Assessing Lifetime Stressor Exposure in Sport Performers: Associations with Trait Stress Appraisals, Health, Well-Being, and Performance

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Abstract

Research has found that greater lifetime stressor exposure increases the risk for mental and physical health problems. Despite this, few studies have examined how stressors occurring over the entire lifespan affect sport performers' health, well-being, and performance, partly due to the difficulty of assessing lifetime stressor exposure. To address this issue, we developed a sport-specific stress assessment module (Sport SAM) for the Stress and Adversity Inventory (STRAIN) and then analyzed the instrument's usability, acceptability, validity, and test-retest reliability. Furthermore, we examined whether trait-like tendencies to appraise stressful situations as a challenge or threat mediated the relationship between lifetime stressor exposure and health, well-being, and performance. Participants were 395 sport performers (M_{age} = 22.50 years, *SD* = 5.33) who completed an online survey. Results revealed that the Sport SAM demonstrated good usability and acceptability, good concurrent validity in relation to the Adult STRAIN (*r*s = .23 to .29), and very good test-retest reliability (r_{icc} = .87 to .89). Furthermore, the Sport SAM was significantly associated with symptoms of depression (β = .21 to .24, *ps* ≤ .001) and anxiety (β = .13 to .19, *ps* ≤ .012), and general physical (β = .24 to .27, *ps* = ≤ .001) and mental (β = .23 to .32, $p \leq .001$) health complaints. Finally, we found that associations between total lifetime non-sport and sport-specific stressor severity and health were mediated by trait stress appraisals. Consequently, these findings may help practitioners better identify sport performers who are at risk of developing stress-related health problems.

Keywords: adversity, allostatic load, assessment, challenge and threat, stressors

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It is well-established that exposure to life stressors can affect health, well-being, and performance through psychological (e.g., cognitive appraisals) and biological (e.g., sympathetic nervous system, immunological responses) pathways (Arnold & Fletcher, 2021; Slavich, 2020). Moreover, greater exposure to stressors over the lifespan has been related to a variety of mental and physical health conditions, including anxiety disorders, depression, and heart disease (Slavich & Shields, 2018). One theoretical framework that explains how stressor exposure affects health is the integrative model of lifespan stress and health (Epel et al., 2018). This model comprises three main elements: (a) contextual factors, including individual and environmental factors (e.g., genetics and developmental contexts), cumulative life stressor exposure (e.g., past and current stressors), and protective factors (e.g., social, psychological, and behavioural processes); (b) psychophysiological stress responses (e.g., cognitive appraisals, cardiovascular reactivity); and (c) biological aging and disease. As a result, this model identifies individual and environmental factors that shape an individual's vulnerability to stressor-related health problems (Epel et al., 2018). This is particularly noteworthy given that an important factor missing from many stress and health models (e.g., transactional model of stress and coping; Lazarus & Folkman, 1984) is *cumulative* stressor exposure, which refers to the total count or severity of all the stressors an individual has experienced across their lifespan (Lam et al., 2019). Overall, this model suggests that contextual factors (e.g., greater lifetime stressor exposure) alter how individuals typically respond to stressors (e.g., repeated threat appraisals), which affects health (Epel et al., 2018). The present study represented a novel test of this model and sought to advance our understanding of how lifetime stressor exposure is associated with sport performers' health, well-being, and performance.

Although the theoretical literature describing how lifetime stressor exposure may affect

health is large, the empirical literature is surprisingly limited (Slavich & Shields, 2018). This is partly because no measurement tool has existed for systematically assessing lifetime stressor exposure (Slavich, 2019). To elaborate, prior research has largely defined life stress as a single unitary construct even though different types of life stressors exist (e.g., acute life events vs. chronic difficulties) and occur across different time periods (e.g., early life vs. adulthood), life domains (e.g., housing, health, work), and social-psychological characteristics (e.g., interpersonal loss, physical danger, humiliation; Epel et al., 2018). As a result, the current understanding of lifetime stressor exposure is overly simplistic and has largely ignored the fact that different types of stressors can have varying effects on health (Epel et al., 2018).

To address these issues, G. M. Slavich developed the Stress and Adversity Inventory (STRAIN), which has been used to examine associations between lifetime stressor exposure and a variety of psychological, biological, and health outcomes (see Slavich and Shields 2018). Most notably, greater lifetime stressor exposure has been related to more symptoms of depression (e.g., Pegg et al., 2019) and anxiety disorders (e.g., Slavich et al., 2019), and more physical health complaints (e.g., respiratory infections; Cazassa et al., 2020). Despite these findings, the STRAIN has only been used once in a sporting context (McLoughlin et al., 2021). This is particularly important given recent interest in sport performers' mental health and well-being (for a review, see Rice et al., 2021), with some scholars suggesting that sport performers are at increased risk of developing mental health problems (Gulliver et al., 2015).

The limited use of the STRAIN in the sport psychology literature is particularly noteworthy given that the sporting environment imposes numerous stressors on sport performers, which are associated with their competitive performance (e.g., opponent rivalry), the sporting organization within which they operate (e.g., coach-athlete relationship), and personal non-sporting life events (e.g., death of a relative; Arnold & Fletcher, 2021). The consensus from this body of work is that exposure to such stressors can have detrimental

consequences for sport performers' health, well-being, and performance (Arnold & Fletcher, 2021). Indeed, some stressors have been found to negatively impact performance (e.g., Arnold et al., 2017), well-being (e.g., Roberts et al., 2019), and health (e.g., Simms et al., 2020). However, some stressors such as injury have been associated with more positive outcomes (e.g., *stress-related growth*; Roy-Davis et al., 2017). One potential explanation for these disparate findings could be the ways in which sport performers appraise stressful situations (Lazarus & Folkman, 1984). Although insightful, most stress-related research in the sporting domain has examined certain types of life stressors in isolation (e.g., competitive, organizational, or personal), as opposed to assessing the combined and cumulative effect of stressors on health (Fletcher et al., 2006). Furthermore, prior studies have relied on trauma or life event checklists to assess sport performers exposure to negative life events (e.g., Moore et al., 2017). Despite some strengths, such as brevity, self-report checklists have been criticised for only assessing the frequency of a relatively limited number of events (e.g., death of a loved one) and overlooking other key dimensions of lifetime stressors (e.g., severity; Slavich, 2019).

To our knowledge, only one study has addressed these concerns by using the STRAIN to assess how lifetime stressor exposure is associated with mental health and well-being among elite athletes (McLoughlin et al., 2021). The results of this study revealed that elite athletes who experienced more chronic difficulties and adulthood stressors exhibited greater symptoms of depression and anxiety, and poorer psychological well-being. Additionally, the findings from follow-up interviews with elite athletes suggested that cumulative lifetime stressor exposure fostered poorer mental health and well-being by promoting maladaptive long-term coping strategies, increasing susceptibility to stressful experiences in the future, and limiting interpersonal relationships (McLoughlin et al., 2021). Notwithstanding these findings, this study did not assess sport-specific stressors (e.g., underperformance) and was restricted to a sample of elite athletes (McLoughlin et al., 2021). Moreover, the mechanisms linking lifetime

stressor exposure with health in athletes remains largely unknown despite the substantial disease burden experienced by this population (McLoughlin et al., 2021).

