

# Current Status and Future Challenges in Psychological Research of Sport Injury Prediction and Prevention: A Methodological Perspective

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*CURRENT STATUS AND FUTURE CHALLENGES IN PSYCHOLOGICAL RESEARCH OF SPORT INJURY PREDICTION AND PREVENTION: A METHODOLOGICAL PERSPECTIVE*

KEY WORDS: Intervention, Methodology, Prevention, Psychology, Sport injury.

ABSTRACT: The purpose of this critical review was to propose methodological developments in sport injury prediction and prevention research. Altogether, 24 studies (e.g., quantitative, qualitative, and prevention intervention studies) conducted from 2006 forward were analysed, related to the "stress-injury model." The injury prediction studies were mostly based on prospective designs, using regression analysis, and studied trait anxiety and life stress. The qualitative studies used mainly thematic analysis, and the intervention studies showed some promising effects, but also inconclusive results. We proposed five specific needs for future research: (a) focus on separate research cohorts, (b) variation in preventive intervention designs, including sound protocols conducting experimental studies, (c) focus on behaviours in relation to cognition, (d) application of repeated-measure designs, and (e) use of statistics that could test complex interactions and intraindividual differences. Future research attention should also be oriented towards the psychology of overuse injuries, biopsychosocial perspectives, and health economic evaluations. While progress has been made in research on psychological antecedents of sport injury, prevention, and intervention in the last 10-15 years, several methodological issues still remain to be further developed, as outlined in this article.

Injuries are a common problem in sports. For example, Ristolainen, Heinonen, Waller, Kujala, and Kettunen (2009) found that 92% of elite Finnish male and 79% of Finnish female soccer players reported at least one injury per year. Similar results have also been found in Swedish elite athletes, with 65%-95% reporting at least one injury during a single season (Häggglund, Waldén and Ekstrand, 2009). Over the past two decades conceptual, empirical, and applied knowledge regarding the psychology of injury have grown substantially. Still, given the magnitude of injuries each year, the pursuit of knowledge about the causes of injury occurrence continues.

Based on the review from 2007 (Johnson, 2007), which included all identified and relevant studies conducted from 2006 and past, a few general themes for the advancement of the field was addressed. First, it was highlighted the existence of empirical evidence of a relationship between psychosocial antecedents and sport injuries. However, it was concluded that even though several studies have been completed, more research is needed to examine Williams and Andersen's (1998) "stress-injury model." This would yield an advanced understanding of complex interactions between different antecedent variables. Secondly, it was noted that there is a need for more comprehensive studies of overuse injuries as well as gender differences. Thirdly, it was remarked that several intervention studies offer evidence of the efficacy of treatments, particularly short-term and cognitive-

based interventions. At the same time, it was identified different methodological problems, such as few studies that used control groups and many that lacked theoretical models guiding the intervention. Lastly, it was also discussed the position that future studies should continue to use standardized measurements and experimental and prospective studies, as well as sport-specific questionnaires, alone or in combination with qualitative measures.

Given the profound physical and psychosocial burden of injury, efforts aimed at minimizing injury risk, based on systematic research, are important. However, despite the amount of research published in the field, shortcomings still exist. Based on a presentation of Williams and Andersen's (1998) stress-injury model and a critical review of studies conducted between 2006 and 2013, the purpose of this article is to propose future methodological development within the field of sport injury prediction and prevention.

## Stress-injury Model and Related Empirical Findings

The most frequently cited theoretical model for investigating the impact of psychosocial variables on injury rates is probably the stress-injury model (Williams and Andersen, 1998). This model states that a potentially stressful situation will generate a stress response. The intensity of the stress response will be influenced by the interplay between various psychosocial factors,

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divided into three categories: personality factors (e.g., anxiety, Type-A behaviour and attentional style), history of stressors (eg, life event stress, hassle, uplifts, and previous injuries) and coping strategies/resources (e.g., social support, acceptance, and positive reappraisal). As one example, an athlete who experiences a number of stressors, who has additional personality factors that increase stress susceptibility, and who also uses poor coping resources, will appraise more situations as threatening, show greater muscle tension, and have a narrowed peripheral view in comparison to other athletes. It is suggested that all these reactions increase injury risk. In the model, the authors also suggest that psychological interventions could decrease the magnitude of the stress response, which in turn, could decrease the injury risk that athletes are exposed to.

