CAHIERS MAGELLANES-NS
Volume 07 Issue 1
2025

ISSN:1624-1940
http://magellanes.com/

KNOWLEDGE AND AWARENESS OF GENERAL PUBLIC IN KSA ABOUT PERIODONTAL DISEASE WITH INVISALIGN TREATMENT

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Abstract

Introduction: In 1999 Invisalign was showed off and become remarkable to management a different type of malocclusions. Invisalign treatment may complicate the health of periodontal tissue due to accumulation of bacteria and toxins in oral biofilm. This study aimed to assessed the level of knowledge and awareness among the general public in KSA toward the influence of Invisalign treatment on periodontal health to promote the oral preventive care and improving the patient education. **Objectives**: to determine knowledge and awareness levels of periodontal disease with Invisalign treatment among general public in KSA. **Methodology:** The cross-sectional study is going to take place in Saudi Arabia from July to December 2024. A sample recruiting strategy was on social media apps to find people from all around Saudi Arabia. We have included Saudi population males and females who use Invisalign treatment (clear aligners). Sample size was determined that 385 was the sample size with an indicator percentage of 0.50, a margin of error of 5%, and a confidence interval (CI) of 95%. **Results:** The study investigated the knowledge and awareness of the general public in Saudi Arabia regarding periodontal disease in relation to Invisalign treatment, surveying 1,066 participants. Results revealed a predominantly young demographic (60.5% aged 23-30) with a notable gender imbalance (60.4% female). Awareness of Invisalign was high (70.7%), yet only 29.1% understood its application. Alarmingly, 63.8% were unaware of potential adverse effects like swollen gums, and 69% believed Invisalign does not initiate periodontal issues. While 46.2% exhibited high knowledge of periodontal health in orthodontic care, 57.4% demonstrated low awareness. The findings underscore a critical need for educational outreach tailored to demographic factors. **Conclusion:** In conclusion, the findings of this study underscore significant deficiencies in public knowledge and awareness regarding periodontal disease and Invisalign treatment among the population in Saudi Arabia.

Keywords: Orthodontic applinces, aligners, oral biofilm, KSA.

ISSN:1624-1940
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Introduction:

Gingivitis is the gingival tissue's inflammatory reaction to bacterial metabolic products and pathogenic toxins prevalent in the mouth biofilm. The inflammatory alteration in supragingival plaque is a major risk factor for disease development. Periodontitis is always preceded by gingivitis, even if it does not always advance to periodontitis [1]. But the bacteria do not directly adhere to tooth structures [2]. However, they adhere indirectly to the pellicle, an acellular proteinaceous layer that covers enamel surfaces [3]. Since its debut in 1999, Invisalign has become more popular due to its capacity to use thermoformed plastic aligners to treat a variety of malocclusions [4]. although the results of Invisalign treatments might be greatly impacted by the existence of periodontal disease [5]. and Patients with a thin gingival biotype are more likely to experience gingival recession [6]. Differences in the PI, GI, and BOP in the short- and medium-term follow-ups, in the PPD in long-term follow-up, and the gingival recessions in the short-term follow-up were found between subjects with clear aligners and fixed appliances, revealing a slight tendency for clear aligners to be associated with healthier periodontal conditions [7]. After 1-month and after 3 months of treatment there was only one sample with periodontopathic anaerobes found in patient treated using fixed orthodontic appliances. The Invisalign® group showed better results in terms of periodontal health and total biofilm mass compared to the fixed orthodontic appliance group. A statistical significant difference ($P < 0.05$) at the T2 in the total biofilm mass was found between the two groups [8]. None of the patients resulted positive for the periodontal anaerobes analyzed. PI, PD, BOP, FMPS and FMBS resulted significantly lower and compliance to oral hygiene resulted significantly higher in the group treated with Invisalign? compared to the group treated with fixed brackets [9]. The prospective study by Mummolo et al. (2020) showed that only 8% of participants wearing aligners versus around 40% of participants wearing brackets showed elevated levels of Streptococcus. Mutans after 6 months of treatment and only 2.5% of patients treated with aligners versus approximately 37.5% of those with brackets showed elevated levels of lactobacilli with a tendency for plaque index to increase over time in patients treated with ibrakets [10].

