

# Variables associated with neck dysfunction in amateur soccer players

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A research project submitted in partial fulfilment of the requirements for the degree of Master of Osteopathy, Unitec Institute of Technology, 2011

## Declaration



Name of candidate: Lisa Walker

This Research Project entitled “Variables associated with neck dysfunction in amateur soccer players” is submitted in partial fulfilment for the requirements for the Unitec degree of Master of Osteopathy.

### CANDIDATE’S DECLARATION

I confirm that:

- This Thesis/Dissertation/Research Project represents my own work;
- Research for this work has been conducted in accordance with the Unitec Research Ethics Committee Policy and Procedures, and has fulfilled any requirements set for this project by the Unitec Research Ethics Committee.

Research Ethics Committee Approval Number: 2010-1090

Candidate Signature: ..... Date: .....

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# Contents

Declaration.....	2
Acknowledgments.....	3
Contents.....	4
Introduction to Thesis.....	6
Section 1: Literature Review .....	8
Introduction .....	9
Neck Injuries and Pain .....	10
Measurement of Neck Pain, Disability and Dysfunction .....	11
Cervical Examination.....	11
Intra-examiner and Inter-examiner Reliability.....	13
Neck Disability Index.....	13
Soccer Injuries.....	15
Injury Definition .....	16
Incidence of Injuries In Soccer.....	17
Head and Neck Injuries During Soccer .....	21
Heading Technique .....	22
Conclusion .....	26
References.....	27
Section 2: Manuscript.....	33
Abstract .....	34
Introduction .....	35
Methods.....	38
Participants .....	38
Experimental Procedure .....	38
Modifications from Pilot Study.....	39
Main Study .....	40
Sub-Study .....	40
Data Analysis.....	41
Pilot Study .....	41
Main Study .....	41
Sub study .....	42
Results.....	43

Pilot study.....	43
Main Study.....	45
Sub study.....	48
Discussion.....	50
References.....	54
Section 3: Appendices.....	56
Appendix A: Ethics approval for this project.....	57
Appendix B: Pilot study information for participants.....	58
Appendix C: Main study information sheet.....	60
Appendix D: Pilot study consent form.....	63
Appendix E: Main study consent form.....	64
Appendix F: Coaches information letter.....	65
Appendix G: Heading criteria.....	66
Appendix H: Neck Disability Questionnaire.....	67
Appendix I: Soccer questionnaire.....	73
Appendix J: Active and Passive examination assessment.....	75
Appendix K: Authors for submission to the journal of International Sports Med..	76

## Introduction to Thesis

Soccer is a physical and competitive contact sport with a high injury incidence rate, often higher than occupations classed as high risk (Hawkins, Hulse, Wilkinson, Hodson, & Gibson, 2001). Soccer injuries arise from contact: tackles and collisions; and non-contact: running, shooting, turning and heading, both of which result in equal injury incidence rates (Hawkins et al., 2001).

Neck injuries in the general population are a common occurrence, and are second only to lower back pain (Hogg-Johnson et al., 2008). Injuries to the upper extremity, trunk and head-neck make up 13 – 19% of all soccer injuries (Hawkins & Fuller, 1999; Hawkins et al., 2001). Because neck injury rates are rarely specified alone in research on soccer injuries, but are usually collectively categorised as both head and neck injuries or under the umbrella term of spinal injuries, the incidence of neck injuries is unclear.

Although the incidence of neck injuries from soccer is unknown, there is some anecdotal evidence that repetitive heading of the soccer ball may result in neck dysfunction and disability. Lending support to this anecdotal evidence is data from a study conducted 30 years ago that showed professional players suffer cervical degeneration 10 to 15 years early than a control group of similarly aged men (Sortland, Tysvaer, & Storli, 1982). Because of the total injury incidence rate so high within soccer and the possibility that game activities, in particular heading, might bring about or exacerbate neck pain or injury, it is important to determine preventive measures that reduce the injury risk, by becoming more aware of the underlying cause of these injuries.

The purposes of the research study were firstly to determine predictors of the Neck Disability Index (NDI) and its correlates from demographic and soccer-related variables identified in a self-report questionnaire completed by amateur soccer players. The second purpose was to identify predictors and correlates of clinically assessed neck dysfunction in amateur soccer players. The final purpose was to determine the degree and direction of correlation between neck disability or dysfunction and skill in heading the soccer ball.

This thesis has been divided into three sections: Section One is a review of the relevant literature including an outline of the tools that measure neck pain and disability, particularly focusing on the Neck Disability Index and physical cervical (neck) examinations; soccer and neck injuries and correct heading technique. Section Two of the thesis is a manuscript reporting on the above study that is laid out for submission to the Journal of International Sports Med. Section Three contains appendices including all other material related to the thesis.

## **Section 1: Literature Review**

## **Introduction**

Soccer (football) is a continually growing sport. Between 2000 and 2006, there was a 10% increase in the number of registered players worldwide and the total number of estimated players at 265 million. Around 500,000 of these players were registered in Oceania (KUNZ, 2007). In New Zealand soccer is one of the fastest growing sports, with youth registration increasing from 65,000 to 100,000 from 2000 till 2010 (Craymer & Clegg, 2011).

With the expansion of soccer, there has also been an increase in the injury rates. Injuries arise in two different situations, player-to-player contact and non-player contact (Hawkins et al., 2001). Injuries within soccer are an area of the sport for which additional research is of great importance, particularly as current research into defining the incidence rate of injuries, their underlying causes and best prevention is limited within research. As a site of chronic pain, it is well supported by research that the neck is second only to the back within the general population (Hogg-Johnson et al., 2008), however within the current research it is unknown what role soccer may have on causing neck dysfunction and disability.

The aims of this review are twofold. The first is to describe the phenomenon and assessment of neck pain and disability, with a focus on the commonly used tools: Neck Disability Index and cervical (neck) examination. The second is to discuss common injuries in New Zealand amateur soccer players, including exploration of the limited research surrounding neck complaints associated with soccer, in particular soccer heading.

## **Neck Injuries and Pain**

The neck or cervical spine is made up of seven vertebrae, four typical and three atypical. The occiput of the cranium articulates with the first cervical vertebrae and the seventh cervical vertebrae articulates with the first thoracic vertebrae (Moore & Dalley, 2006).

Neck pain is a common complaint, affecting an estimated 12% to 72% of adults within a twelve-month period (Hogg-Johnson et al., 2008). Neck pain prevalence increases with age and women have a higher incidence than males (Borghouts, Koes, & Bouter, 1998; Bovim, Schrader, & Sand, 1994; Cote, Cassidy, & Carroll, 1998; Makela et al., 1991; Picavet & Schouten, 2003).

Neck pain may arise from any anatomical structure within the neck: cervical vertebra, intervertebral discs, nerves, muscles, ligaments and compromised blood supply (Bogduk, 1988). Neck pain may result from an injury e.g. whiplash, sporting or recreational injuries; infection, e.g. osteomyelitis; pathology, e.g. tumor malignant/benign; inflammatory disorder, e.g. rheumatoid arthritis or osteoarthritis; a congenital disorder, e.g. Klippel-Feil syndrome; or may be non-specific neck pain (Ferrari & Russell, 2003). Neck dysfunctions may refer pain to the surrounding structures, which may include the shoulders, upper back, chest, arms, or may even result in a headache (Ferrari & Russell, 2003). The referral pattern may make it difficult for a health practitioner to determine a definitive diagnosis for neck pain (Dreyfuss, Michaelsen, & Fletcher, 1994; Sammut & Searle-Barnes, 1998).

Practitioners who commonly assess neck pain range vastly in qualifications and experience. They may be primary health-care physicians or manual therapists from various fields e.g. physical therapists, osteopaths and chiropractors. Assessment of patients with neck pain may vary dramatically between different fields of practice (Carey et al., 1995). Some may conduct quite basic, cursory investigation prior to treatment whereas others may

employ a more thorough process (Atlas & Deyo, 2001). Osteopaths are one example of a manual therapist. Osteopathy is a field of medical practice in which underlying principles recognise that pain and disability stem from abnormalities in the function of the body structure as well as damage caused to it by disease (Parsons & Marcer, 2005). When a patient presents with neck pain, osteopaths would typically take a detailed case history, consisting of information about the neck pain e.g. location of pain, intensity (often using a visual analog scale or a verbal rating scale out of 10) (Anna Maria, 1983; Bijur, Silver, & Gallagher, 2001), aggravating factors, relieving factors, any referral pain patterns, the daily pattern of the pain and the onset of pain or chronicity of the pain. Chronicity of pain is divided into two categories: acute and chronic. Acute pain is defined as pain that has a sudden onset or gradual onset and lasts three to six weeks, whereas chronic pain is pain that lasts for more than six weeks in duration and may follow acute pain if the pain persists more than six weeks (Ferrari & Russell, 2003). Establishing the above pattern of pain helps to formulate initial differential diagnoses, which would then help determine the appropriate course of examination. The osteopath would then provide a very broad and thorough physical assessment to establish a specific working diagnosis suitable for the patient, before beginning treatment (Ward, 2003).

### **Measurement of Neck Pain, Disability and Dysfunction**

Neck pain may be assessed using a physical cervical (neck) examination or by questionnaire, one commonly used tool being the Neck Disability Index (NDI).

### **Cervical Examination**

Reviewers of medical literature in the field of spinal pain uphold that a thorough case history and examination is essential for correct diagnosis (Atlas & Deyo, 2001; DiGiovanna, Schiowitz, & Dowling, 2005). A patient's case history should include information about the presenting complaint in order to determine the nature of the complaint, whether it be a one-off occurrence or a recurring incident, and to allow the practitioner to

distinguish between musculoskeletal dysfunction or pathology (Parsons & Marcer, 2005).

The case history indicates the structures that may be producing the symptoms being expressed by the patient. The practitioner needs to determine the tissue causing symptoms, whether it is coming from the joint, muscles or neurological structures (Brukner, Khan, & Anton, 2001). The examination will help to determine the tissue causing symptoms, allowing the practitioner to form a working diagnosis from the initial hypothesis, from which they will then treat (Parsons & Marcer, 2005).

A cervical examination consists of many components, observation of the site of pain, palpation of the tissues, and an active and passive examination. During the active examination, the patient moves their own neck without help, whereas in a passive examination, the practitioner moves the neck through a range of motions while the patient relaxes, to test joint movement, muscle length and health and ligamentous stability (Brukner et al., 2001). It is important to assess the neck both actively and passively as each can differentiate problems arising from different anatomical structures. Active examination indicates muscle or tendon injury and passive indicates bony or joint dysfunction (Sammut & Searle-Barnes, 1998; Ward, 2003).

The most commonly reported features of neck dysfunction are pain and decreased range of motion (DiGiovanna et al., 2005). A normal neck will have gradual resistance of the cervical muscles to an elastic end-point. To determine whether the examination is indicating degeneration or a protective state, a sudden resistance in the neck musculature that may occur or a notable decrease range of motion in all directions maybe apparent, often with a degree of crepitis (Sammut & Searle-Barnes, 1998). It is important to note any 'binding' at particular segments, as this may indicate a specific segment dysfunction (Ward, 2003).

## **Intra-examiner and Inter-examiner Reliability**

A recent systemic review of current research surrounding intra-examiner and inter-examiner reliability of vertebral segmental assessment concluded weaknesses in study design and a need to further investigate the reliability of current methods of assessment (Seffinger et al., 2004).

A study conducted by Pool et al. (2004) concluded that it is difficult to achieve reliability between two examiners when assessing both general spinal movements and segmental spinal movements. Two physiotherapists assessed 32 participants with non-specific neck pain, using a set protocol they had been provided with. The protocol was made up of a six movements for actively testing cervical (neck) range of motion and a passive assessment. Movements were classified as restricted or non-restricted, with the patient scoring any pain felt on a ten-point scale (Pool, Hoving, de Vet, Van Mameren, & Bouter, 2004). For general spinal movements, agreement between practitioners ranged from 52% to 97%, with a mean of 71%. Segmental testing agreement ranged from 48% to 90%, with a mean of 74%. From the results provided, the ranges between the two assessments were too wide to be considered reliable, therefore it was concluded that the inter-tester reliability of spinal segmental assessment is insufficient (Pool et al., 2004). In a review of the reliability of spinal palpation for diagnosis, Seffinger et al. (2004) also concluded that inter-examiner reliability was low.