Consistent with the predictions of the integrative model of lifespan stress and health (Epel et al., 2018), the relationship between lifetime stressor exposure and health may be partly explained by cognitive appraisals (Lazarus & Folkman, 1984). Cognitive appraisal has been defined as "an evaluative process that determines why and to what extent a particular transaction or series of transactions between the person and the environment is stressful" (Lazarus & Folkman, 1984, p. 21). The biopsychosocial model (BPSM; Blascovich & Tomaka, 1996) of challenge and threat extends Lazarus and Folkman's (1984) transactional model of stress by incorporating psychophysiological responses to stress, in order to understand why individuals react differently to stressful situations (Blascovich, 2008a). According to the BPSM, a challenge appraisal occurs when an individual perceives that they have sufficient coping resources to meet the demands of a stressful situation, whereas a threat appraisal occurs when an individual perceives that the demands of a stressful situation exceed their coping resources (Blascovich, 2008a). This conceptualisation differs from that of Lazarus and colleagues, who consider challenge and threat as primary appraisals relating to the potential for gain or harm, respectively. Although predominately situation-specific, research has illustrated that individuals also have a trait-like tendency to generally appraise stressful situations as more of a challenge or a threat (Moore et al., 2019; Power & Hill, 2010; Rumbold et al., 2020). This is particularly important given that threat appraisals have been related to poorer health and performance (Blascovich, 2008b). Therefore, an individual's tendency to appraise stressful situations as more of a challenge or a threat may be an important mechanism linking the effects of lifetime stressor exposure on health and performance (Epel et al., 2018).

Building on existing research, the present study aimed to: (a) create a sport-specific stress assessment module (Sport SAM) for the Adult STRAIN to provide an additional life

course assessment of sport-related stressors; (b) examine the Sport SAM's usability, acceptability, validity (viz. concurrent, predictive, and comparative predictive), and test-retest reliability; (c) assess how the different types of lifetime (non-sport) stressor exposure assessed by the Adult STRAIN are associated with depression, anxiety, well-being, general mental and physical health complaints, and subjective sports performance; and (d) investigate if the relationship between lifetime stressor exposure (non-sport and sport-specific) and the aforementioned outcomes is mediated by the general tendency to appraise stressful situations as more of a challenge or a threat. Based on prior research, we hypothesized that greater lifetime stressor exposure (non-sport and sport-specific) would be associated with poorer health, well-being, and subjective sports performance. Furthermore, we hypothesized that trait stress appraisals would mediate the relation between lifetime stressor exposure (non-sport and sport-specific) and outcomes, such that sport performers who reported experiencing greater lifetime stressor exposure would be more likely to report typically appraising stressors as more of a threat, in turn leading to poorer health, well-being, and performance.

Method

Participants

Participants were 395 sport performers (251 female, 144 male) between the ages of 18 and 63 years old (M_{age} = 22.50 years, SD = 5.33). Participants were from a range of sports (e.g., swimming, soccer, netball) and had an average of 9.91 years (SD = 6.43) of experience in their sport. Participants represented a range of competitive levels, with 8.1% performing at senior international level, 12.1% at international level, 18.0% at national level, 15.4% at regional level, 28.6% at university level, 5.1% at county level, and 12.7% at club level. Furthermore, participants represented an international sample and were from 22 different countries, including the United Kingdom, America, France, and Russia. An *a priori* power calculation using G*Power software (Faul et al., 2007) revealed that a minimum sample of 395 participants

was required to perform multiple regression analyses with six predictors (i.e., lifetime stressor exposure, age, sex, sport type, performance level, and length of time competing in sport). The effect size entered into this calculation was based on the small effect ($\beta = 0.16$) between stress appraisals and depression reported in prior research (e.g., Tomaka et al., 2018), and was entered with an alpha of 0.05 and power of 0.80. This sample size is also consistent with the recommendations of Schönbrodt and Perugini (2013), who suggested that a minimum sample size of 238 participants is required for correlations to stabilize.

Study Design and Procedure

This study used a cross-sectional design. Following institutional ethical approval (University of Bath, Research Ethics Approval Committee for Health, EP 18/19 107), sport performers were recruited using the research team's existing contacts, and by emailing clubs, sport organizations, and universities to advertise and distribute study information. In addition, the study was advertised on social media (e.g., Twitter). Data were collected between April and June 2020 during the Coronavirus pandemic. Once recruited, participants were sent a link to the online survey, which was created by JISC Online Surveys (https://www.onlinesurveys.ac.uk) and took approximately 30 minutes to complete. Immediately before completing the online survey, participants were advised of their ethical rights (e.g., confidentiality, anonymity, right to withdraw) via an information sheet and subsequently provided informed consent.

Measures

Lifetime (Non-Sport) Stressor Exposure

Lifetime stressor exposure was assessed using the Adult STRAIN (Slavich & Shields, 2018), which assesses 55 major life stressors including 26 acute life events (e.g., death of a loved one) and 29 chronic difficulties (e.g., ongoing health problems). Once a stressor is endorsed, and to ensure a multidimensional assessment of lifetime stressor exposure, follow-

up questions are asked that determine the stressor's frequency (*1* to *5 or more* times), severity (1 = *not at all* to 5 = *extremely*), timing (1 = *ongoing* to 7 = *over 5 years ago*), and duration (years and/or months). Stressors can be categorized by stressor type (acute life events vs. chronic difficulties), timing (early life vs. adulthood), primary life domain (housing, education, work, health, marital/partner, reproduction, financial, legal, other relationships, death, life-threatening situations, and possessions), and core social-psychological characteristic (interpersonal loss, physical danger, humiliation, entrapment, and role change/disruption). The primary analyses were based on the STRAIN's two main variables: (a) total count of lifetime stressors, calculated by summing the number of stressors experienced (range = 0-166); and (b) total severity of lifetime stressors, calculated by summing the perceived severity of the stressors experienced (range = 0-265). The Adult STRAIN has demonstrated excellent test-retest reliability (*r*s = .90 to .95), and very good concurrent (*r*s = .15 to .62) and predictive validity across a variety of health-related outcomes (e.g., Cazassa et al., 2020).

Sport-Specific Stress Assessment Module (Sport SAM)

A five-step procedure was used to develop and add a sport-specific stress assessment module (Sport SAM) to the Adult STRAIN. First, a detailed literature review was conducted to identify stressors that have been commonly reported by sport performers (e.g., Arnold & Fletcher, 2012, 2021; Rice et al., 2016). Second, existing measures of sport-specific stressors were reviewed to catalogue stressors that have been frequently assessed in the sport psychology literature (e.g., Organizational Stressor Indicator for Sport Performers, Arnold et al., 2013; Life Events Survey for Collegiate Athletes, Petrie, 1992). Third, review articles describing stressors faced by sport performers were identified and reviewed (e.g., Howells et al., 2017; Sarkar & Fletcher, 2014). Fourth, an exhaustive review of studies that have examined the impact of sport-specific stressors on sport performers' mental and physical health was conducted to identify stressors that consistently predict poor health (Rice et al., 2016). Fifth, the stressors

most frequently reported by sport performers and consistently associated with poor health were then identified from this rigorous literature search and selected to remain in the item set for the Sport SAM. As a result, some items were removed (e.g., funding/scholarship, balancing dual career, media obligations) given that they were not frequently reported by all sport performers and/or consistently associated with poor health. Furthermore, stressors already assessed by the Adult STRAIN were removed to avoid redundancy (e.g., illness, relocation, and finance). This process resulted in an initial list of stressors that were evidence-based (see Supplementary Materials Table S1). It is important to note that this instrument did not aim to assess *all* stressors that sport performers experience, but rather the most prevalent and impactful stressors.