Limited research has been conducted to explore the general public's knowledge and awareness regarding the impact of Invisalign treatment on periodontal health in Saudi Arabian. Assessing the current level of public awareness is crucial, as it can help identify knowledge gaps and inform the development of future educational initiatives aimed at promoting better oral health outcomes. Invisalign treatment has the potential to impact periodontal health if not properly managed. Evaluating the public's understanding of these potential implications is paramount, as it can inform strategies to enhance preventive care and patient education. By examining the level of knowledge and awareness among the general public, this research can pinpoint specific areas where gaps in understanding exist. This information can guide the design and implementation of targeted educational interventions, tailored to address the identified knowledge deficits. Such an approach can contribute to improving the overall oral health literacy and promoting better-informed decision-making among individuals undergoing Invisalign treatment. Our study was designed to determine the Saudi Arabian public's level of knowledge and awareness of periodontal disease with Invisalign therapy Further, we intended to draw attention to any other connections that may exist between the use of Invisalign treatment and changes in the oral microbiota, such as risk factors for the development of infections and periodontal diseases, which may have an effect on the oral and general health of orthodontic patients.

Objectives: to determine knowledge and awareness levels of periodontal disease with Invisalign treatment among general public in KSA.

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Methodology:

Study design and Setting:

This study was a cross-sectional questionnaire survey, conducted from July to December 2024 in Saudi Arabia. Based on a structured questionnaire that was developed by authors.

Selection of Study Participant: the study's population consisted of general public in KSA.

Sample size:

The sample size estimate to be at least 385 participants, using the Qualtrics calculator with a confidence level of 95% and margin error determine as 5%. The Sample size was appraised by the formula: n= P (1-P) * Zα 2 / d 2 with a confidence level of 95%.

Inclusion and exclusion criteria:

Males and females who use invisalign treatment (clear aligners) from all social classes were included in Saudi Arabia.

Method for data collection, instrument and score system:

A structured questionnaire was employed as a study tool. This tool was developed after consulting relevant studies conducted in Saudi Arabia, The questionnaire consisted of 18 questions organized into four sections: the first section included three demographic questions regarding gender, age, region. The second section asked general knowledge questions regarding clear aligner (invisalign), with multiple choice answers. Correct answers were added to the total score regarding clear aligner (invisalign) knowledge and were derived from previous literature [11]. The third section asked for the participant's awareness of clear aligner (invisalign). The fourth section asked for the participant's attitude.

Scoring System:

for periodontal disease with Invisalign treatment Knowledge, Awareness, and Attitudes

Overview

A total of 20 statements were used to assess the participants' degree of knowledge, awareness, and attitudes regarding periodontal disease with Invisalign treatment. Five additional statements were used to gather demographic information but were not included in the scoring. Each correct answer was awarded one point, while incorrect answers or "I don't know" responses were given zero points. The maximum possible score is 15 points. Participants' responses are categorized into three levels based on Bloom's cut-off points: 80%-100%, 60%-79%, and below 59%. This ensures a clear classification of participants' knowledge, awareness, and attitudes

Part I: Knowledge

Knowledge was assessed with 5 questions, scoring from 0 to 6 points. Correct answers received 1 point;

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incorrect or "I don't know" answers got 0 points. Based on Bloom's cut-off points, scores of 4-6 (80%-100%) indicate high knowledge, 3 (60%-79%) moderate knowledge, and 2 or below (below 59%) low knowledge.

Part II: Awareness

Awareness was measured through 5 questions, with scores ranging from 0 to 5 points. Each correct answer earned 1 point; incorrect or "I don't know" answers got 0 points. Using Bloom's cut-off, 4-5 points (80%-100%) signify high awareness, 3 (60%-79%) moderate awareness, and 2 or below (below 59%) low awareness.

Part III: Attitude

Attitude was evaluated with 5 questions, scoring from 0 to 4 points. Correct answers received 1 point; incorrect or "I don't know" answers got 0 points. Bloom's cut-off classified score of 4 (80%-100%) as high attitude, 3 (60%-79%) as moderate attitude, and 2 or below (below 59%) as low attitude.

