The epidemiology of medically attended sport and recreational injuries in Queensland

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The Queensland Sport and Recreation Injury Survey (QSRIS) is a retrospective study describing the annual incidence of injuries in the state of Queensland, Australia, resulting from sport and recreational activity involvement. Data were collected by means of a computer-assisted-telephone-interview (CATI) survey of a representative sample of Queenslanders in the spring of 2000. The sample produced a total of 1337 respondents aged 18 to 94 years. The survey asked information regarding medically attended, non-fatal injuries resulting from sport and recreational activities in the past 12 months. Of the 1337 individuals surveyed, 191 of the respondents reported one or more injuries that required medical attention resulting in a total of 222 injuries. This represents an overall rate of 1,666 medically attended injuries per 10,000 people. Among those reporting a sport or recreational injury, the most common types of injuries were a strained/pulled muscle (30.9%), sprained/torn ligament (24.1%), and fracture (12.6%). The most common bodily locations of injuries were the shoulders (13.0%) and knees (12.5%). Results detail the nature and type of injury, medical professional attending to the injury and the nature of the sport or recreational activity that led to the reported injury, highlighting the number of injuries associated with general fitness activities achieved through high participation rates and low injury rates. This remains an area of much needed attention given the promotional push towards raising the levels of physical activity at a population level.

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Introduction

Injuries from sports and recreational activities are the unwanted side effects of efforts to engage the population in physical activity in its many forms. It remains difficult, however, to obtain a clear picture of the nature and extent of the injury problem arising from participation in leisure-time sports and/or recreational activities. This difficulty arises from differing definitions of injury and of activity. In addition, varying types of research and methods of data collection provide different insights into injuries occurring from pursuit in various activities. This paper presents the results of a telephone survey of a representative sample of the adult population of Queensland, Australia, regarding the incidence of injuries arising from sport and recreational physical activity involvement in the 12-month period prior to the survey. A broad

definition of sport and recreational physical activity was utilised, consisting of participation in any form of recognised sporting activity - organised, or spontaneous, as well as physically active recreation - including activities such as walking and gardening in one's leisure time.

There is little doubt that the practice and promotion of physical activity in the general population offers tremendous benefits from the perspective of health and well-being. Research evidence supports the positive benefits of physical activity in terms of all-cause mortality (Lee & Paffenbarger, 2000), cardiovascular disease (Bauman & Owen, 1999), diabetes (Ivy, Zderic, & Fogt, 1999) and various cancers (Shephard & Shek, 1998). In addition, physical activity in its many forms has been associated with positive mental health (Paluska & Schwenk, 2000) and numerous psycho-social benefits (Gauvin & Spence, 1996). Although the maintenance of a physically active lifestyle is essential for many forms of health and well-being, the possibility of increased morbidity from active participation in the various forms of physical activity, including sport or recreation, calls for attention at multiple levels of investigation. Injury has the potential to reduce the benefits of involvement in sport and recreational physical activity, and act as a barrier to future involvement (Finch, Owen, & Price, 2001; Wankel, Mummery, Stephens, & Craig, 1994).

Evidence from American emergency room presentations indicate that sports injuries rank second highest in terms of cause of injury, after home accidents; and rank third in terms of severity, after traffic accidents and violence (Dekker, Kingma, Groothoff, Eisma, & Ten Duis, 2000). In the United States it has been estimated that there are an average of 2.6 million emergency department visits per year for sports-related injuries by persons between the ages of 5 and 24 years (Burt & Overpeck, 2001). In the Australian context, Finch, Valuri, and Ozanne-Smith, (1998) reported that most sporting injuries occurred during organised competition or practice whereas the active recreation injuries occurred in a variety of settings.

Stevenson, Hamer, Finch, Elliot and Kresnow (2000) provide a picture of the incidence of sports injuries in Western Australia using community level sports participants. This prospective cohort study showed recreational sporting activity to be relatively free of serious injury, with only 3% of the participant sample requiring emergency department treatment or hospital stay. Interestingly, the authors describe an important seasonal variation in the incidence of injury evidencing the need for an emphasis on pre-season conditioning to reduce further injury rates in organised community sport.