In accordance with scale development recommendations (DeVellis, 2017), an expert and usability panel reviewed the initial list of items. Five leading sport psychologists formed the expert panel and provided feedback on each stressor item in terms of its relevance (e.g., does this stressor relate to the sport environment?), clarity (e.g., is this stressor easily understood?), and specificity (e.g., is this stressor specific enough?). The expert panel was also asked five open-ended questions to assess: (1) whether the Sport SAM was pitched at an appropriate level for all sport-performers, (2) if they would add anything to the Sport SAM to improve it (e.g., other key stressors), (3) if they would delete any of the items from the Sport SAM, (4) if they would make any modifications to the Sport SAM, and (5) if they had any further comments on the Sport SAM. Additionally, we recruited a usability panel consisting of 20 sport performers from a range of individual and team sports and competitive levels to gather feedback on the item set, order, and wording. Finally, the item set was finalized based on the expert and usability panel feedback, and with the developer of the STRAIN (G.M. Slavich), in order to maximize the clarity, readability, and item order.

The final version of the Sport SAM was deemed multidimensional as it assessed the frequency (*1* to *5 or more times*), severity (1 = *not at all* to 5 = *extremely*), timing (1 = *ongoing*

to 7 = *over 5 years ago*), and duration (years and/or months) of eight different sport-specific stressors, including four that were more competitive (i.e., overtraining; underperformance; training while injured; and injury) and four that were more organizational (i.e., excessive external pressure to perform; non-selection; coach-athlete relationship difficulties; and bullying) in nature[1]. The main variables used for analyses were: (a) total count of sport-specific stressors, which was calculated by summing the number of stressors experienced (possible range = 0-24)[2], and (b) total severity of sport-specific stressors, which was calculated by summing the perceived severity of the stressors experienced (possible range = 0-40).

Depression

The Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001) was used to assess symptoms of depression over the past two weeks. The PHQ-9 includes nine items (e.g., little interest or pleasure in doing things), with each item scored on a 4-point Likert scale ranging from 0 (*not at all*) to 3 (*nearly every day*). Total scores were calculated by summing participants' responses for the individual items (range = 0-27). Higher total scores indicated greater symptoms of depression, with scores of 5, 10, 15, and 20 representing mild, moderate, moderately severe, and severe depression, respectively (Kroenke et al., 2001). Previously, the PHQ-9 has demonstrated very good internal consistency (α = .86 to .89) and good test-retest reliability (r = .84), as well as good construct and criterion validity (Kroenke et al., 2001). In this study, the PHQ-9 demonstrated good internal consistency (α = .82).

Anxiety

The Generalized Anxiety Disorder scale (GAD-7; Spitzer et al., 2006) was used to assess symptoms of anxiety over the past two weeks. The GAD-7 includes seven items (e.g.,

[1] The Sport SAM items are available on request from the corresponding author.

[2] For the Sport SAM, the total number of stressors that can be endorsed is eight. However, four of these stressors are acute life events and can thus occur more than once (i.e., *1* to 5 *or more times*) in the STRAIN system. In contrast, the other four stressors are chronic difficulties and, according to the STRAIN, are assessed only once for the most-severe occurrence to ensure an efficient lifetime assessment. Consequently, the maximum number of sport-specific stressors an individual could have experienced was 24.

feeling nervous, anxious, or on-edge), with each item scored on a 4-point Likert scale ranging from 0 (*not at all)* to 3 (*nearly every day*). Total scores were calculated by summing participants' responses for the individual items (range = 0-21). Higher total scores indicated greater symptoms of anxiety, with scores of 5, 10, and 15 representing mild, moderate, and severe anxiety, respectively (Spitzer et al., 2006). Previously, the GAD-7 has demonstrated excellent internal consistency (α = .89 to .92) and good test-retest reliability (*r*s = .83), as well as good convergent, construct, criterion, and factorial validity (e.g., Spitzer et al., 2006). In this study, the GAD-7 demonstrated very good internal consistency (α = .88).

Well-being

The World Health Organization's Well-being Index (WHO-5) was used to assess psychological well-being over the past two weeks (WHO, 1998). The WHO-5 consists of five items (e.g., I have felt cheerful and in good spirits), with each item scored on a 6-point Likert scale ranging from 0 (*at no time*) to 5 (*all of the time*). The total score across all five items, ranging from 0-25, was multiplied by 4 to produce a final score (range = 0-100). Higher final scores represented greater well-being (WHO, 1998). Previously, the WHO-5 has demonstrated excellent construct and convergent validity, and excellent internal consistency (α = .90; Topp et al., 2015). In this study, the WHO-5 demonstrated good internal consistency (α = .80).

Physical Health Complaints

The Physical Health Questionnaire (PHQ; Schat et al., 2005) was used to assess general physical health complaints over the past month. The PHQ includes 14 items (e.g., how often have you had difficulty getting to sleep at night?) assessing sleep disturbances, headaches, and respiratory infections. Responses to 11 of the items were scored on a 7-point Likert scale ranging from 1 (*not at all*) to 7 (*all the time*), whereas responses to two items were scored on a 7-point Likert scale ranging from *0 times* to *7+ times*, and one item was scored on a 7-point Likert scale ranging from *1 day* to *7+ days*. The scores for all items were summed to produce

a total score (range = 12-98), with higher total scores indicating greater physical health complaints. Previously, the PHQ has demonstrated acceptable factorial validity, excellent convergent and divergent validity, and good internal consistency (α = .83; Schat et al., 2005). In this study, the PHQ demonstrated good internal consistency (α = .80).

Mental Health Complaints

The Kessler 6-Item Psychological Distress Inventory (K-6; Kessler et al., 2002) was used to assess general mental health complaints over the past month. The K-6 consists of six items (e.g., how often did you feel hopeless?), with each item scored on a 5-point Likert scale ranging from 1 (*never*) to 5 (*very often*). The scores for all items were summed to produce a total score (range = 6-30), with higher total scores indicating greater mental health complaints. Previously, the K-6 has demonstrated very good internal consistency (α = .86), and excellent predictive validity (e.g., Kessler et al., 2002). In this study, the K-6 demonstrated very good internal consistency (α = .88).

Subjective Sports Performance

Three items from the Athlete Satisfaction Questionnaire (ASQ; Riemer & Chelladurai, 1998) were used to assess subjective sports performance over the past four months. This timeframe was used due to data collection occurring during the Coronavirus pandemic when sporting involvement was largely paused. The ASQ includes three items (e.g., the degree to which I have reached my performance goals), with each item scored on a 7-point Likert scale ranging from 1 (*not at all satisfied*) to 7 (*extremely satisfied*). The scores for all items were summed to produce a total score (range = 3-21), with higher total scores indicating greater performance satisfaction. Previously, the ASQ has demonstrated good criterion and construct-related validity, as well as acceptable-to-excellent internal consistency (α = .78 to .95; Riemer & Chelladurai, 1998). In this study, the ASQ demonstrated very good internal consistency (α = .89).

Stress Appraisals

The Appraisal of Challenge and Threat Scale (ACTS; Tomaka et al., 2018) was used to assess individual differences in trait stress appraisals. In this study, the 'transportation' principal component from the ACTS (e.g., car breaks down in rush hour) was removed to ensure all items were relevant to the entire sample (i.e., not all participants will have driven a car). Next, we included only the highest three factor loading items for the remaining five principal components (i.e., conflict situations, unexpected events, public speaking, social anxiety, and financial issues) in the online survey to aid brevity. As a result, participants were presented with 15 potentially stressful events (e.g., you find out that you have a chronic disease), with each event followed by one item assessing primary appraisals (i.e., how demanding is this event to you?), and one assessing secondary appraisals (i.e., how able are you to take action to deal with it?). Both items were scored on a 5-point Likert scale ranging from 1 (*not at all)* to 5 *(very much)*. Scores were calculated by subtracting the secondary appraisal score from the primary appraisal score for each event, and then calculating the mean across all potentially stressful events to derive an overall appraisal tendency score (range = -4 to +4). Positive scores indicated a tendency to appraise events as threatening, whereas negative scores indicated a tendency to appraise events as challenging. Previously, the ACTS has demonstrated good factorial validity, reliability, and acceptable-to-good construct validity (α = .77 to .88; Tomaka et al., 2018). In this study, the ACTS demonstrated good internal consistency (α = .86).

