Abstract

The present doctoral thesis addresses the research/application dilemma which has been described by Beckmann and Kellmann (2008). The aim was to evaluate and validate two measures of the acute recovery and stress state in sport. The Acute Recovery and Stress Scale (ARSS) and the Short Recovery and Stress Scale (SRSS) were developed in two stages. In the development phase, the focus lay on constructing the model. Three studies were included in this phase. The second phase followed as a validation phase. Two more studies were used to test the model’s construct and criterion validity.

The questionnaire development of the ARSS was carried out in four consecutive phases, consisting of a preparatory phase, two preliminary studies and a main study with the target population, which were published by Hitzschke et al. (2016; Publication 1). Following an expert survey, a first draft was completed by sport students (N = 257). Based on the results of an exploratory factor and a reliability analysis, separate models for recovery (with the scales Physical Performance Capability, Mental Performance Capability, Emotional Balance, Overall Recovery) and for stress (Muscular Stress, Lack of Activation, Negative Emotional State, Overall Stress), were extracted. The revised version was analyzed via a confirmatory factor analysis among performance-oriented athletes (N = 429). Finally, the slightly modified version was validated among high-level athletes (N = 574). The confirmatory factor analysis indicated good fit-indices (Recovery: $\chi^2 = 290.28$, df = 90, $p = .001$, RMSEA = .06, LO90 = .05, HI90 = .07, CFI = .96, SRMR = .04; Stress: $\chi^2 = 352.76$, df = 90, $p = .001$, RMSEA = .07, LO90 = .06, HI90 = .08, CFI = .95, SRMR = .06) as well as good scale homogeneity ($\alpha = .76 - .90$). Furthermore, first indications of construct validity were obtained, as could be shown by conforming correlations with the convergent procedures RESTQ-Sport (Kellmann & Kallus, 2000, 2016) and DOMS (Ohnhaus & Adler, 1975).

The SRSS represents a reduced version of the ARSS from which the items were derived based on content and statistics (Study 3). Thus, the eight items of the SRSS depict the underlying factor structure of the ARSS. The development and the first validation study (Study 4) were published by Hitzschke et al. (2015). The SRSS indicated acceptable homogeneity for both short scales (Recovery: $\alpha = .72$ and Stress: $\alpha = .75$), moderate intercorrelation, and hypothetically conforming correlations with the ARSS. The SRSS also shows comparable correlation patterns to the ARSS in reference to the convergent questionnaires RESTQ-Sport and DOMS. During a training camp of the German junior national field hockey team, the sensitivity to change of the SRSS was proved and a concurring result pattern in reference to the ARSS (Kölling et al., 2015), with the RESTQ-Sport, and the DOMS was demonstrated.
In the second validation study (Hitzschke et al., 2017), the sensitivity to change and criterion validity of both questionnaires were determined within a six-day microcycle of intensive strength training and high intensity interval training (HIIT) in comparison to the change in the criterion measures (estimated 1 repetition maximum; 1RMest in the strength training group or Repeated Sprint Ability; RSA in the HIIT group). In addition, this data was compared with the results of the physiological and performance-based fatigue markers reported by Raeder et al. (2016) and Wiewelhove et al. (2015). The results showed a sensitive to change and practical representation of the fatigue and recovery phases of the ARSS and the SRSS, which have a similar pattern to the RESTQ-Sport (Kölling, Wiewelhove et al., 2016) and DOMS (Wiewelhove et al., Raeder et al., 2016). The strongest sensitivity to change could be demonstrated in the physical and general scales of the measures. Equal to the results of the physiological and performance-related stress parameters (Wiewelhove et al., 2015, Raeder et al., 2016), psychometric procedures could not differentiate between fatigued and recovered subjects depending on the criterion markers. The comparison of the various markers underlines the strong sensitivity to change of the psychological markers, especially in the recovery processes. Furthermore, a recommendation for intraindividual and longitudinal interpretation can be derived. The low correlation between subjective and objective measures also supports the multivariate assessment of recovery and stress for training monitoring.

Overall, the results of the development and validation studies support the validity and the sensitivity to change of both methods for the assessment of recovery and stress patterns in competitive sports. One of the measures’ strengths is the practical applicability in training monitoring, as they are compact, multidimensional, and at the same time valid and sensitive. According to Kellmann et al. (2016), the ARSS and SRSS are two independent questionnaires, which can be used both independently and in combination. However, the results of the studies indicate that the SRSS cannot completely replace the ARSS. Thus, the ARSS seems to be more sensitive than the SRSS, especially in the emotional and mental scales. By reducing the number of items from 32 to 8, the SRSS represents a more economical and practicable method for applied sports practice. Kellmann et al. (2016) therefore recommend a combined use in which the procedures can be adapted individually and flexibly to different needs and settings.