation of participants’ views about different individuals (i.e., coaches, physiotherapists, and teammates) who may influence athletes’ SRC reporting, thereby assisting in the identification of concerns about reporting an SRC and developing interventions to address these specific concerns. Future researchers may also use the adapted version to evaluate the effectiveness of SRC education interventions for Urdu-speaking athletes.

This study contributes significantly to advancing the evidence on exercise and sports psychology in Pakistan. While sports are a significant part of Pakistani culture and sports psychology publications are on the rise, the field of SRCs remains underresearched (Haider, 2016). In our region, children are taught to tolerate pain, and most individuals with concussions do not seek medical attention until they develop postconcussion syndrome (Dave et al., 2019). Public knowledge on SRCs is particularly scarce, and the injury burden is unknown due to poor reporting and monitoring (Haider, 2016). Thus, assessing SRC knowledge and the factors that drive SRC reporting will benefit athletes and contribute to developing a national policy on SRCs.

Study Limitations

This study is subject to some limitations. First, as men represented 60.7% of the respondents, the data are skewed toward male athletes. Sports participation among women in Islamic countries is often reported to be lower than among men (Laar et al., 2019), which may explain the higher male ratio in this study. Second, all respondents were athletes participating in contact or collision sports. Future studies should also include athletes who play noncontact sports to confirm the fit of the data. Additional exploratory studies are needed to investigate the underlying social, psychological, and emotional factors influencing Pakistani athletes’
attitudes about SRCs and their reporting behaviors with the goal of incorporating these factors into future concussion awareness programs.

**Conclusions**

This study shows that the Urdu version of the RoCKAS-ST is a valid and reliable tool for investigating concussion knowledge and attitudes. It is linguistically equivalent to the original English version and conceptually and culturally appropriate for the Urdu-speaking population. The Urdu version of the RoCKAS-ST can be used to measure knowledge of and attitudes toward concussions in future SRC studies that involve Urdu-speaking athletes.

**References**


Byrne, B.M. (2010). *Structural equation modeling with AMOS: Basic concepts, applications, and programming (multivariate applications series)* (2nd ed.). Routledge.


