

Research Article

Sugary Snack Intake Frequency, Socioeconomic Status, and Oral Hygiene Compliance among Adolescents with Fixed Orthodontic Appliances

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ABSTRACT

Background: This study evaluated the relationships among sugary snack intake frequency, socioeconomic status (SES), parental supervision, treatment duration, and clinical oral hygiene outcomes in adolescent patients undergoing fixed orthodontic treatment.

Methods: A cross-sectional analytical study was conducted on 132 adolescent patients (aged 12-18 years) with a minimum of 6 months of fixed orthodontic treatment selected via systematic random sampling. Structured questionnaires recorded snack intake frequency, SES, treatment duration, parental supervision, and self-care compliance. Plaque accumulation was measured using the Turesky modification of the Quigley-Hein Plaque Index. Data were analyzed using descriptive statistics, Chi-square tests, multivariable regression, and mediation/moderation analysis via the PROCESS macro ($p < 0.05$).

Results: High dietary snack frequency and extended treatment duration (>24 months) were significantly associated with elevated plaque accumulation and lower compliance. Snack frequency mediated the relationship between lower SES and higher plaque scores. Active parental supervision served as a significant moderating variable, correlating with lower plaque buildup, particularly in patients with high dietary snack intake.

Conclusion: Extended orthodontic treatment duration, frequent sugary snack consumption, and lower SES are significantly associated with poor oral hygiene compliance and plaque accumulation. Targeted dietary counseling and structured, direct parental involvement correlate with improved clinical outcomes during fixed appliance therapy.

INTRODUCTION

Adolescence is a critical period for establishing long-term oral health habits, during which fixed orthodontic appliances are routinely indicated for malocclusion correction. However, orthodontic components—including brackets, archwires, bands, and elastomeric ligatures—impair natural oral self-cleansing mechanisms and create retention sites for microbial biofilm (1,2). Consequently, fixed appliance wearers exhibit significantly higher rates of gingival inflammation, localized plaque buildup, and enamel demineralization compared to non-orthodontic controls (1-4).

Achieving adequate plaque control during orthodontic therapy depends heavily on patient motivation, self-discipline, and dietary habits (3-5). Frequent consumption of fermentable

carbohydrates provides a continuous substrate for cariogenic and acidogenic bacteria, compounding plaque retention around orthodontic attachments (5,10). Furthermore, broader psychosocial and socioeconomic factors influence health literacy, dietary choices, and parental capacity to oversee home care practices (6). While treatment motivation is often high at appliance bonding, compliance frequently declines over prolonged treatment durations (4,7). Direct parental supervision and targeted behavioral reinforcements are therefore required to maintain oral health outcomes across extended treatment timeframes (4,7).

Building on recent work examining these variables (8), this cross-sectional study aimed to analyze the associations between sugary

snack intake frequency, socioeconomic status, treatment duration, and parental supervision with clinically measured plaque index scores and self-care compliance among adolescent orthodontic patients.

METHODOLOGY

Study Design & Participant Selection

A cross-sectional analytical study was conducted among 132 adolescent patients aged 12–18 years undergoing active fixed orthodontic treatment for a minimum duration of 6 months. Participants were selected using systematic random sampling from the clinical appointments roster. Exclusion criteria comprised patients receiving removable appliances, individuals with systemic conditions or medications altering salivary flow/gingival tissue, and those unable to undergo clinical examinations.

Sample Size Justification

Sample size was calculated using OpenEpi software based on an anticipated moderate effect size, 80% statistical power, and a 95% confidence interval, yielding a minimum required sample of 132 participants to detect statistically significant associations between dietary habits and plaque index scores.

Ethical Considerations

Institutional Review Board (IRB) approval was obtained prior to study commencement. Written informed consent was secured from parents or legal guardians, alongside documented assent from all adolescent participants.

Data Collection & Assessment Tools

A pre-tested, structured questionnaire gathered data on demographics, sugary snack intake frequency (rarely: ≤ 1 time/week; occasionally: 2–3 times/week; frequently: 4–6 times/week; daily: ≥ 1 time/day), socioeconomic status (modified scale: low, lower-middle, upper-middle, high), treatment duration (6–12

months, 13–24 months, >24 months), and direct parental supervision levels. Self-care oral hygiene compliance was evaluated via a standardized scoring matrix assessing brushing frequency, interdental/bracket cleaning adherence, and consistency (categorized as poor, moderate, good, or excellent).