Based on the three categories of psychosocial factors suggested to influence the intensity of the stress response, as well as on prevention intervention studies, we conducted a literature search of studies published after 2006. The reason for selecting studies that have been conducted after 2006 is that our intention is to do a follow-up study of Johnson (2007) where previous studies, conducted before 2007, were critically reviewed. The keywords psychological, psychosocial, predictors, sport injuries, prediction, injury, intervention, and prevention, with appropriate truncations for each database also citing articles, were, in different combinations, used in the following databases: Cinahl, Psycinfo, Pubmed, Sportdiscus, and Web of Science. The result of the database search is presented below.

Study	Design	Participants (Mean age)	Variables	Statistical analyses	Result
Alizadeh et al. (2012)	Retrospective	81 male junior soccer players (18,0)	State anxiety	Pearson's correlation	There were statistically significant relationships between injury occurrence and (1) cognitive and (2) somatic anxiety.
Devantier (2011)	Prospective	87 male elite soccer players (24,6)	Trait anxiety	ANOVAs, Logistic regressions	There were no statistically significant differences between the injury and non-injury groups.
Ivarsson, and Johnson (2010)	Prospective	48 male soccer players (22,0)	Variables from SSP*	MANOVA, ANOVAs, Linear regression	Injured players experienced statistically significantly higher levels of somatic and cognitive trait anxiety, stress susceptibility, and trait irritability.
Johnson, and Ivarsson (2011)	Prospective	108 male and female junior soccer players (17,6)	Variables from SSP*	ANOVAs, Logistic regressions	Injured players experienced a statistically significant higher level of somatic trait anxiety.
Kleinert (2007)	Prospective	Study 1: 293 male and female soccer players (20,7)  Study 2: 1021 female soccer players (16,3)	Perceived physical state, Emotional/physiological/ motivational states	Logistic regressions	Low levels of perceived physical health and high levels of sociability were statistically significant predictors of injury occurrence in both studies.
Schwebel et al. (2007)	Prospective	60 male soccer players (12,0)	Inhibitory control, fear and aggression	Pearson's correlations, Linear regressions	The three suggested variables were statistically significant predictors of sport injuries.
Sibold, Howard, and Zizzi (2011)	Prospective	177 male and female athletes (19,5)	Anxiety, Worry, Concentration disruption	Hurdle regression analysis	Somatic anxiety was a statistically significant predictor of injury occurrence.
Steffen, Pensgaard, and Bahr (2009)	Prospective	1430 female soccer players (15,4)	Anxiety, Worry, Concentration disruption	MANOVA, Logistic regression	A high level of concentration disruption was a statistically significant predictor of sport injuries.
Vassos (2009)	Prospective	41 male and female athletes (29,6)	Attentional style, Anxiety, Perceived risk of injury	Student t-test, Mediation analyses	Injured athletes experienced a statistically significantly lower level of anxiety. Attentional style and perceived risk of injury were not statistically significant mediators between psychosocial variables and injury risk.
Wadey et al. (2012a)	Prospective	694 athletes (19,2)	Hardiness	Logistic regression	Low levels of hardiness were associated with an increased injury risk.

\*Swedish university scale of personality (SSP) consists of 13 personality subscales. Those subscales are Somatic trait anxiety, Cognitive trait anxiety, Mistrust, Stress susceptibility, Submission, Impulsiveness, Adventure-loving, Interpersonal distance, Social conformity, Bitterness, Annoyance tendency, Verbal trait aggression and Physical trait aggression.

Table 1. Injury prediction studies from 2006, focusing on personality variables.

