1

2

3

4   **Development and Preliminary Validation of the Sport Injury-Related Growth Inventory**

Abstract

Aligned with future research recommendations (e.g., Wadey & Everard, 2021), the purpose of this multi-study investigation was to construct a measure of athletes' experiences of growth following sport injury. Study 1 systematically reviewed the literature on sport injury-related growth (SIRG) and extracted a pool of relevant and specific items. In Study 2, a panel of experts (i.e., academics, sport psychologists, and previously injured athletes) was then asked to quantitatively and qualitatively assess the items for relevance, clarity, and specificity. The final study tested the psychometric properties of the instrument on a sample of previously injured athletes ($N = 452$). The study resulted in a 24-item scale, named the Sport Injury-Related Growth Inventory-24 (SIRGI-24), measuring eight sub-dimensions of SIRG. Satisfactory reliability and construct validity (i.e., factor structure, concurrent validity) were also identified. To conclude, the SIRGI-24 allows researchers and practitioners to assess the SIRG experienced by injured athletes.

Keywords: adversarial growth, stress-related growth, post-traumatic growth, psychological well-being.

Development and Preliminary Validation of the Sport Injury-Related Growth Inventory

Over their sporting careers, athletes' experience injuries that prevent them from training and competing (Brewer, 2009). Although the negative aspects of incurring an injury have been systematically evidenced for several decades (e.g., depression, anxiety, and loss of identity; Brewer et al., 2002; Wiese-Bjornstal et al., 1998), the positive by-products of injury have more recently been studied to complement and problematise previous research to provide a more nuanced understanding of athletes' experiences of sport injury (e.g., how distress can co-exist with positive by-products; Wadey, 2021; Wadey et al., 2021). By positive-by products, we mean increased mental strength, improved self-awareness, and more positive relationships with other people, all of which have been reported following injured athletes' return to competitive sport. Collectively, these positive-by products have recently been referred to as sport injury-related growth (SIRG; Roy-Davis et al., 2017; Wadey & Everard, 2021) which is defined as:

"… a context-specific form of meanings made that can be defined as the end-results of inner (i.e., psychological, physical, embodied) and/or outer (i.e., observable actions) changes that give meaning to a sport injury experience(s) as a result of certain environmental factors (e.g., physical resources) and a cognitive, relational, and cultural meaning-making process (Wadey & Everard, 2021, p. 193).

A pursual of the empirical landscape on SIRG soon reveals that much of the research has been qualitative in nature. For example, researchers have explored the meaning and experiences of SIRG (e.g., Udry et al., 1997), as well as the personal (e.g., personality traits), situational (e.g., social support), and mechanisms (e.g., emotional disclosure) that impact and lead to SIRG (e.g., Salim & Wadey, 2018; Wadey et al., 2011). While this research has greatly helped our understanding of the phenomenon, it is important that future researchers shift to a more inclusive research landscape (cf. Wadey, 2021) and enable quantitative researchers who adhere to a positivist research philosophy to examine this concept and open another way of knowing. Yet, a quantitative measure of SIRG does not exist. Up until now, a few researchers have used the PTGI (Tedeschi & Calhoun, 1996) and SRGS

46 (Park et al., 1996) to assess SIRG (e.g., Brewer et al., 2017; Salim et al., 2015; Wadey et al., 2016).

47 But these measures were not developed for injured athletes and do not include many of the

48 experiences reported in the qualitative literature (e.g., new appropriation and outlook on sport and

49 expanding one's sporting intelligence). As Wadey and Everard reported, "A new measure developed

50 specifically for injured athletes that represents their experiences would significantly extend the

51 current research landscape and help provide a platform for research" (p. 199).

52 Informed by the theory of scale development (DeVellis, 2016; MacKenzie et al., 2011;

53 Tenembaum et al., 2012), The purpose of this multi-study investigation was to construct a measure

54 of SIRG. Specifically, Study 1 aims to synthesize the literature to identity items for measure

55 development. Study 2 aims to assess the content validity of the items and their relevance, clarity, and

56 specificity. The final study aims to examine factor structure of the questionnaire and its psychometric

57 properties.

58 **Study 1**

59 **Thematic Synthesis**

60 A thematic synthesis (Nicholson et al., 2016; Thomas & Harden, 2008) was conducted, which

61 firstly involved a systematic review to identify relevant articles from the following journals :

62 *International Journal of Applied Sport Science (2000-2021), International Journal of Sport and*

63 *Exercise Psychology (1970-2021);Journal of Applied Sport Psychology (1989-2021);Journal of*

64 *Sport and Exercise Psychology (1988-2021); Journal of Sport Behaviour (1978-2021); Journal of*

65 *Sport Sciences (1983-2021); Psychology of Sport and Exercise (2000-2021);Research Quarterly in*

66 *Sport and Exercise(2000-2021); Sport Exercise and Performance Psychology (2012-2021); The*

67 *Sport Psychologist (1984-2019); Qualitative Research in Sport, Exercise and Health (2011-2021);*

68 *Qualitative Research in Sport and Exercise(2009-2010)* and online databases PsycINFO,

69 PsycARTICLES, SPORTDiscus, Scopus, Science Direct, and Google Scholar. The search was

70 limited to articles published in English with no restriction in terms of the date range. To ensure an

71 exhaustive search of the literature was conducted, a Librarian with more than 10 years of experience

72 in search databases was consulted to assist with searching for and retrieving qualitative studies (cf.

73 Barroso et al., 2003). The primary search was conducted using the following combination of search

74 strings:

75   String 1 : Post-traumatic growth* OR Stress-related growth* OR Adversarial growth* OR

76 Benefit finding* OR Perceived benefits* OR Positive outcomes* OR Thriving* OR Well-being*

77   String 2: Sport* OR Sport injury* OR Athlete/athletes* OR Injured athlete/injured athletes*

78   The second method of searching for relevant studies a strategy known as pearl growing

79 (Papaioannou et al., 2010), which consists in examining the reference lists of the eligible full texts to

80 identify any additional studies that might meet the inclusion criteria. Potentially appropriate papers

81 were, therefore, evaluated by title, abstract, and full text, and those studies that did not meet eligibility

82 requirements were excluded.

83 **Criteria for Inclusion and Exclusion**

84   Following recommended guidelines for systematic reviews (Weed, 2005), inclusion and

85 exclusion criteria were refined, and the identified articles were screened using the following criteria:

86 (a) qualitative research methods of data collection were used; (b) participants had sustained a sports-

87 related injury. A sports injury was defined as a bodily tissue or function impairment that had occurred

88 in consequence of sport-related activities such as training, competition, and recreational engagement

89 (Wiese-Bjornstal et al., 2018); and (c) the aim and the scope of the paper was on growth following

90 sport injury.

91 **Item Generation**

92   From the 20 studies identified in the systematic review, a pool of items were generated and

93 reduced in four steps according to guidelines for scale development (DeVellis, 2016; MacKenzie et

94 al., 2011): Step 1 involved extracting data according to item selection criteria: ambiguity, leading

95 questions, reverse coding, negative wording, double negatives, jargon, colloquialism, acronyms,

96 prestige bias, social desirability, acquiescence bias, athlete-specific factors (i.e., items that seemed

97 specific just for some athletes). It should be noted that, according to DeVellis (2016), redundancy

98   was not considered a criterion for exclusion at this stage of questionnaire development. Similarly,

99   according to MacKenzie and colleagues (2011), double-barrelled items were not necessarily removed,

100   but they may have been split in two or more different items.

101   Step 2 involved removing any of the items if they did not align with the definition of SIRG

102   (Wadey & Everard, 2021). In fact, Wadey and Everard's (2021) definition is considered to be a

103   suitable framework for the development of the present questionnaire. In particular, at this step items

104   were removed if they did not describe a perceived change or if this change was not leading to a

105   meaning-making process.

106   In Step 3, items were grouped according to their content using codebook thematic analysis (TA;

107   Braun & Clarke, 2019; 2022). The process of doing the codebook TA involved six phases. The first

108   phase–data familiarisation through the process of immersion–entailed forming ideas about patterns

109   in the data by reading and re-reading the dataset. This phase was done independently by the authors.

110   In the second phase, codes (i.e., segments of data that appear interesting to the authors) were

111   constructed from the dataset that were identified as relevant to the study. In the third phase, the codes

112   were clustered together to develop themes or domain summaries. Specifically, this phase entailed

113   going back and forth with the previous phases (e.g., further data immersion), comparing and

114   contrasting with previous research, and exploring other fields of research of relevance. In the fourth

115   phases–reviewing and refining the themes–a collaborative approach was taken between the authors

116   to strive for consensus between us (Braun & Clarke, 2019; 2022). Here, the co-authors acted as a

117   "critical-friend" to the first author to challenge his construction of the themes. Specifically, the first

118   author presented his interpretations of the data on a regular basis to the co-authors who provided a

119   sounding board to encourage reflection upon, and exploration of, alternative explanations and

120   interpretations. As part of this process of dialogue, the first author was required to make a defendable

121   case that the available data supported his interpretations. Here, statistical criteria were adopted for

122   further item reduction. That is, subscales with less than 6 items were removed in order not to create

123   problems for future statistical analyses (DeVellis, 2016; Froman, 2001). This cut-off was decided to

avoid problems of reliability and identification of the factor structure in the final scale; in fact, a minimum of three items is recommended in the final questionnaire (Froman, 2001), and DeVellis (2016) suggests that, at the stage of item generation, is preferable to have the double of items desired in the final scale. In the fifth phase, themes were defined to show each theme's scope and boundaries. Finally, the sixth phase involved writing up the report (Braun et al., 2016).