The overall level of knowledge was assessed Using Bloom's cut-off points, scores of 12-15 (80%-100%) were high, 9-11 (60%-79%) moderate, and below 9 (below 59%) low. This system effectively assesses participants' knowledge, awareness, and attitudes towards periodontal disease with Invisalign treatment.

Pilot test:

A pilot study was conducted to assess the simplicity of the questionnaire and the feasibility of the overall research methodology. In this pilot phase, the questionnaire was distributed to and completed by a sample of 20 individuals. The data collected during this pilot phase was excluded from the final analysis, as the purpose was to refine the research instruments and procedures rather than to include the pilot participants' responses in the main study.

Analyzes and entry method:

Using the "Microsoft Office Excel Software" software for Windows (2016), data had been entered on the computer. After that, data was moved to be statistically analyzed using the Statistical Package of Social Science Software (SPSS) program, version 20 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.).

Results:

Table (1) displays various demographic parameters of the participants with a total number of (1066). This suggests a relatively young demographic, with nearly two thirds (or approximately 60.5%) residing between the ages of 23-30, a cohort that is probably just as likely to see the world differently as they are because of their age. Distribution of gender reveals a higher number of females (60.4) than males (39.6) possibly indicating implications for research outcome, especially in the study of gender dynamics. Participants are geographically concentrated in the southern and western regions, which collectively comprise nearly three quarters of the total sample. In particular it illustrates the need to contextualize findings within the local sociocultural landscape. Furthermore, marital status shows that over half of the participants are single (55.2%) and might exert an effect from sociocultural to psychological factors.

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Table (1): Sociodemographic characteristics of participants (n=1066)

Parameter		***No.***	***Percent (%)***
Age ***(Mean: 33.8, STD: 13.8)***	Less than 23	178	16.7
	23 to 24	192	18.0
	25 to 30	260	24.4
	31 to 40	118	11.1
	41 to 50	160	15.0
	More than 50	158	14.8
Gender	Female	644	60.4
	Male	422	39.6
Residential region	Northern region	46	4.3
	Southern region	496	46.5
	Central region	144	13.5
	Eastern region	60	5.6
	Western region	320	30.0
Marital status	Single	588	55.2
	Married	408	38.3
	Divorced	40	3.8
	Widowed	30	2.8

As shown in figure 1, When we look at the data of average duration of clear aligner treatment, like Invisalign, from 1,066 participants, we see that majority of people are treated for about 6 months to 1 year. Of course, in particular, 43%, or 458 of the sample are in this category. Thirty nine per cent, or 410 people, of respondents then reported treatment duration of one to two years. Meanwhile, 110 participants of the sample represented a smaller segment of 10%, who completed their treatment in 1 to 6 months, and 8% (88 participants) indicated treatment from 2 to 3 years.

Figure (1): Illustrates average time for Invisalign braces among participants.

