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Golf-related lower back injuries: an epidemiological survey

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Abstract

Objective: This study describes the playing characteristics of golfers who had an injury to their lower back in the course of play or practice in the previous year (12 months).

Methods: A retrospective survey was mailed to members of randomly selected golf clubs across Australia. Statistical methods used included 2-sample t test to compare means of 2 independent populations and the χ^2 test to examine the association between categorical variables/factors in the study.

Results: Of 1634 Australian amateur golfers surveyed, 17.6% of golfers sustained at least 1 injury in the previous year. The lower back accounted for 25% of all golf-related injuries in the previous year, making the lower back the most common site of injury. The golfer with a golf-related lower back injury was likely to have a previous history of lower back injury, while the injury had a progressive onset compared with an acute single onset. The follow-through phase of the golf swing was reported to be associated with the greatest likelihood of injury compared with other phases of the swing. Most of the injured golfers received treatment of their injury with a general practitioner (69%), a physiotherapist (49%), or a chiropractor (40%).

Conclusion: Practitioners treating golfers with a history of lower back injury should evaluate the golf swing follow-through to identify potential causes of aggravation to the lower back. Targeted measures such as spinal manipulative therapy, soft tissue and back exercise, and conditioning programs to assist the strength and mobility of the golfer could then be implemented.

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Introduction

Injuries to the lower back are one of the most common golf-related problems.[1-7] The incidence of golf-related lower back injury ranges from 15% to 34% in the amateur golfer[3,5-7] and 22% to 24% in the professional.[3,4,7] Collectively, the incidence of lower back pain in the male golfer is 25% to 36% and 22% to 27% in the female golfer.[1-7] However, despite the high participation rate and the large financial support of the golf industry, there remains limited current data on golf-related injury epidemiology[3] that could specifically direct practitioners in the management of these problems.

The aim of this study was to describe the play characteristics of golfers who had an injury to their lower back in the course of play or practice in the previous year (12 months). In addition, common injury mechanisms for the back injury were sought to determine if factors such as age, sex, and the amount of play or practice affected the back injury rate. Finally, the study aimed to report the practitioner utilization or back injury management among the golfers surveyed.

Methods

A survey was developed to collect data for evaluating the effects of possible variables or risk factors associated with golf injuries. Information on the golfer, including age, sex, skill level, experience, warm-up habits, golfing equipment, and tuition, was collected in the survey. Before the distribution of the survey instrument, a pilot study of the survey was prepared and distributed to a representative group of golfers to test the questions in the survey and identify possible problems with the survey. The survey was then amended and the resultant survey was used as the main survey instrument. Ethics approval for this study was obtained through Macquarie University.

In the survey, subjects were asked if they had sustained a golf-related injury in the past 12 months and if they currently had an injury. The lower back was described as any marking on the anatomical drawing that was enclosed in the shaded area shown in Fig 1. For the purpose of this study, a *golf-related injury* was defined as "any condition sustained during the playing/practicing of golf that stops play/practice, impedes normal performance, or requires medical treatment including over-the-counter medication such as analgesics, anti-inflammatories, or liniments." Normative data of the golfer population from the Australian Bureau of Statistics were also obtained and were used to determine how representative the study sample was to the general golfing population in terms of male-to-female distribution and skill level.

There are approximately 500 000 registered amateur golfers (golf club members) in Australia. A list of golf clubs in each Australian state was obtained, and each golf club was assigned a number. Once assigned, numbers were randomly selected with the aid of a random number generator and those selected golf clubs were invited to take part in the survey.

Once a club was selected, the club secretary/manager was contacted. The secretary/manager was asked if the club would consent to participate by allowing the survey materials to be sent to all club members. If they agreed to participate, all members of the club had the survey materials mailed to them. If the club declined to participate, another club was randomly selected as the replacement, following with the above protocol, and asked to participate. This procedure was followed until a sample of golfers (n = 10 000) was recruited from 12 clubs. Because of some concerns with privacy and access to member databases, the investigators agreed that clubs address and mail the survey envelopes to their members and then be reimbursed for postage. A strict protocol of the mailing process was followed after communicating the importance of record keeping for statistical purposes. As such, the survey was completely anonymously, and only one mail-out to the members of each golf club was able to take place. As a result, methods to increase response rate through repeated mail-outs, such as those outlined by the Dillman[8,9] method, were considered but were unable to be implemented.

