

Australian Soccer in Asia; the effects of Asian Champions League on Load, Recovery and Injury.

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Certificate of authorship and originality of thesis

I, Kieran Howle declare that this thesis, is submitted in the fulfillment of the requirements for the award of Doctor of Philosophy, in the Faculty of Health at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise reference of acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution. This research is supported by the Australian Government Research Training Program.

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Publications resulting from this thesis

Howle K, Waterson A, Duffield R. Injury incidence and workloads during congested schedules in football. *International Journal of Sports Medicine*. 2019;40(1)1-7.

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Abbreviations, Symbols and Subunits

ACL	Asian Champions League
ACWR	Acute chronic workload ratio
AKE	Active knee extension
AU	Arbitrary units
BPM	Beats per minute
CD	Central defender
CF	Center forward
CK	Creatine kinase
CM	Central midfield
Cm	Centimetre
CMJ	Counter movement jump
CRP	C-reactive protein
CV	Coefficient of variation
DOMS	Delayed onset muscle soreness
EMG	Electromyographic
EPL	English Premier League
ES	Effect size
EWMA	Exponentially weighted moving average
FB	Fullback
FIFA	Football Internationale de Federation Association
FOR	Functional overreaching
GOT	Glutamic oxaloacetic transaminase
GPS	Globalised positioning systems
H	Hours
HAST	Hip adduction squeeze test
HIR	High intensity running
HPBPT	High percentage ball possession team
HR	Heart rate
IMU	Inertial measurement units
IL-6	Interleukin 6
IRR	Injury risk ratio
KTW	Knee to wall
LDH	Lactate dehydrogenase
LIR	Low intensity running
LPBPT	Low percentage ball possession team
MHC	Myosin heavy-chain
MM	Multi-match
MU	Motor unit
MVC	Maximal voluntary contraction
M/min	Meters per minute
NFOR	Non-functional overreaching
OR	Odds ratio
OTS	Overtraining syndrome
PM	Purposeful movement
ROM	Range of movement
SD	Standard deviation
SM	Single match
SR	Sarcoplasmic reticulum

sRPE	Session rating of perceived exertion
SSC	Stretch shortening cycle
S-IgA	Salivary IgA
THIR	Total high intensity running
TMA	Time motion analysis
TNF	Tumour necrosis factor
TQR	Total quality recovery
TRIMP	Training impulse
UEFA	Union of European Football Associations
VHIR	Very high intensity running
VO ₂	Oxygen consumption
VO _{2 max}	Maximal oxygen consumption
VS	Versus
WF	Wide forward
YYIRT	Yo-yo intermittent recovery test level 1
s	Seconds
m	Meter
m/s	Meters per second
mL:kg ⁻¹ :min ⁻¹	Millilitre of oxygen per kilogram of body mass per minute
km.h	Kilometres per hour
>	Greater than
<	Less than
±	Plus or minus
=	Equal
~	Approximately
%	Percentage
%MaxHR	Percentage of maximal heart rate

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Abstract

This thesis examines the effect of congested schedules on injury, training load distribution and recovery in Australian football (soccer) as a consequence of competing in the Asian Champions League (ACL). To achieve this, data were collected across 3 seasons between 2012-2015 from one club playing in concurrent competitions of the A-League and ACL. Acute and prolonged competition periods of congested scheduling were identified, along with seasons with and without congested schedules. For study 1, acute (by week) and prolonged (by season) periods of congestion were investigated independently to establish the effects on injury and training load during multi-match (MM) or single-match (SM) weeks. In study 2, a prolonged 36-day period of 11 matches was identified and compared with a matched non-congested period that maintained 'normal' 1 match/week microcycles. Respective periods were then compared to establish the effect of longer periods of congestion on training loads, recovery profiles and injury risk. For study 3, recovery profiles were compared between SM and MM weeks using subjective wellness and selected outcome measures including; hip adduction squeeze test (HAST), active knee extension (AKE), knee to wall (KTW) and sit and reach.

Key findings from these studies were:

Study 1 - Injury incidence and workloads during congested schedules in football.

- Increased total, match and training injury rates existed in acute congested (MM) periods.
- Total, match and training injuries are increased in seasons with greater volume of fixture congestion.

- No differences existed in session rating of perceived exertion (sRPE) total load between MM and SM, despite significant reduction in sRPE training load in MM weeks.
- Total injury rates are increased in seasons with greater match scheduling despite significantly reduced sRPE total and training load.

Study 2 - Prolonged periods of fixture congestion in Australian soccer; effects on training load distribution, recovery and injury.

- Total load (match + training) during prolonged congested was reduced when compared to the non-congested period.
- sRPE Acute to Chronic Workload Ratio's (ACWR) do not differ between congested and non-congested periods, despite reduced internal and external training loads during the congested period.
- Perceived wellness was reduced at 48h post and 24h pre (72h post) match in a prolonged congested period.
- Increased total, match and training injury rates are evident during prolonged congested periods.

Study 3 - Recovery profiles following single and multiple matches per week in professional football.

- Perceived wellness and total quality recovery were reduced at 48h post MM match 2, when compared to SM and Baseline.
- Measures of wellness returned to Baseline at 72h post-match 1 in SM playing group indicating a 72h recovery period during SM weeks.

- The hip adduction squeeze test measures at 48h post MM match 2 were reduced when compared to SM match and MM match 1.

Collectively, these findings show that both acute and prolonged congested schedules have a negative impact on injury rates for this Australian team competing in A-League and ACL competitions. Of interest, despite similar sRPE total loads (match + training) between SM and MM weeks, increased injury rates existed in acute congested periods. In prolonged periods, the ACWR was also not significantly different between periods, indicating that internal sRPE total load distribution was not sensitive to differences between periods. Further, despite significantly decreased sRPE total and training load, injury rates were increased for total, match and training. Accordingly, increased match exposures within acute and prolonged congested schedules may help to explain the increased match injuries reported; however, the reason for higher training injuries in both acute and prolonged periods is less clear. When considering MM weeks, slower recovery was reported when compared to SM, suggesting that players take longer to recover during acute congested schedules. Therefore, practitioners should consider these findings when planning periodisation of training, recovery and squad rotation during congested schedules.