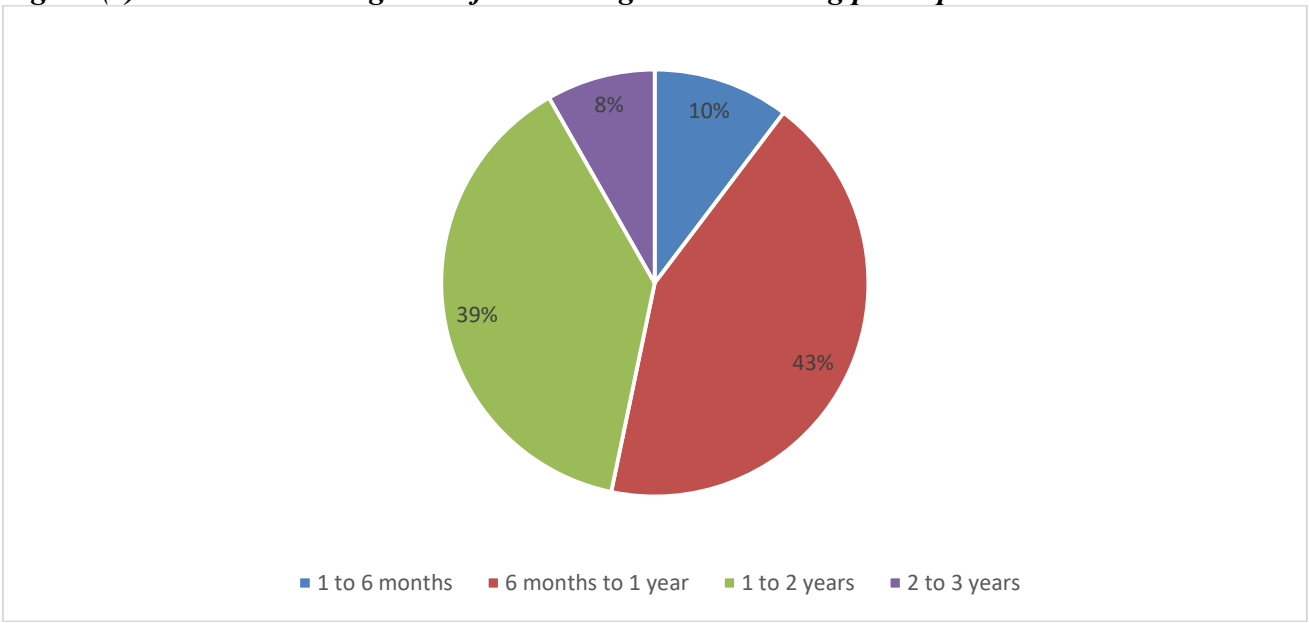

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Table 2 presents valuable data indicating public knowledge of the Invisalign treatment among the surveyed sample of 1,066 respondents. For a therapy such as clear aligner therapy, a large 70.7 percent of participants recognized it exists, but a disappointingly low 29.1 percent correctly described how the treatment generally runs. The results reveal that the majority perceive the advantage of Invisalign versus traditional braces among 81.4%. Yet a total of 55.5% still hold that it is not suitable for all orthodontic cases, an indication of a large gap in education about the treatment's employment. Therefore, to further clarify eligibility criteria, 64.9 % of respondents also indicate that not everyone can be a candidate for clear aligner therapy.

Table (2): Parameters related to knowledge about periodontal disease with Invisalign treatment (n=1066).

Parameter		***No.***	***Percent (%)***
Do you know what clear aligner treatment (Invisalign) is?	No	312	29.3
	Yes	754	70.7
Do you know the exact treatment duration for clear braces (Invisalign)?	No	756	70.9
	Yes	310	29.1
What's the average time forclear aligner treatment (Invisalign)?	1 to 6 months	110	10.3
	6 months to 1 year	458	43.0
	1 to 2 years	410	38.5
	2 to 3 years	88	8.3
Does the clear aligner treatment (Invisalign) suitable for all orthodontic cases?	No	592	55.5
	Yes	474	44.5
Is clear aligner treatment (Invisalign) better than traditional braces?	No	198	18.6
	Yes	868	81.4
Can Anyone Get clear aligner treatment (Invisalign)?	No	692	64.9
	Yes	374	35.1

As shown in figure (2), The results shown here suggest the responses of a total sample of 1,066 survey respondents on the effect of clear aligners (Invisalign in particular) on plaque buildup. A majority (49.8%, or 530 respondents) indicated that they were sceptical that clear aligners cause increased plaque formation. A significant minority, however, did claim that clear aligners actually result in higher plaque accumulation, with 33.8% (360 individuals) agreeing. In addition, 16.5 percent (176 participants) answered "maybe" and indicated uncertainty.

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Figure (2): Illustrates whether Invisalign braces increase plaque formation according to participants.