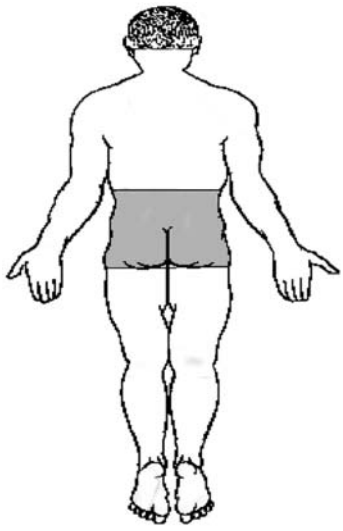

Fig 1. Survey diagram showing the area defined as the lower back (shaded).

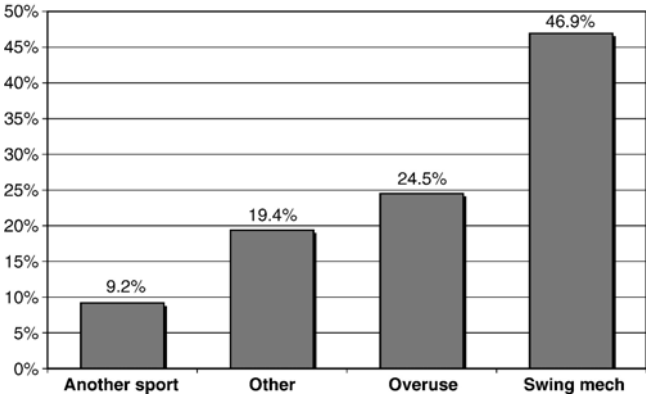

Fig 2. Common low back injury mechanisms as self-reported by respondents.

An envelope containing a cover letter stating the purpose of the study, an information/consent form, the survey, and a reply-paid envelope to improve the response rate was mailed to each member of the golf clubs agreeing to participate in the study. To further improve the response rate, 1 participant who participated in the survey won a prize, which was a set of golf clubs and bag. Those respondents who indicated they would like to go into the draw by placing their golf membership number and unique golf club initials on the survey were included in the draw, a procedure that was explained in the "survey questions explanation" section of the survey. The winning respondent was then identified by their respective golf club. A total of 10 300 survey forms were sent out across Australia.

The statistical methods used in this study include the 2-sample t test to compare means of 2 independent populations and the χ^2 test to examine the association between any 2 categorical variables/factors in the study. The study investigated the null hypotheses that the frequency of play/practice does not influence lower back injury rates and that lower back golf-related injury is not related to the golfers' age or sex.

Results

A total of 1725 amateur golfers from 12 clubs in Australia participated in the survey. Of them, 315 reported an injury and 1410 reported no injury in the previous year (12 months). Two of the 12 clubs with 91 responses were excluded from further analysis as they deviated from the survey methodology by not adhering to survey guidelines (to mail the survey to every member of the golf club). As a result, 1634 golfers responded to the survey, of 7813 surveys sent, from 10 clubs achieving a 21% response rate.

The average age of the 1634 golfers was 55.15 years (SD, 14.59 years). There were 318 females (19.5%) and their average age was 59.22 years (SD, 12.24 years). There were 1316 males (80.5%), having average age of 54.25 years (SD, 15.34 years). The average handicap was 26.3 (SD, 9.45) for female respondents and 18.1 (SD, 6.97) for males. In comparison to national data on golfing handicap[10] (average male handicap of 18.1 and female handicap of 27.5), the study data appear to be a reasonable representative sample of Australian golfers.

A total of 288 golfers had more than 1 injury in the previous 12 months and 73 golfers sustained this injury in the lower back region (25.3%). In this cohort, the lower back was the site injured most often, followed by the elbow (15.3%) and the shoulder (9.4%). Seventy golfers reported to have sustained 2 injuries in the previous year, with 16 of these second injuries being sustained in the lower back (22.9%). Eleven golfers sustained more than 3 injuries in the previous year. Summarily, of a total of 369 injuries sustained by 288 golfers, 92 injuries sustained by 90 golfers (15 females and 75 males) were located in the lower back (24.9%).

