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A Study to Examine the Relationship Between Dietary Acid Load and Oral Health-Related Quality of Life in Adolescents *

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Abstract: This study aimed to examine the relationship between dietary acid load and oral health-related quality of life in adolescents. A total of 374 adolescents participated by completing a demographic questionnaire and the Oral Health Impact Profile-14 (OHIP-14) scale. Additionally, 24-hour recall food consumption records were gathered. The dietary acid load (DAL) was evaluated through the calculation of net endogenous acid production (NEAP) and potential renal acid load (PRAL). Data analysis was conducted using the SPSS 24 software package. Students who regularly visited the dentist had higher OHIP-14, NEAP, and PRAL values than those who did not ($p<0.05$). The OHIP-14 scale score of students with mouth sores was 11.75±11.12 compared to 6.88±7.18 in those without sores ($p<0.05$). Furthermore, DAL was shown to have a positive effect on the total score of the OHIP-14 scale ($p<0.05$). In conclusion, these findings indicate that adolescents with a higher dietary acid load have poorer oral health outcomes and a lower oral health-related quality of life. These results highlight the potential impact of dietary patterns on oral health and emphasize the importance of promoting balanced, alkaline-rich diets during adolescence.

Keywords: Dietary Acid Load, Oral Health, Quality of Life, Adolescents.

JEL Classification: I10, I12, I18

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Adolesanlarda Diyet Asit Yükü ile Ağız Sağlığıyla ilgili Yaşam Kalitesi Arasındaki İlişkiyi İncelemeye Yönelik Bir Araştırma

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Öz: Bu çalışmada, adolesanlarda diyet asit yükü ile ağız sağlığı ile ilişkili yaşam kalitesi arasındaki ilişkinin incelenmesi amaçlanmıştır. Toplam 374 adolesana, demografik yapı anketi ve Ağız Sağlığı Etki Profili-14 (OHIP-14) ölçeği uygulanmıştır ve 24 saatlik geriye dönük besin tüketim kayıtları toplandı. Diyet asit yükü (DAL), potansiyel böbrek asit yükü (PRAL) ve net endojen asit üretimi (NEAP) hesaplanarak değerlendirilmiştir. Veri analizi SPSS 24 yazılım paketi kullanılarak yapılmıştır. Düzenli olarak diş hekimine giden öğrencilerin OHIP-14, NEAP ve PRAL değerleri gitmeyenlere göre daha yüksek saptanmıştır ($p<0,05$). Ağız yarası olan öğrencilerin OHIP-14 ölçek puanı 11,75±11,12 iken, yarası olmayan öğrencilerin OHIP-14 ölçek puanı 6,88±7,18 olarak bulunmuştur ($p<0,05$). Ayrıca, diyet asit yükünün OHIP-14 ölçeğinin toplam puanı üzerinde olumlu bir etkisi olduğu saptanmıştır ($p<0,05$). Sonuç olarak; bu bulgular, diyet asit yükü yüksek olan ergenlerde ağız sağlığı sonuçlarının daha kötü ve yaşam kalitesinin daha düşük olduğunu göstermektedir. Bu sonuçlar, beslenme alışkanlıklarının ağız sağlığı üzerindeki potansiyel etkisini vurgulamakta ve ergenlik döneminde dengeli, alkali yönünden zengin diyetlerin teşvik edilmesinin önemine dikkat çekmektedir.

Anahtar Kelimeler: Diyet Asit Yükü, Ağız Sağlığı, Yaşam Kalitesi, Adolesan.

JEL Sınıflandırması: I10, I12, I18

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GENİŞLETİLMİŞ ÖZ

Araştırma Problemi

Çalışmanın amacı, adolesanlarda diyet asit yükü ile ağız sağlığı ile ilgili yaşam kalitesi arasındaki ilişkiyi incelemektir.

Araştırma Soruları

Diyet asit yükü adolesanlarda ağız sağlığı ile ilgili yaşam kalitesini nasıl etkiler? Adolesanlarda diyet asit yükü ile dental erozyon ve çürük prevalansı arasındaki ilişki nedir? Adölesanlarda diş problemleri ağız sağlığı ile ilgili yaşam kalitesini etkiler mi?

Literatür Taraması

Ağız sağlığı, çocukların psikolojik ve fiziksel gelişiminde çok önemli bir rol oynamakta, günlük aktivitelerini doğrudan etkilemekte ve yüksek diyet asit yükü, kemik mineral dengesini bozarak iskelet ve diş sağlığını olumsuz etkileyebilmektedir. Ayrıca ağız sağlığı problemleri (okul çağındaki çocukların yaklaşık %60-90'ında görülen diş çürükleri gibi), yaşam kalitesini önemli ölçüde etkileyebilmektedir. Ağız sağlığı ile ilgili yaşam kalitesi; ağız fonksiyonu, psikososyal etkiler, orofasiyal görünüm ve ağrı gibi faktörleri içermektedir. Diş yaralanmaları ve davranışsal sorunları olan çocuklar, ağız sağlığı sorunları yaşayanlara göre daha fazla zorluk yaşayabilmektedir. Ayrıca, asidik diyetler; kardiyovasküler hastalıklar, obezite, insülin direnci ve metabolik sendrom gibi sağlık sorunlarıyla ilişkilendirilmiştir. Kırmızı et, tavuk, balık gibi protein bakımından zengin yiyecekler, vücutta asidik bir yük oluştururken, meyve ve sebzeler daha alkali bir diyet sağlamaktadır. Bu faktörler, diyetin kemik ve diş sağlığı üzerindeki etkilerini göstermektedir.

