

Neck pain in multisport athletes

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Object. The sport of triathlon is very physically demanding and has experienced rapid growth in recent years. The number of triathletes seen for spine disorders at neurosurgery clinics is increasing. Neck pain and overuse injuries have not been adequately studied in multisport athletes. The authors undertook an epidemiological study to establish the lifetime incidence of neck pain and the prevalence of possible discogenic pain, and to identify risk factors among triathletes in the Boulder, Colorado area.

Methods. An online questionnaire was developed to collect information about physical characteristics, training habits, athletic status, number of races completed, and neck pain among triathletes. The incidence of possible cervical discogenic pain was defined according to the duration of symptoms for the most recent pain episode.

Results. One hundred and sixty-four athletes responded to the questionnaire. The lifetime incidence of neck pain was 47.6% (78 athletes), with 15.4% possibly being of discogenic origin based on the duration of symptoms. Approximately 64% of responding athletes reported that their neck pain was sports related. Although the number of previous triathlons was not predictive of neck pain, total years in the sport ($p = 0.029$) and number of previous sports-related injuries ($p < 0.0001$) were.

Conclusions. Two major risk factors for long-term spinal problems in triathletes are sports-related injuries and overuse. This report is one of the first comprehensive studies of neck pain and overuse injury in multisport athletes. (DOI: 10.3171/SPI-07/10/408)

KEY WORDS • neck pain • sports injury • sports medicine • triathlete • triathlon

NECK pain is a common complaint in the general population with about 20% of people reporting it in the past year⁷ and 66% reporting it at some point in their lives.⁶ Chronic neck pain is also very common,¹⁰ although its incidence has not been thoroughly evaluated in multisport athletes.

Conceived in the early 1970s, the sport of triathlon consists of swimming, biking, and running, with a varying distance for each activity. Triathlons have gained worldwide recognition with the creation of Ironman-length triathlons and with its inclusion in the Olympic Games beginning in Sydney during the summer of 2000. Sports medicine enthusiasts initially thought that triathlons would be associated with less frequent overuse injuries due to more balanced stress distribution in the musculoskeletal system; unfortunately, this theory has not held true. Instead, it appears that triathletes tend to train more hours per week than any other group of single-sport athletes, leading to a higher incidence of injury.^{3,13} The results of a study conducted after the 1986 Hawaii Ironman Triathlon competition demonstrated that 91% of participating athletes had suffered at least one soft-tissue overuse injury during the previous year's training;

spinal injuries were most common, with 72% of athletes reporting low-back pain or sciatica.¹⁹ In an evaluation of Japanese triathletes, there was a 59% lifetime (64% of men, 41% of women) and 32% yearly (33% of men, 29% of women) incidence of low-back pain.¹⁵ In addition to the focus on overuse or traumatic injuries including back pain,^{5,19} equally important is gaining an understanding of the long-term consequences and predictors of pain and injury in this unique population,³ so as to improve treatment and outcome.^{4,22}

Although neck pain and overuse injuries in cyclists are quite common and appear to occur more frequently than back pain,¹ these issues have not been well-studied in triathletes. Of the 11 articles that we could locate in which overuse injuries were assessed,^{3–5,8,11–13,15,19,25} only two studies included an assessment of cervical problems,^{11,15} and none looked specifically at pain or its quantification.

In recreational cyclists, 50% or more^{23,24} reported pain related to neck overuse injuries; this appears to be the most common overuse injury encountered.^{1,23,24} Most amateur triathletes spend between 10 and 20 hours training per week, with approximately 50% of this time being on the

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bike,^{4,22} putting them at significant risk for neck overuse injuries and pain.