Emergency room presentations and sport participant cohort studies provide a rich, albeit limited picture of the true extent of medically-attended sport and recreational injuries in the overall population. Less severe injuries may never present to an emergency department. Instead assistance may be sought from another medical professional. In addition, injuries that arise from sporting activities that occur outside of the organised setting, or in a setting where formalised injury surveillance is not conducted, would result in an under-representation of the true scope of the problem.

Another approach that has been used to establish an overview of the incidence of injuries arising from sport and recreational involvement in the general population is the representative–scale survey of the general

population. Nicholl, Coleman and Williams (1995) conducted a national study of exercise related morbidity in England and Wales using a postal questionnaire sent to 28,857 adults aged 16-45 years. The questionnaire asked about regular participation in sports or other recreational fitness activities involving physical exercise, and collected information pertaining to any injuries that occurred during the 28-day period prior to survey. It was estimated that each year there were 29 million incidents resulting in new or recurrent injuries, however minor. Of these, 9.8 million resulted in new 'substantive' injuries that left participants unable to take part in their usual activities. Bijur et al. (1995) determined that sports activities account for a large, albeit not a disproportional, amount of all injuries to American children and youth. The authors conducted a community-based survey regarding sports or recreational injuries to adolescents aged 5 to 17 years, defining injuries as incidents resulting in hospitalisation, surgical treatment, missed school, or half a day or more in bed. Mummery, Spence, Vincenten, and Voaklander (1998) conducted a population-based retrospective study describing the annual incidence of sport and recreational injuries in the province of Alberta, Canada. Data were collected by means of a telephone survey to obtain a representative sample of Albertans in the winter of 1995-96. The sample produced a total of 3,790 respondents from 1,478 households evenly split between genders, with an age range of 6 to 93 years. The survey asked a knowledgeable respondent in each selected household to provide individual and proxy information regarding medically attended, non-fatal injuries resulting from sport and recreational activities. Findings revealed an annual incidence of sport or recreational injuries of 11%. Among those reporting a sport or recreational injury, the most common types of injuries were a sprained/torn ligament (31%), strained/pulled muscle (19%), and fracture (13%). The most common bodily locations of injuries were the knees (21%) and the ankle (14%). Finch, Cassell and Stathakis (1999) conducted an epidemiological study of sports and active recreational actives in the Latrobe Valley of Victoria, Australia. The study included a random household telephone survey of sport and recreational activity participation and gathered information regarding injuries relating to participation. Results showed that 5% of the sample reported a sport or recreational activity injury in the two-week period prior to the survey. Based on the self-report data collected the sport and recreational activities with the highest injury rates per 1,000 participants were cricket (242/1,000), horse riding (122/1,000), soccer (107/1,000), netball (51/1,000) and Australian Rules football (37/1,000).

The present study utilises computer-assisted-telephone-interview (CATI) technology to conduct a representative sampling of the adult population of Queensland, Australia, regarding the incidence of medically attended injuries arising from sport and recreational activity involvement. The intent of the study is to extend the existing literature regarding such injuries at a population-based level.

Methods & Procedures

Sampling Design

The sample frame (N=1337) covered the entire state of Queensland. To insure adequate geographical coverage for sampling purposes a proportional, stratified sample (Hansen, Hurwitz, & Madow, 1993) was drawn to reflect the

geographical distribution of the Queensland population as reported by the 1996 Australian Census of Population and Housing (1996). The proportional stratification resulted in the following sample size from each region:

- Southern Queensland (77%, n = 970)
- Central Queensland (9%, n = 156)
- Northern Queensland (14%, n = 211)

There was a two-stage selection process utilised to obtain the desired respondent. The first stage involved the random selection of household using the Electronic White Pages (EWP). The second stage involved the random selection of individual within the household by interviewing the adult member of each household who was going to celebrate the next birthday. Gender quotas were established within the sampling program to ensure that the male/female response rate was similar to existing census data.

