A clinical investigation linked the incidence of myopia in young adulthood to periodontitis and dental caries

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Abstract

Aim: Inflammation and collagen abnormalities may both affect oral and ocular health. Previous research have shown contradictory outcomes, nevertheless. Examining whether or not myopia in young people is linked to dental caries and periodontitis was the focus of this research. **Materials and methods:** This research comprised 1000participants aged 19 to 39 who were scheduled for dental and vision screenings between 2022 and 2023. Myopia severity was ranked from nonexistent to severe, low myopia and high myopia. Myopia was found to be correlated with active dental caries, filled teeth, periodontitis stages II and III, smoking, alcohol consumption, number of missing teeth, blood leukocyte counts, triglyceride levels, high-density lipoprotein levels, and uric acid levels in a multivariate logistic regression analysis. **Results:** There was a statistically significant increase in the probability of low or high myopia for those with any actively dental caries present but no such increase was seen for those with treated teeth. In addition, only extreme myopia was linked to advanced stages of periodontitis and was not observed with low myopia. **Conclusions:** Our findings imply that the dental inflammatory state in the oral cavity may be linked to ocular disorders, since only actively developing dental caries and increased severity of periodontitis were associated with myopia among young persons.

Keywords: Actively dental caries, Filled teeth, Periodontitis, Myopia, Young adults

Introduction:

Many individuals across the globe suffer from dental caries and periodontal disease, and the high expense of providing care for them puts a strain on healthcare systems [1]. Pain when chewing, trouble communicating, diminished confidence, tooth loss, and the necessity for dental surgery are among potential outcomes of dental caries [2]. Myopia, on the other hand, is another prevalent eye condition. Myopia has become a major public health issue across the world, especially among young people, with the greatest growth seen in East Asia [3]. This is supported by epidemiological research conducted over the last several decades. Asians and women, in particular, were shown to have a higher prevalence of myopia in early adulthood, and this trend persisted with increasing age [4]. Myopia is difficult to prevent and cure since its specific cause is unknown, although it seems to be linked to interactions between hereditary and environmental factors [5].

Low levels of physical activity and obesity, for example, have been linked to both high myopia and dental caries [6-9]. The systemic inflammation caused by periodontitis [10] and aggressive dental caries [11] may also play a role in the onset of a variety of ocular diseases. Goldstein et al. [12] and Hirsh et al. [13] performed research in the 1970s showing that myopic children had a higher risk of dental caries than their nonmyopic counterparts.

However, in a different group of studies [14-16], no such associations were discovered. The risk ratio for developing ocular diseases (in this example, glaucoma) among people with periodontitis was 1.26 in just two investigations [17, 18]. The research had certain limitations, such that it couldn't tell how severe periodontitis was or whether it increased the chance of myopia. Therefore, the goal of the present study was to examine the correlations between myopia and dental caries, with and without the use of comprehensive dental treatment.

"Methods and methods:

Study population:

Those who met the oral health examination requirements were included, whereas those who did not include those who had not had an eye examination in the same year or who had a history of ocular surgery. There were three subgroups of participants: those with no myopia, those with mild myopia, and those with severe myopia.

Clinical and demographic measurements:

Before the yearly health inspection, the military populace was ordered to fast for more than 12 hours. Anthropometric characteristics such as height and weight were measured while the subjects were upright. By dividing the subject's kilogram weight by their square meter height, we were able to calculate their body mass index (BMI). Each participant's systolic and diastolic BP measurements were taken while they remained still for at least 15 minutes using the same automated blood pressure monitor equipment. All of these laboratory parameters were measured using the same automated analyzer: total leukocyte count, fasting plasma glucose, triglyceride level, cholesterol level, and serum uric acid level.

Dental caries and periodontal condition measurements:

A dental mirror and a community periodontal index probe from HU Friedy (Chicago, USA) were used to examine the teeth and gums. The proportion of the population with cavities, missing teeth, or restorations was determined using WHO standards (WHO, 2013). Teeth that had pits and grooves, cavitated enamel, or felt softer when probed were identified as having active dental caries. Tooth enamel covered by a temporary filling or a tooth that had been treated but still had cavities were also considered to be experiencing active dental caries. Those who received faulty sealants were more likely to have active tooth decay. Teeth were considered filled when the dental caries were no longer visible after receiving full treatment. No participants with impacted teeth or third molars were included.

