Research Square

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Effect of source-based tele-dentistry using AI-generated educational videos on awareness of Egyptian children and caregivers regarding risks of early childhood caries; Prospective Cohort Study

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Abstract

Background

Tele-dentistry is a relatively new approach that helps the challenged population with accessibility and socioeconomic problems to get the advice and consultations required to manage preventable oral health issues such as dental caries and periodontal disease. The current study assesses awareness changes after using AI videos as source-based tele-dentistry.

Methods

An AI-generated video describing important advice about prevention of early childhood caries, diet modifications, and first molar hypomineralisation was sent to children and caregivers through kindergartens and clinics, and an electronic questionnaire to assess awareness was completed before and after watching the videos once and twice.

Results

70 children and 67 caregivers were included in the current study. Overall reliability of the parents and children electronic questionnaire was assessed with Cronbach's alpha values between 0.709 and 0.889, respectively. Children's awareness, including Knowledge, Attitude, and Practice domains heatmap analysis, showed a significant positive correlation with completion time of the e-questionnaire, while the educational level had a critical influence on the parents' KAP scores.

Conclusions

Within the limitations of the current study, AI-generated educational videos showed a promising source for tele-dentistry enhancing practices and attitudes towards oral health issues in both children and caregivers and signify important collaboration with pediatric physicians and nursery houses. This trial was registered in 23\11\2025 in Clinicaltrials.gov under the number: NCT07248800. Retrospectively registered.

1. Introduction

Background and rationale: Children's oral health is paramount for their general health and their well-being; it affects the physical, social, and mental health [1]. Oral health awareness can be spread in a wide range using the technological advancements used by pediatric dentists to ensure better access to oral health services and improve oral health behaviors [2, 3]. Internet based mobile technologies and health applications had promoted oral health education programs for the public use [4].

Dental caries is an irreversible microbial disease affecting the hard tissues of the tooth, and its manifestation persists throughout life even after treatment. It is reported by the World Health Organization (WHO) to affect different genders, social classes, and all age groups, with about 60–90% of children affected by dental caries [5]. According to the American Academy of Pediatric Dentistry (AAPD), dental caries in infants and children aged 71 months or below is known as early childhood caries (ECC) and is defined as the presence of one or more decayed

teeth (non-cavitated or cavitated lesions), missing tooth due to caries, or filled tooth surfaces in any primary tooth [6].

The prevention and early management of ECC, as it is the most virulent form of caries. It can be seen on smooth surfaces that start as soon as the teeth erupt and progress rapidly, causing a detrimental impact on the dentition. Despite this, the lack of awareness among children and/or their caregivers is considered a major contributing factor to the high prevalence and severity of ECC, particularly with respect to improper oral hygiene practices, inappropriate feeding habits, and delayed dental visits [7].

“Telemedicine” is the delivery of healthcare services over long distances using electronically generated information-based on technology and telecommunication infrastructure [8]. It is used for diagnosis, consultation, treatment of diseases, and patient education [9]. The global increased use of wireless technologies in communications has changed the way dentistry is being practiced. Analogous to telemedicine, “Tele-dentistry” is a branch of dentistry that employs the internet and uses information technology [4].

The origin of tele-dentistry goes back to the late 20th century as a subset of telemedicine, developed to address the challenges of providing dental care in remote and underserved areas. The concept emerged with early advancements in telecommunication, allowing healthcare professionals to exchange medical records over long distances [10].

The United States military recorded one of the earliest uses of tele-dentistry, where they launched the Total Dental Access (TDA) project in the mid-1990s to test the feasibility of transmitting digital dental records and radiographs to specialists for remote diagnosis and treatment planning. This project demonstrated that electronic communication could enhance dental care by overcoming geographic barriers [11].

Tele-dentistry, with its various applications, is a skill that must be learned by oral health providers to ensure access to good oral care for those patients in remote and rural areas or patients with special needs [12]. Its applications include tele-triage, which focuses on prioritizing the patient’s needs, telediagnosis using images of oral pathologies, teleconsultation, and telemonitoring that minimize the need for traveling, therefore can help to reduce financial burden in the patients [13]. Further advantages of such technologies are keeping digital records available for referral to dental specialist consultations, whether the images or records were provided by non-specialists or by dental assistants. These records can include data from patient history using a questionnaire, clinical examination findings, and radiographic images, as well as photos from an intraoral camera or a digital camera [4, 14-16].

Dentists do not frequently see children under three, which leaves them susceptible to oral diseases. Healthy baby visit programs provide pediatricians with the opportunity to examine newborns from birth, thereby offering the optimal means for the timely detection of dental issues. By educating parents on oral preventive healthcare, pediatricians are well-positioned to provide screening services for early diagnosis and to make referrals where and when needed [17].

Doctors occupy a critical position in the promotion of oral health among children; this fact has been recognized for more than a decade. Many different healthcare professions share this task, but pediatricians have an important role in this regard [18]. Studies indicate that physicians value oral health, believe they play an important role in preventing dental disease and promoting oral health, and report a willingness to examine children for dental disease and educate caregivers about early childhood caries [19]. This supports the need for cooperation between

the two disciplines. Since 2003, in the United States, recommendations for pediatric oral health risk assessments from the age of 6 months have included the role of pediatricians in oral health [17, 18].

Incorporating artificial intelligence in dentistry is seen to have the potential for better patient outcomes, with the assistance of timely interventions and the ease of clinical practices, which in turn can also lead to the redefinition of the future of dentistry, especially concerning patient education strategies and methods of communicating with them [20, 21]. Depending on Artificial intelligence can work to alleviate fear by making patients aware of the process, whereas automated reminders and follow-ups will reinforce information. Artificial intelligence will ensure that there is consistency in the information delivered by different practices, which will result in a better understanding by the patients. Overall experience. With these solutions that utilize artificial intelligence, dentists can provide improvements in communication, education, and patient satisfaction regarding treatment [22].

Hence, the role of producing video content by professionals such as physicians and specifically dentists represent an important focus of this research. Notably, this is in a scenario where there is an emerging capacity to utilize artificial intelligence to produce high-definition content fairly and easily.

There was no comparative study between awareness and performance change in a pediatric clinic or kindergarten. So, the objective of this research is to investigate the effect of a digital tele-dentistry with AI-generated content on awareness and performance among a sample of Egyptian children and their caregivers in both kindergartens and pediatrician offices.

Objectives: The current study aims to evaluate the effect of source-based tele-dentistry using AI-generated educational videos on awareness of Egyptian children and caregivers regarding risks of early childhood caries, the importance of oral health practices and a healthy diet, and the importance of taking care of the first permanent molars and comparing the resultant awareness from the two sources.

2. Materials and Methods

This manuscript is reported in accordance with CONSORT guidelines for reporting clinical trials updated in 2025 [23].

This research was registered in 23\11\2025 in Clinicaltrials.gov under the number: NCT07248800. Retrospectively registered.

Study Sitting: This study was conducted at multiple kindergartens and private pediatric clinics in Ismailia governorate, Egypt.

Time: January to June 2025.

Eligibility criteria:

Parents and caregivers of children aged 5 – 10 years old of any gender

Exclusion criteria:

1- Children <5 years old or >10 years old

2- Children with special needs, including:

a. Physical disability (sensory or motor defects)

b. Mental retardation

3- Uncooperative children or caregivers

Intervention:

An AI-generated video containing specific information about:

1. The importance of oral health practices and a healthy diet

2. Prevention of early childhood caries

3. The importance of taking care of the first permanent molars was disseminated, and participants were asked to view these videos once per week for 6 months.

Outcomes:

Primary outcome: knowledge and practice changes after using AI-generated videos in tele-dentistry to enhance oral health measures and screening, using an evaluation form (Appendix A.) about dietary habits and dental hygiene practices were registered by the children and their caregivers daily during the trial period

Participant timeline:

T_0: Pretrial awareness assessment questionnaire

T_1: After watching the videos for the first time

T_2: After watching the videos twice

Sample size:

A random sampling technique formula to estimate the sampling size. It is computed as: n = N / (1+Ne2). Slovin's formula [24].

n = required sample size. N = population. e = margin of error at 5% (standard value of 0.05).

Recruitment:

Eligible participants were recruited through their contact information at three different kindergartens and three private pediatrician clinics in Ismailia governorate.

Of the contacted participants who had agreed to sign an informed consent and adhere to the study protocol, they were enrolled in the study.