Results

The systematic review identified 20 qualitative research papers spanning across 22 years of publications (i.e., Bianco et al., 1999; Ford & Gordon, 1999; Galli & Reel, 2012; Galli & Vealey, 2008; Hurley et al., 2007; Ievleva & Orlick, 1991; Podlog & Eklund, 2005; 2006; 2009; Podlog et al., 2012; Podlog et al., 2010; Podlog et al., 2013; Rose & Jevne, 1993; San Jose, 2003; Tamminen et al., 2013; Tracey, 2003; 2011; Udry et al., 1997; Wadey et al., 2011; Wadey et al., 2013). Altogether these studies involved a large number of athletes (i.e., 629), coming from a variety of sports and competitive levels as well as sustaining different types of injury. Statements drawn from interviews (i.e., semi-structured, structured) and focus groups were extracted and created a pool of 301 items.

This pool of items was reduced to 236 items in Step 1, 65 items of which were removed based on the selection criteria. Specifically, 46 of the items were removed because of their ambiguity. For example, the item "I learned how strong I am" did not specify if it was mental or physical strength; 10 items were removed because athlete-specific factors, such as "I am more independent from my sister" as not all athletes have a sister; 5 items were removed because they were double negatives, for example: "I have learnt that I am not indestructible". Two items were removed because of their colloquialism, as slang words and phrases may be interpreted differently from respondents of different countries or geographical areas (Ford & Scandura, 2018). At step 2, based on the alignment with the definition of SIRG, 159 items were retained and 77 items were removed. For example, those items were removed which described opportunities that the athlete had during the rehabilitation (e.g., "I had more time for the relationship with my boyfriend/girlfriend" or "The injury allowed me to spend more time with my family") and not considered SIRG.

150   At step 3, items were divided into themes based on their content. This categorization initially

151   led to 13 themes: mental toughness (51 items), improved relationships (18 items), injury-related

152   intelligence (18 items), self-concept (16 items), emotional ability (11 items), reappraisal of life (9

153   items), sport intelligence (8 items), reappraisal of sport (8 items), body awareness (6 items), nutrition

154   (4 items), self-encouragement (3 items), time management (3 items), and other aspects (4 items). At

155   step 4, and according to previous guidelines (Froman, 2001; De Vellis, 2003), subscales with less

156   than 6 items were removed in order not to create problems for future statistical analyses. Therefore,

157   the dimensions "nutrition", "self-encouragement", "time management", and "other aspects" were

158   removed. One hundred forty-five items were maintained, whereas 14 were removed. A definition for

159   each of the remaining themes was subsequently elaborated based upon the items' content. These steps

160   are summarised in Table 1.

Discussion

162   Underpinned by a clear conceptual foundation, this study has extended the literature by

163   synthesizing the qualitative literature on SIRG that provides a rigorous evidence-base for scale

164   development. Nine themes were identified: mental toughness, improved relationships, injury-related

165   intelligence, self-concept, emotional ability, reappraisal of life, sport intelligence, reappraisal of sport,

166   and body awareness. Although some of these themes resonate with broader measures, it has also

167   identified several context- and population-specific themes (e.g., injury-related intelligence,

168   reappraisal of sport). Aligned with the growing consensus in the broader growth following adversity

169   literature, SIRG is a multidimensional concept that is context- (e.g., rehabilitation) and population-

170   specific (i.e., injured athletes).

171   To summarize, this study has interpreted and synthesized the research identifying aspects of

172   growth following sport injury. The results of the thematic analysis have produced an innovative

173   taxonomy, depicting SIRG as a multidimensional construct comprising of nine themes. This helps to

174   provide a conceptual foundation of SIRG and items for the subsequent development of a measure of

175   growth following sport injury.

Study 2: Expert Panel Assessment

In Study 2, we aimed to refine the provisional scale labelled SIRGI-145 using content validation procedures. To this purpose, the instrument was assessed twice by judging panels comprising academics and sport psychology practitioners working in the field of psychology of sport injury, and athletes with a history of previous injury. The choice to include both experts in the field and potential test takers was in line with recommendations and previous studies in the field (see, e.g., Arnold et al., 2013; Dunn et al., 1999), and allowed to provide evidence for the content validity of the instrument (DeVellis, 2016).

Method

Sample

Twenty-four judges were recruited for the first assessment of this study: eight academic researchers experienced in the psychology of sport injury (female $n = 6$; male $n = 2$) with a mean age of 48.13 years (SD = 7.23); eight sport psychology practitioners with experience on sport injury (female $n = 6$; male $n = 2$) with a mean age of 36.57 years (SD = 3.98); and eight athletes with history of previous injury (female $n = 4$; male $n = 4$) with a mean age of 22.15 years (SD = 2.27). The inclusion criterion for the academics was to have published at least one paper on the psychology of sport injury in a scientific peer reviewed journal. Practitioners were included if they had at least 2 years of experience working with injured athletes. Participants who were both academics and practitioners were assigned to a group based on the field where they were more experienced. Athletes were included if they sustained an injury keeping them away from sport for at least two weeks. Twelve of the judges included in the first panel were involved in a second assessment 3 months later: four academics (female $n = 2$; male $n = 2$; mean age = 51.67 years; SD = 1.76), four practitioners (female $n = 3$; male $n = 1$; mean age = 36.88 years; SD = 4.39), and four athletes (female $n = 1$; male $n = 3$; mean age = 25.17 years; SD = 1.26).

Measures and Procedure

201 Following ethical approval obtained at the University of the third author, participants were

202 contacted via email. The SIRGI-145 developed in Study 2 was administered to the 24 judges in the

203 first assessment. In this phase, the SIRGI-145 was split in two questionnaire packs of 74 (Pack 1) and

204 71 items (Pack 2) respectively. This was done in order to reduce the amount of work required by

205 every judge and make possible to complete it in a reasonable amount of time. Half of participants (4

206 academics, 4 practitioners, and 4 athletes) were asked to complete the Pack 1, while the other half

207 was asked to complete Pack 2. Items were presented for each sub-dimension, then participants were

208 asked to rate each item according to its relevance ("Does this item reflect the definition of [the sub-

209 dimension]?"), clarity ("Is this item easily understood?"), and specificity ("Is this item specific

210 enough?") with respect to the related sub-dimension. This procedure was line with previous studies

211 on scale development (see, Arnold et al., 2013). Each item was rated on a 5-point Likert scale (from

212 "1 not at all" to "5 completely"). In addition, participants were asked to answer an open-ended

213 question with their comments on each item. At the end of the questionnaire, participants were asked

214 to answer six open-ended questions on general aspects of the questionnaire: (1) "Were the instructions

215 easy to follow? Is there anything else that you think we need to include?"; (2) "Is the questionnaire

216 presented and formatted appropriately?"; (3) "Is the response format for the relevance, clarity and

217 specificity scales appropriate for your responses?"; (4) "Is there anything you would add to the SIRGI

218 to improve it?"; (5) "Is there anything you would remove from the SIRGI to improve it?"; and (6)

219 "Do you have any further comments on the SIRGI?". Based on the participants' ratings and comments

220 the SIRGI-145 was revised and reduced in the number of items. Three months later, half of

221 participants were asked to rate and comment the revised version of the questionnaire. This second

222 assessment was considered in the ethical approval and followed the same procedure of the first, with

223 the exception that all the participants examined the scale in full. This was possible because the revised

224 version of SIRGI was shorter, and it was possible for the judges to assess it in a reasonable amount

225 of time.

226 **Data analysis**

227   Quantitative data were analysed in SPSS 28.0. Means for each item were observed and, for the

228   retention of the items, a cut-off of 4.00 (in a range from 1.00 to 5.00) was adopted both in the first

229   and the second assessment. This was in accordance with Dunn and colleagues' (Dunn et al., 1999)

230   suggestions for item reduction. Kruskal-Wallis tests were performed both in the first and the second

231   assessment to examine possible differences between the three groups (academics, sport psychologists,

232   and athletes). Items were discarded if there was a significant disagreement between groups and one

233   of the groups rated the item below 4.00. For example, if one item was rated 4.50 by academics, 4.50

234   by athletes, but 3.00 by practitioners, then the item was discarded. Therefore, items were retained if

235   they achieved the cut-off score for their relevance, clarity and specificity, and if there was no

236   disagreement between groups. Qualitative data were organized in a table, and they were also explored

237   and analysed. All comments provided by the judges were considered for rewording the items and

238   revising the sub-dimensions.

239   **Results**

240   Quantitative analyses based on the first assessment brought the pool of items from 145 to 90

241   items, and the structure of the questionnaire from nine to eight sub-dimensions (with the removal of

242   "sport intelligence"). For the sub-dimension "mental toughness", 25 items out of 51 from the initial

243   pool were retained. For the sub-dimension "improved relationships", 15 items out of 18 were retained.

244   For "injury-related intelligence", 13 items out of 18 were retained. For "self-concept", 9 items out of

245   16 were retained. For "emotional ability" 9 items out of 11 were retained. For "reappraisal of life", 6

246   items out of 9 were retained. For the sub-dimension "sport intelligence" 2 items out of 8 of the initial

247   pool were retained. As the objective for the final scale was to have at least 3 items for every sub-

248   dimension (Froman, 2001), the sub-dimension "sport intelligence" was removed. For "reappraisal of

249   sport", 8 items out of 8 were retained. Finally, for the sub-dimension "body awareness" 5 items out

250   of 6 from the initial pool were retained.

