KNOWLEDGE, AWARENESS AND ATTITUDE LEVEL OF DENTAL PRACTITIONERS AND STUDENTS IN KSA REGARDING THE AETIOLOGY, DIAGNOSIS AND TREATMENT OF PERI-IMPLANT DISEASES: A QUESTIONER-BASED CROSS-SECTIONAL STUDY

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Abstract

Background: Peri-implant diseases, including peri-implant mucositis and peri-implantitis, represent significant challenges in dental practice, affecting a substantial proportion of patients with dental implants. Despite their prevalence, knowledge and awareness of these conditions among dental practitioners and students in Saudi Arabia remain inadequately explored. This study aims to assess the knowledge, awareness, and attitudes of dental practitioners and students in the Kingdom of Saudi Arabia (KSA) regarding the etiology, diagnosis, and treatment of peri-implant diseases.

Methods: A cross-sectional questionnaire-based study was conducted from July to November 2024, involving 1,098 participants, including dental practitioners and students. The structured questionnaire comprised 26 items, categorized into socio-demographic data, knowledge of peri-implant diseases, awareness, and attitudes towards these conditions. Statistical analyses were performed to identify correlations between demographic factors and knowledge levels.

Results: Participants were aged 25.9 years, majority female (57.6%). Awareness of dental implants was 87.8%, but only 80.2% recognized peri-implant diseases, with a 19.6% knowledge gap for the diagnosis of periimplantitis and mucositis. Only 58.5% correctly identified periimplant mucositis as one that was reversible. Yet, attitudinal data showed that 74% considered the replacement of missing teeth 'necessary', however only 35.5 of respondents felt 'very well' informed of dental implants. There were significant correlations between knowledge levels and age, educational qualifications, years of experience and GPA (p<0.05).

Conclusion: Even though awareness of dental implants was at high levels; awareness of peri-implant diseases was minimal among dental practitioners and students in KSA. Findings from the study highlight critical gaps in knowledge and awareness of peri-implant diseases among the dental

practitioners and students in KSA. Enhanced educational initiatives on implant maintenance and management of peri-implant disease are still needed because the percentage of participants who answered that they felt well informed is extremely low. Closing such a gap is crucial in order to improve patient outcomes, and provide good dental care in the light of growing use of dental implants.

Keywords: peri-implant disease, peri-implant mucositis, peri-implantitis

Introduction:

Today's dentists face a significant challenge with peri-implant disease in terms of treatment and epidemiology [1]. The peri-implant tissues, which encircle an osseointegrated dental implant, are classified into two categories: soft tissue components, which are also referred to as the peri-implant mucosa, and complex tissue components, which include bone [2]. The peri-implant disease is referred to as unfavourable outcomes that may follow implant therapy [3]. Furthermore, inflammatory lesions known as peri-implant disease can cause loss of supporting bone (peri-implantitis) or damage the peri-implant mucosa (peri-implant mucositis). [4]. Peri-implantitis affected nearly one-third of patients and one-fifth of all implants, but many studies have reported the varied prevalence of peri-implant mucositis [5]. A systematic review of current epidemiology done by Derks and Tomasi in 2015 recorded that the prevalence of peri-implant mucositis was 43% (range, 19% to 65%), while the prevalence of peri-implantitis was 22% (range, 1% to 47%) [6]. Generally, Peri-implant disease is estimated to have a weighted mean prevalence (95% confidence range) of 19.83% (15.38, 24.27) at the patient level and 9.25% (7.57, 10.93) at the implant level [7]. According to a study conducted in 2021, the overall knowledge and attitude of Saudi dental students, interns, and recently graduated dentists concerning implant disease was 44.4%, showing intermediate knowledge, and 38.9% had a good understanding of various issues related to dental implants of all the respondents [8]. The same year, research on Saudi general dentists' awareness of and attitudes concerning peri-implant conditions was published. Alqahtani, Ali et al. reported that the overall knowledge and attitude among GPs in their study were found to be that 54.8% of all the respondents were able to distinguish between peri-implant mucositis and peri-implantitis, whereas 19.4% were unaware of this distinction [9]. A closely related study conducted by a team from Imam Abdul Rahman bin Faisal University, published in 2024, revealed that 81.6% of the respondents to a survey had excellent knowledge about peri-implantitis as an inflammatory condition [10]. While there are a lot of articles discussing the knowledge, attitude, and awareness of implant diseases among dental practitioners worldwide, compared with Saudi Arabia, it is scarce. Furthermore, a study done in 2018 talking about the understanding of peri-implant conditions among dentists in Iran shows a significant difference in awareness and recognition of different peri-implant diseases between general dentists and specialists [11]. Because there are few sources of information on our topic, particularly in Saudi Arabia, a small sample size, and inconsistent findings from prior research, this study aimed to assess the knowledge, awareness, and attitude level of dental practitioners in KSA regarding the aetiology, Diagnosis and treatment of peri-implant disease. The purpose of this study was to evaluate dental practitioners' and students' knowledge, awareness, and attitude toward the causes, treatments, and Diagnosis of peri-implant disease in Saudi Arabia.