Data Monitoring:

The main investigator had to monitor data entry and accessibility of the information provided in this study. Missing or misinterpretation of data was handled by the agreement between all authors.

Harms: No harm is expected from our intervention.

Auditing: All data were self-recorded using an electronic database, with limited access to the main investigator only. The statistician got the row data after completing the trial period, while backup data was saved and monitored by the main investigator.

Statistical methods:

Statistical analyses were directed to measure and compare the knowledge and Awareness of the Parents participants. Data were collected, reviewed, and prepared into tables and figures using Microsoft Excel 2016. Normality of the data was tested using the Shapiro-Wilk and Kolmogorov-Smirnov tests at a significance level of $p \leq 0.05$ to determine whether the data were parametric or nonparametric. Moreover, nonparametric data were presented using both graphical and numerical descriptions, including frequency (n, %), mean, range, and standard deviation (SD). Parametric data were summarized in terms of mean and SD. Inferential statistics were performed using the Chi-square test to compare nonparametric data for goodness-of-fit. In contrast, parametric data comparisons for the Knowledge and Attitudes, and Awareness scores were conducted using an independent sample t-test. To measure the differences between the two groups according to the source of obtaining the questionnaire, whether parents in schools or parents from pediatric clinics, the Mann-Whitney U test was used to measure the significance of the differences, because the data do not follow normal distribution, and since all Asymp. Sig. (2-tailed) values are greater than the significance level (0.05) in all variables and indicators (knowledge, attitudes, practices, total scores, and percentages). Three levels of statistical significance were defined: $p \leq 0.05$ (*), $p \leq 0.01$ (**), and $p \leq 0.001$ (***). All data analyses were performed using the Statistical Package for the Social Sciences (SPSS), IBM-SPSS version 29.0 for Mac OS. In addition, heat maps were generated to identify correlations. Principal component analysis (PCA) and a Heat map were carried out using PAST statistical software version 4.0.

3. Results

3.1. Children's Questionnaire Results

A total of 70 participants were recorded in this study, using a 3-domain questionnaire: Knowledge, Attitude, and Practice (KAP) domains. The questionnaire demonstrates adequate to excellent internal consistency as measured by Cronbach's alpha coefficients, where the instrument exhibited excellent overall reliability ($\alpha = 0.889$). Cronbach's alpha values of 0.70–0.79 are considered acceptable, 0.80–0.89 indicate good reliability suitable for most research purposes, and values ≥ 0.90 represent exceptional reliability appropriate for clinical and diagnostic assessments (Table 1).

Table 1
The reliability analysis of children's questionnaires and internal consistency as measured by Cronbach's alpha coefficients

Section	variables	Responses	Cronbach's alpha
Knowledge	6	70	0.869
Attitude	5	70	0.823
Practice	8	70	0.703
Total	19	70	0.889

3.1.1 Survey Demographics and Exposure

The survey distribution showed that most child participants were reached through parents in schools (61.4%, n = 43) compared to pediatricians' clinics (38.6%, n = 27), though this difference was not statistically significant (χ^2 p-value = 0.056). Regarding survey completion timing, the highest proportion of children completed the survey before watching the educational video (44.3%, n = 31), followed by after watching twice (22.9%, n = 16), once (17.1%, n = 12), and other circumstances (15.7%, n = 11), with a highly significant distribution (χ^2 p-value = 0.002). This timing variable demonstrated significant associations with knowledge scores (ANOVA p = 0.002, p < 0.01), where children who completed the survey after watching the video twice exhibited the highest knowledge mean (4.44 ± 0.26) compared to those completing it before viewing (3.53 ± 0.93) **(**Table 2, Fig. 1**).**

Table 2
Description of the distribution of Demographics and Exposure of children questionnaires, in terms of frequency (n, %) and chi-square.

Variable	Scale	Frequency		Chi-square
		N	%	
How did the survey reach you?	Parents in schools	43	61.4	0.056 ns
	Pediatrician's Clinic	27	38.6	
When did you complete the current survey?	Before watching the video	31	44.3	0.002**
	After watching the video "once."	12	17.1	
	After watching the video "twice."	16	22.9	
	Other	11	15.7	

The children's knowledge section comprised six variables with an overall mean score of 3.87 ± 0.83. The knowledge items assessed children's understanding of dental caries etiology and prevention using a 5-point Likert scale with emoji-based responses (5 = Strongly agree, 4 = Agree, 3 = Moderate, 2 = Disagree, 1 = Strongly disagree) **(Table, 3)**

The question 2 in knowledge domain ("When we don't brush our teeth this cause tooth cavities") exhibited the highest positive response rate at 70.0% (n = 49) with a mean of 4.40 ± 1.12 (range 1–5) and highly significant association (χ^2, p < 0.001).

While Knowledge item K5 ("Do you think not visiting the dentist can cause tooth cavities") demonstrated the lowest positive response within the knowledge domain at 44.3% (n = 31, mean = 4.00 ± 1.14), yet remained highly significant (χ^2, p < 0.001).

The knowledge scores were categorized into three performance levels: poor (27.1%, n = 19), accepted (31.4%, n = 22), and good (41.4%, n = 29), showing that a plurality of children achieved good knowledge levels. When stratified by survey distribution method, no significant association was found between knowledge scores and how the survey reached participants (χ^2=0.548, p > 0.05), nor by survey completion timing (χ^2 p = 0.086).

The attitude section included five variables with an overall mean of 3.63 ± 0.64. The attitude items assessed children's self-reported dental hygiene behaviors and perceptions using a 5-point Likert scale. **(**Table 3**)**

Attitude item A3 ("I clean my teeth before sleep") exhibited the highest agreement rate at 70.0% (n = 49) with a mean of 4.50 ± 0.90 (range 2–5) and highly significant chi-square (χ^2 $p < 0.001$). The behavioral attitude item A5 ("If you have visited the dentist, mention why?") assessed reasons for dental visits, revealing that pain was the most common motivator (40.0%, n = 28), followed by treating decay (31.4%, n = 22), regular checkups (20.0%, n = 14), and didn't visit (8.6%, n = 6), with a mean of 3.61 ± 1.34 (range 1–5) and highly significant chi-square (χ^2 $p < 0.001$).

Attitude scores were stratified as poor (51.4%, n = 36), accepted (30.0%, n = 21), and good (18.6%, n = 13), indicating that over half of the children demonstrated poor attitude scores. The distribution showed no significant association with how the survey reached participants (χ^2 $p = 0.518$) but demonstrated a significant relationship with survey completion timing (χ^2 $p = 0.023$). ANOVA analysis revealed no significant differences in mean attitude scores across completion timing groups ($p = 0.108$, $p > 0.05$), suggesting that video exposure did not substantially influence attitudes.

The practice section comprised eight variables with an overall mean of 1.36 ± 0.33. The practice items assessed actual oral hygiene behaviors and dietary habits. **(**Table 3**)**

Practice item P1 (toothbrush use) and P2 (toothpaste use) demonstrated exceptionally high adoption rates of 90.0% (n = 63, mean = 0.90 ± 0.30, range 0–1) and 94.3% (n = 66, mean = 0.94 ± 0.23, range 0–1) respectively, both with highly significant chi-square values (χ^2 $p < 0.001$). In contrast, P3 (dental floss usage) showed only 20.0% (n = 14) adoption with a mean of 0.20 ± 0.40, though highly significant (χ^2 $p < 0.001$), and P4 (mouthwash use) exhibited 37.1% (n = 26) usage with a mean of 0.37 ± 0.49 and moderate significance (χ^2 $p = 0.031$).

Practice scores were categorized as poor (20.0%, n = 14), acceptable (70.0%, n = 49), and good (10.0%, n = 7), demonstrating that most children exhibited acceptable practice levels. No significant associations were found between practice scores and survey distribution method (χ^2 $p = 0.170$) or completion timing (χ^2 $p = 0.071$). Mean practice scores differed significantly by distribution method (t-test $p = 0.003$, $p < 0.01$), with school-based recruitment showing higher practice means (1.44 ± 0.30) compared to clinic-based (1.22 ± 0.31).