Both age and handicap were not significantly different on average between those uninjured (n = 1346) and those with a golf-related lower back injury (n = 90), based on the 2-sample t test ($P > .05$). The rate of golf-related lower back injury was not associated with sex, that is, male and female golfers had a similar risk of sustaining a lower back injury according to the χ^2 test ($P > .05$).

When analyzing the most common injury mechanism, 46.9% of golf-related lower back injuries were reported as being the result of a poor swing, followed

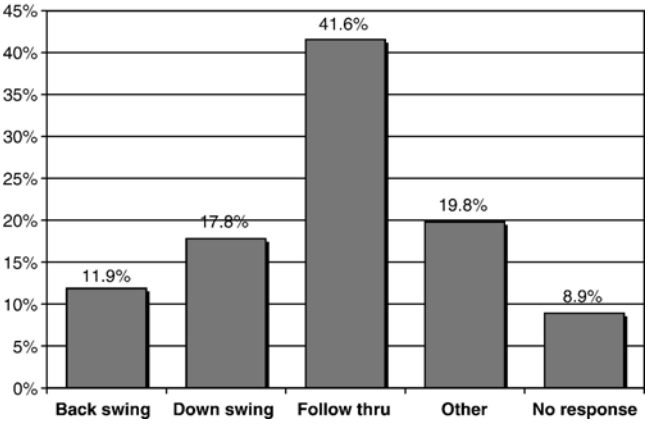

Fig 3. Phases of the golf swing where respondents reported injuring themselves.

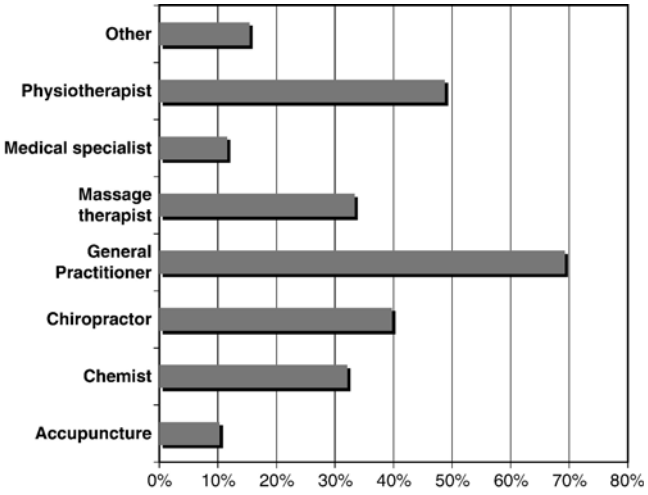

Fig 4. Percentage of total practitioners sought for treatment of golf-related lower back injury.

by overuse (24.5%), and other causes (19.4%) (Fig 2). Injury mechanisms in the "other" category included being hit by a golf ball, pulling a golf buggy, and falls sustained during playing a round of golf (including 1 respondent who fell from a golf cart).

The golf swing can be easily divided into 3 distinct phases to determine potential movement patterns the predispose to injury: the backswing (ball address to top of backswing), the downswing (top of swing to impact), and the follow-through (impact to completion of swing). When asked during which phase of the golf swing lower back injury occurred, most respondents reported the follow-through (41.6%) phase of the golf swing (Fig 3). The "other" response (19.8%) comprised responses such as injury occurring at impact, throughout the swing, or an injury that occurred in more than 1 particular phase of the swing.

The survey asked whether the injury occurred in a singular onset or progressively over time. Among the 90 golfers with low back injury, 64.1% of respondents reported that the injury occurred over a period. In addition, the survey asked if there was a previous history of the injury. Of those with a golf-related lower back injury in the previous year (12 months), 77.2% reported having a previous lower back injury, while 22.8% of those with a lower back injury due to golf reported no previous history of lower back injury.