251   Qualitative data based on the comments provided by the judges in the first assessment were

252   summarized and organized in a table. With regards to the single items, the major issues raised by the

253 judges were relating to: (a) the length of the phrasing (e.g., "some items are too brief"); (b) the

254 specificity of the items for some sub-dimensions; (c) the matching of the items with their sub-

255 dimension; (d) the wording of the items; (e) concerns about the use of academic jargon; (f) concerns

256 about the use of vague/unclear terms. Based on these comments, several items were reworded and

257 maintained, whereas some others were considered for deletion. At this stage, we also started to

258 remove redundant items. Regarding the general aspects of the questionnaire, the judges highlighted

259 the importance of: (a) the consistency with the use of present/past tense across the questionnaire; (b)

260 the wording of items in order to make the questionnaire usable in a prospective way (i.e., avoid "I

261 became…" or "I am more…"); (c) the definitions of each sub-dimension. A focal point was regarding

262 the definition of each sub-dimension. First, according to the experts' suggestions, "mental toughness"

263 was considered too broad as a concept and possibly unclear for the final users; therefore, it was

264 changed to "sense of mastery" in line with the literature on psychological well-being (see, e.g., Durkin

265 & Joseph, 2009; Ryff & Keyes, 1995). Second, "self-concept" was changed to "self-awareness" to

266 better reflect the content of the items. For the same reason "injury-related intelligence" was changed

267 to "responsibility for one's health". The sub-dimensions "reappraisal of sport", "reappraisal of life",

268 and "improved relationships" were renamed respectively "purpose in sport", "purpose in life", and

269 "positive relations with others", this in line with the literature on psychological well-being (Ryff &

270 Keyes, 1995). Definitions for the sub-dimensions were revised according to these changes and to the

271 experts' suggestions.

272 Revising the definitions made the matching with some items problematic; thus, these items

273 were deleted or reworded and assigned to a different sub-dimension. For example, the item "I am

274 more determined to reach my goals" became "I am determined to reach my goals in sport" and was

275 moved from "mental toughness"/"sense of mastery" to the "reappraisal of sport"/"purpose in sport"

276 dimension. Following experts' suggestions, the dimension "body awareness" was enriched with items

277 from a previously validated scale on body awareness (the Body Awareness Questionnaire, BAQ –

278 Shields, Mallory, & Simon, 1989). The revision based on qualitative data led to a 76-item scale,

279 partially different from the initial pool of items, and structured in the following way: sense of mastery

280 (6 items), positive relations with others (12 items), responsibility for one's health (9 items), self-

281 awareness (10 items), emotional ability (6 items), purpose in life (6 items), purpose in sport (14

282 items), and body awareness (13 items).

283   Quantitative analyses based on the second assessment brought the pool of items from 76 to 51

284 items. The structure of the questionnaire maintained 8 sub-dimensions. In particular, for the sub-

285 dimension "sense of mastery", 4 items out of 6 were retained. For the sub-dimension "positive

286 relations with others", 8 items out of 12 were retained. For "responsibility for one's health", 7 items

287 out of 9 were retained. For "self-awareness", 4 items out of 10 were retained. For "emotional ability",

288 4 items out of 6 were retained. For "purpose in life", 5 items out of 6 were retained. For "purpose in

289 sport", 11 items out of 14 were retained. Finally, for the sub-dimension "body awareness" 8 items out

290 of 13 were retained. In addition, the qualitative analyses in the second assessment allowed to select

291 the clearest items and to perfect their wording. This second qualitative assessment led to a 33-item

292 scale structured as follows: sense of mastery (4 items), positive relations with others (5 items),

293 responsibility for one's health (4 items), self-awareness (4 items), emotional ability (4 items), purpose

294 in life (4 items), purpose in sport (4 items), and body awareness (4 items). The revisions brought to

295 the scale following the first and the second assessment are summarized in Table 1.

296 **Discussion**

297   In Study 2, the initial pool of items was reviewed and assessed by two judging panels. Both

298 experts and potential test takers were included in the judging panels in order to demonstrate the

299 content validity of the developed scale. To develop an instrument usable for both research purposes

300 and applied work in sporting contexts, the experts in the judging panels were both academics and

301 practitioners experienced in the field of psychology of sport injury. The content validity of the

302 instrument was then assessed according to Dunn and colleagues' (1999) recommendations, with items

303 and subscales revised and the procedure of assessment repeated. This procedure was consistent with

304 previous studies on scale development in sports and other contexts (see e.g., Arnold, Fletcher, &

305 Daniels, 2013; Gucciardi, Hanton, Gordon, Mallet, & Tenby, 2015).

306 Based on suggestions provided by the experts, a further review of the literature on psychological

307 well-being (e.g., Durkin & Joseph, 2009; Hefferon et al., 2009; Joseph, Maltby, Wood, Stockton,

308 Hunt, & Regel, 2012; Ryff & Keyes, 1995; Springer, & Hauser, 2006) and body awareness (Mehling,

309 Gopisetty, Daubenmier, Price, Hecht, & Stewart, 2009; Shields et al., 1989) allowed for revision of

310 the sub-dimensions and the initial pool of items of the SIRGI. In particular, the dimension "mental

311 toughness" was revised, because it was considered too broad as a concept. The definition was aligned

312 with that of "environmental mastery" (where the high scorer "has a sense of mastery and competence

313 in managing the environment; controls complex array of external activities; makes effective use of

314 surrounding opportunities; able to choose or create contexts suitable to personal needs and values")

315 provided by Ryff and Keyes (1995, p. 727), became "a perceived competence in managing one's

316 environment (e.g., life events, daily frustrations)", and was named "sense of mastery".

317 Similarly, the sub-dimension "body awareness", was modified due to the importance of the

318 construct in the context of physical illness. In fact, Hefferon and colleagues (2009) highlighted the

319 importance of the new awareness of the body experienced by people following physical illness. An

320 examination of the existing scales of body awareness was subsequently undertaken (Mehling et al.,

321 2009) and the BAQ (Shields, 1989) was considered to be appropriate for sporting contexts. New items

322 were therefore extracted from the BAQ and, after the second judges' assessment, were included in

323 the "body awareness" sub-dimension of the SIRGI-33. Ultimately, this process led to a 33-item

324 measure of SIRG, named SIRGI-33, and comprising eight dimensions. This scale demonstrated

325 content validity as an instrument for the assessment of growth experienced by sport performers

326 following the occurrence of sport injuries; it also constitutes a measure of SIRG that needs further

327 validation by testing its factor structure and psychometric properties.

328 **Study 3: Examination of Psychometric Properties**

329   In this final study, a cross-sectional investigation allowed for the examination of the

330   psychometric properties of the developed instrument. Specifically, we assessed: (a) the factor

331   structure of the developed questionnaire; (b) its internal consistency reliability; and (c) its

332   relationships with other relevant variables. This procedure was in line with the most recent standards

333   for test development (see AERA, APA, & NCME, 2014; Tenenbaum et al., 2012; Zumbo & Chan,

334   2014). In particular, Confirmatory Factor Analysis is increasingly seen as an appropriate method to

335   evaluate a theoretical model (Marsh, 2007) and allows for further statistical procedures. Additionally,

336   examining the relationships with other variables allows to prove the concurrent properties of an

337   instrument. To provide this kind of evidence, it is necessary that the instrument is positively correlated

338   with a similar construct and should demonstrate very weak or no correlations with a construct which

339   is considered to be different (Tenenbaum et al., 2012). As SIRG and post-traumatic growth roots in

340   the same theoretical background (see, e.g., Salim & Wadey, 2021), we expected that the components

341   of the SIRGI would correlate positively with sub-dimensions and composite score for the PTGI. On

342   the other hand, as post-traumatic growth is proposed to have no relationship with social desirability

343   (Tedeschi & Calhoun, 1996), we hypothesised the SIRGI to also have weak or no correlations with

344   the Lie Scale.

345   **Method**

346   **Sample**

347   The sample comprised 452 athletes (76,3% men) with a mean age of 23.19 years (SD = 7.33)

348   and involved in different individual (e.g., athletics, boxing, cycling, diving, gymnastics, mixed

349   martial arts, running, swimming, tennis, weightlifting) and team-based sports (e.g., American

350   football, baseball, basketball, cricket, European football, hockey, rugby, softball, volleyball). Most

351   of participants were competing at county, university, or recreational level ($n = 309$), while a minor

352   part at regional ($n = 71$), national ($n = 55$), or international ($n = 17$) level. Inclusion criteria required

353   the athletes to have sustained a sport injury within the last three years, and this injury must have kept

354   them out of training and competition for at least 2 weeks. MacKenzie and colleagues (2011)

355 recommend the sample to be representative of the population, which is the objective of the

356 measurement; so, athletes chosen for this study were athletes with a history of previous injury through

357 sport, and not, for example, athletes injured through other life situations. With regards to the sample

358 size, MacKenzie and colleagues (2011) suggested a minimum of 100-500 participants, and a

359 minimum ratio between the number of respondents and the number of items of at least 3:1. Based on

360 these recommendations, this sample was more than adequate for the assessment of a 33-item scale.

