



Original research

Psychosocial stress as a predictor of injury in elite junior soccer: A latent growth curve analysis

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ABSTRACT

Objectives: To investigate by use of a latent growth curve analysis framework whether athletes' individual levels and changes in hassle and uplift levels over a 10-week period could predict injury outcome in an elite junior soccer population.

Design: A prospective design with repeated measurement points.

Methods: Participants were 101 Swedish elite junior soccer players (67 males and 34 females). Ten sets of measures were taken on a weekly basis during which participants completed the Hassles and Uplifts Scale (HUS). Latent growth curve models were used to examine whether the level and change in psychological stress could predict the frequency of injury over the 10-week period.

Results: The results show that injury occurrence was significantly associated with both the initial level of daily hassle and the change in daily hassle. High initial daily hassle levels and a smaller decrease in daily hassles were associated with injury occurrence. Moreover, injury occurrence was significantly associated with a greater decrease in daily uplift.

Conclusions: The findings highlight the importance of focusing on state variables using prospective designs and appropriate analysis of within-person change to detect complex and dynamic associations across time in injury-prediction research.

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1. Introduction

In both male and female Swedish elite soccer populations, researchers have found injury rates to be between 65% and 95% per year.¹ Pre-injury research has identified a number of factors that could increase injury risk among athletes. For example, Bahr and Krosshaug² developed a theoretical model in which internal risk factors (such as health, physical fitness, skill level, and psychological factors) are associated with an athlete's predisposition towards increased injury risk. The predisposed athlete is then exposed to external risk factors (such as sports equipment and environment) that may render him or her susceptible to a higher risk of injury. Owing to the complex interactions of internal and external risk factors, it has been suggested that injury researchers should adopt prospective designs in order to monitor changes in

injury susceptibility over a period of time.³ This study focuses on the ways in which changes in psychosocial stress influence injury risk among Swedish elite junior soccer players.

Concerning the psychosocial factors that may influence injury risk among athletes, several models have been proposed. One of the most influential and well known is Williams and Andersen's⁴ theoretical model of stress and athletic injury, which suggests that specific psychosocial risk factors influence an athlete's appraisal of a potentially stressful situation. The risk factors are divided into three categories: personality factors (such as proneness to anxiety), history of stressors (such as negative life-event stress and daily hassle), and coping (such as acceptance). How an athlete appraises a situation influences the strength of the stress response s/he will experience. This, in turn, may influence the athlete's cognitive (e.g., peripheral vision) and physiological (e.g., fatigue level) abilities. These changes in cognitive and physiological abilities potentially lead to an increased risk of injury.

Findings from empirical studies using a nomothetic approach have in general supported this model. For example, personality variables such as trait⁵ and state⁶ anxiety have been found

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to have a positive correlation with injury risk among athletes. Regarding the history of stressors and injury occurrence, empirical research has shown distinct support for a positive correlation between major stressors (e.g., negative life-event stressors) and injury occurrence.^{4,7,8} In addition, several empirical studies using an idiographic approach have been conducted in this field. Most of these have found that athletes' pre-injury experiences could be classified in accordance with Williams and Andersen's suggested categories. For example, one interview study found that both life-event stress and personal factors (such as worry and anxiety) were present in the athletes' stories.⁹ Given that the relationship between psychological variables (e.g. personal traits and stress) and injury risk could be influenced by hassles,¹⁰ the injury risk to which an athlete is exposed could fluctuate as a consequence of the level of hassles. *Daily hassles* can be defined as everyday irritations, such as minor problems at work, not getting enough sleep, and losing things.¹¹ Results from other studies also support the link between a high level of hassle and increased risk of injury.^{12,13} When discussing daily stressors, such as hassles, daily uplifts should also be mentioned. *Daily uplifts* can be defined as events that make one feel good; for example, they produce feelings of joy, gladness, or satisfaction.¹¹ Even if high levels of uplift have been found to be associated with lower levels of perceived stress,¹⁴ this relationship has not, to the best of our knowledge, been addressed in the psychology of injury literature.

