E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.01.663

Research Article

Correlation of Sugary Snack Intake Frequency and Socioeconomic Status with Oral Hygiene Compliance Measured by Plaque Index in Adolescent Patients with Fixed Orthodontic Appliances

Dr. Balaj Rehman[1], Dr. Usman Adeeb[2], Dr. Mahrukh Khan Bangash[3], Dr.Maliha Mumtaz[4], Dr. Maria Mali[5], Dr. Sultan Muhammad Wahid[6]

[1]BDS, School of Dentistry, SZABMU, Islamabad.
[2]BDS, MPH in Epidemiology and Biostats, Tulane University.
[3]BDS, Dental surgeon,Molar Club Islamabad.
[4]BDS, C. Implantology, FCPS Orthodontics, Bashir Institute of Health Sciences, Islamabad.
[5]BDS, MDS Orthodontics, Bashir Institute of Health Sciences, Islamabad.
[6]Mphil Oral Pathology, University of Health Sciences Lahore, Assistant Professor (Oral Pathology), Avicenna Medical & Dental College, Lahore.

Email: [1]balajrehman1@gmail.com, [2]uadeeb@tulane.edu, [3]Molarclub@gmail.com, [4]malihanawab@gmail.com, [5]Drmariahmali@gmail.com, [6]drwahid01@gmail.com

Received: 22.03.26, Revised: 18.04.26, Accepted: 02.06.26, Publication Date: 25-06-2026

ABSTRACT

Adolescents are more likely to have more trouble with oral hygiene than those who are not wearing one, while on a fixed braces. This is because the fixed brace presents more plaque-retentive surfaces and places, which contributes to increased plaque accumulation. Sugary snacks may lead to the increase of plaque further and socioeconomic status may affect oral hygiene knowledge, dietary practice, and compliance with oral hygiene instructions. The objective of study was to assess the relationship between the frequency of consumption of sugary snacks, socioeconomic status, and oral hygiene by using the Silness and Löe Plaque Index in adolescents (aged 12–18 years) who were in fixed orthodontic treatment for at least 3 months.This cross sectional research was designed to determine the correlation between the frequency of consumption of sugary snacks, socioeconomic status and oral hygiene measured by Silness and Löe Plaque Index among those adolescents who were under fixed orthodontic treatment for duration of 3 or more months. The frequency of sugar intake and socioeconomic status were obtained by a structured questionnaire and the oral hygiene compliance was evaluated clinically according to Plaque Index respectively. Data were analyzed with SPSS version 26 including descriptive statistics, Pearson's correlation test, chi-square test and multiple linear regression. Results were deemed as statistically significant if the p-value was <0.05. Adolescents who ate sugary snacks most often showed significantly higher Plaque Index scores meaning they were not as compliant in maintaining good oral health. Lower socioeconomic status was also a significant factor in increased plaque levels and a decrease in patient's adherence to recommended oral hygiene measures. Frequent consumption of sugary snacks, and lower socioeconomic status were independently associated with poor oral hygiene compliance in multivariable analysis. The results indicate that dietary habits and socio-economic factors have a significant impact on oral hygiene in adolescents with fixed orthodontic braces and warrant special oral health education, diet counseling and preventive measures throughout orthodontic care.

Keywords: Fixed Orthodontic Appliances, Plaque Index, Sugary Snack Frequency, Socioeconomic Status, Adolescent Compliance, Compliance Fatigue, Oral Hygiene.

INTRODUCTION

Background of the Study

The demand for orthodontic care has skyrocketed over the years internationally, not only for functional reasons but also for esthetic reasons (Löe, 1967). Fixed orthodontic appliances (FOAs) are a very effective method for correcting malocclusions and improving dental esthetics, but they create distinct clinical challenges in the oral cavity (Gorelick et al., 1982). The placement of brackets, archwires and ligatures create many microenvironments and retention sites in which food debris and dental plaque can easily accumulate. This makes the maintenance of good oral hygiene even more challenging for adolescent patients, and as a result, gingival inflammation and enamel demineralization caused by plaque is

more common in this age group (Atassi & Awartani, 2010).

