ORIGINAL ARTICLE

The relation between performance and oral health in male athletes

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ABSTRACT

Objectives: .Oral health is as important to an athlete's sporting successas regular exercise and adequate nutrition. The aim of this study was to investigate the relation between oral health and sporting performance.
Methods: This prospective study was carried out with male athletes. Athletes' demographic characteristics, dental care habits, number of decayed, missing or filled teeth, and sporting performance data were recorded. The Decayed Missing Filled Teeth (DMFT) index, Significant Caries index (SCI) and Plaque index (PI) were used to assess oral health. The T-Drill, Zig-Zag, Lateral Change of Direction (LCD) and 505 tests to assess agility, and 10-, 20- and 30-m short sprint tests were used to assess speed. The results were analyzed on SPSS software, and p values < 0.05 were regarded as significant.
Results: Ninety-six athletes were included in the study. Active caries was determined in 70.8%. The mean DMFT index value was 3.9 ± 3.7, mean SCI 10.2, and mean PI 0.9 ± 0.4. DMFT was ≥ 4 in 45.8% of athletes and < 4 in 57.2%. No difference was determined between subjects with DMFT < 4 and DMFT ≥ 4 in terms of age, height, body weight, or years engaged in sports. Agility and speed tests results were superior in subjects with DMFT<4 than in those with DMFT ≥ 4, and times to completion of performance tests were shorter ($p <$ 0.05). Pearson correlation analysis revealed that DMFT was positively correlated with agility tests [T-Drill test (r = 0.428), Zig-Zag test (r = 0.428), LCD test (r = 0.286) and 505 test (r = 0.529)], and speed tests [short sprint, 10-m (r = 0.309), 20-m (r = 0.336), 30-m (r = 0.449)] ($p < 0.05$).
Conclusion: Impairment of oral health has an adverse effect on sporting performance, and this can lead to poorer results in performance tests such as agility and speed.

Keywords: Athletes, athletic performance, oral health, tooth

An athlete's success is closely associated with physical and mental health [1]. Oral and dental health is one of the principal indicators of quality of life and general physical health, not only in athletes but in the general population [2]. In addition to gingival bleeding, dental caries, and tooth loss, poor oral health can also lead to several systemic diseases [3, 4]. Studies have shown that poor oral health is associated with weight loss, growth delay, coronary artery disease, constipation, and immune system weakness

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[5-8]. Oral health evaluation is based on various parameters, including numbers of decayed, missing or filled teeth, dental erosion, plaque levels, and gingival bleeding. Frequently employed tools include Decayed Missed Filled Teeth (DMFT) index, the Significant Caries index (SCI) and Green and Vermillion's Plaque index (PI) [9-12].

Studies have reported poor oral and dental health in both professional and amateur athletes [13-15]. While this is linked to dental decay occurring in association with frequent consumption of carbohydrates, a good energy source, or energy drinks containing high acid and carbohydrate levels, particularly during exercise, it is also related to individual factors such as nutrition or tooth brushing habits [16, 17]. Compromise of oral health in athletes can affect performance in terms of speed, strength, power, flexibility, and agility, and these changes in performance can be shown by means of tests, both in the field and in the laboratory [18-20].

The aim of this study was to investigate the relation between oral health and athletic performance.

METHODS

Study Design

Approval for the study was granted by the local ethics committee (No. 2012/12-02). This prospective study of male athletes was performed by the Kırıkkale University Department of Physical Education and Sports, Department of Oral Health and Dentistry, and Department of Emergency Medicine in November 2013. Information about the study aim was given to all athletes participating, and all provided informed consent. The study was performed in accordance with the Declaration of Helsinki and the Good Clinical Practice Directive.

Demographic data (age, height, body weight, sports age, heart rate, and fat measurements), oral health, numbers of decayed, missed and filled teeth, teeth brushing behaviors, and speed and agility test results were recorded for all subjects.

