ADAPTATION AND EVALUATION OF THE FINNISH VERSION OF THE RECOVERY-STRESS QUESTIONNAIRE FOR ATHLETES

Felix Pennanen

Master's Thesis in Sport and Exercise Psychology

Spring 2018

Faculty of Sport and Health Sciences

University of Jyväskylä

ACKNOWLEDGEMENTS

Firstly, I would like to express my sincere gratitude towards my supervisor Dr. Montse Ruiz, who provided me with the possibility to write this thesis. I would also like to thank Professor Taru Lintunen for her support and positive spirit.

Secondly, my sincere thanks go to my fellow SEPPRO students, who inspired me and provided me with great motivation.

Last but not least, I owe a huge thank you to my beloved Pernilla Jansson. I could not have done this without your support!

ABSTRACT

Pennanen, Felix (2018) Adaptation and Evaluation of the Finnish Version of the Recovery-Stress Questionnaire for Athletes. Master's Thesis in Sport and Exercise Psychology. Faculty of Sport and Health Sciences. University of Jyväskylä. 53 p.

An optimal balance between physical stress and recovery is essential to athletic performance. Athletes have to balance physical stress and recovery time to avoid overtraining, fatigue and injury. The optimal balance between athletes' stress and recovery can be monitored and maintained through different methods, from physiological measures to psychometric instruments (Kellman, 2010). A commonly used psychometric tool is the Recovery–Stress Questionnaire for Athletes (RESTQ-Sport) developed by Kellman and Kallus (2001). The RESTQ-Sport has been applied in a number of studies (Kellman, 2010), and both validity and reliability has been proven high for the original English version (Kellman & Kallus, 2001). However, there is no version in Finnish language.

The purpose of the current study aimed to evaluate the factor structure and concurrent validity, of a Finnish version of the RESTQ-Sport. A back-translated Finnish version of the RESTQ-sport was completed by 227 competitive athletes from a wide variety of sport disciplines.

The data was evaluated against the model structure proposed by Kellmann and Kallus (2001). To analyze the model fit of the Finnish sample, structural equation modeling was adopted using IBM SPSS AMOS. The factor structure was evaluated using Confirmatory Factor Analysis (CFA) for construct validity. For concurrent validity, a shortened version of the Profiles of Mood States (POMS, McNair, Lorr & Droppleman, 1971) was used.

The CFA revealed inconsistencies in the structural integrity of the Finnish version of RESTQ-Sport. However, the instrument showed strong concurrent validity in correlation with POMS. Some of the structural inconsistencies have been discovered in previous studies, but not all are explained by preexisting weaknesses in the model. Hence, before utilizing the RESTQ-Sport in stress-recovery monitoring in Finnish, the translation of the instrument should be revisited, and further studies to ensure the construct validity of the model are warranted.

Keywords: RESTQ-Sport, recovery, stress

TABLE OF CONTENTS

1 INTRODUCTION

For elite athletes, intensive training load is essential to reach peak athletic performance. Athletes push themselves towards the extreme where both body and mind have to endure tremendous strain that sometimes becomes overwhelming. Without sufficient recovery, athletes are likely to experience a number of negative effects such as overtraining, fatigue, burnout, injury or illness. Understandably, successful training programs not only consist of large quantities of physical stress but also recovery (e.g. Budgett, 1998; Koutedakis & Sharp, 1998). The continuous strive towards higher performance, however, does not always take the latter into account, which can lead to negative consequences for the athletes.

According to Grant et al. (2014), almost 44 % of all injuries during the 2012 London summer Olympics were results of overtraining. In addition, not only elite athletes suffer from issues related to insufficient balance between stress and recovery. Brenner (2007) notes that overtraining and burnout among children and adolescent athletes are increasing problems in the United States. Similar findings are reported in Europe by Matos, Winsley & Williams (2010). However, complications related to an imbalance between stress and recovery can be avoided through awareness of the stress-recovery states of the athletes. This can be achieved by continuous monitoring of the athletes' stress- and recovery levels.

Stress is a complex concept with multiple implications, rendering the monitoring of its levels depending on how stress is perceived. Does the monitoring reflect physiological stress, cardiovascular stress, emotional stress, social stress, psychological stress or a combination of different aspects of stress? A number of different measurements have been developed to measure stress. However, many of these instruments disregard recovery, others are impractical to use continuously due to cost, possible measurement frequency or time for analysis. In addition, some measurements are too narrow in their definition of stress to be beneficial to athletes who wish to find a balance between stress and recovery.

The Recovery-Stress Questionnaire for Athletes (RESTQ-Sport), developed by Kellmann and Kallus (2001), is a psychometric multidimensional self-report instrument for measuring and monitoring stress-recovery patterns among athletes. The questionnaire evaluates

physical, emotional, social, behavioral, sport-specific and general dimensions of stress and recovery to provide the athletes with a holistic overview of their stress-recovery profile. The RESTQ-Sport can be used to avoid issues related to imbalance between stress-recovery among athletes, such as overtraining, overuse injuries and burnout, or at the other end of the spectrum undertraining.

Originally, the RESTQ-Sport was developed in German, and a number of translations have been established during the last years. However, no translation into Finnish has previously been validated. The purpose of this study is to translate and examine the psychometric properties of a Finnish version of the RESTQ-Sport. The construct validity will be evaluated through analyzing the fit of a Finnish sample against the original model of the RESTQ-Sport using confirmatory factor analysis. In addition, convergent validity will be established using the Profiles of Mood States (McNair, Lorr & Droppleman, 1971) as comparison measure.

2 LITERATURE REVIEW

Numerous studies have shown that many athletes competing on elite levels in different sports suffer from injuries and burnout due to overuse or overtraining and a lack of recovery (e.g. Brink et al., 2010; DiFiori et al., 2014; Jacobsson et al., 2013; Purvis, et al. 2010). The key question of optimizing the stress-recovery relationship, however, remains unanswered. This literature review will, therefore, explore contemporary research related to the fields of stress and recovery, focusing on monitoring instruments that can help athletes and coaches optimize their training programs with recovery-stress balance in mind. Monitoring instruments in general will be touched upon, but the Recovery Stress Questionnaire for Athletes (RESTQ-Sport) developed by Michael Kellman and Wolfgang Kallus (2001) will be in particular focus considering the purpose of this study.

Due to the complex nature of the concept of stress I will also, before examining the contemporary research and applicable instruments, present a historical overview and narrow down a functional definition of stress that will serve as a useful foundation for the literature review.

2.1 Historical Aspects and Definitions of Stress

Stress is an amorphous concept usually defined by the context it is placed or used in. Even though the word stress, according to Jackson (2013), has its etymological roots in the 14th century, the scientific community has only been exploring stress in terms of psychological, neurological and hormonal disturbances since the middle of the 19th century. During which the societal changes brought on by the industrial revolution gave birth to new perspectives on stress as a major factor influencing public health.

One of the most commonly cited early researchers on stress was the physiologist Walter B. Cannon (1929) who, after studying the autonomous nervous system (ANS) and the physiological aspects of emotions, coined the term homeostasis (psychobiological self-

regulation) in the 1930's. This new concept was used to describe the systems used by animals (including humans) to maintain inner equilibrium in the face of external changes, and opened up for the first more commonly accepted definitions of stress in terms on "disturbances of the homeostasis" (Jackson, 2013).

During the same time period the Hungarian endocrinologist Hans Selye expanded the concept to distress and eustress, acknowledging the negative versus positive effects of stress including psychological dimensions (Chrousos & Gold, 1992; Jackson, 2013). Selyes work opened up for a constructive discussion about stress where the positive side of the construct came to be adopted by sport psychology. Since a certain level of stress is necessary for both athletic development and performance, the acceptance of the fact that not every disturbance of the homeostasis is negative became a milestone in the development of sport psychology. The idea of mild and controllable stress states as positively stimulating is still an essential component in important frameworks within sport and exercise psychology (Weinberg & Gould, 2011).

In relation, the emergence of psychology in the early 20th century extended perceptions of stress towards the mental aspects with Sigmund Freud as one of the pioneers. Freud introduced the "constancy principle" in his work *Beyond the Pleasure Principle* (1922), and provided a psychological equivalent to the more biological *homeostasis*. (Jackson, 2013). The constancy principle theorized the idea about a psychological regulatory system for maintaining equilibrium through discharging energy or avoiding the excitatory source. Still, the Freudian view of stress remained unclear about what level the constancy principle was striving for, and Freud developed the well-known concept of *death drive* (later *Thanatos*) to describe the zero-stress/excitement level (Freud, 1922). This notion, however, opposes the current views on stress in sport and exercise psychology where extremely low stress levels are viewed as contra productive for optimal performance (Weinberg & Gould. 2011).

In the field of sport and exercise psychology, Richard Lazarus's cognitive-motivational-relational theory of emotion has been widely quoted in regards of stress and coping.

Lazarus views stress, coping and emotion as integral aspects of a holistic single entity, arguing that they should not be considered separate topics. Simultaneously, emotions are considered from a dynamic perspective where Lazarus emphasizes the importance of evaluation of emotions through cognitive, motivational and relational processes, called appraisals. He suggests that how the emotions are appraised directly impacts the meaning they assign to a person's well-being. This becomes important in regards to stress and coping, since Lazarus moves away from a strict division in positive and negative emotions, instead considering the appraisal of different emotions to be the deciding factor in stress and coping.