Methodology:

Study Design and Setting:

This study was a cross-sectional questionnaire based on a structured questionnaire that was developed by the authors.

Subject: Participants, recruitment and sampling procedure:
The study's population consisted of dental practitioners and students in the Kingdom of Saudi Arabia; participants were recruited from July to November 2024 from people receiving the questionnaire.

Sample size:
To determine the minimum number of responses required to provide a representative sample for the entire population. The sample size was calculated by using the Roasoft sample size calculator. Keeping an indicator percentage of 0.50, a margin of error of 5 % and a confidence interval (CI) of 95%, the calculated sample size was 384.

Inclusion and Exclusion Criteria:
The inclusion criteria were male and female Saudi dental practitioners (general dentists, residents, consultants, and specialists), interns, and undergraduate dental students. People who aren't dentists, Dental assistants or dental technicians from private laboratories or dental institutions are excluded.

Method for data collection, instrument and score system:
A structured questionnaire was used as a study tool. After a thorough review of the literature and adoption of several previous research of a similar kind, our survey was created [11,12]. The final version of the questionnaire consisted of 26 questions classified into four main sections. Section one contained socio-demographic data questions such as age and educational qualifications. The second part asked about the knowledge of peri-implant diseases, while the third section included questions on awareness of peri-implant diseases. The fourth part is about the attitude towards peri-implant diseases.

Scoring system:
In all, 26 statements assessed the participants' attitudes, awareness, and degree of knowledge. There were six statements for demographics, 12 for knowledge, 3 for awareness, and 5 for attitude. One point is given for correct answers, and zero points are given for incorrect answers or "I don't know". We used Likert scales (Dichotomous, Three-Point, and Quality Scales) for scoring. The maximum score was 48 and divided as follows: The original Bloom's cut-off points were 80.0%-100.0%, 60.0%-79%, and 59.0%; the participants was divided into two groups based on their scores. Knowledge and awareness scores varied from 0 to 32 points. They were classified into three levels as follows: those with a score of 19 or below (≤19) were classified as having a **low level of knowledge and awareness**, those with scores between 20-25 as having a **moderate level of knowledge and awareness**, and those with scores 26 or above (≥26) as a **high level of knowledge and awareness.**
Attitude scores varied from 0 to 16 points. They were classified into three levels as follows: those with a score of 9 or below (≤9) were classified as having a **low level of attitude**, those with scores of 10 between 12 and as having a **moderate level of** mentality, and those with scores 13or above (≥13)as having a **high level of attitude.**

Pilot test:
The questionnaire was delivered to 20 people, who were asked to complete it. This was done to assess the questionnaire's simplicity and the study's practicality. The pilot study data was not included in the study's final results.