A total of 10 studies focusing on the influence of personality factors on injury risk have been conducted since 2006 (see Table 1). Of those studies, seven used soccer players as the study

population. The most frequently investigated personality factor was trait anxiety ( $n = 4$ ). A majority of the studies used linear or logistic regression analyses to analyse the data.

Study	Design	Participants (Mean age)	Variables	Statistical analyses	Result
Brink et al. (2010)	Prospective	53 elite soccer players (16,5)	Variables from RestQ*	Multinomial regression	Injured players scored statistically significantly higher on the fitness/-injury subscale.
Devantier (2012)	Prospective	87 male elite soccer players (24,6)	Previous injuries	ANOVAs, Logistic regressions	Injured players had a higher statistically significant number of previous injuries.
Ivarsson, and Johnson (2010)	Prospective	48 male soccer players (22,0)	Daily hassles	ANOVA	There was no statistically significant difference between injured and non-injured players.
Ivarsson, Johnson, Lindwall, Gustafsson, and Altemyr (in press)	Prospective, Repeated measure	101 male and female elite junior soccer players (16,7)	Daily hassles, Daily uplifts	Latent growth modelling	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.
Ivarsson, Johnson, and Podlog (2013)	Prospective, Repeated measure	56 male and female elite soccer players (25,1)	Negative life event stress, Daily hassles	Path analysis, Mediation analysis	There was a statistically significant indirect effect between negative life event stress and injury occurrence through daily hassles.
Johnson, and Ivarsson (2011)	Prospective	108 male and female junior soccer players (17,6)	Negative life event stress	ANOVAs, Logistic regressions	Negative life event stress was a statistically significant predictor of injury occurrence.
McDermott (2013)	Prospective, repeated measure	24 male basketball players (19,0)	Life event stress	Student's t-test	There were no statistically significant differences in stress between injured and non-injured players.
Shrier, and Hallé (2011)	Prospective	47 circus artists <sup>1</sup>	Variables from RestQ*	Quasi-Poisson regression	Fitness/injury, emotional exhaustion, self-efficacy, and fatigue were associated with an increased injury risk.
Sibold, and Zizzi (2011)	Prospective	177 male and female athletes (19,5)	Negative life stress, Positive life stress	Hurdle regression analysis	Both negative life event stress and positive life event stress were statistically significant predictors of sport injuries.
Steffen, Pensgaard, and Bahr (2009)	Prospective	1430 female soccer players (15,4)	Stressful events, Previous injuries	MANOVA, Logistic regression	A high level of stressful events was a significant predictor of injury occurrence. Also, previous injuries were a statistically significant predictor for injuries.
Vassos (2009)	Prospective	41 male and female athletes (29,6)	Negative life event stress, Positive life event stress	Student t-test, Mediation analyses	Injured athletes experienced higher levels of negative life event stress.
Wadey et al. (2012a)	Prospective	694 athletes (19,2)	Hardiness	Logistic regression	A high level of stressful events was a significant predictor of injury occurrence.

\*Recovery Stress Questionnaire for Athletes (RestQ-Sport) consists of 19 stress-recovery subscales. Those subscales are General stress, Emotional stress, Social stress, Conflict/pressure, Fatigue, Lack of energy, Physical complaints, Success, Social recovery, Physical recovery, General well-being, Sleep quality, Disturbed breaks, Emotional exhaustion, Fitness/injury, Being in shape, Personal accomplishment, Self-efficacy, Self-regulation.

<sup>1</sup>No information on mean age was available.

Table 2. Injury prediction studies from 2006, focusing on history of stressors.

A total of twelve studies focusing on the influence of the history of stressors on injury risk have been conducted since 2006 (see Table 2). Of those studies, seven used soccer players as the study population. The variables that most studies focused on were negative life event stress, life stress, and daily hassle. Most of the

studies, but not all, found statistically significant associations between the different stress variables and injury risk. More than 50% of the studies used different types of regression analyses to analyse the data.

