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Psychological Predictors of Injury in Collegiate Cheerleaders

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A thesis submitted in partial fulfillment of the requirements for the Master of Arts degree in Kinesiology

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Abstract

According to the revised stress-injury model (Williams & Andersen, 1998), greater life stress predicts greater vulnerability to athletic injury, with this relationship being strongest among athletes exhibiting competitive anxiety, less social support, and non-adaptive coping skills. This study tested the validity of this model among collegiate cheerleaders, an injury-prone athlete group. Ninety-two collegiate cheerleaders recorded instances of injury over 12 weeks. Measures of life stress, competitive anxiety, coping style, social support, and previous injury were obtained. Heightened negative life stress did not coincide with greater injury. A positive stress-injury relationship was observed among cheerleaders reporting high avoidance coping. A negative stress-injury relationship was present among cheerleaders reporting more previous injuries and lower avoidance coping. Worry, social support, concentration disruption, and problem coping demonstrated null moderating effects. Results for somatic anxiety were inconclusive. Future research should include larger samples to better study the conjunctive effects of moderators on the stress-injury relationship.

Keywords

Injury, Sport, Collegiate Cheerleaders, Life Stress, Anxiety, Coping

Summary for Lay Audience

In competitive sports, athletes experience stress from many sources within and outside of their discipline. According to the revised stress-injury model, athletes that perceive greater stress in their lives are prone to experiencing a “stress response” during important sporting events. This reaction consists of multiple symptoms including muscle tension, blurred vision, and distractibility, which can deteriorate performance and increase injury susceptibility. Highly stressed athletes are increasingly likely to exhibit a stress response if they have a history of injuries, fewer social support outlets (i.e. family, friends), are anxious before performing, and tend to avoid and deny pressing issues. Collegiate athletes experience higher rates of injury than recreational athletes. An emerging discipline in the collegiate sporting scene is competitive cheerleading. For their sport, cheerleaders perform gymnastic maneuvers, build human pyramids, and throw and catch each other throughout two-and-a-half minute routines. These athletes face tremendous physical dangers but have relatively little equipment to mitigate their injury risk. The aim of this study was to see whether psychosocial factors and previous injury predict greater subsequent injury among these athletes. We expected athletes with more negatively perceived life stress to sustain more injuries during the study period. A group of 92 collegiate cheerleaders from multiple teams participated. They recorded instances of injury on electronic surveys emailed to them each week for twelve weeks during their season. They also completed surveys that measured their stress, anxiety, previous injury, social support, and coping style. Overall, cheerleaders that reported greater life stress did not sustain more injuries than those reporting lower life stress. Interestingly, greater life stress was found to coincide with increased injury number among cheerleaders that reported high use of avoidance-type coping. Conversely, greater life stress coincided with decreases in injury number among cheerleaders with a high amount of previous injuries. No other factor demonstrated a reliable influence on injury number. We experienced some issues with athletes not self-reporting their injuries, however it is very difficult to have third parties do this for cheerleaders. Future studies should include more participants to properly test how certain combinations of factors predict injury occurrence in collegiate cheerleaders.

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1 Introduction

1.1 Cheerleading and Athletic Injury

Athletic injury is a prominent, omnipresent risk of sport competition. Research on the psychological predictors of injury has become an increasingly critical topic in sport literature over the past four decades (Williams & Andersen, 2007). Injuries often prove costly for athletes and may force them to halt participation in sport for extended periods of time (Uitenbroek, 1996). Athletes that are members of a sports club, such as collegiate athletes, report greater rates of injury than individuals with no such associations (Uitenbroek, 1996). According to injury data from the National Collegiate Athletic Association (NCAA) Injury Surveillance Program, collegiate athletes suffered 3183 severe injuries (i.e. injuries that required 21 or more days off) between 2009 and 2015 (Kay et al., 2017). Here, sports such as gymnastics and wrestling exhibited the highest rates of severe injury. However, it is another collegiate sport, one that operates outside both the NCAA and U Sports, which carries similar risks of severe injury.

Collegiate cheerleading is a team sport that combines dangerous physical tasks with extensive technical demands. Cheerleading routines comprise of gymnastic tumbling skills, stunts, acrobatic tosses, and human pyramids up to three athletes tall, all matched up to routine music. As such, the sport provides ample risk for traumatic injury (Hardy, McFaull, & Saint-Vil, 2015). The National Center for Catastrophic Sport Injury Research found cheerleading to be directly responsible for more severe injuries among female college athletes than any other sport between 1982 and 2018 in the United States (Kucera & Cantu, 2019). In Canada, 25 universities and colleges tout competitive cheerleading programs (Tracey, 2019), evidence of the sport's spread and popularity among Canadian collegiate athletics.

Because competitive cheerleading contains various skills and elements, the nature of physical injury in the sport is multifactorial. Between 1990 and 2010, there were 1496 hospitalizations in Canada as a result of cheerleading (Hardy et al., 2015). Over half of these injuries (56%) were a result of falling from a height, a quarter (26%) were due to

basing or spotting an individual from a height, and the remainder were from being thrown from a high toss or falling from a pyramid (Hardy et al., 2015). Evidently, these athletes are susceptible to a multitude of physical dangers when practicing their sport.

Given the risks cheerleaders face, a critical question arises: are there certain factors that predict greater injury among cheerleading athletes? All competitive cheerleaders must abide by an extensive list of safety rules aimed to ensure skills are performed as safely as possible (International All Star Federation, 2019). Unfortunately, there are no pieces of physical equipment available to cheerleaders to mitigate injury risk, apart from light supports or braces (International All Star Federation, 2019). As such, relevant injury-predictive factors may not be external, but rather internal.

While early medical literature extensively studied the physical aspects of sport that were related to athletic injury, sport injury research has since experienced growth among psychologists (Falkstein, 2000). To gain a better understanding of the mechanisms underlying injury vulnerability, research has recently focused on how athletes' psychological states and characteristics relate to their risk of sustaining physical injury (Williams & Andersen, 2007). Athletic injury is a multidimensional issue posited to be moderated by certain psychosocial risk factors, namely an individual's personality, history of stressors, and coping resources (Johnson & Ivarsson, 2011). A prominent model connecting psychosocial antecedents to injury occurrence is the revised stress-injury model (Williams & Andersen, 1998).

1.2 Model of Stress and Athletic Injury

The revised stress-injury model by Williams and Andersen (1998) is among the most descriptive and extensively tested theoretical models explaining the relationship between heightened stress and increased risk for athletic injury. According to this model, athletic situations which an athlete perceives as being especially stressful can include anything from demanding practices to critical competitions and events. Certain psychosocial factors are theorized to influence an individual's stress response to these situations (Williams & Andersen, 1998). An athlete is most likely to appraise an athletic circumstance as being "stressful" when they present with an extensive history of injury,

undesirable personality factors including high competitive trait anxiety, and few to no stress-coping resources (Williams & Andersen, 1998).

The associated stress response takes the form of a bi-directional relationship between the athlete's cognitive appraisals of the potentially stressful athletic situation and the physiological and attentional changes that are influenced by stress (Williams & Andersen, 1998). Specifically, the stress response is most likely to manifest itself in situations where an athlete appraises a high demand to succeed (e.g., an important competition), but perceives his or herself as possessing inadequate resources to meet these demands (Williams & Andersen, 1998). Symptoms including increased muscle tension, peripheral narrowing of the visual field, and increased distractibility often become present in the athlete along with their negative appraisal, firmly establishing a stress response (Williams & Andersen, 1998). Highly stressed athletes are thus prone to demonstrating delayed reaction to salient visual cues (e.g., a pyramid or stunt falling down), auditory deficits (e.g., mishearing routine music & counting) and poorer coordination and performance, culminating in increased injury risk (Williams & Andersen, 1998). Figure 1 provides a full visual illustration of the model.

