A study of Schoolgirl's Perceptions of Injury Associated with Rowing.

Student:	Michelle Funder 3552125
Principal Supervisor:	Patrick McLaughlin
Co- Supervisor:	Jenny Hynes
Department:	Health Sciences- Osteopathy
Campus:	Flinders Lane, City Campus

Abstract

The aim of this study was to determine the incidence and reported type of injury in senior level schoolgirl rowers over the 2004-2005 rowing season. Data was gathered via survey and it was found that18% of rowers sustained injuries (n=34), of this group 18 were sweep rowers and 16 were scull rowers. There was a difference in injury pattern between sweep and scull rowing. Lumbar and shoulder injuries were more prevalent in sweep rowers. Previous research suggests lumbar spine injuries are the most common injury in rowing and this research supported this with 32% (n=12) of injuries to the lumbar spine. Shoulder injuries were the second most common injury (18%). Apart from illness, shoulder and low back injury caused the greatest amount of time off training. Research shows that whilst most injuries occur due to rowing itself, injuries can be sustained during cross training. Our research showed that rowing caused the most number of injuries 48%, followed by ergometer 21%, running 14% and then weights 12%. It can be suggested that lumbar and shoulder injury prevention and rehabilitation should be incorporated into rowing programs. Rowing technique, especially at times of fatigue, must be a focus for prevention of injury.

Key words: rowing, sweep, scull, injury, school girl

Words 200

Definitions

Sweep rowing: One long oar is used. This style of rowing is asymmetrical and requires the body to rotate towards one side of the boat (stroke or bow side).

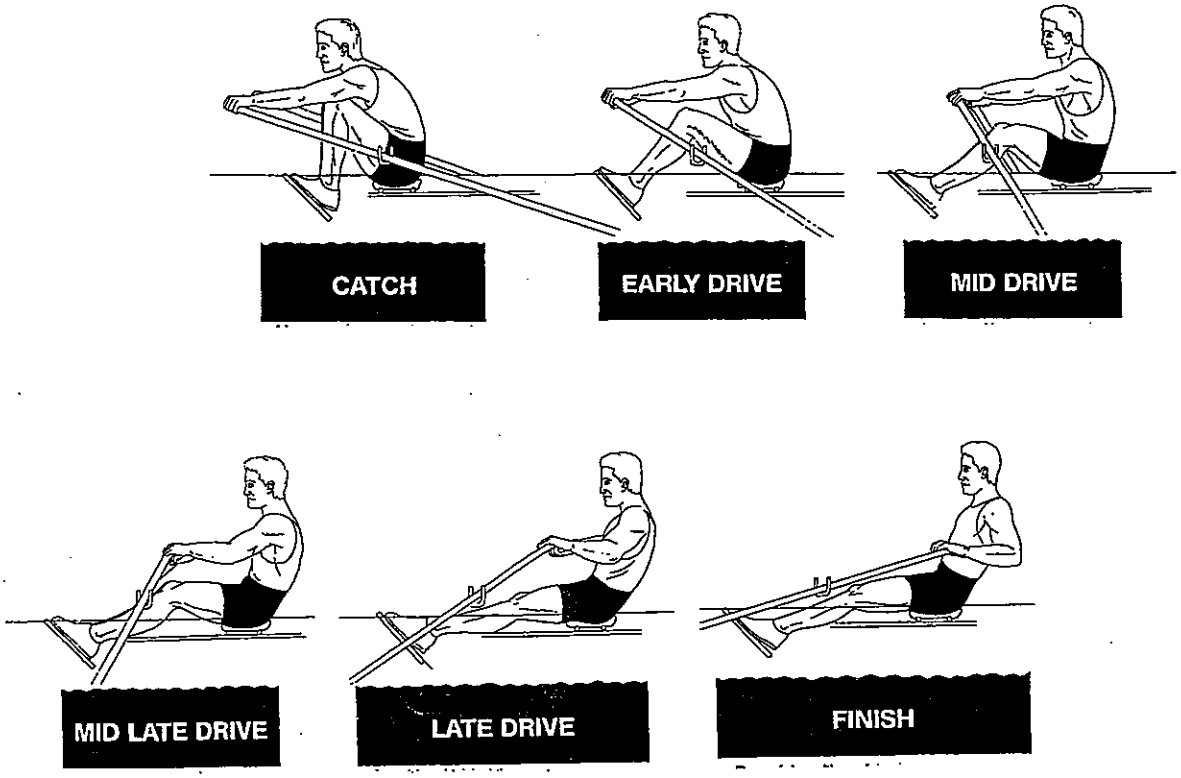
Stroke side: Right hand side oar used in sweep rowing. Asymmetry favours the left.

Bow side: Left hand side oar used in sweep rowing. Asymmetry favours the right.

Scull rowing (sculling): Two short oars are used. It is symmetrical.

Catch: The rower is close to the stern (front) of the boat and has the blade in the water. The knees and hips are flexed, the arms are outstretched and the body is rocked (flexed) over.

Drive: The legs and trunk extend back and the blade moves through the water causing motion of the boat.



Introduction

Rowing is one of the most popular schoolgirl sports in Australia. In Victoria alone there are 47 schools competing and over 1700 (20) girls involved. Rowing is a demanding team sport with senior level rowers (years 11 &12) training 7 times a week (this includes weights, ergometer, running and rowing) and competing every weekend during the first school term. The season lasts approximately 19 weeks from August through to March.

Injuries occur frequently in rowing and may cause loss of training time and inconvenience to crew members and coaches (3). Although rowing is a sport with a long history, studies of rowing injuries have been limited, mainly due to the perceived low risk of major injury as most injuries sustained in the course of rowing training are mild to moderate injuries; more often chronic (6). Most research to date is aimed at elite athletes competing at a State, National or International level. There has been limited research into the types of injuries that schoolgirl rowers experience.

This aim of this research was to collect data on the incidence, site and types of injuries that affect schoolgirl rowers over a single rowing season. Further more comparisons were made between the incidence and site of injury in sweep and scull rowers. From the data gathered, important factors and trends were identified to provide information so that specific injury prevention and awareness can be included in their training programs. (Injury was defined as missing one or more training session).

Injuries may occur during related cross training such as weights(strength training), ergometer or running. Hickey et al. (6) found that there was a large number of injuries sustained during cross training sessions in a 10 year study of Australian Institute of Sport rowers. Coburn and Wajswelner (3) found that 65% of injuries occurred from rowing itself and 28% in the weights room in a survey of 54 consecutive rowing injuries that presented to a sports medicine clinic over a 12 month period.

Difference in injury between sculling and sweep rowing

It has been suggested, but not investigated, that there is a higher incidence of injury in sweep rowers due to the different forces acting on the lumbar spine (11). In both sculling and sweep rowing there is a combination of flexion with compressive load, this has been identified as a mechanism for injury to the lumbar spine. Reid and McNair, (13) reviewed the literature of factors identified in contributing to low back pain in rowers. They suggest that during sweep rowing the combination of flexion, rotation and compression at the catch places considerably more stress through the facet joint capsules and ligaments and may facilitate damage to discs, however, evidence for this is non-conclusive and more research is needed.

Low back injuries

Low back injuries are a significant problem in women rowers (6, 3, 11, 8, 9,16). Mosler & Wajswelner (10), suggested some predisposing factors for lumbar spine injury based on anecdotal clinical evidence, which included poor rowing and weight training technique, inadequate stretching and flexibility especially of the hip joint and or muscles passing over this joint, poor stabilising action of the abdominal and lumbar extensor muscles, and changes in the equipment or position in the boat. Reid &

McNair (13) suggest that the amount of lumbar flexion that occurs during a rowing stroke may influence the possibility of low back injury. This is based upon cadaveric research that shows that an excessive amount of lumbar flexion can sprain ligamentous structures and, in combination with compression, induce damage to intervertebral discs.

Lumbar spine injuries are the most common injuries in rowing according to clinical data collection studies(3,4,8,15). Howell (8), in a retrospective study of 17 national level US lightweight women rowers, found that 82% of female lightweight rowers experienced occasional, or chronic, low backache or discomfort. This study used a very small sample size compared to that of Coburn et al. (4) which used a population of 90 state level and156 international rowers, reporting 44% and 24% had low back injuries respectively. Hickey et al. (6) found lumbar spine injuries to be the second most common over the ten year retrospective study (15.2%)but lumbar spine injury was the highest cause of acute injury, 21.1%.

