

# **The Association of Psychological Factors with Injury Incidence and Outcome in the Australian Football League**

**Warren M. Rozen\* & David J. de L. Horne**  
*University of Melbourne, Parkville*

*\*Dr. Warren Rozen; 32A Wanda Road; North Caulfield 3161; Victoria, Australia; warrenrozen@hotmail.com (email).*

---

**ABSTRACT** - This study assessed whether state and trait psychological factors were related to increased incidence of injury and/or prolonged injury recovery time among 96 participants from three Australian Football League teams, 33 of whom sustained 48 injuries. Visual Analogue Scales (VAS) and the Short Version of the Profile of Mood States (SV-POMS) were used to measure state and trait psychological factors. Psychological assessments were performed on participants before the football season, and following injury. Logistical regression analyses of pre-season psychological factors for the prediction of injury incidence showed that pre-season Vigour, measured by the SV-POMS ( $p = 0.0344$ ), was a statistically significant predictor of injury during the football season. Other associations identified in the study suggest the place for psychological associations in both the prediction of injury incidence and prognosis for injury recovery, and certainly advocate further investigation into such markers.

---

Injuries sustained in Australian Football League (AFL) football games have the capacity to cost the AFL and individual teams millions of dollars in lost player salaries and injury management, to detract from the performance capabilities of AFL teams, and to impact on injured players' state of mind and general well-being (Orchard, Wood, & Seward, 1998; Noblet, 1999). This is equally the case for many other professional sporting bodies. Injury prevention has been explored in the AFL for decades, with much attention focused on identifying risk factors for preventing injury. Only recently have psychological factors been implicated as risk factors for injury recovery, suggesting possible roles for behavioural, pharmaceutical and other therapeutic interventions, aimed at mitigating stress in athletes (Glaser, Marucha, Malarkey, Mercado, & Glaser, 1995).

AFL football players work with anecdotally high levels of psychological stress, with reported consequences including adverse emotional and psychological effects, such as depression and mood swings. The cognitive and emotional responses to stress result in varying player adherence to injury treatment (Lampton, Lambert, & Yost, 1993), and other research suggests that increasing severity of injury contributes to higher negative affect in athletes (Brewer, & Petrie, 1995). This increase in negative affect further diminishes adherence to injury treatment.

Stress and changes in mood state have been shown to affect recovery from injury, with previous research focusing on surgical patients (Kiecolt-Glaser, Page, Marucha, MacCallum, & Glaser, 1998). Recent research with sporting injuries has shown that regardless of the specifics of injury, any sporting

injury can instigate a cascade of inflammatory events that promote healing (Muneta, Sekiya, Ogiuchi, Yagishita, Yamamoto, & Shinomiya, 1998 ; Smith, 2000). Previous research, particularly in surgical recovery and burn rehabilitation, indicates that stress delays wound healing (Field, Peck, Krugman, Tuchel, Schanberg, Kuhn, & Burman, 1998).

Athletes typically respond to sporting injury with mood disturbance, with the consensus being that the affective response to sporting injury is an increase in negative affect and a decrease in Vigour (McDonald, & Hardy, 1990). However, previous research has largely only examined post-injury mood state. The first longitudinal research design was in 1993 (Smith, Stuart, Wiese-Bjornstal, Milliner, O'Fallon, & Crowson, 1993), and examined both pre-injury and post-injury data from players on hockey, basketball, baseball, and volleyball teams. The results showed significant increases in Anger and Depression, and decreases in Vigour following injury, measured with the Profile of Mood States (POMS).

The current study is both a prospective, analytical study as well as a descriptive exploratory study into stress and mood state in AFL footballers. The exploratory aims were to determine associations between psychological factors and injury in AFL footballers. Descriptively, the study aimed to quantify the levels of stress and mood state in AFL footballers. It was hypothesised that negative affect, as measured by any of Anger, Confusion, Depression, Fatigue or Tension in the SV-POMS measure or State Stress or State Anxiety as measured by VAS, would be elevated above players' pre-season levels at the first measurement after acute injuries, would correlate with an increased incidence of injury and would predict prolonged injury recovery time. It was also hypothesised that Vigour, as measured by the SV-POMS, would be decreased at this first post-injury measurement, would correlate with a decreased risk of injury, and would not predict prolonged injury recovery time.