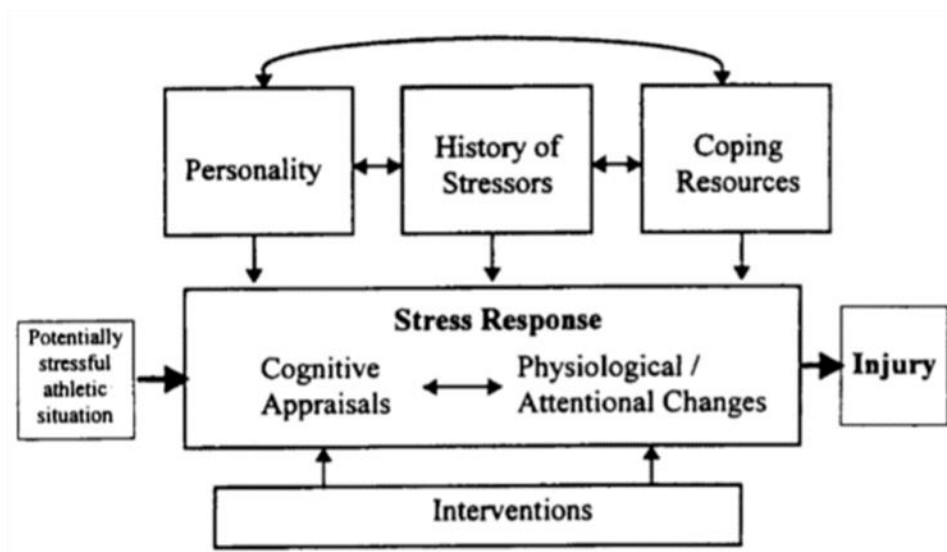


Figure 1: The revised stress-injury model (Williams & Andersen, 1998).

A limitation of this model is the tremendous difficulty that comes with trying to directly measure the stress response in athletes during competition. Instead, researchers typically opt to examine life stress as a surrogate measure for the stress response (Maddison & Prapavessis, 2005). In particular, the revised stress-injury model predicts greater levels of negatively appraised life events, referred to as negative life events (NLE) stress, to put athletes at a greater risk of injury (Williams & Andersen, 1998).

To date, most athletic literature investigating the life-stress/collegiate injury relationship has focused on football players. A recent analysis found neither negative nor positive life stress to significantly relate to injury rate or time-loss from sport in a college football sample (Petrie et al., 2014). While collegiate cheerleaders may face similar life stresses as their football counterparts, cheerleading is a largely coed sport, and the nature of the contact in each sport differs considerably. It is important to expand stress-injury research to more collegiate sports, as each possesses unique physical risks that factor into athletes' susceptibility to injury.

1.2.1 Moderators of the Stress-injury Relationship

For some time, injury vulnerability research was marked by inconsistent findings regarding life stress and injury outcomes. As a result, investigators began searching for potential psychosocial moderator variables that may influence the direction and magnitude of the stress-injury relationship (Smith et al., 2000). Factors such as previous injury, competitive anxiety, coping style, and social support have since become essential components of injury prediction research.

Collegiate athletes are under consistent pressure to exhibit superior performance during competition. Unsurprisingly, this demand for success leads some athletes to exhibit competitive trait anxiety: a tendency to perceive competitive situations as threatening, contributing to excessive worry, concentration disruption, and somatic arousal (Martens et al., 1995; Smith et al., 2006). A study by Lavallée and Flint (1996) found that collegiate football and rugby players who reported higher competitive trait anxiety sustained injuries at a greater rate than those who reported lower levels of anxiety. Indeed, competitive trait anxiety is a significant personality characteristic among athletes,

as Williams and Andersen (1998) suggest it predicts injury via contributions to the stress response. Petrie (1993) investigated both the direct effects and moderating effects of competitive trait anxiety on collegiate football players' injury susceptibility. Competitive trait anxiety was found to have moderated the effects of positive life stress on injury in the athlete sample, as higher levels of anxiety and stress predicted more days off from participating due to injury (Petrie, 1993). A more recent analysis by Maddison and Prapavessis (2005) found competitive anxiety to have no singular moderating effect on the stress-injury relationship among New Zealand rugby players.

Only one study has explored the effects of competitive anxiety in a collegiate cheerleading context. Finkenberg et al. (1992) administered the Competitive State Anxiety Inventory-2 (Martens et al., 1990) to a group of collegiate cheerleaders shortly before they were to compete at a national competition. Interestingly, both male and female participants exhibited significantly greater somatic anxiety scores pre-competition compared to the normative population mean on this subscale. This suggested that the cheerleaders were indeed susceptible to heightened physiological and affective arousal pre-competition and were thus prone to exhibiting the associated symptoms (i.e. shortness of breath, muscle tension, rapid heart rate) (Finkenberg et al., 1992). According to the stress-injury model, these symptoms, elicited by the high demand to succeed during competition, help explain why injury rates for collegiate cheerleaders are higher during competition than in practice settings (Shields & Smith, 2009).

Another factor posited to influence the stress-injury relationship consists of the athlete's repertoire of coping skills. An athlete considered to possess strong coping resources will have social support networks available to them, as well as engage in general coping behaviours (e.g., proper nutrition and rest), to help him or her deal with the stresses they face (Maddison & Prapavessis, 2005). According to the stress-injury model, those with fewer adaptive coping skills are prone to appraising important athletic situations as being more stressful and are thus more vulnerable to injury (Williams & Andersen, 1998). In a study of high school athletes, Smith and colleagues (1990) found negative life stress to most strongly predict time-loss due to injury among athletes that possessed little social support together with few psychological coping skills. Findings by Petrie (1992) have

also suggested coping resources to influence injury vulnerability. Among a group of collegiate female gymnasts, a positive relationship was found between NLE stress and number of minor injuries among those who scored lower in social support (Petrie, 1992). A study by Hanson et al. (1992) found collegiate track athletes who suffered no injuries throughout a season to possess significantly more coping resources and less NLE stress than athletes who suffered severe injuries.

The third factor proposed to influence the stress-injury relationship is an athlete's history of stressors, which considers the role of previous injury in the stress/injury relationship (Williams & Andersen, 1998). Indeed, an athlete returning to sport who has not fully healed from a past injury is at an increased risk of re-injury. On the other hand, an athlete who is physically prepared for competition may still experience anxiety and negative cognitive appraisals upon returning if they are not mentally prepared to do so (Williams & Andersen, 1998). Fear of re-injury may promote a heightened stress response as well, resulting in greater injury vulnerability (Andersen & Williams, 1988). Empirical study has yet to fully support this theory, however. In their study of collegiate track athletes, Hanson et al. (1992) reported no relationship between the period of time from injury recovery and the severity and frequency of subsequent injury. Maddison and Prapavessis (2005) demonstrated that a greater history of injury can, along with low social support and high avoidance-type coping, act to enhance the positive relationship between NLE stress and injury time among rugby athletes, though previous injury did not have any moderating effect on its own.

1.2.2 Conjunctive vs. Disjunctive Moderation

There is a commonly observed pattern in the extant literature in which multiple moderator variables act in conjunction with one another to more strongly influence injury vulnerability in athletes. Maddison and Prapavessis (2005) found the amount of injury variance explained by NLE stress to be maximized among individuals that exhibited both low social support and high avoidance or problem-focused coping, compared to individuals exhibiting only one of these features. When observing the effects of single moderators, avoidance coping was the only variable found to significantly increase the amount of injury variance explained by NLE stress, albeit by only a small amount

(Maddison & Prapavessis, 2005). These findings largely supported earlier research, in which low social support and few coping skills demonstrated a strong conjunctive vulnerability effect on the NLE stress-injury time loss relationship observed in a sample of wrestlers, gymnasts, and basketball players (Smith et al., 1990).

The revised stress-injury model acknowledges the evidence suggesting conjunctive moderation to more strongly influence life stress's relationship on injury vulnerability. Nonetheless, Williams and Andersen (1998) still stressed the need for more research investigating the potential disjunctive effects of the numerous moderator variables. Unfortunately, little work has been done on this topic since the revised model's publication.

1.3 Current Study

There is some empirical support for the link between stress and injury in athletics. A recent review of 34 athletic studies found that the majority (77.2%) demonstrated a positive relationship between stress and injury vulnerability in their samples (Singh & Conroy, 2017). Cheerleading carries the potential for traumatic injury, and collegiate cheerleaders have consistently been found to demonstrate greater rates of injury than both high school and all-star cheerleaders (Shields & Smith, 2009). Such high risk of injury, combined with the sport's continued growth in collegiate athletics, reflected a need for this investigation.

Our first objective was to explore the nature with which NLE stress predicts injury among collegiate cheerleaders. Our second goal was to observe how certain psychosocial factors and previous injury influence the stress-injury relationship among these same athletes. Each moderator variable's effect on the stress-injury relationship was investigated disjunctively. Previous research has implicated social support and coping as being strong conjunctive moderators (Maddison & Prapavessis, 2005; Smith et al., 1990). As such, we decided to test the combined effect of social support and avoidance coping, as well as social support and problem-focused coping, on the stress-injury relationship. Using a prospective cohort design, participants' injury data was compiled over 12 weeks

from September 2019 to December 2019, encompassing the busiest and most competitive portion of the Canadian collegiate cheerleading season.