Data Analysis

Data were analyzed using SPSS version 25.0. First, checks revealed no missing data and that all data was non-normally distributed. Second, outlier analyses were performed prior to the main statistical analyses. Specifically, thirteen univariate outliers were detected by identifying z-scores which were greater or less than 3.29. Moreover, multivariate outliers were detected by considering Cook's distance (values <1.000) and Mahalanobis distance (cut-off

value of 10.828). Third, square root transformations were performed to ensure that all data was normally distributed (i.e., skewness and kurtosis z-scores <1.96). Fourth, checks for the other assumptions of linear regression analyses were conducted, with visual inspection of bivariate scatterplots confirming that all data were linearly related and homoscedastic. Finally, no multicollinearity was evident between the independent variables (i.e., variance inflation factor [or VIF] values <10.00).

First, descriptive statistics (i.e., medians, standard deviations) for, and correlations between, all study variables were computed. Second, to verify the concurrent validity of the Sport SAM in relation to the Adult STRAIN, Pearson correlations and hierarchical linear regression analyses were conducted. Specifically, total count or severity of lifetime (non-sport) stressors were entered into separate models as dependent variables. In each model, total count or severity of sport-specific stressors were entered as independent variables at Step 1 and *a priori* covariates were entered at Step 2 (i.e., age; sex; sport type; highest performance level; and length of time competing in sport). Third, to assess predictive validity, Pearson correlations and hierarchical linear regression models were used to evaluate the Sport SAM in relation to the outcomes assessed. Specifically, depression, anxiety, well-being, physical and mental health complaints, and subjective sports performance were entered into separate models as dependent variables. In each model, the independent variables were entered at Step 1 (e.g., total count or severity of stressors) and the *a priori* covariates were entered at Step 2. These hierarchical linear regression analyses were repeated with the same independent variables, but in reverse order, to verify whether the predictive validity held true regardless of the order in which the variables were entered into the regression models. Fourth, to examine the comparative predictive validity of the Sport SAM in relation to the Adult STRAIN, each scale was included in the regression models simultaneously. Specifically, hierarchical linear regression analyses were conducted to examine the percentage of variance explained by the

Sport SAM over and above the total variance previously explained by *a priori* covariates and the Adult STRAIN. Specifically, *a priori* covariates were entered at Step 1, and independent variables were entered at Step 2 (e.g., Adult STRAIN) and Step 3 (e.g., Sport SAM). Fifth, test-rest reliability of the Sport SAM was examined using intraclass correlation coefficients, which were based on absolute agreement in a two-way mixed effects model. Values of <0.50, 0.50-0.75, 0.75-0.90, and >0.90 indicated poor, moderate, good, and excellent reliability, respectively (Koo & Li, 2016).

Next, a series of hierarchical linear regression analyses were conducted to examine if the different lifetime (non-sport) stressor types (acute life events vs. chronic difficulties), time periods (early life vs. adulthood), life domains (e.g., work, health, death), and core social-psychological characteristics (e.g., physical danger, humiliation, entrapment) from the Adult STRAIN were significantly associated with the outcomes assessed, above and beyond the *a priori* covariates. Specifically, study outcomes were entered into separate models as dependent variables. In each model, the independent variables were entered at Step 1 (e.g., total count or severity of stressors) and the *a priori* covariates were entered at Step 2. However, due to space constraints, we only report Step 2 of these hierarchical linear regression models. Four life domains (i.e., education; work; reproduction; and legal/crime) were excluded from these analyses as very few participants reported experiencing these stressors.

Finally, to examine if trait stress appraisals (i.e., challenge and threat) mediated the relations between stressor exposure [i.e., total count or severity of lifetime (non-sport) stressors, total count or severity of sport-specific stressors] and the outcomes assessed, mediation analyses were conducted using the Process SPSS custom dialog (Hayes, 2018). This custom dialog tests the total, direct, and indirect effect of an independent variable on a dependent variable through a proposed mediator and allows inferences regarding indirect effects using

10,000 bootstrap confidence intervals. The total, direct, and indirect effects were deemed significant if the 95% confidence intervals did not contain zero.

Results

Descriptive Statistics

All descriptive statistics including the medians and standard deviations for, and correlations between, the main study variables are shown in Table 1.

Usability and Acceptability of the Sport SAM

The Adult STRAIN and Sport SAM were completed together, taking an average of 18 minutes and 58 seconds to complete (*SD* = 8 min 47 s; interquartile range = 13 min 52 s to 21 min 23 s). The acceptability of the Sport SAM was excellent, with only 21 (5%) participants failing to complete the instrument, producing a very high completion rate (95%). Following completion of the Sport SAM and Adult STRAIN, participants were asked to provide feedback on whether any of the items were upsetting or distressing. No participants reported any distress because of answering the Sport SAM or Adult STRAIN questions.

Concurrent Validity

Next, we examined how the Sport SAM performed in relation to the Adult STRAIN. In Step 1 of the regression analyses, total count of sport-specific stressors was significantly associated with total count of lifetime (non-sport) stressors (β = .23, p < .001). Similarly, total severity of sport-specific stressors was significantly associated with the total severity of lifetime (non-sport) stressors (β = .29, p < .001). In Step 2 of the regression analyses, these effects were robust while controlling for covariates, with total count of sport-specific stressors still significantly associated with total count of lifetime (non-sport) stressors (β = .23, p < .001), and total severity of sport-specific stressors still significantly associated with total severity of lifetime (non-sport) stressors (β = .30, p < .001). Therefore, these results provide initial evidence for the concurrent validity of the Sport SAM.

Predictive Validity

The predictive validity of the Sport SAM was evaluated in relation to mental and physical health, well-being, and sports performance. In Step 1 of the regression analyses, total count of sport-specific stressors was significantly associated with greater symptoms of depression (β = .21, p < .001) and anxiety (β = .13, p = .012), and more physical (β = .20, p < .001) and mental (β = .22, p < .001) health complaints, but not well-being (β = -.07, p = .182) or subjective sports performance (β = -.09, p = .078). Importantly, these effects were robust while controlling for covariates in Step 2 of the regression analyses, with total count of sport-specific stressors still significantly associated with greater symptoms of depression (β = .21, p < .001) and anxiety (β = .13, p = .012), and more physical (β = .24, p < .001) and mental (β = .23, p < .001) health complaints, but not well-being (β = -.05, p = .309) or subjective sports performance (β = -.05, p = .379)[3].

Likewise, in Step 1 of the regression analyses, total severity of sport-specific stressors was significantly associated with greater symptoms of depression (β = .24, p < .001) and anxiety (β = .20, p < .001), and more physical (β = .28, p < .001) and mental (β = .32, p < .001) health complaints, but not well-being (β = -.06, p = .259) or subjective sports performance (β = -.06, p = .263). Again, these effects were robust while controlling for covariates in Step 2 of the regression analyses, with total severity of sport-specific stressors still significantly associated with greater symptoms of depression (β = .24, p < .001) and anxiety (β = .19, p < .001), and more physical (β = .27, p < .001) and mental (β = .32, p < .001) health complaints, but not well-being (β = -.05, p = .350) or subjective sports performance (β = -.02, p = .752). Therefore, overall, the Sport SAM exhibited very good predictive validity for mental and physical health but not well-being or subjective sports performance.

[3] When these regression analyses were repeated with the same independent variables but in reverse order, the results were nearly identical to those observed here, thus providing further support for the predictive validity of the Sport SAM.