As the sport of triathlon has grown over the past several years, there has been an increasing number of athletes seen in the neurosurgery clinics with various spine conditions. Of concern is that as many as 23% of triathletes report back pain lasting longer than 3 months.²² When coupled with the enhanced potential for cumulative injuries and symptoms associated with ultraendurance sports training,⁴ it becomes clear that a different approach is needed to optimize the evaluation and treatment of triathletes, including the timing in which they can return to participation in their sport.²¹ A critical component of this approach is an understanding of the prevalence of cervical spine issues that could negatively impact training and performance, as well as risk factors for chronic cervical discomfort. To address these issues, an epidemiological study was undertaken to establish the lifetime incidence of neck pain among triathletes in the Boulder, Colorado area. The secondary objectives were to identify the risk factors for neck pain and estimate the probability of discogenic problems in triathletes.

Clinical Material and Methods

Study Population

A list of approximately 4000 email addresses obtained from a local race director (5430 Sports, Boulder, Colorado) was utilized to send a generic message to triathletes that included a link to a live, online survey. The following message was sent via email from the race director:

Help Us Help Each Other: Alan Villavicencio is a neurosurgeon doing a regional study specific to triathletes as to the prevalence of neurosurgical injuries. Please take a moment to complete this brief survey. It could lead to a better understanding of our bodies and our health for all of us.

This message was sent to the addresses on two occasions to optimize the likelihood of obtaining a response. The probability of duplicate responses was minimized by telling athletes not to respond to the questionnaire if they had already done so. In addition, an assessment was performed on all completed questionnaires focusing on relatively stable attributes such as age, gender, height, and weight.

Online Questionnaire

A self-administered online questionnaire was developed that included three groups of questions. The first part of the questionnaire solicited information about physical characteristics, training habits, athletic status, and number of races completed. The second part consisted of questions regarding low-back pain, including frequency, duration and intensity of overall symptoms and of the most recent painful episode, relation of their pain to sporting events, age at first episode, incidence of injuries, medical care received, and sciatica symptoms.²² The third part included similar questions about neck pain. The present study will focus on the results of the first and third parts of the questionnaire.

There is no consensus on the definition of back pain, which could potentially help distinguish nonspecific soft-tissue pain from pain of discogenic origin. Therefore the

TABLE 1

Distribution of survey respondents by sex and age

Age Group (yrs)	No. of Men	No. of Women	Total No. of Respondents (%)
18–24	3	7	10 (6.1)
25–29	9	18	27 (16.5)
30–34	7	25	32 (19.5)
35–39	15	22	37 (22.6)
40–44	12	14	26 (15.9)
45–49	4	10	14 (8.5)
50–54	6	5	11 (6.7)
55–59	2	1	3 (1.8)
60–64	2	0	2 (1.2)
65–69	2	0	2 (1.2)
total (%)	62 (37.8)	102 (62.2)	164 (100)

specificity or severity of cervical back pain in our study was defined according to the duration of symptoms of the most recent pain episode: less than 7 days, less than 3 months, or more than 3 months. This type of classification system was adopted from Mooney¹⁶ and is based on the hypothesis that chronic pain is mainly discogenic. According to this classification, we assigned the following groups: acute pain lasting less than 7 days is generally related to the tendons, ligaments, and fascia, and thus has the highest potential for spontaneous recovery; subacute pain that persists for longer than 7 days but less than 3 months may also involve the facet joints; and chronic pain typically lasts longer than 3 months and is more likely to be disc related. Each of these categories also refers to radiculopathy symptoms. As mentioned previously, acute pain has the highest potential for spontaneous recovery with or without treatment. Compared with acute discomfort that resolves in a short period of time, subacute and chronic neck pain are generally associated with more significant morphological and structural changes. Conservative treatment is therefore typically indicated in such patients; this includes medications (antiinflammatory agents, muscle relaxants, and oral steroids), physical therapy, and injections. Some athletes may have conditions that are more appropriate for surgical intervention.

The athletes were asked to classify themselves as having elite, intermediate, or beginner status, and were asked to answer questions about the number of injuries they had ex-

TABLE 2

*Overall weekly training time distribution according to athletic status**

Sport	Athlete Classification		
	Elite (8 triathletes)	Intermediate (119 triathletes)	Beginner (37 triathletes)
swimming	4.1 (2.5–6)	2.6 (1–9)	2.1 (0.5–4.5)
biking	9.3 (4–15)	5.9 (1–17.5)	4.8 (1–15)
running	5.1 (2.5–8)	3.8 (1–8)	3.3 (1–10)
weight lifting	1.0 (0–2)	1.2 (0–6)	0.7 (0–3)
other	1.2 (0–3)	1.1 (0–5)	0.9 (0–4)
total	20.7 (12.5–30)	14.6 (5–28.5)	11.8 (3.5–21)

* Values are given as the mean hours (range).