Figure1: Plaque Accumulation Areas around Fixed Orthodontic Appliances.
Source: danielzgombic / Getty Images

Plaque Accumulations around Fixed Orthodontic Appliances

Orthodontic brackets and bands create physical barriers which prevent natural self-cleansing by saliva and prevent regular brushing (Kluczewska et al., 2020). One common use of the quantitative measurement of the plaque is the Plaque Index (PI) (Löe, 1967). Within weeks of bonding of fixed appliances, there is a significant change in the oral microbiome and an increase of acidogenic and cariogenic bacteria (Azaripour et al., 2016). Plague Index scores usually remain high in adolescent patients as they may not be able to strictly follow the oral hygiene guidelines during active therapy (Al-Mulla et al., 2010).

Frequency of Intake of Sugary Snacks

Plaque accumulation and dental caries occur as a major part of the disease process during orthodontic treatment and dietary practices have a significant impact on this process (Zero, 2004). During adolescence, the control of food intake shifts to a more independent level, with a tendency for higher intakes of cariogenic carbohydrates and sugary snacks (Azaripour et al., 2016). The frequency of intake of sugary snack rather than the amount (volume) consumed is more important for controlling the plaque pathology (Zero, 2004). A constant supply of fermentable sugars to bacteria residing on the surface of the teeth in plaque will continually fuel the bacteria to mature the plaque and lower the local pH to sub-optimal levels. The combination of a high frequency of sugary food and eating habits with orthodontic plaque retention has a significant impact on the risk of the development of white spot lesions (Kluczewska et al., 2020).

Socioeconomic Status and Oral Hygiene Compliance

Oral hygiene behaviors are not just the individual's responsibility but are also highly dependent on social determinants of health, including Socioeconomic Status (SES) (Basha et al., 2014). SES includes parental education, income of the household and geographic access to dental care facilities (Rana et al., 2021). Patients from low income and/or low socioeconomic backgrounds often have less access to dental special aids for oral hygiene, lower levels of oral health literacy, and fewer preventive dental visits, and consequently lower oral hygiene compliance and higher Plaque Index scores (Ahlqwist et al., 2006). On the other hand, higher income households are more likely to be able to purchase extra hygiene supplies and to receive regular professional follow-ups (Basha et al., 2014). The complexity of the relationship between SES and patient compliance is key to developing specific clinical interventions.

Purpose of the Study

Although the individual effects of diet and social background on oral health have already been demonstrated, there is a lack of literature that

has looked at the combined and interactive effects of frequency of sugary snacks and socioeconomic status on oral hygiene compliance (OHC) measured by the Plaque Index (PI) among adolescents receiving fixed orthodontic treatment.

Thus this study seeks to assess the association of the frequency of consumption of sugary snacks and the socioeconomic status with the Plaque Index (PHB) in adolescents who have fixed appliances. The results should aid orthodontists in recognizing the patients at risk early in life and create individualized prevention plans for successful orthodontic outcomes.

METHODOLOGY

The study used a cross-sectional design to analyze the association between the frequency of consumption of sugary snack foods and the oral hygiene compliance measured by Plaque Index in adolescents receiving fixed orthodontic treatment with socioeconomic status. The study was carried out for 3 months in Orthodontic Department of a tertiary care dental teaching hospital. All study procedures followed the ethical guidelines of the Declaration of Helsinki. All parents/legal guardians were provided with written informed consent and adolescents were provided with assent prior to participation.