Six locations per tooth were charted for probing pocket depth (PPD) and clinical attachment loss during a full mouth periodontal charting. The number of healthy teeth, whether or not they were mobile, whether or not they had furcations, and full-mouth radiographs were also recorded. The American Academy of Periodontology and the European Federation of Periodontology held a combined international workshop in 2017 to design a system for grading and classifying the severity of periodontitis. [19-24]. A single dentist (Kun-Zhe Tsai) performed all procedures required to ascertain the periodontitis's severity and classification. After having their dental diseases thoroughly examined by other dentists in the Outpatient Department within a month, the participants' periodontal stages were verified with an estimated interobserver agreement (kappa coefficient) of 90.6%. Each participant's oral health was evaluated at the beginning, and then a personalized treatment plan was created for them.

Ocular status measures:

An Auto Kerato-Refractometer was used to test each patient's noncycloplegic autorefraction of both eyes, and their best-corrected vision was assessed using a Snellen chart. Extreme myopia (10.0 diopters), pathology impairing the purity of the ocular medium, or a history of high-risk ocular surgery were all factors that excluded applicants during the pre-enlistment exam. Myopia was classified as mild (0.5 to 5.9 diopters) or severe (6.0 diopters). Myopia was not present in the other eye (> 0.5 diopters).

Refractive errors in the left and right eyes were highly correlated, hence only left eye data was used for statistical purposes. (r = 0.96) [7].

Statistical analysis:

To conduct the statistical tests, we utilized IBM's SPSS (Statistical Package for the Social Sciences) version 25.0 (IBM Corp., Armonk, NY, USA).

Results:

There were 1,500 members in all who took the oral exams. After excluding everyone who hadn't had an eye test that same year, the final sample size was reduced to 1000 men and women between the ages of 19 and 39.These individuals were subsequently divided into three groups: no myopia (N = 450), low myopia (N = 250) and high myopia (N = 300).

Patients without myopia had the highest rates of active smoking and concurrent grade B and C periodontitis, but otherwise the three groups had similar demographic, anthropometric, and hazardous substance use characteristics. Subjects with high myopia had higher blood pressure, blood leukocyte count, and serum uric acid levels than those without myopia or with moderate myopia. Although the DMFT score and periodontitis severity were similar across the three myopic groups, the number of filled teeth was significantly lower in the group without myopia.

The findings of both simple and multiple linear regression analyses of refractive error are shown in Table 1. Refractive error was lower in those with higher body mass index and serum uric acid levels, according to univariate analysis.“(direction to no myopia) (β = 0.05 and β = 0.18, respectively; *p* values = 0.03 and 0.01, respectively).”There was a weak correlation between higher rates of dental caries and higher prevalence of refractive errors. (direction to high myopia) (β = − 0.13, *p* value = 0.07). Probing pocket depth, the number of missing teeth, and the number of filled teeth had no effect on refractive errors. Age, BMI, systolic blood pressure, blood leukocyte counts, and serum uric acid levels were included in the multivariable linear regression model with the frequency with which dental caries and tooth loss were observed. Backward regression selection, however, omitted filled tooth counts and probing pocket depth when the p-value was more than 0.30. Multivariate linear regression analysis showed an association between higher numbers of actively carious teeth, older age, lower serum uric acid levels, and “higher refractive errors. (direction to high myopia) (β = − 0.17, β = − 0.04, β = − 0.02 and β = 0.18, respectively; all *p* values < 0.05).”There was also a weak correlation between higher numbers of missing teeth and higher body mass indexes and smaller refractive defects. “(direction to no myopia) (β = 0.11 and β = 0.06, respectively; *p* values = 0.09 and 0.06, respectively).”