Study	Design	Participants (Mean age)	Variables	Statistical analyses	Result
Devantier (2012)	Prospective	87 male elite soccer players (24,6)	Coping skills	ANOVAs, Logistic regressions	Injured players indicated statistically significantly lower levels of coping with adversity than non-injured players.
Ivarsson, and Johnson (2010)	Prospective	48 male soccer players (22,0)	Coping strategies	ANOVA, Linear regression	Injured players indicated higher statistically significant levels of behavioural disengagement and self-blame than non-injured players.
Ivarsson, Johnson, and Podlog (2013)	Prospective, Repeated measure	56 male and female elite soccer players (25,1)	Coping	Path analysis, Mediation analysis	Coping had no statistically significant relationship with injury occurrence.
Johnson, and Ivarsson (2011)	Prospective	108 male and female junior soccer players (17,6)	Coping strategies	ANOVAs, Logistic regressions	There were no statistically significant differences in negative coping between injured and non-injured players. However, negative coping was one significant predictor of injuries in the empirical model.
McDermott (2013)	Prospective, repeated measure	24 male basketball players (19,0)	Coping skills	Student's t-test	There were no statistically significant differences in coping between injured and non-injured players.
Steffen, Penggaard, and Bahr (2009)	Prospective	1430 female soccer players (15,4)	Coping strategies	MANOVA, Logistic regression	There were no statistical differences in coping between injured and non-injured players.
Vassos (2009)	Prospective	41 male and female athletes (29,6)	Coping strategies	Student t-test, Mediation analyses	There were no statistical differences in coping between injured and non-injured players.

Table 3. Injury prediction studies from 2006, focusing on coping.

A total of seven studies focusing on coping influencing injury risk have been conducted since 2006 (see Table 3). Of those studies, five used soccer players as the study population. The

studies showed mixed results concerning the association between coping and injury occurrence. Most studies used linear or logistic regression analyses to analyse the data.

Study	Design	Participants (Mean age)	Data collection	Analyses	Result
Johnson (2011)	Retrospective	20 athletes (22,7)	Semi-structured interview guide	Thematic content analysis	The players experienced that high level of history of stressors, specific person factors, high levels of fatigue, and ineffective coping increased the likelihood of becoming injured.
Tranaeus et al. (2014)	Retrospective	11 elite floorball players (25,0)	Semi-structured interview guide	Thematic content analysis	The players experienced that high levels of history of stressors, specific-person factors, high levels of psycho-physiological fatigue, psychosocial factors, and ineffective coping increased the likelihood of overuse injuries.
Wadey et al. (2012b)	Retrospective	10 athletes (21,7).	Semi-structured interview guide	Composite sequence analysis	Athletes who in Wadey et al. (2012a) reported a low level of hardiness experienced negative major life events prior to their injury occurrence. These negative events were perceived to influence physiological, psychological, and behavioural states.
Van Wilgen, and Verhagen (2012)	Retrospective	9 athletes (21,3) and 9 coaches (40,1)	Semi-structured interview guide	Categorical classification	Both intrinsic and extrinsic factors were found to increase the likelihood for overuse injuries.

Table 4. Qualitative studies from 2006.



Four qualitative studies were found (see Table 4). Two of these aimed to focus on acute injuries, while the other two investigated psychological predictors of overuse injuries. All

studies supported the notion that athletes' perceived psychological state could influence the interpreted injury risk. Thematic content analyses were used to analyse data in two of the studies.

Study	Design	Participant (Mean age)	Intervention	Control group(s)	Analysis	Result
Edvardsson et al. (2012)	Quantitative	29 male and female soccer players (17,1)	Bio-feedback, Psychological skills training	Yes	Mann Whitney U-test	There was no significant effect and fewer injuries.
Fuhrmann et al. (2010)	Quantitative	13 female pre-and professional dancers (22,0)	Education	No	Un-paired t-test	There was no significant effect.
Noh et al. (2007)	Quantitative	35 female ballet dancers (16,8)	Psychological skills training, Autogenic training	Yes	ANCOVA	Athletes experienced less time injured.
Tranaeus (2006)	Quantitative	22 male ice hockey players (22,9)	Psychological skills training	Yes	Mann Whitney U-test	There were fewer injuries in total, and significantly fewer acute injuries.