1.4 Hypotheses

Based on the literature reviewed above, the following hypotheses were generated:

1. A mild positive relationship will be found between negative life events (NLE) stress and number of cheerleading injuries sustained throughout the season.
2. High avoidance coping will demonstrate a small vulnerability (susceptibility) effect on the amount of injury variance explained by NLE stress among cheerleaders. In other words, under this moderator condition, a significant positive relationship is expected to be found between NLE stress and injury number.
3. Low avoidance coping will demonstrate a protective (buffering) effect on the amount of injury variance explained by NLE stress among cheerleaders. In other words, under this moderator condition, no relationship is expected to be found between negative life stress and injury number.
4. Previous injury, problem-focused coping, social support, and anxiety (i.e., worry, somatic anxiety, and concentration disruption) will not serve to moderate relations between NLE stress and injury number among our collegiate cheerleader sample.
5. Given our limited sample size of Canadian collegiate cheerleaders, we will not be able to observe a significant conjunctive moderating effect for social support and coping (both types) on the amount of injury variance accounted for by NLE stress

2 Methods

2.1 Participants

Participants were 92 Canadian-based collegiate cheerleaders (1 male, 91 females) from across three collegiate teams. Age ranged from 17 years to 23 years. Participants had to have joined their respective team either on or before September 2019 and have remained a member of their team until the national championship on November 30th, 2019.

2.2 Variables

2.2.1 Predictor Variable: Life Stress

The Life Events Survey for Collegiate Athletes (LESCA; Petrie, 1992) was used to measure life stress (Appendix B). The LESCA is a 69-item questionnaire that records positive and negative life changes. Participants were asked to report each such event they had experienced in the previous 12 months. For each life event experienced, the athlete was asked to indicate its impact on an 8-point Likert scale from -4 (extremely negative) to $+4$ (extremely positive). Responses from 1 to 4 indicated positive life stress, and responses from -1 to -4 indicated negative life stress. Summing the respective life stress values yielded two life stress scores, negative (NLE) and positive (PLE). Only NLE data was analyzed here, as it has demonstrated the most consistent relationship with injury (Maddison & Prapavessis, 2005). Three female-only items were deleted as not every potential participant identified as being female, leaving 66 items. Petrie (1992) noted the strong content validity of this scale, as well as consistent test-retest reliability correlations ranging from $r = .76$ to $r = .84$.

2.2.2 Moderator Variables

2.2.2.1 Coping Resources

The Ways of Coping Scale (WOCS; Grove, Eklund, & Heard, 1997) was used to measure how often athletes utilize specific strategies when coping with the stress of competition (Appendix C). The WOCS is a 26-item multidimensional scale that measures five coping components: seeking social support (5-items), effort/resolve (5-items) denial/avoidance (8-items), wishful thinking (5-items), and emotional control (3-items). Participants were asked to indicate how regularly they used these coping strategies when dealing with stressful events such as competition. Responses were made on a 4-point bipolar scale ranging from 0 (does not apply) to 3 (used a great deal). Cronbach's alpha values for each subscale were as follows: seeking social support, .79; effort/resolve, .67; denial/avoidance, .66; wishful thinking, .73; emotional control, .49. A "problem-focused" coping scale was derived by summing values from effort/resolve and seeking social support ($\alpha = .84$). Scores for avoidance coping were comprised of summed values

from denial/avoidance and wishful thinking ($\alpha = .82$). The range of possible scores for each scale was 0-39. Emotional control questions were not included in subsequent analysis given the poor internal consistency with these items.

2.2.2.2 Personality-Competitive Anxiety

The Sport Anxiety Scale-2 (SAS-2: Smith, Smoll, Cumming, & Grossbard, 2006) was used to measure sport-specific competitive anxiety (Appendix D). This 15-item scale assesses three factors in athletes' reactions to playing sports: somatic anxiety (i.e. perceived physical arousal), worry, and concentration disruption (5-items each). Participants responded on a 4-point scale their propensity for each reaction, ranging from 1 (not at all) to 4 (very much). Cronbach's alpha values for each subscale were as follows: concentration disruption, .85; somatic anxiety, .87; worry, .91.

2.2.2.3 Social Support

The Social Support Questionnaire (Smith et al., 1990) assessed the amount of social support each participant reported having available to them (Appendix E). For each item, participants indicated the extent to which certain individuals (e.g., father, mother) or groups (e.g., teammates, athletic organization) could be relied on to offer them with emotional support and caring. There were 20 items in total, with scores ranging from 1 (not all helpful) to 5 (very helpful) per item. Participants were further asked to indicate on a scale from 1 (never) to 7 (always) whether they were the type of person to seek others for caring and emotional support. Scores were summed, providing a complete measure of social support. Smith et al. (1990) found strong 1-week test-retest reliability ($r = .87$) for the emotional support subscale of the questionnaire, the same subscale used here.

2.2.2.4 Previous Injury

Previous injury data was obtained through the first electronic weekly survey submitted by participants (Appendix F). Individuals were asked to indicate the number of physical injuries they had sustained over the previous 12 months that required medical attention, took away time from cheerleading, or that resulted in modification of cheerleading training.

2.2.3 Dependent Variable: Injury Number

Participants were asked to record the number of injuries they sustained each week via a survey sent by email (Appendix G). Specifically, they were to record injuries that required medical attention, took away time from cheerleading, or that resulted in modification of cheerleading training.

The stress-injury model states that an individual possesses a greater likelihood of injury if he or she has experienced many life events (Williams & Andersen, 1998). In other words, more negative life events predict more injuries, regardless of severity (Andersen & Williams, 1999). As such, our injury variable was defined as the mean number of injuries per athlete.

2.3 Procedure

Approval for the study was obtained from Western University's Health Sciences Research Ethics Board (Appendix A). Several months prior to the 2019 collegiate cheerleading season, the author contacted coaches from numerous Ontario collegiate cheerleading teams either in person or via email to seek their willingness to have their teams participate. For teams whose coaches were willing to participate, the author scheduled a meeting with each team at their respective practice facility. At this meeting, prospective participants were told of the objectives of the study, provided a letter of information (Appendix H), and were given the opportunity to provide informed consent. Consenting participants received a unique anonymous 'identifier number' in an envelope and were asked to provide their email address on a slip of paper. Signed consent forms and email slips were sealed in an envelope and brought back to the Exercise and Health Psychology Laboratory immediately after each team's meeting for secure storage.

All scales and surveys were produced and distributed through Qualtrics, a survey software offered by Western University. Email lists for each team were compiled and stored in Qualtrics. Participants were emailed anonymous links to each survey, all of which were password protected. Electronic versions of the four psychological scales (Appendices B, C, D, and E) were emailed to participants prior to the beginning of the cheerleading season. Participants also were asked to complete an electronic injury

recording questionnaire each week for 12 weeks from September 15th, 2019 to December 1st, 2019 (Appendix G). For each questionnaire, they were to record (a) the number of hours of cheerleading practiced that week, (b) the number of injuries sustained, and (c) the number of hours of cheerleading missed or modified due to injury. Participants had until 11:59 pm on December 7th, 2019 to submit all their questionnaire data.

Demographic data (participants' age and gender) were obtained from additional questions included in the first week's injury recording questionnaire (Appendix F). To track responses throughout the study, participants were asked to enter their identifier number for each questionnaire they filled out. Participants were emailed an end of study form (Appendix I) after the study's final week of injury surveillance.

3 Results

A total of 54 participants, all female, provided injury data and/or survey data. To handle missing data, multiple imputation (MI) was performed using SPSS version 25. This technique involved simulating missing data using suitable estimates, minimizing potential biases that may have resulted from the data's 'missingness' (Pampaka et al., 2016).

Subsequent analysis was performed using the filled-in data, maintaining the sample size and resulting in more efficient datasets (Pampaka, et al., 2016). MI was chosen over simply deleting cases (participants) with incomplete data, as 68% of our respondents had at least one missing value in their datasets. Listwise deletion would therefore have done away with about two thirds of our useful participant sample, taking with it a wealth of valuable information. Little's Missing Completely at Random (MCAR) test failed to reach significance ($\chi^2(70) = 101.28, p = .312$), indicating that our data's 'missingness' was likely random and that we could perform imputation techniques without the risk of creating biased results.

Missing data that was imputed included scores for the questionnaires measuring the predictor and moderator variables, as well as injury responses from the weekly online surveys emailed to participants. Table 1 summarizes the descriptive data (including imputations).

Table 1: Means and respective standard deviations for NLE stress data (LESCA), psychological moderators (WOCS, SAS-2, SSQ), previous injury, and injury number.