Caldwell et al. (2) studied a group of 16 young adult school rowers and the effects of repetitive motion on lumbar flexion and erector spinae muscle activity in rowers. The study used computerised motion analysis of surface markers attached to the spinous processes of L5 and S1 to measure lumbar flexion and surface electromyography to quantify fatigue in the erector spinae muscles whilst preforming an ergometer trial. The researchers observed during the ergometer that extensor muscle fatigue occurred and lumbar spine range of flexion increased which, led them to hypothesis that this would place the soft tissue structures of the spine under more stress. They also speculated that muscle fatigue may lead to a decrease in the ability of the subjects to

sense a change in lumbar position and that a decrease in proprioception may lead to an increase in lumbar flexion.

Teitz et al. (17) did a follow up study on a group of American College rowers who had experienced back pain during their rowing career. They hypothesised that rowers who develop back pain in college are more likely than the general population to have back pain later in life. They found that 51.4% of the sample had experienced low back pain for at least 1 weeks duration since ceasing rowing. They also found that subsequent back pain was twice as likely in subjects who had back pain in college than in those who had not had back pain during college.

Rib stress fractures

Stress fractures have been identified more commonly in women rowers (19,6,3). In a 10 year study of injuries to elite rowers Hickey et al., (6) found that 15 rib stress fractures occurred in a group of 84 females compared with 2 in a group of 88 males. Many of these females had repeated stress fractures over the years. Rib stress fractures are reported to be the cause for most time lost from on-water training and competition (3). Coburn & Wajswelner (3) found that 44% of athletes with stress fractures had more than 1 week off training. The exact cause of rib stress fractures has not been identified. Warden et al. (19) in a review of literature of the aetiology of rib stress fractures in rowers hypothesised many causes for rib stress fractures, these included equipment type, rowing technique, weight training technique and volume and a range of muscle and joint factors.

Knee injuries

The prevalence of knee pain in rowers is not high. Hickey et al. (6) reported that only 9.3% of injuries over a 10 year period were associated with the knee. Coburn and Wajswelner (3) found from eight knee injuries five included semimembranosis bursitis and three patellofemoral tracking dysfunctions. Karlson (9) suggests that patella femoral tracking problems are more prevalent in women, in any sport, but in rowing there is a further possible exacerbated due to the fixed nature of the shoes within the boat. This however is merely a hypothesis and has no evidence to support it.

Wrist injuries

Based on clinical anecdotal evidence Mosler & Wajswselner (10) suggest that both forearm extensors and flexors can become compromised mainly due to poor technique such as excessive grip of the oar and this may lead to compartment syndrome. Again, anecdotal evidence is not credible evidence and further study should be conducted. Wrist injuries were classed as the third most common injury by both Hickey et al. (6) and Coburn et al. (4). Hickey et al. (6) found that forearm and wrist injuries were the second highest cause of chronic injuries and that the most common specific injury in female rowers was tendonitis/tenosynovitis of the wrist/forearm. This diagnosis included De Quervain's tenosynovitis, intersection syndrome and tendinitis/tenosynovitis involving other tendons of the wrist/forearm.

Dermatological injuries

Dermatological problems are very prevalent as the hands of rowers are highly susceptible to blisters from friction between their hands and the oar handle. Blisters

are mostly self treated and not limiting to training except in the case of secondary infection where antibiotic is the best form of treatment. Oars are usually shared among different crews, therefore open wounds or blisters may serve as a potential source for blood or body fluid exposure (9). Roach & Chretien (14) found an increased incidence of hand warts among members of a rowing team.

Adolescent females and sports injuries

Senior school girl rowers are aged between 15 and 18 years. Adolescents are vulnerable to repeated injury owing to growth-related soft tissue and bone stresses. Grimmer et al. (5), undertook descriptive retrospective research into the prevalence of adolescent recreational and sporting activities and associated injuries in Australia. The study did not include rowing. A sample size of 3538 randomly selected 11-12 and 15-16 year olds in South Australia participated. The study established that 8% of adolescents drop out annually because of injury or because of fear of it. Also, injury-related attrition of adolescents from recreational exercise has implications for their future mental and physical health, fitness, and well-being. Though the study was not rowing specific we can draw some parallels with the nature of adolescent attitudes towards injury.

Method

This was a retrospective study that involved senior level schoolgirl rowers from 7 Melbourne girl schools over the 2004-2005 school rowing season (n=186). Ethical approval was granted by the Victorian University Ethics committee before the commencement of data collection. Schools were invited to participate in the study via direct contact with the Director of Rowing. Athletes were then invited to participate in the study via a group meeting with the student researcher. Confidentiality was maintained by the return of anonymous questionnaires via the mail to the principal researcher.

An initial history of injuries was obtained from participants in an Initial Injury Report Form (***appendix A***) and this was returned (via reply paid mail) along with a consent form completed by the participant and their guardian. Over the 2004-2005 rowing season Injury Report Forms (***appendix B***) were filled out when participants received a new injury, aggravated an old injury or were ill. Injury was defined as: injury that caused the athlete to miss a training session. Injury reports were filled out when the injury occurred during: rowing, weights, ergometer, cycling, equipment, running or other school sport activity. Forms were lodged at the individual school's rowing shed in a secure box that the subjects were aware of. All forms were collected at the end of the 2004-2005 rowing season.

Surveys were constructed by the student researcher and a professional in the field, and trialed amongst three health care professionals. Due to ethical confidentiality considerations there were no identifying factors on either the Initial Injury Report Forms or Injury Report Forms. As a result of this there was no way to match those

participants that filled in Initial Injury Report Forms to those that completed Injury Report forms during the season or to identify if an athlete filled in more than one Injury Form.

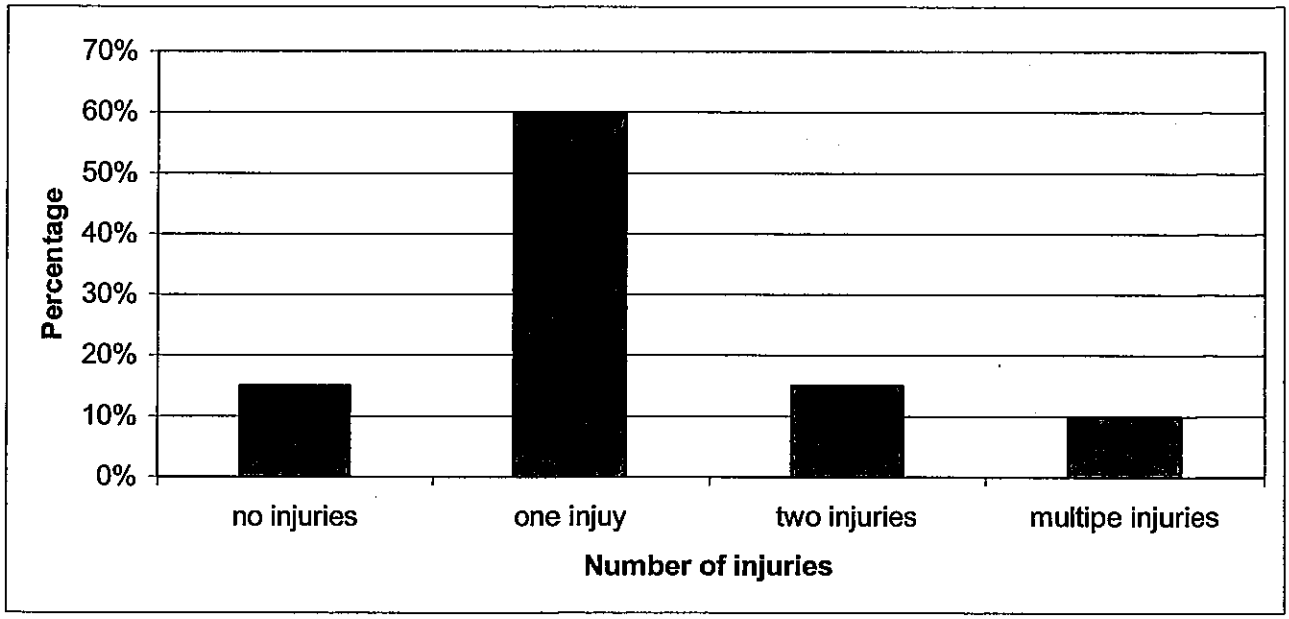
Data was gathered on the site, type and incidence of injury, treatment modality, and time required away from training due to injury. General information about rowing status was also obtained such as type of boat rowed in, if in a sweep boat what side did they row on, what year level they are in and how many years they have rowed for? Data were analysed and graphed using Microsoft Excel.

Results

Initial Injury Report Form Data:

There was a return rate of 11% of the initial injury surveys (n=20). Graph 1 illustrates that from the surveys returned, 85% of rowers (n=17) had one or more injuries during a previous rowing season.