Table 3
Description of K, A, and P in terms of frequency n, %, mean ± SD, True (n, %), and chi-square

Variables		Frequency n(%)					Mean ± SD	TRUE	Chi square
							(Range)	n (%)	(sign.)
K		**Strongly agree**	**Agree**	**Moderate**	**Disagree**	**Strongly disagree**			
	K1	48(68.6)	8(11.4)	0(0.0)	10(14.3)	4(5.7)	4.23 ± 1.32 (1–5)	48(68.6)	< 0.001***
	K2	49(70.0)	11(15.7)	2(2.9)	5(7.1)	3(4.3)	4.40 ± 1.12 (1–5)	49(70.0)	< 0.001***
	K3	41(58.6)	13(18.6)	6(8.6)	9(12.9)	1(1.4)	4.20 ± 1.14 (1–5)	41(58.6)	< 0.001***
	K4	46(65.7)	7(10.0)	3(4.3)	9(12.9)	5(7.1)	4.14 ± 1.37 (1–5)	46(65.7)	< 0.001***
	K5	31(44.3)	20(28.6)	9(12.9)	8(11.4)	2(2.9)	4.00 ± 1.14 (1–5)	31(44.3)	< 0.001***
	K6	**3 times**	**2 times**	**once**	**I don't know**				
		36(51.4)	21(30.0)	8(11.4)	5(7.1)		2.26 ± 0.93 (0–3)	36(51.4)	< 0.001***
	K-Mean	**3.87 ± 0.83**							
A		**Strongly agree**	**Agree**	**Moderate**	**Disagree**	**Strongly disagree**			
	A1	45(64.3)	12(17.1)	4(5.7)	9(12.9)	0(1.0)	4.33 ± 1.06 (2–5)	45(64.3)	< 0.001***
	A2	33(47.1)	17(24.3)	13(18.6)	5(7.1)	2(2.9)	4.06 ± 1.10 (1–5)	33(47.1)	< 0.001***
	A3	49(70.0)	12(17.1)	4(5.7)	5(7.1)	0(1.0)	4.50 ± 0.90 (2–5)	49(70.0)	< 0.001***
	A4	23(32.9)	21(30.0)	9(12.9)	10(14.3)	7(10.0)	1.63 ± 0.90 (0–3)	14(20.0)	0.003**
	A5	**Didn't visit**	**Pain**	**Treating decay**	**Regular checkup**				
		6(8.6)	28(40.0)	22(31.4)	14(20.0)		3.61 ± 1.34 (1–5)	23(32.9)	< 0.001***

	A-Mean	**3.63 ± 0.64**							
P	Q	**Options**	**Yes**	**No**					
	P1	Toothbrush	63(90.0)	7(10.0)			0.90 ± 0.30 (0–1)	63(90.0)	< 0.001***
	P2	Toothpaste	66(94.3)	4(5.7)			0.94 ± 0.23 (0–1)	66(94.3)	< 0.001***
	P3	Dental floss	14(20.0)	56(80.0)			0.20 ± 0.40 (0–1)	14(20.0)	< 0.001***
	P4	Mouthwash	26(37.1)	44(62.9)			0.37 ± 0.49 (0–1)	26(37.1)	0.031*
	P5	**I don't Know**	**NO**	**Yes**					
		21(30.0)	7(10.0)	42(60.0)			1.30 ± 0.91 (0–2)	42(60.0)	< 0.001***
	P6	**Daily**	**Between meals every day**	**Several times a week**	**Rarely**				
		7(10.0)	18(25.7)	35(50.0)	10(14.3)		2.31 ± 0.84 (1–4)	10(14.3)	< 0.001***
	P7	**Once**	**Twice**	**3 times**	**4 times**	**5 times**			
		22(31.4)	11(15.7)	12(17.1)	9(12.9)	16(22.9)	2.80 ± 1.57 (1–5)	16(22.9)	0.109 ns
	P8	**Yes**		**No**					
		64(91.4)		6(8.6)			0.91 ± 0.28 (0–1)	64(91.4)	< 0.001***
	P-Mean		**1.36 ± 0.33**						

K= Knowledge, A= Attitudes, P= Practice; *, **, *** significant at p < 0.05, < 0.01, < 0.001, ns, non-significant at p > 0.05.

Comparing KAP levels in children's questionnaires with different sittings and repetition of video watching revealed no statistical significance in the knowledge and attitude domains, while Practice domain was significantly affected by sitting (0.003). Repetition of videos showed statistical significance, while knowledge showed statistical significance (0.002). **(**Table 4, Figs. 2 and 3**)**

Table 4
Interaction between demographic personal parameters and KAP.

Sociodemographic variable	Scale	Mean ± SD					
		n	Knowledge		Attitude		Practice	
How did the survey reach you?	Parents in schools	43	3.98 ± 0.84		3.72 ± 0.64		1.44 ± 0.30	
	Pediatrician's Clinic	27	3.70 ± 0.80		3.47 ± 0.62		1.22 ± 0.31	
	Ind t-test		0.165 ns		0.118 ns		0.003**	
When did you complete the current survey?	Before watching the video	31	3.53 ± 0.93	b	3.44 ± 0.74	a	0.31 ± 0.06	a
	After watching video "once"	12	3.79 ± 0.80	b	3.60 ± 0.67	a	0.37 ± 0.11	a
	After watching video “twice"	16	4.44 ± 0.26	a	3.86 ± 0.42	a	0.30 ± 0.08	a
	Other	11	4.09 ± 0.65	ab	3.84 ± 0.45	a	0.28 ± 0.08	a
	ANOVA p-value		0.002**		0.108 ns		0.051 ns	

*, **, *** significant at $p < 0.05$, < 0.01, < 0.001, ns, non-significant at $p > 0.05$.

3.1.2 Correlation Heatmap Analysis

The correlation heatmap for children's questionnaire variables employed a blue-red color scheme, where blue indicates positive correlations and red represents negative correlations, with boxed colors denoting statistically significant relationships ($p < 0.05$).

The completion time was positively and significantly correlated to knowledge, attitudes and practices. Moreover, Access method was negatively non significantly correlated to Knowledge and attitudes and significantly with Practice. **(**Fig. 4**)**

When comparing the method of delivery in children questionnaire, there was clear differences in mean ranks between children in schools versus those in pediatric clinics. These differences were observed across the dimensions of knowledge (K), attitudes (A), and practices (P). The results showed that the school group had higher mean ranks compared to the pediatric clinic group in all dimensions. The differences were most pronounced in the pediatric clinics (P-Mean and P-Sum), with mean ranks of 41.00 and 41.30 for school children, compared to 26.74 and 26.26 for clinic children. This reflects a relatively higher level of practice among the school group. Less pronounced but still present differences were observed in the knowledge and attitudes dimensions, again favoring the school children. **(**Table 5**)**

Table 5
KAP means ranks change in relation to different sittings for the children's questionnaire

How did you receive this questionnaire?		N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
K-Mean	Kids in schools	43	39.26	1688.00	-1.963-	0.050*
	Kids Clinic	27	29.52	797.00		
	Total	70				
A-Mean	Kids in schools	43	39.00	1677.00	-1.828-	.068 ns
	Kids Clinic	27	29.93	808.00		
	Total	70				
P-Mean	Kids in schools	43	41.00	1763.00	-2.872-	0.004 **
	Kids Clinic	27	26.74	722.00		
	Total	70				

3.2. Parents' questionnaire

The parents' questionnaire (n = 67) displayed acceptable to good overall reliability (α = 0.709), falling within the acceptable range for group comparisons and research applications. The subsections showed variable reliability, where attitude showed the highest internal consistency, while the knowledge domain showed questionable internal consistency (Table 6).

Table 6
The reliability analysis of parents' questionnaires and internal consistency as measured by Cronbach's alpha coefficients

Section	Variable / Question	Responses	Cronbach's alpha
Knowledge	14	67	0.663
Attitude	10	67	0.875
Practice	19	67	0.703
Total	43	67	0.709

3.2.1. Survey Demographics and Family Characteristics

The parents' questionnaire demonstrated acceptable to good reliability across sections (Knowledge α = 0.663, Attitude α = 0.875, Practice α = 0.703, Total α = 0.709). Survey distribution showed 56.7% (n = 38) reached through schools and 43.3% (n = 29) through pediatricians' clinics, with no significant difference (χ^2 p = 0.272). Completion timing revealed that 56.7% (n = 38) completed the survey before watching the awareness video about dental care, 23.9% (n = 16) after watching once, and 19.4% (n = 13) after watching twice, demonstrating a highly significant distribution (χ^2 p < 0.001).

3.2.2. Knowledge Domain

The parents' knowledge section comprised 14 variables with an overall mean of 2.37 ± 0.31, demonstrating questionable to acceptable reliability (Cronbach's α = 0.663).