The target population designated for telephone interviewing was all persons 18 years of age or older who, at the time of the survey, were living in a dwelling unit in Queensland that could be contacted by direct-dialled, land-based telephone service. A random selection approach was used to ensure that all respondents had an equal chance to be contacted. The Population Research Laboratory (PRL) at Central Queensland University holds an electronic database of telephone numbers (Electronic White Pages) covering the entire state. This database is updated quarterly and the most recent version was used for generating the survey sample. Research has shown that there is little difference in the health estimates obtained between the EWP method and Random Digit Dialling (RDD) method (Wilson, Starr, Taylor, & Dal Grande, 1999). The 2000 Queensland Sport and Recreational Injury Survey (QSRIS) sample was drawn from the telephone database by using a computer program to select, with replacement, a simple random sample of phone numbers. All duplicate, mobile and business numbers were purged from the computer-generated list. Nursing homes and collective dwellings were also deleted from the sample. Within the household, one eligible person was selected as the respondent for the thirty-minute interview. A knowledgeable respondent aged 18 years and over within each household was selected using a gender quota to ensure the sample closely matched census data for Queensland. Participants provided information regarding their individual sport and recreational involvement and information regarding any medically attended injuries arising from such participation. No proxy data were collected.

The Survey Instrument

The survey instrument was structured to allow for direct comparison to previous population-based injury studies in Canada (Impact Recherche, 1993; McLaren, 1996; Mummery et al., 1998). Participants were informed that the study pertained to sport and recreational injuries. The questions related to 'regular' sport and recreational activities participated in during the 12-month period prior to the survey. Regular sport or recreational activity was defined to the participant as doing the activity at least once a week during the time of the year that the specific activity may take place (i.e., sporting season). These did NOT include activities such as housework, mowing the lawn, picnics or walking for work or to do errands. With respect to participation, respondents were guided by the use of the following qualifiers: bike riding, swimming, home

exercises, team sports, etc. Of principle interest were injuries resulting from sport or recreational activities that led to a visit to a healthcare professional. Where required, participants were prompted that these professionals included doctors, physiotherapists, chiropractors or sports clinic personnel.

The survey instrument consisted of three components: 1) a standardised introduction; 2) questions which dealt with frequency and type of sport/recreational participation; number, types and location of injuries requiring medical attention received; and an estimate of the amount of time lost to work, school or regular activities as a result of the injury in question; and 3) demographic questions. The questionnaire was pilot-tested by trained interviewers on a total of 30 randomly selected households in Rockhampton, Queensland. Interviewer comments (e.g., confusing wording, inadequate response categories, question order effect, etc.) and pre-test frequency distributions were reviewed by the clients before modifications were made to the 2000 QSRIS questionnaire. The 2000 QSRIS received approval by the Human Ethics Research Review Panel at Central Queensland University before administration to the general public

Data Collection

The 2000 QSRIS was administered through the ten-station CATI[1] system installed on a local area network at the Population Research Laboratory at Central Queensland University. The system facilitated the exchange of information among interviewing PC stations and supervisor stations linked via a file server during the data collection period. Supervisors monitored call dispositions, and validated the accumulated data for analysis. Following the pre-test, the electronic version of the questionnaire was modified for the main data collection. The sample database was also loaded into the CATI system that allocates telephone numbers to the interviewing stations. The question text and instructions were presented on the computer screen to the interviewer who asked the questions to the respondent over the telephone and then entered the given responses into the computer. Since the interviewers keyed in the responses directly into the computers, a continual monitoring of the closed-ended responses was possible.

The interviewing began on August 25th, 2000 and was completed on September 11th, 2000. Interviews were conducted in two daily shifts between the hours of 10:30 a.m. to 2:30 p.m. and 5:00 p.m. to 9:00 p.m., seven days a week. If the interviewers were unsuccessful in establishing contact on their first call, a minimum of five callback attempts were made before declaring a telephone number as “no contact.” Upon making contact, interviewers identified themselves, verified the telephone number, and then asked the screening questions for selecting the respondent.