Graph 1: Percentage of rowers that have had a previous injury

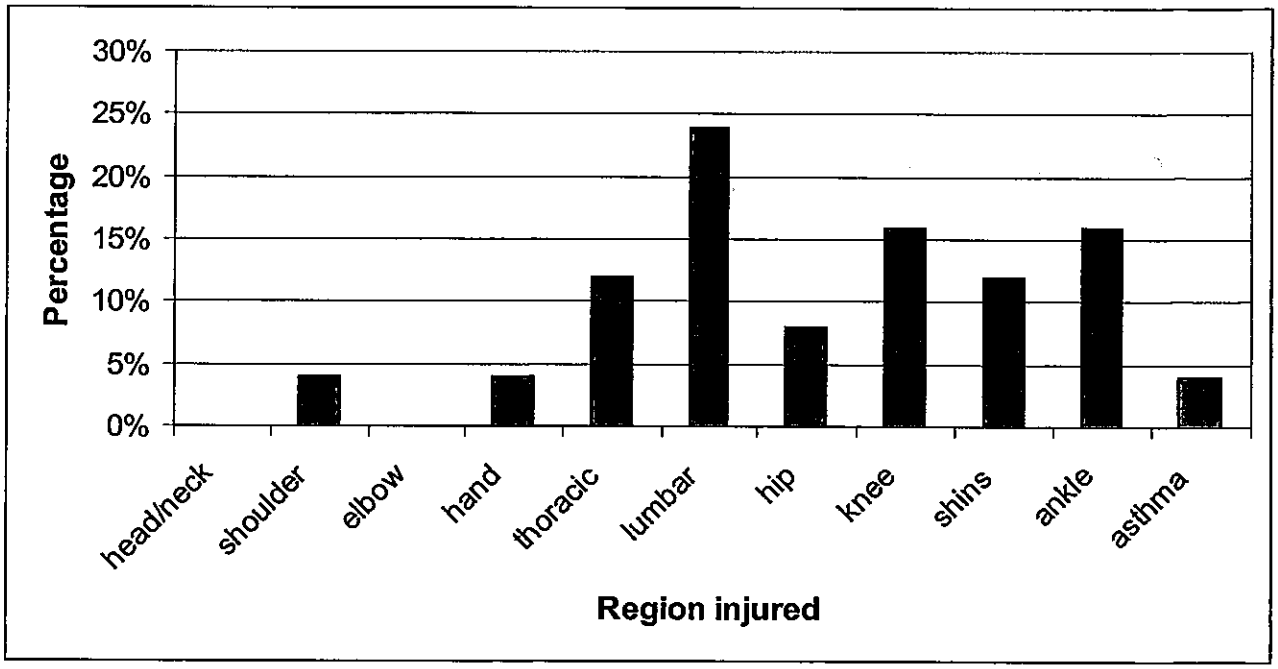


The Initial Injury Report forms gave an indication of whether a participant had an injury during a previous rowing season. Previous history of an injury may predispose an individual to an increased risk of re-injury to that region. Therefore screening athletes for past injuries should play a role in planning their training program so that appropriate prevention or rehabilitation is incorporated.

As shown in Graph 2 low back injuries were the highest number (24%) of reported injuries during previous rowing seasons. All shin injuries were reported as shin splints and were caused by running and not rowing. The two ankle injuries which were two rolled ankles were caused by netball and a fall down the stairs. This highlights that schoolgirls may participate in many other sports and are therefore vulnerable to other sporting injuries. Other sports that rowers participate in must be taken into account when assessing the individual athlete's risk of injury.

Athletes that returned the Initial Injury Survey may have been bias as athletes who have had previous injuries may have more of an immediate interest and awareness of their injuries compared to those without. This may have contributed to the low response rate of the Initial Injury Survey.

Graph 2:Regions of the body that were most commonly injured during a previous rowing season

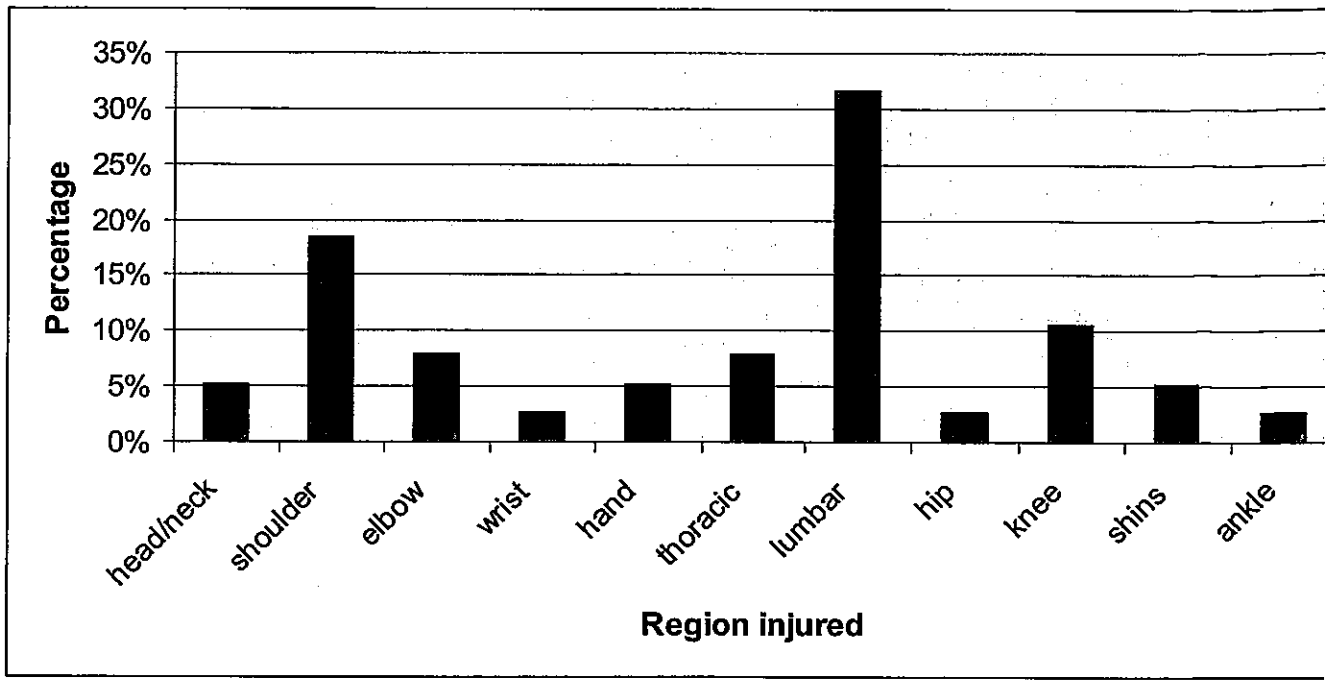


Injury Report Form Analysis:

Of the total sample (n=186) there were 34 returned questionnaires, therefore18% reported an injury during the season. The rest of the data analysis is based on the 34 returned questionnaires.

As hypothesised the most commonly reported injury was to the lumbar spine, which, accounted for 32% (n=12) of injuries (Graph 3). The second most common site for injury causing 18% (n=7) of injuries was to the shoulder followed by 11% (n=4) of injuries occurring at the knee. Shoulder injuries in rowers are often due to poor technique at the catch, such as over reaching causing extra strain though the shoulder complex as the drive phase begins. Of the four knee injuries all were reported as patella tracking dysfunction.