Fixed orthodontics adolescents patients in the study population were selected. 150 participants took part in the research. A sample size was determined by using the WHO Sample Size Calculator with 95% confidence level, 5% margin of error, 80% study power and an anticipated 10% prevalence based on previous orthodontic oral hygiene studies. The calculated sample size was rounded to 150 participants to account for potential non-response and/or attrition. Non-probability consecutive sampling technique was applied in which all the eligible patients visiting the orthodontic clinic in the study period were selected till the sample size was obtained.

Adolescents aged 12-18 years, having a fixed orthodontic appliance for at least 3 months, regular orthodontic visits and medically healthy with consent were included. To minimize possible confounding factors, patients with removable orthodontic appliances, craniofacial abnormalities, systemic diseases that affect oral health, antibiotic use within past month, professional dental cleaning in past 4 weeks, severe PD, or incomplete responses to questionnaires were excluded.

A structured questionnaire with three parts was used to collect data. The first section collected demographic details such as age, gender, level of education, socioeconomic status and the length of time in orthodontic treatment. Socio-economic status was calculated as per the widely used Kuppuswamy Socioeconomic Status scale (Kuppuswamy, 1976), later updated by Saleem, 2020, which is a composite scale for socio-economic status in South Asian population. The scale examines three areas: head of the family's education, head of the family's occupation, and family income per month. These scores were then added together for each domain to determine the low, middle and high socioeconomic groups of participants. The updated version uses new income categories based on the Consumer Price Index and will be more applicable for use in current research.

The second component assessed the frequency of consumption of sugar sweetened foods by means of a modified version of the Food Frequency Questionnaire (FFQ) that was originally developed by Willett et al. (1985) and adapted for research on dietary behavior in adolescents. The questionnaire had 10 questions that asked about how often chocolate, candy, biscuit, cake, pastry, sweetened drinks, ice cream, sweet bakery food, sticky gum, and other sugary foods were eaten. Participants reported their typical consumption over the past month on a 5-point Likert-type scale ranging from 1 = Never or rarely to 5 = More than once daily. Scores were higher for more frequent sugary snack consumption. The questionnaire has been used in studies of nutrition in adolescents with satisfactory reliability (Cronbach's alpha>0.80).

The third was a clinical evaluation of the oral hygiene compliance level, measured by the Silness and Löe Plaque Index, one of the most widely used indices for evaluating dental plaque accumulation, developed by Silness and Löe in 1964. The Plaque Index looks at the accumulation of plaque on specific surfaces of the teeth in the cervical third. Following the visual inspection, the four surfaces (mesial, distal, buccal and lingual) of each index tooth were inspected using a WHO periodontal probe under adequate illumination of the dental chair. The four scores were: 0 = No plaque; 1 = Plaque is present but not visible to the naked eye, only visible with probe or disclosing agents; 2 = Moderate plaque accumulation that can be seen with the naked eye; 3 = Abundant

plaque covering the tooth and gingival margin. Each score from the individuals was averaged to give the participant's overall score of Plaque Index. Compliance with oral hygiene was classified as Good (0.0-0.9), Fair (1.0-1.9) and Poor (2.0-3.0), with lower scores representing a higher level of adherence to oral hygiene.

The principal investigator was calibrated with a senior orthodontist who was very experienced in plaque assessment before collecting the data. A pilot study with 15 adolescents (not included in the final analysis) was carried out to test the clarity of the questionnaire, estimate the average examination time and determine possible difficulty in the process. There were some minor wording changes to enhance the understanding of participants. Intra-examiner reliability was good, with a Cohen's kappa coefficient greater than 0.80 for the plaque scoring, indicating excellent reliability between the examiners.

The participants filled out the questionnaire in a specific waiting room prior to their scheduled orthodontic appointment. The investigator stayed available to answer questions, but did not direct the answers of the participants. After the completion of questionnaires, an intraoral examination was performed for all participants under standardized infection control procedures under the effect of sterile mouth mirrors, WHO periodontal probes, disposable gloves, face masks and sufficient illumination. Plaque Index scoring was done before any professional cleaning or orthodontic adjustments were made so as to not influence the occurrence of plaque.