Metodoloji

Bu kesitsel tanımlayıcı çalışma Türkiye'de Ankara ilinde yaşayan 14-18 yaş arası adolesanla yürütülmüş ve toplam 374 katılımcı ile tamamlanmıştır. Ağız sağlığını veya beslenme alışkanlıklarını etkileyebilecek karıştırıcı faktörlerden kaçınmak için psikiyatrik veya yeme bozukluğu tanısı konmuş adolesanlar çalışma dışı bırakılmıştır. Cinsiyet, yaş, boy uzunluğu, vücut ağırlığı beden kütle indeksi, diş hekimine gitme durumu ve diş sağlığı alışkanlıklarına ilişkin veriler demografik bir anket kullanılarak toplanmıştır. Ağız sağlığıyla ilgili yaşam kalitesini değerlendirmek için OHIP-14 ölçeği kullanılmıştır. Besin alımı 24 saatlik geriye dönük besin tüketim kaydı kullanılarak değerlendirilmiş ve enerji ve besin alımı BeBIS yazılımı kullanılarak analiz edilmiştir. Besin porsiyon boyutları standartlaştırılmış bir fotoğraflı besin katoloğu yardımıyla hesaplanmıştır. Diyet asit yükü için, PRAL ve NEAP değerleri besin tüketim kayıtlarından elde edilen makto ve mikro besin ögeleri kullanılarak formülasyon yoluyla hesaplanmış ve değerlendirilmiştir. Veriler istatistiki olarak analiz edilmesinde SPSS 24 paket programı kullanılmıştır.

Bulgular ve Sonuç

Erkek ve kız öğrencilerin yaş ortalaması sırasıyla 15.86±1.10 ve 15±1.03 yıldır. Ortalama vücut ağırlığı kız öğrenciler için 55.74±10.63 kg, erkek öğrenciler için 68.02±13.16 kg olarak bulunmuştur ($p<0.05$). OHIP-14 skorlarında cinsiyetler arasında anlamlı bir fark bulunmazken, PRAL ve NEAP değerleri erkek öğrencilerde kız öğrencilere kıyasla anlamlı derecede yüksek saptanmıştır ($p<0.05$). Düzenli olarak diş hekimine giden öğrencilerin PRAL skoru daha yüksekken, düzenli olarak diş hekimine gitmeyenlerde hem PRAL hem de NEAP değerleri daha düşük bulunmuştur ($p<0.05$). Ayrıca diş çürüğü olan öğrencilerin PRAL ve NEAP değerleri sırasıyla 12.76±17.6 ve 59.95±21.55 iken, diş çürüğü olmayanların değerleri sırasıyla 15.89±19.08 ve 66.71±27.06 olarak saptanmıştır ($p<0.05$). OHIP-14 skorları diş çürüğü olan öğrencilerde diş çürüğü olmayanlara kıyasla daha yüksek bulunmuştur ($p<0.05$). PRAL ve NEAP değerleri ile enerji, karbonhidrat, protein, yağ, sodyum ve fosfor arasında pozitif; potasyum, magnezyum ve kalsiyum arasında negatif korelasyon saptanmıştır ($p<0.05$). Ayrıca, PRAL değerinin, düzenli egzersize gitmeme, diş çürüğü ve ağız yarası olmamasının OHİP-14 skoru üzerine pozitif yönlü bir etkisi olduğu bulunmuştur. Sonuç olarak, diyetteki asidik yükün artmasının ağız sağlığıyla ilgili yaşam kalitesinde azalmaya yol açabileceğini gösterilmiştir.

INTRODUCTION

Oral health is crucial for the psychological and physical development of children (Alshloul, 2023). The Federal Dental International (FDI) Dental World Federation highlights that oral health is closely connected to activities, such as touching, chewing, swallowing, smelling, speaking, smiling, and expressing various emotions (Sharma et al., 2019). According to the World Health Organization (WHO), oral health problems are common among children, with 60–90% of school-aged children experiencing dental caries, which can significantly affect their quality of life (Chapain et al., 2023; Nepaul and Mahomed, 2020).

Oral health-related quality of life encompasses various factors, including oral function, psychosocial impact, orofacial appearance, and pain, reflecting the influence of oral health on overall quality of life (Naito, 2023). Children without oral diseases are 12 times less likely to experience restrictions in daily activities compared to those with oral diseases (Chapain et al., 2023). Saliva plays a crucial role in maintaining the oral acid-base balance by regulating pH levels, which is essential for preventing enamel demineralization that occurs below a pH of 5.5. Disruptions in this balance, often influenced by dietary habits such as the consumption of acidic foods and beverages, can increase the risk of acid erosion and dental caries, particularly in children and adolescents with developing teeth and oral tissues (Apelbaum et al., 2011; Mladenović and Ugrinović, 2024; Suresh et al., 2022). These findings suggest that dietary acid load could play a significant role in shaping oral health outcomes and, consequently, oral health-related quality of life in this population (Apelbaum et al., 2011; Omara et al., 2023; Staberg et al., 2016; Suresh et al., 2022).

Changes in the body's acid-base balance pose significant health risks (Herter et al., 2023). Chronic low-grade metabolic acidosis, increasingly prevalent in Western countries, has been associated with numerous health conditions (DiNicolantonio and O'Keefe, 2021). Diets high in acid content have been linked to health problems such as cardiovascular diseases, insulin resistance, oral and dental issues, and metabolic syndrome (Şahin and Gunsen, 2023; Vidal et al., 2022). Some studies have also found that the Dietary Acid Load (DAL) can disrupt bone mineral balance (Dolati et al., 2024; Gholami et al., 2022). In children, high DAL has a direct impact on skeletal health. When consuming diets high in acid content, the body draws minerals from bones to maintain acid-homeostasis (Luzardo, 2025). These factors collectively suggest that DAL is associated with bone and dental health.

Protein-rich foods, such as beef, poultry, fish, seafood, and eggs increase DAL, while fruits and vegetables contribute to a more alkaline diet (Elibol and Karabudak, 2016). The acid or base-forming potential of foods is determined by measures like potential renal acid load (PRAL) and net endogenous acid production (NEAP). PRAL is influenced by the intake of calcium, protein, potassium, phosphorus and magnesium a positive PRAL score indicates an acid-forming effect, while a negative score reflects an alkaline effect. NEAP, in contrast, is calculated based on protein and potassium intake (Elibol and Karabudak, 2016; Konyalıgil et al., 2022). For instance, a strict or moderate vegan diet typically results in a NEAP score of 15 mEq/day, whereas a Western-style diet can reach up to 48 mEq/day (Williams et al., 2016).