Graph 3: Percentage of regions injured



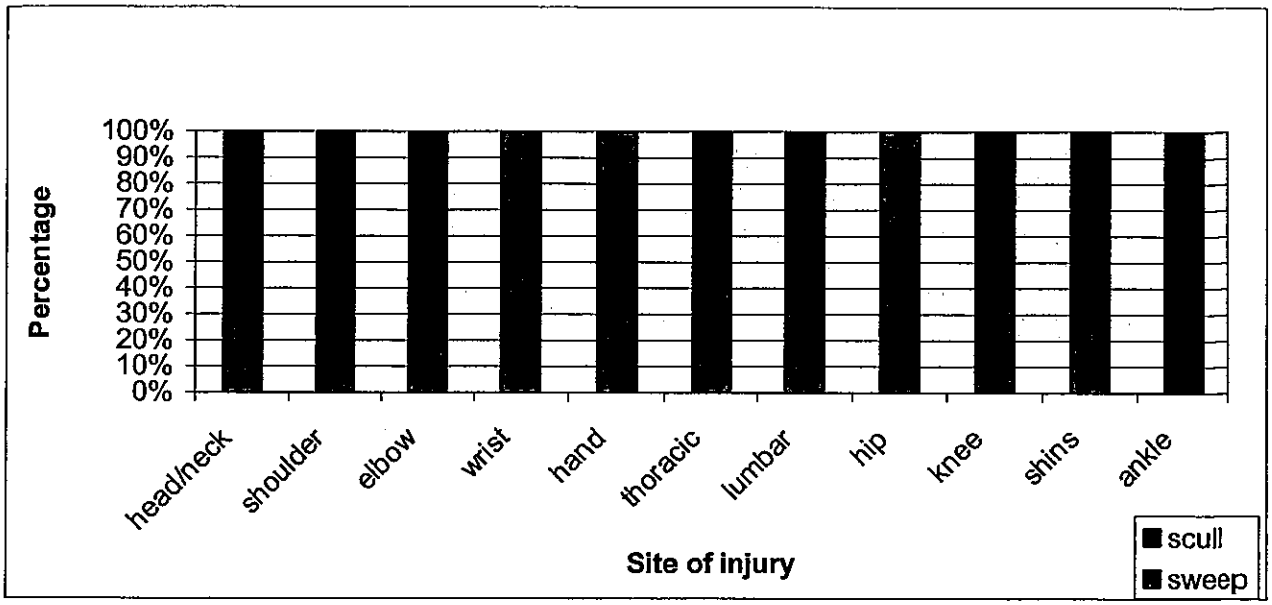
Of the surveys returned 18 were sweep rowers and 16 scull rowers (Table 1).

Table 1: Number of athletes injured sweep vs scull

Type of rowing	Number of athletes with injury
Sweep	18
Scull	16

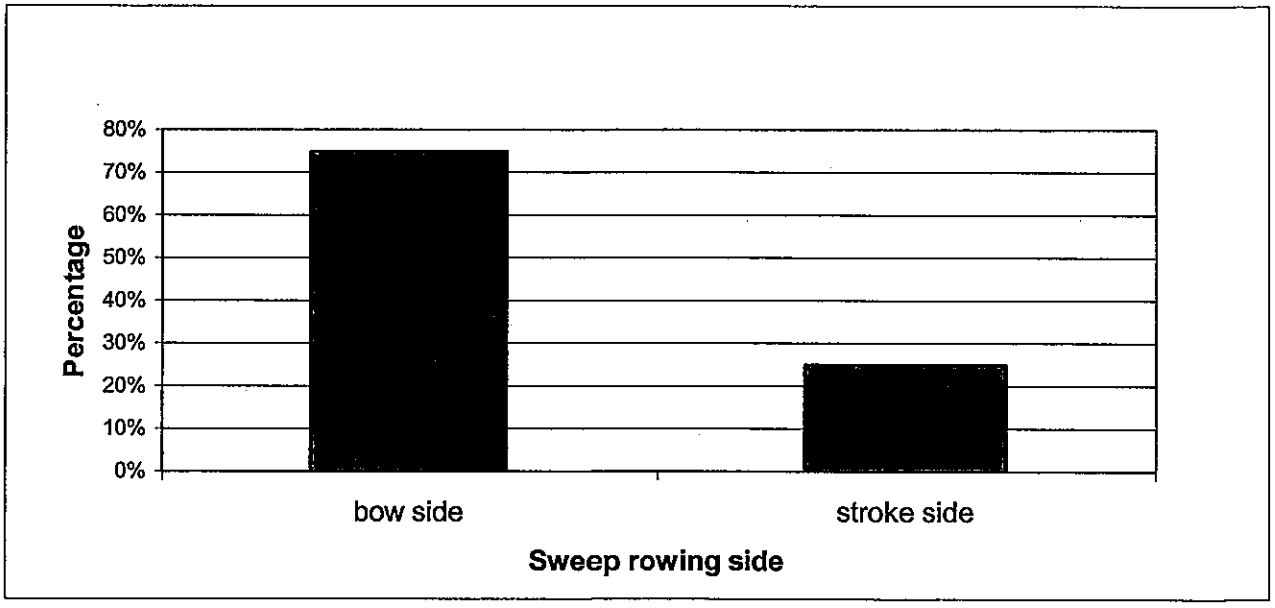
Graph 4 illustrates the percentage of regions injured comparatively between sweep and scull rowing. Lumbar spine injuries were reported in sweep rowers at a slightly higher rate 58% (n=7) compared to scull rowers 42%(n=5). Shoulder injuries occurred more frequently in sweep rowers 60% (n=4) compared with scull rowers 40% (n=3).

Graph 4: Site of injury, sweep vrs scull



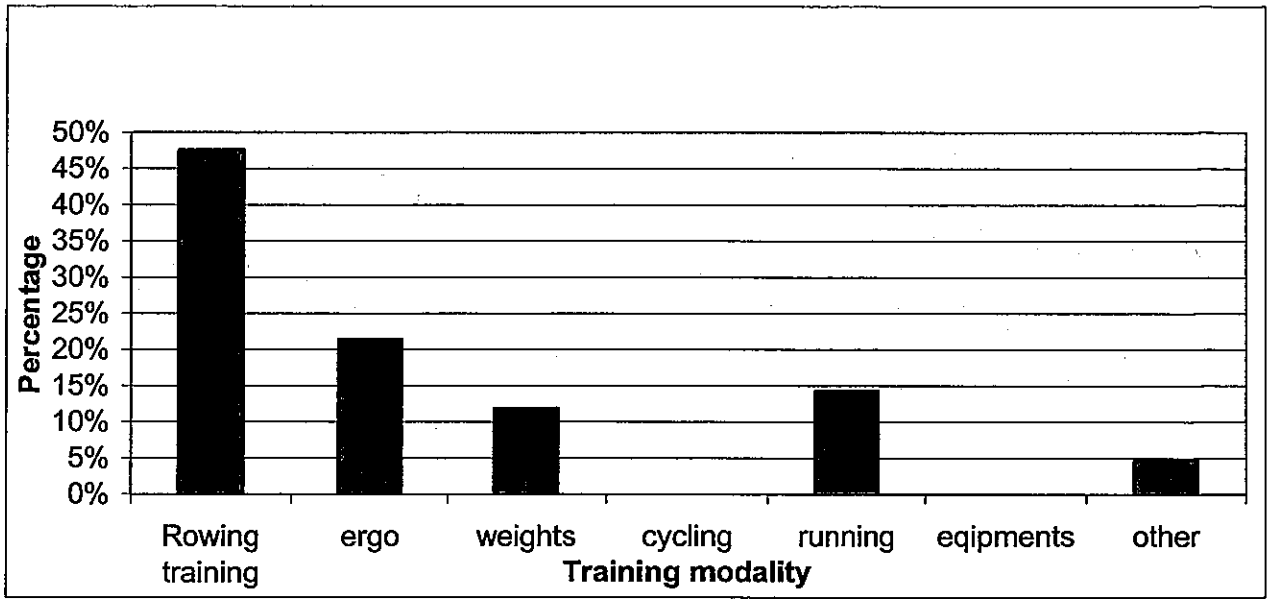
Of the sweep rowers (n=18), 75% presenting with injury were bow side rowers, and 25% were stroke side rowers (Graph 5). Of the stroke side injuries, three were right sided low back pain (the other was an illness; flu). The bow side rowers reported a spectrum of injuries including: low back, patella tracking dysfunction, shoulder injuries (two with associated thoracic dysfunction), infected blisters, wrist injury, chest infection, and shin splints.

Graph 5: Number of injuries in sweep rowing: stroke side vrs bow side.



48% of injuries (n=20) were associated with rowing, followed by ergometer training 21%, running 14%, weights 12% and other 5% (swimming & netball) (Graph 6). No injuries were reported due to equipment or cycling.