Clinical Plaque Index

Plaque accumulation was objectively evaluated using the Turesky modification of the Quigley-Hein Plaque Index following disclosing solution application under standard clinic lighting. Tooth surfaces (facial and lingual) were scored on a 0–5 scale:

- Score 0: No plaque.
- Score 1: Separate spots of plaque at the cervical margin of the tooth.
- Score 2: A thin continuous band of plaque (up to 1 mm) at the cervical margin.
- Score 3: A band of plaque wider than 1 mm but covering less than one-third of the crown.
- Score 4: Plaque covering at least one-third but less than two-thirds of the crown.
- Score 5: Plaque covering two-thirds or more of the crown.

An intra-examiner calibration exercise was conducted prior to study initiation to ensure measurement consistency.

Statistical Analysis

Data were processed using IBM SPSS Statistics (Version 26). Categorical parameters were summarized as frequencies and percentages. Cross-tabulations were evaluated using Chi-square (χ^2) tests. Multivariable linear regression identified independent associations with plaque scores. PROCESS Macro was utilized for mediation (snack frequency between SES and plaque) and moderation (parental supervision between snack intake and plaque) path modeling, with significance established at $p < 0.05$.

RESULTS

Table 1. Demographic and Clinical Characteristics of Study Participants (N = 132)

Variable	Category	n	%
Age Group	12–14 years	43	32.6
	15–16 years	51	38.6
	17–18 years	38	28.8
Gender	Male	58	43.9
	Female	74	56.1
Education Level	Middle school	39	29.5
	Secondary school	61	46.2

	Higher secondary	32	24.2
Treatment Duration	6–12 months	47	35.6
	13–24 months	56	42.4
	>24 months	29	22.0

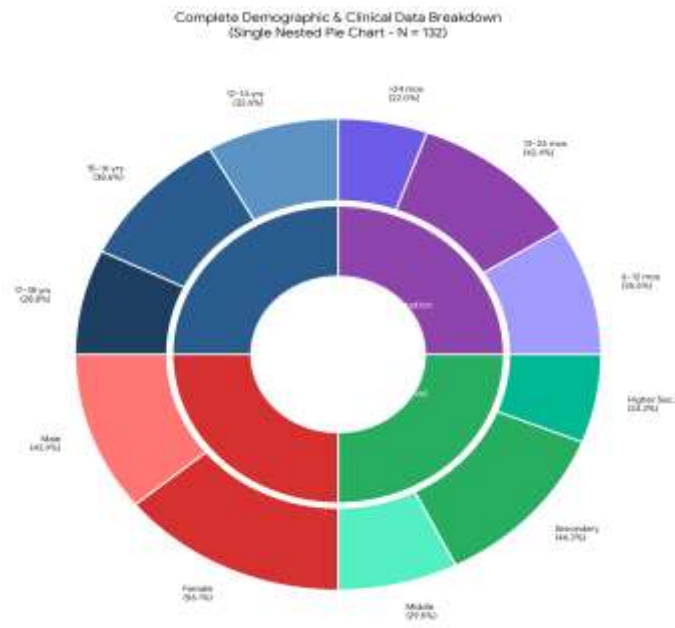


Table 2. Frequency of Sugary Snack Intake among Participants

Sugary Snack Intake Frequency	N	%
Rarely (≤ 1 time/week)	27	20.5
Occasionally (2–3 times/week)	42	31.8
Frequently (4–6 times/week)	38	28.8
Daily (≥ 1 time/day)	25	18.9
Total	132	100.0

Table 3. Socioeconomic Status Distribution

Socioeconomic Status (SES)	N	%
Low	41	31.1
Lower-middle	47	35.6
Upper-middle	31	23.5
High	13	9.8
Total	132	100.0

Table 4. Oral Hygiene Self-Care Compliance and Plaque Index Distribution

Variable	Category	n	%
Self-Care Compliance	Poor	29	22.0
	Moderate	48	36.4
	Good	39	29.5
	Excellent	16	12.1
Plaque Index Severity	Low	34	25.8
	Moderate	57	43.2
	High	41	31.1
Total		132	100.0

Table 5. Association between Sugary Snack Intake Frequency and Plaque Index Category