361 **Measures**

362   **Sport injury-related growth.** The Sport Injury-Related Growth Inventory-33 (SIRGI-33)

363 developed in Study 2 was utilized to assess perceptions of psychological changes following sport

364 injury. The scale comprised 33 items divided into the 8 sub-dimensions mentioned above: sense of

365 mastery, positive relations with others, responsibility for one's health, self-awareness, emotional

366 ability, purpose in life, purpose in sport, and body awareness. For administering the questionnaire to

367 the athletes, items were randomised and were introduced by the stem "Please, indicate on each item

368 how much you perceive yourself to have changed as a result of the sport injury". As noted by Linley

369 and Joseph (2004), self-report measures that do not allow for negative responses should be avoided,

370 so an appropriate answer scale was adopted for the instrument. The response format was on a 7-point

371 Likert scale ranging from -3 (much less so now) to +3 (much more so now).

372   **Post-traumatic growth.** The PTGI (Tedeschi & Calhoun, 1996) was adopted to assess post-

373 traumatic growth for comparison with the SIRGI-33. The PTGI is a 21-item scale divided in 5 sub-

374 dimensions: relating to others, new possibilities, personal strength, spiritual change, and appreciation

375 of life. The items were introduced by the stem "please indicate for each statement below the degree

376 to which this change occurred in your life as a result of the sport injury", and the response format was

377 on a 6-point Likert scale ranging from 0 (I did not experience this change as a result of my sport

378 injury) to 5 (I experienced this change to a very great degree as a result of my sport injury). Cronbach

379 alpha values reported in the original study ranged from .67 to .85.

Social desirability. Social desirability was assessed through the Lie scale (Eysenck, Eysenck, & Barrett, 1985), which is a 21-item instrument with response format YES/NO. Examples of questions are "Are all your habits good and desirable ones?" or "Do you always practice what you preach?". The answers are aggregated to obtain a single score ranging from 0 to 21, where 0 expresses no lies and 21 means that the participant lied on every question.

Procedure

Ethical approval for Study 3 was also obtained from the University of the fourth author. The majority of participants ($n = 322$) were approached in person during their university classes, and the questionnaire was administered on paper to them. Another portion ($n = 130$) completed an online survey. The participants who completed the online survey were recruited in different ways: (a) email contact with the sport club of appurtenance; (b) link to the survey posted on social networks.

Data analysis

To prepare data for the analysis, a listwise deletion approach was adopted for the Lie Scale; whereas a pairwise deletion was adopted for the SIRGI-33 and the PTGI items, and missing values in these scales were substituted with means. Further data screening (i.e., descriptive statistics of the sample and data distribution) was performed using IBM SPSS 28.0. Data was then transferred onto IBM AMOS Graphic 28.0 in order to examine the factor structure of the scale through Confirmatory Factor Analyses (CFAs). CFA tests provide a fit for the whole model, and, in particular: a ratio between Chi-square and degrees of freedom lower than 5 indicates an acceptable model (Byrne, 2016); Comparative Fit Index (CFI), Non-normed Fit Index (NNFI) and Incremental Fit Index (IFI) indices must be equal to 0.90 or higher to be considered acceptable (Bentler & Bonnett, 1980; Byrne, 2016), and with values equal to 0.95 or higher to be considered indices of superior fit (Byrne, 2016; Hu & Bentler, 1999); a Root Mean Square Error of Approximation (RMSEA) lower than .10 is acceptable, while an RMSEA lower than .05 is considered excellent (Byrne, 2016); finally, the lower the Aikake Information Criteria (AIC) the better the model fits (Jackson, Gillaspy, & Purc-Stephenson, 2009). Thereafter, data were re-analysed on SPSS to provide information with regards

to the reliability, and the concurrent properties of the instrument. Internal consistency reliability was evaluated through calculation of Cronbach's alphas and MacDonald's omegas, with values ranging from 0.50 and 0.69 considered acceptable, from 0.7 to .89 considered good, and above .90 considered excellent (Taber, 2018; Watkins, 2017). Pearson's correlations between the SIRGI-33 and its sub-dimensions, the PTGI and its sub-dimensions, and the Lie Scale were also evaluated. Strength of Pearson's correlations was described according to Evans' (1996) guidelines: .00-.19 "very week", .20-.39 "weak", .40-.59 "moderate", .60-.79 "strong", and .80-1.00 "very strong".

Results

Factor Structure

Examination of histograms, and values of skewness and kurtosis showed that further parametric tests were allowed. An initial CFA was performed to assess the structure of the SIRGI-33 and possibly select the items with higher factor loadings. A lower order model with eight dimensions was tested (SIRGI-33 lower order), but did not show acceptable fit indices [Model fit: $\chi^2 = 1574.0(467)$, $\chi^2/df = 3,37$, $p < .001$; CFI = 0.89; NNFI = 0.87; IFI = 0.89; RMSEA = .072 (90% CI = .069–.076); $AIC = 1827.96$], and the covariance matrix was not positive definite, with the dimension and "purpose in life" showing multicollinearity problems with most of the other dimensions, and the dimension "emotional ability" showing multicollinearity problems with "sense of mastery". Thus, items were reduced one at a time based on their lowest standardized regression weight. A second criterion was to maintain at least three items for each dimension. This procedure led to a second lower order model (SIRGI-24 lower order) of SIRG with three items for each dimension. Based on Modification Indices (MIs), three correlations were added one at a time between residual errors of items from the same dimension (i.e., residuals of the items 6 and 24, 3 and 22, and 12 and 13). This second version demonstrated acceptable fit indices [Model fit: $\chi^2 = 605.1(221)$, $\chi^2/df = 2,74$, $p < .001$; CFI = 0.94; NNFI = 0.93; IFI = 0.95; RMSEA = .062 (90% CI = .056–.068); $AIC = 811.15$] and did not show any multicollinearity issues. Finally, a model with SIRG as higher-order factor (SIRGI-24 higher order – see Figure 1) was tested and showed similar fit indices [Model fit: $\chi^2 = 649.2(238)$, $\chi^2/df = 2,73$, $p <$

432 .001; CFI = 0.94; NNFI = 0.93; IFI = 0.94; RMSEA = .062 (90% CI = .056–.068); *AIC* = 821.23],

433 allowing for the use of a composite score of SIRG and for the use of its sub-dimensions as

434 interdependent variables. A comparison between these three models is showed in Table 2.

435 **Reliability**

436   Reliability analyses demonstrated excellent alpha and omega values for the composite score of

437 the SIRGI-24 (α = .96; ω = .96) and good values ranging from .73 to .87 for all its sub-dimensions

438 (in detail, sense of mastery α = .83, ω = .84; positive relations with others α = .80, ω = .80;

439 responsibility for one's health α = .83, ω = .83; self-awareness α = .78, ω = .79; emotional ability α =

440 .77, ω = .78; purpose in life α = .83, ω = .83; purpose in sport α = .87, ω = .87; and body awareness

441 α = .73, ω = .74). Similarly, the PTGI in the present study demonstrated excellent values for the total

442 score (α = .97; ω = .97) and good to excellent values for its sub-dimensions (relating to others α =

443 .94, ω = .94; new possibilities α = .91, ω = .92; personal strength α = .88, ω = .88; spiritual change α

444 = .81, ω not computable due to only two items in the sub-dimension; appreciation of life α = .87, ω =

445 .87).

446 **Concurrent Properties**

447   Once the structure of the questionnaire was defined, an analysis of Pearson's correlations was

448 run to explore the relationships of the SIRGI-24 with the other two measurement instruments (see

449 Table 3 for full results). First, weak to moderate positive correlations were found between the sub-

450 dimensions of the SIRGI-24 and the sub-dimensions of the PTGI. Similarly, all the SIRGI-24 sub-

451 dimensions showed weak to strong positive correlations with the PTGI total score. In detail, the

452 dimension "sense of mastery" showed moderate correlations ranging from .421 to .529 (.541 with

453 PTGI total), and the same was true for the "positive relations with others" dimension, which ranged

454 from .403 to .544. (.542 with PTGI total). The dimension "responsibility for one's health"

455 demonstrated weak to moderate correlations ranging from .236 to .436 (.410 with PTGI total), as well

456 as the dimensions "self-awareness", from .238 to .402 (.374 with PTGI total), and "purpose in sport",

457 from .366 to .547 (.524 with PTGI total). The remaining three dimensions all showed moderate

458   correlations: "emotional ability" ranged from .399 to .495 (.486 with PTGI total), "purpose in life"

459   from .466 to .581 (.604 with PTGI total), and "body awareness" from .420 to .522 (.542 with PTGI

460   total). Furthermore, no correlations or very weak correlations, ranging from .125 to .195, emerged

461   between the sub-dimensions of the SIRGI-24 and the Lie Scale ("sense of mastery" = .195, $p < .01$;

462   "positive relations" = .125, $p < .01$; "responsibility for one's health" = .066, $p > .05$; "self-awareness"

463   = .047, $p > .05$; "emotional ability" = .179, $p < .01$; "purpose in life" = .156, $p < .01$; "purpose in

464   sport" = .144, $p < .01$; "body awareness" = .166, $p < .01$).

Discussion

466   Findings from Study 3 provide support for the reliability and validity of the SIRGI-24 for the

467   measurement of SIRG among athletes (see Appendix 1 for items and definitions of the dimensions).

468   In particular, the examination of the factor structure of the scale and its relationships with other

469   variables provide further evidence to the construct validity of the instrument. Analysis of the factor

470   structure confirms an 8-dimension model should be adopted for the SIRGI-24. As both the lower

471   order and the higher order models satisfied criteria of fit, it is legitimate both the use of a composite

472   score of SIRG, and the use of the scores of the eight sub-dimensions as interdependent variables. In

473   line with theoretical perspectives (see, e.g., Salim & Wadey, 2021) positive correlations were found

474   between the SIRGI-24 and the PTGI. As expected, very weak or absent correlations emerged between

475   the SIRGI-24 and the Lie Scale, and this also was in line with previous studies which found the PTGI

476   to be uncorrelated with the construct of social desirability (Tedeschi & Calhoun, 1996). Altogether,

477   these results provide support for the concurrent properties of the developed instrument.