TABLE 3
Demographic and selected characteristics
for 78 athletes with neck pain*

Parameter	Pain Group		
	Acute	Subacute	Chronic
no. of respondents (%)	58 (74.4)	8 (10.3)	12 (15.4)
age (yrs)	38.3 (20–68)	35.7 (28–51)	36.9 (22–57)
male/female ratio	26:32	3:5	2:10
pain duration (yrs)	10.4 (0.5–50)	7.6 (1–15)	9.7 (0.5–20)
VAS pain score	4.1 (1–8)	6.1 (3–8)	5.4 (3–9)
frequency score†	3.4 (1–6)	4.5 (3–6)	5.9 (5–6)
age at 1st pain episode	28.9 (15–64)	27.2 (16–51)	25.9 (10–40)
no. of injuries	1.4 (0–5)	1.6 (0–5)	1.1 (0–4)
total training (hrs/wk)	15.2 (6–30)	14.8 (8–22)	12.5 (8.5–20)
average no. of races	26.0 (1–268)	34 (3–76)	19.5 (1–74)
yrs in sports	16.4 (2–56)	11 (4–22)	19.2 (1–57)

* Unless otherwise noted all values are expressed as means (range). Abbreviation: VAS = Visual Analog Scale.

† Pain frequency score (mean) on a scale from 1 to 6 (1 = once/year; 6 = constant).

perceived. An injury was defined as an acute event that led to the seeking of medical care, medications, or the cessation of training for at least 1 day.

A scoring system was used to assess the frequency of neck pain episodes: a score of 1 indicated neck pain once a year; 2, once in 6 months; 3, once in 3 months; 4, once a month; 5, once a week; and 6, constant. Pain intensity was established using the Visual Analog Scale.

Statistical Analysis

A database was created and data were analyzed based on the responses to the questionnaire. Logistic regression statistical analysis was used to determine any significant associations or correlations between neck pain and multiple physical, training, and competition-related factors.

Results

One hundred and sixty-four completed questionnaires were received and analyzed. As can be seen in Table 1, 62 (37.8%) of the respondents were men, and 102 (62.2%) were women. The average age of all athletes was 37.2 years (range 20–68 years): 35.5 years (range 20–57 years) for women and 40.0 years (range 21–68 years) for men.

Athletic Status and Training Patterns

In Table 2, the training time distribution and self-reported status level of the athletes is presented. Among all respondents, eight (4.9%) reported their status as elite, 119 (72.5%) as intermediate, and 37 (22.6%) as beginners. The average number of triathlons (including Ironman events) and other running races by each person was 22.7 (range 1–268 races) for all athletes, or 68.8, 24.1, and 7.3 races for elite, intermediate, and beginner triathletes, respectively. The overall mean training time was 14.3 hours per week (range 3.5–30 hours). Mean swimming, biking, and running times accounted for 2.6, 5.8, and 3.7 hours per week, respectively. One hundred and six triathletes (64.6%) supplemented their training with weight lifting for an average of 1.7 hours per week (range 0.25–6.0 hours). Seventy-

eight triathletes (47.6%) also participated in other kinds of sports (such as skiing or basketball) an average of 2.7 hours per week (range 1–18 hours). The total average training time was greatest in elite athletes, with a cumulative average of 20.7 hours/week, compared with 14.6 and 11.8 cumulative average hours/week for intermediate and beginner triathletes, respectively (Table 2).