Item K1 ("The rate of consuming foods and beverages that contain high sugar levels") showed the highest mean at 3.49 ± 1.24 (range 0–5), while K3 ("How should you clean the child mouth before his/her teeth appeared") showed concerning results, with equal proportions using "does not use anything" (41.8%, n = 28) and "cloth" (41.8%, n = 28), only 11.9% (n = 8) using "child's toothbrush," and merely 4.5% (n = 3) using "soft toothbrush" (mean = 1.79 ± 0.83, range 1–4), highly significant (χ^2 $p < 0.001$).

Knowledge scores demonstrated significant associations with parental education and family demographics. Father's education significantly influenced knowledge (ANOVA $p = 0.030$, $p < 0.05$), with postgraduate-educated fathers showing the highest knowledge means (2.59 ± 0.19) compared to secondary-educated (2.26 ± 0.33). Mother's education also significantly affected knowledge (ANOVA $p = 0.010$, $p < 0.05$), with postgraduate (2.51 ± 0.27) and higher education (2.42 ± 0.28) groups outperforming secondary education (2.23 ± 0.32).

Number of children showed a highly significant association (ANOVA $p = 0.001$, $p < 0.001$), with families having 4–6 children demonstrating higher knowledge (2.52 ± 0.36) than those with one child (2.04 ± 0.25). Survey completion timing significantly influenced knowledge (ANOVA $p = 0.009$, $p < 0.01$), with those watching the video twice achieving the highest scores (2.59 ± 0.25).

3.2.3. Attitude Domain

The parents' attitude section comprised 10 binary (Yes/No) variables with an overall mean of 0.44 ± 0.24, demonstrating good reliability (Cronbach's α = 0.875).

A2 ("Did you notice bleeding from your child's gums") showed the lowest prevalence at 14.9% (n = 10) with highly significant distribution (mean = 0.15 ± 0.36, range 0–1, χ^2, $p < 0.001$). A3 ("Did you notice bad breath from your child's mouth") showed the highest prevalence at 59.7% (n = 40) (mean = 0.60 ± 0.49, range 0–1, χ^2, $p = 0.112$).

Attitude scores showed no significant associations with survey distribution method (t-test $p = 0.459$, $p > 0.05$) or completion timing (ANOVA $p = 0.732$, $p > 0.05$). However, fathers' education significantly influenced attitudes (ANOVA $p = 0.046$, $p < 0.05$), with secondary-educated fathers showing higher attitude scores (0.53 ± 0.22) compared to postgraduate-educated (0.33 ± 0.19). Mother's education also significantly affected attitudes (ANOVA $p = 0.028$, $p < 0.05$), with secondary-educated mothers demonstrating higher scores (0.54 ± 0.20) than postgraduate (0.36 ± 0.24) and higher education groups (0.40 ± 0.22).

3.2.4. Practice Domain

The parents' practice section comprised 19 variables with an overall mean of 1.10 ± 0.18, demonstrating acceptable reliability (Cronbach's α = 0.703).

Practice scores demonstrated significant associations with several demographic variables. Survey completion timing significantly influenced practice (ANOVA $p = 0.046$, $p < 0.05$), with those watching the video twice showing the highest practice means (1.20 ± 0.16). Age of youngest child significantly affected practice (ANOVA $p = 0.027$, $p < 0.05$), with parents of children over 6 years demonstrating higher practice scores (1.18 ± 0.13). Child's gender in the > 6 years category also significantly influenced practice (ANOVA $p = 0.017$, $p < 0.05$), with parents of both male and female children showing the highest scores (1.19 ± 0.12). **(**Table 7, Fig. 5**)**

Table 7
Description of sociodemographic variables of parents' questionnaire.

Sociodemographic variable			Mean ± SD					
	Scale	n	Knowledge		Attitude		Practice	
How did the survey reach you?	Parents in schools	38	2.37 ± 0.28		0.42 ± 0.23		1.10 ± 0.16	
	Pediatrician's Clinic	29	2.38 ± 0.35		0.47 ± 0.23		1.09 ± 0.20	
	Ind t-test	0	0.946 ns		0.459 ns		0.790 ns	
When did you complete the current survey?	Before watching the video	38	2.29 ± 0.30	b	0.44 ± 0.21	a	1.09 ± 0.17	ab
	After watching the video "once"	16	2.40 ± 0.32	b	0.48 ± 0.26	a	1.04 ± 0.18	b
	After watching the video "twice"	13	2.59 ± 0.25	a	0.41 ± 0.26	a	1.20 ± 0.16	a
	ANOVA p-value		0.009**		0.732 ns		0.046*	
Father's Education	Secondary	23	2.26 ± 0.33	b	0.53 ± 0.22	a	1.11 ± 0.16	a
	Higher	37	2.41 ± 0.29	ab	0.41 ± 0.23	ab	1.11 ± 0.16	a
	Postgraduate	7	2.59 ± 0.19	a	0.33 ± 0.19	b	1.10 ± 0.18	a
	ANOVA p-value		0.030*		0.046*		0.885 ns	
Mother's Education	Secondary	24	2.23 ± 0.32	b	0.54 ± 0.20	a	1.05 ± 0.20	a
	Higher	26	2.42 ± 0.28	a	0.40 ± 0.22	b	1.13 ± 0.17	a
	Postgraduate	17	2.51 ± 0.27	a	0.36 ± 0.24	b	1.11 ± 0.15	a
	ANOVA p-value		0.010*		0.028*		0.255 ns	
Number of children	One child	8	2.04 ± 0.25	a	0.46 ± 0.16	a	1.01 ± 0.26	b
	2–3 children	45	2.39 ± 0.27	b	0.44 ± 0.25	a	1.09 ± 0.17	ab
	4–6 children	14	2.52 ± 0.36	b	0.44 ± 0.18	a	1.16 ± 0.14	a
	ANOVA p-value		0.001***		0.962 ns		0.159 ns	
Age of youngest child	From 6 to 12 months	10	2.23 ± 0.32	b	0.47 ± 0.22	a	0.97 ± 0.19	b

Sociodemographic variable			Mean ± SD					
	Scale	**n**	**Knowledge**		**Attitude**		**Practice**	
	From 1–2 years	15	2.28 ± 0.34	b	0.42 ± 0.21	a	1.07 ± 0.16	ab
	From 2 to 6 years	25	2.35 ± 0.29	b	0.51 ± 0.24	a	1.11 ± 0.19	a
	Over 6 years old	17	2.60 ± 0.19	a	0.35 ± 0.22	a	1.18 ± 0.13	a
	ANOVA p-value		0.004***		0.145 ns		0.027*	
Age of oldest child	From 6 to 12 months	17	2.37 ± 0.33	a	0.54 ± 0.22	a	1.02 ± 0.21	a
	From 1–2 years	4	2.13 ± 0.33	a	0.43 ± 0.10	a	1.11 ± 0.15	a
	From 2 to 6 years	6	2.13 ± 0.34	a	0.52 ± 0.29	a	1.07 ± 0.19	a
	Over 6 years old	40	2.44 ± 0.28	a	0.39 ± 0.22	a	1.13 ± 0.16	a
	ANOVA p-value		0.043*		0.141 ns		0.215 ns	
Child's Gender (6–12 months)	No Children	7	2.45 ± 0.25	ab	0.40 ± 0.24	a	1.15 ± 0.21	a
	Male	28	2.33 ± 0.35	b	0.50 ± 0.22	a	1.06 ± 0.16	a
	Female	21	2.30 ± 0.29	b	0.39 ± 0.23	a	1.10 ± 0.21	a
	Male and Female	11	2.61 ± 0.15	a	0.43 ± 0.24	a	1.15 ± 0.13	a
	ANOVA p-value		0.030*		0.339 ns		0.456 ns	
Child's Gender (1–2 years	No Children	10	2.42 ± 0.30	ab	0.41 ± 0.24	a	1.14 ± 0.23	a
	Male	23	2.31 ± 0.31	b	0.45 ± 0.20	a	1.08 ± 0.15	a
	Female	28	2.37 ± 0.33	ab	0.48 ± 0.24	a	1.08 ± 0.19	a
	Male and Female	6	2.61 ± 0.15	a	0.30 ± 0.25	a	1.16 ± 0.14	a
	ANOVA p-value		0.201		0.371 ns		0.680 ns	
Child's Gender (2–6 years)	No Children	6	2.49 ± 0.24	a	0.43 ± 0.19	a	1.09 ± 0.26	a
	Male	26	2.31 ± 0.35	a	0.43 ± 0.22	a	1.11 ± 0.16	a