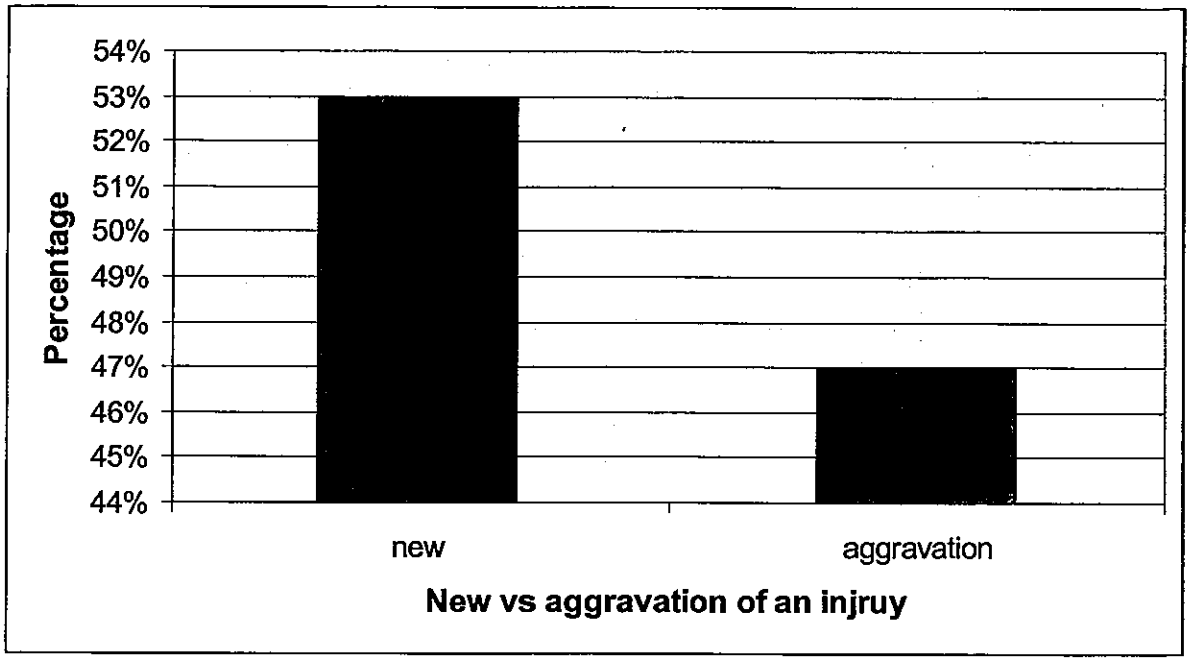
Graph 6: Activity when injury occurred



Graph 7 shows that 53% of injuries (n=18) were reported as new injuries and 48% were aggravation of an injury (n=16) (five illnesses have been removed from this data). The high number of new injuries during the season highlights the need for prevention programs to be implemented during the entire season to decrease the risk of injury. Of the 18 new injuries, 11 were to sweep rowers and 7 were to scull rowers. New injuries were: 7 low back injuries, 7 shoulder injuries, 1 wrist injury, 2 infected blisters and 1 knee graze. This highlights the need for both lumbar and shoulder injury prevention to be incorporated into school girl rowing training.

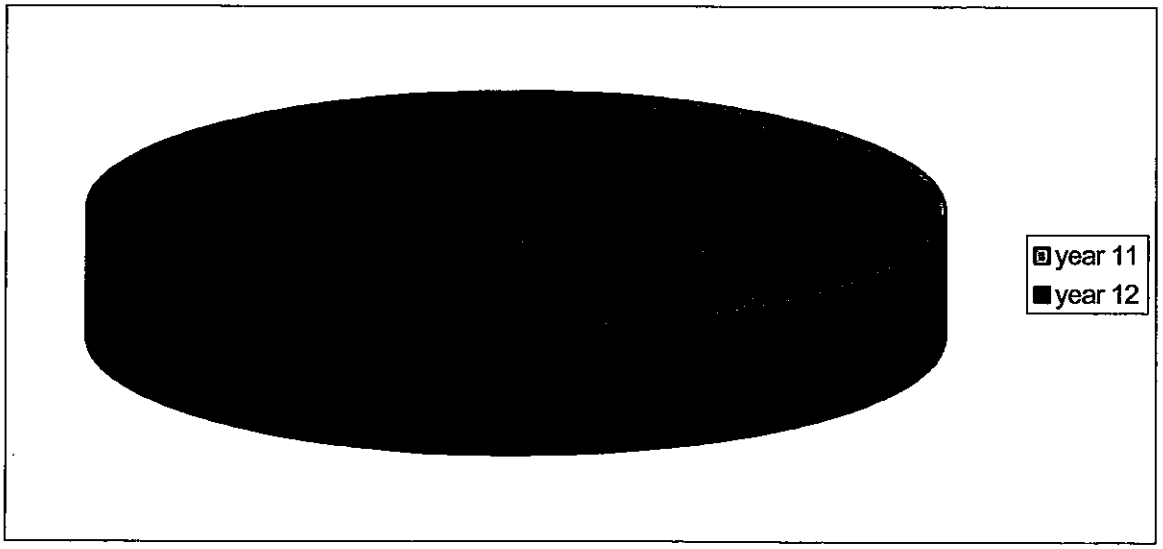
An injury which was aggravated was either one that was obtained during a previous rowing season or sustained from another sport. Of the 16 re aggravated injuries, 5 were low back injuries, 3 patella tracking dysfunction, 3 elbow injuries, 2 thoracic 2 shin splints and 1 compartment syndrome (shin).

Graph 7: Reason for injury presentation: New injury vs Aggravation of an injury.



Senior level rowing comprises of year 11 and 12 students. Of the total number of injuries reported 56% (n=19) were year 11 students (Graph 8).

Graph 8: Distribution of injury between year 11 and 12 students.



Of the 34 injured 17 had time off training and competition. Of the subjects that reported not having time off rowing training (n=17), 12 were receiving treatment for their injuries.

An average of the days off training was calculated for the different sites of injuries to gauge which injury caused the greatest amount of time off rowing training (Table 2). Low back injury and upper limb injury had the greatest number of athletes having time off training and had approximately the same, on average, days off training. Overall illness caused the greatest time off training.

Table 2: Average time out of the boat for an injury:

Injury (region)	Illness	Low back	Upper limb	Lower limb
Range [min-max]	7-21 days	2-18 days	1-28 days	1-7 days
Number of subjects	3	6	6	2
Average time off training	12 days	7 days	8 days	Days

Discussion

During the 2004-2005 rowing season 18% of invited schoolgirl rowers reported that they had sustained injuries (n=34). Of the returned Initial Injury Report Forms (n=20) 85% reported that they had experienced an injury during a prior rowing season. Whilst this is a small number of responses to study, and consideration must be taken into account for athletes that did not report their injuries, trends can still be analysed and used to provide information on injury in schoolgirl rowers.

During the 2004-2005 season, rowing training/competition was reported as causing the largest number of injuries (48%) followed by rowing ergometer training (21%), running (14%) and weights (12%). These findings are in accordance with past literature (6,3).

Schoolgirls have approximately 5 rowing, 2-3 weights and 1 ergometer and running session per week. Pelham et al. (11) suggests that rowing related injuries can be attributed to cumulative stress placed on particular areas or systems of the body by the improper performance of the repetitive pattern of movement or training regiment. Therefore if an injury is aggravated by rowing or ergometer, analysis of the rowing technique must be undertaken to identify whether improper technique is maintaining their injury. Altering the training program for rowing sessions to minimise strain through the areas of injury should also be considered.

Pelham et al. (11) suggested a difference between the incidence of low back pain between sweep rowers and scullers, as sweep rowers have additional rotational forces going through their spine. The present study explored the trends of injuries between

sweep and scull rowing. Of the rowers presenting with injury 53% were sweep rowers and 47% scull rowers. Throughout the season 58% of low back injuries occurred in sweep rowers, this difference is too small to support Pelham's hypotheisis statistically. Another trend noted amongst sweep rowers was a higher number of shoulder injuries reported (60%). This may be due to the extra forces that go through the dominant arm during the asymmetrical sweep stroke. Of the new injuries that were reported during the season 11 of them were sweep rowers compared with 7 scull rowers. Although there is a slight difference between the trends of injury comparing sculling and sweep rowing, due to the small number of participants these comparisons are not meaningful statistically.

Seventy-five percent of the sweep rowers who presented with injury were bow side rowers. This result was surprising as logic may predict more injuries to stroke side, as it is a left side dominant technique and perhaps may be more unnatural for right side dominant athletes. The high number of injuries to bow side is difficult to explain. Perhaps, if a larger population size was studied there may be a more clearly defined difference or equally, similarity between stroke and bow side. No literature has investigated the difference of injury between stroke and bow side injuries so further investigation into this would be of value.

The region of the body that had the greatest number of reported injuries was the lumbar spine 32% (n=12). This finding is consistent with the literature that reports lumbar injuries as the most common site of injury in elite rowers (3,4,8,15). The present study also found that lumbar spine injuries were the most common injury in previous rowing seasons and caused the greatest number of new injuries for the

season. To minimise and manage lumbar spine injury, inclusion of specific stabilisation exercises, with emphasis on the recruitment of deep abdominal and spinal muscles, into their weights/training routine maybe considered (12). Caldwell et al. (2) investigated 16 young adult school rowers and demonstrated that fatigue in spinal muscle may be higher in schoolgirl rowers due to less developed spinal muscles. This highlights that at times of fatigue when the lumbar spine is vulnerable to injury attention should be paid to the rowing technique, especially posture.