## **Neck Disability Index**

The Neck Disability Index (NDI) was designed to provide medical practitioners with a tool to measure the perception of an individual's neck disability resulting from conditions such as whiplash (Hoving, O'Leary, Niere, Green, & Buchbinder, 2003), in order to identify limitations in a person's life due to neck pain, and the impact that these limitations have on activities in daily living (Ackelman & Lindgren, 2002). The NDI was derived from the Oswestry low back pain disability index, a specific questionnaire for

determining the perception of an individual's lower back pain (Riddle & Stratford, 1998).

The NDI has ten dimensions which are measured in ten sections in the questionnaire. These sections are pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping and recreation. Each of the sections is then rated on a 0 to 5-point scale, with 0 indicating no pain or interference when conducting the activity and 5 indicating severe pain or a total inability to complete the activity (Vernon & Mior, 1991). The 10 sections are added and expressed as a percentage of an individual's perceived neck disability: 10-28% is described as mild neck disability, 20-40% is described as moderate neck disability, 50-68% is described as severe neck disability and >72% is described as complete disability (Vernon & Mior, 1991).

The NDI is a tool to assess an individual's perception of how their neck pain influences their everyday living. As a clinical assessment tool for neck pain, it therefore has various limitations. For example, the underlying causes of the neck pain cannot be determined using a questionnaire. A physical examination may help detect anatomical structures that may be dysfunctional, and provide a clearer diagnosis for the individual. Sometimes imaging can be used for diagnosis, however imaging modalities are not readily available to all practitioners who treat these problems and may also incur significant cost to the patients.

Although neck pain can have many causes, in some cases it may stem from participation in sporting activities. Soccer is one such sport, in which participation has been linked to neck pathology (Sortland et al., 1982).

## **Soccer Injuries**

Soccer injuries are categorised by anatomical location or by severity: minor, moderate and serious. Of all soccer injuries most fall into the minor category (>65%) and the least fall into the severe category (10%) (Aglietti, Zaccherotti, De Biase, Latella, & Serni, 1994; Rahnama, Reilly, & Lees, 2002).

Statistics from Accident Compensation Corporation (ACC) in 2005 and many published studies show that the most common injuries in soccer are to the lower extremities (making up around 50% of new soccer injuries in NZ for the period of 2009/2010), especially injuries to the knee and ankle joints. New Zealand soccer players are twice as common as injuries to the rest of the lower limb (Accident Compensation Corporation, 2010; Goga & Gongal, 2003; Astrid Junge & Dvorak, 2004; Llopis, Padrón, & Puente).

For the period between July 2004 and June 2009 there were 29,217 new claims made to the Accident Compensation Corporation (ACC) of New Zealand (NZ) for injuries resulting from playing soccer (Accident Compensation Corporation, 2010). Of those claims, 3011 (around 10%) were classified as neck, back of head vertebrae arising from participation in soccer.

Between 2004 and 2009, new claims for injuries to the neck, back of head vertebrae from soccer have been steadily rising (Accident Compensation Corporation, 2010). However, these statistics do not provide details of the aetiology of each injury and it is consequently difficult to know if specific aspects of the game are directly responsible.

## **Injury Definition In Context Of Soccer**

Defining the term 'injury' in soccer research can be difficult because various definitions have been applied in the literature. There are two commonly used definitions of 'injury' in studies of soccer injuries. The first of these is a player's inability to play in a game or participate in training (A. Junge & Dvorak, 2000; A. Junge, Rösch, Peterson, Graf-Baumann, & Dvorak, 2002). This definition is problematic because less skilled players are more likely to be substituted from play than stronger players. Therefore, it is not an objective measurement of injury because stronger or higher skilled players might continue to play and train with an injury, and would therefore not be classified as injured by this definition (Dvorak & Junge, 2000). The second definition is that the injured player is currently seeking medical treatment for an injury to an anatomical structure that has been diagnosed by a medical practitioner. This second definition, that of "seeking medical treatment", may also be problematic in that it may under-report injuries for which no specific treatment has been sought, for example if the injury was not severe enough to seek medical attention (Dvorak & Junge, 2000). Similarly, in professional players, injury may also be under-reported for fear that players may lose their spot on the team or be financially penalised for missing important matches. Some studies from the United States of America have used medical insurance records to represent the number of injuries in soccer (Pritchett, 1981; Sandelin, Santavirta, & Kiviluoto, 1985), with the assumption that an insurance claim implies the seeking of medical treatment for an injury, as reviewed by Dvorak and Junge (2000). Therefore this definition would not be appropriate for studies completed in countries which have greater government funding of treatment for injuries, where medical insurance covers only a small proportion of the population. The definition "seeking medical treatment", may also be problematic in that it may under-report injuries for which no specific treatment has been sought, for example if the injury was not severe enough to seek medical attention, is the definition used in the following study.

## **Incidence of Injuries In Soccer**

The incidence of injuries in soccer is defined as the number of new injuries incurred during a specific study period (Dvorak & Junge, 2000). In a review of literature, Inklaar (1994) reports that the estimate of the incidence of injuries in soccer vary widely between studies, ranging between 0.5 to 45 per 1000 hours of practice and games (Inklaar, 1994). However in another review of studies it was found that the incidence of injuries for adult males ranges between 12 and 35 per 1000 hours of games and between 1.5 and 7.6 per 1000 hours of training (Dvorak & Junge, 2000), as shown in Table 1.

Table 1. Epidemiologic studies on the incidence of injuries in male soccer player, playing outside.

Authors	No. of players	Population (age)	Study period	Injuries per 1000 hours (mean 6 SD)		
				Games	Practice	Exposure
Hawkins & Fuller	108	Professional players	3 seasons	25.9	3.4	
	30	Youth players (17-35 years)	3 seasons	37.2	4.1	
Luthje Inklaar	263	Elite players	Season	16.6	1.5	
	75	Adolescents (13-14 years)	Season	12.8		
	78	Adolescents (15-16 years)	Season	16.1		
	79	Adolescents (17-18 years)	Season	28.3		
	245	Adolescents (>18 years)	Season	15.8		
Arnason	84	Elite players (18-34 years)	Season	34.8 ± 5.7	5.9 ± 1.1	
de Loe's	350,000	Young people (14-20 years)	1987-1989			0.7
Kibler		Adolescents (12-19 years)	Tournament			2.4
Blaser & Aeschlimann	90	Division leagues (16-42 years)	Tournament			2.1 to 10.7 (different leagues)
Schmidt-Olsen	496	Adolescents (12-18 years)	1 year			3.7
Poulsen	19	Division 1	1 year	19.8	4.1	
	36	Series 3&5		20.7	5.7	
Yde & Nielsen	152	Adolescents (6-18 years)	Season			5.6
Engström Ekstrand & Tropp	64	Elite players	Season	13	3	
	639	Senior players (17-38 years)	1 year			
	135	Division 1		21.8 ± 1.7	4.6 ± 1.7	
Ekstrand	180	Division 2		18.7 ± 1.7	5.1 ± 1.7	
	180	Division 4	1980	16.9 ± 2.1	7.6 ± 2.1	
	144	Division 6		14.6 ± 5.9	7.5 ± 5.9	
Neilsen & Yde	34	Division level	Season	18.5	2.3	
	59	Series level		11.9	5.6	
	30	Youth (>16 years)		14.4	3.6	
Backous	681	Adolescents (6-17 years)	Summer camp			7.3
Hoff & Martin	455	Adolescents (<8-16 years)	Competition	7.4		
Maehlum	1016	Adolescents (<12-18 years)	Norway Cup	9.9		
Schmidt-Olsen	5275	Adolescents (9-17 years)	Tournament	16.1		
Sullivan	931	Adolescent (7-18 years)	Season			0.5
Nilsson & Roaa	25,000	Adolescents (11-18 years)	Tournament	14		

\*This table has been modified from Dvorak and Astrid review of literature (Dvorak & Junge, 2000).

The incidence of injuries in soccer players may also be determined by age and gender. In a review of common soccer injuries, Tucker (1997) concludes from studies by Sullivan et al. (1980), Maehlum and Daljord (1984) and McCarroll et al., (1984), that the incidence of injuries in soccer players increases with age and that very few adolescents suffer from soccer-related injuries (Tucker, 1997). Both studies interviewed coaches, players and parents to determine the injury incidence rates. Results varied between the two studies from 41.2% for Under 16's to 2.9% in Under 8's in Sullivan et al.'s study and 8.74% in Under 19's down to 1.88% for under 10's in McCarroll et al. study (McCarroll, Meaney, & Sieber, 1984; Sullivan, Gross, Grana, & Garcia-Moral, 1980). Another more recent review concluded that the injury rate (or injury incidence) in games and training was lower in adolescents and in females compared to in adult males (Dvorak & Junge, 2000). In contrast, findings from another study of emergency department visits resulting from soccer injuries over a one-year period (Maehlum & Daljord, 1984) showed that players between the ages of 10 – 20 years had 39% incidence rate, which was higher than both the 0 – 9 year group and the 40+ years age group (<5%). Nonetheless, these researchers did find the need for subsequent hospitalisation increased with age (Maehlum & Daljord, 1984).

Another reason why age may be associated with increased incidence of soccer injuries is that it is likely to be positively related to competitive level, which may itself be independently associated with injury incidence. A prospective study of soccer injuries by Fuller et al. (2005) suggested that the number of injuries in professional soccer players is significantly higher than that in amateur soccer players, however there is conflicting evidence between studies (Fuller, Junge, & Dvorak, 2005). Studies by Inklaar (1994), Nielsen and Yde (1989) and Ekstrand and Tropp 1990 note that injury rates relative to playing hours reduce from the most to least competitive professional division Fullers et al., (2005) study (Ekstrand & Tropp, 1990; Inklaar, Bol, Schmikli, & Mosterd, 1996; Nielsen & Yde, 1989). Nielsen and Yde found that at the Division One level the incidence rate was 18.5/1000

playing hours versus 11.9/1000 playing hours in the series level (Nielsen & Yde, 1989). Ekstrand and Tropp observed that the injury incidence rate to be 21.8/1000 playing hours for Division One players versus 14.6/1000 playing hours for Division Six players (Ekstrand & Tropp, 1990). Poulsen et al., (1991) found that there was only a minor difference of 0.9/1000 playing hours between the highest and lowest levels (Poulsen, Freund, Madsen, & Sandvej, 1991).

A study completed at a Danish club showed that the average overall injury incidence was 14.3/1000 game hours and 3.6/1000 training hours. The incidence rate is higher in higher division players (Division One) during a game (18.5 injuries/1000 game hours) compared with the lower division players (Division Six) (11.9 injuries /1000 game hours). However the opposite results were obtained during training, for which Division One injury incidence was 2.3 injuries /1000 training hours whilst Division Six incidence was 5.6 injuries/1000 training hours (Nielsen & Yde, 1989). There is no given explanation for why skill level might affect differences between training and game injury incidence rates, although it could be related to unwillingness of higher division players to report injuries that occur during training. Alternatively, the reason that the injury rate is higher in training with the lower division players may be due to differences in training and game preparation. Lower division players are likely to take fitness and body conditioning less seriously than players in higher grades. They therefore may compromise the duration or quality of warm up or down, or engage in more risky activities during training. There is also the possibility that coaches in the lower divisions may have inferior experience, coach training and/or qualifications, or lack any qualification at all and provide poorer advice to players relating to injury prevention.

## **Summary**

Overall, the precise incidence of injury is unclear and research estimates depend upon a variety of methodological factors including differences in study design, population (notably age and gender) and the definition of

injury used (Chomiak, Junge, Peterson, & Dvorak, 2000; Dvorak & Junge, 2000). It appears as if injury incidence in soccer players may increase with age although it is unclear why this is. It may be because older players usually play at a higher competitive level where greater training hours are required and youth, compared to adults, also often play shorter games. Alternatively, it may be due to repetitive or accumulated injury that occurs with more years participating in the game, or through external stressors or other aspects of the older player's lifestyle, for example sustained computer postures as part of other employment.

### **Head and Neck Injuries During Soccer**

During a soccer game, head and neck injuries result primarily through external contact or force directly applied to the head. This external contact or force can occur in a variety of ways including contact with another player's head, upper extremity, lower extremity, opponent's boots, goal post, the ground or a soccer ball (Kirkendall, Jordan, & Garrett, 2001). A study by Fuller and co-workers found that it is most likely to be the actions of the player themselves e.g. poor technique and the players in the opposing team e.g. illegal tackles that cause head and neck injuries (Fuller et al., 2005).