## Method

### *Participants*

Ninety-six participants were drawn from the senior playing lists of three AFL football clubs, Hawthorn Football Club ( $n=25$ ), Carlton Football Club ( $n=38$ ), and Kangaroos Football Club ( $n=33$ ). Of 120 players on the senior club lists, 24 players were excluded from the study, due to refusal to participate ( $n=3$ ), injury at preseason testing ( $n=2$ ), and unavailability for preseason testing ( $n=19$ ). All research was conducted in accordance with the ethical guidelines of The University Of Melbourne, Psychology Department Ethics Committee and The University Of Melbourne Behavioural and Social Sciences Ethics Committee. Written information regarding voluntary participation and study details were given to all participants, with signed consent prior to participation.

### *Materials*

The psychological testing included three VAS, assessing State Stress, State Anxiety and Trait Anxiety, the rationale described earlier. Participants marked a 10cm horizontal line, at the point on a scale from 1 to 100 of subjective feeling, corresponding to present state. End-points of the line were labelled with extreme statements related to subjective feeling: 'I do not feel stressed at all right now' and 'I feel completely overwhelmed by stress right now' for the State Stress VAS, 'I do not feel anxious at all right now' and 'I feel completely overwhelmed by anxiety right now' for the State Anxiety VAS, and 'I do not generally feel anxious at all' and 'I generally feel completely overwhelmed by anxiety' for the Trait Anxiety VAS. Visual Analogue Scales (VAS) are simple, rapid tests, used reliably in a range of past research conditions to measure subjective experience, with critical reviews concluding their valid and reliable results (McCormack, Horne, & Sheather, 1988).

The Profile of Mood States (POMS) has become the test of choice for studies examining mood changes in sport-science research, with its rapid assessment of fluctuating mood state (McNair, Lorr, & Droppleman, 1981). The Shortened Version of the POMS (SV-POMS) was designed by Shacham (1983), and retains the ability to measure all seven mood factors, while maintaining the statistical significance of results. There is extensive literature on the validity and reliability of POMS results, with the largest studies comprising over 1000 participants and reflecting the average reliabilities of each of the measured factors as well over 90% (McNair, & Lorr, 1964; McNair, Lorr, & Droppleman, 1981). The SV-POMS questionnaire was thus used, and consisted of 30 five-point (1 = 'not at all' to 5 = 'extremely') adjective rating scales. The six-mood factors of the questionnaire were Anger/Hostility, Confusion/Bewilderment, Depression/Dejection, Fatigue/Inertia, Tension/Anxiety and Vigour/Activity. A seventh score, for a Total Mood Disturbance, was calculated by adding the individual scores for each of the six mood factors, giving Vigour a negative weighting. This Total Mood Disturbance can be used as a measure of negative affect (McDonald and Hardy, 1990). The SV-POMS also required six 'hand-scoring keys', which were cardboard scoring sheets used to calculate each of the mood factors.

Injury severity assessments were completed by injured players, club doctors and physiotherapists, as the average of a VAS score, with end-points labelled with the extreme statements: 'I feel that this is an insignificant injury' and 'I feel that this injury is overwhelming', the number of expected games missed and the number of expected days of training missed.

### ***Procedure***

Pre-season testing was performed four weeks before commencement of the AFL football season. The analyses of injured players were performed throughout the season, 3-5 days after an injury was sustained, and included psychological and injury severity assessments. Psychological testing was performed at all pre-season and post-injury assessments. This allowed the assessment of both acute and chronic mood factors, with acute mood assessments performed using a 'right now' timeframe. The Trait Anxiety VAS was performed only pre-season, with trait factors not fluctuating over time.