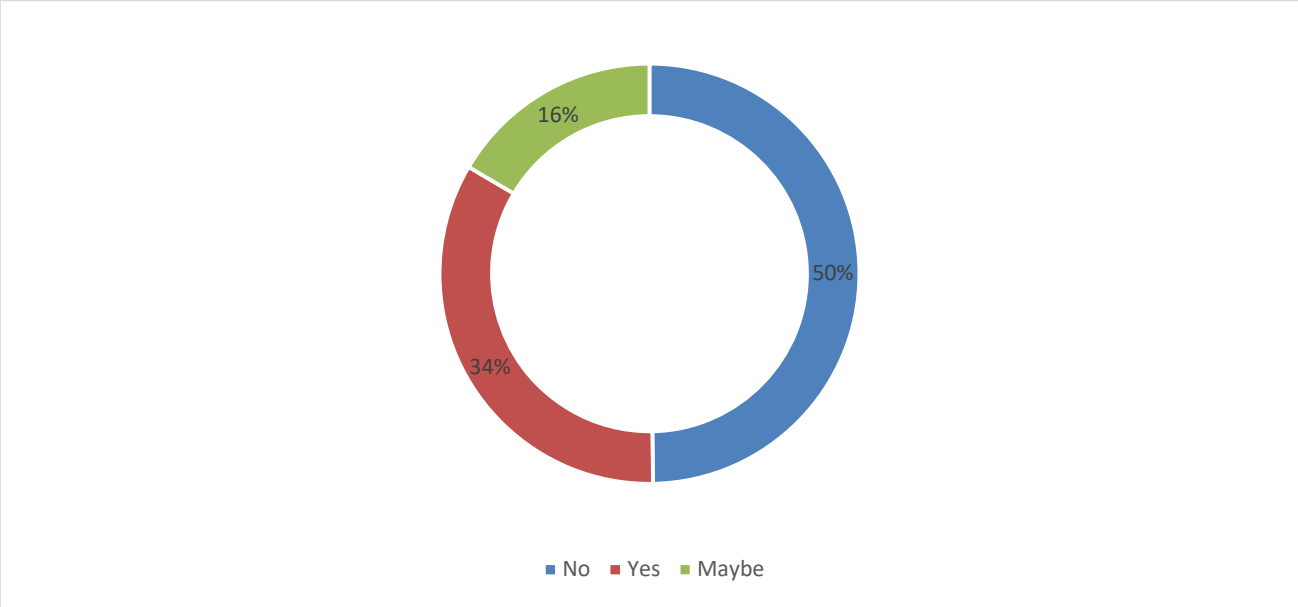

Table (3) shows a big gap in awareness of the potentially adverse effects of orthodontic treatment with clear aligners, for example, Invisalign. Notably importantly, 63.8 percent were unaware that treatment such as could result in swollen gingiva, suggesting a tremendous educational need in this population. Furthermore, while more than half of participants were aware that the possibility of aching gums (51.2%) or halitosis (54.6%) might occur, a significant amount remained unaware of threats like gum recession (70.2%) or plaque build up (49.7%). Finding also shows a huge gap in understanding that there is a connection between clear aligners and periodontal problems, 69% of them believed that Invisalign does not initiate periodontal disease. Nevertheless, given the high levels of acknowledgment of the potential importance of visiting the dentist regularly (95.5%) as well as of conforming with the direction of a clinician (96.1%).

Table (3): participants' awareness and attitude about periodontal disease with Invisalign treatment (n=1066).

Parameter		*No.*	*Percent*
Are you aware that orthodontic treatment with clear aligner (Invisalign) may cause swollen gingiva?	No	680	63.8
	Yes	386	36.2
Are you aware that orthodontic treatment with clear aligner (Invisalign) may cause aching gums during and after treatment?	No	520	48.8
	Yes	546	51.2
Are you aware that orthodontic treatment with clear aligner (Invisalign) may cause bleeding gums?	No	576	54.0
	Yes	490	46.0
Are you aware that orthodontic treatment with clear aligner (Invisalign) may cause Recession?	No	748	70.2
	Yes	318	29.8
Are you aware that orthodontic treatment with clear aligner (Invisalign) may cause halitosis?	No	484	45.4
	Yes	582	54.6

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Does the clear aligner appliance (Invisalign) increase plaque accumulation ?	No	530	49.7
	Yes	360	33.8
	Maybe	176	16.5
Does the clear aligner appliance (Invisalign) may initiate periodontal disease?	No	736	69.0
	Yes	330	31.0
Can regular dental visits prevent gum disease?	No	48	4.5
	Yes	1018	95.5
Is it important to follow the instructions of the clinician about oral hygiene?	No	42	3.9
	Yes	1024	96.1

In Table 4 data is presented with which it is possible to have a complete overview of the related knowledge of the respondents concerning periodontal disease in relation to treatment by means of treatment with Invisalign. Specifically, a very remarkable 46.2% of the participants showed a very high level of knowledge about the relationship between the periodontal health and orthodontic procedures. On the contrary, 34.7% had moderate knowledge, suggesting although they know something about the subject there is space for more education. 19.1% of participants were found in low knowledge category.

