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Incidence of shoulder injuries and related risk factors among master swimmers in South Africa

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Abstract

Incidence of shoulder injuries have been widely reported for work-related musculoskeletal pain in the upper extremities, but there is a limited amount of research and statistics available that reports on the incidence of shoulder pain in master swimmers. This study investigated the association between literature identified risk factors and the incidence of shoulder pain in South African master swimmers. A total of 282 master swimmers completed a shoulder pain and related risk factors questionnaire during the 2010 South African Masters Swimming Championships. Statistical analysis of the data was done to determine frequencies, percentages, odds ratios and significance levels. Shoulder pain was found to be more likely in females (odds ratio (OR) = 1.3), smokers (OR = 1.8), swimmers swimming more than one stroke (OR = 1.2) and competitive swimmers (OR = 2.2). Swimmers engaging in strength training (OR = 0.78) showed a reduced incidence of shoulder pain. The calculated incidence of shoulder pain over the three-year period among the master swimmers was 62.4%. Significant statistical associations between shoulder pain and the risk factors of osteoporosis, volume of training and competitiveness were found. This high incidence of shoulder pain highlights the need for the development of interventions to prevent these injuries in master swimmers. Further research is needed to determine the incidence and causes of shoulder pain in other swimming populations in South Africa.

Keywords: Shoulder pain, incidence, risk factors, master swimmers.

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Introduction

Swimming is a popular leisure time pursuit in South Africa. Masters swimming has been growing in popularity, and open water swims such as the Midmar Mile have been achieving record entry volumes. Due to the increased importance attached to exercise and a healthy lifestyle more people look for recreational pursuits like swimming that provide these benefits. Swimming also provides a good non-weight bearing alternative to exercise for people in all age groups as well as people suffering from injury or disease.

The benefits of exercise through the aging process have been widely reported (Daley & Spinks, 2000; Paterson, Jones & Rice, 2007). Exercise such as swimming increases muscle strength and power, and will increase functional ability in the

activities of daily living in the very old (Daley & Spinks, 2000; Paterson et al., 2007).

The term "swimmers shoulder" is often used to describe a combination of soft tissue injuries that lead to shoulder pain in swimmers (Goldstein & Tanner, 1999). Competitive swimmers at all levels of participation suffer from a variety of shoulder injuries that include rotator cuff disease. Studies have shown that pain from shoulder injuries can interfere with training and can seriously affect swimming performance (McMaster, Robberts & Stodard, 1998).

Prevalence and incidence of shoulder injuries have been widely reported for work-related musculoskeletal pain in the upper extremities (Werner, Franzblau, Gell, Ulin & Armstrong, 2005; Roquelaure, Leclerc, Touranchet, Sauteron, Melchior, Imbernon & Goldberg, 2006). Roquelaure et al. (2006) study involving 2 685 men and women in 2003 in France showed the incidence of shoulder injuries over one year to be 34.3% in women and 39.8% in men. Werner et al. (2005) found in a cohort study over 5.4 years that 94 out of 350 industrial and clerical workers developed upper extremity musculoskeletal disorders.

In a cross-sectional survey conducted by Puckree and Thomas (2006) on competitive swimmers between the ages of 13 and 25 in KwaZulu-Natal, 71% of the respondents experienced shoulder pain, while 64% reported actual shoulder injuries which included impingement, supraspinatus and bicipital tendonitis, bursitis and muscle strain. There is, however, a limited amount of research and statistics available that report on the incidence of shoulder pain in master swimmers (McMaster & Tramp, 1993).

Swimming is a sport involving repetitive force application by the shoulder and arm. Epidemiological studies and reviews of work-related upper extremity musculoskeletal pain found evidence that repetitive mechanical loading and the application of force above shoulder height increase the incidence of shoulder pain (Sommerich & Hughes, 2006, Nawoczenski, Ritter-Soronen, Wilson, Howe & Ludewig, 2006). As certain jobs share the same biomechanical movement patterns and loading as swimming, the risk factors that predict shoulder injury in these jobs may be relevant to the development of shoulder pain in swimmers.

The workplace, lifestyle and demographic risk factors identified in literature on work-related and sport-related studies to determine the risk factors and predictors of shoulder pain in a variety of populations are summarised in Table 1.