The *response rate* is a percentage representing the number of people participating in the survey divided by the number selected in the sample. The numerator is the number of completed interviews and the denominator includes completed interviews, incomplete interviews, refusals, language problems, those who were not available at a verified residential number (e.g., away on vacation, temporarily in hospital, etc.) and an estimate of eligible numbers out of the numbers that were dialled up to 5 times but no contact was made. The overall response rate for the 2000 QSRIS was 44.3%.

Confidence Interval Calculation

Confidence intervals for the difference between population proportions (Daniel, 1991) were calculated to investigate the significance of the observed differences at the 95% level of confidence. Calculated confidence intervals including zero were deemed non-significant.

Results

The Data

The data were tabulated and cleaned using the SPSS for Windows[2] statistical package. The final data set contained 1,337 cases with a total of 179 variables for each case.

Demographic Profile

A total of 1337 participants provided personal data for the Queensland Sport and Recreational Injury Survey, 682 male and 655 females, ranging in age from 18 to 94 years with a mean age of 45.03 years (median 44.0 years).

Sample Representativeness

A sample is considered representative of the larger population from which it is selected if the aggregate characteristics of the sample closely approximate those same characteristics in the population. For purposes of this study the Index of Dissimilarity (Duncan & Duncan, 1955) for age distributions was utilised to provide a measure of sample representativeness. The index of dissimilarity is based on the absolute differences between the proportions of each age group. The differences are summed, without regard to sign, and divided by two.

The Queensland data from the 1996 Australian Bureau of Statistics Census of Population and Housing Statistics was used for comparison with the 2000 QSRIS survey sample. Both data sets provide age in single year increments. To ease interpretation both data sets were grouped into the following age groups: <30 years, 30-39 years, 40-49 years, 50-59 years and over 60 years.

The comparison of the 2000 QSRIS sample's age distributions with the 1996 Australian Bureau of Statistics Census of Population and Housing Statistics resulted in an Index of Dissimilarity for the total sample of 4.95. A difference of 10 or less indicates that there is a similar distribution in the samples with less than 10 % variation overall (Duncan & Duncan, 1955). Thus, the index of dissimilarity for the total sample demonstrates that the sample adequately reflected the population from which they were drawn on this dimension.

Estimated Sampling Error

The sampling error is a measure of the validity of the descriptive statistics that are observed in a sample. The estimated sampling error, at the 95% confidence level, for the statewide sample of 1337 households and a 50/50 binomial percentage distribution is plus or minus 2.7% (Babbie, 1989).

Sport and Recreation Injury Rate

Of the 1337 individuals surveyed, 191 of the respondents reported injuries that required medical attention. Of this number, 31 experienced more than one injury, thus raising the total number of injuries reported to 222. This represents an injury rate of 16.6% that can be expressed as 1666 injuries per

		n	Total Injuries	Injury Rate (per 10,000 population)	95%CI
Total Sample		1,337	222	1,660	1,627-1,694
Gender	Male	682	137	2,009	1,948-2,069
	Female	655	85	1,298	1,264-1,331
Age Group	18- 30 years	270	90	3,333	3,146-3,521
	30-39 years	268	47	1,754	1,674-1,834
	40-49 years	281	35	1,246	1,197-1,294
	50-59 years	221	28	1,267	1,211-1,323
	60+ years	297	22	741	719-763

Table 1: Injury rates (medically attended injuries in the 12 month period prior to survey) in sport and recreational activities by age and gender groupings.

Injury	n	Rate per 10,000	95%CI
1. Strain/pulled muscle	69	516	513-519
2. Sprain/torn ligament	53	396	394-399
3. Fracture	28	209	207-212
4. Dislocation	22	165	163-166
5. Bruise/contusion	10	75	74-76

* Only injuries with at least 10 occurrences are shown in the table.