Neck injury rates are rarely specified in research on soccer injuries, and are usually collectively categorised as either head and neck injuries, or spinal injuries. Injuries to the head or lower spinal regional, as opposed to the neck, are likely to be more frequently represented in both these categories (Al-Kashmiri & Delaney, 2006; Tysvaer, 1992). A further difficulty in estimating the incidence of neck injuries obtained while participating in soccer is that players with mild neck injuries will not present to a medical professional for treatment. As mentioned above the incidence of these minor medical complaints may be underestimated because professional players may fail to report complaints because of fears they may be medically recommended to decreased training or playing hours, or for fear of losing their place in a team due to the intense competition to stay on top of their game (Al-Kashmiri & Delaney, 2006).

Fuller and co-workers conducted a study into head and neck injuries sustained in over 20 Federation International Football Association (FIFA) tournaments, over a period of 6 years (Fuller et al., 2005). The study reviewed the injury type and incidence rates of both men and women playing at a professional level. The total number of injuries reported during the study was 1633. Of these, 237 were to the head and 11 to the neck, with the average incident rate of 12.5 per 1000 player hours. This study concluded that 15% of injuries were head and neck injuries.

### **Heading Technique**

Heading is an important aspect within the game of soccer. During a game a player uses their head to control, pass or shoot the ball. Heading is an aspect of the game which requires a high degree of skill and is complicated by the necessity for ball heading to be performed while standing, walking, running forward, running backwards, jumping, diving, and with opponents challenging for possession of the ball (Barnes et al., 1998; Kirkendall, Jordan, & Garrett, 2001). Players can use heading in two different game situations: in offensive or defensive play. Defensive headers are used to clear the ball away from the goal, and normally require a substantial force to send the ball back in the direction it came from or to deflect it towards another team-mate. An offensive header, usually made from the side of the forehead, is used to place the ball (applying a range of forces depending on requirements) into the goal (Mehnert, Agesen, & Malanga, 2005). Correct heading technique is suggested to be vital in decreasing the risk of head and neck injuries in amateur soccer players that may arise from heading the soccer ball (Kirkendall et al., 2001), as improper heading technique is thought to be a common cause of heading injuries (Barnes et al., 1998).

The act of heading a soccer ball is complex and performing this movement correctly requires a great deal of practice and training (Lynch & Beuer, 1996). The correct technique for heading a soccer ball depends on the

purpose of the header within the game, for example clearing the ball, passing the ball to another player or intercepting the ball from the opponent and gaining ball possession (Witol & Webbe, 2003). Heading consists of various phases; the risk of error is increased if the header is not completed using the correct phases (Lynch & Beuer, 1996). The most basic header is the frontal stationary header, which consists of three phases: Pre Impact, Ball Contact and Follow Through (Shewchenko, Withnall, Keown, Gittens, & Dvorak, 2005a). The first phase, Pre Impact, prepares the player for contact with the ball and provides the player with the ability to direct the ball to their desired direction. The player stands with one foot forward and one back, with knees bent. At the same time the player extends their trunk posteriorly from the hips. The player's shoulders should remain square to the ball, while keeping eye contact with the ball at all times (Lynch & Beuer, 1996; Shewchenko et al., 2005a). In the second phase, Ball Contact, the player's trunk is propelled forward to meet the approaching soccer ball. As the forward motion occurs, the head, neck, and shoulders move with the trunk in the forward direction (Kirkendall et al., 2001; Shewchenko, Withnall, Keown, Gittens, & Dvorak, 2005b). The Ball Contact phase is completed by the trunk and the hip flexors, not the head and neck (Lynch & Beuer, 1996). During the Ball Contact phase the player's eyes remain open, focusing on the ball to ensure the player's forehead, between the hairline and the eyebrows. Maintaining eye contact will allow the player to direct the ball after contact, although the player's eyes will automatically close immediately before ball contact (Lynch & Beuer, 1996). The player should intentionally strike the soccer ball as opposed to being struck by the ball, which is often referred to as an unintentional header (Queen, Weinhold, Kirkendall, & Yu, 2003). In the third and final phase, Follow Through, the player's head and trunk continue in the direction of the contacted ball, and then slowly decelerate to return to the starting position. This allows the player to regain balance and to increase the directional accuracy of the headed soccer ball (Shewchenko et al., 2005b).

There are some current anecdotal thoughts by practising osteopaths that repetitive heading or incorrect heading technique may be responsible for increasing the risk of neck degeneration and dysfunction. Despite these speculations, there is little evidence within the literature to support them. However there is some support of the anecdotal thoughts from a study that compared 43 professional soccer players between 30-69 years of age from the Norwegian national team with 43 people of the same age range, from differing occupations, with no previous history of serious neck injury and who had never played soccer. The researchers conducted a physical examination and collected radiological evidence and found that professional soccer players suffered cervical degeneration 15-20 years earlier than the control group (Sortland et al., 1982). The authors suggested that heading was the cause of early degeneration, but there were no data to substantiate these suggestions. A later study found that repetitive heading of a soccer ball initiated and/or accelerated the degenerative process in the cervical spine of soccer players, due to the hyper-extension and compressive forces resulting in vertebral injury (Tysvaer, 1992). Despite the rarity of professional soccer players seeking or receiving medical attention for neck injuries, there are a variety of common complaints made by players to medical professionals linked to heading a soccer ball, for example headaches, neck pain, dizziness, irritability, insomnia, hearing disturbances and memory loss (Barnes et al., 1998; Smodlaka, 1984). Two reviews have estimated that professional soccer players head the soccer ball five to six times a game (Smodlaka, 1984; Sortland et al., 1982). In 15 years of a professional soccer career a player could therefore head the soccer ball around 5,250 times in competition alone, without even taking into account the number of headers performed in training or prior to their professional careers began (Smodlaka, 1984; Sortland et al., 1982). It is important to note that the available studies on heading in professional soccer (Barnes et al., 1998; Smodlaka, 1984; Sortland et al., 1982; Tysvaer, 1992) were all conducted at a time when an old-style leather ball was used, which was substantially heavier than the synthetic balls used in the modern game (Fuller et al., 2005).

Although repetitive heading may be associated with degenerative changes in the cervical region, it is thought that strains, fractures and dislocations of the cervical spine may be the result of poor heading technique in soccer players (Al-Kashmiri & Delaney, 2006). Cervical strains may be as a result of hyperflexion of the cervical spine. Cervical fractures and dislocations may be as a result of a hyperflexion or hyperextension, with rotational force of the cervical spine during the action of heading a ball (Al-Kashmiri & Delaney, 2006) or player position may be another predictor of head and neck injuries resulting from heading.

Fuller and co-workers reported that although few elite players require medical attention for neck problems after heading a ball, one case study described how one elite player received a neck injury from heading the soccer ball (Fuller et al., 2005). However there was no information provided about the circumstances surrounding the header, nor was it clear whether the player had applied the correct heading technique, the weather conditions, or the type of ball the player headed (Fuller et al., 2005). It may be that elite players seldom sustain neck problems compared to non-elite because they employ correct heading technique that does not tend to result in injury.

Research that establishes whether amateur soccer players are correctly heading the soccer ball during games or training is limited. There is also little research to determine whether coaches have a clear understanding of how a correct header should be completed and whether coaches have the ability to train or re-train a team of amateur soccer players to head the ball correctly. This research may help to decrease the injury rate among soccer players.

## **Conclusion**

Neck pain is a common occurrence within society, with a variety of causes, occupation, trauma, sporting and recreational activities, however there is little research to link soccer with neck dysfunction, particularly soccer heading. Currently research surrounding soccer players is mainly focused on professional soccer players, with few studies investigating the effects that soccer has on the amateur player. There is a need for further studies of the effects of both correctly-applied heading and also when the ball is headed incorrectly.

Overall, it is not clear either whether soccer players in general tend to suffer from an increased prevalence of neck pain and dysfunction that may be associated with heading or what proportion of players employ sound heading technique. Additionally, it is unknown whether neck degeneration, that has been suggested to occur in soccer players, results from a one-off incident or from repetitive heading over many years of playing soccer. If heading is a cause of neck complaints in soccer players at any competitive level, then assessment of how players are taught to head the ball is also an area of interest for future research.

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## **Section 2: Manuscript**

Variables associated with neck dysfunction in amateur soccer players.

The following manuscript has been prepared in accordance with the International SportMed Journal (Appendix: K).

In order to maintain readability and consistency of format throughout the thesis tables have been included in the text, the text is written in size 12 font instead of size 10, spacing is set at 1.5 rather than double spacing and APA style referencing was used to maintain consistency with Unitec guidelines, instead of the NLM style of referencing.

## **Abstract**

**Background:** Heading involves large forces throughout the neck region and is an integral aspect of the game of soccer. Nonetheless, research about neck dysfunction resulting from soccer heading is scarce. **Research question:** What are the predictors of neck disability and dysfunction in amateur soccer players? **Type of study:** Descriptive. **Methods:** Part One, prior to this study, players from a single soccer club took part in a pilot study to assess the within-player and between-coach reliability of a tool for assessing heading skill. Part two, an online survey of players in the Auckland City region included the Neck Disability Index (NDI) and soccer-specific and demographic items, and was distributed to soccer clubs within the Auckland region. A further investigation on a subgroup of 16 participants, randomly selected from the main study, was undertaken to identify variables that might predict clinical assessment of neck dysfunction and establish the importance of heading skill as a predictor of neck dysfunction and disability. Part three, participants in this sub-study were filmed completing 10 headers and underwent active and passive neck examinations. **Results:** Associations between NDI and demographic and soccer-specific variables were trivial to small ( $r = -0.01$  to  $0.15$ , all  $p < 0.05$ ). Similarly, associations between examined neck dysfunction and soccer-specific variables were small to moderate ( $r = 2.0$  to  $3.8$ ,  $p = 0.001$ ) except for a large effect observed for a greater level of neck dysfunction identified during active examination in players who engaged in the least compared to the most heading practice ( $r = 2.0$  to  $3.8$ ,  $p = 0.05$ ). **Conclusions:** Overall, no variables relating to heading or participation in amateur soccer appear to be associated with neck disability. Regular heading practice may prevent less severe forms of dysfunction and so incorporating additional heading practice within soccer training may be beneficial.

**Keywords:** football, recreational sport, overuse injuries, cervical spine, survey.

## **Introduction**

Research within the field of soccer is based mainly on professional players, with little research on amateur soccer players. Soccer is a physical and competitive contact sport with a high injury incidence rate for professional soccer players, often higher than high-risk occupations (Hawkins, Hulse, Wilkinson, Hodson, & Gibson, 2001). Soccer injuries arise from contact, typically with another player during tackles or collisions or sometimes with goalposts; and from non-contact, for example during running, shooting, turning and heading. Both contact and non-contact injuries have equal injury incidence rates in the professional game (Hawkins et al., 2001).

Soccer injuries are typically classified in one of two ways: by severity or by injury location. Categories of severity are minor, moderate and serious. Of these, most injuries fall into the minor category (>65%) and the least fall into the severe category (10%) (Aglietti, Zaccherotti, De Biase, Latella, & Serni, 1994; Rahnama, Reilly, & Lees, 2002). Classified by location, surveys have shown that the most common areas of injury are the lower limb, particularly the ankle and knee joints, which make up an estimate of 81-87% of the total number of injuries resulting from soccer at the professional level (Hawkins & Fuller, 1999; Hawkins et al., 2001). The remaining 13 – 19% of injuries are to the upper extremity: trunk, head and neck. Neck injury rates are rarely specified in soccer research, and are usually collectively categorised as both head and neck injuries or under the umbrella term of spinal injuries. Injuries to the head or lower spinal region, are likely to be more frequently represented in both these categories (Al-Kashmiri & Delaney, 2006; Tysvaer, 1992).

Another difficulty in determining exact injury rates in soccer is that there are various definitions of injury currently used in research. One common definition is a player's inability to play in a soccer game or participate in training (Junge & Dvorak, 2000; Junge, Rösch, Peterson, Graf-Baumann, & Dvorak, 2002). This definition is flawed, as an elite player may be more likely than a player at a lower competitive level to play through an injury due to intense competition or selection pressures. A second definition is that the injured player is currently seeking medical treatment for an injury to an

anatomical structure that has been diagnosed by a medical practitioner. The second definition may underestimate the number of unseen injuries, if a player does not seek medical attention for a minor injury. Lastly, American studies have used medical insurance records to represent the number of injuries in soccer (Pritchett, 1981; Sandelin, Santavirta, & Kiviluoto, 1985), with the assumption that an insurance claim implies that medical treatment has been sought (Dvorak and Junge, 2000). The last definition is not suitable for research within countries with a nationally-funded health system, as insurance claims would vastly underestimate treated injuries.