Table 1: Risk factors for the development of shoulder injuries

Risk factor	Author	Used in questionnaire
Mechanical-related		
Work above shoulder	(Padma & Balasubramanie, 2008)	Yes through stroke
Working with rotated neck	(Padma & Balasubramanie, 2008)	Yes through stroke
Lifestyle-related		
Sports activity	(Padma & Balasubramanie, 2008)	Yes
Weight training	(Northover et al., 2007)	Yes
Volume of sport training	(Padma & Balasubramanie, 2008; Sein, 2008)	Yes
Demographics		
Age	(Kuijpersa, Windta, Heijdenb & Boutera, 2004; Werner et al., 2005; Padma & Balasubramanie, 2008)	Yes
Gender	(Treaster & Burr, 2004; Padma & Balasubramanie, 2008)	Yes
Other		
Psychosocial factors		No
Smoking	(Werner et al., 2005; Northover et al., 2007; Padma & Balasubramanie, 2008; Sein, 2008)	Yes
BMI	(Werner et al., 2005; Padma & Balasubramanie, 2008)	Yes
Trauma	(Padma & Balasubramanie, 2008)	Yes
Disease characteristics		
Prior history of shoulder problems	(Padma & Balasubramanie, 2008)	Yes
Rheumatoid arthritis	(Northover et al., 2007)	Yes
Osteoarthritis	(Northover et al., 2007; Padma & Balasubramanie, 2008)	Yes
Osteoporosis	(Prior et al., 1996)	Yes
Diabetes	(Laslett et al., 2008)	Yes
Obesity	(Werner et al., 2005; Padma & Balasubramanie, 2008)	Yes

The primary objective of the study was to determine the incidence of shoulder pain in master swimmers in South Africa. The secondary objective was to determine whether a relationship exists between selected risk factors and the occurrence of shoulder pain among the master swimmers.

Methods and Material

Study design

The research was conducted as a retrospective case control study and data were collected using a questionnaire.

Population and sample

In early 2010, 450 master swimmers (220 women and 230 men) entered to compete in the South African Masters National Swimming Championships. Among these were 18 foreign swimmers from Russia, UK, Swaziland and Germany who were excluded from the study. Of the 450 swimmers, 417 travelled to Pretoria in March 2010 and actually competed in the championships.

Questionnaire

A shoulder pain and related risk factors questionnaire for master swimmers in South Africa was constructed firstly to determine the incidence of shoulder pain in master swimmers over a three-year period. Questions in this section also reported on the number of times pain was experienced within the period and any known causes.

The presence of risk factors at the time of the injury was also surveyed in the same questionnaire. Only the variables listed in Table 1 that could successfully be surveyed were selected. This excluded psychosocial risk factors that can easily be flawed in recall. Thirty data items covering demographic, lifestyle, training habits and general health were surveyed.

Demographic details included data items such as age, gender, height and weight, while the lifestyle section determined the smoking status of the individual. The general health section of the questionnaire included questions regarding the timing and the occurrence of illnesses linked to shoulder pain such as rheumatoid arthritis, osteoarthritis, osteoporosis and diabetes. The section of training habits included data items such as training stroke, training volume and whether the individual engaged in resistance training.

The questionnaire did not include any data items that reported on the recovery from or interventions taken by the swimmers in the recovery process.

Validity and reliability

Internal validity refers to the extent to which differences identified among people is a result of the intervention or variable being tested (Eldridge, Ashby, Benett, Wakelin & Feder, 2008). To ensure internal validity to eliminate selection bias, the case and control groups were tested and found to be similar in age, gender and BMI. Information bias was eliminated because the case and control groups completed the same questionnaire at the same time. Recall bias was also limited by restricting the research period to only three years. The questionnaires were also completed anonymously, further eliminating possible bias.

Interpretation of results can be affected by possible confounders. Confounders are important in determining whether an apparent association is in fact attributable to other factors such as age or gender differences. Possible confounders were identified in the study as being:

- Illnesses can confound the odds ratios of other risk factors.
- Trauma can confound the odds ratios of other risk factors.
- Other activities indicated to be the cause of shoulder pain can confound the odds ratios of other risk factors.

