Original Article

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Quick Response Code:

Website: www.jfcmonline.com

DOI: 10.4103/jfcm.JFCM_503_20

Factors associated with Achilles tendon pain in cyclists in eastern province of Saudi Arabia

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Abstract:

BACKGROUND: Cyclists are predisposed to different types of injuries whose patterns and distribution change over time. During bicycling, the high demand on lower extremities to produce speed places high load on the legs resulting in overuse injuries of which pain in the Achilles tendon is one. This study assessed Achilles tendon pain in cyclists in the eastern province of Saudi Arabia.

MATERIALS AND METHODS: This was a cross-sectional study of active cyclists in the eastern province of Saudi Arabia. Data were collected using validated and pretested web-based self-administered questionnaire. Of the 511 cyclists invited, 311 completed the questionnaire yielding 60.62% response rate. SPSS was used for data entry and analysis. Descriptive statistics included calculation of frequencies and percentages for categorical variables, and median, mean and standard deviation for continuous variables. Chi-square test measured the associations between Achilles pain and various risk factors. Student's *t*-test, or Mann–Whitney test as appropriate, was used to compare continuous variables.

RESULTS: Ten percent of mature and 9.1% professional cyclists reported that they had Achilles tendon pain. The pain was reported by significantly higher proportion of cyclists who raced (25%) and cyclists who rode mountain bicycles off-road (60.0%); average duration of the Achilles tendon pain was 7 days. Of the cyclists who had Achilles tendon pain, 32.1% reported that the pain increased when they were in running load and 28.6% reported increased pain in cycling load. Most cyclists described the pain as mild (67.9%) and moderate (32.1%). Overweight and underweight cyclists reported significantly higher rates of Achilles tendon pain (60% and 12.5%) compared to other body mass index classes.

CONCLUSION: Achilles tendon pain commonly affects both amateur and professional cyclists. The study underpins the importance of a gradual increase in the training load, proper conditioning, bike fitting, and the maintenance of ideal body weight of cyclists to prevent Achilles tendon pain.

Keywords:

Achilles tendon, amateur, bicycling injuries, professional, Saudi Arabia, sport injuries

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Received: 21-11-2020
Revised: 29-11-2020
Accepted: 13-12-2020
Published: 07-01-2021

Introduction

Bicycling is a unique sport in which equipment is integral to performance. This predisposes cyclists to different types of injuries that change in pattern and distribution over time.[1] During bicycling, there is a high demand on the lower extremities to rotate the crank and produce speed, which puts a heavy load on the legs, thus contributing to overuse injuries.[2] As reported by De Bernardo *et al*.,[3] overuse injuries accounts for 53% of the injuries of top-level cyclist, and overuse injuries of the lower limbs constituted 68.5%.

Three epidemiological studies that evaluated the prevalence of Achilles tendon overuse

How to cite this article: Althunyan AK, Darwish MA, Sabra AA, Alqahtani HA, Mutabgani SM. Factors associated with Achilles tendon pain in cyclists in eastern province of Saudi Arabia. J Fam Community Med 2021;28:35-41.

injuries in professional cyclists, gave a prevalence range from 6.4% to 15%.[1,3,4] The distribution in recreational cyclists was slightly lower.[5] In triathletes, the distribution was close to that for recreational cyclists.[6]

The pathophysiology of Achilles tendinopathy is not completely understood. Many experts believe that Achilles tendon overuse injury is degenerative in nature and that the associated para-tendonitis contributes to the pain. However, recent research data suggest that failure to heal together with chronic inflammatory response and an increased expression pro-inflammatory precursors contribute to tendinopathy.[7]

Many factors have been found to predispose athletes to Achilles tendon overuse injuries. Positive family history, increasing age,[8] Achilles tendon stiffness,[9] and weak plantar flexors[10] are all intrinsic risk factors predisposing individuals to this injury.

Ankling, i.e., excess ankle range of motion during pedaling, low cadence, standing up to climb hills, high training load, and inadequate recovery and stretching were all important contributing factors.[11] Other extrinsic risk factors, including improper saddle height or shoe-pedal interface, have also been documented.[12]

Achilles tendon overuse injury causes a significant performance impairment and time loss for up to 50% of cyclists affected.[4] To the best of our knowledge, there have been no published epidemiological studies in Saudi Arabia, and indeed, there are very few published studies worldwide that describe the prevalence of cyclists' Achilles tendon pain and its associated risk factors. This study was conducted to assess the prevalence of Achilles tendon pain of active cyclists in the eastern province of Saudi Arabia and determine the factors associated with it in the study population.

