Research Article

Knowledge, Attitudes, And Practices Towards Oral Hygiene Among Adolescents Before And After A School-Based Dental Education Program

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Abstract

Background: Poor oral hygiene among adolescents remains a significant public health concern, contributing to dental caries, periodontal diseases, and diminished quality of life. School-based dental education programs represent promising interventions for improving oral health behaviors during this critical developmental period. Objective: This study aimed to evaluate changes in knowledge, attitudes, and practices (KAP) towards oral hygiene among adolescents following implementation of a comprehensive school-based dental education program. Methods: A quasi-experimental pre-post study was conducted among 524 adolescents aged 13–16 years from four secondary schools. A structured dental education program comprising interactive lectures, demonstrations, and practical sessions was delivered over six weeks. Validated KAP questionnaires were administered at baseline (T0), immediately post-intervention (T1), and three months follow-up (T2). Clinical plaque index scores were assessed concurrently. Paired t-tests and McNemar's tests evaluated within-group changes, with significance set at $p<0.05$. Results: Mean knowledge scores increased significantly from 12.34±3.87 at baseline to 18.92±2.56 post-intervention and 17.48±3.12 at follow-up ($p<0.001$). Attitude scores improved from 28.67±5.43 to 36.78±4.21 post-intervention ($p<0.001$). Practice scores demonstrated significant enhancement from 14.23±4.56 to 21.34±3.89 ($p<0.001$). The proportion of adolescents brushing twice daily increased from 34.2% to 71.8% ($p<0.001$). Mean plaque index scores decreased significantly from 1.87±0.54 to 1.12±0.43 ($p<0.001$). Improvements were largely sustained at three-month follow-up. Conclusion: The school-based dental education program significantly improved adolescents' oral hygiene knowledge, attitudes, and practices with sustained effects at three months. Such interventions should be integrated into school health curricula to promote lifelong oral health behaviors.

Keywords: oral hygiene, adolescents, dental education, knowledge attitudes practices, school-based intervention, health promotion.

1. Introduction

Oral diseases represent the most prevalent chronic conditions affecting global populations, with dental caries and periodontal diseases imposing substantial burdens on individuals and healthcare systems alike [1]. The World Health Organization estimates that oral diseases affect nearly 3.5 billion people worldwide, with untreated dental caries in permanent teeth constituting the most common health condition globally [2]. Adolescence represents a particularly critical period for establishing oral health behaviors, as habits formed during this developmental stage frequently persist into adulthood and influence long-term oral health outcomes [3].

Adolescents face unique challenges regarding oral hygiene maintenance, including increased autonomy in health decision-making, dietary changes favoring cariogenic foods and beverages, and competing priorities that may diminish attention to preventive behaviors [4]. Epidemiological studies consistently demonstrate suboptimal oral hygiene practices among adolescent populations, with significant proportions reporting inadequate brushing frequency, improper technique, and infrequent dental visits [5]. These behavioral deficiencies contribute to elevated prevalences of dental caries, gingivitis, and early periodontitis observed in this age group [6].

The Knowledge, Attitudes, and Practices (KAP) framework provides a comprehensive approach for understanding health behaviors and designing targeted interventions [7]. Knowledge encompasses awareness and understanding of

oral health principles, including disease etiology, prevention strategies, and proper hygiene techniques. Attitudes reflect beliefs, feelings, and predispositions toward oral health practices, while practices represent actual behaviors implemented in daily routines [8]. Research indicates that while knowledge is necessary for behavior change, attitudes frequently mediate the relationship between knowledge acquisition and practice adoption [9].

School-based health education programs have demonstrated effectiveness across various health domains and offer distinct advantages for oral health promotion [10]. Schools provide access to large adolescent populations in structured environments conducive to learning, enabling standardized delivery of educational content by trained professionals [11]. Furthermore, school-based interventions can reach adolescents regardless of socioeconomic status or healthcare access patterns, potentially reducing oral health disparities [12].