Some authors have proposed that amateur soccer players have a higher injury incidence rate, compared with professional soccer players (Dvorak & Junge, 2000; Fuller, Junge, & Dvorak, 2005). However these statements have been made without reference to collected data, and data from amateur soccer players to support them is limited. In a recent survey of 204 soccer injuries sustained in 196 amateur and professional players from Benin City, Nigeria, the authors reported that 91% of the total number of injuries, occurred in players with 1 – 10 years playing experience and that player experience was related to the mechanism of injury (Azubuike & Okojie, 2009). The report lacked details to determine whether injuries were over- or under-represented in players with less playing experience and which mechanisms of injury were associated with these players (Azubuike & Okojie, 2009). The authors of this study implied that a lower injury incidence rate was observed in more experienced players and that this may have been due to their training, as they may have developed skills to avoid high risk situations (Azubuike & Okojie, 2009).

Due to the high injury incidence in soccer it has become obvious within research that it is increasingly important to determine and limit the factors that lead to such a high injury rate worldwide (Hawkins et al., 2001). A separate factor that reinforces the above need, is the rising costs to the injured player, teams, clubs, and the public health systems, as shown in New Zealand by the gradual increase in new claims to ACC resulting from soccer injuries (Accident Compensation Corporation, 2010). Current

research in the area surrounds the effects that soccer heading has on brain trauma, however there is limited research on the effects that heading and technique may have on neck dysfunction or disability or on the anatomical structures of the neck.

The primary aims of this research were firstly to identify relationships between Neck Disability Index (NDI) and demographic and soccer-related variables using a self-report questionnaire completed by amateur soccer players (Main Study). The secondary aim, addressed in a follow up Sub-Study, was to identify possible links between demographic and soccer-related variables, including an assessment of heading skill, and clinically-assessed neck dysfunction. Because of the lack of a suitable tool for assessing heading skill, a Pilot Study undertaken prior to the Main Study and Sub-Study developed and assessed such a tool.

## **Methods**

There were three parts to this study, firstly part one, a pilot investigation was conducted to assess the efficacy and reliability of the header-skill assessment tool. Secondly part two, an online survey included the NDI, soccer-specific and demographical items was conducted and thirdly a sub-study was completed assessing heading skill and active and passive neck range of motion. The study was approved by the Unitec Research Ethics Committee (UREC) on the 23<sup>rd</sup> June, 2011 (2010-1090) [see Appendix A].

## **Participants**

Participants were current soccer players (aged  $\geq 18$  years) who were recruited from local soccer clubs in the Auckland area. Participants were excluded if they had a previous history of serious neck or upper spinal trauma or surgery. Recruitment took place via posters displayed around Auckland soccer clubs and through word-of-mouth. Potential participants were provided with an information sheet that explained the purpose of the pilot study, the main study, and sub study; what was required of each of the participants; and outlined the confidential nature of data collected for the study [Appendix B and C]. Participants gave informed written consent before commencement of the study [Appendix D and E].

## **Experimental Procedure**

### **Pilot Study**

Before the main study began, players from a single soccer club took part in a pilot study to standardise the header assessment tool procedure and to determine its efficacy, and also to assess the intra- (within player) and inter- (between coaches) reliability to determine consistency of heading and of assessing technique respectively. The pilot study took place in an indoor facility with standardised lighting. Participants stood on a marked line prior to completing each header. A Size 5 Adidas (Adidas Group, Germany) match ball was used, inflated to 0.8 to 1.0 bar, as specified by the manufacturer. The person delivering the ball stood 1 m from the participant and threw the ball so that it was delivered slightly above and in front of each

participant's hairline. The participant was instructed to head the ball over a line, which was placed 1 m behind the person throwing the ball (therefore 2 m in front of the line upon which the participant was standing). A Sony handy cam, DCR-DVD905 [Sony, New Zealand] video camera was set up on a tripod 1.5 m from the participant on an oblique 48.2° angle to them.

Two qualified coaches from the coaching squad at the Waitemata Soccer Club in West Auckland were spoken to when they expressed an interest in participating in the study. They were then emailed complete information about the study and their involvement [Appendix F] before they agreed to take part. The coaches assessed ball heading techniques from video footage of 10 trials for each participant. Each coach was provided with a set of seven criteria that each received a dichotomous grade (correct or incorrect) [see Appendix G]. Correct grades were summed so that each participant attained a total score out of 7.

Following their assessment and prior to completion of the main study, coaches were given the opportunity to suggest ways they felt the scoring system could be improved with respect to the filming, process of conducting the headers, the assessment criteria and scoring system. Adjustments were made to the tool as applicable.

### **Modifications from Pilot Study**

Three changes were made following recommendations by the two coaches to improve the header assessment tool. These were increasing the distance between the thrower and participant and the distance the ball was to be headed, both to 3 m. Owing to these two changes, the angle between the participant and the camera was also altered to 25°. The third adjustment was to number each header on the video to ensure the coaches were assessing the correct header.

## **Main Study**

Questionnaires were distributed to amateur soccer players within the Auckland region and they were completed either electronically using Survey Monkey ([www.surveymonkey.com](http://www.surveymonkey.com), Palo Alto, CA) or on paper. The questionnaire consisted of the NDI [see Appendix H] and additional items [see Appendix I]. Additional items included questions providing demographic information: age, gender and occupation; and soccer-specific questions regarding previous soccer history and details relating to the current season, which runs through the winter months from approximately April to August in New Zealand.

## **Sub-Study**

A subgroup of participants were selected by convenience from the questionnaire respondents. These participants were filmed completing 10 headers as per the modified protocol developed in the pilot study.

Each Sub-Study participant then underwent an active and passive physical examination of the neck (cervical vertebrae 1 to thoracic vertebrae 1) [outlined in Appendix J]. A senior Osteopath from Unitec Institute of Technology, qualified from the British School of Osteopathy (BSO), with twenty years of clinical experience, and holding a current practising certificate performed all neck examinations in the study. For active examination, restrictions were noted by both the practitioner and the participant for flexion, extension, side bending (each side), and rotation (each direction) to derive a total score out of 12. For passive examination, the neck was examined for dysfunction in all six movements for each of the seven cervical vertebral joints to derive a total score out of 42. The greater the restriction found in the neck, the greater the total scores. Each participant underwent their neck examination on the same day they completed their header assessment.

## **Data Analysis**

### **Pilot Study**

For the pilot study, intra-performer (between-trial) variability was established by reporting coefficients of variation represented as a percentage (SD/mean x 100), for each player over 10 trials, and intra-class correlation coefficients (ICCs) between adjacent trials using a spreadsheet and methods developed by Hopkins (2000).

Inter-tester (between-coach) reliability was established by calculating ICC of scores for both coaches for all trials from every player, and for the average of 10 trials for each player. Since each trial was scored as a sum of seven independently assessed components, there were a total of 560 individual comparisons made by each coach for each trial. The percentage agreement between coaches for these was also calculated.

### **Main Study**

NDI was expressed as a percentage according to author instructions and based on the Oswestry Disability Index (Vernon & Mior, 1991). Due to the small range of disability scores (all less than 32 and only 9 scoring moderate disability, above 20), NDI was alternatively simplified, for the purpose of analysis, by defining categories from 0 = nothing to 3 = moderate. Relationships between NDI and individual demographic and soccer-specific variables were assessed using Pearson's correlation coefficients for continuous variables and t-tests or one way ANOVA for differences between levels of categorical variables. Linear multiple regression models were used to determine predictors of NDI.

**Sub study**

In order to investigate whether the main study variables and/or heading skill were associated with clinically examined assessment of neck dysfunction, differences in active and passive restriction scores between levels of categorical variables and correlations between these scores and continuous variables were assessed. Effect sizes for all studies were evaluated using descriptors from the Scale of Magnitudes suggested by Hopkins (Hopkins, 2000).

## Results

### Pilot study

#### Intra-performer Variability

Of the ten players who agreed to take part in the pilot study, only eight were able to attend on the testing day. Skill scores assessed by each of the two coaches are shown in Table 1. Coefficients of variation within the same participant varied from 9.6 to 51.6% for Coach A and from 0 to 12.9% for Coach B. The mean intra-class correlation coefficients (ICCs) between adjacent trials indicated large effects for intra-player reliability and were 0.49 for Coach A, 0.50 for Coach B, and 0.60 when skill scores were averaged for the two coaches.

Table 1. Skill scores assessed by two coaches over ten trials per participant

Participants	Coach A	Coach B	Average
1	4.4 ± 1.2	6.1 ± 0.6	5.3 ± 0.6
2	3.3 ± 1.7	5.6 ± 0.5	4.5 ± 1.0
3	4.6 ± 1.2	5.5 ± 0.7	5.0 ± 1.0
4	4.1 ± 1.4	6.0 ± 0.0	5.1 ± 0.7
5	2.4 ± 1.1	5.0 ± 0.5	3.7 ± 0.6
6	5.5 ± 0.5	6.0 ± 0.0	5.8 ± 0.3
7	4.1 ± 1.3	5.8 ± 0.4	5.0 ± 0.6
8	4.4 ± 0.8	6.0 ± 0.0	5.2 ± 0.4

Data are mean ± standard deviation.

#### Inter-tester Variability

The ICC between the testers for all 80 trials was 0.26, showing a small – moderate effect for between-tester reliability. When averages of 10 trials for each participant were used rather comparing single trials, a very large effect for between-tester reliability (ICC = 0.71) was found. In order to establish if overall ranking of players was similar between coaches, mean scores from each player were ranked for each of the two coaches. Three of the four highest ranked players were the same between the two coaches. Similarly, the lowest ranked player was consistent for both coaches.

Further analysis of the consistency of the header skill score was completed by establishing the percentage agreement between the two coaches for the eight individual criteria that comprised the skill score, as shown in Table 2. The highest between-coach agreement was obtained for the criterion “players’ eyes remain open” and “player contacts the ball with the forehead area, between the hairline and the eyebrows”. The lowest agreement was obtained for “when the player contacts the ball, one foot is in front of the waist and the other is slightly behind the waist” and “the player tenses their neck muscles and players’ mouth is closed”.

Table 2. Percentage agreement between the two coaches for the individual criteria

Criteria	Agreement (%)
Players mouth is closed	50.0
Player tenses neck muscles	52.5
When the player contacts the ball, one foot is in front of the waist and the other is slightly behind the waist.	58.8
Power is produced from the hips and back, not the players’ neck	77.5
Player hits the ball (ball should not hit the player)	81.3
Players eyes remain open	98.8
Player contacts the ball with the forehead area, between the hairline and the eyebrows	100

## Main Study

From one hundred questionnaires distributed, 89 soccer players consented to take part in the study and 61 completed the survey: 58 did so online and three filled out paper versions. Their characteristics are shown in Table 3.

Table 3. Characteristics of participants in the main study

Age (years)	27.7 ± 7.3
Total seasons played	15.0 ± 6.8
Soccer training (h/season)	87.6 ± 48.1
Game heading (heads/season)	75.5 ± 61.3
Heading practice (min/season)	69.6 ± 67.8
Neck Disability Index (%)	7.3 ± 8.3
Exercise (min/week)	-0.09 (0.6)
Gender	
male	37 (39.3)
female	24 (60.7)
Occupation	
no desk work	21 (34.4)
desk work	40 (65.6)
Medical assistance	
yes	51 (83.6)
no	5 (8.2)
Leather ball (previous use)	
yes	9 (14.8)
no	52 (85.2)
Leather ball use (years)	
0	52 (85.2)
5	3 (4.9)
6	1 (1.6)
10	4 (6.6)
25	1 (1.6)
Most common position	
Goalie	7 (11.5)
Back	20 (32.8)
Midfielder	17 (27.9)
Striker	13 (21.3)

Data are mean ± SD for continuous variables and frequency (percentage) for categorical variables. N = 61.

Univariate correlations between NDI (expressed both as a percent and as a simplified measure) and continuous demographic and soccer-specific variables showed small to trivial effect sizes for all variable pairs (Table 4).