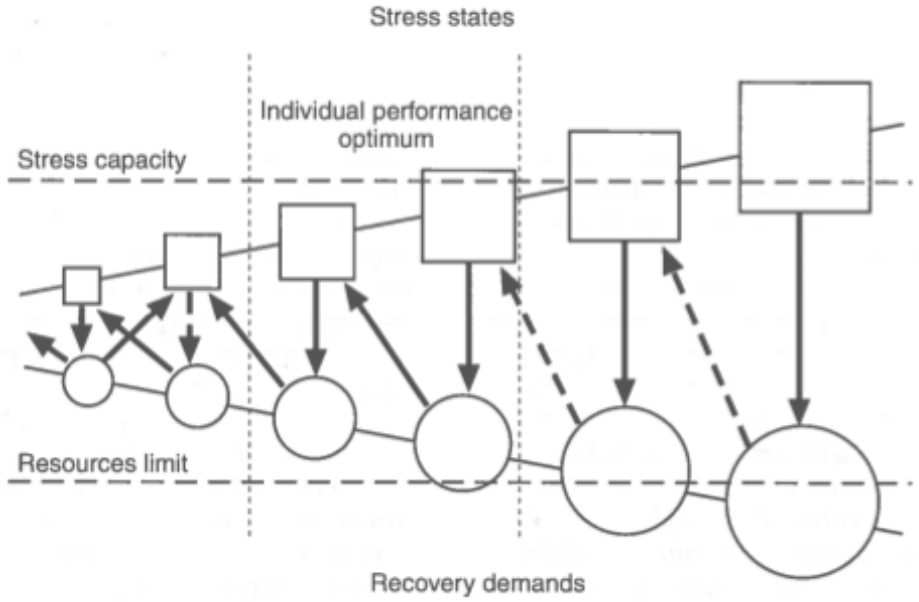
A frequently used reference for stress within sport psychology settings is the American social psychologist Joseph McGrath, who defines stress as "a substantial imbalance between demand [psychological and/or physiological] and response capability, under conditions where failure to meet the demand has important (perceived) consequences" (McGrath, 1970, p. 20). This definition is explained with a simple model in which the stress process is deconstructed into four stages ranging from environmental demands, through subjective perceptions of demands and a factual psychophysiological stress response, to behavioral consequences (Weinberg & Gould, 2011; Staal, 2004). Even if this definition is widely used, it lacks dimensions necessary to fulfill the purposes of the present study, considering finding the optimal balance between stress and recovery for athletes. Therefore, a modified version of the definition of stress provided by Kellman and Kallus (2001), two of the leading contemporary experts on Stress-Recovery states among athletes, will be adopted in this thesis.

Kellman & Kallus (2001) view the concept of stress as a "destabilization or deviation from the norm in a biological/psychological system (psychophysical balance)" (Kellman & Kallus, 2001, p. 21). This definition, then, includes ideas related to both Cannon's biological *homeostasis* (systematic biological balance) and Freud's more psychological equilibrium. In addition, the definition opens up for a more interpretative approach than the definition provided by McGrath, since the latter considers the imbalance/deviation as

"substantial", which excludes the positive effects of stress. This aspect is, in relation to both Selye's concepts of distress and eustress, discussed by Kellman and Kallus (2001), who emphasize the duality of stress in form of positive or negative appraisals similar to Lazarus's theory. Furthermore Kellman and Kallus make a distinction between stress and strain, where the former is considered the subjective experience (internal & external) whereas they chose the word *stressor* for the latter to describe objective situational/external aspects influencing the subject or individual. Even though the stressors are objective, their effect on the individual (perceived stress) is highly different in both quality and quantity since individuals are not passive recipients, but active beings, able to influence the effect of the stressors through coping (Kellman & Kallus, 2001).

The view on stress as both a positive and negative concept depending on the individuals coping resources and abilities opens up for a more constructive approach when it comes to sport. Kellman and Kallus suggest a theoretical model where the level of stress and the individuals' recovery demands increase simultaneously (see Figure 1). This model illustrates the relationship between stress and recovery for optimal performance, where insufficient levels of stress fail to increase performance and levels of stress exceeding the individual's stress capacity/resources limit lead to reduced performance (Kellman & Kallus, 2001).

Figure 1: *The "scissors-model" of the interrelation between stress states and recovery demands* (Kellman & Kallus, 2001, p. 25)



2.2 Stress and Athletic Performance

Kellman and Kallus' (2001) model, combined with similar ones (e.g. the IZOF-model) (Hanin, 2000), constitute the theoretical foundation for a number of studies on stress, recovery, and athletic performance within Sport and Exercise Psychology. These studies can be divided into three main categories where focus is either descriptive, preventive or performance enhancing. In the following chapter contemporary research on stress-recovery states will be explored. Due to the nature of this thesis, the review below will be limited to the psychological perspective.

Researchers and various experts from sport science or sport psychology, working with athletes, use different methods to approach their stress-recovery states, ranging from physiological measures to psychometric instruments and combinations of both. Kellman

approaches the different options available for stress-recovery and emphasizes that “In sports, the importance of optimizing the recovery–stress state is critical. Effective recovery from intense training loads often faced by elite athletes can often determine sporting success or failure” (Kellman, 2010). Regardless of method Kellman suggest a longitudinal approach with continuous monitoring to enable the researcher to detect changes in stress-recovery states. If this strategy is applied, however, the physiological measurements become expensive and consume both time and resources, which leaves psychometric instruments as the most efficient option (Kellman, 2010).

Among these instruments the most commonly used are Profiles of Mood States (POMS) (McNair, Lorr & Droppleman, 1971), the Borg’s Rating of Perceived Exertion (RPE) (Borg, 1970), Total Quality Recovery (TQR) (Kenttä & Hassmén, 1998) and the more contemporary Recovery-Stress Questionnaire for Athletes (RESTQ-Sport, developed by Kellman and Kallus). The different instruments all have their unique benefits, where POMS approaches more holistic mood states, RPE provides a direct sample of perceived exhaustion during physical activity and TQR looks more carefully at recovery, often in combination with RPE. However, the RESTQ-Sport can be considered to be the most versatile of them since it provides data on general stress – recovery states as well as sport specific stress–recovery states (Kellman & Kallus, 2001; Kellman, 2010). In addition the RESTQ-Sport includes a number of dimensions from physical stress/recovery to social, emotional, sleep etc. The application of RESTQ-Sport also covers the whole range of research categories (descriptive, preventive and performance enhancing) and it has been proven to be a reliable and valid instrument for interventions in elite sports (Brink et al., 2010; Kellman & Kallus, 2001; Kellman, 2010).

Even though Kellman and Kallus have performed numerous studies using the RESTQ-Sport (e.g. Kellman & Kallus, 2001; Kellman & Günther, 1999; Kellman et al. 2001), other researchers have also used the RESTQ-Sport to approach stress – recovery in athletes. For example, DiFronso et al. (2013) performed a descriptive study where the stress – recovery states among amateur basketball players was explored. The study showed large differences

in stress–recovery states between men and women and in preseason and competition. In addition, the authors suggested different interventions and changes in the training schedule to lower the stress and strengthen the recovery states in certain areas (sleep quality, physical recovery and self-efficacy).

Furthermore, youth sports and stress in general is a highly current topic since sports are getting more competitive and injuries are becoming more frequent among younger athletes. The American Medical Society for Sports medicine (AMSSM) even released a position statement in January 2014 raising their concerns about injuries, burnout and overtraining among you athletes (DiFiori et al., 2014). In relation to youth sport, Brink et al. (2010) used the RESTQ-Sport to study stress and recovery among young elite soccer players. This study aimed at preventive strategies to avoid injury and burnout, and the authors found correlations between both psychosocial stress and illness, and physical stress and traumatic injuries (Brink et al., 2010). In this study the importance of continuous monitoring of stress-recovery states was highlighted, and the authors conclude that physical-, as well as psychosocial stress, play key roles in the occurrence and frequency of illness and injuries among young athletes (Brink et al., 2010). Furthermore, the authors recognized the need for continuous monitoring and stated that a more frequent administration of the RESTQ-Sport should be advised. (Brink et al., 2010).

Lastly, the RESTQ-Sport can also be applied for performance enhancement, which Coutts et al. (2007) adapted in a study on recovery states in triathletes. In their study Coutts et al. used a multidisciplinary approach to analyze how the athletes recovered during and after overreaching (short-term decrease in performance due to excessive stress). They scrutinized the athletes' performance and monitored changes in physiology, biochemistry and psychology, where the latter was studied using the RESTQ-Sport. The authors found no significant physiological or biochemical responses to intensified training (overreaching), but the RESTQ-Sport provided data suggesting that the training load was increasing the athletes' stress states and decreasing the recovery states. Coutts et al. (2007) found that the RESTQ-Sport 76 scores were able to distinguish the stress/recovery levels between

intensive training and normal training groups, whereas the biochemical/physiological markers did not detect the differences. The authors establish that regular monitoring of stress/recovery is vital to avoid overreaching for athletes who train under high intensity on a regular basis (Coutts et al., 2007).

2.3 Summary

The concept of stress in terms of a destabilization from the norm in the human psycho-physiological balance is best adapted to sport and exercise psychology through viewing it as a concept of duality reflecting both a positive and negative dimension. Simultaneously, an essential component of stress is the notion of a distinction between stress and stressor. The latter is external and can be constant whereas the former is subjectively experienced and influenced in terms of quality and quantity. Stress is therefore predominantly individual and affected by the coping resources the individual has at his/her disposal. These resources include external factors such as time or social support, as well as internal conscious decisions and developed strategies.

For an athlete stress is essential, but a balance between expedient stress and recovery is a crucial component for optimal performance. This discrepancy is often overlooked, which leads to injuries, overtraining, burnout etc. To be able to monitor and regulate stress – recovery levels, applications of physiological, psychometric or combined measurements are fundamental. The Recovery Stress Questionnaire developed by Kellman and Kallus has been proven to fill a number of functions in both research and intervention on stress – recovery among athletes

Finally a note has to be made regarding the fact that the RESTQ-Sport does not provide a diagnosis of for example overtraining or injury. The instrument is used to monitor stress – recovery levels in (elite) athletes and variations on the different subscales/dimensions can give indications of whether the athlete is at risk of overtraining and whether the athletic development is progressing correctly.

3 VALIDATING THE RESTQ-SPORT

Elite athletes put themselves through tremendous amounts of physical and mental stress to increase their performance. However, to be able to compete and perform at the highest level in any sport, the athletes' bodies and minds have to be able to cope with this stress, which raises the question of recovery. An optimized balance between stress and recovery is key to athletic success since insufficient recovery can lead to, overtraining, overreaching, burnout, illness etc. This fine line of balance between high- and excessive training load is often difficult to find, but can be obtained through continuous monitoring of different dimensions of the athlete's stress and recovery.