Variable	N	<i>M</i>	<i>SD</i>	Minimum	Maximum
1. Negative Life Stress	80	14.50	10.84	0	46
2. Avoidance Coping	80	12.01	6.71	2	36
3. Problem Coping	80	19.14	7.85	1	39
4. Somatic Anxiety	87	9.69	3.47	5	20
5. Worry	87	11.41	3.84	5	20
6. Concentration Disruption	87	6.46	1.88	5	12
7. Social Support	78	48.28	10.07	16	78
8. Previous Injury	86	1.29	1.25	0	5
9. Injury Number	93	1.68	1.60	0	6
Valid cases	70				

To satisfy the assumption of normality for the regression analyses, a square root transformation was applied to the dependent variable ‘injury number’.

3.1 Hypothesis 1 - Negative Life Events (NLE) Stress

According to linear regression analysis, the predictor negative life events (NLE) stress explained a negligible amount of the total variance on the dependent variable injury number, $R^2_{Adj} = -.006$, $F(1, 71) = 0.558$, $p = .458$.

3.2 Hypotheses 2 & 3 - Avoidance Coping

To test the moderating effect of avoidance coping on the relationship between stress and injury, a hierarchical multiple regression analysis was conducted with this psychosocial variable.

In the first step, two variables were included: avoidance coping and NLE stress. These variables accounted for a significant amount of variance in injury number, $\Delta R^2 = .088$, $\Delta F(1, 69) = 6.67$, $p = .012$. The variables were centered and an interaction term between avoidance coping and NLE stress was formulated (Aiken & West, 1991). (These steps were repeated for the other moderator variables’ analyses included in hypothesis 4.)

Next, the interaction term between NLE stress and avoidance coping was added to the regression model, which approached accounting for a significant proportion of the variance in injury rate, $\Delta R^2 = .048$, $\Delta F(1, 68) = 3.79$, $p = .056$, $\beta = 0.62$. Inspection of Variance Inflation Factor (VIF = 8.03) and tolerance (= .12) did not raise a significant issue with multicollinearity (Menard, 1995). Examination of the interaction plot (Figure 2) showed a vulnerability effect for high avoidance coping. Among athletes that demonstrated high avoidance coping, those that also reported high NLE stress tended to sustain more injuries than those that were less stressed.

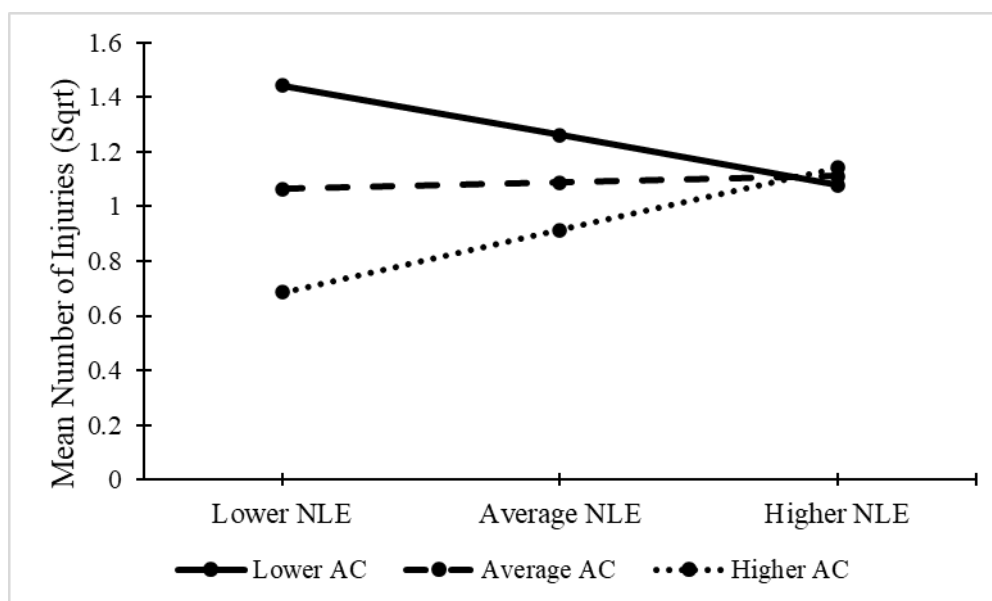


Figure 2: Interaction between Avoidance Coping (AC) and Stress (NLE) on Injury Number in Collegiate Cheerleading Athletes. Avoidance coping was measured according to the avoidance coping subset of questions from the Ways of Coping Scale (WOCS). “NLE” refers to Negative Life Event Stress as measured using the Life Events Survey for Collegiate Athletes (LESCA.) Lower scores were one SD or more below the mean, average scores were within one SD of the mean, higher scores were one SD above the mean or higher.

Among cheerleaders reporting low avoidance coping, those that reported greater stress sustained fewer injuries than those reporting less stress, that is, a negative relationship between NLE stress and injury number was observed (Figure 2). This antagonistic effect on injury number opposed the buffering effect predicted in hypothesis 3.

3.3 Hypothesis 4

3.3.1 Problem-focused Coping

The variables problem-focused coping and NLE stress did not account for a significant amount of variance in injury number in the first regression model, $\Delta R^2 < .001$, $\Delta F(1, 69) = 0.003$, $p = .954$. Adding the interaction term between NLE stress and problem coping to the regression model did not account for a significant proportion of the variance in injury number, $\Delta R^2 = .002$, $\Delta F(1, 68) = 0.12$, $p = .739$, $\beta = -0.14$. Multicollinearity was an issue here (VIF = 11.94, Tolerance = .08). For moderators that demonstrated evidence of multicollinearity, a stepwise regression was subsequently computed. The moderator, the predictor (NLE stress), and the interaction term ('Moderator x NLE Stress') were included to see which, if any, predicted injury number. If the interaction term remained in the regression model, this would provide evidence of moderation (Lewis, 2007). Here, the interaction term did not remain in the model, providing no evidence for a moderating effect of problem-focused coping on the stress-injury relationship.

3.3.2 Somatic Anxiety

The variables somatic anxiety and NLE stress did not account for a significant amount of variance in injury number, $\Delta R^2 = .028$, $\Delta F(1, 69) = 1.98$, $p = .164$. Adding the interaction term between NLE stress and somatic anxiety to the regression model did account for a significant proportion of the variance in injury number, $\Delta R^2 = .093$, $\Delta F(1, 68) = 7.24$, $p = .009$, $\beta = -1.09$. Multicollinearity was an issue with this variable (VIF = 12.73, Tolerance = .08). Subsequent stepwise regression provided no evidence of a significant moderating effect for this factor.

3.3.3 Worry

The variables worry and NLE stress accounted for a significant amount of variance in injury number in the first regression model, $\Delta R^2 = .072$, $\Delta F(1, 69) = 5.38$, $p = .023$. Adding the interaction term between NLE stress and worry to the regression model did not account for a significant proportion of the variance in injury rate, $\Delta R^2 = .012$, $\Delta F(1, 68) = 0.90$, $p = .345$, $\beta = 0.44$. Multicollinearity was an issue with this variable (VIF =

15.68, Tolerance = .06). Subsequent stepwise regression provided no evidence of a significant moderating effect for this factor.

3.3.4 Concentration Disruption

The variables concentration disruption and NLE stress did not account for a significant amount of variance in injury number in the first regression model, $\Delta R^2 = .010$, $\Delta F(1, 69) = 0.67$, $p = .416$. Adding the interaction term between NLE stress and concentration disruption to the regression model did not account for a significant proportion of the variance in injury number, $\Delta R^2 = .006$, $\Delta F(1, 68) = 0.42$, $p = .520$, $\beta = 0.40$.

Multicollinearity was an issue with this variable (VIF = 26.76, Tolerance = .04).

Subsequent stepwise regression provided no evidence for a significant moderating effect for this factor.

3.3.5 Social Support

The variables social support and NLE stress did not account for a significant amount of variance in injury number in the first regression model, $\Delta R^2 < .001$, $\Delta F(1, 69) < .001$, $p = .985$. Adding the interaction term between NLE stress and problem coping to the regression model did not account for a significant proportion of the variance in injury number, $\Delta R^2 = .025$, $\Delta F(1, 68) = 1.75$, $p = .191$, $\beta = -0.77$. Multicollinearity was an issue here (VIF = 23.31, Tolerance = .04). Subsequent stepwise regression provided no evidence of a significant moderating effect for this factor.