Table (4): Shows knowledge about periodontal disease with invisalign treatment score results.

	Frequency	**Percent**
High knowledge Level	492	46.2
Moderate knowledge	370	34.7
Low knowledge level	204	19.1
Total	1066	100.0

Table 5 presented data highlighting a worrisome level of awareness (or no awareness) of periodontal disease in relation to Invisalign treatment within the surveyed population. Of note is that a great majority or 57.4 percent are having low awareness, meaning they might be having some gap in their knowledge which might hinder proper oral health management and preventive measures. However, instead of 60.1 percent high awareness there is room for improvement in educational outreach in both healthcare provider and in patient as only 25.5 percent have a high awareness level. Just 17.1% of the population seeks out the moderate awareness category.

Table (5): Shows awareness about periodontal disease with invisalign treatment score results.

	Frequency	**Percent**
High awareness level	272	25.5
Moderate awareness	182	17.1
Low awareness level	612	57.4
Total	1066	100.0

Table 6 presents the data presented in an insightful manner in terms of the attitudes towards periodontal disease in the light of Invisalign treatment, and a major trend appears to be low attitudes among the people surveyed. While 52.0% of respondents noted their attitude as low, and a combined 33.2% indicated moderate attitude, it appears that a notable amount of the population isn't showing awareness

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or care in relation to how orthodontic treatment choices like Invisalign affect periodontal health. The reverse was true, only 14.8 per cent of participants showed a high attitude of disaffection with the manufacturing process.

Table (6): Shows attitude about periodontal disease with invisalign treatment score results.

	Frequency	**Percent**
High attitude	158	14.8
moderate attitude	354	33.2
Low attitude	554	52.0
Total	1066	100.0

Table (7) shows that knowledge about periodontal disease with invisalign treatment has statistically significant relation to age (P value=0.0001), gender (P value=0.002), and residential region (P value=0.0001). It also shows statistically insignificant relation to marital status.

Table (7): Relation between knowledge about periodontal disease with invisalign treatment and sociodemographic characteristics.

Parameters		***Knowledge Level***		***Total (N=1066)***	***P value****
		High knowledge Level	**Moderate or low knowledge**		
Age	Less than 23	88	90	178	0.0001
		17.9%	15.7%	16.7%	
	23 to 24	40	152	192	
		8.1%	26.5%	18.0%	
	25 to 30	174	86	260	
		35.4%	15.0%	24.4%	
	31 to 40	56	62	118	
		11.4%	10.8%	11.1%	
	41 to 50	74	86	160	
		15.0%	15.0%	15.0%	
	More than 50	60	98	158	
		12.2%	17.1%	14.8%	
Gender	Female	322	322	644	0.002
		65.4%	56.1%	60.4%	
	Male	170	252	422	
		34.6%	43.9%	39.6%	
Residential region	Northern region	28	18	46	0.0001
		5.7%	3.1%	4.3%	
	Southern region	216	280	496	
		43.9%	48.8%	46.5%	
	Central region	96	48	144	
		19.5%	8.4%	13.5%	
	Eastern region	30	30	60	

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		6.1%	5.2%	5.6%	
	Western region	122	198	320	
		24.8%	34.5%	30.0%	
Marital status	Single	270	318	588	0.859
		54.9%	55.4%	55.2%	
	Married	192	216	408	
		39.0%	37.6%	38.3%	
	Divorced	16	24	40	
		3.3%	4.2%	3.8%	
	Widowed	14	16	30	
		2.8%	2.8%	2.8%	

P value was considered significant if ≤ 0.05.