There are two main external approaches to monitor stress/recovery-patterns (in addition to the athlete's own internal perceptions or introspection); (1) Physiological instruments (e.g. blood or tissue analysis and Heart Rate Variability) and (2) psychometric instruments such as Profiles of Mood States (POMS), Total Quality Recovery (TQR), the Emotional Recovery Questionnaire (EmRecQ), or the Recovery Stress Questionnaire for Athletes (RESTQ-Sport). These can advantageously be used in combination to get a more multifaceted image, but the latter psychometric instrument, RESTQ-Sport, has also been widely used on its own since it includes numerous stress-recovery dimensions.

The RESTQ-Sport was developed by the Michael Kellman and Wolfgang Kallus during the 1990s and the manual for the final version was published in 2001 (Kellman & Kallus, 2001). The authors themselves describe the RESTQ-Sport as "an instrument that systematically reveals the *recovery-stress states* of athletes. The recovery-stress state indicate the extent to which persons are physically and/or mentally stressed, whether or not they are capable of using individual strategies for recovery, as well as which strategies are used" (Kellman & Kallus, 2001, p 1). The questionnaire consists of 76 items formulated to continue the statement "In the past three days/nights I…" where the overall goal is to, in a more specific way, answer the question "How are you?" (Kellman & Kallus, 2001). For example item 37 "*In the past (3) days/nights I was in good condition physically*". Each item

is scored on a 7-point Likert scale from 0 (=never) to 6 (=always) and corresponds to 19 subscales (4 items/ subscale). These subscales are describing general stress (7), general recovery (5), sport specific stress (3) and sport specific recovery (4). A shorter version of the questionnaire does exist (RESTQ-Sport 52), but for the purposes of this study the 76-item version is in focus. The RESTQ-Sport is limited to self-reported perceptions of stress/recovery aspects during the past three days. This approach requires the participants to remember their experiences and feelings for three days, which introduces an element of uncertainty to the results. However, the issue has been addressed by the authors, who have found this to be a good balance between repeated frequent measuring and participant exhaustion from measuring too often.

The RESTQ-Sport has been translated into a number of languages from the original German and English versions to Portuguese, Spanish, Dutch, Danish, Swedish, Estonian, French and Italian. In this chapter I will explore the different methods used to validate the original instrument as well as the translations to different languages. Some of the translations have not been validated, but I will briefly mention them as well, since at least construct validity has been established in most languages.

3.1 English and German

During the development of the RESTQ-Sport 76 Kellman and Kallus performed numerous studies and revisions of the questionnaire. The starting point was Kallus' original German 48 item RESTQ (not sport specific) which was validated and applied in English already in the early 1990s and then built upon to form the sport specific RESTQ-Sport. The first editions contained more items (86 in 1992, 85 in 1995 and 80 in 1999) but as the authors continued to develop the instrument they arrived at the current 76. In addition Kellman and Kallus also developed a shortened version in the year 2000 containing 52 items. The RESTQ-Sport 52 has excluded some of the general stress/recovery items and is therefore

more frequently used in longitudinal studies where the focus lies on sport specific scales rather than general. (Kellman & Kallus, 2001).

In addition to the change in number of items, the current time aspect of the items (past 3 days/nights) was previously unspecified (past few days). The unspecified time was, however, not very efficient since respondents reported a very wide range of time chosen for their stress/recovery reference, which led the authors to change the time frame to the three day specification/recommendation (Kellman & Kallus, 2001).

Kellman and Kallus as well as other researchers have explored the validity and reliability of the original RESTQ-Sport in numerous studies. The authors' own studies include samples from various sports (rowing, swimming, golf, track and field, etc.) and use different instruments for criterion validity for example State-Trait Anxiety Inventory (STAI), German Stress Coping Inventory (SCI), Profile of Mood States (POMS), Volitional Component Questionnaire (VCQ) and Multidimensional Physical Symptom List (MPSL).

The sample sizes in these studies vary but are rather small for quantitative validation studies (mean $M \approx 68$). However, the internal consistency for the different subscales is high and almost constantly stay within Cronbach $\alpha > 0.7$. The subscales where Cronbach α sometimes drop slightly below 0.7 are general (*Conflicts/pressure*, *Success and Burnout/Personal Accomplishment*) and the authors explain this deviation with different interpretations of the items by athletes compared to non-athletes (Kellmann & Kallus, 2001). In addition, the fact that some items are directed towards team sports whereas most respondents in the validation studies participated in individual sports might have an effect on these subscales.

The test-retest reliability is also explored by Kellman and Kallus, and they conclude that it is relatively high within 24 hours. However, since the instrument is designed to give a recovery/stress-state view over the past three days, its test-retest reliability is expected to decrease over time. Kellman and Kallus describe this change in a German sample where six tests were carried out over a time period of 37 days. This study shows a steady decline in

test-retest reliability from r > 0.79 after 24 hours to r < 0.30 after 37 days (Kellman & Kallus, 2001, Table 6.2 p. 38). Furthermore the construct validity in regards of scale intercorrelations and factorial structure has been established as relatively stable in Kellman and Kallus' studies where both the general and the sport specific scale can be divided into two factors: stress and recovery. (Kellman & Kallus, 2001).

Even though the main factors of stress-recovery are confirmed and strengthened, the construct validity of the English and German RESTQ-Sport has also been explored in studies where the sub-factorial structure proposed by Kellman and Kallus' has been criticized. For example a large study (*n*=453, 51 different sport disciplines) by Birrer, Binggeli and Seiler (2014) found structural issues especially with items in the Burnout-scales that produced factor loadings under 0.43. In the same study the *Physical Complaints*, *Physical Recovery* and *Fatigue* subscales correlated stronger to sport specific than to general stress. Moreover, a study by Davis, Orzeck and Keelan (2006) found additional issues with the factorial structure. Their study, including 585 Canadian national athletes from seven sport disciplines, supports the main factorial division in stress-recovery but also shows a discrepancy in the General Scales. In this case the *Sleep Quality* subscale does not load on *General Recovery* but instead has a negative load on *General Stress*. However, Davis et al. (2006) simultaneously confirmed construct validity of the Sport-Specific scales of the REST-Q Sport 76.

Even though there seems to be recurring inconsistencies in the General Scales, the construct validity of the instrument has been accepted by Kellman and Kallus (2001). They acknowledge that the *Sleep Quality* sub-scale is problematic but argue that the strong general two-factor solution (stress- and recovery related factors) in combination with the acceptable factor loadings of the sport specific two-factor solution, create a foundation strong enough to claim construct validity for the English and German versions of RESTQ-Sport (Kellman & Kallus, 2001).

Finally, the criterion validity of RESTQ-Sport has been examined through a variety of instruments. The most commonly used instruments for criterion validity are psychological measures of emotional states, but also biological and performance measurements. Kellman and Kallus did mainly use three instruments for criterion validation: (1) MPSL, (2) POMS, and (3) STAI (Kellman & Kallus, 2001). The MPSL was used to assess the actual physiological states among athletes, and its *General Physical Oversensitivity*-subscale (GPO) had a strong positive correlation with the RESTQ-Sport's *Fitness/injury* (.79) and *Physical Complaints* (.78). Simultaneously, the *GPO* correlated negatively with the *Fitness/Being in Shape* (–0.50) and *Physical Recovery* (–0.57) subscales, and the *Stressed Respiration* (SR) correlated positively with a number of the negative subscales of RESTQ-Sport, e.g. *General Stress* (.52), *Emotional Stress* (.45) and *Emotional Exhaustion* (.54). (Kellman & Kallus, 2001).

The POMS is an often-used instrument for assessment of mood states among athletes, and is used for criterion validity of the English and German versions of the RESTQ-Sport. The questionnaire contains 65 items corresponding to 6 different mood states: *Tension, Depression, Anger, Vigor, Fatigue* and *Confusion.* These states are useful for determining criterion validity of some parts of the RESTQ-Sport, however, the scale used in POMS is intensity (1= not at all, 4= extremely), whereas RESTQ-Sport applies a frequency scale (0= never, 6=always). Kellman and Kallus acknowledge this discrepancy, but claim that the correlation patterns are strong enough to overlook this matter (Kellman & Kallus, 2001). Their analysis shows negative correlations between the POMS' *Tension, Depression, Anger, Fatigue* and *Confusion* and the RESTQ-Sport's recovery subscales and positive interrelations with the stress subscales. Simultaneously, *Vigor* has a positive correlation with the recovery subscales and a negative correlation with the stress subscales. These patterns were strengthened through use of the STAI for criterion validity. The comparison with STAI showed positive correlations between anxiety (STAI) and stress subscales (RESTQ-Sport), and negative correlations between anxiety and recovery (Kellman & Kallus, 2001).

3.2 Dutch

The Dutch validation study was carried out by Esther Nederhof, Michel Brink and Koen Lemmink (2008). The Dutch authors approached the validation process in two separate studies, first exploring test-retest reliability, construct validity and criterion validity (using POMS) and secondly, after modifying 13 of the 76 items, assessing the validity and reliability of the modified version. The two studies contained samples relatively large compared to Kellman and Kallus' studies (Study 1 n= 116, Study 2 n= 123). However, these samples are still rather small considering the statistical strength of the studies. Before Study 1, the English version of the RESTQ-Sport was translated into Dutch by a native Dutch speaker who had expertise in both English and Sport, and reviewed by two external experts (Nederhof, Brink & Lemmink, 2008).

In the first study the authors had 116 athletes from five different sport disciplines (basketball, korfball, rowing, speed skating and volleyball) fill out the translated Dutch 76-item (77 with the warm-up) RESTQ-Sport combined with a shortened 32-item Dutch version of the POMS twice, with a week between T1 and T2. The Dutch POMS consists of only five mood states: *Depression, Anger, Fatigue, Vigor* and *Tension*, and utilizes a 5-point Likert scale. Both validity and reliability for the Dutch version of POMS has been proven to be high (Nederhof, Brink & Lemmink, 2008). The results of the absolute- and relative test-retest were inconclusive mainly due to the fact that the retest took place a week after the first measurement. Why the authors decided to do the retest after a week does not become clear from the study, and they acknowledge that "a test-retest bias was present" (Nederhof, Brink & Lemmink, 2008, p. 303). Interestingly, *Sleep Quality* had the lowest test-retest reliability in the Dutch version. As mentioned above, this subscale was also problematic in the English and German versions.