3.3.6 Previous Injury

The variables NLE stress and previous injury number accounted for a significant amount of variance in injury number, $\Delta R^2 = .180$, $\Delta F(1, 69) = 15.41$, $p < .001$. Adding the interaction term between NLE stress and previous injury to the regression model accounted for a significant proportion of the variance in injury number $\Delta R^2 = .047$, $\Delta F(1, 68) = 4.20$, $p = .044$, $\beta = -0.49$. Inspection of Variance Inflation Factor (= 5.19) and tolerance (= .19) did not raise an issue with multicollinearity here. Examination of the interaction plot (Figure 4) showed an antagonistic effect; athletes that reported a

relatively high number of previous injuries were most susceptible to injury if they reported less NLE stress compared to those reporting more NLE stress.

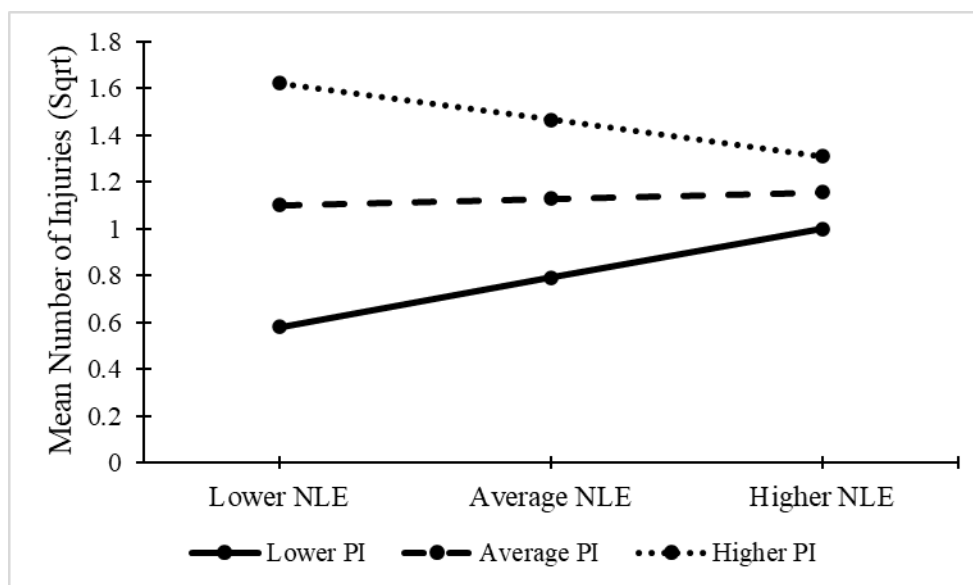


Figure 3: Interaction between Previous Injury (PI) and Stress (NLE) on Injury Number in Collegiate Cheerleading Athletes. Previous injuries were measured using an electronic survey. Lower scores were one standard deviation (SD) or more below the mean, average scores were within one SD of the mean, higher scores were one SD above the mean or higher.

3.4 Hypothesis 5 - Coping and Social Support

Adding the interaction term between NLE stress and avoidance coping plus social support did not account for a significant amount of variance in injury number $\Delta R^2 < .001$, $\Delta F(1, 64) = 0.02$, $p = .878$. Likewise, adding the interaction term between NLE stress and problem-focused coping plus social support did not account for a significant amount of variance in injury number $\Delta R^2 = .027$, $\Delta F(1, 64) = 1.84$, $p = .179$. These findings indicate neither moderator pairing as achieving a significant moderating effect on the stress-injury relationship.

4 Discussion

Generally, results lent partial support for the stress-injury model (Williams & Andersen, 1998) in a collegiate cheerleading context. NLE stress did not significantly predict a greater number of injuries among competitive cheerleaders, contrasting with the first hypothesis. This finding is not in line with most research (Singh & Conroy, 2017), which has largely found significant, albeit small, positive associations between NLE stress and injury.

Despite this, avoidance coping was found to have a near-significant moderating trend ($p = .056$) on the NLE stress - injury number relationship. This result provides partial support for hypothesis 2. Examining the interaction graph (Figure 2), cheerleaders presenting with both high NLE stress and greater avoidance coping tended to sustain more injuries than those reporting greater avoidance coping but low NLE stress. These findings replicate that of Maddison and Prapavessis (2005), who found a significant positive relationship between NLE stress and injury number among rugby players who demonstrated high avoidance coping.

An avoidance-oriented coping styles is punctuated by factors such as denial, avoidance of others, and wishful thinking (Grove et al., 1997). While this may provide athletes the benefit of a break from stressful situations (Maddison & Prapavessis, 2005), it can also make them susceptible to accidental injury by distracting them from dangerous environmental cues and reducing their attentiveness to the tasks at hand (Andersen & Williams, 1988). The current study provides evidence that combining avoidance tendencies with heightened stress can put competitive cheerleaders at greater risk for injury in accordance with the revised stress-injury model (Williams & Andersen, 1998).

The antagonistic effect that low avoidance coping had on the stress-injury relationship (Figure 2) contrasted the buffering effect predicted in hypothesis 3. Lower levels of avoidance coping may exert its protective effect on injury by guarding athletes from attentional symptoms (e.g., greater distractibility) when they are experiencing greater life stress. This effect would likely only be useful in a highly stressed athlete who is prone to

a stress response, which may explain why lower avoidance coping did not appear to robustly reduce injury number among cheerleaders that reported lesser NLE stress.

There is limited support for strong disjunctive moderation on the stress-injury relationship (Williams & Andersen, 1998). Previous work has generally suggested that when social support and coping styles are each considered on their own, the change in the amount of injury variance accounted for by NLE stress remains negligible (Smith et al. 1990; Maddison & Prapavessis, 2005). Rather, it is when athletes possess little social support along with higher avoidance coping or problem-focused coping that a stronger moderating effect is observed. We were unable to find a significant conjunctive moderating effect for social support and either coping style here. This was likely due to our relatively small sample size not providing us with the power sufficient to perform such analyses. We suggest that investigators limit themselves to studying up to two moderators at a time when investigating conjunctive moderating effects in samples similar in size to ours.

Greater previous injury demonstrated a reversing (antagonistic) effect on the proposed positive relationship between NLE stress and injury number in our collegiate cheerleader sample. This of course does not support our fourth hypothesis. Cheerleaders who incurred a relatively high number of previous injuries tended to sustain fewer injuries the more NLE stress they reported (Figure 4). One plausible explanation for this counterintuitive finding may be that greater previous injury protects against subsequent injury by promoting injury prevention behaviour during periods of high NLE stress in these athletes.

Some critical discrepancies between cheerleading and other sports may have also influenced how previous injury and somatic anxiety related to injury occurrence. For example, collegiate cheerleading coaches may not expect a highly stressed athlete with a history of previous injury to continue performing maneuvers with a higher risk of injury, such as “flying” (Hardy et al., 2015). Instead, they may relegate such an athlete to a less risky position, like basing, while appointing lower stressed athletes to perform the riskier duties (even if they have a history of injury). Occurrences like this are much less common

in sports like gymnastics, football, or track, as these athletes have fixed positions and must repeat the same tasks as part of their sport, regardless of stress or injury history. Essentially, the unique lack of structured positioning in cheerleading may help explain how greater injury history can elicit a negative relationship between stress and injury.

The significant antagonistic effect demonstrated by high somatic anxiety was compromised due to collinearity between this factor and NLE stress. It is possible that greater somatic anxiety reflects an optimal psychological state among highly stressed cheerleaders, minimizing their stress-response symptoms and mitigating injury risk. Competitive cheerleading routines involve vigorous, highly technical physical activity over a relatively short period of time, contrasting sharply with previously studied sports like football and rugby, which require much longer periods of action between which athletes can rest. Previous literature has shown collegiate cheerleaders to exhibit relatively high levels of somatic anxiety during competition (Finkenberg et al., 1992). Nevertheless, collinearity issues and conflicting regression analysis results mean further study is needed to understand the true influence somatic anxiety has on the stress-injury relationship in collegiate cheerleaders.

The psychosocial variables worry, concentration disruption, social support, and problem-focused coping each demonstrated no significant moderating effect on the relationship between NLE stress and injury number. Taken together, these findings were congruent with our fourth hypothesis. Indeed, previous work has reported similar findings for these constructs (Maddison & Prapavessis, 2005; Smith et al 1990). Overall, there appears to be converging evidence that these four psychosocial variables on their own are not powerful moderators.

One reason why it is important to study the psychological and social antecedents of injury in collegiate cheerleading is that it has the potential to better shape the way injury-prone athletes are perceived in the sport. By demonstrating that internal factors influence injury occurrence, coaches and trainers can better spot athletes that are at greater risk and take steps to prevent injury occurrence in those individuals. This could vastly improve athlete

safety, while also mitigating any psychological distress that athletes and coaches may experience when a vital team member must take time off due to injury.