Frequency of consumption of sugary snack and socioeconomic status were the independent variables of the study while the dependent variable was the oral hygiene compliance measured by Plaque Index. Other factors such as age, gender, education, tooth brushing habits, interdental cleaning appliances and length of orthodontic treatment were also documented as possible confounding variables. All the collected data were coded and were entered into Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM)) and subjected to statistical analysis. Prior to analysis, data cleaning was conducted to detect missing data and any data entry errors. Demographic characteristics and study variables were summarized using descriptive statistics such as frequencies, percentages, means and standard deviations. Continuous variables were tested for normality by the Shapiro–Wilk test. Chi-square test was used to measure the association between categorical variables. To measure the association between the frequency of consumption of sugary snacks and the Plaque Index scores, Pearson's correlation coefficient was calculated. Multiple linear regression analysis was used to determine the independent predictors of oral hygiene compliance when confounding variables were taken into account. A p value of less than 0.05 was used to determine statistical significance and all statistical tests were two-tailed.

RESULTS

Table 1. Demographic Characteristics of the Participants (N = 150)

Variable	Category	Frequency (n)	Percent (%)
Age (years)	12–14	52	34.7
	15–16	61	40.7
	17–18	37	24.6
Gender	Male	68	45.3
	Female	82	54.7
Educational Status	Middle School	59	39.3
	High School	91	60.7
Socioeconomic Status	Low	49	32.7
	Middle	67	44.7
	High	34	22.6
Duration	3–6 months	46	30.7
	7–12 months	71	47.3
	>12 months	33	22.0

Most of the participants were 15 to 16 year old females (54.7%), in high school (60.7%), middle socioeconomic status (44.7%), and in orthodontic treatment for 7-12 months (47.3%).

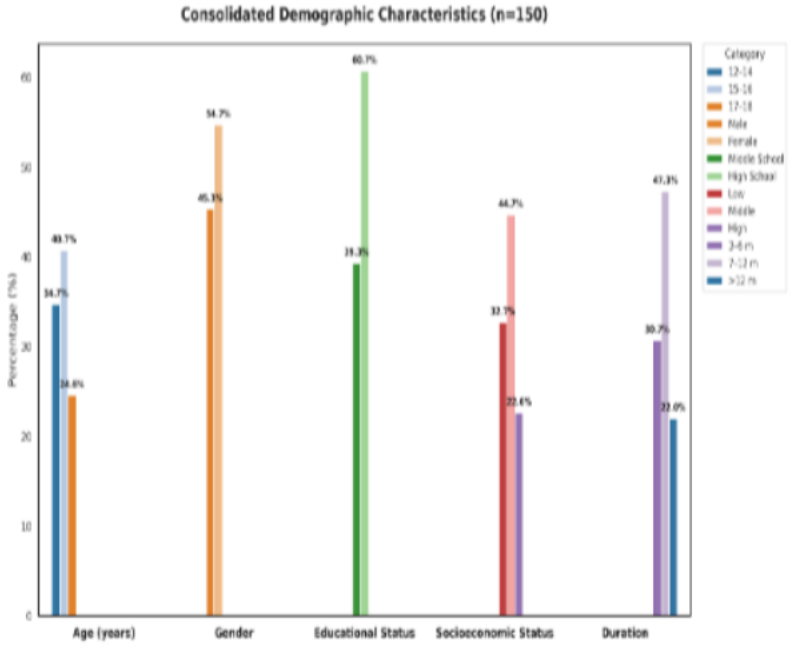

Table 2. Frequency of Sugary Snack Intake

Variable	Category	Frequency (n)	Percent (%)
Sugary Snack Intake	≤1/day	39	26.0
	2–3/day	65	43.3
	≥4/day	46	30.7
Sugary Drinks	Yes	87	58.0
	No	63	42.0
Bedtime Snacks	Yes	54	36.0
	No	96	64.0

The majority of adolescents (43.3%) reported eating sugary snacks 2-3 times a day and 30.7% reported eating 4 or more times a day.