Materials and Methods

A cross-sectional study was conducted to determine the associated factors of Achilles tendon pain in active cyclists in the eastern province of Saudi Arabia. The study population included all active cyclists who were members of a recognized professional or amateur cycling club in the eastern province of Saudi Arabia. An online link to the questionnaire was sent to 513 cyclists; 311 cyclists completed the questionnaire with a response rate of 60.62%. Of these, 283 responses were included in the analysis after applying the inclusion criteria. The study was approved by the Ethical Committee of Postgraduate Saudi Board Program, Eastern Province vide letter number IRB/078/15 dated 17/06/2015, and informed written consent was taken from all participants.

The following inclusion criteria were used: a minimum age of 18 years, should have been bicycling for ≥12 months, and ride a bicycle at least once per week. The data were collected using a structured, self-administered questionnaire designed by the researchers after reviewing the literature and similar studies based on the objectives of the study.[1,3]

The questionnaire consisted of four parts: (1) sociodemographic data: age, gender, nationality, level of education, marital status and club name; (2) sport participation: goal, experience, frequency, duration, warm up, stretching exercises, strengthening exercises, and rest days; (3) type of bicycle used, bicycle fitting and clip-less pedal; (4) Achilles tendon pain in the preceding 12 months, frequency, precipitating event, and management.

A Likert-type frequency scale of always, often, sometimes, seldom, and never was used.[13] The Numeric Rating Scale (NRS-11) was used to categorize pain: mild (1–3), moderate (4–6), and severe (7–10).[14] Body mass index (BMI) was classified into six categories according to the World Health Organization classification.[15] Age was classified into four groups: teenage (18–19.99), young adult (20–39.99), middle age (40–64.99), and elderly (≥65).

Five types of bicycles are commonly used: road bicycle (a bicycle built for travelling at speed on paved roads), time trial bicycle (a racing bicycle designed for use in an individual or team time trials raced on roads), mountain bicycle (a bicycle created for off-road cycling), hybrid bicycle (blend characteristics from road bicycle and mountain bicycle), and the recumbent bicycle (a bicycle that places the rider in a laid-back position).[16]

The questionnaire was validated by 4 faculty staff members and piloted on 40 cyclists (different from the target group). Based on the results, some linguistic and technical modifications of questions were made. The questionnaire was then reviewed by the researcher and 2 faculty members after modification.

All participants were sent an invitation with an explanation of the purpose of the study providing a web link to the survey in October 2015. Confidentiality was assured. Short Message Service, WhatsApp application, and E-mail were used to deliver the message to the participants. Reminders were sent every week for 3 weeks. Respondents that did not meet the inclusion criteria were excluded.

Cyclists were classified into two groups: professional (competitive cyclists who are registered in the Saudi Cycling Federation) and amateur (unpaid cyclists not

under the umbrella of the Saudi Cycling Federation). The term "bicycle fitting" refers to the process in which an expert adjusts the bicycle dimensions according to the cyclist body dimensions. The term "clip-less pedal" refers to a system comprising special pedals and cleats, devises with the pedals that attach to the soles of clip-less cycling shoes.[3] The term "triathlon" refers to a multiple stage competition involving swimming, cycling and running in immediate succession over various distances.[17]

Data were analyzed using the Statistical Package for the Social Sciences software version 20 (IBM Corp, Armonk, NY, USA). Descriptive analysis for categorical variables included frequencies and percentages, whereas median, mean, and standard deviation were calculated for continuous variables. Chi-square test was used to measure the associations between Achilles tendon pain and categorical variables. The Student's *t*-test, or Mann–Whitney test as appropriate, was used to compare continuous variables between different pain categories.

Results

The response rate was 60.6%, as 311 cyclists responded to the questionnaire out of the 513 who received it. Only 283 out of the 311 met the inclusion criteria and were included in the study.