Coburn & Wajswelner (3) found that of 54 rowers with injuries, nine had stress fractures in the ribs. Hickey et al. (6) found 15 rib stress fractures from 84 women over a 10 year period. The present study did not report any stress fractures in the ribs throughout the season or in the past history. The risk factors for developing stress fractures are not well known other than they have a higher occurrence in women than men (19,6,3). Although not statistically analysed, possible conclusions may be drawn that schoolgirl rowers are not at risk of rib stress fractures this maybe due to the vast differences in training programs between the elite and schoolgirl rowers.

Shoulder injuries are not reported in the literature as a common injury for rowers. This study found that it was the second most likely injury during the rowing season and caused approximately the same time off training as low back injuries. Shoulder injuries in rowers are often due to poor technique at the catch, such as over reaching causing excessive strain though the shoulder complex as the drive phase begins. The extra force going through the shoulder as fatigue of the spinal muscles occur should be considered. These results indicate that strengthening of the shoulder complex should be an integral part of a school girl rowing program. It also highlights that

coaches should be aware of the risk of injury in both lumbar and shoulder region and focus on the athletes technique to minimise injury.

Knee injuries were the third most common injury during the rowing season. All incidence of knee injuries during the season were reported as aggravation of an existing patella tracking dysfunction. This is consistent with Coburn & Wajswelner (3) that reported knee injuries as the third most likely cause of rowing injuries. This however is not supported by Coburn et al. (4) who reported knee injury as the 11th most common injury in Australian international rowers. Karlson (9) suggests that patella femoral tracking dysfunctions (PTD) are more prevalent in women, in any sport, but in rowing there is an exacerbation due to the fixed nature of the shoes within the boat. To prevent this, attention may be given to these athletes' foot stretcher angle and position if they have a history of patella tracking dysfunction.

Roach & Cheretein (14) identified the increased risk of dermatological problems in rowers, with an increase in hand warts among rowers. This study found no evidence of hand warts but 5% of injuries were due to infected blisters on the hand. In both incidences they required time out of the boat. Proper treatment of hand blisters should be undertaken to decrease the risk of infection.

Of the 34 subjects who reported injury, 17 had time off training. Of the 17 that did not take time off, 12 were receiving treatment for their injuries from either a physiotherapist, an osteopath or medical practitioner. There were many different injuries reported from this group: 4 low back injuries, 2 illness, 2 PTD, 1 shin splints, 2 shoulder injuries and 1 infected blister. There are many variables that may influence

a rower not to take time off training and although it was not within the scope of this study, some likely factors include: psychological pressure from both crew peers and coaching staff (especially due to the short season), fear of being dropped from the crew, or their injuries maybe low grade and hence they can still train.

Management of athletes with injury must incorporate appropriate treatment, realistic outcomes and proper rehabilitation. It is vital for both the coach, and the director of rowing, to have a good relationship with the treating practitioner and also for the practitioner to have a good knowledge of rowing. This would hopefully give the best outcome for the athlete. As rowing is a repetitive action, injury may suggest improper performance of the rowing stroke. Coaching staff should be aware of the common injuries and certain parts of the stroke where athletes are vulnerable to injury. Emphasis on proper technique particularly at times of fatigue is important for preventing injuries and decreasing the risk of re-aggravation of an injury.

Of the total number of injuries reported, 56% (n=19) were year 11 students. Year 11 students previously compete at a junior level in year 9 and 10 where there is a substantial difference in intensity of training, furthermore they may not be as physically developed as the year 12 athletes. Care must be taken with year 11 students beginning the senior level program as they maybe at a higher risk of injury.

Illness, on average, accounted for the greatest amount of time spent out of the boat (average 12 days). The most common condition was the flu (n=3), chest infection, asthma and glandular fever (n=1). No other research has taken illness into consideration, instead all have focused on musculoskeletal condition. Schoolgirls

have to deal with the stress of Victorian Certificate of Education and school life and therefore they may be run down and have a decreased immune system leading to a greater chance of illness. As the schoolgirl rowing season is relatively short it is imperative, within limits, to decrease the risk of illness.

Hickey et al., (6), Howell (8) and Coburn et al., (4) all researched Australian or state representatives. There are considerable differences between elite athletes and school girl rowers. Because rowing injuries are mainly due to repetition there may be a reduced number of injuries amongst the school girl population compared with the elite, though factors such as poorer technique and muscular development in school girls may predispose them to a high rate of injury. Also the rowing season for schoolgirls is shorter to that of an elite rower so there is a decreased time frame for an injury to occur.

Conclusion

Based on the data collected, it was found that during the 2004-2005 rowing season 34 rowers reported an injury. Of this group 18 were sweep rowers and 16 scull rowers. Whilst overall there was not a large difference between the number of injuries between sweep and scull rowing, there was a difference in injury pattern. Sweep rowers reported a higher number of lumbar and shoulder injuries compared to scull rowers.

Lumbar spine injuries were the most commonly reported injury during the season and in previous rowing seasons. Also, lumbar spine injuries were the greatest number of new injuries reported for the season. Shoulder injuries were the second most commonly reported injury and appears to be more prevalent in school girl rowers compared to the previous research which, studied elite rowers. Both lumbar and shoulder injuries caused, on average, the greatest time off training. This highlights that both lumbar and shoulder injury prevention and rehabilitation programs should be incorporated into rowing training programs. As well as this, education for coaches on the emphasis of technique, to prevent injury especially at times of fatigue, should be considered.

The 2004-2005 school girl rowing season very short in duration. The length of this season will be consistent for the next five years. Although this research had a small response rate and no strong statistical significance, trends gathered from the data collected maybe a good indicator of the injuries reported by schoolgirl rowers for future seasons.

References

1. Bennell K,L., Malcolm S,A., Thomas S,A., Reid S,J., Brukner P,D., Ebeling P,R, Wark J,D, 1996, 'Risk factors for stress fractures in track and field athletes. A twelve-month prospective study', *American Journal of Sports Medicine* Nov-Dec vol.24(6) pp. 810-8

2. Caldwell, J,S., McNair, P,J., Williams, M, 2003, 'The effects of repetitive motion on lumbar flexion and erector spinae muscle activity in rowers', *Clinical Biomechanics*, vol. 18, pp 704-711

3. Coburn, P., Wajswelner, H., 1993, 'A survey of 54 consecutive rowing injuries' *National Annual Scientific Conference in Sports Medicine Melbourne Oct 1993*

4. Coburn,P., Wasjswelner,H., Mosler,A., 1995, 'Musculoskeletal Injuries in Domestic and International Rowing', *Australian Conference of Science and Medicine in Sport Hobart 1995*

5. Grimmer, K,A., Jones, D., Williams, J. 2000, 'Prevalence of Adolescent Injury From Recreational Exercise: An Australian Perspective', *Journal of Adolescent Health*, vol.27, pp.266-272

6. Hickey,G,J., Fricker,P,A., McDonald, W,A., 1997, 'Injuries to elite rowers over a 10 year period', *Medicine and Science in Sports and Exercise,* vol.29 no.12 pp.1567-1572

7. Hosea, T., Boland, A., Mc Karthy,K., 1989, 'Rowing injuries', *Post graduate advances in sports medicine,*

8. Howell, D, W., 1984, 'Musculoskeletal profile and incidence of musculoskeltal injuries in lightweight women rowers', *The American Journal of Sports Medicine,* vol. 12, no. 4, pp 278-282

9. Karlson, K,A., 2000, 'Rowing Injuries Identifying and treating musculoskeletal and nonmusckuloskeltal conditions', *The Physician and Sportsmedicine,* vol 28 no.4 pp1-7

10. Mosler, A., Wajswelner, H, 1995 'The assessment and management of elite rowing injuries', *Australian Conference of Science and Medicine in Sport Hobart 1995*

11. Pelham, A,W., Carter, A,G,W., Holt, L,E., Hallett, D,T.,1994, 'Technique and training-induced injuries in rowing', Biomechanics in sports XII. Proceedings of the 12th Symposium of International Society of Biomechanics in Sports: 1994 July2-6. Budapest.