All these risk factors had very low frequencies and it was assumed that the effect of the confounding on the odds ratio would not be significant. Implementing the controls for internal validity ensured that the conclusions drawn in the study are warranted by the data (Leedy & Ormrod, 2001).

External validity refers to the extent to which the study results can be generalised to other individuals or settings and situations (Eldridge et al., 2008). The results of this study cannot be generalised to the wider population but can be applied to other master swimmers in similar settings.

Reliability has to do with the degree to which a measurement instrument produces consistent results (Leedy & Ormrod, 2001). Reliability was ensured by giving all the participants the same standardised questionnaire to complete. No further measures of reliability were included in the study.

Data and statistical methods

The numerical and categorical data from the questionnaires were captured into an Excel database and encoded with numerical values. All statistical tests were performed using Excel and Statistical Packages for the Social Sciences (SPSS) software. Means and standard deviations were used to describe demographic details such as age and gender. The height and weight data items were used to calculate the Body Mass Index (BMI) for each swimmer. Charts were plotted for the demographic data and some risk factors such as BMI.

The data were categorised to indicate swimmers shoulder pain (cases) and those without pain (controls). A t-test was calculated to determine if statistical differences existed between cases and controls in terms of the mean ages, genders and BMI. Odds ratios (OR) were calculated as estimated measures of association between each risk factor and the outcome, namely shoulder pain and a 95% confidence interval (CI) was applied.

Results

Response rate

Two hundred eighty two (n=282) master swimmers completed the shoulder pain and related risk factors questionnaire after exclusion of 10 pre-master (younger than 25 years) swimmers. The response rate at the championships was thus 67.6%. The high response rate was achieved through the distribution to and control of questionnaires by the respective club captains. Club captains were briefed personally on the goals of the study and the ethical considerations. The questionnaire was only two pages long, further ensuring higher response rate.

The participants' identities were kept confidential by separating questionnaires and informed consent forms, and only placing respondent numbers on the questionnaires.

Demographic analysis

Questionnaires were completed by 282 swimmers of which 144 were females and 136 were males. Females comprised 51.1% of the sample and males, 48.9%. The age distribution for the swimmers is depicted in Figure 1.

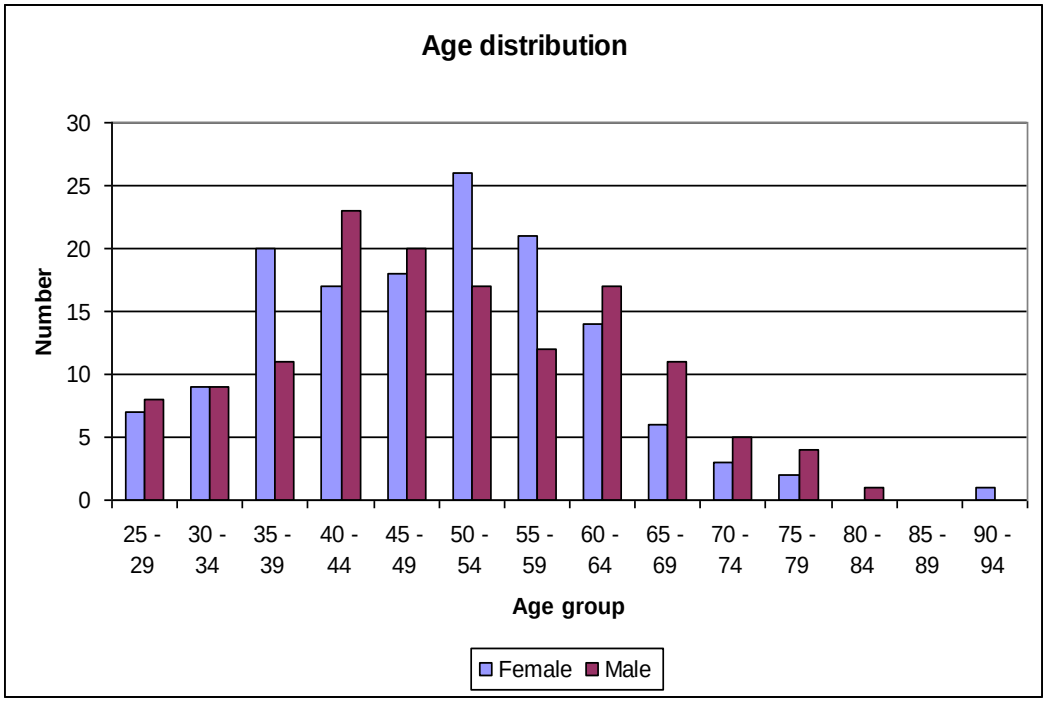

Figure 1: Age distribution of master swimmers at the 2010 SA National Championships