The majority of active cyclists were males (95.1%), Saudis (69.3%), and young adults (63.3%). Nearly three quarters (72.7%) were married, and approximately half of them (49.8%) had Bachelor's and postgraduate degrees.

Concerning smoking, 13.6% of the participants smoked tobacco products, 21.1% had quit smoking, and 65.2% had never smoked. The rate of smoking was higher in amateur cyclists (15.7%) than in professional cyclists (2.3%) (P = 0.001) [Table 1]. None of the participants reported hypertension, diabetes mellitus, cardiovascular diseases, or thyroid disorders.

The overall prevalence (over the past 12 months) of Achilles tendon pain in active cyclists was 9.9% (9.1% for professional cyclists and 10.0% for amateur cyclists), in which 4.6%, 4.2%, and 1.1% of the active cyclists reported pain sometimes, seldom and always/often, respectively [Figure 1]. There were no statistically significant associations between Achilles tendon pain and age, gender, nationality, level of education, and marital status of the active cyclists.

Concerning the mechanisms associated with Achilles tendon pain, increased running load was associated with 32.1% of cases, whereas increased cycling load was associated with 28.6% of cases. Football and swimming were associated with lower rates of pain (3.6%) [Table 2].

Table 1: Distribution of active cyclists according to their sociodemographic characteristics, Eastern Province, Saudi Arabia

Sociodemographic characteristics	Total (*n*=283) *N* (%)
Age (years)	
Teenager (18-<20)	25 (8.8)
Young adult (20-<40)	179 (63.3)
Middle age (40-65)	79 (27.9)
Gender	
Male	269 (95.1)
Female	14 (4.9)
Nationality	
Saudi	196 (69.3)
Asian excluding Arabs	34 (12.0)
European	21 (7.4)
North American	11 (3.9)
Other Arab countries	18 (6.4)
South American and Australian	3 (1.1)
Level of education	
Less than high school	15 (5.3)
High school	54 (19.1)
College	27 (9.5)
Associate's degree	46 (16.3)
Bachelor's degree	109 (38.5)
Postgraduate degree	32 (11.3)
Marital status	
Married	205 (72.7)
Divorced	2 (0.7)
Single	75 (26.6)
Smoking	
Never	182 (65.2)
Quit	59 (21.1)
Current smoker	38 (13.6)

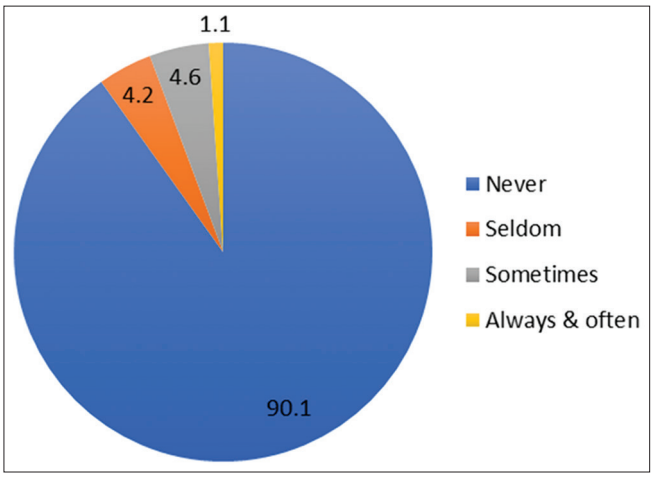

Figure 1: Distribution of cyclists according to the presence of Achilles tendon pain

The average duration of Achilles tendon pain described was 7 days, with an average of 2 days off training owing to this pain. The maximum days-off training reported was 60 days. More than two-thirds (67.9%) of the Achilles tendon pain was mild, and 32.1% was moderate in severity [Table 2].

Only 14.3% of the cyclists had consulted a physician and had been prescribed medications for the Achilles tendon pain, 10.7% had undergone physiotherapy and 4.1% had self-medicated. No cyclists had had surgical intervention or received tendon injections for the pain [Table 2].

There was no significant difference in the distribution of Achilles tendon pain between amateur and professional cyclists. However, the pain was significantly higher for cyclists who raced (25.0%) compared to cyclists with different cycling goals (6.4%, 7.9%, 12.0%, and 16.7% for transportation, triathlon, fitness/weight loss and recreation, respectively) (P = 0.046) [Table 3].