12. Richardson C., Hodges P, W., Hides J., 2004 'Therapeutic exercise for lumbopelvic stabilization : a motor control approach for the treatment and

prevention of low back pain' Edinburgh : Churchill Livingstone, 2004 2nd edition

13. Reid, D,C., McNair, P,J. 2000, 'Factors contributing to low back pain in rowers', *British Journal of Sports Medicine*, vol. 34, pp.321-325

14. Roach M,C., & Chretien J,H., 1995, 'Common hand warts in athletes: association with trauma and the hand', *Journal American College Health,* vol 44(3), pp 125-126

15. Rumball J,S., Lebrun C,M., Di Ciacca S,R., Orlando K., 2005, 'Rowing Injuries', *Sports Medicine,* vol. 35 (6) pp. 537-555

16. Shephard, R,J., 1998, 'Science and medicine of rowing: A review', *Journal of Sports Science,* vol. 16, pp.603-620

17. Teitz, C,C., O'Kane, J,W., Lind, B,K., 2003, 'Back Pain in Former Intercollegiate Rowers', *The American Journal of Sports Medicine,* vol. 31, issue 4, pp 590-595

18. Warden, S, J., Gutschlag, F,R., Wajswelner, H., Crossley, K,M., 2002, 'Aetiology of Rib Stress Fractures in Rowers', *Sports Medicine*, vol.32 no.13 pp.819-836

19. Warren, M, P., Perlroth, N,E., 2001, 'The effects of intense exercise on the female reproductive system', *Journal of Endocrinology,* vol. 170 pp. 3-11

20. www.victorianrowingassociation.com

Date ___/___/___

INITIAL INJURY FORM

Please tick the box where appropriate.

Rowing information

Age:_____ Year level:_____

Sweep ❑ Scull ❑

Type of boat rowed in last season: 8+ ❑ 4+ ❑ 4x ❑ 1x ❑ Sweep side: bow ❑ stroke ❑

Number of years rowing for: _____ Racing boat: ❑ Regulation boat: ❑

What crew are you in?_____

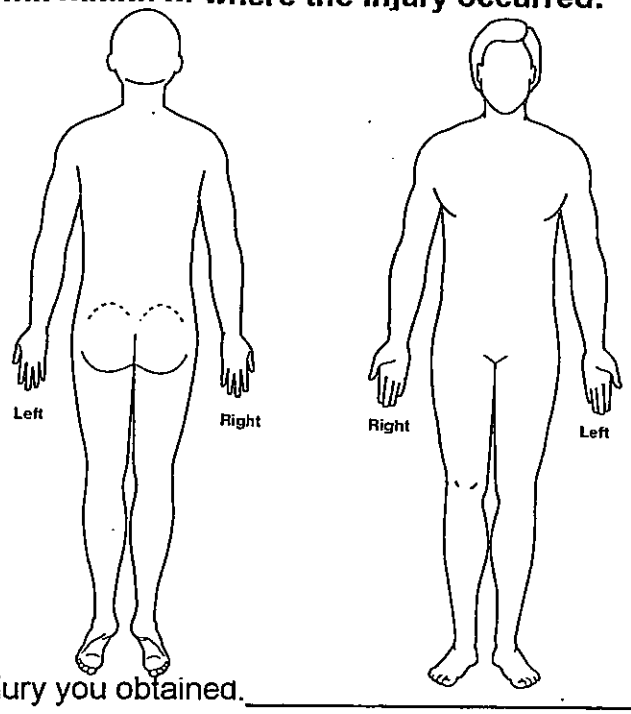
Have you ever experienced an injury during the rowing season? Y ❑ N ❑

What time of the season did you obtain this injury?_____

Activity when injury occurred:

- ❑ Rowing (training/competition) please circle
- ❑ Ergo
- ❑ Weights
- ❑ Cycling
- ❑ Running
- ❑ Equipment
- ❑ Other_____

Please indicate on the diagram the region of where the injury occurred:



In your own words describe the injury you obtained._____

Did this injury require you to have time out of the boat? Y ❑ N ❑

If yes, how long (days/weeks):_____

Did this injury require medical intervention? Y ❑ N ❑

Type of treatment you received? Osteopathy/Physiotherapy/Chiropractic/Medical practitioner

Did you receive a diagnosis from this person? If so what;_____

Date ___/___/___

INJURY REPORT FORM

Please tick the box where appropriate.

Rowing information

Age:_____ Year level: _____

Sweep ❑ Scull ❑

Type of boat rowing in: 8+ ❑ 4+ ❑ 4x ❑ 1x ❑ Sweep side: bow ❑ stroke ❑

Number of years rowing for: _____ Racing boat: ❑ Regulation boat: ❑

What crew are you in?_____

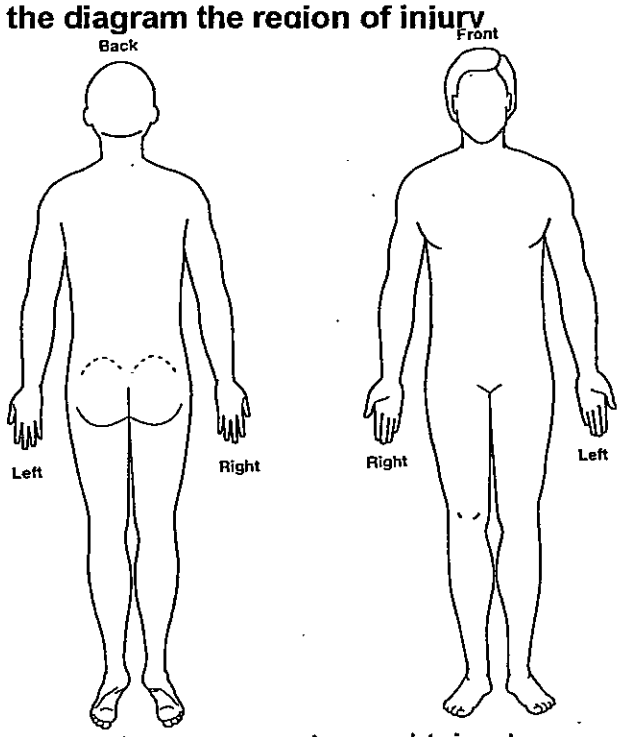
Reason for presentation

- ❑ New injury
- ❑ Aggravated injury
- ❑ Recurrent injury
- ❑ Illness_____
- ❑ Other_____

Activity when injury occurred

- ❑ Rowing (training/competition) please circle
- ❑ Ergo
- ❑ Weights
- ❑ Cycling
- ❑ Running
- ❑ Equipment
- ❑ Other_____

Please indicate on the diagram the region of injury



In your own words describe the injury you have obtained:_____

_____

Did this injury require you to have time out of the boat? Y ❑ N ❑

If yes, how long (days/weeks):_____

Did this injury require medical intervention? Y ❑ N ❑

Type of treatment you received? Osteopathy/Physiotherapy/Chiropractic/Medical practitioner

Did you receive a diagnosis from this person? If so what;_____

_____

Please put this in the injury report box. Thank you.

Victoria University of Technology
PO Box 14428
MELBOURNE CITY MC VIC 8001
Australia

Telephone:
(03) 9248 1140
Facsimile:
(03) 9248 1030

City Flinders Campus
School of Health Sciences
4th Floor
301 Flinders Lane
Melbourne VIC 3000

Consent Form for Subjects Involved in Research

CERTIFICATION BY PARTICIPANT

I,
of
certify that I am voluntarily giving my consent to participate in the study entitled:
The prevalence of injuries in senior level schoolgirl rowers.
being conducted at my School Rowing shed:

[appropriate school rowing shed inserted here]

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by.

Michelle Funder

and that I freely consent to participation involving the use of these procedures on me.

Procedures:
An 'Initial injury form' will be filled out by you and mailed back to the Principal Supervisor. Over the 2004-2005 rowing season you will fill out 'Injury report forms' whenever you are injured or ill.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed: ..... }

Witness other than the researcher: } **Date:** .....

.....}

Any queries about your participation in this project may be directed to the researcher (Name: Patrick McLaughlin ph. 92483140). If you have any queries or complaints about the way you have been treated, you may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone no: 03-9688 4710).

Victoria University of Technology
PO Box 14428
MELBOURNE CITY MC VIC 8001
Australia

Telephone:
(03) 9248 1140
Facsimile:
(03) 9248 1030

City Flinders Campus
School of Health Sciences
4th Floor
301 Flinders Lane
Melbourne VIC 3000

Consent Form for Subjects Involved in Research

CERTIFICATION BY PARENT

I,
of
certify that I am the legal guardian of _____ and that I am voluntarily giving my consent to allow the afore mentioned to participate in the study entitled:

The prevalence of injuries in senior level schoolgirl rowers.

being conducted at their School Rowing shed:

[insert appropriate school rowing shed]

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by:

Michelle Funder

and that I freely consent to participation involving the use of these procedures on my child.

Procedures:

An 'Initial injury form' will be filled out by the volunteer athlete and mailed back to the Principal Supervisor. Over the 2004-2005 rowing season the volunteer athlete will fill out 'Injury report forms' whenever they are injured or are ill.

I certify that I have had the opportunity to have any questions answered and that I understand that my child can withdraw from this study at any time and that this withdrawal will not jeopardise my child in any way.