478   If compared with other measures of growth following adversity, the SIRGI-24 demonstrates a

479   stronger internal consistency reliability than the PTGI. In fact, Cronbach's alpha values for the

480   SIRGI-24 and its sub-dimensions ranged from .73 to .96, whereas they ranged between .67 and .90

481   for the PTGI and its sub-dimensions in the original study (Tedeschi & Calhoun, 1996). The

482   Cronbach's alpha value for the total score of the SIRGI-24 is also in line with that of the SRGS, which

483   was .94 for the total score in the original study (Park, et al., 1996). Regarding the dimensionality, the

484 SRGS demonstrated a single dimension of growth, which is in contrast with what emerged in the

485 literature on growth following sport injury. Differently, the PTGI revealed five factors, and this was

486 partially in line with the multiple themes emerged for the growth following sport injury. However,

487 these five factors (relating to others, new possibilities, personal strength, spiritual change, and

488 appreciation of life) were not sport-specific and did not cover all the facets of SIRG. For example, a

489 dimension regarding bodily sensations, such as the "body awareness" of the SIRGI-24, was not

490 covered by the PTGI. On the other hand, some aspects present in the PTGI, such as the "spiritual

491 change", did not emerge in the sport injury-related literature. In contrast, the SIRGI-24 presents eight

492 context-specific dimensions which encompasses all the principal aspects of growth following sport

493 injury, and it seems a more suitable instrument for the assessment of SIRG.

General Discussion

495 The present multi-study paper aimed to develop and validate a measure to assess SIRG. The

496 instrument was named Sport Injury-Related Growth Inventory-24 (SIRGI-24 – see appendix A) and

497 consists of eight sub-scales of three items each: sense of mastery, positive relations with others,

498 responsibility for one's health, self-awareness, emotional ability, body awareness, purpose in life,

499 purpose in sport, and body awareness. These eight sub-dimensions aims to cover all the facets of

500 psychological growth experienced by athletes following the return from sport injury and emerged in

501 the scientific literature on this topic. In line with the most recent guidelines for scale development

502 (AERA, APA, & NCME, 2014; Tenenbaum et al., 2012; Zumbo & Chan, 2014), the construct validity

503 of this instrument was demonstrated through: (a) assessment of its content validity; (b) examination

504 of the factor structure; and (c) analysis of concurrent properties.

505 Assessment of content validity in this multi-study paper followed a rigorous procedure in line

506 with recommendations and previous studies in the field (e.g., Dunn et al., 1999; Arnold et al., 2013).

507 As suggested by Dunn and colleagues (1999), in the selection of judges for the expert panel

508 assessment, the expertise of participants should be preferred over the number of participants. Indeed,

509 this is strength of the current paper, as all the judges involved in the assessment had a specific

expertise in sport injury contexts. On the one hand, academics and sport psychologists provided the majority of comments and suggestions, useful with particular the regards to the theoretical links of the items with the various sub-dimensions and the scale applicability in the field. On the other end, athletes helped to identify and avoid the use of academic jargon in the items wording, and they also brought their injury experience in relation to some items.

Regarding the factor structure of the instrument, almost the totality of the facets of SIRG emerged in Study 1 are covered by the SIRGI-24. However, a few aspects have been lost in the development procedure; in fact, dimensions initially labelled as "sport intelligence", "nutrition", "self-encouragement", and "time management" were removed because they were scarcely reported in the reviewed literature or due to the judges' assessments (see Table 1). Future studies could also evaluate if enriching the questionnaire with items covering these sub-dimensions. If compared with other studies that proposed possible dimensions of SIRG (i.e., Rubio et al., 2021; Wadey et al., 2013) the SIRGI-24 still exhibits its strengths. In particular, Wadey and colleagues' (2013) investigation among sport coaches identified four aspects of growth following sport injury (i.e., personal, psychological, social, and physical), and these aspects are all covered by the SIRGI-24 sub-dimensions. For example, increased "body awareness" and "responsibility for one's health" may well represent physical growth, "positive relations with others" may cover the aspects of social growth, and the other SIRGI-24 sub-dimensions may cover the aspects of personal and psychological growth. Similarly, Rubio and colleagues (2021) proposed five themes: personal growth, improved social life, health benefits, sport benefits, and social support and recognition. Personal growth may be represented by several sub-dimensions of the SIRGI-24 (i.e., "sense of mastery", "self-awareness", and "emotional ability"), improved social life may be referred to "positive relations with others", health and sport benefits overlap with "responsibility for one's health" and "purpose in sport" respectively. Social support and recognition, instead, is described by Rubio and colleagues (2021) as the fact of receiving support, attention and care during the rehabilitation process; these aspects, in particular, were removed at step 2 of Study 1 (i.e., alignment with the definition of SIRG) because

they were considered more as opportunities that the athlete had during the rehabilitation rather than real aspects of growth.

Correlations between the SIRGI-24 and other relevant variables were in line with theoretical expectations, thus demonstrating concurrent properties. In particular, the instrument demonstrated significant positive correlations with the PTGI. Despite both the SRGS (Park et al., 1996) and the PTGI (Tedeschi & Calhoun, 1996) have been previously utilised in sport injury contexts, we preferred to compare the SIRGI-24 with the PTGI, because of its multidimensionality and its adoption in the most recent studies on this topic (i.e., Brewer et al., 2017; Salim & Wadey, 2021). As well as post-traumatic growth (Tedeschi & Calhoun, 1996), also SIRG demonstrated to be uncorrelated or weakly correlated with social desirability, suggesting that growth following sport injury occurs independently from the desire to be appreciated by others.

Future studies could provide further evidence regarding the predictive properties of the SIRGI-24, for example by investigating the validity of this instrument in predicting a successful return to sport or career transition (see, e.g., Chen & Bansal, 2022; Ivarsson et al., 2018). In facts, in the aftermath of injury, athletes' emotions may change also in the course of the day (see, e.g., Santi & Pietrantoni, 2013) and a measure of SIRG can help determine when these fluctuations have ceased, and the athlete has reached a psychological stability. Along with these aspects, future investigations could also adapt the SIRGI-24 for use within other countries and languages, as the linguistic and cultural adaptation of measurement instruments allows sport psychology researchers and practitioners to compare data across different countries (see ISSP Position Stand – Ryba, Stambulova, Gangyan, & Schinke, 2013).

In conclusion, this multi-study paper provides researchers and practitioners with a valid and reliable instrument for the assessment of SIRG among a population of athletes of various age and competitive levels. This scale (i.e., SIRGI-24) allows for the assessment of context-specific sub-dimensions, such as "responsibility for one's health" or "purpose in sport", that were not included in previous measures of growth following adversity (e.g., the PTGI or the SRGS). Consequently, it

562   permits both a deeper exploration of the psychological growth experienced following sport injury and

563   the enhancement of applied psychological interventions with injured athletes.

564   **Disclosure statement**

569   **Ethics statement**

570   The study is in agreement with the declaration of Helsinki.

571   **Data availability statement**

572   The data that support the findings of this study are available from the corresponding author, GS,

573   upon reasonable request.

References

American Educational Research Association, American Psychological Association, & National

    Council on Measurement in Education. (2014). *Standards for educational and psychological*

    testing. American Psychological Association.

Arnold, R., Fletcher, D., & Daniels, K. (2013). Development and validation of the Organisational

    Stressor Indicator for Sport Performers (OSI-SP). *Journal of Sport and Exercise Psychology,*

    35, 180-196. https://doi.org/10.1123/jsep.35.2.180

Barroso, J., Gollop, C. J., Sandelowski, M, Meynell, J., Pearce, P. F., & Collins, L. J. (2003). The

    challenges of searching for and retrieving qualitative studies. *Western Journal of Nursing*

    Research, 25, 153-178. https://doi.org/10.1177/0193945902250034

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of

    covariance structures. *Psychological Bulletin, 88,* 588-606. https://doi.org/10.1037/0033-

    2909.88.3.588

Bianco, T., Malo, S., & Orlick, T. (1999). Sport injury and illness: Elite skiers describe their

    experiences. *Research Quarterly for Exercise and Sport, 70,* 157-169.

    https://doi.org/10.1080/02701367.1999.10608033

Braun, V., & Clarke, V. (2022). Conceptual and design thinking for thematic analysis. *Qualitative*

    Psychology, 9(1), 3. https://doi.org/10.1037/qup0000196

Braun, V., & Clarke, V. (2019) Reflecting on reflexive thematic analysis. *Qualitative Research in*

    Sport, Exercise and Health, 11, 589-597.

    https://doi.org/https://doi.org/10.1080/2159676X.2019.1628806

Braun, V., Clarke, V., & Weate, P. (2016). Using thematic analysis in sport and exercise research.

    In B. Smith & A. C. Sparkes (Eds.), *Routledge handbook of qualitative research in sport and*

    exercise (pp. 191-205). London: Routledge.

Brewer, B. W. (2009). Injury prevention and rehabilitation. In B. W. Brewer (Ed.), *Sport Psychology* (pp. 83-96). Chichester, UK: Wiley-Blackwell for the International Olympic Committee. ISBN: 978-1-405-17363-6

Brewer, B. W., Andersen, M. B., & Van Raalte, J. L. (2002). Psychological aspect of sport injury rehabilitation: Toward a biopsychosocial approach. In D. L. Mostofsky & L. D. Zaichkowsky (Eds.), *Medical and psychological aspects of sport and exercise* (pp. 41-54). Fitness Information Technology.