Regarding internal consistency, most subscales had a Cronbach's alpha above 0.60, apart from *Conflicts/Pressure.* The factorial structure of the Dutch version showed similar patterns to the original validation findings by Kellman and Kallus, with the two major

factors, stress-recovery, clearly distinguishable. However, *Self-Regulation* loaded positively on both factors, but had a stronger loading on Recovery in both samples. In addition, criterion validity using the POMS revealed positive correlations between the stress scales of the REST-Sport and the negative mood states of POMS, as well as negative correlations with the positive mood states. The opposite correlations were found for the recovery scales of RESTQ-Sport. (Nederhof, Brink & Lemmink, 2008).

After reviewing and altering items related to the problematic subscales discovered in the first study, the objectives of the second study in the Dutch validation process were to "evaluate reliability and validity of the improved version of the Dutch RESTQ-Sport (Nederhof, Brink & Lemmink, 2008, p. 306). In the second study 123 athletes from basketball, gymnastics, handball, rowing and soccer filled out the altered version of the Dutch RESTQ-Sport, and same statistical procedures as in the first study were repeated (POMS-analysis excluded). As expected, the second sample revealed insufficient test-retest reliability (both relative and absolute) for most subscales, and the internal consistency was generally high with Cronbach's alpha above .70 on most subscales. The only exceptions were *Physical Complaints* (0.56), *Success* (0.58) and, in the first sample, *Self-Regulation* (0.56). (Nederhof, Brink & Lemmink, 2008).

In conclusion, the Dutch validation study shows acceptable levels of reliability and validity, and most findings are conclusive with the findings of Kellman and Kallus regarding the English and German versions. One observation the authors highlight is the fact that internal consistency in almost all cases was higher in the second sample, which most likely reflects a familiarity with the instrument. Construct validity was stable in both studies with moderate to strong loadings on the two factors: stress-recovery. However, the authors did not explore the four-factor structure proposed by Kellman and Kallus (general/sport specific stress/recovery). Criterion validity was established using POMS as an external measurement. Even though there were moderate to strong correlations between respective negative and positive aspects of the two instruments, one could argue that the factual measurements not are completely compatible since POMS is measuring states (intensity)

whereas RESTQ-Sport describes frequency of experiences. This discussion, however, was overlooked in the Dutch validation study and should be considered in future validation studies.

3.3 Portuguese

Another language where the RESTQ-Sport has been validated is Portuguese. Unfortunately, the authors Leonardo Costa and Dietmar Samulski have only published their results in Portuguese (Costa & Samulski, 2005), but I will provide their central findings and methodology from their validation study in this review.

The Portuguese validation study has a similar structure as previously described languages. First a back-translation process was conducted in accordance with earlier recommendations for both the RESTQ-Sport and POMS. For criterion validity, POMS was used once again, Pearson's correlation was used for factorial structure, and internal consistency was calculated for reliability. However, the authors did not explore the test-retest reliability of RESTQ-Sport in this study. The sample consisted of 134 athletes (79 male, 55 female) from judo, gymnastics and swimming, with an average age of 18. (Costa & Samulski, 2005).

The results were similar to earlier findings with high internal consistencies and Cronbach's alpha > 0.70 in all subscales except for *Conflict/Pressure* (0.61), *Success* (0.58) and *Personal Accomplishment* (0.64). Simultaneously, the correlations with POMS show similar patterns to the Dutch study, even though the Portuguese version of POMS used was the full version containing 65 items correlating to six mood states/factors. These six states (*tension, depression, anger, vigor, fatigue,* and *confusion*) correlate as expected with the stress/recovery subscales in RESTQ-Sport, i.e. positive correlations between the negative mood states and stress, and positive correlations between positive mood states (*vigor*) and recovery. In addition, the inverted correlations follow the same expected pattern with *vigor*

correlating negatively with all stress-subscales, and the negative mood states correlating negatively with all recovery sub-scales (Costa & Samulski, 2005).

3.4 Spanish

The Spanish validation study by González-Boto et al. (2008) is oriented more towards construct validity than previous mentioned validation studies. After having a parallel back-translation performed by independent experts in sport psychology, the authors applied structural equation modeling to evaluate the factor structure of the Spanish version of RESTQ-Sport. This approach allows for a more detailed factor analysis, but simultaneously excludes the aspects of criterion validity and test-retest reliability.

Once again, the sample (N=294) consisted of rather young male and female athletes from various sports. The participants' gender and sport type, in terms of team/ individual sport, were almost evenly distributed (53 % male, 47 % female, and 47 % individual, 53 % team), with the following sports represented: athletics, swimming, cycling, judo, basketball, soccer, rugby and indoor soccer. The participants filled out the Spanish RESTQ-Sport once, and the authors performed a principal component analysis (PCA) to reveal the factor structure and covariance matrix of the RESTQ-Sport. (González-Boto et al., 2008).

The results of the analysis showed similar factorial structure to previous mentioned studies. The PCA revealed four factors (general stress, general recovery, sport-specific stress, sport specific recovery) in accordance with Kellman and Kallus' studies. The two general scales accounted for 41 % and the sport-specific for 39 % of the variance, which according to Kellman and Kallus' recommendations is acceptable. The loadings used were not item specific, but instead the scores of the 19 subscales were used in the analysis. When looking at the item specific scores, an issue in form of low factor loadings (below 0.4) arose. However, the authors conclude that the minimum acceptable weight of the item factor loadings can be under 0.4 even though this often is the recommended value. Kellman and Kallus, for example, set the minimum value for the English and German RESTQ-Sport to

0.25 (Kellman & Kallus, 2001). Cronbach's alpha for most subscales in the Spanish validation was high (above 0.7), with the exception of *Injury* with $\alpha = 0.54$. (González-Boto et al., 2008).

3.5 Other languages

In addition to the above reviewed validation studies, the RESTQ-Sport has also been applied in Swedish, Danish, Italian and Estonian. However, there are no published validations on these versions. The Swedish version was used by Eriksson (2013) in a shortened version (18 subscales), but the author does not share any information about the translation or validation process. The Danish translation has been validated and applied by Professor Anne-Marie Elbe (University of Copenhagen), but she states that the validation provides "very basic info tested on a small sample" (private email correspondence, march 2014). Even so, the internal consistency of the Danish RESTQ-Sport is high with Cronbach alphas above 0.7 for most subscales apart from *Conflicts/Pressure* (0.63), *Lack of Energy* (0.67), *Success* (0.61), *Disturbed Breaks* (0.56) and *Personal Accomplishment* (0.57) (Elbe, 2008). The Italian version was used by Filho et al. (2013), and the authors performed a standardized back-translation to ensure lexical equivalence to the English version. The authors relied on Kellman and Kallus for construct validity, and Tessitore, et.al, has previously established the criterion validity of the Italian version. (2008; 2011). The Estonian version was applied by Jürimäe et al. (2002), and showed a similar 24-hour test-retest reliability ($r > 0.74$) to the English and German versions tested by Kellman and Kallus. Lastly, a French version of RESTQ-Sport was validated by Chatelier, but the study has not been located for this thesis. However, Martinent et al., (2014) have performed an extensive validation of a more contemporary French translation, which will be touched upon in chapter 5.2.

3.6 Cultural and linguistic considerations

The RESTQ-Sport has been applied and validated in numerous cultures and languages, and the studies have almost exclusively shown consistent strong validation and reliability. Both construct and criterion validity has been established, and the internal consistency as well as test-retest reliability has been acceptable in all studies even though the latter decreases over time. The decrease in test-retest reliability, however, is expected and desirable since the RESTQ-Sport approaches stress- and recovery during a specific time frame (usually "the last 3 days").

The most common tool used to determine criterion validity of RESTQ-Sport is the Profiles of Mood States (POMS; McNair, Lorr & Droppleman, 1971), in accordance with Kellman and Kallus' original validations. This choice can, however, be criticized due to the nature of the two instruments. RESTQ-Sport measures frequency ("how often have you") whereas POMS focus on states and intensities ("how strongly have you"). If the POMS is modified to match the time frame of the RESTQ-Sport the respondents would have to be able to recall how strongly they, on average, have felt during the past three days, which could be misleading since mood states fluctuate rapidly. As an example, the word *Energetic* can be used to illustrate the problem: In the RESTQ-Sport question number 45 reads "During the past three days I felt energetic", rated on a scale from never (0) to always (6), whereas the corresponding item in the POMS reads "How you have been feeling during the past three days": "Energetic", rated on a scale from not at all (0) to extremely (4). Here an inconsistency arises if the athlete for example constantly has felt moderately energetic during the past three days, since this would assign a value of 6 in RESTQ-Sport, but only a 2 in POMS. Kellman and Kallus acknowledge this inconsistency, as mentioned earlier, but since they make use of a number of different instruments for criterion validity the discrepancy between RESTQ-Sport/POMS becomes less significant. This is, however, an aspect one needs to take into consideration when validating the RESTQ-Sport using POMS. The negative mood states in POMS are, in lines with Kellman and Kallus (2001), expected to correlate positively with related subscales in the RESTQ-Sport and vice versa.

In conclusion, cultural and lingual aspects do not seem to have a great impact on the validity and reliability of the RESTQ-Sport. All studies mentioned in this review have shown positive results regarding the functionality and applicability of the RESTQ-Sport in different languages and cultures. The main concerns towards the original construct are centered on the multifactorial structure proposed by Kellman and Kallus. The four factor structure with *general stress*, *general recovery*, *sport specific stress* and *sport specific recovery* is not strongly confirmed in all studies, but the general consensus is that the four factors can be accepted. Finally the 19 subscales are usually confirmed with a few exceptions. The most problematic subscale seems to be *Sleep Quality*, but most non-English studies do not find any issues with this subscale.

4 PURPOSE OF THE STUDY

The purpose of the current study was to evaluate the factor structure and concurrent validity, of a Finnish version of the RESTQ-Sport using POMS as an instrument for determining criterion validity. A sample of Finnish athletes (n = 227) at different competitive levels filled out an online version of both the RESTQ-Sport and a shortened version of POMS. The model fit of the factor structure was expected to reveal some inconsistencies in lines with previous studies (Kellman and Kallus, 2001; Davis et al., 2006). The correlations between RESTQ-Sport subscales and POMS mood states were expected to be strong or moderate, supporting the concurrent validity of the Finnish version of the RESTQ-Sport.