The survey also asked the golfer about play and practice habits. This included an estimation of average weekly chipping/putting practice, full shot practice, and games of golf played. After examining the association between the injury status (low back injured vs noninjured) and play/practice frequency, it was found that players who perform 0 to 1 hour of full shot practice have a significantly lower risk (estimated odds ratio, 0.5; 95% CI, 0.31-0.80) of getting lower back injury compared with those who perform more full shot practice. Neither the frequency of chipping/putting nor the frequency of game play or other sporting activities influenced the risk of lower back injury ($P > .05$).

When asked if golfers had sought treatment of their lower back injury, 84.8% of golfers reported receiving some treatment of injury. Many different types of practitioners were consulted for golf-related lower back injury. The 3 most common professionals visited by golfers were general practitioners (69%), physiotherapists (49%), and chiropractors (40%) (Fig 4).

Discussion

The golf injury literature reports the lower back to be the most injured site of the body.[3-6] The data collected in this study support this view. The study found that the swing was reported to be the most common injury mechanism, accounting for nearly half of all lower back injuries in golf. This study consisted of a self-reported questionnaire and relied on the respondent to answer what they felt had caused their injury. Respondents self-reported the phase of the golf swing they felt caused any injury. The respondents did not break down the swing into technical swing components. The golf injury literature suggests that the golf swing is the most common cause of golf-related injury.[3-6] However, little direct evidence exists to describe the exact nature of the injury mechanism to the lower back in golfers. Burdorf et al[10] conducted a 1-year prospective study on lower back pain in novice golfers and reported risk factors for low back injury in golfers.[10] Despite useful information on risk factors, no information was gathered on the swing-related causes of injury.[10]

The present study found that the lower back injuries sustained by the respondents were most commonly felt during the follow-through phase of the golf swing (impact to completion of swing). It is likely that injury causation cannot be established by a self-reported questionnaire and the pain may have been felt in the follow-through, although the injury was sustained earlier in the swing. From these results it appears that the follow-through phase of the golf swing is an aggravating movement and potentially a predisposing factor for a low back injury. It has been postulated that the body position of the follow-through[11] and the eccentric contraction displayed by

the decelerating torso are significant factors in the etiology of lower back injury in golfers.[12,13] This finding appears to be in agreement with Sugaya et al[14] who examined lower back pain among right-handed professional golfers (n = 282) and found a correlation between right side back pain and the follow-through phase of the golf swing.[14] The literature suggests that 30% of all golf injuries occur in the follow-through and around 40% of low back injuries occur in the follow-through.[4] This study found that 41.6% of lower back injuries occurred in the follow-through. Further studies are required to more accurately investigate the forces occurring in the various phases of a golf swing and with different golf swing types (modern, classic, hybrid).

The present study found lower back injury associated with golf was twice as likely to occur over a period as opposed to a single episode. This figure is lower than that reported for amateurs and professionals by Gosheger et al,[3] who reported 91% of lumbar spine injuries to be due to overuse, as opposed to traumatic singular events.[3] The differences between the studies were that the results of the present study reported changes in amateurs and not professionals, whereas Gosheger et al examined both golfing groups. The difference in the response may be due to the difference in the player characteristics between the relative proportions of amateurs and professionals in the 2 studies. In addition, the present study found those golfers that sustained a lower back injury due to golf in the previous 12 months were 3 times more likely to have had a previous history of lower back injury. The study performed by Gosheger et al appeared to report injuries sustained throughout a career. However, no mention of time frame was included in the retrospective recall associated with the study other than the survey was distributed over 2 seasons.[3]

When comparing the playing and practicing habits between those injured in the lower back and those uninjured, the only significant difference seen was that the golfer who performed less practice had less risk of injury than the golfer who performed more. It may be intuitive that more actual game play would increase the risk of injury through greater participation; a round of golf takes approximately 4 hours to complete with an average of 40 to 45 full shots. This figure compares with the golfer who performs full shot practice at the driving range. In the practice scenario, a bucket of 60 balls generally takes 60 to 70 minutes to hit. Thus, there is a significant increase in the intensity of play in the golfer who performs full shot practice compared with one who performs less full shot practice; this appears to be associated with an increased injury rate.