Brewer, B. W., Cornelius, A. E., VanRaalte, J. L., & Tennen, H. (2017). Adversarial growth after anterior cruciate ligament reconstruction. *Journal of Sport and Exercise Psychology, 39,* 134-144. https://doi.org/10.1123/jsep.2016-0210

Byrne, B. M. (2016). *Structural equation modeling with AMOS.* (3rd ed.). Routledge.

Chen, C. P., Bansal, J. (2022). Assisting athletes facing career transitions post-injury. *International Journal of Educational and Vocational Guidance, 22,* 1-21. https://doi.org/10.1007/s10775-021-09469-0

DeVellis, R. F. (2016). *Scale development. Theory and applications.* (4th ed.). Sage

Dunn, J. G. H., Bouffard, M., & Rogers, W. T. (1999). Assessing item content-relevance in sport psychology scale-construction research: Issues and recommendations. *Measurement in Physical Education and Exercise Science, 3,* 15-36. https://doi.org/10.1207/s15327841mpee0301_2

Durkin, J., & Joseph, S. (2009). Growth following adversity and its relation with subjective well-being and psychological well-being. *Journal of Loss and Trauma, 14,* 228-234. https://doi.org/10.1080.15325020802540561

Evans, J. D. (1996). *Straightforward statistics for the behavioral sciences.* Brooks/Cole Publishing.

622   Eysenck, S. B. G., Eysenck, H. J., & Barrett, P. (1985). A revised version of the psychoticism

623   scale. *Journal of Personality and Individual Differences, 6,* 21-29.

624   https://doi.org/10.1016/0191-8869(85)90026-1

625   Ford, I. W., & Gordon, S. (1999). Coping with sport injury: Resource loss and the role of social

626   support. *Journal of Personal and Interpersonal Loss, 4,* 243-256.

627   https://doi.org/10.1080/10811449908409733

628   Ford, L. R., & Scandura, T. A. (2018). A typology of threats to construct validity in item

629   generation. *American Journal of Management, 18*(2), 132-142.

630   https://doi.org/10.33423/ajm.v18i2.298

631   Froman, R. D. (2001). Elements to consider in planning the use of factor analysis. *Southern*

632   *Online Journal of Nursing Research, 2,* 1-22. Retrieved online on October 15 2021 at

633   https://www.snrs.org/sites/default/files/SOJNR/iss05vol02.pdf

634   Galli, N., & Reel, J. J. (2012). 'It was hard, but it was good': A qualitative exploration of stress-

635   related growth in Division I intercollegiate athletes. *Qualitative Research in Sport, Exercise*

636   *and Health, 4,* 297-319. https://doi.org/10.1080/2159676X.2012.693524

637   Galli, N., & Vealey, R. S. (2008). "Bouncing back" from adversity: Athletes' experiences of

638   resilience. *The Sport Psychologist, 2,* 316-335. https://doi.org/10.1123/tsp.22.3.316

639   Gucciardi, D. F., Hanton, S., Gordon, S., Mallet, C. J., & Tenby, P. (2015). The concept of mental

640   toughness: Tests of dimensionality, nomological network, and traitness. *Journal of*

641   *Personality, 83,* 26-44. https://doi.org/10.1111/jopy.12079

642   Hefferon, K., Grealy, M., & Mutrie, N. (2009). Post-traumatic growth and life-threatening

643   physical illness: A systematic review of the qualitative literature. *British Journal of Health*

644   *Psychology, 14,* 343-378. https://doi.org/10.1348/135910708X332936

645   Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis:

646   Conventional criteria versus new alternatives. *Structural Equation Modeling: A*

647   *Multidisciplinary Journal, 6,* 1-55. https://doi.org/10.1080/10705519909540118

648   Hurley, O. A., Moran, A., & Guerin, S. (2007). Exploring athletes' experience of their injuries: A

649   qualitative investigation. *Sport and Exercise Psychology Review, 3,* 14-22.

650   Ievleva, L., Orlick, T. (1991). Mental links to enhanced healing: An exploratory study. *The Sport*

651   *Psychologist, 5,* 25-40. https://doi.org/10.1123/tsp.5.1.25

652   Ivarsson, A., Stambulova, N., & Johnson, U. (2018). Injury as a career transition: Experiences of a

653   Swedish elite handball player. *International Journal of Sport and Exercise Psychology, 16*(4),

654   365-381. https://doi.org/10.1080/1612197X.2016.1242149

655   Jackson, D. L., Gillaspy Jr, A. J., & Purc-Stephenson, R. (2009). Reporting practices in

656   Confirmatory Factor Analysis: An overview and some recommendations. *Psychological*

657   *Methods, 14,* 6-23. https://doi.apa.org/doi/10.1037/a0014694

658   Joseph, S., Maltby, J., Wood, A. M., Stockton, H., Hunt, N., & Regel, S. (2012). The

659   Psychological Well-Being–Post-Traumatic Changes Questionnaire (PWB-PTCQ): Reliability

660   and validity. *Psychological Trauma: Theory, Research, Practice, and Policy, 4,* 420-428.

661   https://doi.org/10.1037/a0024740

662   Linley, P. A., & Joseph, S. (2004). Positive change following trauma and adversity: A review.

663   *Journal of Traumatic Stress, 6,* 271-279.

664   https://doi.org/10.1023/B:JOTS.0000014671.27856.7e

665   MacKenzie, S. B., Podsakoff, P. M., & Podsakoff, N. P. (2011). Construct measurement and

666   validation procedures in MIS and behavioural research: Integrating new and existing

667   techniques. *MIS Quarterly, 35,* 293-334. https://doi.org/10.2307/23044045

668   Marsh, H. W. (2007). Application of confirmatory factor analysis and structural equation

669   modeling in sport and exercise psychology. In G. Tenenbaum & R. C. Eklund (Eds.),

670   *Handbook of sport psychology* (pp. 774-798). John Wiley & Sons Inc.

671   Mehling, W. E., Gopisetty, V., Daubenmier, J., Price, C. J., Hecht, F. M., & Stewart, A. (2009).

672   Body awareness: Construct and self-report measures. *PLoS ONE, 4,* e5614.

673   https://doi.org/10.1371/journal.pone.0005614

674   Nicholson, E., Murphy, T., Larkin, P., Normand, C., & Guerin, S. (2016). Protocol for a thematic

675   synthesis to identify key themes and messages from a palliative care research network. *BMC*

676   *Research Notes, 9,* 478. https://doi.org/10.1186/s13104-016-2282-1

677   Papaioannou, D., Sutton, S., Carroll, C., Booth, A., & Wong, R. (2010). Literature searching for

678   social science systematic reviews: Consideration of a range of search techniques. *Health*

679   *Information & Libraries Journal, 27,* 114-122. https://doi.org/10.1111/j.1471-

680   1842.2009.00863.x

681   Park, C. L., Cohen, L. H., & Murch, R. L. (1996). Assessment and prediction of stress-related

682   growth. *Journal of Personality, 64,* 71-105. https://doi.org/10.1111/j.1467-

683   6494.1996.tb00815.x

684   Podlog, L., & Eklund R. C. (2005). Return to sport after serious injury: A retrospective

685   examination of motivation and psychological outcomes. *Journal of Sport Rehabilitation, 14,*

686   20-34. https://doi.org/10.1123/jsr.14.1.20

687   Podlog, L., & Eklund, R. C. (2006). A longitudinal investigation of competitive athletes' return to

688   sport following serious injury. *Journal of Applied Sport Psychology, 18,* 44-68.

689   https://doi.org/10.1080/10413200500471319

690   Podlog, L., & Eklund, R. C. (2009). High-level athletes' perceptions of success in returning to

691   sport following injury. *Psychology of Sport and Exercise, 10,* 535-544.

692   https://doi.org/10.1016/j.psychsport.2009.02.003

693   Podlog, L., Kleinert, J., Dimmock, J., Miller, J., & Shiperd, A. M. (2012). A parental perspective

694   on adolescent injury rehabilitation and return to sport experiences. *Journal of Applied Sport*

695   *Psychology, 24,* 175-190. https://doi.org/10.1080/10413200.2011.608102

696   Podlog, L., Lochbaum, M., & Stevens, T. (2010). Need satisfaction, well-being, and perceived

697   return-to-sport outcomes among injured athletes. *Journal of Applied Sport Psychology, 22,*

698   168-182. https://doi.org/10.1080/10413201003664665

699   Podlog, L., Wadey, R., Stark, A., Lochbaum, M., Hannon, J., & Newton, M. (2013). An

700   adolescent perspective on injury recovery and the return to sport. *Psychology of Sport and*

701   *Exercise, 14,* 437-446. https://doi.org/10.1016/j.psychsport.2012.12.005

702   Rose, J., & Jevne, R. F. J. (1993). Psychosocial processes associated with athletic injuries. *The*

703   *Sport Psychologist, 7,* 309-328. https://doi.org/10.1123/tsp.7.3.309

704   Roy-Davis, K., Wadey, R., & Evans, L. (2017). A grounded theory of sport injury-related growth.

705   *Sport, Exercise, and Performance Psychology, 6,* 35-52. https://doi.org/10.1037/spy0000080

706   Rubio, V. J., Quartiroli, A., Podlog, L. W., & Olmedilla, A. (2020). Understanding the dimensions

707   of sport-injury related growth: A DELPHI method approach. *PLOS ONE, 15,* e0235149.

708   https://doi.org/10.1371/journal.pone.0235149

709   Ryba, T. V., Stambulova, N. B., Gangyan, S., & Schinke, R. J. (2013). ISSP Position Stand:

710   Culturally competent research and practice in sport and exercise psychology. *International*

711   *Journal of Sport and Exercise Psychology, 11,* 123-142.