Sociodemographic variable			Mean ± SD					
	Scale	n	Knowledge		Attitude		Practice	
	Female	28	2.38 ± 0.31	a	0.48 ± 0.24	a	1.10 ± 0.18	a
	Male and Female	7	2.50 ± 0.20	a	0.36 ± 0.26	a	1.06 ± 0.19	a
	ANOVA p-value	0	0.392 ns		0.616 ns		0.934 ns	
Child's Gender (More than 6 years)	No Children	3	2.21 ± 0.12	b	0.43 ± 0.06	a	0.86 ± 0.32	b
	Male	29	2.35 ± 0.30	ab	0.45 ± 0.25	a	1.07 ± 0.15	a
	Female	25	2.35 ± 0.32	ab	0.44 ± 0.22	a	1.12 ± 0.18	a
	Male and Female	10	2.56 ± 0.30	a	0.41 ± 0.22	a	1.19 ± 0.12	a
	ANOVA p-value		0.186 ns		0.969 ns		0.017*	

3.2.5: Parents Questionnaire Heatmap:

The correlation heatmap for the parents' questionnaire (n = 67) employs a blue-red color gradient scheme generated using PAST statistical software version 4.0, where blue indicates positive correlations between variables that change together, red represents negative correlations indicating inverse relationships, and boxed colors denote statistically significant associations ($p < 0.05$). The visualization reveals critical sociodemographic influences on KAP domains, with parental education demonstrating positive correlations with knowledge scores (postgraduate-educated fathers: 2.59 ± 0.19 vs. secondary-educated: 2.26 ± 0.33, $p = 0.030$; postgraduate-educated mothers: 2.51 ± 0.27 vs. secondary-educated: 2.23 ± 0.32, $p = 0.010$) but paradoxically showing negative correlations with attitude barrier-reporting, as secondary-educated parents exhibited higher attitude scores. Within domains, the heatmap displays positively correlated clusters representing conceptually related constructs: knowledge items assessing oral hygiene practices (K2-K5) and preventive care awareness (K6, K7, K10), attitude variables grouping observable oral health problems (A1-A4: white spots 46.3%, bad breath 59.7%, pain 47.8%) and behavioral barriers (A5-A9: forgetting 67.2%, uncooperative child 41.8%), and practice items showing healthy dietary patterns (P1-P2, P11-P14) versus cariogenic behaviors (P4-P6, P10: sugar consumption >once daily 55.2%).

Cross-domain correlations reveal that knowledge scores (mean = 2.37 ± 0.31) demonstrate significant positive associations with practice scores (mean = 1.10 ± 0.18), confirmed by educational video intervention effects on both domains (knowledge ANOVA $p = 0.009$; practice ANOVA $p = 0.046$), However, attitude scores (mean = 0.44 ± 0.24) exhibit weak or complex correlations with other domains, remaining unaffected by video exposure (ANOVA $p = 0.732$, $p > 0.05$). Negative correlations likely appear between knowledge levels and barrier-reporting variables (A5-A9), while positive correlations between the number of children and knowledge (4–6 children: 2.52 ± 0.36 vs. one child: 2.04 ± 0.25, $p = 0.001$) and between child age and practice scores (> 6 years: 1.18 ± 0.13 vs. 6–12 months: 0.97 ± 0.19, $p = 0.027$). **(**Fig. 6**)**

Method of questionnaire delivery to the parents was compared; the results indicate that there are no statistically significant differences between parents who received the questionnaire through schools and those who received it through pediatric clinics regarding the levels of knowledge, attitudes, and practices under study. (Table 8)

Table 8
KAP means ranks change in relation to different sittings for children's questionnaire

Ranks	How did the survey reach you?	N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
K-Mean	Parents in schools	38	33.58	1276.00	-0.203	0.839
	Pediatrician's Clinic	29	34.55	1002.00		
	Total	67				
A-Mean	Parents in schools	38	32.61	1239.00	-0.676	0.499
	Pediatrician's Clinic	29	35.83	1039.00		
	Total	67				
P-Mean	Parents in schools	38	34.01	1292.50	-0.006	0.995
	Pediatrician's Clinic	29	33.98	985.50		
	Total	67				

Accordingly, the results indicate that there are no statistically significant differences between parents who received the questionnaire through schools and those who received it through pediatric clinics regarding the levels of knowledge, attitudes, and practices under study.

4. Discussion

Tele-dentistry leverages digital communication technologies to deliver dental services remotely in regions with inadequate or no dental facilities. A variety of tele-dentistry approaches are available, including video conferencing for in-the-moment consultations, store-and-forward techniques involving collection and transmission of diagnostic data for specialist assessment, and remote patient monitoring that enables the continuous delivery of healthcare and patient safety [25].

The use of tele-dentistry for screening of early childhood caries awareness has shown high reliability and feasibility in school settings [26]. The results of the current study support these findings, where excellent and good reliability are found in children's and caregivers' questionnaires, respectively.

In the literature, studies have studied the effect of tele-dentistry application on awareness and performance of oral health and healthy diet for children with a few artificial intelligence (AI) applications [9–11, 15, 16, 26, 27]. Studies have confirmed that artificial intelligence has revolutionary uses in detecting and managing dental caries. Dental care providers can benefit from better diagnostic capabilities with the use of machine-learning algorithms and image recognition technology, allowing them to detect early-stage cavities that may not have been considered with other diagnostic approaches [28, 29].

Others concluded comparable outcomes regarding the awareness level using messaging services (MS) to educate children's caregivers compared to on-site visits to dental hospitals. The caregivers showed high satisfaction with

the MS method [30].

Educational interventions, particularly video-based learning, demonstrated a significant positive effect on the knowledge of both children and caregivers, suggesting evidence-based pathways for community health promotion initiatives. These results were consistent with many researchers who reported increased knowledge level among parents and children using video-based methods [27, 31].

A positive association was found between parent education level and favorable practices of oral health, suggesting that more parents experience enhanced dental health competency. This is consistent with the previous work of Minervini et al., who found that the higher education level of both father and mother was significantly associated with lower Early Childhood Oral Health Impact Scale [32].

During the period of the COVID-19 pandemic, many physicians used telemedicine and tele-dentistry for preventive and educational purposes. One of the most recent publications reported that pediatric dentists had significantly reduced oral health disparities [33]. This supports the need to disseminate tele-consultation among medical health practitioners.

Prevention of early childhood caries and diet modifications using tele-dentistry is an effective method, especially for remote populations. This evidence has been endorsed by many authors, who reported decreased sugar intakes and increased healthy food consumption after exposure to video-based tele-dentistry [34, 35].

The results of the current study showed significant improvement regarding oral health awareness among children and caregivers, these results are consistent with *Sa et al* work which had found that the applications of tele-dentistry can be used as important tool to implement oral heathy habits in the first years of children life, hence reducing sugar consumptions and increased oral hygiene in particular with employed and educated mothers after at least two tele-consultations [34].

Iranparvar et al. highlighted the use of maternal-assisted tele-dentistry using smartphone images in the detection of early childhood caries, which facilitates the early interventions to prevent its progression, with 100% sensitivity and specificity, especially in low-resource settings and remote locations [36].

First, molar caries and molar incisor hypomineralisation are one of the common pediatric oral health preventable conditions via proper screening and interventions, which can include tele-dentistry for early recognition and interception. Current studies showed that application of tele-dentistry can be a useful tool for increased awareness and practices aimed at the detection and recognition of early signs and sites of molar incisor hypomineralisation. This aligns with the recently published systematic review, concluding that mobile-based education can promote better hygiene behavior with high satisfaction among caregivers in rural and low-access settings [37].

AI-driven technologies demonstrated a significant positive impact on patient satisfaction in general dentistry. Enhanced diagnostic precision, personalized care, and effective communication were the key contributors to improved outcomes [38].

Game-based models and interactive mobile applications have shown a promising utility for enhancing behavior and knowledge among gen a, many studies reported significant improvement of knowledge, behavior, and practice in oral hygiene, especially when incorporating gamification or theory-based behavioral strategies [39].

Other studies confirmed that videos can be used to raise awareness of dental health among children [40, 41]. While other studies have shown that using audio-visual aids to teach children how to brush their teeth has proven effective in improving their skills in this area, further development and improvement of these aids to make them more child-friendly is also necessary [42]. In contrast, studies have confirmed that although videos published by government organizations and professional associations contain high-quality, evidence-based, and trustworthy information, there is a possibility that patients may come across YouTube videos that may contain unhelpful and possibly harmful advice [43].