Table 4. Correlation of continuous independent variables with Neck Disability Index (NDI)

	NDI (%) (p value)	NDI (Simple)* (p value)
Age	0.15 (0.3)	0.14 (0.3)
Total seasons played	0.01 (0.9)	0.08 (0.6)
Top division**	0.06 (0.7)	0.03 (0.8)
2010 division <sup>#</sup>	-0.01 (1.0)	-0.08 (0.6)
Soccer training (h/season)	-0.11 (0.4)	-0.17 (0.2)
Game heading (heads/season)	-0.17 (0.2)	-0.15 (0.3)
Heading practice (min/season)	0.002 (1.0)	-0.006 (1.0)
Exercise (min/week)	-0.09 (0.6)	0.02 (0.9)

\*NDI simple categorises NDI into 4 levels of disability: nothing, trivial, very mild, and moderate). \*\* Top division participant has ever played in. <sup>#</sup> Division played in 2010.

Because of a lack of variability in responses, some continuous variables were alternatively defined as categorical variables. These were gender, occupation, medical assistance, past use of and number of years playing using the traditional style leather ball, top division ever played at (recoded into 3 categories), 2010 division played at (recoded into 3 categories) and most common position played (recoded into 4 categories). Only trivial differences in NDI between levels of these and other categorical variables, bar one, were observed. The exception was that females, compared to males [effect size = difference between means / pooled standard deviation = 0.6 (moderate);  $p = 0.03$ ], and those who had sought medical treatment for neck dysfunction following heading a soccer ball, compared to those who had not [effect size = 1.1 (moderate – large);  $p = 0.03$ ] reported higher NDI score (Table 5).

Table 5. Neck Disability Index for different levels of categorical independent variables

	Mean $\pm$ SD	p value
Gender		0.03
female	10.1 $\pm$ 10.6	
male	5.3 $\pm$ 5.7	
Occupation		0.5
active	8.3 $\pm$ 8.3	
sedentary	6.7 $\pm$ 8.4	
Medical assistance following heading a soccer ball		0.03
yes	17.6 $\pm$ 13.4	
no	6.3 $\pm$ 7.1	
Past use of leather ball		0.8
yes	8.0 $\pm$ 8.4	
no	7.1 $\pm$ 8.4	
Top division**		0.5
premierships and premiership reserves	8.8 $\pm$ 9.2	
u19s, 1 <sup>st</sup> and 1 <sup>st</sup> Reserves	6.3 $\pm$ 7.4	
2 <sup>nd</sup> and 3 <sup>rd</sup> Division	9.1 $\pm$ 10.7	
Leather ball (years)		0.2
0	7.1 $\pm$ 8.4	
5	17.3 $\pm$ 8.1	
6	4.0 $\pm$ 0.0	
10	2.5 $\pm$ 3.0	
25	6.0 $\pm$ 0.0	
2010 division 4 <sup>#</sup>		0.5
1 <sup>st</sup> and Under 19s	4.4 $\pm$ 2.4	
2 <sup>nd</sup> , 3 <sup>rd</sup> and Over 35s	9.1 $\pm$ 7.0	
4 <sup>th</sup> , 5 <sup>th</sup> , 6 <sup>th</sup> and 7 <sup>th</sup> Division	7.9 $\pm$ 9.5	
Common position		0.6
Goalie	9.7 $\pm$ 8.5	
Back	6.7 $\pm$ 8.2	
Mid-fielder	5.6 $\pm$ 7.3	
Striker	8.9 $\pm$ 10.0	

Data are mean  $\pm$  SD

(\*NDI simple has been categorised from NDI percentage. \*\* Top division participant played in, in 3 categories. # Division played in 2010, in 3 categories).

Stepwise multiple regression analyses, which applied generous criteria for inclusion ( $p_{in} < 0.1$ ), were completed to determine independent predictors of neck disability and dysfunction from the pool of available descriptive variables. No variables entered these models as predictors of NDI (either expressed as a percent or simplified) when combinations of the above continuous or categorically-defined independent variables were used.

### Sub study

A total of 16 participants from the main study took part in the sub-study.

Their characteristics are shown in Table 6.

Table 6. Active and passive examination results\* by Sub-study participant characteristic

	N	Mean $\pm$ SD (Active)	p value	Mean $\pm$ SD (Passive)	p value
Gender			0.3		0.6
male	8	2.3 $\pm$ 1.0		5.3 $\pm$ 4.6	
female	8	3.0 $\pm$ 1.33		6.4 $\pm$ 4.0	
Occupation			1.0		0.3
Sedentary	6	2.8 $\pm$ 1.6		7.1 $\pm$ 4.8	
Active	8	2.8 $\pm$ 0.9		4.9 $\pm$ 3.3	
Total seasons played			0.4		0.2
<10	3	2.6 $\pm$ 1.5		7.6 $\pm$ 4.8	
13	4	3.5 $\pm$ 1.3		4.8 $\pm$ 3.3	
22	7	2.4 $\pm$ 1.0		5.6 $\pm$ 4.2	
Soccer training (h/season)			0.9		0.6
3	3	2.7 $\pm$ 1.2		8.0 $\pm$ 3.6	
65	8	3.0 $\pm$ 1.5		6.4 $\pm$ 5.0	
72	3	2.7 $\pm$ 0.6		4.3 $\pm$ 3.1	
118					
Heading practice (min/season)			0.05		0.1
15	6	3.8 $\pm$ 1.2		9.2 $\pm$ 3.7	
45	5	2.2 $\pm$ 0.8		5.0 $\pm$ 3.7	
90	2	2.0 $\pm$ 0.0		3.5 $\pm$ 3.5	
210	1	2.0 $\pm$ 0.0		1.0 $\pm$ 0.0	

\*Examination scores are mean  $\pm$  SD. P values denote level of significance for differences between means for t-test or ANOVA.

Heading skill showed no meaningful association with neck dysfunction identified by either active or passive examination of the cervical spine: trivial correlations of  $r = 0.16$  (active) and  $r = -0.08$  (passive) were noted (all  $p < 0.05$ ). Similarly, independent t-tests and one-way ANOVAs failed to show meaningful associations between neck dysfunction and demographic or soccer-specific variables with the exception of the total amount of heading practice in the last season showed an inverse association with dysfunction found in an active examination. This association attained a large effect size for the difference in examination score between the smallest reported amount of heading practice (15 min/season) and the largest (210 min/season) (ES effect size = 1.5;  $p = 0.05$ ; Table 6).

## **Discussion**

The main aim of this study was to identify associations between demographic and soccer-related variables and neck disability. In this survey of amateur soccer players no evidence of any such associations was found. Anecdotally, there appears to be a common perception amongst osteopathic clinicians that repetitive heading in soccer may make individuals more susceptible to neck dysfunction. However, there was no evidence from this study to validate this view, since neither the number of years played, heading skill nor soccer team division were associated with neck disability or examined neck dysfunction.

NDI was designed to assess individuals' perceptions of dysfunction that interfered with their everyday activities resulting from a whiplash injury (Vernon & Mior, 1991). Whiplash injuries are caused by a sudden acceleration/deceleration force, typically resulting from motor vehicle accidents. In contrast, dysfunction of the sort likely to be caused with heading is of a repetitive nature. Therefore neck disability, as assessed by the NDI, may not have been a useful measure of this type of injury.

Participants within this study were an asymptomatic population. Since people reporting severe pain and disability would be unlikely to be participating regularly in a contact sport. Therefore, their NDI measurements were deemed mild or moderate under the NDI scoring system (Vernon & Mior, 1991). Aspects of soccer participant that might exacerbate neck dysfunction, e.g. length of time playing, number of headers performed and the like, may have resulted in subtle changes in neck function, that could not be detected by NDI, but might, nevertheless, NDI lead to chronic pain or degeneration later in life.

A secondary aim was to determine the extent of the association between neck disability/dysfunction and heading the soccer ball. There appears to be evidence of a somewhat meaningful association in the Sub-Study that

showed that less heading practice in the current season (2010) was associated with greater observed dysfunction during the active examination. The effect size for this association was large and a larger sample size in the Sub-Study might have resulted in more confidence in generalising this result to the population of amateur soccer players, by way of a narrower confidence interval. If heading practice does reduce neck dysfunction in soccer players then heading skill level may be a predictor of early onset or chronic neck dysfunction. This finding is reinforced by a study by Kartal et al., (2004) who observed a lesser range of motion in young active players versus a control group of a similar age ( $f = 8.10$ ,  $p = 0.08$ ). It was also reported in Kartal et al., (2004) study that there was greater dysfunction in the cervical vertebral canal, at the level of the fifth vertebrae, in active veteran (30+ years) soccer players, compared to both the active young group and the young control group (Kartal, Yildiran, Senköylü, & Korkusuz, 2004). The authors suggested that this was due to repetitive heading of the soccer ball (Kartal et al., 2004).

The neck examinations were carried out by a qualified osteopathic practitioner. It is well documented that the inter-rater reliability between osteopathic practitioners is low in physical examinations, ranging from 52% to 97% for general spinal movements and from 48% to 90% for segmental spinal movements (Pool, Hoving, de Vet, Van Mameren, & Bouter, 2004; Seffinger et al., 2004), therefore the use of imaging may have provided a more objective measure of any underlying degeneration causing dysfunction. Unfortunately imaging was not a possibility in this study due to lack of funding and the unethical nature of potentially exposing healthy participants to unnecessary radiation, in the case of plain film radiography.

A further limitation of this study was in the assessment of skill. The tool used to assess heading skill was developed using a chapter from a scholarly publication (Lynch & Beuer, 1996) compiled by prominent researchers in the field. Despite this, inter-coach agreement using this tool was modest.

Furthermore, the external validity of the tool may be questioned since the delivery of the soccer ball was not identical to a game heading situation. In the Sub-Study the ball was thrown rather than kicked, as it would mostly have been in a game, to ensure the ball would be delivered to the participants' head and in the direction of the participant waiting to head the ball. As well as the non-standardised force of delivery, the angle of delivery was unable to be standardised for all the participants, due to the thrower having to adapt the delivery depending on the height of the participant. To standardise the delivery of the soccer ball a mechanised thrower may be a more reliable option.

Another limitation within this study was the difficulty in adjusting for other likely causes of individual's neck dysfunction. A full medical case history may have allowed use of covariates such as the type of occupation, or other activities undertaken that required extended lengths of time in a sedentary position. Using a computer is known to cause neck dysfunction (Hoyle, Marras, Sheedy, & Hart, 2011) particularly if the computer is not set correctly for the individual.

This study has highlighted further areas where research would be helpful. Firstly, there is a need for a valid, practically-based tool for the assessment of heading technique to be developed. This would aid soccer coaches in identifying the areas of player weakness and help ensure each individual player was provided with correct advice for improving their technique and potentially preventing neck injury. Secondly, further research is warranted into players heading skill level and the underlying possibility that increased skill may decrease the negative effects that heading may have on the head and neck complex. Thirdly, there is a need for research into the ability of coaches to teach the heading skill correctly, to limit any harm that may come to a player. Lastly, further research into ensuring the Sub-Study is completed with a large sample size to gain greater validity within the study.

## **Conclusion**

The results of this study show that soccer-related variables have trivial effects on neck dysfunction and disability. Although, there are a number of aspects of this study that weakened its validity, this study has uncovered areas for further investigation surrounding the practice of heading in soccer at the amateur level and the possibility that heading, particularly if performed incorrectly, might initiate or exacerbate neck dysfunction and pain.

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## **Section 3: Appendices**

# Appendix A: Ethics approval for this project



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Lisa Walker  
5 Rena Place  
Westharbour  
Auckland

24 June 2010

Dear Lisa

Your file number for this application: 2010-1090

**Title: Determinants of neck dysfunction in amateur soccer players**

Your application for ethics approval has been reviewed by the Unitec Research Ethics Committee (UREC) and has been **approved** for the following period:

Start date: 23 June 2010  
Finish date: 22 June 2011

Please note that:

1. the above dates must be referred to on the information AND consent forms given to all participants
2. you must inform UREC, in advance, of any ethically-relevant deviation in the project. This may require additional approval.

You may now commence your research according to the protocols approved by UREC. We wish you every success with your project.

Yours sincerely

A handwritten signature in blue ink that reads 'Lyndon Walker'.