Table 5. Injury prevention intervention studies from 2006.

Since our initial literature search, three further studies have been published in peer-reviewed journals. We also identified one master's thesis (Tranaeus, 2006) (see Table 5). Even though most research supports psychosocial factors as being associated with the occurrence of sports injuries, there are still few studies aiming to evaluate psychological preventive interventions.

Most of the studies used cognitive-oriented psychological skills training with some variations in the interventions. Relaxation, imagery, and cognitive components were present in three of the studies. One study used an educational programme aimed at increasing the knowledge regarding the aetiology and cause of injuries, and also how to prevent them.

Summary of the Research Presented from 2006 to 2013

Summarizing the research presented above (Tables 1-5), some general conclusions can be drawn regarding the most distinct features of empirical research. In relation to the three psychosocial categories presented in Williams and Andersen's (1998) stress-injury model, a total of 16 different studies, using a quantitative design, have been published. A majority of the studies focused on team sport, with soccer as the leading sport. Most studies included rather small populations, 100 or fewer, with a generally low mean age and mostly men. Throughout, prospective designs and the use of linear or logistic regression dominate the statistical analysis, and the variation in psychological variables investigated inside the three main categories is rather low.

In regard to the qualitative and intervention studies published since 2006, we found a total of eight studies. Once again, the heterogeneity of designs used is narrow, especially when it comes to the qualitative studies. Some promising results are to be found in the interventions studies (see for example Noh et al., 2007), but inconclusive results still exist.

Future Methodological Challenges

Based on the conclusions of the research presented and in relation to the summary of previous research (2006 and earlier), we noted some advancement in designs and analysis. Nevertheless, many methodological issues remain to be critically examined and further developed. Below, we have outlined the most distinct research needs organized by (a) theory and design, and (b) measurement and analysis.

Theory and Design

A need to focus on separate research cohorts

As was presented in the summary, an overwhelming amount of research is performed on team-sport athletes. Therefore, more studies that focus on individual athletes would add to the wide-ranging applicability of the results, since research has found that individual athletes, in comparison with team athletes, not only reported partly different stressors but also used different coping strategies (e.g., Nicholls, Polman, Levy, Taylor and Cobley, 2007). Since stress and coping are suggested to be two important

variables in injury prediction, these differences between the two groups of athletes could, potentially influence the risk of injury. Much in the same vein, a majority of the conducted research is based on rather young male competitive athletes (as compared to elite athletes). It would be favourable for the advancement of the field, if possible, to collect data on other cohorts (e.g., female elite athletes) to learn more about underlying psychological profiles for those particular groups of athletes. For instance, while Nicholls, Polman, Levy, Taylor and Cobley (2007) have claimed that female athletes use a variety of problem-focused (eg, planning, communication) strategies more frequently than males, other researchers state that women tend to activate other coping strategies, such as seeking social support, to a greater extent than men do when faced with potential difficulties (e.g., Vingerhoets and Van Heck, 1990). These results are probably also transferable to pre-injury stress-related situations.

A need of variation in prevention intervention designs and structured protocol of experimental studies

One particular challenge designed for future research is to broaden the spectrum of techniques for psychological prevention intervention. Some promising results have been found using traditional psychological skills training concepts, including variations of cognitive behavioural therapy designs (e.g., Noh et al., 2007; Edvardsson et al., 2012). However, contemporary applied sport psychology literature advocates new and challenging intervention approaches working from a salutogenetic perspective such as mindfulness (Jouper and Gustafsson, 2013) and third-generation coaching (Stelter, 2014). While the latter approach relies on reconstructing dialogues through collaborative practice focusing on values, the mindfulness (and acceptance-based) approach is especially suited for self-regulation. More specifically, it has been suggested that mindfulness practice improves individuals' abilities to regulate emotion and behaviour, for example, within the sport context (Gardner and Moore, 2012). In addition to the theoretically sound and state-of-the-art-based prevention intervention approaches discussed, we have found a growing need to evaluate the long-term effects of prevention intervention. Up till now, no intervention studies have used a longitudinal design reaching beyond the athletic season when the intervention was implemented. In the development of the field such studies would evaluate the long-lasting effects of the interventions used, helping the sports medicine team to select comprehensive strategies for injury reduction.