Neck Pain

The lifetime incidence of neck pain was 47.6% (78 of 164 respondents). Fifty (64.1%) of 78 athletes indicated that their neck pain was sports related, and 30 (60%) of these thought that it was associated with cycling. The duration of the latest neck pain episode was less than 7 days in 58 (74.4%) of the 78 athletes; the pain lasted less than 3 months in eight (10.2%) of 78 athletes, and more than 3 months in 12 (15.4%). Table 3 illustrates the demographics, training patterns, and selected neck pain characteristics in these respondents according to the duration of the most recent neck pain episode.

Triathletes With Acute Cervical Pain

The largest group in our study included athletes with acute cervical pain in whom the latest episode of neck pain lasted less than 7 days. According to the classification developed by Mooney¹⁶ this type of neck pain has the highest potential for spontaneous recovery. This group of 58 respondents made up 74.4% of all athletes complaining of neck pain. Only four athletes (6.9%) in this group reported radicular symptoms. Sixteen (27.6%) of the athletes reported not having had any treatment for their neck pain, and the rest of the respondents had received some type of conservative treatment including massage, medication, chiropractic and physical therapy, with massage being the most frequently reported treatment (40.6% of respondents).

Among respondents with acute pain, the average age was 38.3 years (range 20–68 years), and the weekly training schedule consisted of 15.2 hours (range 6–30 hours). The average number of triathlons and running races in which the people in this group had participated was 26.0 races (range 1–268 races). The majority of triathletes in this group (41 athletes, 70.7%) thought that their neck pain was sports related, but only 9 (15.5%) discontinued their training while in pain. The average number of injuries was 1.4 (range 0–5 injuries).

Triathletes With Subacute Cervical Pain

Only eight athletes (10.2%) noted that their neck pain lasted longer than 7 days and less than 3 months, and only two respondents in this group reported radicular symptoms. All but one had received some type of conservative treatment for the neck pain in the past, and the types of treatments were similar to those in the acute group. The average age was 35.7 years (range 28–51 years). The total weekly training time was 14.8 hours (range 8–22 hours) and did not vary significantly compared with the other groups of athletes with acute and chronic neck pain. However, when comparing the number of triathlons and running races in which the athletes had participated in the past, the statistical significance was marginal in comparison to the other groups ($p = 0.059$, t-test). Five of eight triathletes thought

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that their neck pain was sports related, and consequently stopped training while in pain. The average number of injuries in this group was 1.6 (range 0–5 injuries).

Triathletes With Chronic Cervical Pain

Twelve athletes (15.4%) who reported neck pain in this study stated that the most recent pain episode had lasted longer than 3 months. Based on the Mooney theory,¹⁶ this pain pattern may suggest that the pain's origins are discogenic. All athletes in this group except one complained of constant pain. The pain frequency score in the group with chronic neck pain (5.9) was significantly higher ($p < 0.003$, t-test) than that seen in the groups reporting acute (3.4) and subacute pain (4.5); a higher frequency of pain in the chronic neck pain group also correlated with a higher pain intensity (Table 3).

The average age for the first neck pain episode in the athletes with chronic pain was 25.9 years (range 10–40 years). Four athletes (33.3%) reported radicular symptoms, but only one stopped training while in pain. All athletes in this group underwent some kind of conservative treatment, such as medications and/or physical therapy. The average age of those reporting chronic pain was 36.9 years (range 22–57 years), and their total weekly training time was 12.5 hours (range 8.5–20 hours). On average, these athletes had participated in 19.5 triathlons and other running races (range 1–74 races). Only four of 12 athletes (33.3%) thought that their pain was related to sports, and all of them noted sports-related injuries in the past.

Predictors of Cervical Spine Pain

Logistic regression analyses were performed to determine if any of the demographic or training factors were predictive of neck pain. There was no statistically significant correlation between cervical pain and age ($p = 0.4$), athletic status ($p = 0.2$), body mass index ($p = 0.5$), training duration ($p = 0.2$), or the number of races ($p = 0.1$). Statistical significance with respect to neck pain and sex ($p = 0.6$) could not be demonstrated in this study. However, the relationship between cervical pain and total years in sports ($p = 0.029$) and the correlation between neck pain and the number of previous sports-related injuries ($p < 0.0001$) were significant.