The injury severity assessments were performed 3-5 days following an injury, undertaken by injured player, doctor and physiotherapist. Inclusion criteria required that injuries be sustained within the course of sporting activity, and were acute.

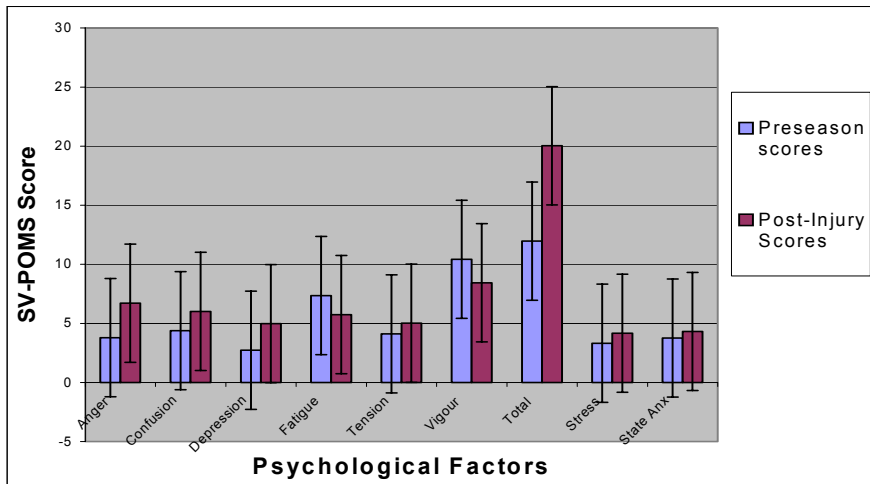
### ***Data Analysis***

Trends were modelled in both linear form and in linear plus quadratic form, using logistic regression. A chance probability of < 5%, or  $p < 0.05$ , was considered significant.

## **Results**

Thirty-three players were injured, with a total of 48 injuries. Four injuries were chronic, and were excluded. The SV-POMS and VAS were successful in quantifying state and trait psychological factors. Figure 1 reflects average changes in individual mood factor scores before and after injury in the injured subset of players. Anger, Confusion, Depression, Tension, State Stress and State Anxiety were elevated above players' pre-season levels at the first measurement after acute injuries, with Fatigue and Vigour decreased at this first post-injury measurement. These were not statistically significant.

**Figure 1**  
*Average Pre-Season and Post-Injury Psychological Testing Scores for Injured Players*



**Figure 2**  
*Pre-season Mood Scores of Injured Players with Higher than Average Psychological Scores, Against Predicted Training Days Missed Subtracted from Actual Training Days Missed*