Analyzes and entry method:

The Microsoft Excel program (2016) for Windows was used to enter the collected data on the computer. The statistical package for social science software (SPSS), version 20, was then used to receive the data. To undergo statistical analysis.

Results:

The demographic parameters of the participants described in Table (1) are with a total number of (1098). Participants are on average 25.9 years old, and a large proportion of which are 25 to 27 years (33.3% of the sample). The gender distribution shows that females (57.6%) noticeably outnumber males (42.4%) perhaps indicating gender related trends in participation. The geographical representation of the respondent is well balanced for the southern and least for the northern region as more than half (53.2%) from the southern region respond. In terms of educational qualifications, general dentists (29.3%) are the next largest category of undergraduate, followed by undergraduates (39.0%). In addition, the data shows a diversity of professional experience with over half (34,6%) having 0 to 2 year experience. Notably, academic performance is amazing and 50.6 percent have good GPA. Overall, these findings characterize a young, predominantly female cohort with excellent academic backgrounds and varying degrees of professional experience.

Table (1): Sociodemographic characteristics of participants (n=1098)

Parameter		No.	Percent (%)
Age (Mean: 25.9, STD:7.6)	less than 23 years	216	19.7
	23 to 24	327	29.8
	25 to 27	366	33.3
	28 to 35	139	12.7
	more than 35 years	50	4.6
Gender	Female	632	57.6
	Male	466	42.4
Residential region	Northern region	36	3.3
	Southern region	584	53.2
	Center region	118	10.7
	Eastern Region	114	10.4
	Western Region	246	22.4
Educational qualification	Undergraduate	428	39.0
	Dental Intern	190	17.3
	Resident	90	8.2
	General Dentist	322	29.3
	Specialist	32	2.9
	Consultant	36	3.3
Years of experience	No experience	104	9.5
	0 to 2 years	380	34.6
	3 to 4 years	355	32.3
	5 to 7 years	189	17.2
	more than 7 years	70	6.4
Current GPA	Not student	86	7.8

	Satisfactory (from 1.00 to 1.74 out of 4.00) OR (from 2.00 to 2.74 out of 5.00)	18	1.6
	Good (from 1.75 to 2.74 out of 4.00) OR (from 2.75 to 3.74 out of 5.00)	80	7.3
	Very good (from 2.75 to 3.49 out of 4.00) OR (from 3.75 to 4.49 out of 5.00)	358	32.6
	Excellent (no less than 3.50 out of 4.00) OR (no less than 4.50 out of 5.00)	556	50.6

Figure 1 shows the data presented delineates the distribution of peri-implantitis classifications across the sample population. Interestingly, the great majority (442; 44.2%) fall into the category of 'Two' classification, which is more than half (59.3%) of the sample. Next, the majority (36.0%) of people are those classified as 'Three' which are 360 individuals. The "One" classification consists of 148 people or 14.8%, while the "More than three" also make up 148, another 14.8%.