5 METHODOLOGY

5.1 Participants

In total, 332 athletes filled out the survey, out of which 227 completed it (68 % completion). The majority of the participants (n=198, 87 %) were athletes from one of five participating schools, 22 athletes (9,7 %) from major league teams, and 7 (3,1 %) competitive runners from a running forum.

Gender distribution was quite equal (female 47,1 %, male 52,9 %), whereas the age distribution was rather homogenic. The age of the athletes ranged from 15 to 52 years old (M = 19.17, SD = 4.93). The narrow age group was a result of around 85 % of the participants being young athletes from one of the high schools.

The participants were give three options for competitive level: “Regional/ Lower league/ Lower competitive level” (RegLow), “National/ Highest competitive level (Not in the National Team)” (NatHigh), and “International/ National Team” (InterHigh). In total, 142 athletes declared their competitive level as NatHigh, 53 as InterHigh and 32 as RegLow.

Kellman’s and Kallus’ criterion regarding distribution of sports discipline for validation was met with the participants being athletes from a wide range of sports. Over 20 different sport disciplines were represented by the participating athletes. The different disciplines were grouped into 12 categories to allow for a more comprehensive overview (see Table 1). The most noticeable of these groups is aesthetic sports where figure skating, gymnastics, cheerleading and competitive dance were categorized.

Table 1 – Sport discipline

Sport	Frequency	Percent
Football	37	16,3
Track and Field/Running/Orienteering	36	15,9
Cross-Country Skiing/Biathlon	34	15,0
Ice hockey/Bandy	27	11,9
Snowboard	21	9,3
Competitive dance/Cheerleading/Gymnastics/Figure skating	16	7,0
Swimming	14	6,2
Volleyball/Basketball	14	6,2
Ski Jumping/Alpine Skiing	9	4,0
Finnish Baseball	8	3,5
Wrestling/BJJ/Judo	6	2,6
Golf/Tennis/Badminton	5	2,2
Total	227	100

5.2 RESTQ-Sport

The RESTQ-Sport contains 76 items plus an initial warm-up item (item 1), that the participants answer on a 7-point Likert scale from 0 (=never) to 6 (=always). The items address possible stressful or recovery related events during the past three days, resulting in statements formulated as, for example, item 2: *In the past (3) days/nights I did not get enough sleep*. The items correspond to 19 subscales divided into 4 major factors (*General Stress, General Recovery, Sport-Specific Stress Sport-Specific Recovery*), with 12 subscales being non-specific and 7 being sport specific. The subscales are distributed as follows: In the General Stress factor, *General Stress, Emotional Stress, Social Stress, Conflicts/Pressure, Fatigue, Lack of Energy* and *Physical Complaints* are included. General Recovery includes the subscales *Success, Social Recovery, Physical Recovery, General Well-Being* and *Sleep Quality*. The Sport-Specific stress factor comprises *Disturbed Breaks, Burnout/Emotional Exhaustion* and *Fitness/Injury*, and finally the Sport-Specific recovery factor includes the subscales *Fitness/Being in Shape, Burnout/Personal Accomplishment, Self-Efficacy* and *Self-Regulation*. Each subscale contains four items.

To provide a better understanding of the content of the subscales, an example item for each subscale will be presented followed by the number of the item. The seven subscales of the General Stress factor are represented by the following examples: General Stress "*...I felt down"* (22), Emotional Stress "*…I was annoyed*" (37), Social Stress "*...I was angry with someone*" (48), Conflicts/Pressure "*...I felt under pressure*" (44), Fatigue "*...I was overtired*" (35), Lack of Energy "*...I was unable to concentrate well*" (4), Physical Complaints "*...I felt physically exhausted*" (42). Within the General Recovery factor, the following items are found: Success "*...I was successful in what I did*" (17), Social Relaxation "*...I had fun*" (33), Physical Relaxation "*...I felt physically fit*" (29), General Well-Being "*...I felt happy*" (43), Sleep Quality "*...I had a satisfying sleep*" (27). The three Sport-Specific subscales can be exemplified by the following items: Disturbed Breaks "*...I could not get rest during the breaks*" (51), Burnout/Emotional Exhaustion "*...I felt emotionally drained from performance*" (63), Fitness/Injury "*...I felt vulnerable to injuries*"

(73). Finally, the four subscales of the Sport-Specific recovery factor can be exemplified by the following items: Fitness/Being in Shape "*...I recovered well physically*" (53), Burnout/Personal Accomplishment "*...I dealt with emotional problems in my sport very calmly*" (77), Self-Efficacy "*...I was convinced that I performed well*" (65), Self-Regulation "*...I pushed myself during performance*" (62).

5.3 POMS shortened version

Profile of Mood States (McNair, Lorr & Droppleman, 1971) is a psychological instrument used to measure six different mood states (*Tension, Depression, Anger, Vigor, Fatigue* and *Confusion*). The questionnaire consists of 65 items (e.g. "`Sad" or "Energetic") corresponding to the mood states, and the items are evaluated based on intensity (1 = *not at all*, 4 = *extremely*). The time frame for POMS can be adapted describing mood states during certain periods, for example how the participants feel right now, or during the last three days. POMS has previously been used as an instrument for criterion validity of the RESTQ-Sport. However, due to the length of the REST-Q combined with POMS, a shortened version of POMS was used in this study to avoid negative effects on response rates and quality due to exhaustion. The shortened version of POMS, containing 38 items instead of 65, was developed by Shacham (1983) and validated by Curran et al. (1995). The Finnish version used in this study was presented by Hänninen (1989), and utilizes a similar 5-point likert scale (0-4) to the original version. The participants are asked to grade different mood states during the past three days on a scale from 0 (*Not at all*), to 4 (*Very much*).

Lastly, it must be noted that using POMS for convergent validity is problematic due to the differences in scale compared to RESTQ-Sport (frequency vs. intensity), but the scaling discrepancies can be overlooked in accordance with Kellman's and Kallus' findings (2001). To further enable the different scales to be comparable, the same three day time period as

RESTQ-Sport utilizes was added to the POMS-questionnaire: "…circle the intensity that best describes your mood during the last three days."

5.4 Data collection

An online version of the Finnish RESTQ-Sport 76 was constructed using the online survey tool Surveymonkey. The online version also contained the shortened Finnish version of POMS, and a modified introductory item (warm-up item) where the participants were asked to estimate their level of physical activity during the past three days/nights. In addition, the participants were asked to fill out their competitive level and sport discipline.

The survey link was sent out through email to 15 different high schools and vocational colleges with sport specialization. In addition, the survey was posted on an online Finnish running forum and sent out to Finnish major league sport clubs in football, ice hockey, floor ball, basketball, volleyball and swimming. Five of the contacted schools agreed to participate in the study, and some of the major league teams chose to forward the link to their athletes.

The online survey also included an informed consent to be filled out by the legal guardians of all minors participating in the study. Apart from age, gender, competitive level and sport discipline, no personal information was collected.

The criteria for participating in the present study were (a) that the participants were active competitive athletes, and (b) that they were over 15 years old. Since the purpose of the study focuses on validating a cross-cultural instrument, no further limiting criteria were set. According to Gudmundson (2009), validity studies of psychological instruments require broad samples to reflect the population properly. In this case the participation criteria aimed to reach a broad sample in regards of gender, age, sports, competitive level etc. A broad usage over different sports and various groups was also set as a criterion for claim to validity of the RESTQ-Sport by Kellman and Kallus (2001).

5.5 Translation

The translation of the RESTQ-Sport into Finnish was carried out using back-translation and reconciliation. First, an initial translation from English to Finnish was carried out by a bilingual expert in the field of sport and exercise psychology**.** This Finnish version was then sent out to three independent experts in Sport Sciences, who were all native Finnish speakers and fluent in English. The independent experts back-translated the Finnish version into English, compared their translations and evaluated inconsistencies on a 4-point scale from 1 (*No changes required*), 2 (*Minor changes required*), 3 (*Major changes required*) to 4 (*Reject and retranslate*). All three experts agreed that items 3, 59, 62 and 63 were in need of major changes or retranslations. Alternatives for the four inconsistent items were proposed by the experts and finally evaluated by a professional translator and adjusted in accordance with the translator's suggestions.

5.6 Data analysis

The dataset was exported from Surveymonkey to SPSS where outliers and responses containing missing values were removed. The variables were structured and renamed, and the sport disciplines were categorized as seen in table 1 above. Items 36 and 46 of the Sleep Quality were inverted in accordance with the instructions provided by Kellmann and Kallus (2001). Different frequencies were calculated to get an overview over the sample, and correlations between the RESTQ-Sport and POMS were calculated. In this analysis, specific focus was laid on correlational paths between POMS and RESTQ-factors that had previously been established in other validations.

Confirmatory factor analysis (CFA) was performed using AMOS 21 software. In CFA, latent constructs, or factors, are measured indirectly by using multiple measured variables. In contrast to exploratory factor analysis, CFA does not allow for cross-loadings, which means a structural model like the dimensions of RESTQ-Sport can be evaluated (construct validity).

The model fit was evaluated based on Comparative Fit Index (CFI), Goodness-of-Fit Index (GFI) and the root mean square error of approximation (RMSEA). Hu and Bentler (1999) suggest the CFI and GFI values to be above 0.9 and RMSEA under .06 for a structural equation model fit to be acceptable.

After analyzing the initial model, adjustments in accordance to the model fit indices were made to evaluate possible structures that would increase the model fit. The convergent validity was evaluated through comparison to the administered POMS-questionnaire.

6 RESULTS

6.1 Confirmatory Factor Analysis

Firstly, a Kaiser-Meyer-Olkin measure of sampling adequacy was performed and returned a value of 0.89. In addition, Bartlett's test of Sphericity returned $p<0.001$. Both results are indicative of adequate sampling for factor analysis.