Although the effect of DAL on adults has been studied for years, research focusing on children and adolescents is relatively new (Luzardo, 2025). It is important to emphasize that maintaining a balanced diet with an appropriate DAL can improve oral health and contribute to the quality of life in adolescents. Therefore, this study aimed to investigate the relationship between dietary acid load and oral health-related quality of life in adolescents. Based on the literature, it was hypothesized that a higher dietary acid load would be associated with poorer oral health-related

quality of life among adolescents.

2. MATERIAL AND METHODS

This descriptive, cross-sectional study was conducted in Ankara, Türkiye, between January 1 and May 15, 2023. The study population consisted of adolescents aged 14–18 years who were enrolled in a public high school in Ankara. All students within this age range at the school were invited to participate. Inclusion criteria required voluntary participation of both the adolescents and their families, and exclusion criteria included adolescents with diagnosed psychiatric or eating disorders. The minimum sample size was calculated as 302 adolescents, ensuring a 5% margin of error and 80% statistical power, using G*Power 3.1. Initially, 392 students were contacted; however, those with incomplete anthropometric, demographic, or dietary data were excluded, resulting in a final sample size of 374. This study was conducted in accordance with the principles outlined in the Declaration of Helsinki and received ethical approval from the Ankara Yıldırım Beyazıt University Health Sciences Ethics Committee (approval date: December 8, 2022; decision number: 19-1234). Additionally, permission was obtained from the Ankara Provincial Directorate of National Education, Republic of Türkiye. All participants and their parents provided informed consent prior to participation.

2.1. Data Collection Tools

2.1.1. Demographic Structure Questionnaire

The demographic structure questionnaire collected information on participants' personal characteristics, such as gender, age, body weight, height, dental check-ups, oral and dental health protection habits, and dietary practices.

In this study, oral examinations were not performed directly by the researchers. However, information regarding oral health was accepted as accurate if participants and their parents reported that they had previously visited a dentist and received a diagnosis from the dentist. Thus, diagnoses made by dentists were confirmed through participant and parental reports and included in the study. This approach ensured that oral health data were based on reliable patient records and family consent rather than clinical examination.

Researchers measured participants' height (cm) and weight (kg) while they stood upright, facing forward, with their ears and eyes aligned in the Frankfort Plane (Lohman et al., 1988). BMI was determined using the formula weight (kg)/height (m^2), and classifications were made based on WHO standards (World Health Organization, 2024).

2.1.2. Oral Health Impact Profile-14 (OHIP-14)

This scale was utilized to evaluate the impact of oral health on both overall quality of life and general well-being. It was originally developed by Slade and Spencer (1994) and later adapted into Turkish with a validity and reliability study conducted by Başol et al., who reported a Cronbach's Alpha coefficient of 0.74 (Başol et al., 2014).

The scale includes 14 items, each assessed using a 5-point Likert-type system, with options ranging from 0 to 4 points, based on a five-choice scaling method. It was concluded that an increase in the total score indicates a higher severity of the issue, which corresponds to a reduction in quality of life (Başol et al., 2014).

2.1.3. 24-hour Food Consumption Record

Dietary intake was assessed using the 24-hour dietary recall method. Energy and nutrient values were calculated using BeBIS (Ebispro for Windows, 2021) software. Trained nutritionists assisted participants in accurately estimating portion sizes using the the Food and Portion Size Photo Catalog: Measurements and Quantities (Rakıcıoğlu et al., 2010). This method provided an estimate of participants' daily food consumption by recording all

meals, beverages, and snacks consumed in the 24 hours preceding the study.

2.1.4. Calculation of Dietary Acid Load

Dietary acid load, potential renal acid load (PRAL), and net endogenous acid production (NEAP) were calculated based on the 24 hours recall food consumption record (Frassetto et al., 1998; Lennon et al., 1966; Remer and Manz, 1994; Remer and Manz, 1995). The formula for PRAL is as follows:

NEAP (mEq/day) = [54.5 x protein (g/day) / potassium (mEq/day)] – 10.2

PRAL (mEq/day) = 0.0366 x phosphorus (mg/day) + 0.4888 x protein (g/day) -0.0205 x potassium (mg/day)– 0.0263 x magnesium (mg/day) – 0.0125 x calcium (mg/day)

2.2. Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics 24. Descriptive statistics included mean ± standard deviation, frequency (n), and percentage (%). For comparing two independent groups, the Independent Samples t-test was used for normal data and the Mann-Whitney U test for non-normal data. ANOVA was used for comparisons of three or more groups with normal distribution, while the Kruskal-Wallis H test was applied for non-normal data. Pearson's correlation coefficient assessed the relationship between two quantitative variables with normal distribution, and Spearman's correlation was used for non-normal data. Linear regression analysis identified factors influencing OHIP-14 scores.

3. RESULTS

The mean age of the female students was 15±1.03 years, while the mean age of the male students was 15.86±1.10 years. The mean body weight of the female students was 55.74±10.63 kg, whereas the male students had a mean body weight of 68.02±13.16 kg ($p<0.05$). The mean BMI of the students was 60.12±12.98 kg/m² (See Table 1).