Pediatricians and health advisors with access to medical support can significantly influence oral health practices and knowledge of children and their caregivers. The results imply that advice from pediatric physicians has a positive correlation with caregivers' attitudes. This agrees with results from recent papers conducted in Saudi Arabia and another one in Russia, which concluded that pediatricians, as the first medical professionals to meet parents of infants, possess significant potential to contribute to comprehensive caries prevention by advising on healthy nutrition and timely referral to a dentist [17, 44].

According to our knowledge, few studies have correlated the effect of advisor personnel on adherence and motivation for oral health care. This link emphasizes the important role of nursery schools in maintaining excellent oral hygiene and increasing the awareness of oral health, especially for children.

5. Limitations and Conclusions

Despite the limited sample size, and lack of adherence to watching the educational videos we can conclude that AI-generated educational videos, delivered as source-based tele-dentistry, can significantly improve knowledge and practices regarding children's oral health among parents and children. This strengthens the participation of other medical practitioners, nursery schools, and kindergartens in education and prevention of oral health problems.

These findings support the beneficial role of applications utilizing AI content in public and oral health issues using tele-dentistry. Further source-based studies are needed to compare the effects of different methods on oral health awareness.

Abbreviations

- AAPD: American Academy of Pediatric Dentistry
- AI: Artificial Intelligence
- ECC: Early Childhood Caries
- KAP: Knowledge, Attitude and Practice
- PCA: Principal Component Analysis
- SD: Standard Deviation
- TDA: Total Dental Access
- WHO: World Health Organization

Declarations

Ethics approval and consent to participate: This study was conducted in accordance with the ethical principles for medical research involving human subjects outlined in the World Medical Association Declaration of Helsinki (2024

revision). The study protocol was approved by the ethics committee for clinical trials at Sinai University under the number: SU.REC.2024 (24 H). All participants had signed an informed consent before the enrollment in the study, for children under the age of 16, their parent's had signed an informed consent also.

Consent for publication: Not applicable.

Availability of data and materials: Videos and data supporting the current results are available upon reasonable request and agreement of all authors of this study.

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Figures

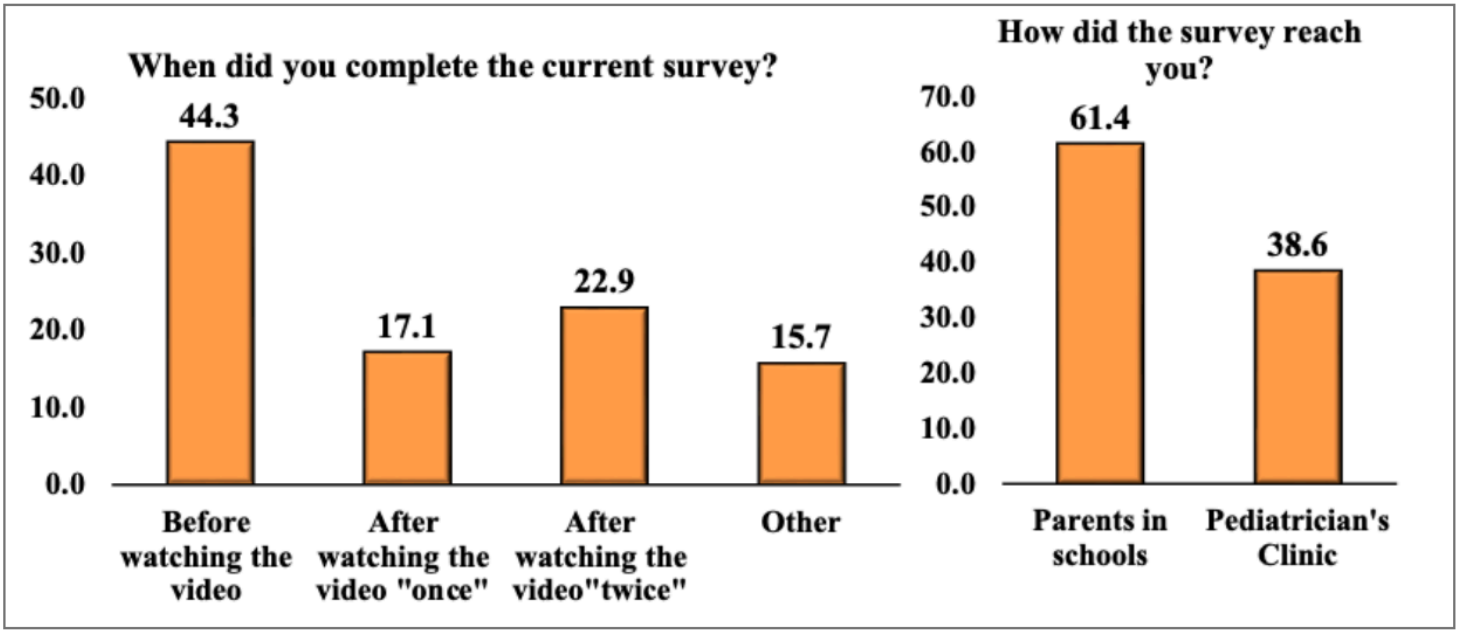


Figure 1

Bar chart presenting the description of the distribution of Demographics and Exposure of children questionnaires, in terms of frequency (n, %) and chi-square

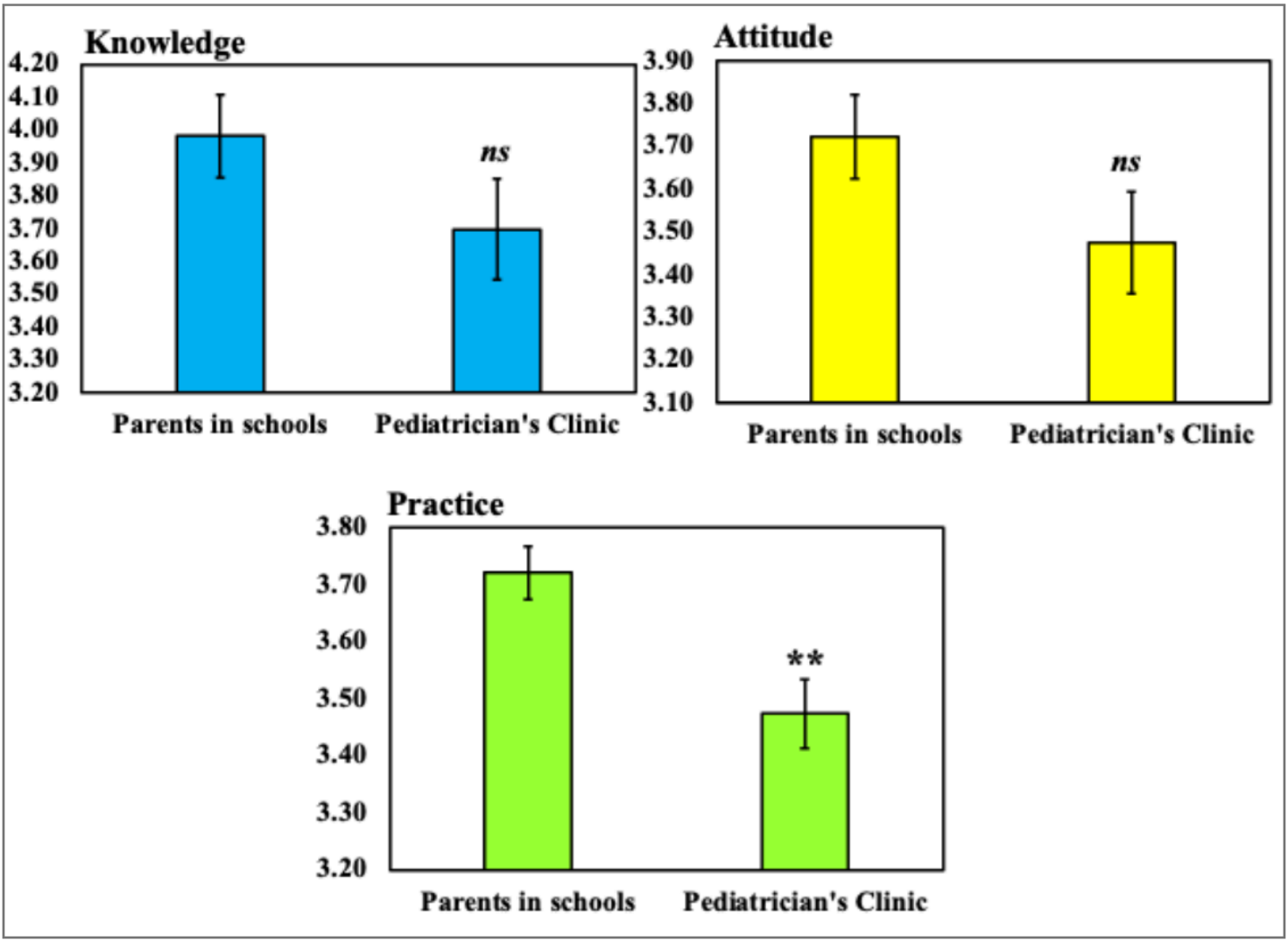


Figure 2

Interaction between demographic personal parameters and KAP.