Finally, to better understand our findings it is important to explore our descriptive data (Table 1) to see what types of discrepancies arise between cheerleaders and athletes from different psychological injury prediction studies. The rugby sample in Maddison and Prapavessis (2005) differed from our collegiate cheerleader group on some variables but demonstrated similarity in others. The mean number of previous injuries reported by our cheerleading sample ($M = 1.29, SD = 1.25$) and Maddison and Prapavessis' (2005) rugby group ($M = 1.35, SD = 1.27$) were near identical. Likewise, similar mean SSQ avoidance coping scores were observed among the collegiate cheerleaders ($M = 12.01, SD = 6.71$) and the rugby players ($M = 11.19, SD = 5.73$). This latter finding may have been expected, as both studies found high avoidance coping to have a small vulnerability effect on the stress-injury relationship.

The differences between each group, however, are especially notable. Here, collegiate cheerleaders reported a noticeably greater overall mean score for NLE stress on the LESCA ($M = 14.50, SD = 10.84$) than did the Maddison & Prapavessis (2005) rugby sample ($M = 9.28, SD = 10.78$). This disparity may reflect a gender difference in the amount of NLE stress that male and female athletes experience, as our cheerleader respondents were all females, while Maddison and Prapavessis (2005) employed a male sample. Regarding injury data, the mean number of injuries reported by our cheerleading sample ($M = 1.68, SD = 1.60$) was almost double that of the rugby sample ($M = 0.95, SD = 1.37$; Maddison and Prapavessis, 2005). These results suggest that collegiate cheerleaders may experience more negative life stress and sustain even more injuries than rugby athletes. The differences in injury number between studies may also reflect a tendency for athletes to hide injuries from coaches, as coaches were tasked with recording injury in Maddison & Prapavessis (2005), whereas in the current study athletes self-reported injury. That our cheerleader sample reported relatively greater stress overall may help explain the differing moderating effects observed in each study, specifically the unexpected interaction effect of greater previous injury found here. Future research comparing the psychological and injury data of athletes from a variety of sports would

help form a more complete understanding of the patterns and trends regarding stress and its relationship with injury in athletics.

4.1 Strengths and Limitations

A strength of our study was the use of electronic surveys. We were able to provide participants with each injury survey and psychological questionnaire conveniently and in a timely manner by email. The Qualtrics software allowed participants to easily record instances of injury over the course of the study, and reliably organized their responses for data analyses. Another strength was our implementation of psychometrically sound measures for the predictor and moderator variables. These questionnaires have been used in previous stress-related injury vulnerability study (Maddison & Prapavessis, 2005; Smith et al., 1990) and as such have been subject to psychometric evaluation.

A particularly strong element of our study was that injury was measured prospectively as the season progressed, minimizing recall biases that could have arisen had injury been measured retrospectively.

A vast majority of injury prediction studies rely on coaches, trainers, or medical staff to register instances of injuries among participants. This method, however, cannot be as easily replicated in cheerleading. Firstly, very few Canadian collegiate teams employ their own trainers or therapists. Cheerleaders do not have identifiers such as uniform numbers or playing positions either, further complicating the process. Lastly, cheerleading athletes do not have their playing time recorded like players in other major collegiate sports like football, hockey, or basketball. For these reasons, it was decided that the athletes themselves would track their own injury time and injury instances. This was a strength in that each participant served as their own injury recorder, minimizing the chance that an injury would go undetected. Even so, the use of self-report for injury surveillance did present some problems here. Participant attrition was a primary issue, as initially only 54 of 92 recruited participants provided response data. Athletes may have also forgotten to track their injuries, become disinterested in the process, or inaccurately entered data, which may have influenced a portion of the outcome variance.

Tracking injury among cheerleading athletes, and collegiate ones at that, presents numerous challenges. In Canada, collegiate cheerleading is not governed by U Sports or any large sporting association, so there exists no injury surveillance system to help inform our methodology or compare our results to. Indeed, no published study has prospectively tracked injury among collegiate cheerleaders, an athlete group largely overlooked in the literature. Hence, we could not compare our findings to any normative cheerleading injury reference data to see how it matched with previous trends.

Our injury surveillance period was 12 weeks long, which may not have been long enough for a meaningful amount of cheerleading injuries to have taken place. While the same time period has been employed before (Ivarsson & Johnson, 2010), previous stress-injury studies have generally allocated between 18 weeks (Hanson et al., 1992) to eight months (Johnson & Ivarsson, 2011) for injury surveillance.

Lastly, our sample size was relatively small, which inhibited our ability to test the conjunctive moderating effects of certain variables on the stress-injury relationship. Our use of multiple hierarchical regression made us vulnerable to collinearity effects in our disjunctive moderation analysis.

4.2 Future Directions

Future studies of injury among collegiate cheerleaders should aim to develop ways to ensure greater participant engagement throughout. Collegiate athletes face many demands in their daily lives, so relying on these individuals to record their own injuries accurately may have proved challenging for our participants. Providing an incentive for the athletes to do so may be a valuable strategy. Alternatively, researchers may want to employ teams with greater resources, and which possess training staffs, as trainers may be able to provide a more thorough record of injury instances, as well as allow for a greater time period for injury surveillance. It may prove insightful to see whether there is convergence between self-report and trainer-reported injury data as well.

Future work should also investigate whether psychosocial and stress factors influence injury incidence rates and injury severity. There has been no injury prediction work

published among collegiate cheerleaders before the current study, which only measured injury number. Investigating injury rate and injury severity would be a logical next step in establishing a solid base of information for the sport of collegiate cheerleading in rehab and injury psychology research.

Finally, qualitative investigation of the psychosocial predictors of injury in cheerleaders would be a particularly fruitful area for future study. Interview data may unlock deeper insights as to why cheerleaders themselves feel stress and psychosocial factors influence injury risk, aiding researchers in developing effective injury intervention strategies for these athletes.

4.3 Conclusions

Negative life events stress was not found to predict a greater number of injuries among collegiate cheerleaders. The current research presents evidence for high avoidance coping as having an enhancing effect on the stress-injury relationship among these athletes.

Alternatively, greater previous injury demonstrated an antagonistic (reversing) effect on the predicted positive relationship between NLE stress and injury number, an unexpected result. Regression analyses for somatic anxiety produced conflicting results and issues with collinearity, warranting further investigation. Problem-focused coping, social support, worry, and concentration disruption demonstrated no significant disjunctive interactions. Future studies should aim to observe larger samples with a greater variety of teams to study conjunctive moderation, and consider allocating a greater period of time, as well as incentives, for injury surveillance.

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Appendices

Appendix A: HSREB approval for this thesis project



Date: 27 May 2019
To: Prof. Harry Praprevassis
Project ID: 113819
Study Title: Psychological Predictors of Injury in Collegiate Cheerleaders
Application Type: HSREB Initial Application
Review Type: Full Board
Meeting Date / Full Board Reporting Date: 23/Apr/2019 13:00
Date Approval Issued: 27/May/2019
REB Approval Expiry Date: 27/May/2020

Dear Prof. Harry Praprevassis

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above mentioned study as described in the WREM application form, as of the HSREB Initial Approval Date noted above. This research study is to be conducted by the investigator noted above. All other required institutional approvals must also be obtained prior to the conduct of the study.

Documents Approved:

Document Name	Document Type	Document Date	Document Version
Email Script	Email Script	30/Apr/2019	2
End of Study Form	End of Study Letter	09/May/2019	2
Life Event Scale for Collegiate Athletes (LESCA)	Paper Survey	05/May/2019	2
Life Event Scale for Collegiate Athletes (LESCA) Electronic Version	Online Survey	06/May/2019	1
LOI and Consent	Written Consent/Assent	16/May/2019	3
Protocol Research Plan	Protocol	09/May/2019	2
Recruitment Poster	Recruitment Materials	06/May/2019	1
Social Support Questionnaire (SSQ)	Paper Survey	14/Mar/2019	1
Social Support Questionnaire (SSQ) Electronic Version	Online Survey	06/May/2019	1
Sport Anxiety Scale-2 (SAS-2) Electronic Version	Online Survey	06/May/2019	1
Sport Anxiety Scale-2 (SAS-2) Smith, Small, Cumming, Grossbard (2006)	Paper Survey	29/Apr/2019	2
Ways of Coping Scale (M-WCS)	Paper Survey	14/Mar/2019	1
Ways of Coping Scale (M-WCS) Electronic Version	Online Survey	06/May/2019	1
Week 1 Electronic Injury Survey	Online Survey	26/Mar/2019	1
Weeks 2-12 Electronic Injury Survey	Online Survey	26/Mar/2019	1

Documents Acknowledged:

Document Name	Document Type	Document Date	Document Version
References	References	13/Mar/2019	1

No deviations from, or changes to, the protocol or WREM application should be initiated without prior written approval of an appropriate amendment from Western

HSREB , except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

REB members involved in the research project do not participate in the review, discussion or decision.