Previous investigations examining school-based dental education have yielded promising results, though methodological heterogeneity and limited follow-up periods complicate synthesis of evidence [13]. Studies employing interactive, multi-component approaches generally demonstrate superior outcomes compared to didactic lecture-only formats [14]. However, research gaps persist regarding optimal program duration, content components, and strategies for maintaining behavioral improvements over time [15].

Recent systematic reviews have emphasized the need for rigorous evaluations incorporating validated assessment instruments, adequate sample sizes, and follow-up assessments to determine intervention sustainability [16]. Additionally, few studies have simultaneously evaluated changes across all KAP domains while including clinical outcome measures, limiting comprehensive understanding of intervention mechanisms and effectiveness [17].

Therefore, this study aimed to evaluate changes in knowledge, attitudes, and practices towards oral hygiene among adolescents following implementation of a comprehensive school-based dental education program, with assessment of both immediate and sustained effects at three-month follow-up.

2.Materials and Methods

2.1 Study Design and Setting

This quasi-experimental pre-post study with three assessment time points was conducted between January and June 2024 in four public secondary schools located within an urban school district. The study protocol received ethical approval from the Institutional Review Board (Protocol #EDU-2024-0156), and all procedures complied with the Declaration of Helsinki guidelines for research involving human subjects.

2.2 Sample Size Determination

Sample size calculation was performed using G*Power software version 3.1, based on anticipated medium effect size (Cohen's d=0.5) for knowledge score changes, 95% confidence level, 80% statistical power, and paired samples design. The minimum required sample was calculated as 464 participants, increased to 560 to accommodate an anticipated 15% attrition rate over the study period.

2.3 Participant Selection and Recruitment

Adolescents aged 13–16 years enrolled in grades 8–10 were eligible for participation. Inclusion criteria comprised: (1) age between 13–16 years; (2) enrollment in participating schools; (3) ability to read and comprehend questionnaire content; (4) provision of written parental consent and participant assent. Exclusion criteria included: (1) current orthodontic treatment that might influence hygiene practices; (2) systemic conditions affecting oral health; (3) participation in other oral health education programs within the preceding six months; and (4) anticipated school transfer during the study period.

Cluster sampling was employed with schools as primary sampling units. Two classes from each grade level within participating schools were randomly selected for inclusion. All eligible students within selected classes were invited to participate.

2.4 Intervention Description

The comprehensive dental education program was developed based on Health Belief Model constructs and implemented over six consecutive weeks, with one 45-minute session per week. Program components included:

Week 1: Introduction to oral anatomy, tooth structure, and functions of dentition. Interactive presentation with anatomical models and visual aids.

Week 2: Etiology of dental caries and periodontal diseases. Discussion of bacterial plaque, dietary factors, and disease progression using age-appropriate animations and case examples.

Week 3: Proper toothbrushing technique demonstration using Bass method. Hands-on practice with dental models and mirrors. Distribution of standardized toothbrushes and fluoride toothpaste.

Week 4: Interdental cleaning techniques including dental floss and interdental brushes. Practical demonstration and supervised practice sessions.

Week 5: Dietary counseling emphasizing reduction of cariogenic snacks and beverages. Interactive group activities including sugar content identification exercises.

Week 6: Review and reinforcement session. Question-answer discussions, individual feedback, and goal-setting for sustained behavior change.

All sessions were delivered by two calibrated dental hygienists using standardized presentation materials. Educational resources including brushing technique posters and dietary guidance pamphlets were distributed for home reference.

2.5 Data Collection Instruments

KAP Questionnaire: A validated 45-item questionnaire assessed knowledge (15 items, 0–1 scoring, range 0–15 rescaled to 0–25), attitudes (12 items, 5-point Likert scale, range 12–60), and practices (10 items, multiple-choice format, range 0–30). The questionnaire demonstrated acceptable psychometric properties (Cronbach's alpha: knowledge=0.78, attitudes=0.82, practices=0.76; test-retest reliability ICC=0.84).

Sociodemographic Questionnaire: Items captured age, sex, grade level, parental education, and household income category.