Cyclists who rode mountain bikes off normal roads had a significantly higher rate of Achilles tendon pain (60.0%) than cyclists riding different bike types on normal roads (0.0%, 4.3%, 8.4%, 14.3%, and 18.2% for recumbent bike, mountain bike on road, road bike, hybrid bike, and time trial bike, respectively) (P = 0.003) [Table 3].

The preventive measures tested were not associated with a statistically significant difference in the rates of pain between cyclists who undertook these measures and cyclists who did not undertake these measures [Tables 3 and 4].

There was no statistically significant difference in the average number of years of cycling, cycling hours per week, riding frequency per week, kilometers ridden per week, and rest days of cyclists who had Achilles pain and cyclists who did not have Achilles pain [Table 4].

Concerning BMI, 60% of participants with class III obesity and 12.5% of underweight participants reported Achilles tendon pain, which was significantly higher than other BMI classes (0.0% to 11.3%) (P = 0.002) [Figure 2].

Table 2: Characteristics of Achilles tendon pain among cyclists in Eastern Province, Saudi Arabia (n=28)

Characteristics	*N* (%)
Mechanism of Achilles tendon pain	
Increased running load	9 (32.1)
Increased cycling load	8 (28.6)
Increased swimming load	1 (3.6)
Spontaneously	1 (3.6)
Football	1 (3.6)
Other sports	8 (28.6)
Duration of the Achilles tendon pain (months), median (minimum-maximum)	7.0 (0.5-36.0)
Number of days off training due to Achilles tendon pain, median (minimum-maximum)	2.0 (0.0-60.0)
Severity of Achilles tendon pain	
Mild	19 (67.9)
Moderate	9 (32.1)
Severe	0
Management received (some received more than one type of management)	
Physician consultation	4 (14.3)
Physician-prescribed medication	4 (14.3)
Self-prescribed medication	2 (4.1)
Physiotherapy	3 (10.7)
Achilles tendon injection	0
Surgical intervention	0

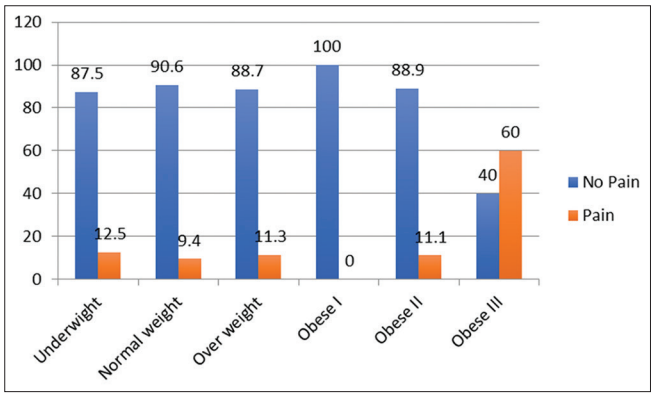

Figure 2: Association between Achilles tendon pain and body mass index of cyclists, Eastern Province, Saudi Arabia (P = 0.002)

Discussion

Achilles tendon pain is quite common in active cyclists in the eastern province of Saudi Arabia, with approximately 9.9% of active cyclists reporting the pain over the 12-month period prior to the study. The difference in the prevalence between amateur and professional cyclists was not statistically significant (10.0% and 9.1%, respectively). It is possible that the intensive training and competition of the experienced physically fit professional cyclists places them at risk of Achilles tendon injury. However, amateur cyclists are more susceptible to Achilles tendon injury because of inadequate coaching and inappropriate bicycling equipment.

The prevalence of Achilles tendon pain in this study lies within the range of previously documented rates of professional and amateur cyclists found in the literature (6.4% to 15.0% and 3.7% to 12.0%, respectively).[1,3-5] This wide range of rates is attributable to the different methodologies used, the period of follow-up and the variable levels of the fitness of the cyclists'. Choi *et al.*, reported a lower rate of Achilles tendon pain in amateur cyclists during a voluntary road race.[5] The difference in rates is best explained by the shorter study period (3 weeks). The incidence of Achilles tendon pain in runners (9.1% to 10.9%) is close to that of this study.[18]

The prevalence of Achilles tendon pain in our study population was higher in cyclists who participated in cycling races (25.0%) and in off-road mountain bike riders (60.0%). This finding may be due to the high