Moreover, most of the experimental studies conducted use no-attention control groups (ie, the participants in these groups are not given a placebo treatment). In those studies it is likely that the large effects in many of the studies could be partly explained by the participants' expectations (see, e.g., Rosenthal and Rosnow, 1991). To address this problem, it is vital to include active control groups. However, doing so is probably not enough to control for potential biases. For instance, Boot, Simons, Stothart, and Stutts (2013) claimed that the most important aspect is to control for the expectation effects, both in the experimental and in the active control group. This procedure might give the researcher more information to discuss the results of the studies with a decreased impact of the expectancy effect.

A need to focus on behaviours in relation to cognition in prediction and prevention research

In almost all studies that have been conducted within the field of psychological aspects of sport injury prediction and prevention the focus has been on cognitive factors such as ability to concentrate. One reason for this procedure is that the stress-injury model mainly addresses cognitive risk factors. These factors are important to investigate; however, it is also important to focus on the actual behaviour as one potential link between personality states (e.g., physiological, psychological, emotional) and injury occurrence. For example, an athlete who has experienced a number of stressors may have problems focusing on the right cues in competition. If the athlete has problems focusing, it is also likely that he/she won't obtain all the important information (e.g., position of opponents) and will therefore utilize behaviours based on limited information. These selected behaviours (e.g., risk situations) are likely to put the athlete in more vulnerable situations, which in turn, will increase the risk of injuries. Therefore, it is warranted to increase the knowledge of what mechanisms will increase injury risk, as well as to focus on behaviours in both injury prediction and prevention research.

## Measurement and Analysis

A need to apply repeated-measure designs

One particularly important issue related to research designs, which has been acknowledged by several researchers, is that future studies should focus on multiple psychosocial factors, taking into account also how this interaction will influence injury risk (e.g., Johnson, 2007; Williams and Andersen, 2007). For researchers to be able to investigate such relationships, a prospective design with repeated measures is highly recommended (Roth and MacKinnon, 2012). In our review, all studies using a quantitative methodological design had used prospective designs, but only three had used more than one wave of measure. Using repeated-measure designs allows for investigating relationships between independent variables more thoroughly, without relying on theoretical hypotheses. Since all independent variables of interest in a prospective design with only one wave of measure are collected at the same time, no claims for causality should be stated, which in turn makes it difficult for researchers to test and investigate theoretical hypotheses that propose directed relationships between dependent variables. Another shortcoming of using one wave of measure for the independent variables is that it is assumed that the effects of the psychological variables in injury risk are not dependent on the lengths between the measurements of the variables.

A need to use statistics that could test complex interactions and intraindividual differences

A majority of the studies included in the review used ANOVAs and/or variation of regression analyses to analyse data, which is the case for most of the studies conducted before 2006 (Johnson, 2007). One potential shortcoming with those analytical procedures is that they are based on general linear modelling (GLM). All GLM methods take only the group means value into account in the calculation and do not consider the specific person (Cade and Noon, 2003). Because it is not likely that all

individuals studied in injury research will follow the mean—and it is often those athletes who do not who are the most interesting—analysis based on GLM will probably leave out a substantial amount of relevant data (see, e.g., Ivarsson and Johnson, 2014). Therefore, latent growth curve models as well as latent growth mixture models could be used to generate valuable results (eg, injury risk factors for specific subgroups within the sample). Another suggestion is that, to test the complex interactions between independent variables, more researchers should use structural equation models (SEM; e.g., Williams and Andersen, 2007), allowing the researcher to test mediation effects (Ivarsson, Johnson and Podlog, 2013). This analytical procedure has also been sparsely used in previous studies.