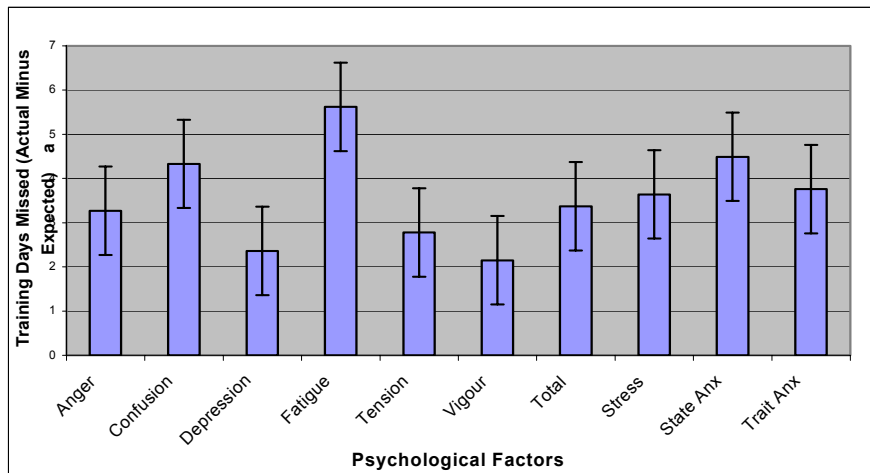


Figure 2 depicts the pre-season mood scores of injured players with higher than average mood scores plotted against predicted training days missed subtracted from actual training days missed. The average ‘actual minus expected’ training days missed for all injured players was 3.34 days, reflected by an imaginary horizontal line at this level, and thus the psychological factors scoring higher than this average, resulted in longer than average injury recovery times. The factors scoring higher were Confusion, Fatigue, Total Mood Disturbance, State Stress, State Anxiety and Trait Anxiety. These factors were modelled in both linear and linear plus quadratic forms, using logistic regression. Despite the absence of significant results, trends were apparent that were consistent with the literature.

The probability of incurring injury was modelled against each of the ten psychological factors. These data are presented in Figure 3. Again, these factors were modelled in both linear and linear plus quadratic forms, using logistic regression. One significant outcome was found, with pre-season Vigour having a model significance of  $p = 0.0344$ , through a linear plus quadratic relationship.

The formula for determining the probability of a player incurring an injury, determined using the logistic regression formula, is:

$$Pr\ obability(injury) = \frac{1}{1 + e^{6.4218 - 1.1631v + 0.0543v^2}};$$

where,  $v$  = pre-season Vigour score measured by the SV-POMS, and  $e$  = the constant 2.718..., the base of the natural logarithm.

**Figure 3**  
*Average Pre-Season Psychological Testing Scores for All Players, Compared to the Scores for Injured Players*

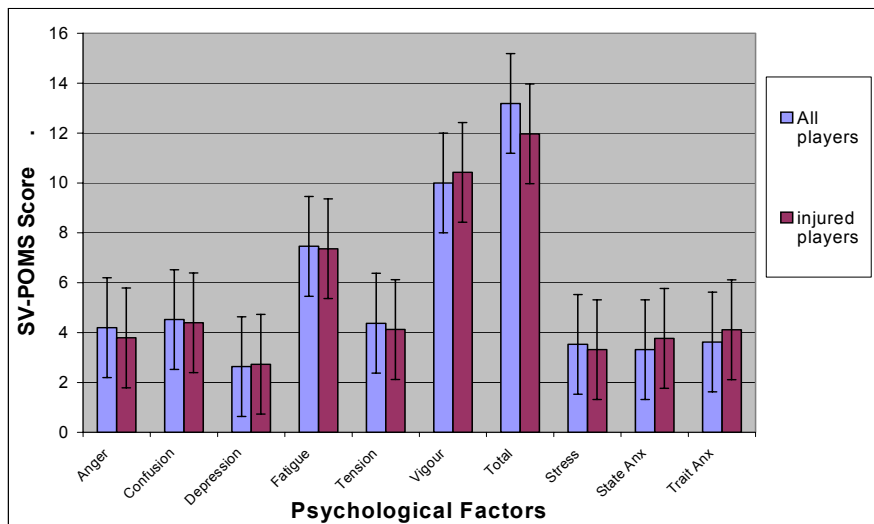
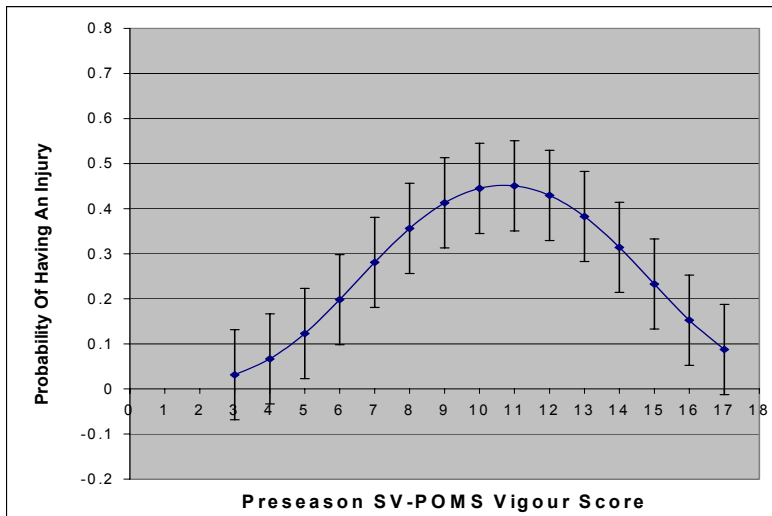