Table 3: Association between Achilles tendon pain and cycling practices among cyclists in Eastern Province, Saudi Arabia

Factors	Achilles tendon pain		*P*-value
	Yes (*n*=28), *N* (%)	No (*n*=255), *N* (%)	
Club type			
Professional	4 (9.1)	40 (90.9)	0.846
Amateur	24 (10.0)	215 (90.0)	
Cycling goal			
Recreation	7 (6.4)	103 (93.6)	0.046
Fitness and/or weight loss	7 (7.9)	82 (92.1)	
Competition (triathlon)	6 (12.0)	44 (88.0)	
Competition (cycling races)	7 (25.0)	21 (75.0)	
Transportation	1 (16.7)	5 (83.3)	
Bicycle fit			
No	8 (9.5)	76 (90.5)	0.892
Yes	20 (10.1)	179 (89.9)	
Type of the bicycle used			
Road bike	17 (8.4)	185 (91.6)	0.003
Time trial bike	2 (18.2)	9 (81.8)	
Hybrid bike	5 (14.3)	30 (85.7)	
Mountain bike on road	1 (4.3)	22 (95.7)	
Mountain bike off road	3 (60.0)	2 (40.0)	
Recumbent bike	0	7 (100.0)	
Clip-less pedals usage frequency			
Always	14 (9.5)	133 (90.5)	0.914
Often	2 (11.1)	16 (88.9)	
Sometimes	1 (16.7)	5 (83.3)	
Seldom	1 (20.0)	4 (80.0)	
Never	10 (9.3)	97 (90.7)	

intensity of the races, climbing and sprinting, which places a heavy load on the Achilles tendon. This effect was magnified when the height of the saddle and the clip-pedal interface were improperly set for the cyclists.[19,20]

Although the average cycling time in our study population is four times more than the average running time, a large proportion of participants related their Achilles tendon pain to an increased running load (32.1%), while 28.6% of Achilles tendon pain was associated with an increase in cycling load. In a systematic review that examined the effect of training load on the incidence of injuries, it was found that increased training load was significantly associated with increased incidence of injury.[21] Some individual characteristics were found to affect athletes' adaptation to an increased training load and a consequent occurrence of tendinopathies. These characteristics are age, fitness level, body composition, and previous injuries.[22,23] Tissue types react variably to training overload; tendons are in fact more susceptible to injury when there is an increase in the training load than muscles and bones, especially when the increase in training load is sudden. A training load that is compatible with the athlete tissue capacity will result in a decreased predisposition to overuse injuries. Therefore, it is essential to increase the training load gradually and monitor it appropriately, paying attention to adequate recovery to reduce the risk of injury.[24]

We did not find significant differences in average weekly training duration, training frequency and distance ridden by cyclists with Achilles tendon pain and those who had no Achilles tendon pain. This may be explained by the fact that a rapid increase in the training load is a key risk factor that predisposes individuals to overuse injuries,[24] which is better assessed in a longitudinal study.

The vast majority of the cohort described their Achilles tendon pain as intermittent (seldom and sometimes) with a mild intensity and an average duration of 7 months. Moreover, they needed only 2 rest days on average before resumption of training. These findings are pointers to overuse as the nature of the cause of their injury.[8]

Only 18.4% had used pain medication to control their pain, and only 10.7% had sought the help of physiotherapists. These results could be explained by the scarcity of sports medicine facilities in Saudi Arabia and the difficulty in accessing those available.

Obesity (BMI class III), in our study population, was a major risk factor for Achilles tendon pain (P = 0.002). In-addition to increasing the tendon overload, pro-inflammatory state, and consequently adipopathy, it can contribute to the increased pain rate.[25] Interestingly, in comparison with the group with normal weight lower BMI classes were not associated with an increase in the rate of Achilles tendon pain. Not surprisingly, underweight was also associated with a slightly higher rate of Achilles tendon pain compared with normal weight. This finding is consistent with the results of a prospective cohort study of young conscripts in whom the authors found a U shape relationship between BMIs and incidents of overuse injury.[26]

In this study, strength training did not show a significant protective association with Achilles tendon pain. Not surprisingly, protective effect which is well documented by a systematic review of randomized controlled trials, showed that strength training was indeed protective for overuse injuries (relative risk = 0.373–0.746).[27]