Clinical Assessment: Plaque accumulation was evaluated using the Silness-Löe Plaque Index, assessing four surfaces (mesial, distal, buccal, lingual) of six index teeth (teeth #16, #12, #24, #36, #32, #44). Scores ranged from 0 (no plaque) to 3 (abundant plaque), with mean scores calculated.

2.6 Data Collection Procedures

Baseline assessments (T0) were conducted one week prior to intervention commencement. Participants completed questionnaires in classroom settings under standardized conditions, followed by clinical examinations performed in school health rooms by two calibrated examiners (inter-examiner kappa=0.87). Post-intervention assessments (T1) occurred within one week of program completion, and follow-up assessments (T2) were conducted three months post-intervention.

2.7 Statistical Analysis

Data were analyzed using SPSS version 28.0 (IBM Corporation, Armonk, NY). Descriptive statistics included frequencies, percentages, means, and standard deviations. Normality was assessed using the Shapiro-Wilk test. Within-group changes across time points were evaluated using repeated measures ANOVA with Bonferroni post-hoc corrections for continuous variables and Cochran's Q test with McNemar's post-hoc tests for categorical variables. Effect sizes were calculated using Cohen's d. Subgroup analyses examined differences by sex and age group. Statistical significance was established at $p<0.05$.

3.Results

3.1 Participant Characteristics and Retention

Of 560 initially enrolled adolescents, 524 completed all three assessment time points (retention rate: 93.6%). Attrition was primarily due to school absences during assessment sessions (n=28) and incomplete questionnaire responses (n=8). The final sample comprised 278 females (53.1%) and 246 males (46.9%), with a mean age of 14.38±1.12 years. Sociodemographic characteristics demonstrated balanced distribution across schools and grade levels.

3.2 Changes in Knowledge, Attitudes, and Practices Scores

Significant improvements were observed across all KAP domains following the intervention. Mean knowledge scores increased from 12.34±3.87 at baseline to 18.92±2.56 immediately post-intervention ($p<0.001$, Cohen's $d=2.01$), with partial retention at 17.48±3.12 during three-month follow-up. Attitude scores improved significantly from 28.67±5.43 to 36.78±4.21 post-intervention ($p<0.001$, Cohen's $d=1.67$). Practice scores demonstrated substantial enhancement

from 14.23±4.56 to 21.34±3.89 at T1 (p<0.001, Cohen's d=1.68), maintaining significant improvement at 19.87±4.23 during follow-up.

Table 1: Comparison of KAP Scores Across Assessment Time Points (N=524)

Variable	Baseline (T0) Mean±SD	Post-Intervention (T1) Mean±SD	Follow-up (T2) Mean±SD	F-value	p-value	Effect Size (T0 vs T1)
Knowledge Score (0-25)	12.34±3.87	18.92±2.56	17.48±3.12	487.23	<0.001*	d=2.01
Attitude Score (12-60)	28.67±5.43	36.78±4.21	34.56±4.87	312.45	<0.001*	d=1.67
Practice Score (0-30)	14.23±4.56	21.34±3.89	19.87±4.23	278.67	<0.001*	d=1.68
Total KAP Score	55.24±10.12	77.04±8.34	71.91±9.45	398.56	<0.001*	d=2.35
Plaque Index (0-3)	1.87±0.54	1.12±0.43	1.28±0.48	234.12	<0.001*	d=1.54

*Statistically significant (Repeated measures ANOVA with Greenhouse-Geisser correction)

Post-hoc analyses revealed significant differences between all pairwise time point comparisons (T0 vs T1, T1 vs T2, T0 vs T2) for all variables (p<0.001), indicating significant initial improvement with modest but statistically significant decline during follow-up while remaining substantially above baseline levels.

3.3 Changes in Specific Oral Hygiene Behaviors

Analysis of individual practice items revealed significant improvements in key oral hygiene behaviors. The proportion of adolescents reporting twice-daily brushing increased from 34.2% at baseline to 71.8% post-intervention and 64.5% at follow-up (p<0.001). Regular dental floss use increased from 8.4% to 38.9% at T1 and 28.6% at T2. Significant reductions were observed in consumption frequency of sugary snacks and carbonated beverages.