Table 2: Incidence rate of specific injuries experienced during sport & recreational activities (per 10,000).*

10,000 people (95% C.I. 1,627-1,694). No significant difference was found between males and females (95% CI of the difference -3.2% to 17.2%). Comparison of age groups show that the youngest age grouping (18-30 years) displayed the highest injury rate, with a gradual decline in the incidence of medically attended sport and recreational injuries across subsequent age groupings. The 95% confidence intervals for the differences between population proportions indicated that individuals between the ages of 18 and 30 years had incident rates significantly higher than all other age groups. In addition, respondents aged 30 to 29 years and over displayed an injury rate significantly higher than participants aged 60 years and over (95% CI of the difference 1.1% to 19.1%).

Nature of Injuries

Each participant who reported experiencing a medically attended injury as a result of involvement in a sport or recreational activity was queried as to the nature of the activity that led to the injury. The questions regarding the nature each injury was repeated for individuals who reported more than one injury in the 12 months preceding the survey. As shown in Table 2, the most common injury that people sought medical attention for was a strained or pulled muscle

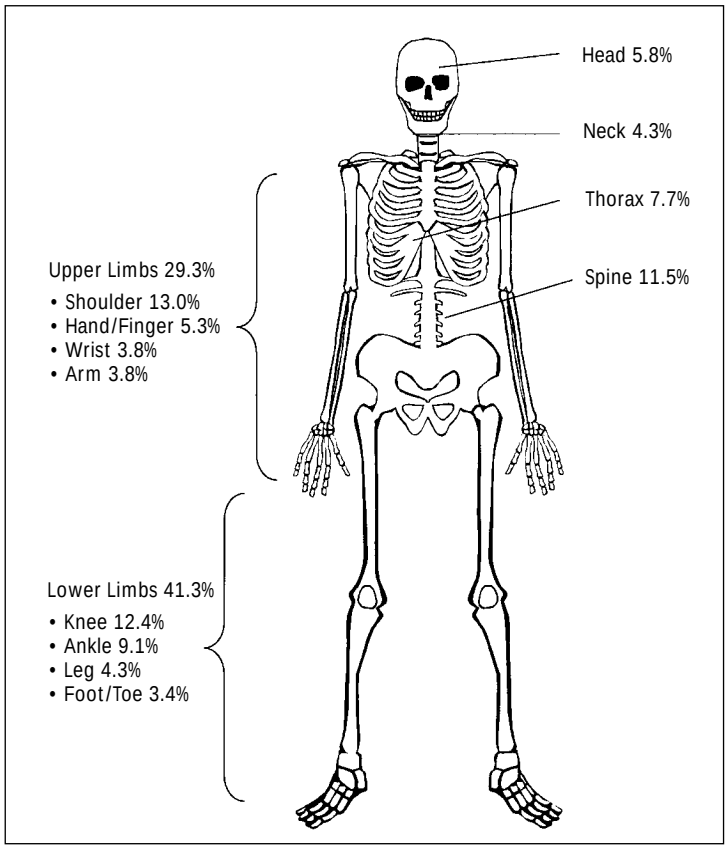

Figure 1: Percentage distribution of sport and recreational injuries over the body area.

(30.9% of all reported injuries), followed by sprained or torn ligaments (24.1%) and fractures (12.6%).

Bodily Location of Injuries

Participants were asked to identify the bodily location of their most serious injury and up to three other injuries that they may have experienced in the preceding 12 months. As displayed in Figure 1 over 40% of the injuries - including soft tissue and skeletal - were to the lower limbs, with the knee (12.5%) and ankle (9.1%) accounting for the majority of these injuries. Almost 30% of the injuries reported were to the upper limbs, with the shoulder (13%) being the most frequently reported injury location while the spine received over 11% of the injuries.