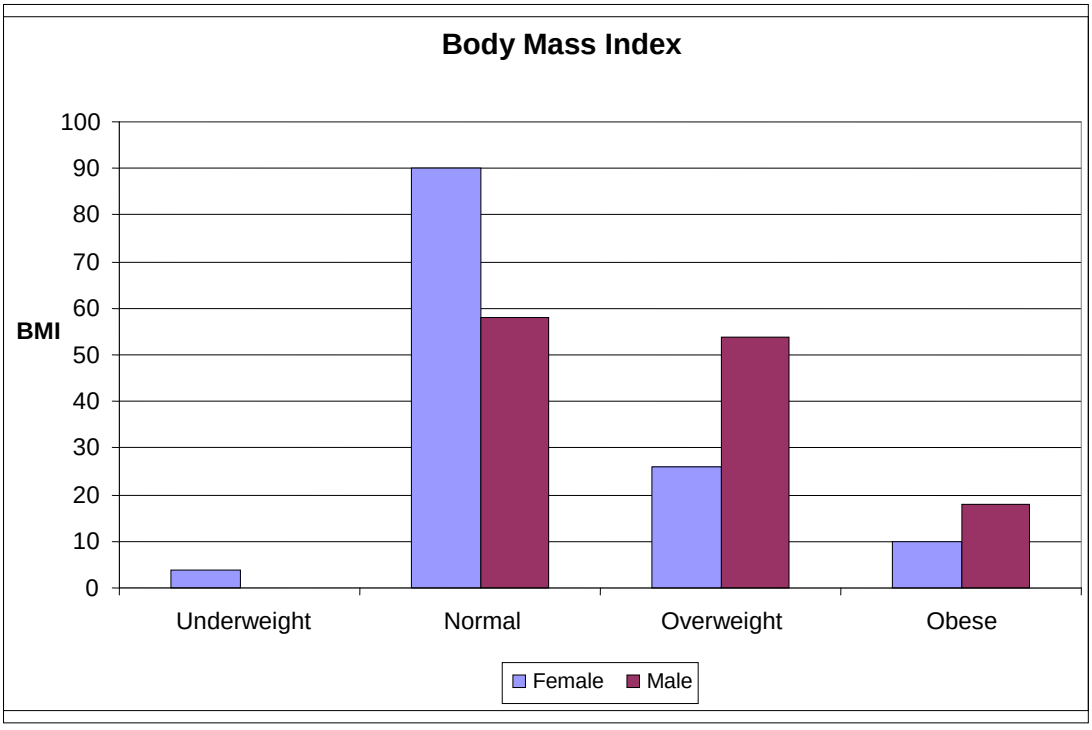

Figure 2: BMI distribution of master swimmers at the 2010 SA National Championships

BMI calculations were made according to WHO prescriptions (Williams, 2007) and are depicted in Figure 2.

Incidence

The calculated incidence of shoulder pain over the three-year period in the master swimmers was 62.4%. Of these swimmers, 28.7% indicated that they experienced recurring pain during the three-year period and 20.9% described their pain as chronic. In 37.2% of the swimmers the pain was so severe that they had to discontinue their training. Swimmers gave the responses provided in Table 2 concerning the possible causes of their shoulder pain.

Table 2: Swimmer perceived causes of shoulder pain

Cause	n	Total
Shoulder pathology		51
Rotator cuff	20	
Muscle injuries	8	
Problems in neck	5	
Tendonitis	5	
Other	13	

Cause	n	Total
Swim and strength training		89
Overtraining	17	
Paddles	15	
Swimming	14	
Strength training	9	
Other	34	
Posture and flexibility		14
Flexibility	7	
Weak muscles/stabilizers	7	
Trauma		12
Other		37
Overuse	11	
Other sport/recreational activities	9	
Lifting/carrying heavy objects	6	
Deconditioning	4	
Other	7	

Comparison of the groups

The results of the analysis of the cases and control groups by means of a t-test are set out in Table 3.