The response rate achieved in this survey was 21%. This is a low value compared with a response rate of more than 60%, which is considered excellent.[15] Although it is considered that a higher response rate provides a more accurate data set, the method of distribution of the survey affects the response rate achieved.[16] Many improve response rates by mailing multiple reminders/surveys to nonresponders.[17,18] The size of the survey instrument also affects response rate, with shorter questionnaires of less than 1000 words in length having a higher response rate.[19] Multiple mail-out surveys are commonly sent to nonrespondents to achieve a high response rate, often more than 70%.[17,18] However, follow-up surveys were not sent to nonresponders for several reasons. Firstly, the investigators were blinded as to the identity of the golf club members who were selected to participate because of privacy considerations, and we had no control over access and use of the club databases. This forced us to rely on club administrators to distribute the survey. In addition, multiple mail-outs are more appropriate for smaller, discrete sample sizes and or very large budgets. It is likely that without large budgets, a national distribution will be unable to be replicated because of cost. The accepted survey response rate for a single mail-out to a large sample size is 15% to 30%.[5,20-24] The survey instrument in this study was 1975 words in total, due to the large volume of information that was sought. While it is acknowledged that the size of the survey may result in a lower response rate, the investigators sought to collect comprehensive data to allow multiple factors to be analyzed in the statistical evaluation of factors possibly associated with golf-related injury.

The primary concern with a low response rate is the representativeness of the respondents to the population being examined. However, a low response rate does not automatically imply a nonrepresentative sample has been selected. Researchers appear more concerned about the likelihood of bias in the collection of the sample rather than the specific sample size in isolation.[17,18] An analysis of the latest Australian Bureau of Statistics data on sports participation and Australian Golf Union data on handicaps was conducted to examine how representative the characteristics of the survey respondents were to the golfing population. This analysis revealed that the male-to-female breakdown of golfers was 82.2% vs 17.8% (890 300 vs 193 300).[25] The present study achieved a comparable male-to-female ratio of 80.5% vs 19.5%

(1316 men vs 318 women). Australian Golf Union data (www.agu.org.au) described the average male handicap as 18.1 and female handicap as 27.5. The average handicap in this study was quite similar with the average male handicap being 18.1 (SD, 6.97) and the average female handicap being 26.3 (SD, 9.45). We conclude that despite the low response rate, our data appear to be reasonably representative of the general population of golfers in Australia, and the response rate, although small, is not as problematic as a small response rate that is not representative of the population being surveyed.

The use of a mail survey is not the only way to achieve a high response rate in a survey. Face-to-face interviews are more conducive to a higher rate of response.[26] However, because of the important goal of establishing a national survey and not a small regional survey, the investigators felt that a mail survey was the most cost-effective way to achieve this aim (because of the size of the country and the potential cost of travel). In addition, the mail survey and the method of distribution used in the study allowed for anonymity to be kept, something a face-to-face interview and phone interview study are not able to ensure.[15]

The findings of this study are important to the sports practitioner. By understanding associated factors in the generation of lower back injuries in golfers, the practitioner can develop rehabilitation programs that can expedite the golfer back onto the golf course and develop preventive exercise programs to reduce the chance of golf-related lower back injury. Further prospective studies on golf-related lower back injuries investigating the influence of variables such as age, sex, handicap, and frequency of play/practice are required so that management programs may be developed and tested to reduce the incidence of lower back injuries among golfers. Studies investigating the forces acting during the golf swing in various golf swing types would also contribute to the science of golf-related injury.

Conclusion

In the year before survey administration, 17.6% of golfers sustained at least 1 injury. Of those injuries, 25% sustained a golf-related injury to the lower back. The type of golfer who sustained this injury was more likely to have had a previous history of lower back injury and it was chronic in nature. The lower back injury was most likely due to the golf swing and was very likely to have occurred in the follow-through phase. Most of the injured golfers received treatment of their injury from the general practitioner, the physiotherapist, or the chiropractor. The treating practitioner should be knowledgeable of the golf swing of this popular sport to educate the patient with a history of lower back injury on appropriate follow-through positions that are thought to predispose injury, and thus, the chance of golf-related lower back injury can be reduced or eliminated.

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