Table 1. Anthropometric Variables, Dietary Acid Load Values According to Gender

	Female (n:226)	*Male (n:148)*	*Total (n:374)*	
	X±SS	**X**±SS	**X**±SS	**p**
Anthropometric Variables				
Age (y)	15,76±1,06	15,85±1,05	15,79±1,06	0,414
Weight (kg)	55,25±10,66	67,46±13,39	60,08±13,23	**0,000***
BMI (kg/m²)	20,56±3,26	21,59±3,50	20,96±3,39	**0,013***
	n(%)	n(%)	n(%)	
PRAL				
Negative	48(21,2)	11(7,4)	59(15,8)	**0,001****
Positive	178(78,8)	137(92,6)	315(84,2)	

**Mann-Whitney U testi **Chi square test*
BMI: Body mass index, PRAL: Potential renal acid load

No statistically significant difference was observed in the OHIP-14 scores between male and female students. However, PRAL and NEAP values were significantly higher in male students compared to female students ($p<0.05$) (See Table 2).

The PRAL score of students who visited the dentist regularly was found to be statistically higher, while their PRAL and NEAP values were lower than those of students who did not visit the dentist regularly ($p<0.05$). Students with dental caries had higher OHIP-14 scores compared to those without dental caries ($p<0.05$). The PRAL and NEAP values of students with dental caries were 12.76±17.6 and 59.95±21.55, respectively, while those without

dental caries had values of 15.89±19.08 and 66.71±27.06, respectively ($p<0.05$). The lowest OHIP-14, PRAL, and NEAP values were observed in individuals experiencing persistent gingival pain (See Table 2).

Table 2. PRAL, NEAP, and OHIP-14 Values According to Gender and Oral Health Status of the Students

	OHIP-14 X̄±SS	p	***PRAL*** **X̄±SS**	p	***NEAP*** **X̄±SS**	p
Gender						
Erkek	8,16±8,65	0,341	11,48±18,13	**0,000**	59,66±23,93	**0,000**
Kadın	7,30±7,75		20,45±16,60		72,77±26,82	
Regular dental check-ups						
Yes (n:121)	10,36±8,67	**0,001***	13,46±18,42	**0,039***	60,72±25,20	**0,009***
No (n:253)	6,6±7,85		15,78±18,78		66,82±26,20	
Body mas index (kg/m^2)						
Under/Normal weight (322)	7,84±8,48	0,704	14,90±19,17	0,548	64,50±25,90	0,907
Overweight/Obese(52)	7,71±7,17		15,82±15,34		67,02±25,93	
Dental caries						
Yes (103)	10,64±9,91	**0,001**	12,76±17,6	**0,080**	59,95±21,55	**0,030**
No (271)	6,75±7,35		15,89±19,08		66,71±27,06	
Gingival pain						
Yes (n:21)[1]	20,19±13,75	**0,001****	21,97±20,85	**0,044****	63,48±15,41	**0,022****
Sometimes (n:234)[2]	7,93±7,42	**[1-2,3]**	13,36±19,18	**[1-2,3]**	62,23±25,28	**[1-2,3]**
No (n:119)[3]	5,42±6,64	**[2-3]**	17,09±16,84	**[2-3]**	70,23±27,79	**[2-3]**
Bleeding gum						
Yes (n:47)	10,62±9,96	0,059	13,34±16,48	0,099	59,71±16,07	0,269
Sometimes (n:160)	8,25±8,80		16,24±20,01		66,52±26,51	
No (n:167)	6,62±7,03		14,35±17,94		64,69±27,39	

**Mann-Whitney U test, **Kruskal-Wallis test*
NEAP: Net endogenous acid production OHIP-14: Oral Health Impact Profile-14, PRAL: Potential renal acid load

A positive correlation was found between PRAL and energy, carbohydrates, protein, fat, sodium, and phosphorus, while a statistically significant negative relationship was observed with potassium, magnesium, and calcium ($p<0.05$). Similarly, NEAP showed a statistically significant positive correlation with energy, carbohydrates, protein, fiber, sodium, and phosphorus, and a statistically significant negative correlation with potassium, magnesium, and calcium ($p<0.05$) (see Table 3).

Table 3. Relationship Between Energy and Nutrients with PRAL and NEAP

	PRAL		**NEAP**	
	r	**p**	**r**	**p**
Energy (kcal)	0,479	**0,000**	0,149	**0,004**
Carbohydrate (g)	0,343	**0,000**	0,096	**0,181**
Protein (g)	0,704	**0,000**	0,286	**0,000**
Fat (g)	0,358	**0,000**	0,074	0,152
Fiber (g)	0,081	0,119	0,209	**0,000**
Sodium (mg)	0,443	**0,000**	0,204	**0,000**
Potassium (mg)	-0,470	**0,000**	-0,347	**0,000**
Magnesium (mg)	-0,198	**0,000**	-0,161	**0,002**
Phosphorus (mg)	0,548	**0,000**	0,127	**0,014**
Calsium (mg)	-0,423	**0,000**	-0,030	0,569

NEAP: Net endogenous acid production, PRAL: Potential renal acid load

In addition, it was found that PRAL, lack of regular exercise, dental caries, and the presence of a mouth wound had a positive effect on the OHIP-14 score (see Table 4).

Table 4. Linear Regression Analysis of the Factors Affecting OHIP-14

	Univariable					%95,0	
	B	SH	β	t	p	Lower	Upper
PRAL	0,12	0,02	0,27	5,47	**0,001**	0,08	0,017
NEAP	1,09	0,065	0,09	1,69	0,092	-0,19	2,37
Age (y)	0,49	0,41	0,06	1,20	0,229	-0,31	1,29
BMI (kg/m^2)	-0,10	0,13	-0,04	-0,83	0,408	-0,36	0,15
Regular dental check-ups (No)	-3,76	0,9	-0,21	-4,18	**0,001**	-5,53	-1,98
Dental caries (No)	-3,89	0,94	-021	-4,14	**0,001**	-5,75	-2,03
Mouth sores (No)	-4,87	1,06	-0,23	-4,59	**0,001**	-6,96	-2,77

Referans kategory: Regular dental check-ups (Yes), Dental caries (Yes), Mouth sores (Yes)

BMI: Body mass index, NEAP: Net endogenous acid production OHIP-14: Oral Health Impact Profile-14, PRAL: Potential renal acid load

CONCLUSION AND DISCUSSION

The hypothesis of this study was that an increased dietary acid load (DAL) negatively affects oral health-related quality of life in adolescents. The findings support this hypothesis, as higher DAL was associated with increased OHIP-14 scores, and adolescents with higher DAL had more frequent occurrences of dental caries and gingival pain. Therefore, it can be concluded that higher DAL adversely impacts oral health-related quality of life.