Table 3: Results of the comparison of the master swimmers with and without shoulder pain

Variables	Pain	n	Mean	Std deviation
Gender	Control	106	.56	.499
	Cases	176	.48	.501
Age	Control	106	50.58	13.149
	Cases	176	49.04	11.737
BMI	Control	98	25.50	5.202
	Cases	165	25.28	4.203

The result showed that the groups were homogeneous with relation to age, gender and BMI variables.

Frequencies

The frequencies and the percentages for all the data were tabulated (Table 4).

Table 4: Results summary

Risk factor	No pain		Pain	
Age	n	%	n	%
25-34	14	42	19	58
35-44	22	31	49	69
45-54	27	33	54	67
55-64	28	44	37	56
65-74	11	44	14	56
75-94	4	50	4	50
Gender				
Male	47	34	91	66
Female	59	41	85	59
BMI				
Underweight	1	25	3	75
Normal	46	37	77	63
Overweight	36	37	61	63
Obese	13	37	22	63
Smoking				
Current/Ex-smoker	18	50	18	50
Non-smoker	88	36	158	64
RA				
Sufferer	1	13	7	88
Non-sufferer	105	38	169	62
OA				
Sufferer	8	36	14	64
Non-sufferer	98	38	162	62
OP				
Sufferer	7	70	3	30
Non-sufferer	99	36	173	64

Associations

Odds ratios, 95% confidence intervals and significance levels were calculated using the SPSS software (Table 5).

Participation in other activities

Swimmers participate in a range of other sporting and recreational activities (Table 6).

Table 5: Odds ratios, confidence intervals and significance levels of statistics of master swimmers at the 2010 SA National Championships

	Odds ratio	95% confidence		Fisher's scale
Risk factor		Low	Up	Exact significance (1-sided)
Age				
25-34	1.0			
35-44	0.61	0.259	1.431	0.179
45-54	0.68	0.296	1.558	0.24
55-64	1.06	0.452	2.469	0.538
65-74	1.07	0.374	3.040	0.558
75-94	1.36	0.289	6.369	0.5
Gender				
Male	1.0			
Female	1.34	0.829	2.179	0.141
Body mass index				
Underweight/ Normal	1.0			
Overweight/ Obese	1.01	0.607	1.664	0.544
Smoking				
Non-smoker	1.0			
Current/ Ex-smoker	1.8	0.889	3.623	0.073
RA				
Non-sufferer	1.0			
Diagnosed with	0.23	0.028	1.894	0.13
OA				
Non-sufferer	1.0			
Diagnosed with	0.94	0.382	2.331	0.548
OP				
Non-sufferer	1.0			
Diagnosed with	4.08	1.031*	16.129	0.036*
Diabetic				
Non-sufferer	1.0			

	Odds ratio	95% confidence		Fisher's scale
Risk factor		Low	Up	Exact significance (1-sided)
Diagnosed with	1.11	0.182	6.757	0.622
Trauma				
None	1.0			
Suffered trauma	0.99	0.98	1.007	0.845
Training strokes				
Only freestyle	1.0			
Only breaststroke	1.41	0.467	4.202	0.367
More than one stroke	1.21	0.698	2.110	0.292
Swims fly	1.06	0.440	2.538	0.533
Training volume				
Low/Medium	1.0			
High	0.36	0.568	0.680	0.004*
Type of swimmer				
Recreational	1.0			
Competitive	2.18	1.205*	4.000	0.008*
Strength training				
No	1.0			
Yes	0.78	0.434	1.387	0.239

* Indicates a significant level of association

When asked if these activities contributed to their shoulder pain, swimmers indicated that the activities of gymnasium, golf, rowing and waterpolo did. These data could, however, not be used, as the questions were not structured well enough to isolate any confounding risk factors.