Injury Producing Activities

Estimated participation (per 10,000 population) and injury (per 1,000 participants) rates, for the activities reporting more than one sport or recreational related injury are presented in Table 3. The participation rate reflects the percentage of respondents who self-identified the activity

	n	Participation Rate per 10,000	95%CI Lo	95%CI Hi	N	Injury Rate Per 1,000	95%CIL.
Rugby League	24	179.5	178.2	180.8	14	583.3	468.3-698.4
Basketball	19	142.1	141.2	143.0	11	578.9	450.4-707.5
Martial Arts	16	119.7	119.0	120.4	9	562.5	425.8-699.2
Netball (Indoor/Outdoor)	34	254.3	252.2	256.4	11	323.5	272.7-374.4
Touch Footy	50	374.0	370.2	377.8	16	320.0	278.6-361.4
Equestrian	21	157.1	156.0	158.1	6	285.7	230.5-340.9
BMX/Motocross	24	179.5	178.2	180.8	6	250.0	206.7-293.3
Weightlifting	22	164.5	163.4	165.7	4	181.8	152.5-211.1
Gym	93	695.6	686.1	705.1	16	172.0	158.8-185.2
Bicycling (Competitive)	25	187.0	185.6	188.3	4	160.0	137.0-183.0
Sailing	13	97.2	96.7	97.7	2	153.8	123.7-184.0
Soccer	36	269.3	266.9	271.6	5	138.9	123.2-154.6
Cricket (Indoor/Outdoor)	29	216.9	215.2	218.6	4	137.9	120.6-155.2
Jogging/Running	108	807.8	796.0	819.6	13	120.4	113.0-127.8
Tenni	101	755.4	744.7	766.1	8	79.2	75.0-83.4
Volleyball	51	381.5	377.5	385.4	4	78.4	72.6-84.2
Dance	62	463.7	458.5	469.0	3	48.4	45.8-51.0
Gardening	92	688.1	678.8	697.4	4	43.5	41.7-45.3
Bowling	69	516.1	510.0	522.2	3	43.5	41.4-45.6
Bicycling (Recreational)	151	1129.4	1110.2	1148.6	6	39.7	38.5-41.0
Walking	672	5026.2	4891.5	5160.9	17	25.3	25.0-25.6
Golf	128	957.4	942.3	972.5	3	23.4	22.8-24.1
Swimming (Recreational)	153	1144.4	1124.8	1163.9	2	13.1	12.8-13.3

Table 3: Estimated participation and injury rates in activities reporting more than one sport/recreational related injury.

(respondents were prompted five times for the identification of regular activity involvement). The activity with the highest level of participation in the sample was walking (5026 participants/10,000 persons). Other popular activities were swimming and bike-riding (1144 participants/10,000 persons and 1129 participants/10,000 persons respectively). The most popular team sports in the sample were Volleyball (381 participants/10,000 persons), Touch Footy (374 participants/10,000 persons) and Netball (254 participants/10,000 persons).

Although injuries were reported in 42 different activities (88% of respondents reported being regularly active in more than one activity), over half of the total reported injuries came from nine different activities including individual activities such as walking, gym, jogging, martial arts and tennis, and team sports including touch footy, rugby league, basketball and netball. To compare injury risk across sports and activities only those indicating participation in the activity were included in the denominator for the calculation of injury rates. Rugby league was the activity with the highest injury rate (583 injuries/1,000 participants). Followed by basketball (579 injuries/1,000 participants), martial arts (563 injuries/1,000 participants) and netball (323

	N	% of visits	% of injuries
Family doctor	111	31.4	50.0
Physiotherapist	78	22.1	35.1
Emergency room doctor	40	11.3	18.0
Chiropractor	22	6.2	9.9
Don't know	21	5.9	9.5
Orthopaedic surgeon	19	5.4	8.6
Sports medicine doctor	16	4.5	7.2
Other Medical specialist	16	4.5	7.2
Massage therapist	11	3.1	5.0
Ambulance officer	9	2.5	4.1
Sports trainer	6	1.7	2.7
Nurse	4	1.1	1.8
Totals	353	100.0	159.0

Table 4: Healthcare professionals seen for treatment (total number) by percentage of visits and by percentage of injuries.

injuries/1,000 participants).