Table (8) shows that awareness about periodontal disease with invisalign treatment has statistically significant relation to age (P value=0.0001), gender (P value=0.006), residential region (P value=0.0001), and marital status (P value=0.010).

Table (8): Awareness about periodontal disease with Invisalign treatment in association with sociodemographic characteristics.

Parameters		***Awareness Level***		***Total (N=1066)***	***P value****
		High or moderate awareness	**Low awareness level**		
Age	Less than 23	76	102	178	0.0001
		16.7%	16.7%	16.7%	
	23 to 24	66	126	192	
		14.5%	20.6%	18.0%	
	25 to 30	148	112	260	
		32.6%	18.3%	24.4%	
	31 to 40	50	68	118	
		11.0%	11.1%	11.1%	
	41 to 50	62	98	160	
		13.7%	16.0%	15.0%	
	More than 50	52	106	158	
		11.5%	17.3%	14.8%	
Gender	Female	296	348	644	0.006
		65.2%	56.9%	60.4%	
	Male	158	264	422	
		34.8%	43.1%	39.6%	
Residential region	Northern region	36	10	46	0.0001
		7.9%	1.6%	4.3%	
	Southern region	212	284	496	
		46.7%	46.4%	46.5%	
	Central region	60	84	144	

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		13.2%	13.7%	13.5%	
	Eastern region	28	32	60	
		6.2%	5.2%	5.6%	
	Western region	118	202	320	
		26.0%	33.0%	30.0%	
Marital status	Single	260	328	588	0.010
		57.3%	53.6%	55.2%	
	Married	174	234	408	
		38.3%	38.2%	38.3%	
	Divorced	16	24	40	
		3.5%	3.9%	3.8%	
	Widowed	4	26	30	
		0.9%	4.2%	2.8%	

P value was considered significant if ≤ 0.05.

Table (9) shows that awareness about periodontal disease with invisalign treatment has statistically significant relation to age (P value=0.0001), residential region (P value=0.0001), and marital status (P value=0.019). It also shows statistically insignificant relation to gender.

Table (9): Attitude about periodontal disease with Invisalign treatment in association with sociodemographic characteristics.

Parameters		***Attitude Level***		***Total (N=1066)***	***P value****
		High or moderate attitude	**Low attitude**		
Age	Less than 23	112	66	178	0.0001
		21.9%	11.9%	16.7%	
	23 to 24	74	118	192	
		14.5%	21.3%	18.0%	
	25 to 30	146	114	260	
		28.5%	20.6%	24.4%	
	31 to 40	54	64	118	
		10.5%	11.6%	11.1%	
	41 to 50	68	92	160	
		13.3%	16.6%	15.0%	
	More than 50	58	100	158	
		11.3%	18.1%	14.8%	
Gender	Female	310	334	644	0.931
		60.5%	60.3%	60.4%	
	Male	202	220	422	
		39.5%	39.7%	39.6%	
Residential region	Northern region	34	12	46	0.0001
		6.6%	2.2%	4.3%	
	Southern region	246	250	496	

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		48.0%	45.1%	46.5%	
	Central region	76	68	144	
		14.8%	12.3%	13.5%	
	Eastern region	32	28	60	
		6.3%	5.1%	5.6%	
	Western region	124	196	320	
		24.2%	35.4%	30.0%	
Marital status	Single	306	282	588	0.019
		59.8%	50.9%	55.2%	
	Married	180	228	408	
		35.2%	41.2%	38.3%	
	Divorced	16	24	40	
		3.1%	4.3%	3.8%	
	Widowed	10	20	30	
		2.0%	3.6%	2.8%	

P value was considered significant if ≤ 0.05.

Discussion:

The intention of the present study was to assess the knowledge and awareness of the general public in Saudi Arabia about periodontal disease as regards to Invisalign treatment. The results demonstrate important gaps still in our understanding, specifically concerning what the effects of Invisalign may be on periodontal health. Finally, this discussion will relate our results to the main literature on periodontal disease awareness and treatment modalities.