Figure 4 shows the relationship between pre-season Vigour and the probability of incurring an injury with Table 1 tabulating pre-season Vigour scores and the subsequent probability of getting injured.

**Figure 4**  
***Probability of Incurring an Injury According to Pre-Season Vigour Score***



**Table 1**  
***Pre-season Vigour Scores of Injured Participants, and the Subsequent Probability of Incurring an Injury***

Vigour Score	Number of Players	Probability of Injury
3	3	0.03 ± 0.15
4	1	0.07 ± 0.15
5	5	0.12 ± 0.15
6	5	0.20 ± 0.15
7	6	0.28 ± 0.15
8	9	0.36 ± 0.15
9	9	0.41 ± 0.15
10	14	0.45 ± 0.15
11	14	0.45 ± 0.15
12	9	0.43 ± 0.15
13	7	0.38 ± 0.15
14	8	0.31 ± 0.15
15	3	0.23 ± 0.15
16	1	0.15 ± 0.15
17	1	0.09 ± 0.15

## Discussion

The quantification of preseason and post-injury mood profiles demonstrated the association that acute injury precipitated significant mood disturbance. Anger, Confusion, Depression, Tension, Vigour (negatively weighted), Total Mood Disturbance, State Stress and State Anxiety all increased in response to acute injury. One mood factor, Fatigue, did not conform with previous research, by showing a decrease in response to injury (Noblet, 1999; Brewer, & Petrie, 1995; McDonald, & Hardy, 1990). This is difficult to interpret without measurements of preseason training intensity; however, with limited research in AFL football, this finding may be unique to AFL footballers. With the intensity of AFL football training and playing routines, injury may reduce the activity level and physical stress on injured footballers.

Prolonged injury recovery times were associated with increased pre-season Confusion, Fatigue, Total Mood Disturbance, State Stress, State Anxiety and Trait Anxiety. These were consistent with previous research; however, despite these trends, there were no statistically significant relationships.

The prediction of injury incidence, however, showed strong trends for elevated pre-season Depression, State Anxiety and Trait Anxiety associated with increased rates of football injury. A statistically significant relationship between pre-season Vigour and the incidence of injury was found, using logistic regression. A linear plus quadratic relationship, with a statistical significance of  $p=0.0344$ , was found, showing that both elevated and reduced pre-season Vigour correlated with a low probability of injury, whereas intermediate Vigour scores correlated with high probabilities of injury.

The finding that of all mood factors explored, Vigour alone showed statistical significance in predicting injury incidence was the first of its kind in all preceding research (Noblet, 1999; Brewer, & Petrie, 1995; McDonald, & Hardy, 1990). Vigour in AFL footballers is necessarily high with conceivably more intense and lengthy training in AFL football than other sports (Noblet, 1999). The significance of the inverse quadratic relationship found between Vigour and injury incidence may be explained by the nature of AFL injuries themselves. A highly vigorous footballer may be more capable of engaging in dangerous scenarios, while being proficient enough to prevent an injury from occurring. A non-vigorous footballer may not engage in as many dangerous scenarios, reducing exposure to injury. Players with intermediate vigour may be left at highest risk of injury.

Substantial links between mood state and AFL football injury were identified, heralding significant implications to other team sports, such as rugby, soccer and others. The significant findings of this study advocate the need for increased investigation into the effects of mood state on sporting injury.