Medical Assistance: Location and Profession

The definition of injury utilised in this project was one that required medical attention. As part of the study, respondents were asked what health care professional they were treated by in the course of their injury. Information was gathered regarding the percentage of visits attributed to various medical or healthcare professionals and the percentage of injures attended to by the same population. In sum, nearly 90% of all injuries were first seen by either a family doctor (44.1%), a hospital emergency ward (23.1%) or a physiotherapist (20.9%). Many injuries are seen, or treated by more than one healthcare professional during the course of initial or remedial treatment. Table 4 displays the results of the total treatment of injury in terms of percentage of visits and percentage of injuries. It can be seen from Table 4 that the family doctor saw half of all injuries, whereas the family doctor made up slightly more than one-third of the total visits in the study.

Discussion

Lifelong physical activity is a goal towards which many countries are moving. There is an underlying assumption that the public health benefits of being active outweigh the health costs associated with such involvement. To date however, there has been little research at the population level that investigates the incidence of medically attended injury arising from the participation in physically active pastimes such as sports or active recreation. The present paper provides a retrospective view of the incidence of medically attended sport and recreational injuries occurring in a twelve-month period in the state of Queensland Australia.

Population-based surveys are useful in providing a broad, albeit not

particularly deep picture of the nature of the injury problem. In stating the strengths of the approach it is equally important to sight its limitations. It is acknowledged that the precision of the information presented here may be subject to some error due to the nature of the survey techniques used. The present study is limited by approach and scope. There is likely an underestimation of the injury rates due to memory decay over the one-year recall period. This bias may also lead to an over-representation of more serious injuries that are more likely to be remembered over events of a less serious nature (Robertson, 1992). Likewise the measurement of sport and recreational involvement is prone to recall bias. It may therefore be expected that more regular and recent involvement - including the potential effects of seasonal sport - show higher participation rates within the survey. The current project did not obtain detailed exposure information and therefore the results are generalised to simple descriptions of 'regular' participation. Future population-based research must reliably collect information regarding activity exposure - including information about the frequency, duration and intensity of participation - in order to better quantify the actual risks inherent in various activities. When interpreting the data it must be noted that the sample is considered representative of the general adult population of the state. It provides, for example, a sample of Queenslanders who walk, but not a sample of walking Queenslanders. Thus, there remains a need for large-scale studies in sport and activity-specific domains to further clarify the issues surrounding injuries arising from participation. In terms of scope, there remains a need for larger studies to be done in order to provide representative sub-samples of the population. Although costly in nature, future studies of this type will allow for more detailed analysis of selected elements within the population.

Although the style and magnitude of the current study has limitations, there remains valuable information to be gleaned from it. In absolute terms three of the top five injury-producing activities were recreational fitness activities as opposed to organised sports. These included walking (17 reported injuries), gym (16), and jogging (13). When looked at in terms of participation, the individual activities display significantly lower injury rate - walking for example drops to a mere 25.3 injuries per 1,000 participants compared to rugby leagues rate of 583/1,000. Even so, the finding, combined with similar findings from the Latrobe Valley Study (Finch, Cassell & Stathakis, 1999), indicates that there are a large absolute number of injuries associated with recreational walking and, should communities and governments succeed in promoting increased activity levels, we can expect to see large numbers of walking-related maladies, which will require substantial resources to be devoted to their diagnosis and treatment due to the sheer magnitude of participation. That a substantial portion of the population either are injured while walking - or at least attribute the injury to walking - means that more efforts should be directed toward injury prevention in mass participation activities, while maintaining a vigil on the traditional game-based sports such as football, basketball and netball.

The current approach also allows for direct comparison to previous research at a population level that used the similar methods and measurement instruments, an issue often cited as a weakness in sports injury research (Phillips, 2000). Direct comparisons can be made to sport and recreational