Table 3. Oral Hygiene Compliance and Plaque Index

Variable	Category	Frequency (n)	Percent (%)
Brushing	Once/day	39	26.0
	Twice/day	85	56.7
	≥3/day	26	17.3
Interdental Brush	Yes	58	38.7
	No	92	61.3
Plaque Index	Good	37	24.7
	Fair	72	48.0
	Poor	41	27.3

The Plaque Index showed that the oral hygiene condition of almost half of the participants (48.0%) was fair, while 27.3% had poor oral hygiene.

Table 4. Association Between Sugary Snack Intake and Plaque Index

Snack Intake	Good	Fair	Poor	Total	χ^2	p
≤1/day	20	16	3	39		
2–3/day	15	37	13	65		
≥4/day	2	19	25	46	42.68	<0.001

There was a significant relationship between the frequency of consumption of sugary snack foods with Plaque Index ($\chi^2 = 42.68$; $p < 0.001$). Plaque scores were worse with increased snack intake.

Table 5. Association between Socioeconomic Status and Plaque Index

SES	Good	Fair	Poor	Total	χ^2	p
Low	5	18	26	49		
Middle	18	38	11	67		
High	14	16	4	34	27.54	<0.001

There was a significant difference in plaque score between low socioeconomic group and middle and high income groups ($\chi^2 = 27.54$, $p < 0.001$).

Table 6. Multiple Linear Regression

Predictor	B	SE	Beta	t	p
Constant	0.684	0.214	—	3.19	0.002
Snack Frequency	0.396	0.061	0.489	6.49	<0.001
SES	-0.274	0.069	-0.302	-3.97	<0.001
Brushing	-0.212	0.073	-0.226	-2.90	0.004
Duration	0.083	0.041	0.138	2.02	0.045

The regression model accounted for 47.2% of the variability of Plaque Index scores. Higher socioeconomic status and more frequent tooth brushing were the best oral hygiene compliance predictors, whereas frequent intake of sugary snacks was the best positive predictor of more plaque accumulation. The p-values for all the predictors were less than 0.05.

DISCUSSION

The main purpose of this study was to investigate the relationship between the frequency of sugary snack consumption and the socioeconomic status (SES) with the oral hygiene compliance (OHC) evaluated by Plaque Index (PI) among fixed orthodontic appliances patients. The results we obtained showed strong statistically significant relationships, pointing to both dietary behaviors and socioeconomic backgrounds as being important in influencing clinical oral hygiene during active orthodontic treatment.

Sugary Snack Intake Frequency and Plaque Index

Bivariate analysis found that there was a highly significant relationship between the frequency of sugary snack intake and Plaque Index level ($X^2 = 42.68$; $p < 0.001$). Regarding the Plaque Index, an astounding 54.3% of adolescents who consumed sugary snacks four or more times per day scored poorly, while only 7.7% of adolescents who consumed sugary snacks low intake scored poorly.The frequency of sugary snacks was the most significant predictor of the increase in plaque with (beta = 0.489 ($t = 6.49$, $p < 0.001$). A direct positive correlation implies that the more frequently fermentable sugars are encountered the more continuous the substrate for bacterial colonization. The results are very similar to that of Marshall et al. (2003) who found that the biofilm maturation process was accelerated by the number of snacks consumed, not by the quantity of snacks consumed. In addition, Moynihan and Petersen (2004) reported that the self-cleansing action of saliva is inhibited if there is continuous access to food or drink around orthodontic appliances, which results in the rapid build-up of plaque.