Sugary Snack Intake	Low Plaque n (%)	Moderate Plaque n (%)	High Plaque n (%)	χ^2 p-value
Rarely	13 (48.1%)	10 (37.0%)	4 (14.8%)	< 0.001
Occasionally	13 (31.0%)	20 (47.6%)	9 (21.4%)	
Frequently	6 (15.8%)	18 (47.4%)	14 (36.8%)	
Daily	2 (8.0%)	9 (36.0%)	14 (56.0%)	

Table 6. Association between Socioeconomic Status and Plaque Accumulation

Socioeconomic Status	Low Plaque n (%)	Moderate Plaque n (%)	High Plaque n (%)	χ^2 p-value
Low	6 (14.6%)	16 (39.0%)	19 (46.3%)	0.002
Lower-middle	9 (19.1%)	22 (46.8%)	16 (34.0%)	
Upper-middle	14 (45.2%)	14 (45.2%)	3 (9.7%)	
High	5 (38.5%)	5 (38.5%)	3 (23.1%)	

Table 7. Relationship Between Parental Supervision Level and Oral Hygiene Compliance

Parental Supervision	Poor Compliance n (%)	Moderate Compliance n (%)	Good/Excellent Compliance n (%)	χ^2 p-value
Low	19 (35.8%)	23 (43.4%)	11 (20.8%)	< 0.001
Moderate	9 (19.1%)	20 (42.6%)	18 (38.3%)	
High	1 (3.1%)	5 (15.6%)	26 (81.3%)	

(Note: Data reflects combined Good/Excellent compliance [n=55] against total cohort N=132)

Table 8. Multivariable Linear Regression Model for Correlates of Plaque Index Scores

Predictor Variable	Unstandardized β	Standard Error (SE)	95% Confidence Interval	P-Value
Frequent Sugary Snack Intake	0.31	0.09	0.14 – 0.48	< 0.001
Low Socioeconomic Status	0.24	0.10	0.05 – 0.43	0.013
Extended Treatment (>24 mos)	0.21	0.08	0.06 – 0.37	0.007
Poor Oral Hygiene Compliance	0.39	0.08	0.23 – 0.55	< 0.001
High Parental Supervision	-0.18	0.07	-0.32 – -0.04	0.012

DISCUSSION

The present study demonstrates that dietary habits, treatment length, socioeconomic background, and parental oversight are significantly correlated with oral hygiene outcomes in adolescent orthodontic patients. Frequent sugary snack consumption was directly associated with higher Turesky Plaque Index scores ($p < 0.001$), aligning with broader literature establishing that carbohydrate availability accelerates bacterial colonization around fixed attachments (5,10). These findings closely reflect those reported by Rehman et al. (8), who similarly identified

dietary snacking and low socioeconomic standing as major correlates of diminished oral hygiene compliance.

Furthermore, mediation path analysis indicated that sugary snack frequency partially mediates the relationship between low socioeconomic status and high plaque accumulation. Patients from lower SES strata exhibited compound risks, potentially related to restricted access to specialized interdental cleaning aids and variable health literacy levels (6,8).

Treatment duration was significantly associated with plaque levels; participants undergoing treatment for over 24 months exhibited worse

compliance and higher plaque buildup compared to those in earlier stages (6–12 months). This decline highlights “compliance fatigue,” wherein initial patient motivation wanes over extended care periods (4,7,12,13). Crucially, active parental supervision operated as a significant moderating variable ($p = 0.012$), correlating with improved compliance and lower plaque formation even in high-snack consumers (13).

Limitations

Given the cross-sectional design of this study, causality between variables such as diet, parental supervision, and plaque accumulation cannot be definitively established. Self-reported data regarding dietary intake and oral hygiene compliance are subject to recall and social desirability biases. Furthermore, the reliance on a single-center sample may limit the generalizability of the findings across broader demographic populations.

CONCLUSION

- Frequent sugary snack intake and low socioeconomic status are significantly associated with poor oral hygiene and elevated plaque accumulation in adolescent fixed orthodontic patients.
- Treatment fatigue is prevalent in patients with treatment durations exceeding 24 months.
- Active, direct parental supervision correlates with improved oral hygiene compliance and serves as a vital associative control against plaque accumulation.
- Orthodontic treatment protocols should incorporate routine dietary reinforcement and structured parental involvement alongside standard hygiene instructions.

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