Comparative Predictive Validity

As shown in Table 2, total count and severity of sport-specific stressors from the Sport SAM were significantly associated with all the outcomes assessed except well-being and subjective sports performance. Moreover, these results were nearly identical to those observed for the Adult STRAIN, with total count and severity of lifetime (non-sport) stressors significantly associated with all outcomes except for subjective sports performance.

Next, to directly compare the Sport SAM and Adult STRAIN, we examined the percentage of variance that was explained by the Sport SAM out of the total variance explained by the complete model (i.e., age; sex; sport type; highest performance level; length of time competing in sport; Adult STRAIN; and Sport SAM). To calculate the increase in variance explained by the Sport SAM over and above the total variance previously explained, we divided the ΔR^2 of the third model (i.e., Covariates + Adult STRAIN + Sport SAM) by the Total R^2 from the second model (i.e., Covariates + Adult STRAIN). Total count of sport-specific stressors explained a significant amount of variance in symptoms of depression (10.26% increase in variance explained), physical health complaints (13.86% increase in variance explained), and mental health complaints (13.87% increase in variance explained), but not symptoms of anxiety, well-being, or subjective sports performance. Furthermore, total severity of sport-specific stressors explained a significant amount of variance in symptoms of depression (7.53% increase in variance explained), physical health complaints (13.70% increase in variance explained), and mental health complaints (19.81% increase in variance explained), but not symptoms of anxiety, well-being, or subjective sports performance (see Table 3). Therefore, assessing sport-related stressors added significant value over and above assessing non-sport-related stressors over the life course for several outcomes.

Test-Retest Reliability

To assess the test-retest reliability of both the Sport SAM and Adult STRAIN, 135

participants recompleted these instruments on a second occasion approximately two months after the first administration (M = 52.80 days; SD = 11.78; Range = 20-76 days). For the Sport SAM, very good test-retest reliability was observed for both total count (r_{icc} = .87, p < .001) and total severity (r_{icc} = .89, p < .001) of sport-specific stressors. In turn, excellent test-retest reliability was observed for the Adult STRAIN for both total count (r_{icc} = .95, p < .001) and total severity (r_{icc} = .93, p < .001) of lifetime (non-sport) stressors.

Lifetime (Non-Sport) Stressor Count Characteristics

Next, a series of hierarchical linear regression analyses were conducted to examine associations between the different types of lifetime (non-sport) stressor count and sport performers' health, well-being, and subjective sports performance. With respect to stressor type (acute vs. chronic), total count of acute life events was significantly associated with symptoms of depression (β = .24, p < .001) and anxiety (β = .20, p < .001), as well as physical (β = .19, p < .001) and mental (β = .20, p < .001) health complaints, above and beyond covariates, but not well-being (β = -.04, p = .410) or subjective sports performance (β = -.04, p = .439). In contrast, total count of chronic difficulties was significantly associated with symptoms of depression (β = .41, p < .001) and anxiety (β =.35, p < .001), as well as well-being (β = -.23, p < .001), physical (β =.32, p < .001) and mental (β =.36, p < .001) health complaints, and subjective sports performance (β = -.12, p = .014), above and beyond covariates.

With respect to the timing of stressor exposure (early life vs. adulthood), total count of early life stressors was significantly associated with symptoms of depression (β = .26, p < .001) and anxiety (β = .22, p < .001), as well as physical (β = .16, p = .001) and mental (β = .20, p < .001) health complaints, above and beyond covariates, but not well-being (β = -.05, p = .337) or subjective sports performance (β = -.07, p = .171). In contrast, total count of adulthood stressors was significantly associated with symptoms of depression (β = .33, p < .001) and anxiety (β = .28, p < .001), as well as well-being (β = -.18, p = .001), and physical (β = .29, p

< .001) and mental (β = .30, p < .001) health complaints, above and beyond covariates, but not subjective sports performance (β = -.07, p = .194).

As shown in Figure 1, most primary life domains assessed by the Adult STRAIN were significantly associated with outcomes for lifetime (non-sport) stressor count (ps ≤ .040). Stressors involving other relationships were most strongly associated with outcomes, whereas stressors involving death and possessions were not related to outcomes. As shown in Figure 2, most social-psychological characteristics were significantly associated with outcomes for lifetime (non-sport) stressor count (ps ≤ .017), except for subjective sports performance. Stressors involving role change/disruption were most strongly associated with outcomes.

Lifetime (Non-Sport) Stressor Severity Characteristics

Next, a series of hierarchical linear regression analyses were conducted to examine associations between the different types of lifetime (non-sport) stressor severity and sport performers' health, well-being, and subjective sports performance. With respect to stressor type (acute vs chronic), the total severity of acute life events was significantly associated with symptoms of depression (β =.29, p < .001) and anxiety (β =.24, p < .001), as well as physical (β =.23, p < .001) and mental (β =.25, p < .001) health complaints, above and beyond covariates, but not well-being (β = -.08, p = .118) or subjective sports performance (β = -.04, p = .468). In contrast, total severity of chronic difficulties was significantly associated with symptoms of depression (β =.42, p < .001) and anxiety (β =.38, p < .001), as well as well-being (β = -.23, p < .001), physical (β =.33, p < .001) and mental (β =.39, p < .001) health complaints, and subjective sports performance (β = -.10, p = .041), above and beyond covariates.

With respect to the timing of stressor exposure (early life vs adulthood), total severity of early life stressors was significantly associated with symptoms of depression (β = .30, p < .001) and anxiety (β = .25, p < .001), as well as physical (β = .20, p < .001) and mental (β = .24, p < .001) health complaints, above and beyond covariates, but not well-being (β = -.09,

p = .081) or subjective sports performance (β = -.07, p = .161). In contrast, total severity of adulthood stressors was significantly associated with symptoms of depression (β = .34, p < .001) and anxiety (β = .31, p < .001), as well as well-being (β = -.20, p < .001), and physical (β = .30, p < .001) and mental (β = .34, p < .001) health complaints, above and beyond covariates, but not subjective sports performance (β = -.07, p = .154).

As shown in Figure 1, most primary life domains were significantly associated with outcomes for lifetime (non-sport) stressor severity (ps ≤ .049). Stressors involving other relationships were most strongly associated with outcomes, whereas those involving death and possessions were not associated with outcomes. As shown in Figure 2, most social-psychological characteristics were significantly associated with outcomes for lifetime (non-sport) stressor severity (ps ≤ .013), except for subjective sports performance. Stressors involving role change/disruption were most strongly associated with outcomes.

Mediation Analyses

Finally, we examined whether the relationships between stressor exposure (non-sport and sport-specific) and outcomes were mediated by participants' trait stress appraisals. The results revealed no significant indirect effects between total count of lifetime (non-sport) or sport-specific stressors and outcomes (see Table 4). Therefore, trait stress appraisals did not mediate the relationship between stressor count and the sport performers' mental and physical health, well-being, or sports performance. In contrast, mediation analyses revealed significant indirect effects between total severity of lifetime (non-sport) stressors and symptoms of depression (95% CI = .005 to .037) and anxiety (95% CI = .007 to .052), well-being (95% CI = -.038 to -.005), and physical (95% CI = .006 to .045) and mental (95% CI = .006 to .039) health complaints, but not subjective sports performance (95% CI = -.003 to .003). Similarly, there were significant indirect effects between total severity of sport-specific stressors and symptoms of depression (95% CI = .003 to .055) and anxiety (95% CI = .003 to .073), well-

being (95% CI = -.054 to -.002), and physical (95% CI = .002 to .061), and mental (95% CI = .002 to .052) health complaints, but not subjective sports performance (95% CI = -.004 to .003). Therefore, trait stress appraisals appeared to mediate the effects of total stressor severity (both non-sport and sport-specific) on sport performers' health and well-being.