Table 1: Liner regression analysis models for refractive error

	Univariate				Multivariate		
	R	**B**	**95% CI**	***p* value**	**B**	**95% CI**	***p* value**
Actively dental caries numbers	0.03	− 0.1	− 0.21, 0.01	0.06	− 0.16	− 0.35, − 0.02	0.01
Missing teeth numbers	0.02	0.04	− 0.05, 0.16	0.31	0.15	− 0.01, 0.19	0.07
Filled teeth numbers	0.01	− 0.01	− 0.06, 0.02	0.34			
Probing pocket depth	0.01	0.02	− 0.33, 0.42	0.77			

Age	0.04	− 0.01	− 0.05, 0.01	0.21	− 0.03	− 0.06, − 0.01	0.01
Body mass index	0.06	0.03	0.01, 0.08	0.01	0.05	− 0.01, 0.18	0.05
Systolic blood pressure	0.03	− 0.01	− 0.01, 0.01	0.31	− 0.01	− 0.02, − 0.01	0.01
Blood leucocyte counts	0.04	0.06	− 0.01, 0.21	0.19	0.05	− 0.04, 0.17	0.31
Serum triglycerides	0.02	0.02	− 0.01, 0.01	0.23			
High density lipoprotein	0.06	− 0.01	− 0.02, 0.01	0.04			
Serum uric acid	0.07	0.16	0.04, 0.26	0.01	0.17	0.02, 0.21	0.01”

“Table 3 shows the findings of a multiple logistic regression study of the correlation between low and high myopia and the presence of actively developing dental caries, filled teeth, and stage II/III periodontitis. Due to the presence of confounders between the myopic groups, the association between the presence of any actively dental caries and any myopia (low and high) was not significant in the crude model, but was marginally significant in Model 1 and significant in Model 2. Furthermore, in Model 2, identical odds ratios (OR) were found between the presence of any actively dental caries with either low myopia or high myopia. In contrast, Model 2 and Model 1 found that the presence of stage II/III periodontitis was exclusively linked with high myopia, and not mild myopia. Myopia was not linked to the number of filled teeth, however.

Table 3: Multivariate logistic regression analysis model for low and high myopia (no myopia as reference) with actively decayed teeth, filled teeth and stage II/III periodontitis

	Any myopia			**Low myopia**			**High myopia**		
	OR	**95% CI**	***p* value**	**OR**	**95% CI**	***p* value**	**OR**	**95% CI**	***p* value**
Presence of any actively dental caries									
Crude	1.16	(0.87, 1.32)	0.15	1.21	(0.87, 1.45)	0.11	1.11	(0.76, 1.45)	0.34
Model 1	1.21	(0.87, 1.34)	0.03	1.21	(0.76, 1.34)	0.12	1.23	(0.88, 1.76)	0.22
Model 2	1.32	(1.11, 1.67)	0.01	1.34	(0.87, 1.78)	0.05	1.23	(0.86, 2.11)	0.05

Presence of any filled teeth									
Crude	1.09	(0.78, 1.45)	0.18	1.27	(0.77, 1.45)	0.12	1.14	(0.67, 1.34)	0.67
Model 1	1.01	(0.67, 1.23)	0.67	1.18	(0.76, 1.45)	0.27	0.56	(0.56, 1.33)	0.87
Model 2	1.01	(0.67, 1.34)	0.76	1.08	(0.56, 1.63)	0.34	0.76	(0.45, 1.21)	0.88
Presence of stage II/III periodontitis"									
Crude	1.21	(0.81, 1.45)	0.21	0.76	(0.56, 1.12)	0.67	1.12	(0.87, 1.67)	0.03
Model 1	1.31	(0.67, 1.45)	0.21	0.86	(0.45, 1.31)	0.76	1.32	(1.12, 2.11)	0.01
Model 2	1.21	(0.76, 1.45)	0.13	1.11	(0.56, 1.23)	0.85	1.23	(1.22, 2.12)	0.01

The findings of the sensitivity test for the link between stages I and II/III periodontitis and myopia (with healthy persons serving as the reference group) are shown in Table 1 of the present study. Stage I periodontitis was not linked to either low or high myopia. "In contrast, an association between stage II/III periodontitis and high myopia was suggested (OR: 1.41 [0.99–2.01], $p = 0.054$) and consistent with the results found in Table 3."

Discussion:

The primary takeaway from this research was that active dental caries increased the likelihood of developing myopia. Myopia risk factors did not include dental caries that had been treated (i.e., fillings) and had not returned. Even more so, advanced periodontitis was linked to extreme nearsightedness. However, we did not find any correlation between periodontal disease severity and nearsightedness in young people.