712   https://doi.org/10.1080/1612197X.2013.779812

713   Ryff, C. D., & Keyes, C. L. M. (1995). The structure of psychological well-being revisited.

714   *Journal of Personality and Social Psychology, 69,* 719-727. https://doi.org/10.1037/0022-

715   3514.69.4.719

716   Salim, J., & Wadey, R. (2018). Can emotional disclosure promote sport injury-related growth?

717   *Journal of Applied Sport Psychology, 30,* 367-387.

718   https://doi.org/10.1080/10413200.2017.1417338

719   Salim, J., & Wadey, R. (2021). Using gratitude to promote sport injury-related growth. *Journal of*

720   *Applied Sport Psychology, 33,* 131-150. https://doi.org/10.1080/10413200.2019.1626515

721   Salim, J., Wadey, R., & Diss, C. (2015). Examining the relationship between hardiness and

722   perceived stress-related growth in a sport injury context. *Psychology of Sport and Exercise,*

723   *19,* 10-17. https://doi.org/10.1016/j.psychsport.2014.12.004

724   San Jose, A. (2003). Injury of elite athletes: Sport- and gender-related representations.

725   *International Journal of Sport and Exercise Psychology, 1,* 434-459.

726   https://doi.org/10.1080/1612197X.2003.9671729

727   Santi, G., & Pietrantoni, L. (2013). Psychology of sport injury rehabilitation: a review of models

728   and interventions. *Journal of Human Sport and Exercise, 8*(4), 1029-1044.

729   https://doi.org/10.4100/jhse.2013.84.13

730   Shields, S. A., Mallory, M. E., & Simon, A. (1989). The Body Awareness Questionnaire:

731   Reliability and validity. *Journal of Personality Assessment, 53,* 802-815.

732   https://doi.org/10.1207/s15327752jpa5304_16

733   Springer, K. W., & Hauser, R. M. (2006). An assessment of the construct validity of Ryff's Scales

734   of Psychological Well-Being: Method, mode, and measurement effects. *Social Science*

735   *Research, 35*, 1080–1102. https://doi.org/10.1016/j.ssresearch.2005.07.004

736   Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research

737   instruments in science education. *Research in Science Education, 48,* 1273-1296.

738   https://doi.org/10.1007/s11165-016-9602-2

739   Tamminen, K. A., Holt, N. L., & Neely, K. (2013). Exploring adversity and the potential growth

740   among elite female athletes. *Psychology of Sport and Exercise, 14,* 28-36.

741   https://doi.org/10.1016/j.psychsport.2012.07.002

742   Tedeschi, R. G., & Calhoun, L. G. (1996). The post-traumatic growth inventory: Measuring the

743   positive legacy of trauma. *Journal of Traumatic Stress, 9,* 455-471.

744   https://doi.org/10.1007/BF02103658

745   Tenenbaum, G., Eklund, R. C., & Kamata, A. (2012). *Measurement in sport and exercise*

746   *psychology.* Human Kinetics.

747   Thomas, J., & Harden, A. (2008). Methods for the thematic synthesis of qualitative research in

748   systematic reviews. *BMC Medical Research Methodology, 8,* 45.

749   https://doi.org/10.1186/1471-2288-8-45

Tracey, J. (2003). The emotional response to the injury and rehabilitation process. *Journal of Applied Sport Psychology, 15,* 279-293. https://doi.org/10.1080/714044197

Tracey, J. (2011). Self-cultivation and meaning through the experience of injury rehabilitation: A case study of two female basketball players. *Journal of Excellence, 15,* 28-39.

Udry, E., Gould, D., Bridges, D., & Beck, L. (1997). Down but not out: Athlete responses to season-ending injuries. *Journal of Sport and Exercise Psychology, 19,* 229-248. https://doi.org/10.1123/jsep.19.3.229

Wadey, R. (2021). *Sport injury psychology: Cultural, relational, methodological, and applied considerations.* Routledge.

Wadey, R., Clark, S., Podlog, L., & McCullough, D. (2013). Coaches' perceptions of athletes' stress-related growth following sport injury. *Psychology of Sport and Exercise, 14,* 125-135. https://doi.org/10.1016/j.psychsport.2012.08.004

Wadey, R., Day, M., & Howells, K. (2021). *Growth following adversity in sport: A mechanism to positive change.* Routledge.

Wadey, R., Evans, L., Evans, K., & Mitchell, I. (2011). Perceived benefits following sport injury: A qualitative examination of their antecedents and underlying mechanisms. *Journal of Applied Sport Psychology, 23,* 142-158. https://doi.org/10.1080/10413200.2010.543119

Wadey, R., & Everard, C. (2021). Sport Injury-Related Growth: A conceptual foundation. In R. Wadey, M. Day, & K. Howells (Eds.), *Growth following adversity in sport: A mechanism to positive change* (pp. 189-203). Routledge.

Wadey, R., Podlog, L., Galli, N., Mellalieu, S. D. (2016). Stress-related growth following sport injury: Examining the applicability of the organismic valuing theory. *Scandinavian Journal of Medicine and Science in Sports, 26,* 1132-1139. https://doi.org/10.1111/sms.12579

Wadey, R., Roy-Davis, K., Evans, L., Howells, K., Salim, J., & Diss, C. (2019). Sport psychology consultants' perspectives on facilitating Sport-Injury-Related Growth. *The Sport Psychologist, 33,* 245-255. https://doi.org/10.1123/tsp.2018-0110

776   Watkins, M. W. (2017). The reliability of multidimensional neuropsychological measures: From

777   alpha to omega. *The Clinical Neuropsychologist, 31,* 1113-1126.

778   https://doi.org/10.1080/13854046.2017.1317364

779   Weed, M. (2005). "Meta Interpretation": A method for the interpretive synthesis of qualitative

780   research. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *6*.

781   https://doi.org/10.17169/fqs-6.1.508

782   Wiese-Bjornstal, D. M., Smith, A. M., Shaffer, S. M., & Morrey, M. A. (1998). An integrated

783   model of response to sport injury: Psychological and sociological dynamics. *Journal of*

784   *Applied Sport Psychology, 10,* 46-69. https://doi.org/10.1080/10413209808406377

785   Wiese-Bjornstal, D. M., White, A. C., Wood, K. N., & Russell, H. C. (2018). Sport medicine

786   psychology. In T. S. Horn & A. L. Smith (Eds.), *Advances in Sport and Exercise Psychology*

787   (4th ed.) (pp.387-408). Champaign, IL: Human Kinetics.

788   Zumbo, B. D., & Chan, E. K. H. (2014). *Validity and validation in social, behavioral, and health*

789   *sciences.* Springer.

790 **Appendix 1**

791 Items of the SIRGI-24 and definitions of the sub-dimensions.

Sport Injury-Related Growth Inventory-24 (SIRGI-24)

Sport injury-related growth refers to those perceived changes that propel the injured athletes to a higher level of functioning than that which existed prior to the injury

---

"Sense of mastery" is a perceived competence in managing one's environment (e.g., life events, daily frustrations).

3. I can overcome challenging non-sporting life events.
17. I can manage the responsibilities of my daily life.
22. I can cope with the hassles of everyday life.

"Positive relations with others" where the person has good relationships with others and understands the importance of human relationships.

6. I have a good relationship with other people in sport.
10. I have good relationships with other people outside of sport (e.g., friends and family).
24. I value trust in a relationship.

"Responsibility for one's health" is an appreciation of being healthy and having an understanding of healthy behaviours.

9. I appreciate the importance of being healthy.
12. I understand how healthy behaviours can contribute to my sporting performance.
13. I have a good understanding of healthy behaviours.

"Self-awareness" is being aware of one's personal strengths, limitations, and qualities.

11. I am aware of my limitations in sport.
14. I am aware of my strengths in sport.
15. I am aware of my qualities.

"Emotional ability" is an ability to understand and regulate one's emotions.

1. I am able to manage my emotions outside of sport.
4. I have the ability to manage my emotions in sport.
8. I understand my own emotions.

"Purpose in life" is a sense of purpose and an appreciation on one's life.

2. I know what is important to me in life.
5. I enjoy working towards my plans to make them a reality.
19. I enjoy making plans for the future.

"Purpose in sport" is a sense of purpose and an appreciation on sport in one's life.

20. I am determined to reach my goals in sport.
21. I know what I want to get from sport.
23. I have a clear idea of what I want to achieve in sport.

"Body awareness" is having the capacity to perceive and understand one's bodily sensations, processes, and actions.

7. I know how much sleep I will need at night in order to wake up refreshed.
16. I always know when I have exerted myself to the point where I will be sore the next day.
18. I am aware of internal changes in my body (e.g., body temperature, heart beating).