Previous research in sports-injury literature has largely focused on major stressors (i.e., acute life events such as the death of a relative or a job loss^{7,8}) without taking into consideration individual differences in state variables (i.e. hassle and uplift). Moreover, analyses used in previous research have been predicated on means or paths (e.g. repeated-measures ANOVA), without an acknowledgement of the potential influence of individual differences.^{15,16} In the present study, we instead use a latent growth curve analysis (LGC) to investigate how the intercept (starting point) and slope (change) of the level of hassle are associated with injury occurrence. More specifically, using latent growth curve models (LGCs), it is possible to investigate both inter- and intra-individual change. Hence, LGC includes a powerful and flexible methodology to model intra-individual changes, inter-individual differences in intra-individual change, and the ways that level and true change may predict other outcomes.^{15,16} Consistent with these suggestions, our aim was to highlight the concept of change (in hassle and uplift level, respectively) and how it might predict risk of injury. Consequently, the objective of this study was to investigate whether athletes' individual levels and changes in levels of hassle and uplift during a 10-week period could predict injury outcome. We hypothesised that a high hassle level would be associated with an increased likelihood for injury (hypothesis A). Moreover, a low uplift level was hypothesised to be associated with a high injury risk (hypothesis B).

2. Method

The participants were 101 elite junior soccer players (67 males and 34 females), aged between 15 and 19 years (mean age [16.7 ± 0.9 yr]). They were high school students whose soccer programmes were certified by the Swedish Soccer Association (four schools in total). During the study period, the players practiced between 4.5 and 20 h per week [11.22 ± 3.22 h]. At the beginning of 2012, all players included in the study were injury free and in full training.

During the study period, 67 injuries were reported across 44 players. An *injury* was defined as a condition meeting the following two criteria: (1) it occurred as a result of participation in an soccer practice or game, and (2) it led to the restriction of the athlete's participation for three days or more beyond the day of injury. A

power analysis based on effect size of root mean square error of approximation (RMSEA)¹⁷ showed sufficient power for the number of participants in the study. All participation was voluntary, and confidentiality of responses was assured. The study was approved by an Institutional Ethics Committee for Human Studies.

The Hassles and Uplifts Scale (HUS)¹¹ was used to measure players' levels of daily hassles and daily uplifts. The inventory consists of 53 items addressing potential daily hassles and uplifts (e.g., family issues, personal responsibilities, work relationships). Players were asked to indicate whether the given situation had constituted a hassle and/or an uplifting event over the course of the preceding week. Questions were answered on a four-point Likert scale, ranging from 0 (*not at all*) to 3 (*very much*). HUS has a high test-retest reliability¹¹ and a reported Cronbach's alpha of 0.71.¹⁸ The alpha for the present study was 0.87.

Data collection took place between February 2012 and April 2012. Coaches from the participating schools were first contacted by telephone. In this conversation, the coaches received information regarding the overall aim of the study, and meeting with the participants was scheduled. At the meeting, participants were informed about the aims of the study, informed consent was and players were asked to complete the HUS for the first time. Following the meeting, participants completed the HUS on a weekly basis during a 10-week period throughout the preseason. The scale was administered with the assistance of each team's coach. Given that *daily hassle* and *uplift* are state variables (i.e., they are fluid in nature), a repeated measures-type design allowed for a more accurate assessment of changes in athletes' perceptions over time than the use of a single measurement point would have allowed. During the testing period, the athletic trainer at each school was asked to record any injuries that had occurred during the previous week.

Intraclass correlations (ICC) were calculated to investigate the amount of the total variance in hassle and uplift that exist among individuals, across the 10 observations. The ICC is the proportion of variance that exists between individuals. The original basic models of growth curve analysis have been extended by researchers¹⁹ so as to include it in structural equation modelling (SEM) frameworks. In LGCs within the SEM framework, observed repeated measures across time are used as indicators of unobserved (latent) underlying true growth trajectory factors.²⁰

In the present study, LGCs were fitted to data using Mplus (version 7.1) with a robust maximum likelihood estimator. The baseline models contained one latent factor of level (i.e. an athlete's initial value of psychosocial stress at week 1), one latent factor of change (i.e. an athlete's change trajectories in daily hassle and uplift, respectively, across the ten measurement points, one per week for 10 weeks), and one dependent categorical factor (i.e. injured/uninjured). Further, the variance across the mean for both level and change was estimated to determine whether between-person differences existed concerning level and change in daily hassle and uplift. The following fit indices were used: (1) Chi-square statistics, (2) the Bentler Comparative Fit Index (CFI), and (3) RMSEA (with 90% CI).

Injury could be conceived as an endpoint event, and since the present study focused on injury prediction, only the pre-injury data are of interest. Pattern-mixture models were used to estimate a growth model for hassle and uplift, intercept, and slope, containing binary dummy dropout indicators as covariates. This specific model is used to specify the influence of dropout indicators on growth factors.²¹

3. Results

The hassle and uplift trajectories for the two groups (injured and uninjured players) appear in Fig. 1. This figure illustrates the

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