Table 6: Summary of sporting activities in which master swimmers compete

Activity	n
Cycling/ Spinning	56
Running	46
Gymnasium and weight training	30
Walking	22
Golf	13
Triathlon	8
Pilates and yoga	7
Hiking	6
Tennis	6
Waterpolo	6
Rowing	5

Activity	n
Squash	5
Other	64

Discussion

Comparison of case and control groups

There were no significant differences between the case group and the control group for age gender and BMI. These groups can therefore be considered homogenous.

Age

Werner et al. (2005) found that it is not common for a person to develop non-traumatic shoulder tendonitis before the age of 40, but it is fairly common in older individuals. This association is mostly related to repeated injury over time and the body's decreased ability to repair the injury quickly. Range of motion (ROM) and joint stiffness increases with age. This is mostly due to degenerative changes in the elastin component of connective tissue that surround the joints (Baechle & Earle, 2008). This may lead to an increase in shoulder injuries with age.

The average age of swimmers at the championships was 49 years for females and 50 years for males. The oldest female swimmer was 90 years old and the oldest male swimmer was aged 81 years.

The odds ratio decreased between the ages of 35-55, maybe showing the protective effect of swimming. As expected, the odds ratio gradually increased over the age groups from age 55 onwards, showing that the older swimmers were more likely to develop shoulder pain than the younger swimmers. However, the tests showed no significant association between age and the incidence of shoulder pain in the swimmers.

Gender

Treaster and Burr (2004) conducted a literature review to determine whether women experience higher prevalence of upper extremity musculoskeletal disorders (MSDs) than men. They reviewed 56 articles on gender differences in incidence, prevalence and frequency rates for MSDs of the upper extremity. Most of the studies showed that women had significantly higher incidence of upper extremity MSDs than men. Although the odds ratio showed that females were 1.3 times more likely to develop shoulder pain than the male swimmers, the tests showed no significant association between gender and incidence of shoulder pain in the swimmers.

Gun (1990) found that the incidence rates varied between different occupations and stated that the gender differences were not so much biological differences but that they were rather mostly due to the different tasks assigned to women and men. Male and female swimmers train and compete in the same strokes, and this might offer some insight into the fact that the association of shoulder pain to gender is not significant.

Body mass index (BMI)

BMI is a measurement that has replaced weight as the preferred determinant of obesity (Williams, 2007). Results indicate that almost double the amount of males to female swimmers fall in the overweight and obese categories. The average BMI for females and males were 24 and 27 respectively.

Werner et al. (2005) found that a person with a BMI over 30 is likely to develop an upper extremity tendonitis (UET) in the near future. There is no clear explanation for BMI as a risk factor for UET, except that it possibly acts as an indicator of deconditioning.

The 1.01 odds ratio for overweight/obese swimmers shows that BMI does not affect the odds ratio of shoulder pain in master swimmers. This might substantiate the joint protective properties of swimming, as it provides a good non-weight bearing alternative to exercise for overweight and obese individuals. The tests slso showed no significant association between BMI and the incidence of shoulder pain in the swimmers.

Smoking

The study by Northover, Lunn, Clark and Phillipson (2007) suggests that limited micro vascular blood supply to the tendons of the rotator cuff muscles predisposes the muscles to atrophy. It would be expected that smoking will increase the risk of rotator cuff disease in a similar way, but the study did not find smoking to be a risk factor. A study by Werner et al. (2005) found that the incidence of upper extremity tendonitis amongst smokers over a 5.4-year period was 34.6%. In this study an average of 89.6% of swimmers were found to be non-smokers. A total of 36 master swimmers are currently smoking. This constitutes only 12.8% of the sampled swimmers.

Although odds ratios showed that smokers were 1.8 times more likely to develop shoulder pain, no statistically significant association could be established between smoking and the incidence of shoulder pain due to the small number of smokers in the present study.

Rheumatoid arthritis (RA)

Antoniou, Tsai, Baker, Schumacher, Williams and Ianotti (2003) found that incidence of rotator cuff pathology (which causes shoulder pain) is higher in patients with rheumatoid arthritis, but they might mistake the pain they felt from shoulder impingement for inflammatory pain of the glenohumeral joint (Northover et al., 2007). Only eight swimmers indicated that they suffered from RA. The odds ratio showed a high negative association with shoulder pain, which could possibly be linked to the use of anti-inflammatory medication. No statistically significant association could be established between RA and shoulder pain in this study.