Lyndon Walker  
Deputy Chair, UREC

CC Andrew Stewart  
Cynthia Almeida

experience  
100 years of learning

## Appendix B: Pilot study information for participants



### Information for participants

#### Pilot study-filmed headers

My name is Lisa Walker and I am currently in the fourth year of a programme in Osteopathy program at Unitec. Part of my Master of Osteopathy degree entails a research thesis on a subject of my choice. My research topic investigates the determinants of neck dysfunction in amateur soccer players. This study has been approved by the Unitec Research Ethics Committee.

#### ***What we are doing***

Before beginning the main study, I will be undergoing a pilot study. The pilot study will allow the researcher to make appropriate amendments to the standardised protocol to assess heading skill. Adjustments may be subsequently be made to the filming techniques, assessment criteria and scoring system following evaluation of the skill measurement process.

#### ***What it will mean for you***

You will be asked to complete, 10 filmed headers (which will take a 30 minutes to complete). The aim of this will be to:

- Determine whether the camera angle is correct
- Determine whether the criterion is sufficient to evaluate heading ability of each participant.
- Ensure the instructions are clear and concise.

If you agree to participate, you will be asked to sign a consent form. This does not stop you from changing your mind if you wish to withdraw, without consequence from the pilot study. However, due to my schedule, participants will be able to withdrawal from this study until the pilot study is complete.

Your anonymity will be maintained at all times during and after completion of the study.

Your name, personal details and any information that may identify you will be kept completely confidential. All information collected from you will be stored on a password protected file and the researcher and my supervisors will have access to this information.

Please contact me if you need more information about the project. At any time if you have any concerns about the research project you can contact my supervisor:

My supervisor is Andrew Stewart, phone 815 4321 ext. 5193 or email [astewart@unitec.ac.nz](mailto:astewart@unitec.ac.nz)

**UREC REGISTRATION NUMBER: (2010-1090)**

**This study has been approved by the UNITEC Research Ethics Committee from 23/6/2010 to 22/6/2011. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (ph: 09 815-4321 ext 6162. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.**

## Appendix C: Main study information sheet



Information for participants

### Determinants of neck dysfunction in amateur soccer players

My name is Lisa Walker and I am currently in the fourth year of a programme in Osteopathy program at Unitec. Part of my Master of Osteopathy degree entails a research thesis on a subject of my choice. My research topic investigates the determinants of neck dysfunction in amateur soccer players. This study has been approved by the Unitec Research Ethics Committee.

#### ***What we are doing***

I want to identify relationships between specific predictors of the Neck Disability Index (NDI) from demographic and soccer-related variables assessed in a self-report questionnaire completed by amateur soccer players. Secondly, I'm aiming to identify possible predictors of clinically assessed neck dysfunction in amateur soccer players and thirdly to determine the correlation between neck disability or dysfunction and variables associated with heading the soccer ball. By participating in this study you will be helping us to highlight any predisposing factors for neck disability that may be present in amateur soccer players, and possibly provide information to limit/decrease these predisposing factors.

#### ***What it will mean for you***

You will be asked to complete two questionnaires, Neck Disability Index and Soccer questionnaire, both questionnaires will take 15-20 minutes to complete. These questionnaires will ask you about:

- Level of the following: pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping and recreation.
- Details such as your gender and age, and your training competitive history within the last and previous soccer seasons.

You may also be randomly selected from the whole group to complete, 10 filmed headers (will take a 15-20 minutes to complete) and an active and passive neck examination by either a qualified Osteopath or the researcher (will be a 20 minute appointment). The aim of these will be to:

- Determine your ability to correctly header the soccer ball
- Determine whether you have any noticeable neck dysfunction

If you agree to participate, you will be asked to sign a consent form. This does not stop you from changing your mind if you wish to withdraw, without consequence from this study. However, due to my schedule, participants will be able to withdraws from this study until 2 weeks after data collection.

Your anonymity will be maintained at all times during and after completion of the study.

Your name, personal details and any information that may identify you will be kept completely confidential. All information collected from you will be stored on a password protected file and the researcher and my supervisors will have access to this information.

Please contact me if you need more information about the project, Lisa Walker, 0211445847 or [not\\_on@hotmail.com](mailto:not_on@hotmail.com).

At any time if you have any concerns about the research project you can contact my supervisor: My supervisor is Andrew Stewart, phone 815 4321 ext. 5193 or email [astewart@unitec.ac.nz](mailto:astewart@unitec.ac.nz)

**UREC REGISTRATION NUMBER: (2010-1090)**

**This study has been approved by the UNITEC Research Ethics Committee from 23/6/2010 to 22/6/2011. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (ph: 09 815-4321 ext 6162. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome**

## Appendix D: Pilot study consent form



### Participant consent form

<p>Determinants of neck dysfunction in amateur soccer players</p> <p>Pilot study</p>
--

I have had the pilot study explained to me and I have read and understood the information sheet given to me.

I understand that I don't have to take part in this study if I don't want to and I may withdraw from this study without consequence until completion of the pilot study.

I understand that everything I say is confidential and none of the personal information I give will be displayed in public documents in a way that could identify me. The only persons who will have access to my individual data are the researcher and their academic supervisors. I also understand that all hardcopy information will be stored in a locked cabinet at the researchers home address and the electronic data will be stored by both the researcher and supervisors in a password secure computer and that the data will be stored for up to five years as per Unitec policy and then destroyed.

I understand that I will conduct 10 headers and these headers will be filmed and reviewed by two qualified Soccer coaches.

I understand that I can see the finished research document.

I have had time to consider everything and I give my consent to be a part of this project.

*Participant Signature:* ..... *Date:* .....

*Project Researcher:* ..... *Date:* .....

UREC REGISTRATION NUMBER: (2010-1090)

This study has been approved by the UNITEC Research Ethics Committee from 23/6/2010 to 22/6/2011. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (ph: 09 815-4321 ext 6162). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

## Appendix E: Main study consent form



### Participant consent form

#### Determinants of neck dysfunction in amateur soccer players

I have had the research project explained to me and I have read and understood the information sheet given to me.

I understand that I don't have to take part in this study if I don't want to and I may withdraw from this study without consequence until 2 weeks after data collection.

I understand that everything I say is confidential and none of the personal information I give will be displayed in public documents in a way that could identify me. The only persons who will have access to my individual data are the researcher and their academic supervisors. I also understand that all hardcopy information will be stored in a locked cabinet at the researchers home address and the electronic data will be stored by both the researcher and supervisors in a password secure computer and that the data will be stored for up to five years as per Unitec policy and then destroyed.

I understand that I may also be asked, to complete an active and passive examination of my neck.

I understand that I may also be asked to conduct 10 headers and these headers will be filmed and reviewed by two qualified United One Soccer coaches.

I understand that I can see the finished research document.

I have had time to consider everything and I give my consent to be a part of this project.

*Participant Signature:* ..... *Date:* .....

*Participant Name:* ..... *(Please print)*

*Participant contact number:* .....

*Participant email:* ..... *(Please print)*

*Project Researcher:* ..... *Date:* .....

UREC REGISTRATION NUMBER: (2010-1090)

This study has been approved by the UNITEC Research Ethics Committee from 23/6/2010 to 22/6/2011. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (ph: 09 815-4321 ext 6162). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

## Appendix F: Coaches information letter

To Coach,

My name is Lisa Walker and I am currently in the fourth year of a programme in Osteopathy at Unitec. The Master of Osteopathy degree requires a research thesis on a subject of my choice. My research topic investigates the determinants of neck dysfunction in amateur soccer players. This study has been approved by the Unitec Research Ethics Committee.

### ***What we are doing***

Various neck and shoulder complaints which may be related to heading the soccer ball have been reported in soccer players. The main aim of this study is to assess neck disability in New Zealand amateur soccer players using a questionnaire that has been developed to provide a measurement of minor neck injury, called the Neck Disability Index (NDI). I want to identify relationships between specific predictors of the Neck Disability Index (NDI) from demographic and soccer-related variables assessed in a self-report questionnaire completed by amateur soccer players. Secondly, I'm aiming to identify possible predictors of clinically assessed neck dysfunction in amateur soccer players and thirdly I'm aiming to determine the correlation between neck disability or dysfunction and variables associated with heading the soccer ball. By participating in this study you will be helping us to highlight any predisposing factors for neck disability that may be present in amateur soccer players, and possibly provide information to limit/decrease these predisposing factors.

### ***What it will mean for you***

I require two coaches to analyse header footage. The criteria and footage will be provided for you to view at your earliest convenience.

There is two parts of my study that I would require your help for,

1. Pilot study

Will consist of 10 people completing 10 headers each, for a total of 100 headers. You will be required to mark the headers with the provided 7 point scale. The pilot study allows for feedback from both the participants and coaches to evaluate what works and what doesn't, to improve this aspect of my study for the main study. The pilot study will provide me with a standardised protocol to assess the headers, which will be used in the main study

2. Main study

Will consist of 50 people completing 10 headers each, for a total of 500 headers. Using the criteria from the pilot study and the header footage provided, you will be required to mark the headers

Please don't hesitate in contacting me if you have any further questions.

Thank you for your time.

Lisa Walker

# Appendix G: Heading criteria

## Header Analysis

- Please write yes or no for each of the following questions.
- Each participant completed 10 headers; there is a column for each header.

Participant Number.....

Header Number	1	2	3	4	5	6	7	8	9	10
---------------	---	---	---	---	---	---	---	---	---	----

Eyes open

Mouth closed

Contacts the ball with the forehead area, between the hairline and eyebrows

Tenses neck muscles

Player hits the ball (ball should not hit the player)

Power produced from the hips and back (not the neck)

When person contacts the ball, one foot is in front of the waist and the other is slightly behind the waist

## Appendix H: Neck Disability Questionnaire

### 1. Pain intensity

- .I have no pain at the moment.
- .The pain is very mild at the moment.
- .The pain is moderate at the moment.
- .The pain is fairly severe at the moment.
- .The pain is very severe at the moment.
- .The pain is the worst imaginable at the moment.

### 2. Personal care (Washing, Dressing, etc.)

- .I can look after myself normally, without causing extra pain.
- .I can look after myself normally, but it causes extra pain.
- .It is painful to look after myself and I am slow and careful.
- .I need some help, but manage most of my personal care.
- .I need help every day in most aspects of self care.
- .I do not get dressed; I wash with difficulty and stay in bed.

### 3. Lifting

- .I can lift heavy weights without extra pain.
- .I can lift heavy weights, but it gives extra pain.
- .Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example, on a table.
- .Pain prevents me from lifting heavy weights off the floor, but I can manage light to medium weights if they are conveniently positioned.
- .I can lift very light weights.
- .I cannot lift or carry anything at all.

### 4. Reading

- .I can read as much as I want to, with no pain in my neck.
- .I can read as much as I want to, with slight pain in my neck.
- .I can read as much as I want to, with moderate pain in my neck.
- .I can't read as much as I want, because of moderate pain in my neck.
- .I can hardly read at all, because of severe pain in my neck.
- .I cannot read at all.

## 5. Headaches

- .I have no headaches at all.
- .I have slight headaches that come infrequently.
- .I have moderate headaches that come infrequently.
- .I have moderate headaches that come frequently.
- .I have severe headaches that come frequently.
- .I have headaches almost all the time.

## 6. Concentration

- .I can concentrate fully when I want to, with no difficulty.
- .I can concentrate fully when I want to, with slight difficulty.
- .I have a fair degree of difficulty in concentrating when I want to.
- .I have a lot of difficulty in concentrating when I want to.
- .I have a great deal of difficulty in concentrating when I want to.
- .I cannot concentrate at all.

## 7. Work

- .I can do as much work as I want to.
- .I can do my usual work, but no more.
- .I can do most of my usual work, but no more.
- .I cannot do my usual work.
- .I can hardly do any work at all.
- .I can't do any work at all.

## 8. Driving

- .I can drive my car without any neck pain.
- .I can drive my car as long as I want, with slight pain in my neck.
- .I can drive my car as long as I want, with moderate pain in my neck.
- .I can't drive my car as long as I want, because of moderate pain in my neck.
- .I can hardly drive at all, because of severe pain in my neck.
- .I can't drive my car at all.

## 9. Sleeping

- .I have no trouble sleeping.
- .My sleep is slightly disturbed (less than 1 hr sleepless).
- .My sleep is mildly disturbed (1-2 hrs sleepless).
- .My sleep is moderately disturbed (2-3 hrs sleepless).
- .My sleep is greatly disturbed (3-5 hrs sleepless).
- .My sleep is completely disturbed (5-7 hrs sleepless).