Discussion

Prior research has documented the health-damaging consequences of greater lifetime stressor exposure for a variety of mental and physical health outcomes (e.g., Slavich & Shields, 2018). Despite this, few studies have examined the combined and cumulative effect of stressors occurring across the lifespan on sport performers' health, well-being, and performance, partly due to the absence of an appropriate instrument for assessing these stressors. Furthermore, researchers in sport have predominantly assessed the *frequency* of a limited number of adverse life (non-sport) stressors and have overlooked other key dimensions such as stressor severity (Moore et al., 2017). This is surprising given that stressor severity is a key dimension that contributes to the development of stress-related illness (Arnold & Fletcher, 2021). To address these issues, we (a) created a Sport SAM for the Adult STRAIN to provide an additional life course assessment of sport-related stressors; (b) examined the Sport SAM's usability, acceptability, validity, and test-retest reliability; (c) assessed how the different types of lifetime (non-sport) stressor exposure assessed by the Adult STRAIN were associated with study outcomes; and (d) investigated the extent to which the relationship between lifetime stressor exposure (non-sport and sport-specific) and outcomes are mediated by trait stress appraisals.

The Sport SAM that we created and validated to accompany the Adult STRAIN assesses eight sport-specific stressors that have frequently been reported by sport performers and are consistently associated with poor health—namely, overtraining; excessive external pressure to perform; underperformance; non-selection; training while injured; injury; coach-athlete relationship difficulties; and bullying (Rice et al., 2016). The development of the Sport

SAM advances extant literature by providing the first multidimensional instrument that can assess both the frequency and severity of sport-specific stressors over the entire lifespan. The results revealed that participants completed the Adult STRAIN and Sport SAM together in approximately 19 minutes, with minimal missing data and no reported complaints; therefore, it is deemed a usable and acceptable measure. Moreover, this usability and acceptability data was collected from a diverse sample of performers from a variety of sports and competitive levels. Further, the Sport SAM demonstrated very good concurrent validity and test-retest reliability. Finally, in terms of predictive validity, the Sport SAM was associated with four out of the six outcomes assessed, including symptoms of depression and anxiety, and physical and mental health complaints, but not well-being or subjective sports performance. Therefore, sport performers who were exposed to greater and more severe sport-specific stressors over the lifespan were more likely to exhibit poorer health outcomes.

Turning to the comparative predictive validity data, the results observed for the Sport SAM were almost identical to those obtained for the Adult STRAIN, with the exception that the Adult STRAIN (i.e., non-sport stressor count and severity) was also significantly associated with lower levels of well-being. One potential explanation for these contrasting findings could be the antithetical nature of sporting participation, whereby sport can contribute to, or detract from, sport performers' well-being (Giles et al., 2020). Therefore, although experiencing sport-specific stressors might have a detrimental impact on a sport performers' well-being, this effect could be attenuated by the benefits of sports participation, such as having a sense of belonging with teammates, coaches, or competitors (Beauchamp & Eys, 2014). Additionally, when directly comparing the Sport SAM and Adult STRAIN, the Sport SAM explained substantial variance in physical and mental health over and above the Adult STRAIN and covariates assessed. This finding emphasizes the importance of assessing sport-specific stressors in addition to lifetime (non-sport) stressors to provide further insight into sport performers' health.

Moreover, the results revealed that the perceived severity of lifetime stressors (i.e., non-sport and sport-specific) was more strongly associated with outcomes than the count of such stressors. These findings reinforce the importance of assessing other dimensions beyond count (e.g., severity; Arnold & Fletcher, 2021). An interesting lack of association was observed between stressor exposure (non-sport and sport-specific) and subjective sports performance. One potential explanation for this could be due to the equivocal research findings in the sport psychology literature which have found support for both positive and negative relationships between stressor exposure and performance-related outcomes. Indeed, although some research indicates that experiencing stressors can have a positive impact on performance-related outcomes (e.g., McLoughlin et al., 2021; Moore et al., 2017), some studies have suggested that exposure to stressors can negatively impact performance (e.g., Arnold et al., 2017). In explaining these equivocal findings, scholars have suggested that future research needs to consider the role of key mediators, such as coping strategies, and develop and validate more robust measures of subjective sports performance (Arnold et al., 2018).

To address the third aim, we examined how lifetime (non-sport) stressors assessed using the Adult STRAIN were associated with sport performers' health, well-being, and performance. The results revealed that the total count and severity of chronic difficulties were more strongly associated with the outcomes assessed than the total lifetime count and severity of acute life events. These findings are consistent with extant theory and literature indicating that chronic stressors play a key role in shaping negative health outcomes (e.g., Epel et al., 2018; Slavich et al., 2019). Furthermore, the results revealed that stressors occurring in adulthood were more strongly associated with outcomes than early life stressors. These findings are congruent with prior research showing that exposure to greater and more severe recent lifetime stressors is more predictive of ill-health (e.g., Lam et al., 2019; McLoughlin et al., 2021). Finally, the stressor indices that were consistently and significantly associated with

the outcomes assessed were other relationships (e.g., parental or non-intimate relationship problems) and role change/disruption (e.g., starting a new job). These results are contrary to classic stress theories (e.g., Selye, 1976) and support the idea that different types of stressors (e.g., acute vs. chronic) might have varying effects on health (Epel et al., 2018).

To address the fourth aim, we examined whether trait stress appraisals mediated the effects of lifetime stressor exposure (non-sport and sport-specific) on sport performers' health, well-being, and performance. The results provided some support for the predictions of the integrative model of lifespan stress and health (Epel et al., 2018), demonstrating that sport performers who had experienced greater lifetime stressor severity (non-sport and sport-specific) were more likely to appraise stressors as threating (i.e., situational demands exceed personal coping resources), leading to poorer health-related outcomes such as greater symptoms of depression. Although these results were significant, it is important to note that the mediation effects were cross-sectional and relatively small in size. Despite this, however, the data suggests that a severe history of lifetime stressor exposure increases the likelihood of developing maladaptive stress responses that are predictive of ill-health (Epel et al., 2018). An interesting lack of association was observed between trait stress appraisals and subjective sports performance. This is surprising given that research has revealed a relation between cognitive appraisals and performance, with challenge appraisals predicting superior performance (e.g., Hase et al., 2019). One potential explanation for this finding could be due to the challenges associated with assessing subjective sports performance (Arnold et al., 2018).

Despite the novel findings of this study, several limitations should be noted. First, the study design was cross-sectional, which limits the conclusions that can be drawn from the mediation analyses and in determining directionality or causality. Future research should thus use longitudinal study designs that yield prospective data on the associations between lifetime stressor exposure and health, well-being, and performance (Roberts et al., 2019). Second, the

study used self-report measures, which could have been influenced by cognitive bias and social desirability. Therefore, additional research is needed to examine how lifetime stressor exposure (non-sport and sport-specific) influences objective physiological markers of disease (e.g., immune responses) and trait stress appraisals (e.g., cardiovascular reactivity; Hase et al., 2019) that cannot be affected by self-report biases. Third, although participants represented a wide range of ages (i.e., 18-63 years), the average age of participants was relatively young at 23 years old, which could have limited the number of stressors the sample had experienced. While age was included as a covariate in the statistical analyses, future research should attempt to replicate these findings in an older and more experienced sample of sport performers.