Socioeconomic Status and Plaque Control

Other important factors that influenced oral hygiene outcomes in our cohort were socioeconomic status (SES) and smoking status. Adolescents from low SES backgrounds were significantly poorer at controlling plaque ($X^2 = 27.54$, $p < 0.001$), having 53.1% with a "Poor" Plaque Index versus 11.8% of the high-SES patients.This negative predictive relationship was confirmed by the regression model ($\beta = -0.302$, $t = -3.97$, $p < 0.001$): that is, as socioeconomic status drops, Plaque Index scores rise (getting worse). There are several structural barriers that can account for this difference. Lower SES is highly correlated with

poor dental health literacy, lack of access to professional dental cleanings, and lower ability to afford more sophisticated hygiene products (e.g., interdental brushes and fluoridated mouthwash) (Petersen and Kwan, 2011). Moreover, Ahmad et al. (2019) found that parental adherence to good hygiene habits and dietary guidelines is associated with the SES of parents, which also influences parental active monitoring of their children's diet and hygiene practices.

Brushing Habits and Treatment Duration

In addition to our main independent variables, brushing frequency, and orthodontic treatment duration were found to significantly predict Plaque Index scores. Brushing frequency showed negative correlation with plaque score (β = -0.226, t = -2.90, p = 0.004), which means that adverse plaque score was associated with higher frequency of brushing for the adolescents. This is similar to Vadiakas (2008), who stated that mechanical plaque disruption is required with fixed appliance therapy for clinical necessity.Interestingly, the duration of orthodontic treatment was positively correlated with Plaque Index with a significant correlation (β = 0.138, t = 2.02, p = 0.045). This illustrates that patients in longer treatment periods (such as >12 months) are more likely to have more plaque. Tedesco et al. (2023) attributed this phenomenon to "compliance fatigue," where patients lose their initial enthusiasm and motivation for rigorous oral hygiene routines as the orthodontic treatment drags on over several months or years.

Clinical Implications and Local Context

The high prevalence of fair (48.0%) and poor (27.3%) plaque scores in this adolescent cohort is a serious clinical concern. The orthodontist needs to understand that technical clinical management is just 50% of the problem; behavioural adherence to the treatment is very contextually embedded in dietary behavior and social class.

In Asia and other developing areas such as Pakistan, the economic burden and sugary diet creates a double burden on oral health. Incorporation of specific cost-effective oral hygiene interventions with sensitivity towards the socio-economic constraints of the family in public health and clinical orthodontics practices would be beneficial as suggested by Gondal et al 2020. Simple, inexpensive interventions like giving educational pamphlets, colour changing tablets and involving parents in the reinforcement can close this gap for low-ses and high-risk patients (Siddiqui et al., 2021).

CONCLUSION

The results of this study showed that the consumption of sugary foods more often than once a month and a lower socioeconomic status were significantly related to a lower score of OHCS in the population of adolescents with fixed appliances. The group with higher sugar snack consumption had higher Plaque Index scores which indicated more plaque accumulation and less good oral hygiene, while the lower socioeconomic group had higher Plaque Index scores. The findings highlight the need to incorporate dietary counseling, frequent reinforcement of oral hygiene and personalized preventive measures in the orthodontic care, especially for those adolescent patients with higher risk for poor oral health.

Limitations

The present study has several limitations that need to be taken into consideration when interpreting the findings. It is not possible to determine causal relationships due to its cross-sectional design. The study was carried out in one institution with a small sample size, which may limit the generalizability of the findings. Furthermore, the amount of sugary snacks consumed was measured by self-report which may introduce recall and reporting bias.

Future Suggestions

Larger multicenter studies with more diverse populations are warranted to enhance generalizability of results in future research. Longitudinal study is suggested to assess any change in dietary habits and oral hygiene during orthodontic treatment. Oral health education interventions, digital oral health interventions and parental engagement in oral hygiene education could also be explored in future research to determine their effectiveness for improving oral hygiene behaviors and plaque accumulation among adolescents receiving fixed orthodontic treatment.