Assessment of Oral Health and Dental Care

Oral health and dental care examinations were conducted separately for all subjects. All oral and dental health examinations were carried out at the

Kırıkkale University Faculty of Dentistry and by the same experienced dentist. The Green and Vermillion PI was used to evaluate oral hygiene, while assessment of decayed, missed or filled teeth was based on the DMFT index. The SCI indexwas used to evaluate the prevalence of caries in groups of individuals. Care was taken during oral health examinations to adhere to World Health Organization oral health and dental care rules[10, 11, 21-23].

Assessment of Speed and Agility

Athletes' performance tests were conducted at the Kırıkkale University Faculty of Physical Education and Sports gymnasium. Calibration and linearity settings of the instruments used in the measurements were completed before the performance tests. Height, weight and body composition measurements were performed using a Tanita body composition analyzer (Tanita Body Composition Analyzer BC 418 professional model, USA). All athletes were familiarized with the performance test procedures through practice in the gymnasium before the final tests. In order to prevent fatigue, athletes were instructed to avoid intense exercise for the 24-h period before the testing session. We used 10-, 20-, and 30-m short sprint tests to assess speed, and the T-Drill test, Zig-Zag test, 505 test, and Lateral Change of Direction (LCD) test to evaluate agility [24]. All tests were performed three times, and the best results were recorded.

Statistical Analysis

All data were analyzed on SPSS 18.0 (Statistical Package for the Social Sciences Inc., Chicago, IL, USA) software. Data obtained from the performance tests exhibited normal distribution and are expressed as mean ± standard deviation (SD). The independent samples t-test was used to compare the test results between the DMTF < 4 and DMTF ≥ 4 groups. We also determined relations between DMTF and different performance tests using Pearson correlations (r) and determination (r^2) coefficients. The p values < 0.05 were regarded as statistically significant.

RESULTS

Ninety-six male athletes were included in the

Table 1. Relations between athletes' demographic data and the DMFT index

	DMFT	n	mean ± SD	*p value*
Age (years)	≥ 4	41	20.29 ± 1.15	0.308
	< 4	55	20.58 ± 1.51	
Height (cm)	≥ 4	41	1.77 ± 0.76	0.698
	< 4	55	1.78 ± 0.61	
Weight (kg)	≥ 4	41	72.48 ± 14.04	0.344
	< 4	55	70.30 ± 8.29	
Years in sport	≥ 4	41	7.1 ± 2.5	0.76
	< 4	55	6.2 ± 2.6	

DMFT = Decayed missing filled teeth, SD = standard deviation

study. The mean age of the athletes was 20.4 ± 1.3 years, mean body mass index (BMI) was 22.01 ± 2.3 kg/m^2, mean body weight was 71.2 ± 11.0 kg, mean height was 178.4 ± 0.7 cm, mean body fat was $12.6 \pm 2.5\%$, and mean heart rate was 68.2 ± 5.2 beats/min (resting state). The participants had been actively engaged in sports for a mean 6.6 ± 2.6 years and trained 3-4 times a week (for a total of 6-8 hours a week). Twenty-five (26.1%) attended regular dental check-ups. Twenty-eight (29.2%) brushed their teeth twice or more a day. However, only thirty-eight (39.6%) used dental floss or mouth rinses. The most frequently reported symptom was gingival bleeding (66.8 %).

The mean DMFT index value was 3.9 ± 3.7 based on the following component measures: mean number of teeth with active caries 2.7 ± 2.9, missing teeth 0.6 ± 1.1, and filled teeth 0.5 ± 1.4. Forty-one athletes (42.7%) had DMFT ≥ 4 and 55 (57.3%) had DMFT < 4. The mean SCI value was 10.2, and the prevalence of caries was 66%. The mean PI score was 0.9 ± 0.4. Twenty-eight (%29.2) athletes had non-carious teeth

and 70.8% carious teeth.

There was no significant difference between the DMFT ≥ 4 and DMFT < 4 groups in terms of age, height, weight or years engaged in sport ($p > 0.05$) (Table 1).
A difference was determined between the DMFT ≥ 4 and DMFT < 4 groups in terms of decayed, missing, and filled teeth ($p < 0.01$, $p < 0.01$, and $p < 0.05$, respectively). The most important factor affecting DMFT values was the number of decayed teeth (Table 2).