Alexy et al. (2008) reported that the DAL of boys over the age of 8 was found to be higher than that of girls. Similarly, in another study, the DAL of boys was reported to be higher than that of girls (Bühlmeier et al., 2018). Additionally, López-Sayer et al. (2015) observed that the dietary PRAL value of males was higher than that of females. In this study, the PRAL value of female students was found to be 11.48±18.13, with a NEAP value of 59.66±23.93. In contrast, the PRAL value for male students was 20.45±16.60, and the NEAP value was 72.77±26.82, indicating that the DAL of male students was statistically higher than that of female students (See Table 2 and See Table 4). Previous studies have shown that girls consume more fruits and vegetables—foods that reduce DAL—compared to boys (Cooke and Wardle, 2005; Perez-Rodrigo et al., 2003). This may explain the lower DAL observed among female students in the current study.

In one study, it was reported that 91% of children had a positive PRAL value in their diets, while only 9% had a negative PRAL value (Sravani et al., 2024). Another study conducted on children with chronic renal failure found that all participants had a positive PRAL value (Lopez et al., 2020). In the present study, 84.2% of the children had positive PRAL values, and only 15.8% had negative PRAL values. These findings indicate a common pattern of diet-induced acid load in children. Previous studies have shown that children's diets are typically rich in acid-producing foods such as meat, dairy products, and grains, and low in base-producing foods like fruits and vegetables (López-Sayers et al., 2015; Remer et al., 2003; Remer & Manz, 2007). This dietary pattern leads to a higher DAL. Therefore, the high proportion of positive PRAL values observed in this study can be attributed to the predominance of protein-based and acidogenic foods in children's diets. In light of these findings, it is recommended that nutrition education programs targeting this age group emphasize the importance of a balanced diet that includes more alkalizing foods, such as fruits and vegetables, to help reduce DAL.

While fruits and vegetables reduce the acidity of the diet, foods, such as eggs, fish, meat, and dairy products increase its acidity (Luzardo, 2025). In one study, it was found that vegetable and fruit consumption had a protective effect on oral health (Rafiq et al., 2024). Similarly, other studies have shown that higher consumption of vegetables and fruits plays a role in reducing the risk of oral diseases (Yahia et al., 2017; Yahia et al., 2019). In this study, the PRAL and NEAP values of individuals with gum disease were found to be higher than those without gum disease (See Table 2).

The composition of the diet consumed plays a significant role in bone mineral density. A study demonstrated that children and adolescents with high dietary PRAL values had lower bone mineral density (Alexy et al., 2005). Similarly, another study found that a high DALwas associated with reduced diaphyseal bone mass and density (Shi et al., 2012). Kantorowicz et al. (2022) reported that daily consumption of fruits and vegetables, which reduce DAL, was associated with lower dental caries. Consistent with these findings, the present study found that the PRAL and NEAP values of individuals with dental caries were higher than those without dental caries (See Table 2). This suggests that an increased DAL may cause tooth erosion, ultimately leading to dental caries.

Good oral health enables children to carry out their daily activities without experiencing pain or discomfort, thereby enhancing their quality of life (Chamut et al., 2024). A study conducted in Brazil found that molar incisor hypomineralisation significantly impacted children's quality of life (Portella et al., 2019). Similarly, other studies have shown that oral health problems can reduce quality of life (Das et al., 2022; Jawdekar et al., 2022). In the present study, children with dental caries, gingival pain, and mouth sores had higher OHIP-14 scores than those without such conditions (See Table 2). This finding suggests that these children experience a lower quality of life related to oral health.

Vulnerable groups, such as children and adolescents, are more prone to dental diseases and have a lower quality of life (Noor, 2024). Some studies have found that a healthier diet improves the quality of life in children and adolescents (Dumuid et al., 2017; Muros et al., 2017; Zervaki et al., 2017). A study conducted on women emphasized that DAL may be associated with certain psychological conditions, such as anxiety and depression (Zare, 2024). Other studies have highlighted that DALmay be linked to hyperactivity in children and that it affects their mental health (Bühlmeier et al., 2018; Ghasemi et al., 2023). In this study, it was found that the PRAL value had a positive effect on the OHIP-14 value. In other words, a relationship was found between an increase in DAL and a decrease in oral health-related quality of life (See Table 4).

Macro and micronutrients affect DAL. In a study conducted with children, it was found that PRAL increased as daily energy and protein intake increased (Sravani et al., 2024). A study found a statistically significant positive relationship between daily energy, protein, fat, meat, and milk consumption and PRAL. In this study, a statistically significant positive relationship was found between PRAL and energy, sodium, carbohydrate, fat, protein, and phosphorus, and a negative relationship was found between potassium, magnesium, and calcium (See Table 3).

Unhealthy eating habits cause tooth decay and erosion, as well as deterioration in oral health (Harpuneet, 2023). In addition, regular dental health check-ups help prevent many problems, including tooth decay (Dušan et al., 2021). In this study, the OHIP-14, PRAL, and NEAP scores of individuals who regularly visited the dentist were found to be statistically higher than those who did not (See Table 2). In a study conducted in Türkiye, it was found that only 3% of children attended routine dental check-ups (Özdemir, 2023). Children with oral health problems tend to visit the dentist more frequently. Therefore, it is thought that the higher levels of OHIP-14, PRAL, and NEAP in those who went to the dentist were due to the fact that children with any problems in their teeth or mouth went to the dentist more often to address these issues.