Discussion

Neck pain is a frequent occurrence among triathletes, with a lifetime incidence of 47.6% in the respondents in the present study. This has never been shown before, probably because this area of the body has never been assessed in triathletes.^{3-5,8,11-13,15,19,25} The majority of episodes of neck pain in our study lasted less than 7 days, suggesting mainly soft tissue and ligament involvement. More enduring pain (≥ 3 months), possibly of discogenic origin, was reported by 15.4% of triathlete respondents. Radiculopathy symptoms were very common (33.3% of triathletes), but did not appear to cause the athlete to stop training. It is likely that triathletes simply change their routine to involve more of the subsport (swimming, biking, or running) that does not exacerbate their symptoms; this was not evaluated in our study and deserves further investigation.

The intensity of neck pain symptoms revealed in this study is concerning. The highest average Visual Analog Scale score for neck pain was 6.1 in the subacute group with a mean frequency of 4.5, meaning the pain was quite intense and present weekly to monthly. In contrast, athletes in the chronic group experienced pain of a similar intensity (5.4), but it was usually constant. This is the first study to characterize the frequency and quality of neck pain in this unique group of multisport athletes.

The majority of sports-related back problems resolve with conservative, nonsurgical management. A large percentage of our triathlete respondents with neck pain reported using conservative therapies such as massage, chiropractic medicine, physical therapy, or medications. These are important alternatives to consider when determining which treatment will result in the most rapid return to active sports.

Because cervical pain has not been studied in the literature, it is difficult to make comparisons with the findings of other studies. Manninen and Kallinen¹⁵ reported that cervical spine injuries occurred less frequently than those involving the lower back, and raised concerns regarding injuries associated with chronic low-back pain in Japanese triathletes. What remains unclear is the potential rate of morbidity associated with chronic cervical spine pain in triathletes. In the present study, the individuals who reported a pain duration of longer than 3 months also reported a reduction in total weekly training time and had a lower average number of races. Such a reduction in training participation could have significant effects on an athlete's quality of life.

For neck pain in the general population, age is predictive of symptoms.¹⁰ Age appears to be a risk factor for injury in triathletes in some⁸ but not all studies.³ In the present study, no relationship was seen between age and the presence of cervical spine pain. This could be due to the fact that the majority of our sample population was younger than 40 years of age (~81%), and older individuals (45–59 years of age) have been found to be most likely to report persistent neck pain.¹⁰ A large risk factor for pain in our population was the incidence of previous sports-related injury, which could occur at any age.

Sex, athletic status, body mass index, training duration, and number of races were not predictive of cervical pain in our study. Thus, this type of pain appears to be somewhat equally distributed across the population of triathletes, with no single demographic factor posing a more significant risk than another. Total number of years in sports and previous sports-related injuries were predictive of neck pain, further supporting the hypothesis that pain in this region of the spine in this population is most likely due to overuse injury.^{3,4} In some ways, this seems counterintuitive. One could rationalize that greater fitness levels would be required to participate in more events, and that greater fitness levels would be associated with a lower incidence of painful disorders. It may also be the case that participating in more events, regardless of fitness level, could result in a higher number of injuries due to overuse, leading to more pain. When left untreated, overuse injuries are thought to lead to cumulative overload and consequently to spine discogenic pain. Previous neck trauma has been shown to be predictive of neck pain,^{7,10} as has cycling.¹⁰ This resulting self-perpetuating cycle could be specifically related to the demands of endurance sports in general, or to the indi-

vidual components of the multicomponent sport of triathlon (such as biking).