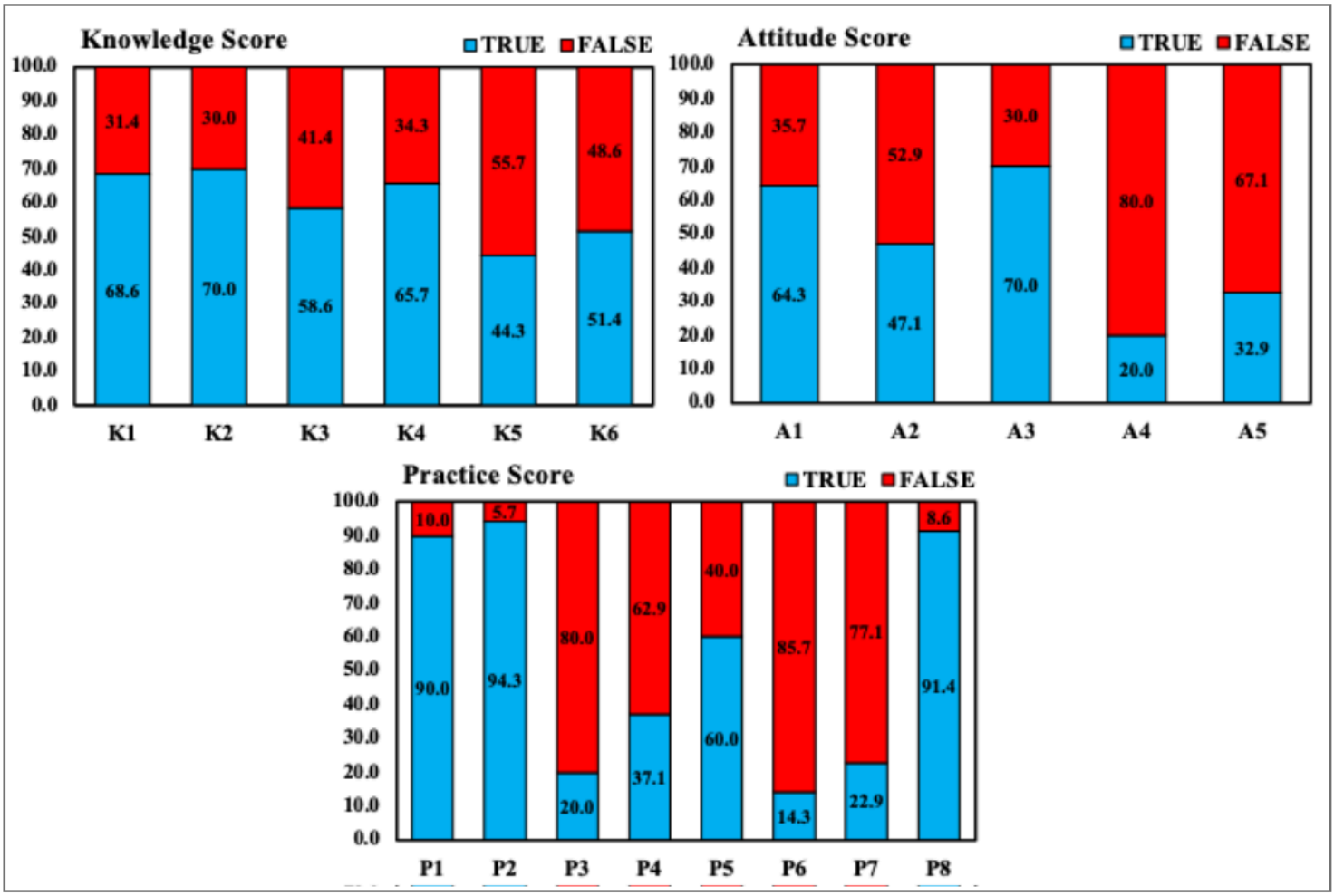


Figure 3

Evaluation (true, False) response of Knowledge, attitudes and practice.

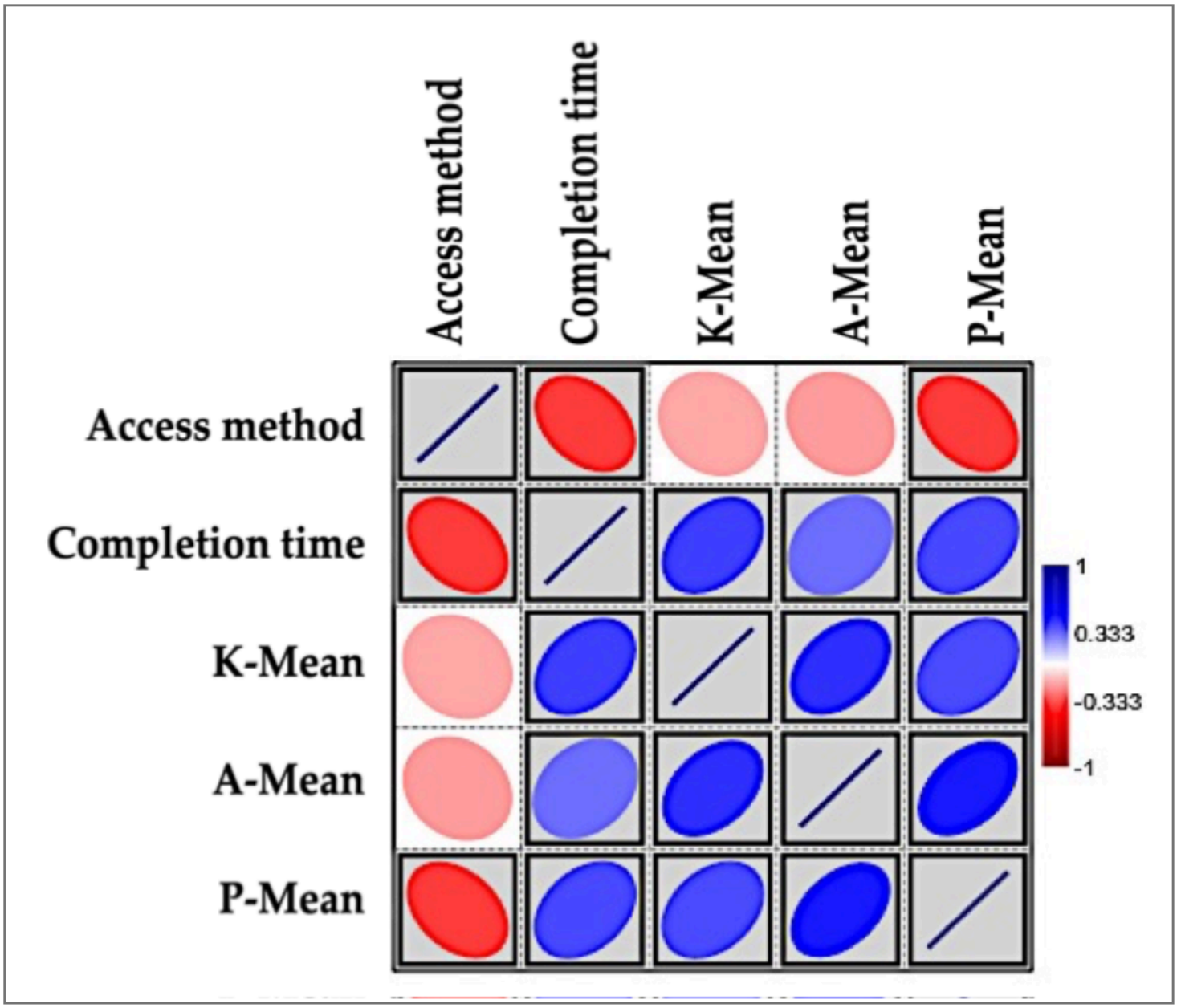


Figure 4

Heatmap presenting the interaction between study variables.