We recommend the provision of injury prevention educational programs involving both athletes and coaches. These programs should emphasize periods of proper training, gradual increase in the training load appropriate for the fitness level of an athlete and

Table 4: Association between Achilles tendon pain and sports practices among cyclists, Eastern Province, Saudi Arabia

Factors	Achilles tendon pain		*P*-value
	Yes (*n*=28), *N* (%)	No (*n*=255), *N* (%)	
Coach supervision			
No	17 (9.7)	158 (90.3)	0.980
Onsite live coaching	7 (9.9)	64 (90.1)	
Distant coaching	4 (10.8)	33 (89.2)	
Warm up frequency			
Always	14 (10.8)	116 (89.2)	0.302
Often	4 (8.5)	43 (91.5)	
Sometimes	2 (3.7)	52 (96.3)	
Seldom	6 (17.6)	28 (82.4)	
Never	2 (11.1)	16 (88.9)	
Years of cycling			
Median	2.2	2.2	0.395
Mean±SD	5.8±6.7	5.7±8.9	
Range	0.7-24	0.5-50	
Cycling time (h/week)			
Median	4	4	0.853
Mean±SD	5.7±5.5	5.1±4.2	
Range	1-25	1-30	
Riding frequency/week			
Median	3	3	0.839
Mean±SD	3.3±1.6	3.2±1.7	
Range	1-7	0-10	
Kilometers ridden/week			
Median	72.5	72.5	0.548
Mean±SD	147.9±168.2	112±104.9	
Range	20-600	0-500	
Resistance training time (h/week)			
Median	1	1	0.202
Mean±SD	1.8±1.7	1.4±1.6	
Range	0-5	0-7	
Stretching time (min/week)			
Median	10	10	0.333
Mean±SD	16.7±16.7	14.9±19.2	
Range	0-60	0-120	
Rest days/week			
Median	2	2	0.473
Mean±SD	2±1.3	2.2±1.3	
Range	0-4	0-6	
Football participation			
No	22 (9.9)	200 (90.1)	0.986
Yes	6 (9.8)	55 (90.2)	
Swimming time (h/week)			
Median	0.0	0.0	0.118
Mean±SD	1.1±1.3	0.7±1.1	
Range	0-4	0-6	
Jogging/running time (h/week)			
Median	1	1	0.097
Mean±SD	2.3±1.9	1.8±2.3	
Range	0-6	0-25	

SD: Standard deviation

the importance of appropriate bicycle dimensions. Furthermore, bicycle fitting workshops will be of great value to this population. These programs will be more efficacious when provided by a national sports organization. Access to sports medicine facilities should also be improved, and their utilization encouraged. Emphasis should also be put on the importance of the maintenance of ideal body weight and cessation of smoking. A prospective cohort study will be beneficial in evaluating the risk factors of injuries in this population. Moreover, more interventional studies are needed to evaluate the effect of coaching, bicycle fitting, strength training, and other preventive measures for bicycling injuries.

The data were collected using a selfadministered questionnaire and may have been subject to recall bias. A nonresponse bias may be present because of the low response rate (60.6%). A simple short survey was used for preventive measures, but a prospective study is necessary for a better assessment. The number of cyclists in Saudi Arabia is still low and female participation was rare at the time of data collection. Therefore, the study population was small with no female participants. Nevertheless, this first study of the population surveyed has highlighted Achilles tendon pain in cyclists in Saudi Arabia and emphasized the need for National Health Education Programmes on this problem as well as the necessity to improve the infrastructure for sports medicine and its accessibility.

Conclusion

Achilles tendon pain was common in our study population, affecting both amateur and professional cyclists. Most Achilles tendon pain was mild, with seldom or sometimes frequency. An increase in training load was the most important risk factor for Achilles tendon pain. Cyclists who participated in road races and in off-road cycling had a higher rate of pain. Obesity and underweight were associated with higher rates of Achilles tendon pain (U-shaped relationship between BMI and Achilles tendon pain). The study underpins the importance of a gradual increase in the training load, proper conditioning, bike fitting and the maintenance of ideal body weight to prevent Achilles tendon pain in cyclists.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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