## Discussion

This critical review provides an overview of the current status and future challenges in psychological research on sport injury prediction and prevention with a specific focus toward methodological needs. During the last 10–15 years an accumulated interest in health-promotive behaviour and preventive actions has been observed in many health-related fields such as sport and exercise psychology (Wold et al., 2013). At the same time, it seems that an increasingly number of sports medicine researchers are asking for complementary knowledge and cooperation with experts from the social and behavioural sciences to understand complex relationships between biopsychosocial factors, including extrinsic and intrinsic risk factors and injury occurrence in sport (Van Wilgen and Verhagen, 2012).

As this review has revealed research with a focus on psychological aspects of sport injury prediction and prevention has in some areas seen advancements, while in other areas still remains to be developed. Consequently, and in accordance with the stated aims, a critical discussion about future methodological challenges, with a special focus on published research from 2006 forward, will follow.

As was explicitly outlined in the review, we have put forward five specific needs of future research. First, adding extended research on specific cohorts would bring, for instance, enhanced knowledge about subpopulations in relation to injury outcome. Another obvious conclusion for future research is the need of variation in preventive intervention designs, including more structured protocol before conducting experimental studies. In particular, we pointed out the importance of controlling for the expectancy effects, both in the experimental and in the active control group. Still another conclusion is the need to focus on behaviours in relation to cognition. We underlined the importance of increasing knowledge of the mechanisms that will increase injury risk, not least in light of the fact that it is the athletes' behaviour that ultimately affects risk of injury.

An overall need noticed by social and behavioural as well as sports medicine scientists is for the necessity of integrated and holistic research designs, especially based on a biopsychosocial perspective, to capture the complexity of injury risk. That is, as a compliment to the stress-injury model (Williams and Andersen, 1998), the more comprehensive biopsychosocial model suggested by Wiese-Bjornstal (2010) deserves attention. This model

suggests four different categories, biological, psychological, physical, and sociocultural factors, which might influence injury risk. Another challenging theoretical model, with a focus on psychosocial injury risk factors, is the “action-theory based approach to study sport injuries” (Hackfort and Kleinert, 2007). This framework suggests that researchers should analyse and develop an understanding of the full injury-recovery situation, by considering the athlete's person, the task, and the environment. However, both models presented need to be evaluated to incorporate and involve in prevention interventions the factors mentioned above.

In relation to methodological development, targeting measurement and analysis, we advocate a specific need of applying repeated-measure designs. For instance, using repeated-measure designs allows for better investigating relationships between independent variables, without relying on theoretical hypotheses about changes in relationships over time. This in turn allows for more conclusive assumptions about the data generated. Finally, including use of latent growth curve models and structural equation models would permit researchers to investigate the complex interactions between independent variables in a more elaborated way.

In addition, some other needs that have to be applied for the advancement of the field were identified in the review. For instance, overuse injuries have been sparsely investigated in contemporary prevention studies. Given that different antecedents could be present for the two different types of injuries (overuse and trauma), it is important to design studies acknowledging the different mechanisms (such as different stress exposures) between injury-specific psychological risk factors and injury risk. As of now, few such designs have been documented. Tranaeus et al. (2014) have proposed a promising working model targeting the importance of specifically focusing on psychosocial antecedents contributing to overuse injuries.

A special and warranted need to develop, not identified in the review, is research about health economy and sport injury. For instance, a cost-of illness study might analyse the actual cost of a specific injury or the cost of injuries in a certain sport that might burden the injured athletes as well as the society. Research taking into account such variables is essential for the advancement of the sport injury prediction and prevention field, and thus, attention should be given to validating and highlighting the economic value of prevention studies. The results of such studies could be used to speak to the value of prevention intervention studies. A cost-effectiveness analysis is especially recommended to evaluate an intervention in terms of the cost of a prolongation of the effect, in this case, staying injury free, and is expressed in both costs and effects (Drummond, Sculpher, Torrance, O'Brien and Stoddart, 2005).

To sum up, we conclude that research on psychological antecedents of sport injury, prevention, and intervention has made progress in the last 10–15 years. Still, several methodological issues remain to be advanced, as reported in this article. It is our hope that researchers involved in sport and exercise psychology with a focus on sport injury, as well as researchers in related fields, will value the content of the review, and that perhaps it will stimulate methodological advancement in the future.