The internal consistencies of the subscales are overall acceptable or good (see table 2). However, there are a few exceptions: Burnout/Personal Accomplishment and Success have questionable values with $\alpha < 0{,}65$. The lower cronbach's alpha in both cases can be explained by their respective two weak item loadings (see Figure 1). Both subscales have also in previous studies been observed as problematic, as mentioned in chapter 3.1 and 3.2 (Kellmann & Kallus, 2001; Nederhof et al., 2008). In general, these values support the proposed latent constructs even though some of the values are questionable.

Table 2 – Internal Consistencies

Subscales	Mean	SD	α
1. General Stress	1.13	.97	.87
2. Emotional Stress	1.50	.85	.79
3. Social Stress	1.41	.79	.76
4. Conflicts/Pressure	2.43	1.05	.73
5.Fatigue	1.82	1.02	.76
6. Lack of Energy	1.87	.83	.69
7. Somatic Complaints	1.75	.87	.67
8. Success	2.88	.89	.65
9. Social Relaxation	3.67	1.15	.78
10. Physical Relaxation	2.93	1.04	.79
11. General Well-being	3.65	1.13	.89
12. Sleep Quality	3.98	.91	.70
13. Disturbed Breaks	1.26	.80	.68
14. Burnout/Emotional Exhaustion	1.32	1.05	.81
15. Fitness/Injury	2.36	1.19	.77
16. Fitness/Being in Shape	3.20	1.18	.83
17.Burnout/Personal Accomplishment	2.97	1.00	.62
18. Self-Efficacy	3.28	1.18	.85
19. Self-Regulation	3.20	1.14	.74

Inspecting the relationships between constructs, it becomes clear that all correlational relationships between the four underlying dimensions have values to support the general core of the model (See Figure 1). The correlations between General Stress and Sport-Specific Stress, as well as between General Recovery and Sport-Specific Recovery are very significant (*r=0.80*). In addition, General Stress and General Recovery have a very strong

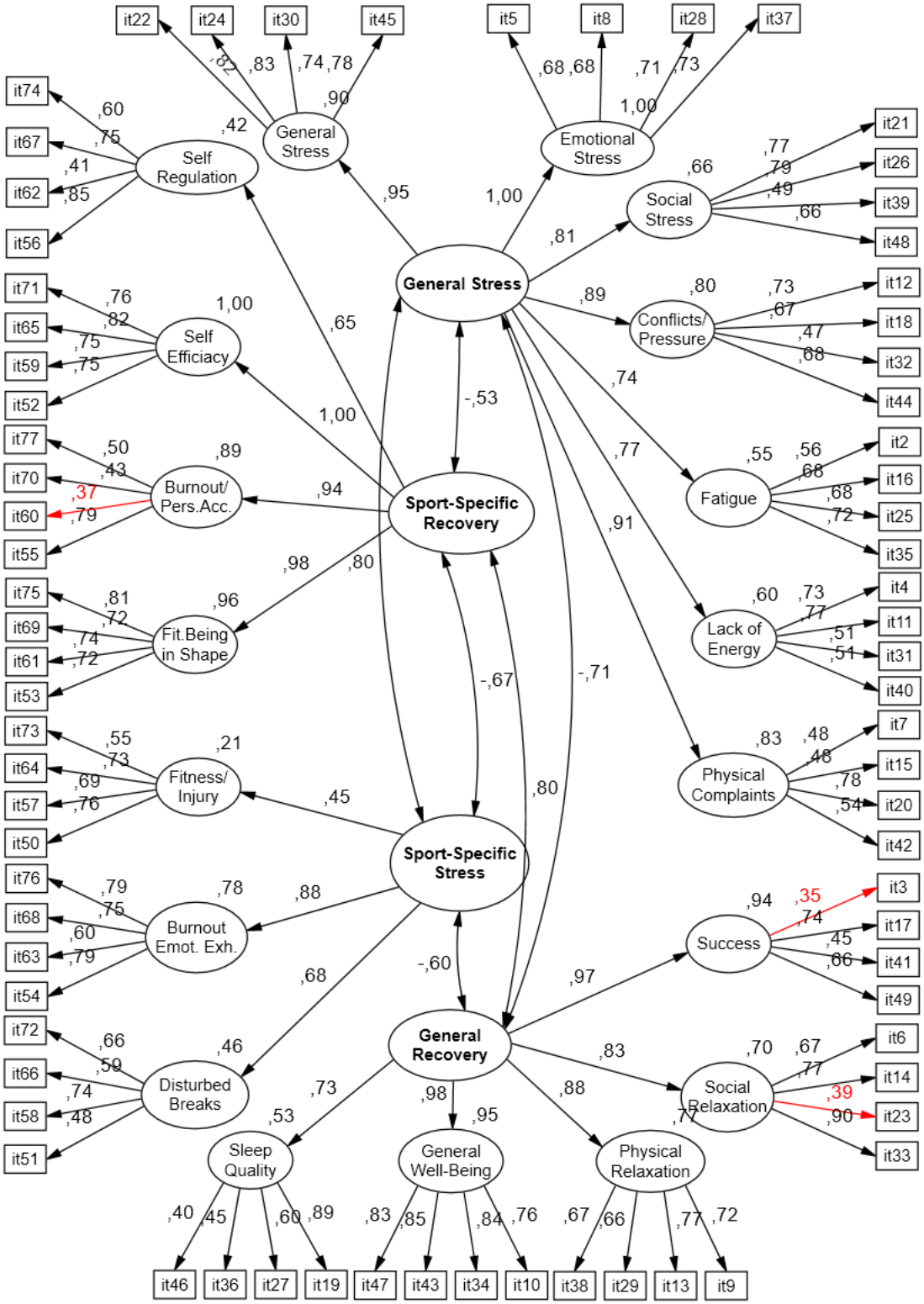
negative correlation (*r=-0.71*) and General Stress also has a strong negative correlation with Sport-Specific Recovery (*r=-0.53*). General recovery has a strong negative correlation with Sport-Specific Stress (*r=0.60*), and Sport-Specific Stress and Sport-Specific Recovery have a strong negative correlation (*r=0.67*). The strong correlational values support the core four-factor structure of the RESTQ-Sport.

Secondly, looking at the relationship between the factors and observed variables, some inconsistencies appear. Most structural relationships between the exo- and endogenous constructs have strong dependencies in the CFA-analysis. However, the loadings between Fitness/Injury and Sport-Specific Stress, is rather low at *0.45*, which means that Fitness/Injury does not explain Sport-Specific Stress to a great extent.

The CFA representing the 76-item four factor RESTQ model revealed a poor fit to the data, $\chi^2(df)$ = 2.23; *CFI* = 0.685; *GFI* = 0.567; *RMSEA* = 0.074. These numbers are, according to Hu and Bentler (1999), reason to consider the model fit unacceptable. The only value supporting the model structure is the relative chi-square, however, when the sample size exceeds 200 the relative chi-square becomes less reliable as an indicator of model fit (Schumacker & Lomax, 2004).

Furthermore, the relationships between the measured variables and the factor constructs have to be evaluated. Here, it becomes more evident where the discrepancies in the model fit arise from. The squared multiple correlations between variables and constructs are lower than .50 in almost 20 % of the cases, with three items having values under .40. This indicates that the factors are not explained by the items in the Finnish RESTQ-Sport to a great extent. However, a closer look at the specific items does provide some explanations to this fact. Items with lower values than 0.40 are marked red in the CFA diagram (Figure 1).

Figure 1 – Path diagram CFA (all parameters are standardized)



gfi= .567, cfi= .685, rmsea= .074

6.2 Correlation with POMS

The bivariate correlations between the subscales of RESTQ-Sport (Table 3) were expected in almost all cases. Most subscales have strong significant positive correlations with their related subscales, for example General Stress and Emotional Stress (r =.78) or Being in Shape and Self-Efficacy (r =.84). Where weak positive correlations appear, the subscales are quite different, for example regarding the correlation between Sleep Quality and Social Recovery (r =.26) or between Injury and Emotional Exhaustion (r =.35).

The concurrent validity of the RESTQ-Sport is presented in Table 4 and 5. Here, significant positive correlations between the RESTQ-Sport General Stress subscales and POMS depression can be seen. The exception is Fatigue, where a significant positive correlation is found between the two Fatigue-scales. The shortened POMS mainly include negative moods. These correlate negatively with the recovery dimensions of RESTQ-Sport without exception. On the opposite side of the spectrum all stress-related dimensions of RESTQ-Sport correlate positively with the negative moods of POMS. A clear example of this can be seen in the correlation between Depression (POMS) and General Well-Being (RESTQ-Sport). Furthermore, the only positive mood of POMS, Vigor, significantly correlates positively with the recovery dimensions of RESTQ-Sport, and negatively with the stress dimensions. These results are in line with previous validation studies and confirm the concurrent validity of the RESTQ-Sport in Finnish.

In regards to the four main factors of RESTQ-Sport (General Stress, General Recovery, Sport-Specific Stress and Sport Specific Recovery), all bivariate correlations with POMS mood states were expected (see table 5). Especially General Stress had a strong significant correlation with Depression (r = .73) and Tension (r = .70). Furthermore, the RESTQ-Sport main factors had expected significant respectively negative and positive intercorrelations (e.g. General Stress – Sport Specific stress r = .68, General Recovery – Sport Specific Recovery r = .73).