The DMFT < 4 group was more successful than the DMFT ≥ 4 group in the agility tests (T-drill, Zig-Zag, LCD, and 505) and speed tests (10-, 20-, and 30-m short sprint) ($p < 0.05$). Success rates decreased as DMFT values increased. Increased DMFT values were associated with prolonged times to completion of agility and speed tests. Analysis of t values in the agility tests revealed that the most significant difference was in the Zig-Zag tests, while the greatest difference in the speed test was observed in the 20-m sprint test (Table 3).

Table 2. Comparison of athletes with DMFT < 4 and with DMFT ≥ 4 in terms of numbers of decayed, missing and filled teeth

n = 96	DMFT	min-max	mean ± SD	*p value*
Decayed	≥ 4	0-11	4.97 ± 3.12	**< 0.01**
	< 4	0-3	1.04 ± 1.02	
Filled	≥ 4	0-7	1.24 ± 1.93	**< 0.01**
	< 4	0-1	0.09 ± 0.29	
Missing	≥ 4	0-4	1.20 ± 1.29	**< 0.05**
	< 4	0-3	0.18 ± 0.51	
Total	≥ 4	4-15	7.39 ± 3.00	**< 0.01**
	< 4	0-3	1.31 ± 1.10	

DMFT = Decayed missing filled teeth, SD = standard deviation, min = minimum, max = maximum

Table 3. Analysis of performance test results by DMFT index scores

n = 96		DMFT	min - max	mean ± SD	p^{*} value
Agility	**T-Drill test** (sec)	≥ 4	9.14 - 13.78	11.33 ± 1.06	**< 0.05**
		< 4	9.06 - 13.50	10.64 ± 0.91	
	Zig-Zag test (sec)	≥ 4	5.64 - 7.34	6.47 ± 0.40	**< 0.05**
		< 4	5.08 - 6.86	6.03 ± 0.39	
	505 test (sec)	≥ 4	2.27 - 4.44	3.02 ± 0.47	**< 0.05**
		< 4	2.31 - 3.53	2.77 ± 0.36	
	LCD test(sec)	≥ 4	4.70 - 7.44	6.12 ± 0.61	**< 0.05**
		< 4	4.22 - 7.12	5.64 ± 0.73	
Speed	**10 m sprint best** (sec)	≥ 4	1.59 - 2.75	1.99 ± 0.29	**< 0.05**
		< 4	1.56 - 2.38	1.85 ± 0.18	
	20 m sprint best (sec)	≥ 4	2.34 - 3.10	2.63 ± 0.21	**< 0.05**
		< 4	1.75 - 2.81	2.47 ± 0.21	
	30 m sprint best (sec)	≥ 4	3.24 - 5.56	4.25 ± 0.60	**< 0.05**
		< 4	3.16 - 4.78	3.89 0.50	

DMFT = Decayed missing filled teeth, SD = standard deviation, min = minimum, max = maximum, *The independent samples t-test

The results showed that the correlation coefficient values of the agility and speed tests were all significant ($p < 0.01$). Positive correlations were observed between the DMFT index and performance tests. This correlation was especially significant in the Zig-Zag test (among the agility tests) and in the 30-m sprint test (among the speed tests) (Table 4).

DISCUSSION

A successful athlete must always take regular exercise andreceive balanced nutrition, and must always keep his body healthy and prepared. As also reported in previous studies, considering the link between oral and dental health, general health, and adequate nutrition, these play a significant role in athletic performance, and impairment of oral health has a negative effect on sporting performance [2, 3, 25, 26]. The findings from our study show that an increasing number of decayed, missing and filled teeth has an adverse impact on performance, and prolongs the completion of both agility and speed tests.