The lifetime incidence of neck pain in triathletes is higher in our study than in the general population when assessed over the past 12 months (20%), but similar to the incidence of persistent neck pain in the general population (48%)¹⁰ and in that reported by recreational cyclists (48.8–66.4%).^{23,24} The similar level of pain reported by cyclists and triathletes may appear unexpected given that triathletes should, in theory, have a more balanced stress distribution among the three sports that compose it. That said, it could be that the number of hours spent on the bicycle plays a major role in neck overuse injury symptoms. Recreational cyclists cycled for an estimated 4 to 5 hours/week,²⁴ similar to the time spent by beginner triathletes (4.8 hours/week), but less time than that seen in elite triathletes (9.3 hours/week) in the present study. Training regimen, intensity, individual physical fitness level, and riding techniques also cannot be overlooked, as an extremely high percentage of recreational cyclists complained of neck pain in a study by Weiss.²³ Regardless, neck pain is of concern in any population given its potential for associated health problems. Although spinal anatomy and physiology may be the same for athletes and nonathletes, the forces exerted on the spine in sports like triathlons are in theory much greater than those on nonathletes, and may increase the strain and vulnerability of the spine or surrounding tissue to damage.^{1,21} Moreover, the livelihood and quality of life of an athlete may be more adversely affected by overuse injury of the spine than that of a nonathlete.

Training duration requirements in triathletes may result in chronic pain of discogenic origin. The results of our study demonstrate that some triathletes report that their neck pain is not sports related, but overuse injuries and intense repetitive loads during training and competitions may simply exacerbate it. Early back-pain symptoms should not be ignored, even if they last fewer than 7 days with spontaneous recovery. The origin of injuries in triathletes should be assessed so that the cycle of overuse-associated injuries can be modified to increase training time devoted to promoting flexibility and muscular balance. In addition, a temporary modification in training technique has been suggested by some authors, such as more time devoted to swimming.¹⁹

Minimizing disability associated with back and neck pain is as important in the athlete as in the nonathlete. However, the most efficacious methods for doing so may be distinct for each group. A strong functional rehabilitation program^{2,18,26} tailored to the athlete (such as one that takes into account their high level of activity and endurance, as well as their strong motivation to return to training and competition) could effectively address early back-related problems and help prevent long-term consequences.

Limitations of This Study

There are several limitations to the present study. First, the triathletes surveyed were primarily from the Boulder, Colorado area, which may not be representative of triathletes in general even though a large number of triathletes do choose to train in this region because of its higher elevation and bike-friendly roads. Secondly, the low response rate may influence our ability to generalize. Future studies

could increase response rate by using only email addresses that have been validated incorporating an advance letter. Utilizing advanced contact has been found to increase the likelihood of individuals being interested in participating in the study.^{14,17} The data do support our sample as reflective of triathletes in general because the training patterns in the present study (number of hours per week and their distribution among running, biking, swimming) are similar to those reported in other studies in the literature.^{4,19}

The lifetime incidence of neck pain could be overestimated in our study. This is because even though we asked all triathletes to respond regardless of the presence or absence of symptoms, it is reasonable to assume that the athletes who have neck pain symptoms would be more likely to respond than asymptomatic individuals. However, this should not have affected our attempt to identify the prevalence of discogenic back pain, possibly requiring intense multidisciplinary rehabilitation, conservative treatment, or surgical intervention.

Because athletes completed the survey in a retrospective fashion, the results may not be as accurate as in a prospective study. Moreover, these results are based on self-reported information and were not verified by an independent source. Each of these limitations is shared by studies that use retrospective survey methodologies.

Our respondents were predominantly women (62%), which is a much larger proportion than in other studies in the literature in which female triathletes generally make up about 20 to 30%.^{5,11,15,19} A gender difference in research volunteerism has been the subject of much debate for decades, with no clear consensus.²⁰ In the present study we also demonstrated a similar prevalence of neck pain in male and female athletes (of all athletes, 50.0% of men compared with 46.1% of women reported neck pain), which differs from that reported previously by authors who showed that female cyclists are up to two times more likely to develop neck and shoulder pain than male cyclists.⁹ The significance of the difference is unknown and further evaluation is needed to assess these findings.

Conclusions

The lifetime incidence of neck pain in our sample of triathletes was 47.6%. The two main predictors of neck pain were total number of years of participation in sports and the presence of previous sports-related injuries. These findings support a tendency toward overuse injuries and accompanying symptoms in triathletes. What remains to be determined in future studies is the degree of morbidity associated with neck pain in this population and its overall impact on quality of life.

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