This study has some limitations, as its cross-sectional design makes it difficult to establish a causal relationship between oral health-related quality of life and DAL. Additionally, since the data collection was conducted only once and relied on self-reports and family reports from adolescents, response errors and social desirability bias may have

occurred. Moreover, the oral health assessments were based on the adolescents' self-reports of visits to dentists rather than examinations conducted directly by researchers, which may introduce reporting bias and affect the accuracy of the oral health status data. Furthermore, the analyses examining the relationship between DAL and oral health-related quality of life could have been influenced by the demographic characteristics of the adolescents. The fact that the sample was limited to a single region in Türkiye may limit the generalizability of the findings to individuals with different dietary habits worldwide. These limitations may affect the generalizability of the study's findings and emphasize the need for further research.

In conclusion, the study found a relationship between higher DAL and lower oral health-related quality of life. Adolescents with dental caries and gingival pain had a higher DAL. However, due to the lack of sufficient studies on this topic in the literature, this study provides valuable insights. Moreover, there is a need for more research in the future to explore this subject further.

AUTHOR CONTRIBUTIONS STATEMENT

All authors have contributed equally.

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CONFLICT OF INTEREST STATEMENT

There are no disclosed conflicts of interest for the authors.

REFERENCES

Alexy, U., Kersting, M., & Remer, T. (2008). Potential renal acid load in the diet of children and adolescents: impact of food groups, age and time trends. *Public Health Nutr.*, 11(3), 300-306. https://doi.org/10.1017/S1368980007000328

Alexy, U., Remer, T., Manz, F., Neu, C.M., & Schoenau, E. (2005). Long-term protein intake and dietary potential renal acid load are associated with bone modeling and remodeling at the proximal radius in healthy children. *Am J Clin Nutr*, 82(5), 1107–1114. https://doi.org/10.1093/ajcn/82.5.1107

Alshloul, M. N. (2023). Oral health knowledge, attitude, and practice among school children in Abha-Saudi Arabia. *The Journal of School Nursing*, 39(4), 295-304. https://doi.org/10.1177/10598405211012981

Apelbaum, D. N., Pomarico, L., Graciene, A., & Valente, L. R. (2011). Erosão ácida em Odontopediatria: um desafio dos nossos dias Acid erosion in Pediatric Dentistry: a challenge of our days. *Revista Brasileira de Odontologia*, 68(2), 229–232.

Başol, M.E., Karaağaçlıoğlu, L., & Yılmaz, B. (2014). Türkçe Ağız Sağlığı Etki Ölçeğinin geliştirilmesi-OHIP-14-TR. *Turkiye Klinikleri J Dental Sci, 20*(2), 85-92. https://tr-scales.arabpsychology.com/wp-content/uploads/pdf/agiz-sagligi-etki-olcegi-toad.pdf

Bühlmeier, J., Harris, C., Koletzko, S., Lehmann, I., Bauer, C.P., Schikowski, T., … & Libuda, L. (2018). Dietary acid load and mental health outcomes in children and adolescents: results from the GINIplus and LISA birth cohort studies. *Nutrients*, 10(5), 582. https://doi.org/10.3390/nu10050582

Čanković, D., Mastilović, G., Canković, M., Radić, I., Harhaji, S., & Canković, S. (2021). The association between the frequency of dental visits and independent factors among adults aged 20 years and over in Serbia. *Vojnosanitetski Pregled*, 78(8), 874-881. https://doi.org/10.2298/VSP190924006C

Chamut, S., Alhassan, M., Hameedaldeen, A., Kaplish, S., Yang, A.H., Wade, C.G., … Chandel, T. (2024). Every bite counts to achieve oral health: a scoping review on diet and oral health preventive practices. *Int J Equity Health*, 23(1), 261. https://doi.org/10.1186/s12939-024-02279-0

Chapain, K. P., Rampal, K. G., Gaulee-Pokhrel, K., Adhikari, C., Hamal, D., & Pokhrel, K. N. (2023). Influence of gender and oral health knowledge on DMFT index: a cross sectional study among school children in Kaski District, Nepal. *BMC Oral Health*, 23(1), 59. https://doi.org/10.1186/s12903-023-02755-z

Cooke, L.J., & Wardle, J. (2005). Age and gender differences in children's food preferences. *British Journal of Nutrition*, 93(5), 741-6. https://doi.org/10.1079/bjn20051389

Das, P., Mishra, L., Jena, D., Govind, S., Panda, S., & Lapinska, B. (2022). Oral health-related quality of life in children and adolescents with a traumatic injury of permanent teeth and the impact on their families: A systematic review. *Int J Environ Res Public Health*, 19(5), 3087. https://doi.org/10.3390/ijerph19053087

DiNicolantonio, J.J., & O'Keefe, J. (2021). Low-grade metabolic acidosis as a driver of chronic disease: A 21st century public health crisis. *Open Heart*, 8(2), e001730. https://doi.org/10.1136/openhrt-2021-001730

Dolati, S., Razmjouei, S., Alizadeh, M., Faghfouri, A.H., & Moridpour, A.H. (2024). A high dietary acid load can potentially exacerbate cardiometabolic risk factors: An updated systematic review and meta-analysis of observational studies. *Nutrition, Metabolism and Cardiovascular Diseases*, 34(3), 569-580. https://doi.org/10.1016/j.numecd.2024.01.013

Dumuid, D., Olds, T., Lewis, L.K., Martin-Fernández, J.A., Katzmarzyk, P.T., Barreira, T., … Maher, C. International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) research group. (2017). Health-related quality of life and lifestyle behavior clusters in school-aged children from 12 countries. *J Pediatr*, 183, 178-183.e2. https://doi.org/10.1016/j.jpeds.2016.12.048

Ebispro for Windows, Stuttgart, Germany; Turkish Version (BeBiS 9), (2021), Pasifik Elektirik Elektronik Ltd. Şti. (www.bebis.com.tr); Istanbul.