I have been informed that the information my child provides will be kept confidential.

Signed: ..... }
Witness other than the researcher: } **Date:** .....

.....}

Any queries about your participation in this project may be directed to the researcher (Name: Patrick McLaughlin ph. 92483140). If you have any queries or complaints about the way you have been treated, you may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone no: 03-9688 4710).

Initial Injury Report Form Data

Number of surveys given out=186 Number returned=20 Response rate 11%

Type of rowing	
sweep	10
scull	9
both	1
TOTAL	20

Number of injuries	number of athletes	percentage
none	3	15%
one	12	60%
two	3	15%
multiple	2	10%
TOTAL	20	100%

Site of injury	number of athletes	percentage
head/neck	0	0%
shoulder	1	4%
elbow	0	0%
hand	1	4%
thoracic	3	12%
lumbar	6	24%
hip	2	8%
knee	4	16%
shins	3	12%
ankle	4	16%
asthma	1	4%
TOTAL	25	100%

Activity when injury occurred	number of athletes
rowing	8
ergo	4
weights	2
cycling	0
running	6
equipment	2
other	netball x2, 1 fell over
total	25

Injury Report Forms

Type of rowing	number of athletes
scull	16
sweep	18
TOTAL	34

TOTAL number of athletes presenting with injury = 34
It must be noted that some had multiple injuries

Activity when injury occ	sweep	scull	total	percentage
rowing training	10	10	20	48%
ergo	4	5	9	21%
weights	1	4	5	12%
cycling	0	0	0	0%
running	3	3	6	14%
equipment	0	0	0	0%
other	swimming	netball	2	5%

Site of injury	sweep	percentage	scull	percentage	total	percentage
head/neck	1	50%	1	50%	2	5%
shoulder	4	60%	3	40%	7	18%
elbow	1	33%	2	67%	3	8%
wrist	1	100%	0	0	1	3%
hand	2	100%	0	0	2	5%
thoracic	2	67%	1	33%	3	8%
lumbar	7	58%	5	42%	12	32%
hip	1	100%	0	0	1	3%
knee	2	50%	2	50%	4	11%
shins	1	50%	1	50%	2	5%
ankle	0	0	1	100%	1	3%
	22		16		38	100%

Sweep rowing side	Number of presenting injuries	
bow side	12	75%
stroke side	4	25%
2 didn't specify	0	0
TOTAL	18	100%

Time out of boat	scull	sweep	total
yes	9	8	17
no	7	10	17

Reason for presentatior	sweep	scull	total
new injury	32%	21%	53%
aggravated injury	21%	26%	47%
illness	2	3	5

Year level	number of athletes	
yr 11	19	56%
yr 12	15	44%
TOTAL	34	100%

Medicine & Science in Sports & Exercise® *(MSSE®)* is the official journal of the American College of Sports Medicine and is published monthly. Manuscripts dealing with original investigations, clinical studies, special communications, or brief reviews on topics relevant to the areas of interest of the College will be considered for publication.

Order of Manuscript

An original investigation should contain the following items and satisfy the given specifications.

- Title Page
  1) Title of no more than 85 characters, including spaces. Do not use a complete sentence as a title.
  2) Full names of the authors—Only those investigators who contributed substantially or who had a primary role in the research represented in the manuscript should be listed as authors. Manuscripts listing more than six (6) authors should provide justification. The Editor-in-Chief reserves the right to request that the author list be reduced.
  3) Institutional affiliation of each author clearly identified; linked to each author by use of superscript numbers
  4) Corresponding author name, mailing address, telephone, fax, and e-mail information
  5) Running title of no more than 45 characters, including spaces
- Abstract
  1) Limit of 275 words, including numbers, abbreviations, and symbols
  2) Structure states purpose, methods, results, and conclusion
- Key Words
  1) Four (4) to six (6) words following the abstract
  2) Should not repeat terms or phrases from the title
- Introduction
  1) State clearly the purpose and hypothesis of the study
  2) Provide relevant references
  3) Do not exhaustively review the subject
- Methods
  1) Present subject information
  2) Describe the experimental subjects and their controls
  3) Insert "written informed consent" statement or animal-use statement and ethics committee approval statement (required) (see "Human & Animal Experimentation Policy Statements")
  4) Identify the methods, apparatus, and procedures employed with sufficient details to allow others to reproduce the results
  5) Provide references for established methods and statistical procedures
  6) Provide rationale for use and include a description of possible limitations for utilized methods not well known
  7) Denote statistical significance when appropriate and include detailed statistical analyses, mathematical derivation, or computer programs in an appendix
- Results
  1) Present findings of the study in the text, tables, or figures
  2) Do not include the same data in tables and figures
- Discussion
  1) Emphasize the original and important features of the study and avoid repeating all the data presented within the results section
  2) Incorporate the significance of the findings and the relationship(s) and relevance to published observations
  3) Provide only those conclusions that are supported by the study

- Acknowledgments
  1) Identify funding sources
  2) Identify external reviewers, if any
  3) Current contact information of corresponding author
  4) Contact for reprints, if any
- Conflict of Interest
  Authors are required to state in the acknowledgments all funding sources, and the names of companies, manufacturers, or outside organizations providing technical or equipment support. In particular, authors should:
  - 1) Disclose professional relationships with companies or manufacturers who will benefit from the results of the present study
  - 2) State that the results of the present study do not constitute endorsement of the product by the authors or ACSM

  Failure to disclose such information could result in the rejection of the submitted manuscript.
- References
  The format for references is that which has been adopted by the United States National Library of Medicine and employed in *Index Medicus*. For those not included in *Index Medicus*, adhere to the form established by the American National Standard for Bibliographic References. The reference list shall be in alphabetic order, rather than in the order of citation, and numbered. All references shall appear in the text. Examples of the types of references are as follows:

  1) Books
  - American College of Sports Medicine. *Guidelines for Exercise Testing and Prescription*. Philadelphia, PA: Lea and Febiger, 1986, pp. 158–161.
  - Paffenbarger, R. S., R. T. Hyde, and A. L. Wing. Physical activity and physical fitness as determinants of health and longevity. In: *Exercise, Fitness, and Health*. C. Bouchard, R. J. Shephard, T. Stephens, J. R. Sutton, and B. D. McPherson (Eds.) Champaign, IL: Human Kinetics, 1990, pp. 33–48.

  2) Doctoral Dissertations—Crandall, Craig. Alterations in human baroreceptor reflex regulation of blood pressure following 15 days of simulated microgravity exposure. *Doctoral Dissertation*. University of North Texas HSC, Dept. of Physiology, Fort Worth, Texas, August 1993.

  3) Government Reports—U.S. Department of Health and Human Services. *Healthy People 200: National Health and Disease Prevention Objectives* (full report, with commentary). Washington, DC: Department of Health and Human Services, Publication 91:50212, 1991, pp. 91–125.

  4) Journal Articles—Blair, S. N., N. M. Ellsworth, W. L. Haskell, M. P. Stern, J. W. Farguhar, and P. D. Wood. Comparison of nutrient intake in middle-aged men and women runners and controls. *Med. Sci. Sports Exerc*. 12:310–315, 1981.

  5) Software Manuals—SAS Institute. *SAS/STAT Software: The PHREG Procedure*, Version 6. Cary, NC: SAS Institute Inc., 1991, 1054 pp.

  6) Conference Proceedings—Conference proceedings can be used only if the publication has an ISBN or ISSN number. This information must accompany the reference—Matthie J. R., P. O. Withers, M.D. Van Loan, and P. L. Mayclin. Development of a commercial complex bio-impedance spectroscopic (CBIS) system for determining intracellular water (ICW) and extracellular water (ECW) volumes. In *Proceedings of the 8th International Conference on Electrical Bio-impedance*. Kuopio, Finland: University of Kuopio, Finland, ISBN: 952-90-3999-9, pp. 203–205, 1992.

  7) Abstracts—An abstract can be cited when it is the only source of information.

Note: In-text reference citations shall be baseline in parentheses, not superscripts [e.g., (14,15), not [14,15]]. Internet sources, Master of Science theses, personal communications, or other unpublished material are not acceptable as references. There should not be more than 30 references for original investigations. Review articles are limited to 50 references. All book references require page numbers. Examples to follow for corporate authors, chapters, editors, center publication, etc., can be observed in the *British Medical Journal* 1:1334–1336, 1978. Journal abbreviations should follow the abbreviations of *Index Medicus* published by the Library of Congress. Use of et al.—If fewer than seven (7) authors are listed, all should be mentioned. When seven or more authors are named, list only the first three.

- Figure Captions
  1) Provide a caption for each figure
  2) List captions together following references section