## Conclusion

The current study achieved both a quantitative analysis of the mood state of AFL footballers, as well as being a prospective, longitudinal study that produced significant findings which will form the basis for future investigation. This was the first study of its kind in the literature.

The study assessed state and trait mood profiles of AFL footballers and explored whether links existed between mood and AFL football injury. The trends that were established suggest that psychological factors play significant roles in both the incidence of injury and the course of recovery, and despite the conservative use of a  $p$  value of 0.05, a statistically significant finding for pre-season Vigour was shown to correlate with the incidence of football injury.

The association of Vigour and other mood factors with injury incidence suggests more definitive roles for these mood factors in the incidence and course of AFL injuries. These findings are likely to have implications in injury prevention and treatment, and certainly have applicability in other sporting settings. This study presents a focus for future research.

## References

- Brewer, B. W., & Petrie, T. A. (1995). A Comparison Between Injured and Uninjured Football layers on Selected Psychosocial Variables. *Academic Athletic Journal*, 2, 11-18.
- Field, T., Peck, M., Krugman, S., Tuchel, T., Schanberg, S., Kuhn, C., & Burman, I. (1998). Burn Injuries Benefit From Massage Therapy. *Journal Of Burn Care And Rehabilitation*, 19(3), 1-4.
- Kiecolt-Glaser, J. K., Marucha, P. T., Malarkey, W. B., Mercado, A. M., & Glaser, R. (1995). Slowing of Wound Healing by Psychological Stress. *Lancet*, 346, 1194-1196.
- Kiecolt-Glaser, J. K., Page, G. G., Marucha, P. T., MacCallum, R. C., & Glaser, R. (1998). Psychological Influences on Surgical Recovery. *American Psychologist*, 53(11), 1209-1218.
- Lampton, C. C., Lambert, M. E., & Yost, R. (1993). The Effects of Psychological Factors in Sports Medicine Rehabilitation Adherence. *Journal Of Sports Medicine And Physical Fitness*, 33, 292-299.
- McCormack, H. M., Horne, D. J., & Sheather, S. (1988). Clinical Applications of Visual Analogue Scales: A Critical Review. *Psychological Medicine*, 18, 1007-1019.
- McDonald, S. A., & Hardy, C. J. (1990). Affective Response Patterns of the Injured Athlete: An Exploratory Analysis. *Sport Psychologist*, 4, 261-274.
- McNair, D. M., & Lorr, N. (1964). An Analysis of Mood in Neurotics. *Journal of Abnormal Social Psychology*, 69, 620-627.
- McNair, D. M., Lorr, N., & Droppleman, L. F. (1981). *Manual for the Profile of Mood States*. Education and Industrial Testing Service. San Diego.
- Muneta, T., Sekiya, I., Ogiuchi, T., Yagishita, K., Yamamoto, H., & Shinomiya, K. (1998). Objective Factors Affecting Overall Subjective Evaluation of Recovery After Anterior Cruciate Ligament Reconstruction. *Scandinavian Journal Of Medicine And Science In Sports*, 8(5), 283-289.
- Noblet, A. (1999). *The Nature and Impact of Stressors and Social Support Experienced by AFL Footballers*. Honours Thesis. Deakin University. Melbourne.
- Orchard, J., Wood, T., & Seward, H. (1998). *AFL Report on Injuries 1998*. AFL Medical Officers Association. Melbourne.
- Shacham, S. (1983). A Shortened Version of the Profile of Mood States. *Journal Of Personal Assessment*, 47(3), 305-306.
- Smith, L. L. (2000). Cytokine Hypothesis of Overtraining: A Physiological Adaptation to Excessive Stress? *Medicine And Science In Sports And Exercise*, 32(2), 317-331.
- Smith, A. M., Stuart, M. J., Wiese-Bjornstal, D. M., Milliner, E. K., O'Fallon, W. M., & Crowson, C. S. (1993). Competitive Athletes: Preinjury and Postinjury Mood State and Self-Esteem. *Mayo Clinic Proceedings*, 68(10), 939-947.