Elibol, E., & Karabudak, E. (2016). Hemodiyaliz hastalarında diyet asit yükü (DAL) ile kardiyovasküler risk etmenleri arasındaki ilişki: Pilot çalışma. *Beslenme ve Diyet Dergisi, 44*(1), 38-46. https://beslenmevediyetdergisi.org/index.php/bdd/article/view/79/50.

Frassetto, L.A., Todd, K.M., Morris, R.C. Jr. & Sebastian, A. (1998) Estimation of net endogenous noncarbonic acid production in humans from diet potassium and protein contents, *American Journal of Clinical Nutrition*, 68(3), 576–583. https://doi.org/10.1093/ajcn/68.3.576.

Ghasemi, F., Abbasi, K., Ghiasvand, R., Clark, C.C.T., & Rouhani, M.H. (2023). The association between dietary acid load and risk of attention-deficit hyperactivity disorder: a case-control study. *Child Neuropsychology*, 29, 474–485. https://doi.org/10.1080/09297049.2022.2099536.

Gholami, F., Naghshi, S., Samadi, M., Rasaei, N., & Mirzaei, K. (2022). Dietary acid load and bone health: A systematic review and meta-analysis of observational studies. *Frontiers in Nutrition*, 9, 869132. https://doi.org/10.3389/fnut.2022.869132

Herter, J., Lederer, A.K., Ronco, A.L., Hannibal, L., Huber, R., & Storz, M.A. (2023). Dietary acid load correlates with serum amino acid concentrations after a four-week intervention with vegan vs. meat-rich diets: A secondary data analysis. *Nutrients*, 15(13), 2942. https://doi.org/10.3390/nu15132942

Jawdekar, A. M., Kamath, S., Kale, S., & Mistry, L. (2022). Assessment of oral health-related quality of life (OHRQoL) in children with molar incisor hypomineralization (MIH) - A systematic review and meta-analysis of observational studies. *Journal of the Indian Society of Pedodontics and Preventive Dentistry*, 40(4), 368-376. https://doi.org/10.4103/jisppd.jisppd_27_23

Kantorowicz, M., Olszewska-Czyż, I., Lipska, W., Kolarzyk, E., Chomyszyn-Gajewska, M., Darczuk, D., & Kaczmarzyk, T. (2022). Impact of dietary habits on the incidence of oral diseases. *Dent Med Probl*, 59(4), 547–554. https://doi.org/10.17219/dmp/134749

Kaur, H. (2023). Diet, nutrition and oral health. *International Dental Journal of Student's Research*, 11(1), 1-4. https://doi.org/10.18231/j.idjsr.2023.002

Konyalıgil, N., Çiçek, B., Tekin, T., & Sönmez, M. Ü. (2022). Evaluation of the relationship between quality of life and dietary acid load in obese women. *Karya Journal of Health Science*, 3(2), 145-149. https://doi.org/10.52831/kjhs.1137880

Lennon, E.J., Lemann, J. Jr. & Litzow, J.R. (1966) 'The effect of diet and stool composition on the net external acid balance of normal subjects', *Journal of Clinical Investigation*, 45, 1601–1607. https://doi.org/10.1172/JCI105466.

Lohman, T. G., Roche, A. F., & Martorell, R. (1988). *Anthropometric standardization reference manual*. Human Kinetics Books.

López, M., Moreno, G., Lugo, G., & Marcano, G. (2020). Dietary acid load in children with chronic kidney disease. *European Journal of Clinical Nutrition*, 74, 57–62. https://doi.org/10.1038/s41430-020-0687-3

López-Sayers, M., Bernal, J., & López, M. (2015). Dietary potential renal acid load in Venezuelan children. *Nutrición Hospitalaria*, 31(5), 2054-2061. https://doi.org/10.3305/nh.2015.31.5.8187.

Luzardo, M.L. (2025). Effects of higher dietary acid load: a narrative review with special emphasis in children. *Pediatric Nephrology*, 40(1), 25-37. https://doi.org/10.1007/s00467-024-06466-7

Mladenović, N., & Ugrinović, H. (2024). Specificities of acid-base balance disorders in children. *Galenika Medical Journal*, 3(9), 21–28. https://doi.org/10.5937/galmed2411020m

Muros, J. J., Salvador-Pérez, F., Zurita-Ortega, F., Gámez-Sánchez, V. M., & Knox, E. (2017). The association between healthy lifestyle behaviors and health-related quality of life among adolescents. *Journal of Pediatrics (Rio J)*, 93(4), 406-412. https://doi.org/10.1016/j.jped.2016.10.005

Naito, M. (2023). Quality of life assessment in oral health. *Annals of Japan Prosthodontic Society*. https://doi.org/10.2186/ajps.15.164

Nepaul, P., & Mahomed, O. (2020). Influence of parents' oral health knowledge and attitudes on oral health practices of children (5–12 years) in a rural school in KwaZulu-Natal, South Africa. *Journal of International Society of Preventive and Community Dentistry*, 10(5), 605-612. https://doi.org/10.4103/jispcd.JISPCD_273_20

Noor, A. (2025). Improving oral health and quality of life in vulnerable populations. *Journal of Medical Internet Research*. https://doi.org/10.2196/preprints.60310.