The Western University HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Patricia Sargeant, Ethics Officer [REDACTED] on behalf of Dr. Joseph Gilbert, HSREB Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Appendix C: Ways of Coping Scale (WOCS) electronic version



Please enter the identifier number which you received in your envelope.

Read each statement. Then TICK THE BOX next to the statement that indicates how much you use this strategy when dealing with stressful events such as competition.

	Does not apply	Applies sometimes	Used most of the time	Used a great deal
1. Go on as if nothing happened.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I train harder, longer, or more often.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Ask someone I respect for advice.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I try to relax myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Wish that I can change what is happening.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Talk to someone who can do something concrete about the problem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Try to make myself feel better by eating, drinking or smoking prior to games.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Take it out on other performers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I avoid other players.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. I daydream or imagine a better time or place than the one I am in.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. I try to keep my feelings from interfering with my concentration on the game.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Take a big chance or do something risky.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. Hope things will change.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. Talk to someone about how I am performing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. I know what has to be done, so I am doubling my efforts to make things work out.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. Refuse to believe it is happening.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. Accept it, since nothing can be done.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. Try harder.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. Maintain my pride and keep my cool.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. Change something about my performance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. Wish that the situation would resolve itself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. Have fantasies or wishes about how things might turn out.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. Do something which I don't think will work but at least I'm doing something.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. Talk to someone about it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25. Stand my ground and fight harder.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26. I look for help.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Survey Powered By Qualtrics

Appendix E: Social Support Questionnaire (SSQ) electronic version



Please enter the identifier number which you received in your envelope.

We would like to ask you some questions about the people that are important to you in your day-to-day life. These include Parent, Friends, Teachers, Coaches, Teammates, and others. There may be people in your life who provide you with caring and emotional support. These are people that you count on to care about you, regardless of what is happening to you, and who accept you totally, including your good and bad points.

Instructions. Please rate each of the people below in terms of how helpful they would be in providing you with caring and emotional support if you needed it. CHECK the appropriate number to indicate your rating or place an X to indicate people, who are not part of your social network.

	Do not have or rarely see.	Not at all helpful (1)	(2)	Somewhat helpful (3)	(4)	Very helpful (5)
1. Father	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Mother	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Step-father	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Step-mother	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Brothers, sisters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Other relatives (grandparents)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Teachers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. School counselor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. School principal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Best adult friend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Clergy, priest, etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Best friend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Partner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Head coach	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Assistant coach	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Closest team-mate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Other team-mates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Team trainer/physio	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Team manager	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. Athletic organization	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

In general, when the occasion arises, are you the type of person who turns to others for caring and emotional support?

Never (1) (2) (3) Sometimes (4) (5) (6) Always (7)

Answer using likert scale

Survey Powered By: Qualtrics

Appendix F: Electronic demographics survey

Western
UNIVERSITY • CANADA

Week 1 (September 8-14). Thank you for taking the time to complete this survey. Questions 2, 3, and 4 will only be asked this week for demographic purposes.

Q1. Please enter your Identifier Number. This is the random number you received in your envelope.

Q2. What is your gender?

Male

Female

Other

Q3. What is your age in years?

17

18

19

20

21

22

23

24

25

Other

Q4. How many physical injuries have you sustained from cheerleading over the past 12 months? Count all injuries that required medical attention, that resulted in you missing time from cheerleading, or that resulted in you needing to modify your cheerleading training.

0 1 2 3 4 5 6 7 8 9 10

Drag bar

→

Survey Powered By **Qualtrics**

Appendix G: Electronic injury recording survey (week 2 of 12 shown)

Western UNIVERSITY · CANADA

Thank you for taking the time to complete this survey.

Q1. Please enter your Identifier Number. This is the random number you received in your envelope.

→

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Western UNIVERSITY · CANADA

Thank you for taking the time to complete this survey.

Q4. Please indicate the number of hours of cheerleading training and competition you completed this week. (Sunday Sept 15 - Saturday Sept 21)

0 4 8 12 16 20 24 28 32 36 40

Hours cheering at practice, football games, events, competitions, etc.

Q5. Please indicate the number of injuries you sustained from cheerleading this week. (Sunday Sept 15 - Saturday Sept 21)

0 1 2 3 4 5 6 7 8

Number of Injuries that required medical attention, absence from cheer, or modification to training

Q6. Please indicate the number of hours of cheerleading you needed to miss or modify due to injury during the week (Sunday Sept 15 - Saturday Sept 21). Examples of "modification" include needing to mark skills instead of competing them due to pain, being unable to perform your skills comfortably, requiring protective equipment, etc.

0 4 8 12 16 20 24 28 32 36 40

Hours of cheerleading missed or modified due to injury

← →

Survey Powered By Qualtrics

Appendix H: Letter of information and consent



LETTER OF INFORMATION AND CONSENT

Project Title: Psychological Predictors of Injury in Collegiate Cheerleaders

Principal Investigator

Harry Prapavessis, Ph.D. (School of Kinesiology, Western University)

Co-Investigator

Alexander Marchand, B.Sc. (School of Kinesiology, Western University)

Letter of Information

1. Invitation to Participate

You are being invited to participate in a research study examining the relationship between life stress and injury vulnerability in cheerleading athletes. You are being invited to participate because you are a member of your school's varsity cheerleading team and you plan to compete for your team at the 2019 PCA Collegiate Cheerleading Championships. The purpose of this letter is to provide you with the information needed to make an informed decision about participating in this research. Please take your time when reading this letter and please do not hesitate to ask questions throughout. Please take note that this is a student project. We hope to enroll approximately 140 participants for this study.

2. Purpose of this Study

Cheerleading is a risky, technically demanding sport. At the collegiate level, athletes dedicate many hours each week to training. During the intensive, competitive portion of the collegiate cheerleading season, typically September to November, physical injury is a prime concern for athletes and coaches. For some time, sports psychologists have been investigating the types of psychological factors that predict and physical injury in athletes. The purpose of this study is to investigate just how psychological factors such as life stress, mental coping skills, history of stressors, and personality characteristics predict injury vulnerability among cheerleaders. The current study will be the first to examine the nature of the link between stress and injury in cheerleading athletes. The findings of this study will serve as useful information for cheerleading coaches and athletes, helping them to better identify athletes predisposed to physical injury based on psychological factors. The findings from this study are not intended to be used in the future to screen for at-risk athletes to determine a team roster, but rather to make coaches more aware of how psychological factors may expose their athletes to greater injury risk.

3. How long will you be in the study?

The period of study will last 12 weeks in total, beginning during the week of Sunday September 8th, 2019 and culminating on Saturday November 30th, 2019, the day of the PCA College Cheerleading Championships. All data collection will finish Saturday, December 7th, 2019



4. What are the study procedures?

On your institutional email account, you will receive an email from your cheerleading coach some time during the last week of August 2019. This email will inform you of the study and that you are a potentially eligible participant, as well as provide the co-investigator's contact information should you have any urgent questions or concerns. This letter of information will be included for your review. The co-investigator will attend a team meeting at your training gym during the first week of September 2019, during which you may provide informed consent to participate. During this meeting, the co-investigator will provide each consenting participant with a random unsealed envelope containing paper copies of the following questionnaires: 1) The Life Events Survey for Collegiate Athletes (LESCA), a measure of the impact of various life events you have experienced over the last 12 months; 2) The Ways of Coping Scale (M-WCS), a measure of how often you use specific strategies to cope with the stresses of competition; 3) The Sport Anxiety Scale-2 (SAS-2), a measure of the reactions you experience while cheerleading competitively; and 4) The Social Support Questionnaire, an assessment of the amount of social support you have available. Combined, the questionnaires will take about 10 minutes to complete. You will be given the option to complete these questionnaires in an electronic format (cellphone or laptop; password "**cheerpsych**") or on paper. Also inside your envelope you will find a slip with a number between 1 and 140. This number, also written on the inside flap of your envelope, is your random identifier number and is unique to you. You will keep this number slip. Do not share it with anyone. If you lose or forget this number, you will be provided via email another number that has not been given to any other participants for you to use for the rest of the study. The envelope will also contain a slip with the password for the online injury recording document: "**cheerpsych**".