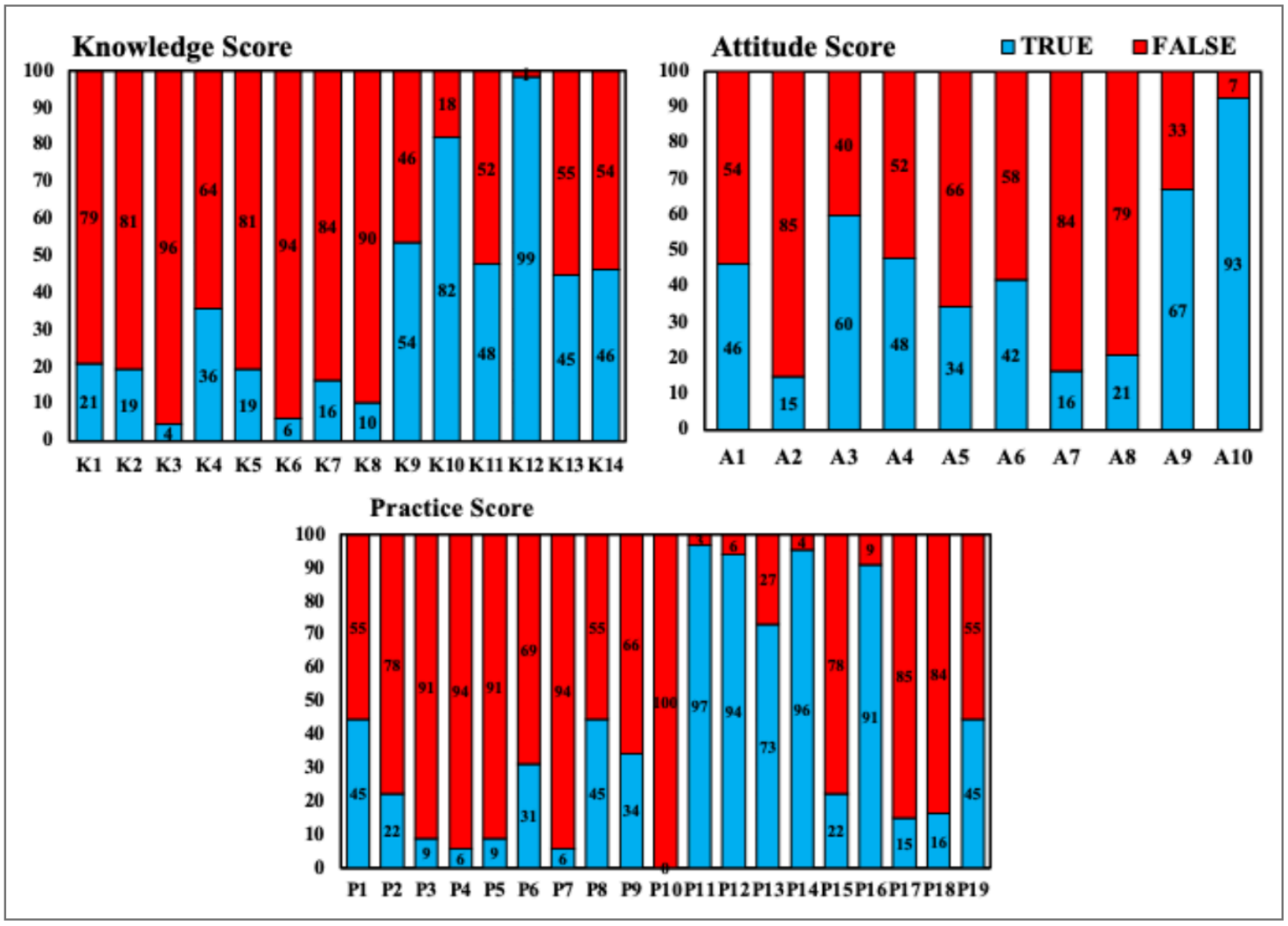


Figure 5

Stacked column presenting the evaluation of true response in Knowledge, attitudes, and practices.

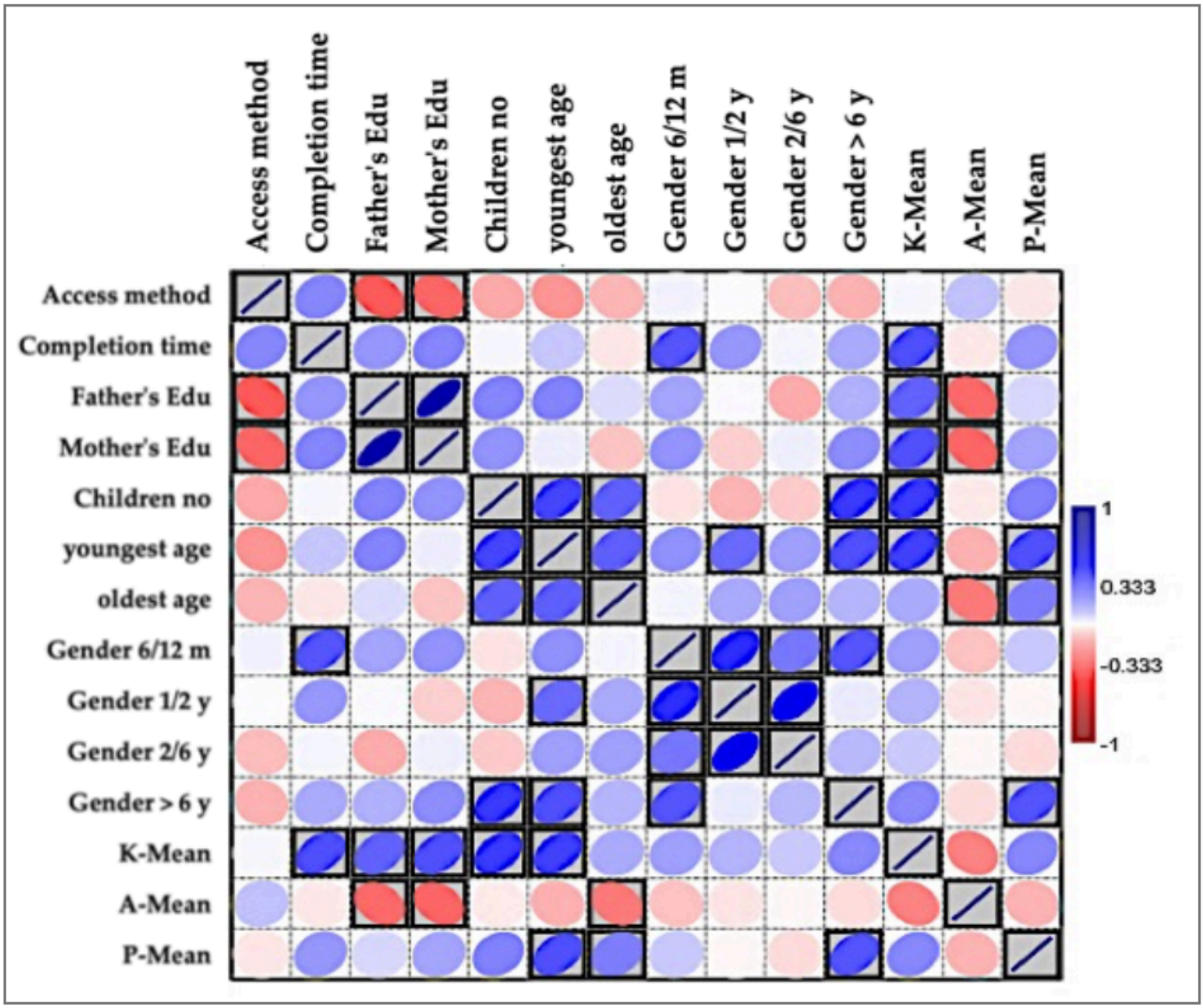


Figure 6

Blue, red heatmap presenting Pearson's correlation between study variables. Blue indicates positive correlation, red indicates negative correlation, and boxed blue or red indicates significant correlation as revealed by two-tailed significance tests.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Studyquestionnaires.docx