Table 3 – Bivariate correlations for the RESTQ-Sport subscales

	Subscale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	General Stress	1																		
2	Emotional Stress	.78																		
3	Social Stress	.72	.66	1																
4	Conflict/Pressure	.67	.69	.54	1															
5	Fatigue	.58	.52	.44	.53	1														
6	Lack of Energy	.60	.64	.43	.58	.61	1													
7	Physical Complaints	.60	.66	.51	.52	.52	.55	1												
8	Success	-.37	-.38	-.27	-.20	-.17	-.34	-.32	1											
9	Social Relaxation	-.30	-.38	-.19	-.18	-.06	-.23	-.16	.56	1										
10	Physical Relaxation	-.52	-.55	-.33	-.45	-.49	-.56	-.54	.63	.48	1									
11	General Well Being	-.64	-.66	-.49	-.46	-.38	-.46	-.44	.69	.67	.69	1								
12	Sleep Quality	-.42	-.47	-.28	-.46	-.43	-.42	-.41	.35	.26	.58	.51	1							
13	Disturbed Breaks	.41	.37	.41	.44	.53	.48	.38	-.10	-.02	-.34	-.26	-.32	1						
14	Burnout/Emot. Exhaust.	.67	.55	.49	.50	.51	.45	.47	-.36	-.21	-.44	-.52	-.32	.52	1					
15	Fitness/Injury	.24	.32	.12	.31	.39	.38	.43	-.09	-.07	-.33	-.14	-.28	.37	.35	1				
16	Fitness/Being in Shape	-.47	-.49	-.27	-.33	-.38	-.43	-.49	.57	.39	.74	.65	.50	-.39	-.53	-.36	1			
17	Burnout/Personal Accomplishment	-.27	-.28	-.16	-.12	-.06	-.19	-.19	.52	.52	.51	.57	.33	-.16	-.37	-.05	.60	1		
18	Self-Efficacy	-.46	-.43	-.28	-.30	-.33	-.37	-.41	.59	.42	.66	.66	.46	-.34	-.53	-.25	.84	.65	1	
19	Self-Regulation	-.25	-.12	-.08	-.01	-.07	-.08	-.11	.43	.28	.36	.37	.22	.02	-.19	.07	.49	.49	.58	1

Note. Correlations of .14 and above are significant at P < .05; correlations of .18 and above are significant at P < .01

Table 4 – Correlations between RESTQ-Sport and POMS

	Scales of the Profile of Mood States							
RESTQ-Sport Scales	Tension	Fatigue	Confus.	Vigor	Depress.	Anger	Ineff.	Uncert.
1. General Stress	.54	.54	.58	-.42	.72	.62	.57	.59
2. Emotional Stress	.63	.50	.54	-.39	.71	.69	.58	.61
3. Social Stress	.46	.33	.40	-.25	.63	.73	.38	.54
4. Conflicts/Pressure	.56	.45	.49	-.29	.61	.54	.45	.56
5. Fatigue	.43	.66	.50	-.33	.43	.42	.47	.44
6. Lack of Energy	.53	.46	.64	-.41	.49	.42	.62	.54
7. Somatic Complaints	.54	.57	.46	-.35	.54	.55	.49	.49
8. Success	-.29	-.30	-.33	.49	-.42	-.26	-.44	-.32
9. Social Relaxation	-.31	-.28	-.23	.40	-.32	-.21	-.37	-.18
10. Physical Relaxation	-.53	-.56	-.46	.54	-.50	-.44	-.56	-.51
11. General Well-being	-.50	-.46	-.41	.61	-.61	-.50	-.54	-.46
12. Sleep Quality	-.39	-.37	-.38	.42	-.37	-.35	-.39	-.35
13. Disturbed Breaks	.37	.42	.38	-.35	.33	.41	.41	.38
14. Burnout/Emot. Exh.	.42	.54	.53	-.49	.59	.49	.52	.53
15. Fitness/Injury	.34	.53	.40	-.15	.25	.21	.41	.36
16. Fitness/Being in Shape	-.42	-.54	-.39	.61	-.46	-.38	-.56	-.40
17. Burnout/Pers. Acc.	-.28	-.25	-.18	.52	-.27	-.23	-.33	-.23
18. Self-Efficacy	-.42	-.43	-.38	.61	-.46	-.36	-.50	-.40
19. Self-Regulation	-.07	-.10	-.10	.43	-.26	-.09	-.26	-.09

Table 5 - Bivariate Correlations between RESTQ-Sport main factors and POMS

	1	2	3	4	5	6	7	8	9	10	11	12
General Stress	1											
General Recovery	-.58	1										
S-S Stress	.68	-.40	1									
S-S Recovery	-.39	.73	-.40	1								
Tension	.65	-.51	.48	-.36	1							
Fatigue	.61	-.50	.65	-.40	.56	1						
Confusion	.64	-.45	.56	-.32	.59	.59	1					
Vigor	-.43	.62	-.41	.65	-.32	-.36	-.26	1				
Depression	.73	-.56	.50	-.43	.67	.50	.57	-.43	1			
Irritability	.70	-.45	.46	-.32	.66	.48	.52	-.30	.72	1		
Inefficiency	.63	-.58	.57	-.50	.61	.65	.63	-.54	.68	.57	1	
Uncertainty	.67	-.45	.54	-.34	.77	.51	.66	-.29	.71	.64	.64	1

Note: All correlations are significant at the 0.01 level (2-tailed)

7 DISCUSSION

The goal of the present study was to evaluate the factor structure and concurrent validity, of a Finnish version of the RESTQ-Sport. Performing the CFA in this study revealed an unacceptable model fit (*GFI=0.567; CFI=0.685, RMSEA=0.074*). The adjusted model after modification indices strengthened the model fit slightly, but was still unacceptable (*GFI= .603, CFI= .734, RMSEA= .071*.). Comparing the RESTQ-Sport to POMS did confirm the concurrent validity of the RESTQ-Sport with significant correlations between similar subscales and structures.

Previous studies of the psychometric properties of the RESTQ-Sport have found different weaknesses in the original English model (Davis et al., 2006) and the more recent French translation (Martinent et al., 2014). However, most studies agree that the weaknesses can be overlooked or solved by restructuring of the subscales. A few studies propose alternative models (e.g. Davis et al., 2006), but these models are usually not empirically evaluated by further research.

In this study the 76-item 19 subscale model of the Finnish RESTQ-Sport suffer from similar weaknesses as the English version. However, some inconsistencies are not explained by previous studies. The low GFI and CFI values in the CFA were expected since the whole model was analyzed at once. In most studies, the analysis has been performed in stages where the general stress and recovery factors have been compared separately from the sport-specific stress and recovery factors. When performed this way, the CFA has often revealed stronger GFI and CFI values (e.g. Martinent et al., 2014). Adopting said strategy to the current sample returns a marginally higher GFI (0.66) and CFI (0.75) for general stress and –recovery, and a close to adequate GFI (0.78) and CFI (0.83) for the sport-specific stress and recovery subscales.

The subscale Fitness/Injury and core factor Sport-Specific Stress have rather low loadings at L=*0.45*. This finding is supported by Birrer et al. (2014), who found an even lower loading between the two constructs in the English version (*L=0.23*). Since this

inconsistency has been found in the English version, it does not affect this Finnish validation in particular.

As previously mentioned in chapter 4.4, items 3, 59, 62 and 63 were flagged as problematic by the translators. Among these were items 3 and 62, that here have squared multiple correlation values of 0.35 respectively 0.41. Item 3 has been problematic in previous studies as well (Birrel, et al., 2014), which indicates a problematic item rather than issues related to language or culture. Item 62, on the other hand, does not appear to have any inconsistencies in previous studies. This is indicative of a linguistic problem where the original understanding of the item has been lost during the translation process.

Items 36, 46, 60, 70 are structured under previously questioned constructs in the RESTQ-Sport (Sleep Quality, Burnout/Personal Accomplishment), which might explain their low loadings on respective construct. Furthermore, items 7, 15, 32, 39 and 41 have showed low values in previous studies (Birrer et al., 2014), hence suggesting that the translation is not at fault for the low values in this study. Item 51 is displaying strong correlational values in most studies, however, Kellman's and Kallus' cross-cultural study on German (*n=128*) and Canadian (*n=128*) athletes provide rather low values for item 51 (*German r=0.59, Canadian r=0.49*) (Kellmann & Kallus, 2001). Finally, item 23 has a squared multiple correlation value of 0.39 in this study, which calls for further investigation since the item neither displays any low values in previous studies nor was flagged in the translation process.

One commonly used method when validating RESTQ-Sport is to remove or restructure items, subscales and latent factors. Martinent et al. (2014), among others, removed the subscales Success and Social Relaxation and a conflicting item (31 – Lack of Energy) due to low loadings. This way they attained a stronger model fit with a 67-item 17-subscale model. However, in this study, removing items with low loadings and covarying errors did not result in an acceptable model fit. Consequently, a restructuring of the factors is needed to find a more suitable model for the Finnish version of the RESTQ-Sport.

In the present study, the Finnish version of the RESTQ-Sport was tested for the first time and did show inconsistencies among the translated items. Especially item 62 ("…I pushed myself during performance") was causing issues throughout both the translation process and the confirmatory factor analysis, indicating weak face validity. The item needs to be revisited and rephrased before further testing of the Finnish RESTQ-Sport can proceed.

Furthermore, item 23 ("…I visited some close friends") had an especially low correlation with its subscale with no apparent explanation. However, both Davis et al. (2006), Martinent et al. (2014) and Kellmann and Kallus (2001) found the subscale Social relaxation to be problematic. Even though none of the aforementioned studies encountered low values for item 23 in particular, the structural removal of its subscale is indicative of an underlying issue that also occurs in the English original version of RESTQ-Sport.

The criterion validity of the Finnish RESTQ-Sport is strong when using POMS as a validation criterion. All correlational scores were expected, since positive and negative mood states correlated with their respective stress- and recovery subscales. This also reflects previous findings by Kellmann and Kallus (2001). In addition, the criterion validity is strengthened by theoretical framework regarding e.g. correlations between general- and emotional stress and depression (Beekman et al., 2000).

Even though modifications and further studies are needed before a more adequate Finnish model of the RESTQ-Sport is developed, the questionnaire can still be used to monitor certain aspects of athletes' stress and recovery. Some of the participants in the study were given the option to receive feedback on the results of their filled out RESTQ-Sport. The data received from the RESTQ-Sport in this study helped at least one coach to gain a deeper understanding of the athletes' needs in terms of recovery. As a result, interventions were implemented to adhere to these needs. The study also provided a stress-recovery sample of Finnish elite athletes that could be used to further study different aspects of how stress and recovery impact performance. However, the sample is quite limited and homogenic especially considering age.

Furthermore, a new manual for the RESTQ-Sport was published by Kellmann and Kallus in 2016. The major changes to the questionnaire concerns its extent, as a result of it being implicated as too lengthy (Nicolas et al., 2016). The new manual includes a modified 36-item version of the RESTQ-Sport divided into 12 subscales, each containing three items. Kellmann and Kallus (2016) also point out that the relationship between stress and recovery scores is non-symmetrical, and should be interpreted separately e.g. as a graphical profile.