injury studies in Quebec (Impact Recherche, 1993), Ontario (McLaren, 1996) and Alberta (Mummery et al., 1998) Canada. Results show a higher injury rate in Queensland (the equivalent, for comparison purposes, of 16 injuries per 100 persons) than in Alberta (11 injuries per 100 persons), Ontario (7 injuries per 100 persons) or Quebec (5 injuries per 100 persons). These studies are separated by culture and time. Expectedly, given the vastly different participation rates between the two nations, Rugby League replaced Ice Hockey as the principal injury producing activity in the Queensland study. Of notable difference is the population's tendency to include individual fitness activities during their prompted recall in the present study. Although asked about sport and recreation involvement in a similar fashion, a higher proportion of the sample in the present study identified individual fitness activities such as walking as injury sources than did the Alberta sample. It is possible that the intervening time periods between studies - a period of high promotion of physical activity in both countries - has successfully raised the awareness of the Queensland population to such activities. Similar injury rates were reported for the fitness activity if jogging/running in Alberta (11%) and Queensland (12%). In reviewing the injury rates between studies it follows that increased participation may lead to increased injuries. The participation rate of Canadians prior to 1998 was only 34.2% (CFLRI, 1998), whereas recent studies in Australia show a participation rate of 54.7% (Armstrong, Bauman, & Davies, 2000). These differences may contribute to the noticeable differences in injury rates exhibited in the studies.

The present findings report substantially higher injury rates (1660 injuries/10,000 population) than did work conducted by Finch, Cassell and Stathakis (1999) in the Latrobe Valley who reported the equivalent to 500 injuries per 10,000 sport participants. The noticeable difference in the two studies, which may explain the varying results, is that the Latrobe valley study asked for sport and recreational injuries - not restricted only to those which required medical attention - that occurred in four separate, two-week data collection periods, whereas the current research utilised a one-year recall frame. By contrast, recent research in Western Australia (Stevenson et al., 2000) reported an injury rate in excess of 50% of an active sample of sport participants during a season-long prospective study. Differing timeframes and study populations make direct comparison often difficult.

With only 11% of recorded injuries presenting at a hospital emergency room we see that although emergency room data offers generally reliable and detailed information regarding the injuries presented, the majority of injuries are not seen in this forum. As a result the generalisation of emergency room visitations to the entire population likely underestimates the extent of the problem while overstating the severity, a point shared by Mulder (1997). Emergency room data should be utilised in conjunction with large-sale population surveys to piece together the entire picture of the nature and extend of injuries arising from sport and recreational activity involvement. The family doctor seems to be a rich source of injury information with 50% of all injuries in this study having been seen by a family doctor at some point during the treatment process.

Results show that the majority of the reported injuries were strains or sprains (55%) with the upper and lower limbs being the subject of the vast

majority of the injuries (70.6%). In the absence of detailed severity data it is evident that although there are a large number of medically treated injuries annually, most of these are not serious in terms of hospitalisation or surgery. There still remains the possibility of loss of activity time and, perhaps more importantly, the development of a fear of further injury - especially in the older cohort (Wankel et al., 1994) as a result of previous involvement. Given the current focus nationally and internationally on the promotion of physical activity, there remains a need to ensure a minimisation of injuries in all activities, including sport activities. Finch et al. (2001) point out that the consideration of injury prevention principles is crucial when promoting physical activity to the general population. To date the issue of injury in non-sporting recreational activities such as walking, gym use and jogging seems under-represented in the literature. It is evident from the current study that efforts to ensure safe, injury-free participation in these areas should not be neglected. Only through the combination of injury and participation rates do we obtain a estimate of the actual number of injuries per annum. It is easy to overlook activities exhibiting low injury rates if the total participation rate is not factored into the equation.

In conclusion, the current paper makes a contribution to the overall picture concerning the nature and extent of injuries sustained during sport and recreational activities. It highlights the number of injuries associated with general fitness activities achieved through high participation rates and low injury rates. This is an area of much needed attention given the promotional push towards raising the levels of physical activity at a population level. As it is likely that the levels of activity will be elevated by means of individual recreational activity participation, as opposed to sport participation, efforts need to be increased to ensure a safe, enjoyable environmental for the population as a whole.

Footnotes

1 The Ci3 CATI System is a PC-based product of Sawtooth Software, Evanston, Illinois.

2 SPSS (Statistical Package for the Social Sciences) is a product of SPSS Inc. Chicago, Illinois.

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