Osteoarthritis (OA)

People who suffer from osteoarthritis seem to have an increased risk of rotator cuff disease and this may predispose them to sub-acromial osteophytes at the acromio-clavicular joint. This can be abrasive to the supraspinatus tendon, and cause inflammation and tears (Antoniou et al., 2003; Northover et al., 2007). Twenty-two swimmers indicated that they had suffered from OA for an average of 8.3 years. However, no statistically significant association could be established between OA and shoulder pain in this study.

Osteoporosis (OP)

Due to the non-weight-bearing characteristic of swimming it has been associated with bone mineral density deficits in female swimmers, which is a risk factor for osteoporosis later in life (Derman, Cinemre, Kanbur, Doğan, Kılıç & Karaduman, 2008). Osteoporosis can lead to compression fractures in the thoracic spine, which tend to collapse anteriorly, develop rounding of the back (kyphosis), which leads to loss of height and may lead to back and shoulder pain (Prior, Barr, Chow & Faulkner, 1996). Ten of the surveyed swimmers indicated that they had suffered from osteoporosis for an average of 5.7 years. The odds ratio showed that swimmers with OP were 4.08 times more likely to develop shoulder pain. A statistically significant association was established between OP and shoulder pain among the swimmers.

Diabetes

In this study diabetes was found to be a significant risk factor for the development of rotator cuff disease. This is because diabetes affects the micro vascular blood supply and this then impedes the supply of nutrients, predisposing the muscles to atrophy. It also reduces the ability of the tendon to repair itself in the event of trauma (Northover et al., 2007). According to Laslett, Burnet, Redmond and McNeil (2008), shoulder pain and disability are common and persistent in adults with diabetes. Poor glycaemia control and diabetic complications are factors that can worsen shoulder

pain and disability. There were seven swimmers who indicated that they had been diagnosed with diabetes. Only one swimmer had suffered from the disease for more than 20 years. The odds ratio was 1.1, indicating only a slightly higher increased risk of shoulder pain linked to diabetes. However, no statistically significant association could be established between diabetes and shoulder pain in this study.

Trauma

One of the work-related risk factors for shoulder and neck pain identified by Padma and Balasubramanie (2008) is previous trauma. Shugars, Williams, Cline and Fishburne (1984) concluded in their study that prevalence of musculoskeletal disorder was related to sports injuries and trauma injuries. Twenty-four swimmers indicated that their shoulder pain resulted from a traumatic event. No further details as to the nature of this traumatic event were included in the questionnaire.

Swimming stroke

According to Padma and Balasubramanie (2008) working with arms above shoulder level is one of the mechanical-related risk factors to shoulder pain. Work by Jarvholm, Palmerud, Styf, Herberts and Kadefors (1988) on muscle physiology showed that when the arm is raised above 30˚, the pressure within the supraspinatus muscle increases to such an extent that normal blood flow to the muscle might be impaired. This can contribute to rotator cuff disease and ultimately shoulder pain.

Northover et al. (2007) also found that regular overhead activities increased the risk of rotator cuff disease. High rates of shoulder pain are seen in people who are exposed to routine overhead work, such as construction workers or athletes whose sports involve frequent overhead arm use. This pain frequently progresses to functional loss and disability (Nawoczenski et al., 2006).

The strokes front crawl, breaststroke and butterfly all have the potential for incorrect stroke mechanics due to incorrect catch positions and force application above shoulder height (Maglischo, 2003). Front crawl and backstroke use alternating arm patterns and a body roll is used to position the shoulder effectively. Breaststroke and butterfly use a simultaneous bilateral arm action with no body roll. Breaststroke has the lowest reported incidence of shoulder injuries (Souza, 1995).

Swimmers were asked to indicate in which stroke they did most of their training. Unfortunately due to the way the question was structured, this caused ambiguity and many swimmers indicated more than one stroke in their answer. The data was sorted according to the following categories:

- Those who indicated only freestyle
- Those who indicated only breaststroke
- Those who indicated more than one stroke
- Those who indicated butterfly

Odds ratios were determined for the categories comparing them to swimmers who swam freestyle only as a reference. Results indicated that swimming more than one stroke raised the risk of developing shoulder pain slightly. No statistically significant association was established between swimming stroke and shoulder pain in this study.