## 10. Recreation

- .I am able to engage in all my recreation activities, with no neck pain at all.
- .I am able to engage in all my recreation activities, with some neck pain.
- .I am able to engage in most, but not all, of my usual recreation activities, because of pain in my neck.
- .I am able to engage in few of my recreation activities, because of pain in my neck.
- .I can hardly do any recreation activities, because of pain in my neck.
- .I can't do any recreation activities at all.

**Score: /50 Transform to percentage score x 100 = %points**

**Scoring:** For each section the total possible score is 5: if the first statement is marked the section score = 0, if the last statement is marked it = 5. If all ten sections are completed the score is calculated as follows: Example:16 (total scored)

50 (total possible score) x 100 = 32%

If one section is missed or not applicable the score is calculated: 16 (total scored)

45 (total possible score) x 100 = 35.5%

Minimum Detectable Change (90% confidence): 5 points or 10 %points

NDI developed by: Vernon, H. & Mior, S. (1991). The Neck Disability Index: A study of reliability and validity. *Journal of Manipulative and Physiological Therapeutics*. 14, 409-415

# Appendix I: Soccer questionnaire

The following questionnaire will be broken into three sections, general, recent (2010 season) and historical questions.

## General

1. What is your date of birth?
2. What gender are you?  
Male or Female
3. What is your occupation?

## Recent (All responses are for the 2010 season only).

1. What division did you play in, in 2010?
2. How many scheduled games did you play in the last season?
3. How many days a week do you complete soccer training in winter? (Do not include games in your answer)
4. How many days a week do you complete other forms of training or exercise? Please list the other forms of training/exercise.
5. What position/s do you play on the soccer field? (you may select more than one answer)  
Striker, Centre Mid-field, Right Mid-field, Left Mid-field, Centre Back, Right Back, Left Back and Goalie. (If you selected more than one, please specify most frequent to less frequent)
6. Do you head the soccer ball?
  - Yes
  - No, if no please explain why you do not header the soccer ball?
7. On average, how many times would you head the ball in a game?
8. How much heading practice in total, did you complete in the 2010 season?

## Historical

1. What age did you start playing soccer?
2. What is the total number of seasons you have actively played soccer for?
3. What divisions/levels of soccer have you played in? (eg. Division 1, Under 17s) Please list them.
4. Have you ever had to visit a Doctor, specialist, physiotherapist, osteopath or chiropractor after suffering a neck or other injury after heading a soccer ball? If yes, please provide details of the incident.
5. Did you play regularly with the old-style leather ball? If yes, how many years did you play with the old-style leather ball?

# Appendix J: Active and Passive examination assessment

## Active Examination

With the patient sitting, the patient

- Flexes (forward bending)
- Extends (backward bending)
- Rotation left and right
- Sidebending left and right

If the patient or practitioner indicates restriction then they will be given one point per movement that is restricted, the total number of points in the active examination is 6. Practitioner will also note if participant experiences any pain in certain ranges of motion. The higher the patients total score the greater the neck restriction in active movements.

## Passive Examination

Patient will be supine (lying on their back), while the practitioner carries out the following passive examination of the following segments C1-C2, C2-C3, C3-C4, C4-C5, C5-C6, C6-C7 and C7-T1 (C=cervical and T=thoracic).

- Rotate to the left and the right at each vertebral segment
- Sidebend to the left and right at each vertebral segment
- Flexion (forward bending) at each vertebral segment
- Extension (backward bending) at each segment

If the patient or practitioner indicates restriction then a point will be given to the specific segment that restriction is identified, the total number of points in the passive examination will be 42 points. The practitioner will also note if there is any pain at a specific segment. The higher the patients total score the greater the restriction of the neck in passive movements.

# **Appendix K: Authors for submission to the journal of International Sports Med**

Guide for Authors

Available on ISMJ web site: <http://www.ismj.com>

The International SportMed Journal (ISMJ) is an electronically delivered, international, peer-reviewed journal for professionals with a primary interest in sports and exercise medicine, as well as exercise science. In addition to review articles (invited and submitted), the ISMJ publishes original research covering diagnostics, therapeutics and rehabilitation in healthy and physically challenged individuals of all ages and levels of sport and exercise participation (see types of articles below).

Manuscripts are welcomed from all countries, and may be submitted for consideration on the understanding that they have not been previously published elsewhere, either in print or electronically, that they are not under consideration by any other publisher, that Research Ethics Committee (Board) approval has been obtained, and that all potential conflicts of interest have been declared.

All manuscripts must be submitted in English, and because the ISMJ is an English-language journal, the English must be of an acceptable standard. If a manuscript is submitted by an author who does not have English as their first language, the manuscript may require editing before it is submitted. This can be done by an online service that offers editing of scientific language for non-English speakers before it is submitted to reviewers.

Manuscripts not submitted in accordance with the ISMJ Author Instructions and guidelines are more likely to be rejected.

All original research articles, review articles and short articles are subject to peer review. Therefore when manuscripts are submitted to the Editorial Office, kindly include the names of 3 international reviewers, with their verified contact details (tel./fax numbers, and email addresses). This will assist in speeding up the review process.

## 1. Scope

The International SportMed Journal invites articles for submission from the areas of: (1) prevention, diagnosis, treatment, and rehabilitation of sport- and exercise-related injuries; (2) medical illnesses induced by, or exacerbated by exercise; (3) the relationship between exercise and health, including exercise physiology; (4) the medical care of physically active individuals; (5) biomechanics related to sport; (6) sports psychology; (7) sports nutrition; (8) sports pharmacology; (9) sports radiology.

## 2. Editorial Office

All enquiries should be directed to the Technical Editor, Ms Yvonne Blomkamp. Her contact details are: UCT/MRC Research Unit for Exercise Science and Sports Medicine, Department of Human Biology, University of Cape Town, Sports Science Institute of South Africa, Boundary Road, Newlands 7700, South Africa. Tel. +27 (21) 650 4579; Fax: +27 (21) 686 7530; Email: Yvonne.Blomkamp@uct.ac.za

The Editorial Office will assist with any other queries about the journal's requirements.

## 3. General guidelines for the preparation of a manuscript

### *a. Style*

Manuscripts should be prepared in accordance with the Uniform Requirements for Manuscripts Submitted to Biomedical Journals as set out by the International Committee of Medical Journal Editors. (Available at: <http://www.icmje.org>).

When preparing the manuscript, kindly bear the following points in mind:

- All original research studies and case reports must contain a declaration (typically in the methods section), that a Research Ethics Committee (Board) has approved the research study.
- When reporting experiments on human subjects, authors should indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. If doubt exists whether the research was conducted in accordance with the Helsinki Declaration, the authors must explain the rationale for their approach and demonstrate that the institutional review body explicitly approved the doubtful aspects of the study. When reporting experiments on animals, authors should indicate whether the institutional and national guide for the care and use of laboratory animals was followed.
- Each author must be able to certify that he/she participated sufficiently in the work to take responsibility for the content and that the work is valid.
- To ensure that there is no conflict of interest, all affiliations, financial or otherwise, with any organisation or entity with a financial interest in the subject matter or materials discussed in the manuscript must be fully disclosed. In other words, there should be no financial interest that might influence, knowingly or unknowingly, the interpretation of results or those of others.
- All financial and material support for the work must be clearly identified.

*b. Submission details*

Kindly email manuscripts in electronic format to the Editorial Office for the attention of: Ms Yvonne Blomkamp at the following email address: Yvonne.Blomkamp@uct.ac.za. The physical address and other contact details are repeated here: UCT/MRC Research Unit for Exercise Science and Sports Medicine, Department of Human Biology, University of Cape Town, Sports Science Institute of South Africa, Boundary Road, Newlands 7700, South Africa. Tel. +27 (21) 650 4579; Fax: +27 (21) 686 7530

Authors should retain a copy of their article for reference, as manuscripts are not routinely returned.

*c. Formatting guidelines for all manuscripts*

All manuscripts must be produced using one of the following standard word processing formats: Microsoft Word (preferred), or Rich Text format (rtf). The files must be Windows-based.

The manuscript must be typeset and should not contain any extraneous formatting instructions. For example, use hard carriage returns only at the end of paragraphs and display lines (e.g. titles, subheadings). Please observe the following conventions concerning dashes:

- a single hyphen with a space before it for a minus sign,
- a double hyphen (with space before and after) to indicate a 'long dash' in text
- a single hyphen (with no extra space before or after) to indicate a range of numbers (e.g. 23-45).

There should be no indented paragraphs.

*d. Language and grammar*

All manuscripts must be prepared in UK English, and because the ISMJ is an English-language journal, the English must be of an acceptable standard. If a manuscript is submitted by an author who does not have English as their first language, their manuscript may require to be checked by an online service that offers editing/proofreading of scientific language for non-English speakers before it is submitted to reviewers.

Use the passive voice in writing (e.g. Six elite athletes were tested).

Spelling should be English, not American, e.g. aetiology, anaemia. Use s-spellings, rather than z-spellings, e.g. minimise, organisation.

#### *e. Spacing and font*

- double-spaced text, with 2.5cm (1¼") left, right, top and bottom margins, with single line spacing,
- 10-pt font in Arial should be used in the text
- On the Title Page, title and sub-title heading - 14-pt Arial Bold
- author names in heading - 12-pt Arial Bold
- author affiliations - 10-pt Arial
- use sentence case for the title and sub-title of your article, and the author names

#### *f. Punctuation*

- no full stops in initials or abbreviations
- minimal hyphenation ¼ use only for words with non-, -like, -type, and for adjectival phrases that include a preposition, such as one-off event, run-in trial
- quotation marks ¼ use double inverted commas for reported speech. Full stops and commas go inside quotation marks
- reference numbers go before commas, full stops, semicolons and colons

#### *g. Headings and sub-headings*

For clarity, headings and subheadings in the text are recommended wherever appropriate.

- Major headings should be bold sentence case
- Sub-headings should be in italics sentence case
- Sub-subheadings should be plain sentence case underlined
- Non-standard characters

Greek letters, mathematical symbols, etc. should be coded consistently throughout the text. Please make a list of such characters and provide a listing of the codes used at the end of the manuscript.

### *i. Abbreviations*

These should be kept to a minimum, and if necessary, must first be written in full with the abbreviation given in brackets afterwards. Thereafter only the abbreviation should be used. Follow the CBE Style Manual (available from the Council of Biology Editors, 9650 Rockville Pike, Bethesda, Maryland 20814, USA) or other standard sources. For abbreviations of journal names, refer to the List of Journals Indexed in Index Medicus (<http://www.nlm.nih.gov/tsd/serials/lsiou.html>).

### *j. Drug names*

Use generic names only when referring to drugs, followed in parentheses after first mention by a commonly used variant generic.

### *k. Units of measurement*

These should be in metric (SI) units, except for blood pressure values which are reported in mmHg. Exceptions include calories, haematocrit, blood cell counts, fluid pressures, etc.

If in doubt, include both with the conventional units in parentheses. Temperature should be expressed in degrees Celsius, and time in terms of the 24-hour clock.

### *l. Acknowledgements*

These should be made where appropriate, particularly any source of funding provided for the study, technical assistance, and intellectual contributions not associated with authorship.

### *m. References (see examples following):*

The authors are responsible for the accuracy and completeness of the references. These are to be numbered consecutively in the text in superscript, without brackets,

in the order that they appear in the text. List all authors when there are three or fewer. If there are more than three, list the first three followed by, et al. The reference section should be inserted at the end of the text using the Vancouver style (see <http://www.icmje.org> ), following the sample formats given below. Journal titles should be abbreviated according to the abbreviations approved by Index Medicus (<http://www.nlm.nih.gov/tsd/serials/lji.html>).

All single word journal titles should be spelled out. Complete information should be given for each reference. It is the author(s) responsibility to verify references from the original sources before submitting the manuscript. Numbered references in the reference section should correspond to the order in which they appear in the text.

### **Examples of references:**

#### Journal article

1. Stratford PW, Miserfi D, Ogilvie R, et al. Assessing the responsiveness of Five KT1000 knee arthrometer measures used to evaluate anterior laxity at the knee joint. Clin J Sport Med 1991; 1: 225-228.