While we discovered that a large portion of participants acknowledged the existence of clear aligner therapy (70.7%), a scant 29.1% of them were educated to the degree necessary for complete comprehension of intricacies associated with how clear aligner therapy operates. Almotairy has found that public awareness of Invisalign was very low, with about one-fifth of respondents familiar with the treatment [12]. Such disparities indicate the importance at an urgent level of educational programs to increase people's knowledge of orthodontics and what they could imply in terms of oral health.

In addition, 64.9 % participants believed in the value of patient eligibility for clear aligner therapy, however shocking as it were, 63.8 % were oblivious to potential negative effects, experiencing swollen gums. As evidenced here, and by findings from Dolińska et al. on the need for public education on disease and management of periodontal disease [13], it is also consistent with less awareness of periodontal disease. Despite the alarming gap in knowledge regarding the relationship between orthodontic treatments and periodontal health, poor oral hygiene practices and often periodontal complications can result.

As well, the study showed that 69 percent of people thought that Invisalign does not cause gingivitis, an example of a widespread fallacy within the community. This finding corroborates the work of Alwaeli and Al-Jundi showing that there is little awareness of periodontal disease in different populations [14]. The misperceptions regarding Invisalign treatment and its implication on periodontal health are called for targeted educational campaigns aimed at warding off these misperceptions and encouraging better oral health habit.

Additionally, we saw in our study that only 46.2 percent of individuals have a high level of understanding about the link between periodontal disease and Invisalign. This is worrisome, and when juxtaposed with the findings of El-Qaderi and Taani, that education in periodontal knowledge can

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markedly decrease periodontal disease prevalence [15], is more so. We infer from the low awareness levels in our study that many individuals might not perceive the relevance of keeping periodontal health under control whilst undergoing orthodontic therapy and consequently leads to worse outcome.
Our findings when attitudes towards periodontal disease were considered in the context of orthodontic treatments indicated that 52.0% of participants expressed their low attitudes toward periodontal disease in context of orthodontic treatments. That's particularly concerning, since we already know that good periodontal health is a good indicator for better overall health. Several previous studies of Hendek et al showed that the awareness of periodontal disease was of great importance for the effective management and prevention [16]. The low level of our participants' concern speaks to the importance of developing not only educational strategies to inform the public of the risks of periodontal disease, but help create a proactive attitude about oral health as well.
In our study, knowledge and awareness of periodontal disease with Invisalign and demographic variables age, gender and geographic region were shown to be significantly associated. The research done by Hendek et al also found that demographic variables significantly influenced knowledge and attitude about periodontal health [16]. Knowing those associations also allows one to reintroduce them into an educational intervention and make it more effective focused on specific demographic groups.
However, our study offers several valuable insights that, unfortunately, must be acknowledged. Causal relationships between knowledge and awareness and demographic variables tested by cross sectional design cannot be ascertained. Furthermore, self reported data may not be obvously or consistently measured. Participants may also over estimate their knowledge or ability. Longitudinal designs along with the use of objective measures of periodontal health are needed in future studies to better reveal the possible link between the two, as would be provided by prospective studies.

Conclusion:
Finally, as mentioned, the findings of this study indicate a huge deficiency in public knowledge and how much people know about periodontal disease and Invisalign treatment. Areas where there is a gap in understanding of the implications of orthodontic treatments on periodontal health have been identified, recommending the urgent need for educational initiatives focused on the implications of orthodontic treatment on periodontal health. By addressing these knowledge deficits we may encourage individuals undergoing Invisalign treatment to think more about what they are getting and promote better oral health literacy. Integration of educational programs into community health initiatives could serve as an important tool to form better public awareness for and to improve oral health outcomes as well.

Acknowledgement:

Special thanks to the Deanship of Scientific Research (DSR) and the Faculty of Dentistry at King Abdulaziz University, Jeddah, for supporting this project.

Ethical approval

An informed consent was obtained from each participant after explaining the study in full and clarifying that participation is voluntary. Data collected were securely saved and used for research purposes only.

ISSN:1624-1940
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Funding

There was no external funding for this study.

Conflict of interests

The authors declare no conflict of interest.

Informed consent:

Written informed consent was acquired from each individual study participant.

Data and materials availability

All data associated with this study are present in the paper.

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