Notwithstanding these limitations, this study is the first to develop and preliminarily validate a life course assessment of sport-specific stressors (i.e., Sport SAM for the Adult STRAIN). This more holistic assessment tool developed for the sporting domain will advance research on this topic by enabling researchers to examine the combined and cumulative effect of non-sport and sport-specific stressors, which has rarely been done (Fletcher, 2019). Furthermore, this instrument can provide researchers and practitioners with important information indicating which stressors are particularly harmful for sport performers' health, well-being, and performance (e.g., chronic difficulties, recent life events). In addition, we examined a variety of outcomes relating to sport performers' health, well-being, and performance, which is noteworthy considering that prior research has typically focused on only one of these outcomes in isolation (e.g., performance; Moore et al., 2017). Finally, we examined a potential cognitive mechanism (i.e., trait stress appraisals) underpinning the lifetime stressor-health relation, which has not been examined previously.

As a result of these strengths, this study has some important theoretical and applied implications. From a theoretical perspective, the findings support the predictions of the integrative model of lifespan stress and health by highlighting which stressors (i.e., chronic

difficulties, adulthood stressors) are particularly harmful for sport performers' health, well-being, and performance, as well as improving our understanding of how stressor exposure over the lifespan influences sport performers' general tendencies to appraise stressful situations as a challenge or threat (Epel et al., 2018). Furthermore, this study supports the predictions of the BPSM (Blascovich, 2008b), illustrating that threat appraisals, when frequently experienced, may influence important outcomes beyond sports performance, including health and well-being. As a result, we believe these findings can help guide practitioners in developing interventions designed to mitigate the negative effects of lifetime stressor exposure.

From an applied perspective, practitioners and sporting organizations could use the Sport SAM together with the Adult STRAIN to proactively identify, and provide tailored support to, sport performers who are at elevated risk of developing stress-related health problems (e.g., those currently experiencing chronic difficulties). Moreover, where possible, practitioners and sporting organizations should attempt to eliminate or reduce the quantity, frequency, or intensity of stressors by altering the environment in which sport performers operate (Fletcher & Arnold, 2021). We believe that adopting such preventative stress management techniques will help alleviate the overall demand placed upon sport performers (Fletcher et al., 2006). Despite these efforts, it is not always possible to prevent, reduce, or eliminate stressors (Fletcher & Arnold, 2021). As a result, practitioners should also work with sport performers to help them appraise, manage, and deal with stressors more effectively (Fletcher & Arnold, 2021). Indeed, the mediation results support the importance of interventions that encourage sport performers to appraise potentially stressful situations as more a challenge, as opposed to a threat. Research has shown that several intervention strategies could be effective at promoting challenge appraisals (e.g., arousal reappraisal; Moore et al., 2015). Indeed, as part of an arousal reappraisal intervention, practitioners and sporting organizations could encourage sport performers to view pressure-induced elevations in

physiological arousal (e.g., racing heart) as a tool that can aid performance (Moore et al., 2015). Finally, sporting organizations must view mental health as a priority by fostering an environment where sport performers feel comfortable seeking help (Rice et al., 2021).

In conclusion, this study summarized the development and preliminary validation of the Sport SAM to accompany the Adult STRAIN, as well as examining how lifetime non-sport and sport-specific stressors were related to sport performers' health, well-being, and performance. We also investigated whether trait stress appraisals mediated the relationship between lifetime non-sport and sport-specific stressor exposure and health and performance. The results revealed that the Sport SAM demonstrated good usability and acceptability, concurrent and predictive validity, and test-retest reliability. More specifically, the findings suggest that exposure to stressors that are either chronic, or have occurred in adulthood, are particularly pernicious to sport performers' health and well-being. Finally, the findings demonstrated that athletes who experienced more severe lifetime non-sport and sport-specific stressors tended to appraise stressors as more of a threat (than a challenge), leading in turn to poorer health. Looking forward, additional research is needed to replicate these findings in longitudinal studies; to elucidate the biological mechanisms linking lifetime stress exposure, health, and well-being; and to determine the interventions that are most helpful for mitigating negative stress-related effects.

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Table 1

Medians, standard deviations, and intercorrelations for main study variables

	Median	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Depression	5.00	4.44	-														
2. Anxiety	4.00	4.40	.70***	-													
3. Well-being	64.00	15.94	.50***	.40***	-												
4. Mental Health Complaints	13.00	5.23	.67***	.72***	.43***	-											
5. Physical Health Complaints	32.00	10.84	.51***	.54***	.34***	.57***	-										
6. Subjective Sporting Performance	4.00	1.36	.20***	.14**	.31***	.22***	.17**	-									
7. Total count of lifetime stressors	9.00	7.70	.34***	.28***	.13**	.27***	.26***	.11*	-								
8. Total severity of lifetime stressors	19.00	18.24	.37***	.33***	.16**	.33***	.30***	.10*	.92***	-							
9. Total count of sport stressors	5.00	4.21	.21***	.13*	.07	.22***	.20***	.09	.22***	.24***	-						
10. Total severity of sport stressors	9.00	7.39	.24***	.20***	.06	.32***	.28***	.06	.24***	.29***	.84***	-					
11. Age	21.00	5.33	-.12*	-.07	-.13*	-.18***	-.11*	.09	.16**	.19***	-.03	-.13	-				
12. Sex	-	-	.07	.15**	-.05	.17**	.32***	-.06	.002	.05	-.09	.05	.04	-			
13. Sport type	-	-	-.03	-.05	-.03	-.04	-.01	-.08	-.01*	-.07	-.21***	-.24***	-.11*	-.02	-		
14. Highest performance level	-	-	-.02	.03	-.07	-.004	.01	.017**	.09	.11*	.13**	.15**	.60***	.14**	-.12*	-	
15. Length of time competing in sport	10.00	6.43	-.02	-.04	-.01	-.01	.07	.01	.02	.04	.08	.10	-.04	.08	.22***	.14**	-

Note. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 2

Comparative predictive validity of the Sport SAM and Adult STRAIN

		Sport SAM	Adult STRAIN
		β	
Stressor Count:	Depression (PHQ-9)	.21***	.37***
	Anxiety (GAD-7)	.13*	.30***
	Well-being (WHO-5)	-.05	-.15**
	Physical Health (PHQ)	.24***	.29***
	Mental Health (K-6)	.23***	.31***
	Subjective Sports Performance (ASQ)	-.05	-.09
Stressor Severity:	Depression (PHQ-9)	.24***	.41***
	Anxiety (GAD-7)	.19***	.36***
	Well-being (WHO-5)	-.05	-.19***
	Physical Health (PHQ)	.27***	.32***
	Mental Health (K-6)	.32***	.37***
	Subjective Sports Performance (ASQ)	-.02	-.09

Note. * $p < .05$, ** $p < .01$, *** $p < .001$, two-tailed. All associations are adjusted for relevant covariates including age, sex, sport type, highest performance level, and length of time competing in sport.