There has been research on whether or not dental caries is linked to myopia since the 1970s, but the results have been mixed. There was no correlation found between dental caries and myopia in studies including children and teens. [14, 15], This contradicted the results for the young adult demographic. [12, 13]. The fact that myopia is more common in young adults than in children could help to explain this. [4]. Active dental caries were more common among young people than among young adults, most likely because of lower standards of oral hygiene among young people. [26]. Myopia was also shown to have no association with dental caries following treatment (filled teeth) in the current investigation. Due to poor oral hygiene and subsequent increased bacterial proliferation on the teeth, patients may have active dental caries [27], which may lead to the loss of oral tissue and systemic inflammation [11]. When dental caries are treated, the systemic inflammatory response that causes lens fibrosis is greatly reduced. Reduces the likelihood of developing myopia [28], [29] in turn. The new

study verifies prior studies between dental caries and myopia, which implies that the submalnutrition status reflected by a lower BMI level may harm both the teeth enamel and the lens collagen tissue, contributing to the link between dental caries and myopia. This study adds to the growing body of evidence that links youth tooth decay and myopia, and suggests that higher blood uric acid levels (an antioxidant agent in the body) may protect against oxidative stress [30] caused by both conditions.

The immune response is implicated in periodontal tissue loss [20-22], rather than the germs themselves. Inflammatory cells and fibroblasts inside the host are activated in response to dental biofilm stimulation, setting off the process of periodontal tissue loss. Matrix metalloproteinases (MMPs) and proinflammatory cytokines such tumor necrosis factor-, interleukin (IL)-1, IL-6, and leptin are secreted by these cells and fibroblasts. [20–22]. Even local inflammation may have far-reaching consequences for health [31]. Myopia is believed to result from collagen cleavage by MMP-2, a target of TGF- signaling via NF-kappaB. [32, 33].

The expression of bacteria's pathogenic potential is linked to the development of periodontitis, which has both hereditary and behavioral components (particularly smoking and poor dental hygiene). [34, 35]. In a study of raised-apart sets of identical twins, researchers found that heritability remained strong even after adjusting for behavioral characteristics like smoking status. This suggests that genetic factors may account for between 38 and 80 percent of the population variation in periodontal disease. [36]. Researchers have found evidence linking periodontal disease to genes encoding for interleukin, formyl peptide receptor, and Fc gamma receptor. [37]. High myopia, like periodontitis, has a complex etiology due to the interplay of several genes and environmental variables. [38]. Despite the overwhelming evidence from human and animal research that environmental variables play a significant role in the onset and progression of myopia, studies of human populations have consistently shown that hereditary factors account for at least 70% of the variation in refraction. [39]. There may be a connection between high myopia and periodontal disease due to shared genetic abnormalities and behavioral variables, such as inactivity.

The current research has a few flaws. For instance, the cross-sectional nature of this research prevented an evaluation of timing and causation. The military health checkup did not advise its candidates that spending less time outside and being closer to work might raise the risk of myopia [40]. Myopia has been linked to dental caries and periodontitis, although the underlying physiological mechanism connecting these conditions remains unclear. Finally, since our study included only young individuals, we cannot guarantee that our findings will apply to people of other ages. However, the current research had a number of advantages. The first novel finding was the correlation between advanced periodontitis and extreme nearsightedness in young people. To further contribute to the area of dentistry, this study clarified the discrepancy between prior research that included both decaying and filled teeth in the "dental caries" category when calculating the risk of myopia. Last but not least, numerous potential confounders were taken into account at the outset because of similarities in parameters like nutrition and exercise routines within the armed forces. Myopia is strongly correlated with dental caries, and members of the armed forces were shown to be less likely to acquire myopia than the general population of young people because they were more physically active and spent less time reading papers and watching television.

Conclusions:

Finally, we discovered that only dental caries and periodontitis in their active-developmental phases II and III were associated with myopia in young persons, suggesting an inflammatory state in the oral cavity as a probable related to near sightedness. Primary prevention of myopia progression may depend on treating actively carious teeth and severe periodontitis in young people.

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