#### Online journal article

2. Grant S, Corbett K, Todd K, et al. A comparison of physiological responses and rating of perceived exertion in two modes of aerobic exercise in men and women over 50 years of age. BJSM 2002; 36: 276-281. Available at URL: <http://bjsm.bmjournals.com/cgi/content/full/36/4/276>

#### World Wide Web

3. International Federation of Sports Medicine (FIMS). Ventilatory muscle training in patients with chronic obstructive pulmonary disease (COPD). Available at: URL: [http://www.fims.org/position statements](http://www.fims.org/position%20statements). Accessed 30 September 2002.

## Book

4. Antonaccio MJ. Cardiovascular pharmacology. New York: Raven Press, 1990. References to books should give the names of any Editors, and page numbers, where relevant. The page numbers follow the date of publication.

## Chapter in book

5. Pedersen BK, Rohde T, Bruunsgard H. In: Pedersen BK (Ed). Exercise immunology. Austin, TX: RG Landes, 1997, pp. 89-111.

## Unpublished materials

6. This refers to any information source that is not officially released by an individual, publishing house, or other company, and can include both paper and electronic sources. Some examples of unpublished sources may include manuscripts accepted for publication but still "In press," data from an unpublished study, letters, manuscripts in preparation, memos, personal communications (including e-mails), and raw data Refer to these as "Unpublished manuscript", or if it has been accepted for publication use the term "In press". Authors of such papers should obtain written permission to cite them, and include verification that they have been accepted for publication, where relevant. For personal communications, these should be cited only in the text, not as a formal reference. Authors should get permission from the source to cite personal communications.

## *n. Tables:*

- Tables should be created with MSWord's Table facility, each on a separate page, with the title above and any notes below. Do not use MSExcel or comparative spreadsheet programs to create the Table.
- Tabs should used to separate columns.
- Explain all abbreviations.
- Do not give the same information in Tables and Figures.
- Each Table should be accompanied by an explicit, detailed legend.
- Number Tables sequentially as they appear in the text.

- If any Tables submitted have been published elsewhere, written consent to republish them should be obtained by the author from the copyright holder and/or the author(s).

*o. Figures and illustrations (including Images):*

- These must be mentioned in the text and should be referred to as Figures in the text (e.g. Figure 1, Figure 2, etc.). They should be provided in such a format that this Editorial Office is able to edit them, if necessary.
- Pictures, photographs, drawings, X-Rays or radiological images should be submitted as .jpeg files and should be of a high quality but should not exceed 1MB.
- Graphs should be submitted as .jpeg files, and should be provided such a format that this Editorial Office is able to edit it.
- Figure legend/s should be clearly indicated and they should be numbered sequentially in the text. Each figure should have a separate, detailed, fully explicit legend. All sections of the figure and all abbreviations and symbols used should be clearly defined.
- There should be no markings on X-Rays before photographing (such as patient's initials, dates, degree markings). Any arrows or lettering must be applied with a professional product. These identifying marks should be large enough to be seen when the photo is reduced. Sequences of radiographs should be of the same magnification. The subject should be centred in clinical photographs.
- A consent form from the subject must be included, or the subject and case details must be made unidentifiable.
- Crop out extraneous material and background, or provide this in such a format that this Editorial Office is able to edit the Figure.
- If any of these illustrations have been published elsewhere, written consent to use them should be obtained by the author from the copyright holder and/or the author(s).

*p. Patient anonymity and informed consent*

Articles reporting results on human subjects or patients must be accompanied by a statement that the subject(s) gave written, informed consent, and the necessary documentation of approval from the appropriate Ethics Committee. It is the author(s) responsibility to ensure that a patient's anonymity is protected in the manuscript submitted. Authors should mask patients' eyes and remove patients' names from figures unless written consent has been obtained from the patients to leave these details in the manuscript.

*q. Verification of data*

If necessary, the author(s) must be prepared to produce the data on which the manuscript is based for examination by the Editor-in-Chief.

*r. Rejected articles*

In the event of an article being rejected as unsuitable for publication by the ISMJ, the Editor's decision must be regarded as final.

*s. Reprints*

Once an article has been published on the web site, the authors will have free access for a limited time (3 months) to the article. The .pdf file of the article will be made available to each author on publication of the issue of the journal on the web site. This .pdf file will be sent to all authors and will be available for downloading from the full-text version on the web site as shown following the Abstract.

#### *t. Copyright*

The International Federation of Sports Medicine (FIMS) will hold copyright on all published articles. In view of the present copyright law, it is necessary that the author of a submitted manuscript sign a statement expressly transferring copyright in the event the paper is published in the journal. The Editorial Office will send a Copyright Transfer form to the corresponding author before the manuscript is published online.

#### *u. Permissions*

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#### 4. Specific guidelines according to different types of articles

The ISMJ publishes original research articles, review articles, short articles, and Letters to the Editor.

The specific detailed author instructions for each are discussed below:

##### *a. Original research articles*

This should be clinically relevant original research, and the length of the article should generally not exceed 3000 words.

All articles should contain original data concerning the course (prognosis), cause (aetiology), diagnosis, treatment, prevention, or economic analysis of a clinical disorder or an intervention to improve the quality of health care.

A structured abstract of no longer than 250 words must be included, using the following headings;

- Background: State in 1-2 sentences the background for performing the study.
- Research question: State the main research question or objective of the study and the major hypothesis tested, if any.
- Type of study: Indicate the type of study design used to answer the question, e.g. randomised controlled study.
- Methods: Describe in 1-2 paragraphs the methodology used to answer the research question. The following sub-headings are useful: subjects (or participants, patients), sampling, experimental procedure (including if any interventions), and main measures of outcome.
- Results: Describe the results, including actual numerical values and statistical test results.
- Conclusions: State only those conclusions of the study that are directly supported by data, along with their clinical application (avoiding over-generalisation) or whether additional study is required before the information should be used in usual clinical settings. Equal emphasis must be given to positive and negative findings of equal scientific merit.

The text of the manuscript with regard to original research articles should be arranged in the following sequence:

- Title page

This should contain the title and sub-title (where relevant) of the article, the full names, highest academic degrees, and affiliations of all authors. The full contact details (including address, tel. no., fax no., and email address) of the corresponding author must appear at the bottom left of the page. An appropriate running title header, not exceeding 45 letters and spaces, should also be included. Information concerning sources of financial support should be placed in the Acknowledgement section.

- Abstract (including 5 keywords)

The page following the title page should include a structured abstract as described above. The abstract should be followed by 5 keywords (e.g. Keywords: )

- Author biography (ies)

Each author should include a short biography that includes academic title/degrees, affiliation, research focus, awards and societal affiliations, and previous publications of note (not more than 10 of the most recent).

- Introduction

An outline of the article's background and rationale should be included, ending with a clear statement of the research question, where relevant.

- Methods

This should provide sufficient detail for the reader to be able to replicate the study. Published methods should be described in brief, with appropriate citation.

- Results

These should be concise and not contain repetition of the methods. Data in the text should not be replicated in the tables or figures or vice versa.

- Discussion

There should be a distinction between deduction and speculation.

- Conclusions

Only conclusions directly supported by the evidence should be included, as well as applications in clinical and other settings. Implications for further study should also be mentioned. A short section should summarise the clinical relevance of the research.

Suitable Tables and Figures can be included, followed by the References.

All Original Research articles are reviewed by 3 international reviewers.

### *b. Review articles*

These are systematic, critical assessments of literature and data sources pertaining to the course (prognosis), cause (aetiology), diagnosis, treatment, prevention, or economic analysis of a clinical disorder or an intervention to improve the quality of health care, covering established and new concepts in sports medicine. Their length should generally be 2500-4000 words.

There should be an abstract of not more than 250 words summarising the main points in the review, under the following headings:

- Objective: State the primary objective of the article.
- Data sources: Describe the data sources that were searched, including dates, terms and constraints.
- Study section: Identify the number of studies reviewed and the criteria used for their selection.
- Data extraction: Summarise guidelines used for abstracting data and how they were applied.
- Data synthesis: State the main results of the review and the methods used to obtain these results.
- Conclusions: State primary conclusions and their clinical applications, avoiding overgeneralization. Suggest areas for additional research if needed.

The abstract should be followed by 5 keywords.

The text of the manuscript with regard to review articles should be arranged in the following sequence:

- Title page

This should contain the title and sub-title (where relevant) of the article, the full names, highest academic degrees, and affiliations of all authors. The full contact details (including address, tel. no., fax no. and email address), of the corresponding author must appear at the bottom left of the page. An appropriate running title header, not exceeding 45 letters and spaces, should also be included. Unless otherwise indicated, the proofs will be sent to the corresponding author. Information

concerning sources of financial support should be placed in the Acknowledgement section.

- Abstract (including 5 keywords)

The page following the title page should include a structured abstract as described above. The abstract should be followed by 5 keywords (e.g. Keywords: )

- Author biography (ies)

Each author should include a short biography that includes academic title/degrees, affiliation, research focus, awards and societal affiliations.

- Introduction

An outline of the article's background and rationale should be included, ending with a clear statement of the research question, where relevant.

- Methods

This should provide sufficient detail for the reader to be able to replicate the study. Published methods should be described in brief, with appropriate citation.

- Results

These should be concise and not contain repetition of the methods. Data in the text should not be replicated in the Tables or Figures or vice versa.

- Discussion

There should be a distinction between deduction and speculation.

- Conclusions

Only conclusion directly supported by the evidence should be included, as well as applications in clinical and other settings. Implications for further study should also be mentioned.

Suitable Tables and Figures can be included, followed by the References.

All Review articles are reviewed by 3 international reviewers.

### *c. Short articles*

Short articles can be a case report, an office procedure, or a clinical examination, and should not exceed 2000 words. The articles should have an unstructured abstract of no more than 200 words that summarises the objective, main points, and conclusions of the article. The abstract should be followed by up to 5 keywords

In general, the text of the manuscript with regard to short articles should be arranged in the following sequence:

- Title page

This should contain the title and sub-title (where relevant) of the article, the full names, highest academic degrees, and affiliations of all authors. The full contact details (including address, tel. no., fax no. and email address), of the corresponding author must appear at the bottom left of the page. An appropriate running title header, not exceeding 45 letters and spaces, should also be included. Information concerning sources of financial support should be placed in the Acknowledgement section.

- Abstract

The page following the title page should include a structured abstract (link this) as described above. The abstract should be followed by 5 keywords (e.g. Keywords: )

- Author biography (ies)

Each author should include a short biography that includes academic title/degrees, affiliation, research focus, awards and societal affiliations.

Then follow the guidelines listed below, based on the type of short article.

#### Types of short articles:

##### Case report

- An Introduction should outline the unique importance for presenting the case report.
- Clinical history should follow (1-2 paragraphs) and the differential diagnosis.

- Under Clinical examination, relevant findings (both positive and negative) should be outlined in 1-2 paragraphs, followed by the clinical diagnosis (this can be a list).
- Special investigations. If undertaken, their results should be described in 1-2 paragraphs. These can be illustrated with a maximum of 2 images.
- Final diagnosis should be expressed in 1-2 lines.
- Management should be discussed in 1-2 paragraphs.

### Office procedure

This should be discussed under the following headings:

- Introduction
- Indications and contra-indications
- Description of the clinical procedure, including a maximum of 2 images where relevant.
- Main clinical importance of the procedure. A summary of the main clinical practice points should conclude the report (i.e. what can a clinician learn from this case).

### Clinical examination technique

The following headings can be used as guidelines:

- Introduction, discussing the reason(s) for the test.
- Indications
- Results
- Notes on the repeatability and validity of the test.
- Where relevant, a maximum of 2 images can be included for illustration.

In all cases the length of the articles excludes Tables, Figures, Images and References.

All these articles will be reviewed by 3 international reviewers.

#### *d. Letters to the Editor*

The ISMJ welcomes letters discussing recent articles published in the journal. They should not exceed 300 words and contain not more than 3 references. The author's name and affiliation, as well as an email address should be included.

#### 5. Manuscript revisions

If a manuscript is returned to the authors for revision after review, the reviewers and/or editorial comments will be included. If it is indicated that the manuscript may be resubmitted, this should be done within one month to be considered for publication. Revised manuscripts must be returned with a cover letter, the revised manuscript, and a letter itemising, point by point, the response to each of the suggestions/criticisms raised by the reviewers, highlighting the response and revisions made to the manuscript, or providing justifiable rebuttal. The ISMJ will acknowledge receipt of the revised manuscript and where required, will send the revised manuscript back to the reviewers. If the revisions are satisfactory, the ISMJ will notify the authors that their manuscript has been accepted for publication.