Table 3

Comparative predictive validity of the Adult STRAIN and Sport SAM by highlighting the variance explained in each outcome in each multiple linear regression model

Model	Depression			Anxiety			Well-being			Physical Health			Mental Health			Performance		
	R^2	Adj. R^2	ΔR^2	R^2	Adj. R^2	ΔR^2	R^2	Adj. R^2	ΔR^2	R^2	Adj. R^2	ΔR^2	R^2	Adj. R^2	ΔR^2	R^2	Adj. R^2	ΔR^2
Count:																		
Covariates	.03	.01	-	.04	.03	-	.02	.01	-	.12	.11	-	.08	.07	-	.04	.03	-
Covariates + Adult STRAIN	.16	.14	.13***	.13	.11	.09***	.04	.03	.02**	.20	.19	.08***	.16	.16	.09***	.05	.03	.01
Covariates + Adult STRAIN + Sport SAM	.17	.16	.02**	.13	.11	.00	.04	.03	.00	.23	.22	.03***	.18	.18	.02***	.05	.03	.00
% of variance explained by the Sport SAM over and above the total variance previously explained		10.26%			3.17%			0%			13.86%			13.87%			2.08%	

Model	Depression			Anxiety			Well-being			Physical Health			Mental Health			Performance		
	R^2	Adj. R^2	ΔR^2	R^2	Adj. R^2	ΔR^2	R^2	Adj. R^2	ΔR^2	R^2	Adj. R^2	ΔR^2	R^2	Adj. R^2	ΔR^2	R^2	Adj. R^2	ΔR^2
Severity:																		
Covariates	.03	.01	-	.04	.03	-	.02	.01	-	.12	.11	-	.08	.07	-	.04	.03	-
Covariates + Adult STRAIN	.19	.17	.16***	.16	.15	.12***	.06	.04	.04***	.22	.21	.01***	.21	.20	.13***	.05	.03	.01
Covariates + Adult STRAIN + Sport SAM	.20	.19	.01**	.17	.15	.01	.06	.04	.00	.25	.24	.03***	.25	.24	.04***	.05	.03	.00
% of variance explained by the Sport SAM over and above the total variance previously explained		7.53%			3.70%			0%			13.70%			19.81%			0%	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$, two-tailed. To calculate the increase in variance explained by the Sport SAM over and above the total variance previously explained, we divided the ΔR^2 of the third model (i.e., Covariates + Adult STRAIN + Sport SAM) by the Total R^2 from the second model (i.e., Covariates + Adult STRAIN).

Table 4

Mediation analyses with stressor exposure (i.e., total count of lifetime stressors, total severity of lifetime stressors, total count of sport-specific stressors, and total severity of sport-specific stressors) entered as the independent variable; study outcomes (i.e., depression, anxiety, well-being, general physical and mental health complaints, or subjective sports performance) entered as the dependent variable; and trait stress appraisals (i.e., challenge and threat) entered as the potential mediator

IV	DV	Effect	*SE*	LL 95% CI	UL 95% CI
Total Count of Lifetime Stressors	Depression	.010	.015	-.021	.040
	Anxiety	.013	.020	-.027	.052
	Well-being	-.009	.014	-.036	.019
	Physical Health Complaints	.011	.018	-.024	.047
	Mental Health Complaints	.010	.015	-.020	.039
	Subjective Sports Performance	-.001	.001	-.002	.003
Total Severity of Lifetime Stressors	Depression	.021	.008	.005	.037*
	Anxiety	.029	.011	.007	.052*
	Well-being	-.020	.009	-.038	-.005*
	Physical Health Complaints	.025	.010	.006	.045*
	Mental Health Complaints	.022	.008	.006	.039*
	Subjective Sports Performance	.000	.002	-.003	.003
Total Count of Sport-Specific Stressors	Depression	.004	.018	-.030	.042
	Anxiety	.005	.024	-.041	.053
	Well-being	-.003	.017	-.040	.039
	Physical Health Complaints	.004	.020	-.034	.046
	Mental Health Complaints	.004	.018	-.032	.038
	Subjective Sports Performance	.000	.001	-.003	.002
Total Severity of Sport-Specific Stressors	Depression	.027	.013	.003	.055*
	Anxiety	.036	.018	.003	.073*
	Well-being	.025	.013	-.054	-.002*
	Physical Health Complaints	.030	.015	.002	.061*
	Mental Health Complaints	.027	.013	.002	.052*
	Subjective Sports Performance	.000	.002	-.004	.003

Note. LL = lower limit; CI = confidence interval; UL = upper limit. * = significant indirect effect.

Figure 1

Multiple linear regression models examining associations between the primary life domains assessed by the Adult STRAIN and the six outcomes assessed

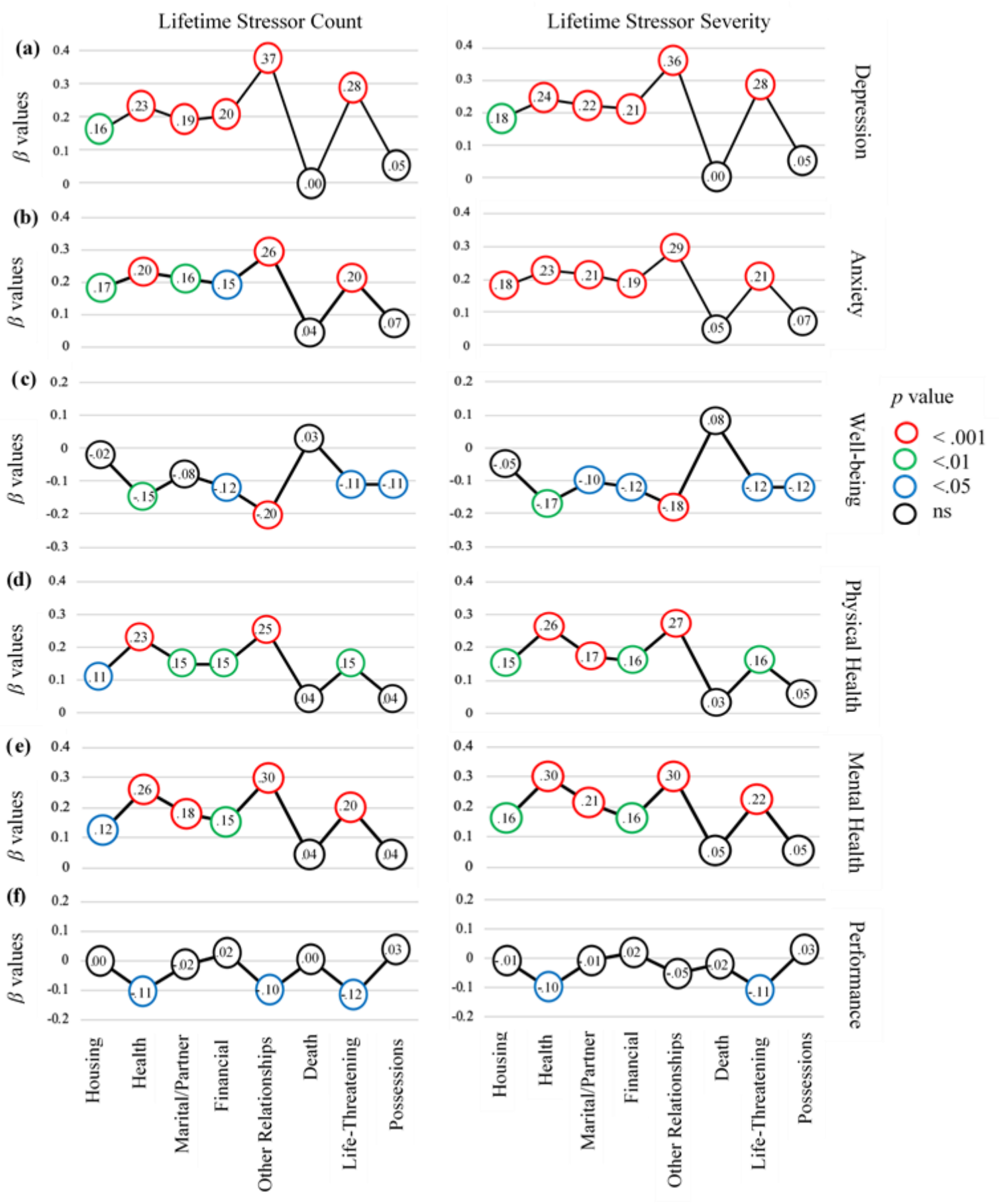

Figure 2

Multiple linear regression models examining associations between the core social-psychological characteristics assessed by the Adult STRAIN and the six outcomes assessed