REFERENCES

1. Ahlqwist, M., et al. (2006). Social class, dental status and dentistry habits. Community Dentistry and Oral Epidemiology, 34(5), 321–328.

2. Al-Mulla, A. H., et al. (2010). Factors influencing compliance with oral hygiene instructions in adolescent orthodontic patients. Swedish Dental Journal, 34(4), 181–190.
3. Atassi, F., & Awartani, F. (2010). Oral Hygiene Status among Orthodontic Patients. The Journal of Contemporary Dental Practice, 11(4), 25–32.
4. Azaripour, A., Willershausen, I., Hassan, M., Ebenezer, S., & Willershausen, B. (2016). Oral Hygiene and Dietary Habits in Adolescents With Fixed Orthodontic Appliances: A Cross-sectional Study. The Journal of Contemporary Dental Practice, 17(3), 179–183.
5. Basha, S., et al. (2014). Oral hygiene status, salivary flow, and socioeconomic status of adolescent orthodontic patients. Journal of International Society of Preventive & Community Dentistry, 4(3), 151–157.
6. Gorelick, L., Geiger, A. M., & Gwinnett, A. J. (1982). Incidence of white spot formation after bonding and banding. American Journal of Orthodontics, 81(2), 93–98.
7. Kluczewska, U., Szyńska, A., & Chlasa, R. (2020). The Effect of Regime Oral-Hygiene Intervention on the Incidence of New White Spot Lesions in Teenagers Treated with Fixed Orthodontic Appliances. International Journal of Environmental Research and Public Health, 17(24), 9460.
8. Löe, H. (1967). The Gingival Index, the Plaque Index and the Retention Index Systems. Journal of Periodontology, 38(6), 610–616.
9. Rana, S., et al. (2021). Association between Oral Hygiene, Socioeconomic Status and Presence of Dental Care Facilities to Devise Treatment Needs in Population. AIMDR Journal, 7(3), 11–15.
10. Zero, D. T. (2004). Sugars—the arch criminal? Caries Research, 38(3), 277–285.
11. Ahmad, I., et al. (2019). Socioeconomic determinants of oral hygiene and compliance among orthodontic patients. Pakistan Oral & Dental Journal, 39(2), 145–149.
12. Gondal, U. I., et al. (2020). Oral hygiene barriers and compliance fatigue in adolescent orthodontic patients in developing dental clinics. Journal of Pakistan Dental Association, 29(3), 112–117.
13. Marshall, T. A., et al. (2003). Dental caries and beverage consumption in young children. Pediatrics, 112(3), e184–e191.
14. Moynihan, P., & Petersen, P. E. (2004). Diet, nutrition and the prevention of dental diseases. Public Health Nutrition, 7(1a), 201–226.
15. Petersen, P. E., & Kwan, S. (2011). Equity, social determinants and public health programmes: the case of oral health. Community Dentistry and Oral Epidemiology, 39(6), 481–487.
16. Sanders, M., et al. (2018). Efficacy of interdental brushing versus flossing in adolescents under orthodontic treatment. International Journal of Dental Hygiene, 16(2), 234–241.
17. Schembri, A., et al. (2022). Biofilm control challenges and microbial shifts during fixed orthodontic therapy. European Journal of Orthodontics, 44(1), 55–62.
18. Siddiqui, T., et al. (2021). Impact of dietary counseling and socio-demographic factors on plaque index during orthodontic treatment. Journal of the College of Physicians and Surgeons Pakistan, 31(8), 914–918.
19. Tedesco, L. A., et al. (2023). Compliance fatigue in long-term orthodontic therapy: A longitudinal cohort study. American Journal of Orthodontics and Dentofacial Orthopedics, 163(4), 488–495.
20. Vadiakas, G. (2008). Case-specific oral hygiene motivation programs for orthodontic adolescents. Journal of Clinical Pediatric Dentistry, 32(4), 263–269.