792

793

794 **Table 1**

795 *Phases of item reduction.*

Study	Phase	Outcome
Study 1: Thematic synthesis	Systematic review and item extraction	301 items extracted from twenty scientific papers on psychological growth following sport injury.
	Step 1: Item selection criteria	236 items (65 items removed based on item selection criteria, e.g., due to ambiguity in the wording).
	Step 2: Alignment with the definition of SIRG	159 items (77 items removed because they did not align with the definition of SIRG).
	Step 3: Thematic analysis	159 items divided into 13 themes: mental toughness (51 items), improved relationships (18 items), injury-related intelligence (18 items), self-concept (16 items), emotional ability (11 items), reappraisal of life (9 items), reappraisal of sport (8 items), sport intelligence (8 items), body awareness (6 items), nutrition (4 items), self-encouragement (3 items), time management (3 items), other aspects (4 items).
	Step 4: Statistical criteria	145 items divided into 9 themes: mental toughness (51 items), improved relationships (18 items), injury-related intelligence (18 items), self-concept (16 items), emotional ability (11 items), reappraisal of life (9 items), reappraisal of sport (8 items), sport intelligence (8 items), body awareness (6 items). Based on scale development guidelines, dimensions with less than 6 items were removed. A definition for each theme was elaborated.
Study 2: Expert panel assessment	1st assessment (quantitative)	90 items divided into 8 themes: mental toughness (25 items), improved relationships (15 items), injury-related intelligence (13 items), self-concept (9 items), emotional ability (9 items), reappraisal of life (6 items), reappraisal of sport (8 items), body awareness (5 items). The theme "sport intelligence" was removed because it remained with less than 3 items.
	1st assessment (qualitative)	76 items partially reorganised into 8 themes: "mental toughness" redefined as "sense of mastery" (6 items); "improved relationships" redefined as "positive relations with others" (12 items); "injury-related intelligence" redefined as "responsibility for one's health" (9 items); "self-concept" enriched with items from the previous "mental toughness" theme and redefined as "self-awareness" (10 items); emotional ability (6 items); "reappraisal of life" redefined as "purpose in life" and enriched with new items (6 items); "reappraisal of sport" enriched with items from the previous "mental toughness" theme and redefined as "purpose in sport" (14 items), "body awareness" enriched with new items (13 items). Elaboration of new definitions for each theme.
	2nd assessment (quantitative)	51 items divided into 8 themes: sense of mastery (4 items), positive relations with others (8 items), responsibility for one's health (7 items), self-awareness (4 items), emotional ability (4 items), purpose in life (5 items), purpose in sport (11 items), body awareness (8 items).
	2nd assessment (qualitative)	SIRGI-33: 33 items divided into 8 themes: sense of mastery (4 items), positive relations with others (5 items), responsibility for one's health (4 items), self-awareness (4 items), emotional ability (4 items), purpose in life (4 items), purpose in sport (4 items), body awareness (4 items). Definitions confirmed as in 1st qualitative assessment.
Study 3: Examination of psychometric properties	CFA	SIRGI-24: confirmation of 8 dimensions in line with previous themes; selection of the three strongest items for each dimension, and definitions slightly revised to reflect the content of the remaining items; both a lower order model and a model with SIRG as high ordered factor showed acceptable fit indices.

796

797   **Table 2**

798   *Comparison between the three proposed models for the SIRGI.*

Model	χ^2	df	p	(χ^2/df)	CFI	NNFI	IFI	RMSEA	AIC	notes
SIRGI-33 8-factor lower order	1574.0	467	< .001	(3.4)	0.89	0.87	0.89	.072 CI=.069-.076	1827.96	Covariance matrix not positively definite
SIRGI-24 8-factor lower order	605.1	221	< .001	(2.7)	0.94	0.93	0.95	.062 CI=.056-.068	811.15	
SIRGI-24 8-factor higher order	649.2	238	< .001	(2.7)	0.94	0.93	0.94	. 062 CI=.056-.068	821.23	

799

800

Table 3

*Correlations between the SIRGI-24, the PTGI, and the Lie scale.*

	SM	PR	RH	SA	EA	PL	PS	BA	SIRGI total	1	2	3	4	5	PTGI total	Lie scale
SIRGI-24																
Sense of mastery (SM)	(.83)															
Positive relations with others (PR)	.681**	(.80)														
Responsibility for one's health (RH)	.599**	.690**	(.83)													
Self-awareness (SA)	.578**	.661**	.711**	(.78)												
Emotional ability (EA)	.776**	.604**	.604**	.545**	(.77)											
Purpose in life (PL)	.759**	.744**	.664**	.629**	.686**	(.83)										
Purpose in sport (PS)	.661**	.649**	.586**	.561**	.573**	.744**	(.87)									
Body awareness (BA)	.676**	.727**	.660**	.634**	.605**	.725**	.615**	(.73)								
Total score	.858**	.862**	.822**	.790**	.805**	.892**	.815**	.840**	(.96)							
PTGI																
Relating to others (1)	.502**	.544**	.370**	.331**	.432**	.560**	.489**	.521**	.563**	(.94)						
New possibilities (2)	.500**	.493**	.387**	.353**	.455**	.568**	.460**	.497**	.557**	.824**	(.91)					
Personal strength (3)	.529**	.500**	.436**	.402**	.495**	.581**	.547**	.522**	.602**	.842**	.819**	(.88)				
Spiritual change (4)	.421**	.403**	.236**	.238**	.399**	.466**	.366**	.420**	.443**	.722**	.681**	.667**	(.81)			
Appreciation of life (5)	.496**	.469**	.393**	.356**	.438**	.552**	.494**	.475**	.552**	.819**	.844**	.843**	.671**	(.87)		
Total score	.541**	.542**	.410**	.374**	.486**	.604**	.524**	.542**	.604**	.951**	.929**	.924**	.783**	.916**	(.97)	
Lie Scale	.195**	.125**	.066	.047	.179**	.156**	.144**	.166**	.162**	.235**	.204**	.212**	.276**	.200**	.241**	-

Notes. Alpha values are reported between parentheses. *Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

Figure 1

806 *Higher order model of the SIRGI-24.*
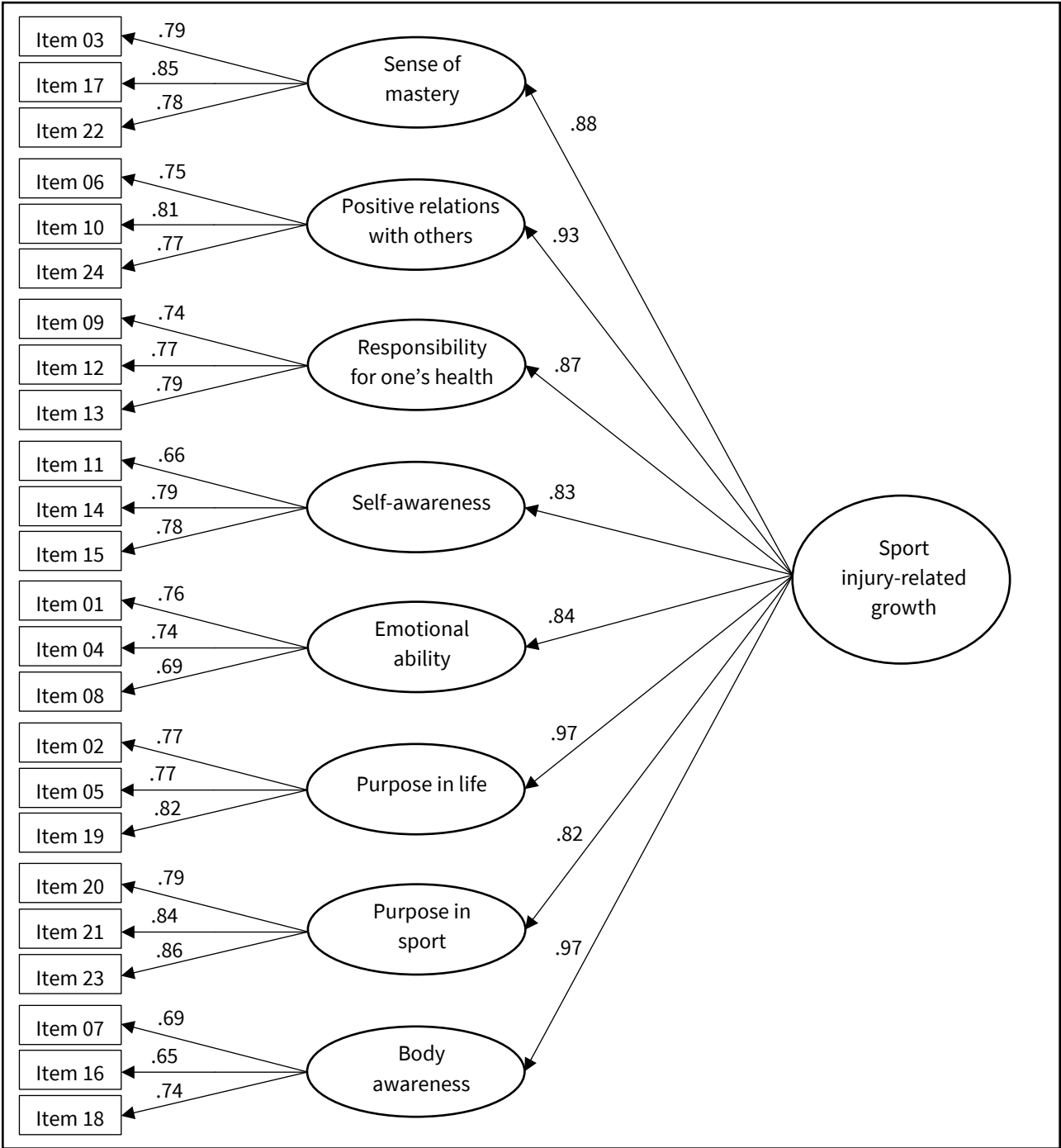
807 *Notes.* Standardized estimates are reported in the figure. Residual errors are not reported in order to

808 simplify the figure. Model fit: $\chi^2 = 649.2(238)$, $\chi^2/\text{df} = 2.73$, $p < .001$; CFI = 0.94; NNFI = 0.93; IFI

809 = 0.94; RMSEA = .062 (90% CI = .056–.068); *AIC* = 821.23.