Table 2: Changes in Specific Oral Hygiene Practices Across Time Points (N=524)

Practice Variable	Baseline (T0) n (%)	Post-Intervention (T1) n (%)	Follow-up (T2) n (%)	Cochran's Q	p-value
Brushing Frequency				312.45	<0.001*
Once daily or less	345 (65.8%)	148 (28.2%)	186 (35.5%)		
Twice daily	179 (34.2%)	376 (71.8%)	338 (64.5%)		
Brushing Duration ≥2 minutes	156 (29.8%)	389 (74.2%)	342 (65.3%)	287.34	<0.001*
Proper Brushing Technique	98 (18.7%)	412 (78.6%)	367 (70.0%)	423.56	<0.001*
Regular Floss Use	44 (8.4%)	204 (38.9%)	150 (28.6%)	198.23	<0.001*

Practice Variable	Baseline (T0) n (%)	Post-Intervention (T1) n (%)	Follow-up (T2) n (%)	Cochran's Q	p-value
Fluoride Toothpaste Use	312 (59.5%)	478 (91.2%)	445 (84.9%)	167.89	<0.001*
Daily Sugary Snacks ≤2	234 (44.7%)	387 (73.9%)	356 (67.9%)	145.67	<0.001*
Carbonated Drinks ≤1/week	189 (36.1%)	334 (63.7%)	298 (56.9%)	134.23	<0.001*
Regular Dental Visits	167 (31.9%)	256 (48.9%)	278 (53.1%)	78.45	<0.001*

*Statistically significant (Cochran's Q test)

3.4 Subgroup Analyses by Sex and Age

Subgroup analyses revealed differential intervention effects by sex and age group. Females demonstrated higher baseline knowledge scores (13.12±3.65 vs 11.46±3.98; p<0.001) and greater absolute improvement post-intervention compared to males. However, males showed larger relative gains, suggesting the intervention effectively addressed baseline disparities. Younger adolescents (13–14 years) demonstrated greater knowledge retention at follow-up compared to older participants (15–16 years).

Table 3: KAP Score Changes by Sex and Age Group

Subgroup	n	Knowledge Change (T0-T1)	Attitude Change (T0-T1)	Practice Change (T0-T1)	p-value (interaction)
Sex					
Male	246	7.12±3.23	8.45±4.12	7.34±3.87	0.034*
Female	278	6.14±2.98	7.78±3.89	6.89±3.56	
Age Group					
13-14 years	287	6.89±3.12	8.34±4.01	7.23±3.67	0.087
15-16 years	237	6.32±3.08	7.84±3.98	6.98±3.78	
Parental Education					
Secondary or below	198	7.34±3.45	8.67±4.23	7.56±3.89	0.012*
Higher education	326	6.12±2.89	7.67±3.78	6.78±3.45	

*Statistically significant interaction effect

Clinical plaque index improvements were consistent across subgroups, with no significant interaction effects observed (p>0.05), suggesting the intervention effectively improved clinical outcomes regardless of demographic characteristics.

4.Discussion

This quasi-experimental study demonstrated that a comprehensive six-week school-based dental education program significantly improved knowledge, attitudes, and practices towards oral hygiene among adolescents, with substantial retention of improvements at three-month follow-up. These findings contribute to the growing evidence supporting school-based interventions as effective strategies for promoting adolescent oral health.

The magnitude of knowledge improvement observed in our study (mean increase of 6.58 points, Cohen's d=2.01) exceeds effects reported in several previous investigations and likely reflects our multi-component, interactive intervention approach [18]. Comparable studies employing lecture-only formats typically demonstrate smaller effect sizes, supporting theoretical frameworks emphasizing active learning and practical skill development for health behavior change [19]. The significant knowledge retention at three months (17.48±3.12 vs 18.92±2.56 post-intervention) suggests that the educational content was effectively encoded into long-term memory, possibly facilitated by the distributed learning schedule and practical reinforcement activities [20].