Studies of professional and non-professional athletes in various different spheres have evaluated athletes in terms of oral health, nutritional habits, and saliva profiles [13-15, 27, 28]. Ashley *et al*. [25] reported poor oral health in professional athletes, with a dental caries rate of 15-75%, and a dental erosion rate of 36-85%, while Gay-Escoda *et al*. [14] reported a gingival bleeding rate of 60%. Using a similar method to that in our study, Forrest [29] evaluated numbers of decayed, missing, and filled teeth in Olympic and non-Olympic athletes and reported DMFT indices of 2.8 to 16.8. In two different studies of footballers, de Sant'Anna *et al*. [15] reported

Table 4. Correlation between performance tests and the DMFT index

Relation to DMFT		r	r^{2}	p^{*} value
Agility	T- Drill test	0.428	0.18	**< 0.01**
	Zig-Zag test	0.529	0.28	**< 0.01**
	505 test	0.286	0.08	**< 0.01**
	LCD test	0.398	0.15	**< 0.01**
Speed	10-m sprint best	0.281	0.08	**< 0.01**
	20-m sprint best	0.309	0.09	**< 0.01**
	30-m sprint best	0.336	0.11	**< 0.01**

DMFT = Decayed missing filled teeth, Pearson correlations (r) and determination (r²) coefficients.
*The independent samples t-test

DMFT = 8, and SCI = 12, while another study reported findings of DMFT = 5.7 ± 4.1, and SCI = 10 in the Barcelona soccer team [14]. In our study, dental decay was determined in 70.8% of athletes and gingival bleeding in 66.8%, whilethe mean DMFT score was 3.9 ± 3.7, mean SCI = 10.2, and mean PI = 0.9 ± 0.4. Our results are in agreement with those of previous studies, and suggest that Turkish athletes, like those in other parts of the world, do not attach sufficient importance to oral and dental health.

Several studies have investigated the effect of oral health on physical performance. However, these studies have reported general conclusions that poor oral health has an adverse impact on physical performance. Needleman *et al*. [30] reported that approximately half of footballers in the United Kingdom were troubled by poor oral health, and that some experienced decreased quality of life and physical performance due to poor oral health. In studies of Olympic athletes, most subjects have reported decreased performance due to poor oral health, while some have even reported being prevented from training due to problems deriving from oral and dental health impairment [2, 29, 31, 32]. This led the International Olympic Committee to take action, and obliged it to issue calls to all relevant countries concerning oral health protection [33]. One more specific investigation of oral health and performance examined the link between oral health and grip strength and showed that poor oral health had an adverse effect on grip strength [34]. Iwasaki *et al*. [35] considered the subject from a different perspective and showed that poor oral health also caused compromise of cognitive functions. Our study investigated the relation between male athletes' oral health and sporting performances using previously developed performance tests [24]. In one previous study, Reilly *et al*. reported a mean 30-m short sprint time of 4.46 ± 0.21 sec, while in our study the relevant timings were 4.25 ± 0.60 sec in subjects with DMFT ≥ 4 and 3.89 ± 0.50 sec in those with DMFT < 4 [36]. In their study of 106 professional athletes, Little *et al*. reported a 10-m short sprint time of 1.83 sec, a 20-m sprint time of 2.40 sec and a mean Zig-Zag agility test time of 5.34 sec, while in our study these values were similar to those of professional athletes only in the subjects with DMFT < 4, but were longer in those with DMFT ≥ 4 [37]. Similarly,in their study of agility in

footballers, Hoffman *et al* reported a mean T-Drill test time of 9.36 ± 0.44 sec, while in our study this time was only approached by athletes withDMFT < 4 (T-drill agility test results; DMFT < 4 = 10.64 ± 0.91 sec; DMFT ≥ 4 = 11.33 ± 1.06 sec) [38]. It would appear that an increased number of decayed, missing or filled teeth has an adverse impact on physical performance. This thesis is supported by all agility and speed test results being better in athletes with better oral health, with DMFT < 4, than in those with DMFT ≥ 4.

Limitations

There are a number of limitations to our study. First, although athletes were asked to rest in the period before the tests were to be performed, some may not have complied. This may have affected the results obtained in the performance tests. Second, since only male athletes were included in the study, the results obtained cannot be generalized to all athletes. Wide-ranging performance studies also including female athletes are therefore needed.

CONCLUSION

In conclusion, the data we obtained show that impairment of oral health in male athletes, in other words an increasing number of decayed, missing or filled teeth or gingival bleeding, has an adverse effect on physical performance and that this results in slower times in tests of physical performance, such as speed and agility, and to poorer outcomes.

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