Once finished with the questionnaires, place the documents in your envelope, seal the envelope, and hand it back to the co-investigator.

After the first week, on Sunday September 15th, 2019 the co-investigator will send to your institutional email account a link to a secure electronic survey. This survey is password protected, to access it you must enter the password "**cheerpsych**" each week. On this document, you will be asked for your random identifier number, your age, and your gender, and the number of cheerleading injuries sustained over the past year. Three main questions will also be asked: 1. the number of hours you practiced and/or competed cheerleading during the week, 2. the number of cheerleading injuries sustained during the week, 3. the number of hours of cheerleading you needed to miss and/or modify due to injury that week. Filling out each week's questionnaire should take less than one minute to do. You will be emailed a link to a new survey with the three main questions each Sunday at noon, with the final link being emailed on December 1st, 2019. You will have until midnight on Saturday December 7th, 2019 to complete the final survey. It is suggested that you complete each week's survey within 7 days of being emailed the link.

5. What are the harms and risks of participating in this study?

There are no known risks or harms from participating in the study. However, should any questionnaires or scales trigger a stressful response, please contact the Ontario Mental Health Helpline toll-free at [1-800-468-6868](tel:1-800-468-6868). This helpline will connect you with the proper treatment services and supports in your community to help begin recovery.



6. What are the benefits of participating in this study?

There are no direct personal benefits to your participation in this study. Nonetheless, your participation will benefit the collegiate cheerleading community, as you will provide invaluable insight on the stresses faced by its athletes and the ways in which psychology can predict and prevent injury in cheerleaders. Written copies of the main findings will be available to those participants who request them. Contact the co-investigator for this.

7. Can participants choose to leave the study?

You have the right to voluntarily withdraw from this study at any point. Should you withdraw from the study during the study period, your data will still be used for descriptive data and for data analysis purposes, and will be retained for 7 years after the study is complete (as per Western's data retention policy).

8. How will participants' data be kept confidential?

All data collected will remain confidential and will be accessible only to the investigators of this study except as required by law. Representatives of The University of Western Ontario Health-Sciences Research Ethics Board may require access to your study-related records to monitor the conduct of the research. None of the paper questionnaires you complete will have any personal identifying information, such as name, age, gender, or team name, included on it. Once the co-investigator receives every participant's sealed envelope at your respective team's meeting, he will place them all in a locked briefcase and will immediately transport them to the Exercise and Health Psychology Lab on the Western University campus, where they will be stored in a locked filing cabinet. All paper-and-pencil study forms will be stored in this locked office and will be destroyed by confidential shredding. The electronic surveys you will complete each week will be password protected and encrypted. Your data will be accessible to you and the co-investigator only. The electronic injury surveys will not ask for your name or the school you are affiliated with. Only your random identifier number, unique to you, will be used to anonymously connect your injury data with your questionnaire responses. If the results of this study are published, your name will not be used. Any data from the study made available to other researchers upon publication will be in a fully anonymized form and will contain no information that could identify you. No individual or team study results will be shared with your coaches or other teammates. The overall results will be combined with the other study data and shared in presentations and publications. All study records will be destroyed 7 years after the study has finished. Please note that because some personal identifiers such as age and gender are being recorded electronically, there is always a risk of breach of privacy.

9. Are participants compensated to be in this study?

No financial compensation will be provided for your participation in the study.

10. What are the rights of the participant?



Your participation in this study is voluntary. You may decide not to be in this study. Even if you consent to participate you have the right to not answer individual questions, to not fill in information, and to withdraw from the study at any time. If you choose not to participate or to leave the study at any time, it will have no effect on your academic standing as a student or your standing on your respective school's cheerleading team.

You do not waive any legal right by signing this consent form.

11. Whom do participants contact for questions about the study?

If you have any further questions about the study, you may contact Alexander Marchand at

If you have any questions about your rights as a research participant or the conduct of this study, you may contact the Office of Human Research Ethics



Informed Consent

Study Title: Psychological Predictors of Injury in Collegiate Cheerleaders

I have read the Letter of Information, had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction. I will be given a copy of the Letter of Information and consent form once it has been signed.

Consenting Signature:

Participant: _____
Please Print Name

Participant: _____
Please Sign Name

Date: _____

Please send me a summary of the findings from this research: Yes __ No __

Researcher Signature: _____
Please Sign Name

Person obtaining informed consent: _____
Please Print Name

Date: _____

Appendix I: End of study form



END OF STUDY FORM

Project Title: Psychological Predictors of Injury in Collegiate Cheerleaders

Principal Investigator

Harry Prapavessis, Ph.D. (School of Kinesiology, Western University)

Co-Investigator

Alexander Marchand, B.Sc. (School of Kinesiology, Western University)

Thank you for your participation in this study. The purpose of this study was to see if an association exists between the life stress of cheerleading athletes and the number of athletic injuries they sustain during a portion of the season. We predicted that, overall, cheerleaders who reported experiencing more negative life events would report sustaining more injuries and more time missed from cheerleading due to injury than those cheerleaders reporting fewer negative life events. Furthermore, we predicted finding a particularly strong positive relationship between life stress and injury among cheerleaders who reported low social support, high avoidance coping, high competitive anxiety, and an extensive history of injury. The study was carried out from September 8th 2019 to November 30th 2019, encompassing the busiest period of the collegiate cheerleading season and culminating with the 2019 Power Cheer Athletics college cheerleading championship. According to the Stress-Injury Model, athletes who possess fewer stress coping skills, experience more life stress, and report greater competitive anxiety are more prone to perceiving athletic situations and competition as being "stressful". This perceived stress can lead to a "stress-response", consisting of symptoms such as muscle tension, narrowed vision, and attentional difficulties that arise in the athlete, ultimately resulting in a greater risk of physical injury.

Personal data such as your age and sex were recorded strictly for demographic purposes. "Negative life event stress" was measured according to your responses on the Life Events Survey for Collegiate Athletes (LESCA). "Mental coping skills" were measured using the Ways of Coping Scale (M-WCS). The Social Support Questionnaire was used to assess the amount of "social support" you have available. "History of stressors" was assessed using the online survey by asking you to record the number of cheerleading injuries you sustained over the last year.

Here are some references if you would like to read more:

Grove, R.J., Eklund, R.C., & Heard, P.N. (1997). Coping with performance slumps: Factor analysis of the Ways of Coping in Sport Scale. *The Australian Journal of Science and Medicine in Sport*, 29(4), 99-105.

Maddison, R., & Prapavessis, H. (2005). A Psychological Approach to the Prediction and Prevention of Athletic Injury. *Journal of Sport and Exercise Psychology*, 27, 289–310.



Petrie, T. (1992). Psychosocial antecedents of athletic injury: The effects of life stress and social support on female collegiate gymnasts. *Behavioral Medicine, 18*, 127-138.

Smith, R. E., Smoll, F. L., & Ptacek, J. T. (1990). Conjunctive moderator variables in vulnerability and resiliency research: Life stress, social support and coping skills and adolescent sport injuries. *Journal of Personality and Social Psychology, 58*, 360-370.

Williams, J. M., & Andersen, M. B. (1998). Psychosocial Antecedents of Sport Injury: Review and Critique of the Stress and Injury Model. *Journal of Applied Sport Psychology, 10*, 5-25.

As a participant your results are confidential to the experimenters and all results are published anonymously as group data. If you have any questions or concerns, feel free to contact Alexander Marchand

Thank you,

Alexander Marchand, B.Sc. (School of Kinesiology, Western University)

Curriculum Vitae

Name: Alexander Marchand

Post-secondary Education and Degrees: the University of Western Ontario
London, Ontario, Canada
2014-2018 B.Sc.

the University of Western Ontario
London, Ontario, Canada
2018-2020 M.A.

Honours and Awards: Province of Ontario Graduate Scholarship
2019

Social Science and Humanities Research Council (SSHRC)
Graduate Scholarship Masters
2019

Dean's Honour List
2015, 2016, 2017, 2018

Western Scholarship of Excellence
2014

Related Work Experience Teaching Assistant
the University of Western Ontario
2018-2020

Publications:
Maddison, R., Rollo, S., **Marchand, A.**, & Prapavessis, H. (2020). Chapter 4: Preventing Sports Injuries: A Case for Psychological Interventions. In Ivarsson A. & Johnson U. (Eds.), *Psychological Bases of Sport Injuries, Fourth Edition*. Morgantown, WV: FiT Publishing.