Omara, M., Stamm, T., & Bekes, K. (2021). Four-dimensional oral health-related quality of life impact in children: A systematic review. *Journal of Oral Rehabilitation, 48*(3), 293-304. https://doi.org/10.1111/joor.13066

Özdemir, D. S. (2023). Çocuk hastaların diş hekimine başvuru nedenleri. *Journal of International Dental Sciences*, 9(1), 26-33. https://doi.org/10.21306/dishekimligi.1220703

Pérez-Rodrigo, C., Ribas, L., Serra-Majem, L., & Aranceta, J. (2003). Food preferences of Spanish children and young people: the enKid study. *European Journal of Clinical Nutrition*, 57 Suppl 1, S45-8. https://doi.org/10.1038/sj.ejcn.1601814

Portella, P.D., Menoncin, B.L.V., de Souza, J.F., de Menezes, J.V.N.B., Fraiz, F.C., & Assunção, L.R.D.S. (2019). Impact of molar incisor hypomineralization on quality of life in children with early mixed dentition: A hierarchical approach. *Int J Paediatr Dent*, 29(4), 496-506. https://doi.org/10.1111/ipd.12482

Rafiq, T., Aqeel, R., Javed, M., Yousaf, L., Bano, S., & Akbar, A. (2024). Diet and oral health: An investigation into the impact of Pakistani dietary habits on oral disease prevalence. *Cureus*, 16(10), e71423. https://doi.org/10.7759/cureus.71423

Rakıcıoğlu, N., Tek, N., Ayaz, A., & Pekcan, A. (2010). *Yemek ve besin fotoğraf kataloğu ölçü ve miktarlar* (9th edit). Ankara: Nobel Tıp Kitabevleri.

Remer, T. & Manz, F. (1994) 'Estimation of the renal net acid excretion by adults consuming diets containing variable amounts of protein', *American Journal of Clinical Nutrition*, 59, 1356–1361. https://doi.org/10.1093/ajcn/59.6.1356

Remer, T. & Manz, F. (1995) 'Potential renal acid load of foods and its influence on urine pH', *Journal of the American Dietetic Association*, 95(7), 791–797. https://doi.org/10.1016/S0002-8223(95)00219-7

Remer, T., Dimitriou, T., & Manz, F. (2003). Dietary potential renal acid load and renal net acid excretion in healthy, free-living children and adolescents. *American Journal of Clinical Nutrition*, 77(5), 1255–1260. https://doi.org/10.1093/ajcn/77.5.1255

Sahın, N., & Gunsen, U. (2023). Dietary acid load and cardiovascular diseases. *Critical Reviews in Food Science and Nutrition*, 63(28), 9033-9038. https://doi.org/10.1080/10408398.2022.2066063

Sharma, V., Yadav, A., Thakur, A., Dubey, S., Mohanty, L., & Paul, R. (2019). Knowledge about oral health, hygiene and practices among under-graduate and post-graduate dental students in the state of Jharkhand in Eastern India. *International Journal of Research in Health and Allied Sciences, 5*(5), 1–6. https://ijrhas.com/uploadfiles/1Oralhealthvol5issue5p1-6.20190927122524.pdf

Shi, L., Libuda, L., Schönau, E., Frassetto, L., & Remer, T. (2012). Long term higher urinary calcium excretion within the normal physiologic range predicts impaired bone status of the proximal radius in healthy children with higher potential renal acid load. *Bone*, 50(5), 1026–1031. https://doi.org/10.1016/j.bone.2012.01.026

Slade, G.D., & Spencer, A.J. (1994). Development and evaluation of the Oral Health Impact Profile. *Community Dent Health, 11*(1), 3-11. https://pubmed.ncbi.nlm.nih.gov/8193981/

Sravani, M., Collins, S., & Iyengar, A. (2024). Assessment of dietary acid load in children with chronic kidney disease: An observational study. *Indian Journal of Nephrology*, 34(1), 50-55. https://doi.org/10.4103/ijn.ijn_29_23

Staberg, M., Norén, J.G., Gahnberg, L., Ghaderi, A., Kadesjö, C., & Robertson, A. (2016). Behavioural characteristics in externalising children with low and elevated risk for dental caries. *European Archives of Paediatric Dentistry*, 17(6), 475-484. https://doi.org/10.1007/s40368-016-0256-6

Suresh, C., Veeraraghavan, V. P., Jayaraman, S., Gayathri, R., & Kavitha, S. (2022). Awareness about the significance of acid–base balance of saliva in maintaining oral health. *Journal of Advanced Pharmaceutical Technology & Research*, 13(Suppl 1), S325–S329. https://doi.org/10.4103/japtr.japtr_402_22

Vidal, A., Pineda, C., Raya, A.I., Rios, R., Espartero, A., Muñoz-Castañeda, J.R., Rodriguez, M., Aguilera-Tejero, E., & Lopez, I. (2022). Oral acid load down-regulates fibroblast growth factor 23. *Nutrients*, 14(5), 1041. https://doi.org/10.3390/nu14051041

Williams, R.S., Heilbronn, L.K., Chen, D.L., Coster, A.C., Greenfield, J.R., & Samocha-Bonet, D. (2016). Dietary acid load, metabolic acidosis and insulin resistance - Lessons from cross-sectional and overfeeding studies in humans. *Clin Nutr.*, 35(5), 1084-1090. https://doi.org/10.1016/j.clnu.2015.08.002

World Health Organization (WHO). Body Mass Index (BMI). Retrieved from https://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi. Accessed October 18, 2024.

Yahia, E. M., García-Solís, P., & Celis, M. E. (2019). Contribution of fruits and vegetables to human nutrition and health. In *Postharvest physiology and biochemistry of fruits and vegetables* (pp. 19–45). Chelmsford, UK: Woodland Publishing.

Yahia, E. M., Maldonado-Celis, M. E., & Svendsen, M. (2017). The contribution of fruit and vegetable consumption to human health. In *Fruit and vegetable phytochemicals: Chemistry and human health* (Vol. 2, p. 52). Hoboken, New Jersey: John Wiley & Sons. https://doi.org/10.1002/9781119158042.ch1

Zare, M.J., Madani, S., & Ahmadi, A. (2024). Association between dietary acid load and depression, anxiety, and stress: A systematic review. *International Journal of Nutrition Sciences*, 10(1). https://doi.org/10.30476/ijns.2024.101366.1308

Zervaki, K., Yiannakouris, N., Sdrali, D., & Costarelli, V. (2017). Diet quality, disordered eating, and health-related quality of life in Greek adolescents. *Nutrition & Food Science*, 47(4), 511–521. https://doi.org/10.1108/NFS-12-2016-0189