In conclusion, the Finnish translation of the RESTQ-Sport shows a promising modular structure when considering innate discrepancies in the structure of the RESTQ-Sport discovered in previous studies. The convergent and discriminant validity of the Finnish version is established through using POMS with all Cronbach's alpha values above $\alpha = 0.60$, and most subscales attaining values above $\alpha = 0.70$ (see table 7). However, some items need to be revisited, and especially item 62 must be rephrased to avoid lexical errors in the model output. After scrutinizing the problematic items in general and item 62 in particular, further validation studies are warranted. In future studies, the structural equation modeling should also include remodeling and restructuring of the subscales to find an optimal model fit for the Finnish version of the RESTQ-Sport.

REFERENCES

Beekman, A. T. F., De Beurs, E., Van Balkom, A. J. L. M., Deeg, D. J. H., Van Dyck, R., & Van Tilburg, W. (2000). Anxiety and depression in later life: Co-occurrence and communality of risk factors. *American Journal of Psychiatry*, 157, 89-95.

Birrer, D., Binggeli, A., & Seiler, R. (2014). Examination of the factor structure of the recovery-stress-questionnaire. *Swiss Federal Institute of Sports Magglingen, Federal Office of Sport*. Switzerland: Magglingen.

Borg, G. (1970). Perceived exertion as an indicator of somatic stress. *Scandinavian Journal of Rehabilitation Medicine.* 2(2), 92-98.

Brenner, J. S. (2007). Overuse injuries, overtraining, and burnout in child and adolescent Athletes. *Pediatrics, 119*, 1242-1245.

Brink, M. S., Visscher, C., Arends, S., Zwerver, J., Post, W. J. & Lemmink, K. A. P. M. (2010). Monitoring stress and recovery: New insights for the prevention of injuries and illnesses in elite youth soccer players. *British Journal of Sports Medicine, 44*, 809-815.

Budgett, R. (1998). Fatigue and underperformance in athletes: The overtraining syndrome. *British Journal of Sports Medicine, 32*, 107-110.

Cannon, W. B. (1929). Organization for physiological homeostasis. *Physiological Reviews*, IX(3), 399-431.

Chrousos, G. P. & Gold, P. W. (1992). The concepts of stress and stress system disorders. *Journal of the American Medical Association, 262*(9), 1245-1252.

Costa, L.O.P., & Samulski, D.M. (2005). Processo de Validação do Questionário de Estresse e Recuperação para Atletas (RESTQ-Sport) na língua portuguesa. *R. bras. Ci e Mov*, 13(1), 79-86.

Coutts, A. J., Wallace, L. K. & Slattery, K. M. (2007). Monitoring changes in performance, physiology, biochemistry, and psychology during overreaching and recovery in Triathletes. *International Journal of Sports Medicine, 28*, 125-134.

Curran, S. L., Andrykowski, M. A., Studts, J. L. (1995). Short form of the Profile of Mood States (POMS-SF): Psychometric information. *Psychological Assessment, 7*(1), 80-83.

Davis, H., Orzeck, T., & Keelan, P. (2006). Psychometric item evaluation of the Recovery-Stress Questionnaire for Athletes. *Psychology of Sport and Exercise, 8,* 917-938.

DiFiori, J. P., Benjamin, H. J., Brenner, J., Gregory, A., Jayanthi, N., Landry, G. L. & Luke, A. (2014). Overuse injuries and burnout in youth sports: A position statement from the American medical society for sports medicine. *Clinical Journal of Sport Medicine, 24*, 3-20.

DiFronso, S., Nakamura, F. Y., Bortoli, L., Robazza, C. & Bertello, M. (2013). Stress and recovery balance in amateur basketball players: Differences by gender and preparation phase. *International Journal of Sports Physiology and Performance, 8,* 618-622.

Elbe, A.-M. (2008). *The Danish version of the Recovery-Stress Questionnaire for athletes*. Unpublished Manuscript, University of Copenhagen, Denmark.

Eriksson, E. (2013). *Stress, recovery and coping during competitive and non-competitive diet*. (C- Essay in sport psychology 61-90 ECTS credits). School of Social and Health Scienses. Halmstad University.

Filho, E., di Fronso, S., Forzini, F., Agostini, T., Bortoli, L., Robazza, C., & Bertollo, M. (2013). Stress/recovery balance during the Girobio: Profile of highly trained road cyclists. *Sport Sciences for Health, 9*, 107-112.

Freud, S. (1922). *Beyond the pleasure principle*; Trans. by C. J. M. Hubback. London, Vienna: International Psycho-Analytical.

Gonzáles-Boto, R., Salguero, A., Tuero, C., & Márquez, S. (2008). Spanish adaptation and analysis by structural equation modeling of an instrument for monitoring overtraining: The Recovery-Stress Questionnaire (RESTQ-Sport). *Social Behavior and Personality*, *36*(5), 635-650.

Grant M., Steffen K., Glasgow P., Philips, N., Booth, L., Galligan, M. (2014). The role of sports physiotherapy at the London 2012 Olympic Games. *British Journal of Sports Medicine, 48,* 63-70.

Gudmundson, E. (2009). Guidelines for translating and adapting psychological instruments. *Nordic Psychology*, *61*(2), 29-45.

Hanin, Y. L. (2000). Individual zones of optimal functioning (IZOF) model. In Y. L. Hanin (Ed.), *Emotions in sport* (pp. 65-89). Leeds, UK: Human Kinetics.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6(1), 1-55.

Hänninen, H (1989). *Neurotoksisten haittojen seulonta - oirekyselyt ja psykologiset testit*. Helsinki, Finland: Työterveyslaitos; 1989 (in Finnish).

Jackson, M. (2013). *The age of stress – Science and the search for stability*. Oxford: Oxford University Press.

Jacobsson, J., Timpka, T., Kowalski, J., Nilsson, S., Ekberg, J., Dahlström, Ö & Renström, P. (2013). Injury patterns in Swedish elite athletics: Annual incidence, injury types and risk factors. *British Journal of Sports Medicine, 47,* 941-952.

Jürimäe, J., Mäestu, J., Purge, P, Jürimäe, T., & Sööt, T. (2002). Relations among heavy training stress, mood state and performance for male junior rowers. *Perceptual and Motor Skills, 95,* 520-526.

Kellman, M. & Günther, K-D (1999). Changes in stress and recovery in elite rowers during preparation for the olympic games. *Medicine and Science in Sports and Exercise, 32,* 676-683.

Kellman, M. & Kallus, K. W. (2001). *The Recovery-Stress Questionnaire for Athletes: User manual*. Champaign, IL: Human Kinetics.

Kellman, M. (2010). Preventing overtraining in athletes in high-intensity sports and stress/ recovery monitoring. *Scandinavian Journal of Medicine and Science in Sports, 20*, 95-102.

Kellmann M., Altenburg D., Lormes W. & Steinacker J. M. (2001). Assessing stress and recovery during preparation for the world championships in rowing. *The Sport Psychologist, 15*, 151-167.

Kenttä, G., & Hassmén, P. (1998). Overtraining and recovery. *Sports Medicine, 26,* 1-16.

Koutedakis, Y. & Sharp, N. C. C. (1998). Seasonal variations of injury and overtraining in elite athletes. *Clinical Journal of Sport Medicine, 8*, 18-21.

Lazarus, R. S. (2000). How emotions influence athletic performance. The Sport Psychologist, *14*, 229-252.

Martinent, G., Decret, J, Filaire, E., Isoard-Gautheur, S., Ferrand, C. (2014). Evaluations of the psychometric properties of the Recovery-stress questionnaire for athletes among a sample of young French table tennis players. *Psychological Reports, 114* (2), 326-340.

Matos, N. F., Winsley, R. J., & Williams, C. A. (2010). Prevalence of nonfunctional overreaching/overtraining in young English athletes. *Medicine & Science in Sports & Exercise, 43* (7), 1287-1294.

McGrath, J. E. (1970). Major methodological issues. In J. E. McGrath (Ed.) *Social and psychological factors in stress* (pp. 19-49). New York: Hold, Rinehart & Winston.

McNair, P. M., Lorr, M., & Droppleman, L. F. (1971). *POMS manual (2nd ed.)*. San Diego: Educational and Industrial Testing Service.

Nederhof, E., Brink, M.S. & Lemmink, K.A.P.M. (2008). Reliability and validity of the Dutch Recovery Stress Questionnaire for Athletes. *International Journal Of Sport Psychology, 4,* 301-311.

Nicolas, M., Vacher, P., Martinent, G., & Mourot, L. (2016). Monitoring stress and recovery states: Structural and external stages of the short version of the RESTQ-Sport in elite swimmers before championships. *Journal of Sport and Health Science,* http://dx.doi.org/10.1016/j.jshs.2016.03.007

Purvis, D., Gonsalves, S. & Deuster P. A. (2010). Physiological and psychological fatigue in extreme conditions: overtraining and elite athletes. *American Academy of Physical Medicine and Rehabilitation*, 2, 442-450.

Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modeling, Second edition*. Mahwah, NJ: Lawrence Erlbaum Associates.

Shacham, S. (1983). A shortened version of the Profile of Mood States. *Journal of Personality Assessment*, 47, 305-306.

Staal, M. A. (2004). Stress, cognition and human performance: A literature review and conceptual framework. *NASA Technical Memorandum*, 2004-212824.

Tessitore, A., Meeusen, R., Pagano, R., Benvenuti, C., Tiberi, M., & Capranica, T. (2008) Effectiveness of Active Versus Passive Recovery Strategies After Futsal Games. Journal of Strength and Conditioning Research. 22 (5): 1402-1412.

Tessitore, A., Perroni, F., Cortis, C., Meeusen, R., Lupo, C., & Capranica, L. (2011) Coordination of Soccer Players During Preseason Training. Journal of Strength and Conditioning Research. 25 (11): 2059-3069.

Weinberg, R. S. & Gould, D. (2011) Foundations of Sport and Exercise Psychology. Champaign, IL: Human Kinetics.