Attitude improvements represented a particularly encouraging finding, as attitudes frequently prove more resistant to change than factual knowledge [21]. The significant enhancement in attitude scores (Cohen's d=1.67) may reflect our intervention's incorporation of Health Belief Model constructs, including perceived susceptibility to oral diseases, perceived benefits of preventive behaviors, and self-efficacy enhancement through guided practice [22]. Research indicates that attitude change often precedes sustained behavioral modification, suggesting our observed attitude improvements may support continued practice adoption beyond the follow-up period [23].

The translation of knowledge and attitude gains into improved practices represents a critical outcome, as behavioral change constitutes the ultimate intervention objective [24]. The substantial increase in twice-daily brushing prevalence (34.2% to 71.8%) aligns with findings from effective school-based programs internationally, though direct comparisons are complicated by varying baseline rates and measurement approaches [25]. Notably, the provision of standardized oral hygiene supplies may have facilitated practice adoption by removing access barriers, an approach recommended by systematic reviews of school-based oral health interventions [26].

The improvement in dental floss use (8.4% to 38.9%) represents a substantial achievement, as interdental cleaning behaviors are notoriously difficult to establish among adolescents [27]. The hands-on demonstration and supervised practice components likely contributed to self-efficacy development, addressing a primary barrier to flossing behavior identified in previous research [28]. However, the decline to 28.6% at follow-up indicates that sustained interdental cleaning requires ongoing reinforcement and possibly parental involvement to become habitual [29].

Clinical validation through plaque index assessment strengthened our findings by demonstrating objective improvement in oral hygiene status corresponding to self-reported behavioral changes [30]. The significant reduction in mean plaque index scores (1.87±0.54 to 1.12±0.43) provides biological plausibility for the reported practice improvements and suggests clinically meaningful effects on oral health [31]. The modest increase in plaque scores at follow-up (1.28±0.48) parallels self-reported practice declines and underscores the need for reinforcement mechanisms to sustain behavioral improvements [32].

Subgroup analyses revealed that males demonstrated larger relative improvements despite lower baseline scores, suggesting the intervention effectively addressed sex-based disparities in oral health knowledge and practices [33]. This finding has important implications for program design, as adolescent males frequently demonstrate poorer oral hygiene behaviors and may benefit from targeted intervention approaches [34]. The trend toward greater knowledge retention among younger adolescents suggests that earlier intervention may optimize long-term outcomes, consistent with developmental theories emphasizing habit formation during early adolescence [35].

The differential improvement among participants with lower parental education levels suggests potential for school-based programs to reduce socioeconomic disparities in oral health knowledge and behaviors [36]. Schools represent equalizing environments where adolescents from disadvantaged backgrounds can access quality health education regardless of family resources, supporting equity-focused public health approaches [37].

Several limitations warrant consideration. The absence of a control group limits causal inference, though the magnitude and consistency of improvements across multiple outcomes strengthen confidence in intervention effectiveness. Self-reported practices may be subject to social desirability bias, though clinical plaque assessments provided objective validation. The three-month follow-up period may inadequately capture long-term behavioral sustainability, and extended longitudinal assessment would strengthen conclusions regarding intervention durability [38].

5.Conclusion

This study demonstrated that a comprehensive six-week school-based dental education program significantly improved knowledge, attitudes, and practices towards oral hygiene among adolescents aged 13–16 years. Knowledge scores increased by 53.3%, attitude scores improved by 28.3%, and practice scores enhanced by 50.0% following the intervention, with substantial retention at three-month follow-up. Clinical plaque index scores corroborated self-reported behavioral improvements, demonstrating objective oral health enhancement.

The intervention effectively addressed baseline disparities, with males and participants from lower socioeconomic backgrounds demonstrating larger relative improvements. These findings support the integration of comprehensive, interactive dental education programs into school health curricula as effective strategies for promoting adolescent oral health.

Future research should incorporate longer follow-up periods, control group comparisons, and evaluation of reinforcement strategies to optimize sustained behavioral change. School-based dental education represents a promising, accessible, and equitable approach for establishing lifelong oral health behaviors during the critical adolescent developmental period.

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