*SITUACIÓN ACTUAL Y RETOS FUTUROS EN LA INVESTIGACIÓN PSICOLÓGICA SOBRE PREDICCIÓN Y PREVENCIÓN DE LA LESIÓN DEPORTIVA: UNA PERSPECTIVA METODOLÓGICA*

**PALABRAS CLAVE:** Intervención, Metodología, Prevención, Psicología, Lesión deportiva.

**RESUMEN:** El propósito de esta revisión crítica es proponer una serie de progresos metodológicos en la investigación sobre predicción y prevención de lesiones. Para ello, se analizaron conjuntamente 24 estudios (cuantitativos, cualitativos y de intervención preventiva) llevados a cabo desde el año 2006 en adelante relacionados con el "modelo de estrés-lesión". Los estudios de predicción de lesiones utilizaron mayoritariamente diseños prospectivos, utilizando el análisis de regresión y estudiando el rasgo ansiedad y los eventos vitales. Los estudios cualitativos utilizaron principalmente el análisis temático. Los estudios de intervención mostraron resultados promisorios, aunque todavía no definitivos. En este trabajo proponemos cinco necesidades específicas para la investigación futura: (a) centrarse en diferentes cohortes, (b) variar los diseños de intervención preventiva, incluyendo protocolos experimentales, (c) centrarse en las conductas relacionadas con las cogniciones, (d) utilización de diseños de medidas repetidas, y (e) utilización de estadísticos que puedan verificar las complejas interacciones y las diferencias individuales. El foco de la investigación futura también debe orientarse hacia la psicología de las lesiones por desgaste excesivo, las perspectivas biopsicosociales y las evaluaciones económicas del impacto en la salud. Si bien en los últimos 10-15 años se han conseguido importantes avances en la investigación sobre los antecedentes psicológicos de la lesión deportiva, la prevención y la intervención, algunas cuestiones metodológicas deben ser aún desarrolladas, tal y como se señala en este artículo.

*SITUAÇÃO ACTUAL E DESAFIOS FUTUROS NA INVESTIGAÇÃO PSICOLÓGICA SOBRE A PREDIÇÃO E PREVENÇÃO DA LESÃO DESPORTIVA: UMA PERSPECTIVA METODOLÓGICA*

**PALAVRAS-CHAVE:** Intervenção, Metodologia, Prevenção, Psicologia, Lesão desportiva.

**RESUMO:** O objectivo desta revisão crítica é propor uma série de progressos metodológicos na investigação sobre a predição e prevenção de lesões. Para tal, analisaram-se conjuntamente 24 estudos (quantitativos, qualitativos e de intervenção preventiva), realizados a partir do ano de 2006, relacionados com o "modelo de stress-lesão". Os estudos de predição de lesões utilizaram maioritariamente delineamentos prospectivos, utilizando a análise de regressão e analisando o traço de ansiedade e os acontecimentos de vida. Os estudos qualitativos utilizaram principalmente a análise temática. Os estudos de intervenção revelaram resultados promissores, embora ainda não definitivos. Neste trabalho propomos cinco necessidades específicas para futuras investigações: (a) foco em diferentes grupos, (b) variar os delineamentos de intervenção preventiva, incluindo protocolos experimentais, (c) abordar os comportamentos relacionados com as cognições, (d) utilização de delineamentos de medidas repetidas, e (e) utilização de métodos estatísticos que permitam verificar as interacções complexas e as diferenças individuais. O foco da investigação futura também deve ser direccionado para a psicologia das lesões por desgaste excessivo, as perspectivas biopsicossociais e as avaliações económicas do impacto na saúde. Embora nos últimos 10-15 anos se tenham conseguido importantes progressos na investigação sobre os antecedentes psicológicos da lesão desportiva, a prevenção e a intervenção, algumas questões metodológicas necessitam ainda de ser desenvolvidas, tal como se assinala neste artigo.

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