Volume of training

According to Northover et al. (2007), people who undertake manual work are at higher risk of developing shoulder pain through rotator cuff disease than those who have a clerical job. They also identified a relationship between the strenuousness of the work undertaken and the development of rotator cuff disease. They found that the probability ratios of developing this disease with clerical, light and heavy manual work were 1: 1.85: 3.81, respectively. In a survey of the training habits of USA master swimmers, Taylor, Stager, Tanner, Battista and Roberts (2001) found that the swimmers averaged four days of training per week all year round with an almost uniform training volume across all age groups of between 1800 m and 3 200 m per session with very little difference between the genders.

The volume training load of the master swimmers was calculated for each swimmer by multiplying the weekly frequency of training with the daily distance per training session. This was then divided into three groups according to the following criteria:

- Low volume 0-4 999 m/week
- Medium volume 5 000-11 999 m/week
- High volume 12 000 m and greater/week

Odds ratios were calculated comparing low/medium volume swimmers with high volume swimmers. It showed that low volume swimmers were 2.8 times more likely to develop shoulder pain. This result is contradictory to previous research and may be linked to the fact that swimmers are swimming less due to the high incidence of shoulder pain. Puckree and Thomas (2006) found that 75% of the swimmers who complained of shoulder injuries had to stop swimming temporarily due to the injury. Finding an association between volume of training and shoulder pain will need further prospective research. A statistically significant association was established between the volume of training and shoulder pain in this study.

Competitiveness

Competitive swimmers engage in professional training programmes and sport-specific conditioning in order to optimise performance. Sein (2008) found that large amounts of swimming training (number of hours swam per week and weekly mileage) in competitive swimmers resulted in a higher incidence of supraspinatus tendinopathy.

A total of 165 swimmers indicated that they perceived themselves to be recreational swimmers, while 74 swimmers regarded themselves as competitive swimmers. Odds ratios indicated that competitive swimmers were 2.2 times more likely to develop shoulder pain than recreational swimmers. A statistically significant association was established between the competitiveness of swimmers and shoulder pain in this study.

Strength training

People undertaking shoulder intensive recreational activities such as weight training are at an increased risk of developing rotator cuff disease (Northover et al., 2007). Odds ratios indicated that master swimmers who did strength training had a reduced risk of developing shoulder pain. This may indicate a protective association for swimmers who strengthen the shoulder joint through regular strength training. No statistically significant association could be established between the strength training and shoulder pain in this study.

Limitations of the study

Master swimmers can compete in both open water and pool competitions. Only swimmers who are registered with the South African Master Swimmers (SAMS) and Swim South Africa (SSA) can compete in the national championships. Master swimmers who compete in open water events do not have to register. This study was limited to swimmers who were registered with SSA. Furthermore, master swimmers with current severe shoulder pain might not have entered for the championships and were thus excluded from the survey. This might have led to underreporting of injury incidence rates. A test-retest reliability test should have been done, but because the master swimmers were only available during the South African Masters National Swimming Championships, it was not possible.

Conclusion and Recommendations

Master swimmers in South Africa are not professionally supported, and usually have wide responsibilities such as families and work. Shoulder pain not only impacts on the training and performance of these swimmers, but also carries over into other spheres of life that may for instance lead to lost work time (McMaster et al., 1998).

Understanding the risk factors of shoulder pain will help in the prediction and early diagnosis of shoulder injuries. Early diagnosis improves the prognosis for complete recovery from the injuries. It will allow master swimmers to enjoy the benefits of fitness and exercise until old age.

The study showed significant statistical associations between shoulder pain and the risk factors of osteoporosis, volume of training and competitiveness in the sampled master swimmers. The incidence of shoulder pain in the master swimmers was 64.2%. Reporting on this high incidence highlights the need for the development of interventions to prevent shoulder injuries in recreational and competitive master swimmers.

Further research is needed to determine the incidence of shoulder pain in other swimming populations in South Africa; specifically open water swimming that is growing in popularity in South Africa. The relationship between volume of training and shoulder pain also needs further investigation.

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