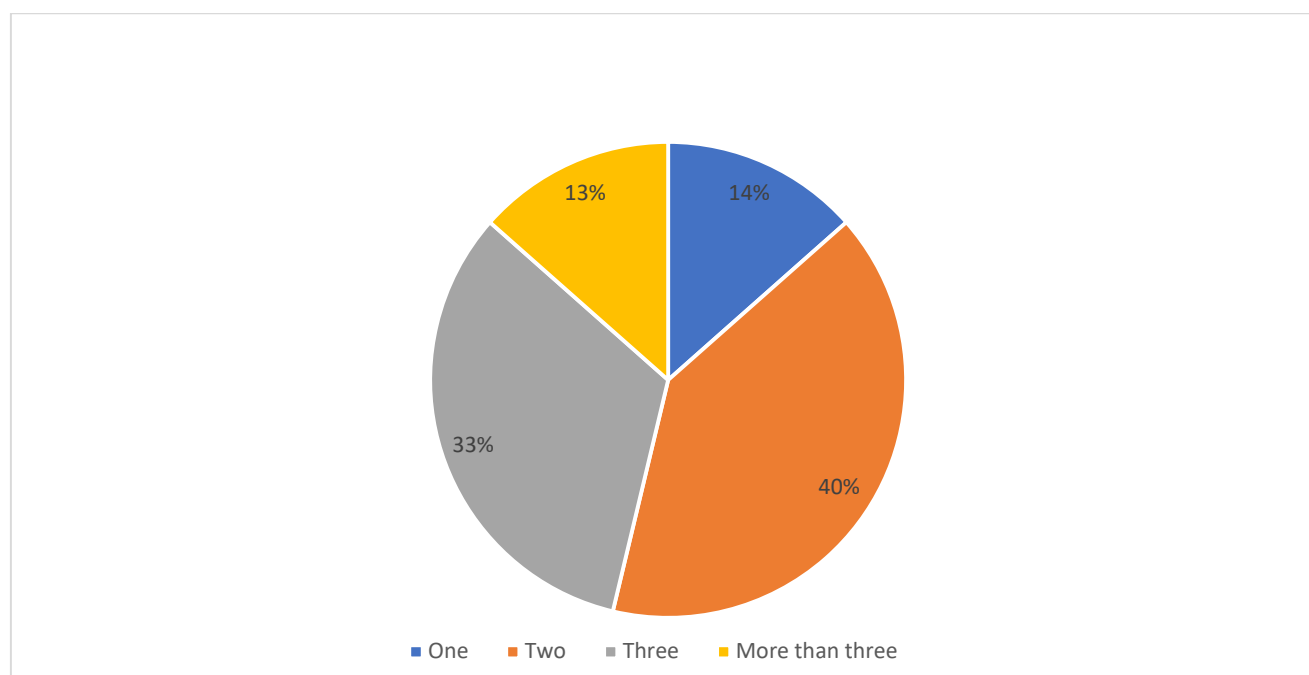*Figure (1): Illustrates classifications of peri-implantitis among participants.*

Table (2), illustrates The data presented give an overall knowledge and awareness on preimplant disease among a sample size of 1,098 respondents. Of note, 87.8 percent of participants were aware of dental implants; however, only 80.5 percent were familiar withperi-implantitis andperi-implant mucositis. We found a troubling segment in certain participants not knowing about peri-implantitis and peri-implant mucositis at 19.5%. This was a substantial drain in the knowledge bank about these deteriorating conditions. Additionally, the respondents provided diffuse understanding of the classification and clinical features of peri-implant diseases and only 58.5% agreed that peri–implant mucositis is reversible. Noteworthy was the fact that despite a prevailing knowledge of disease concepts, many

respondents were greatly uncertain as to similarities and differences between peri-implant mucositis and peri implantitis, clinical features and progress of these conditions and of periodontitis.

Table (2): Parameters related to knowledge and awareness regarding pre-implant diseases (n=1098).

Parameter		No.	Percent (%)
Have you heard about dental implants?	No	134	12.2
	Yes	964	87.8
Have you heard about peri-implantitis?	No	214	19.5
	Yes	884	80.5
Have you heard about Peri-implant mucositis?	No	214	19.5
	Yes	884	80.5
How many Peri-implantitis classifications are there?	One	148	13.5
	Two	442	40.3
	Three	360	32.8
	More than three	148	13.5
Which is reversible?	Peri-implant mucositis	642	58.5
	Peri-implantitis	252	23.0
	Both of the above	100	9.1
	None of the above	104	9.5
Can you Differentiate peri-implant mucositis from peri-implantitis?	No	196	17.9
	Yes	696	63.4
	Don't know	206	18.8
Is there a difference between the initiating mechanisms of periodontitis and peri-implantitis?	No	266	24.2
	Yes	582	53.0
	Don't know	250	22.8
Is there a Difference in the progression time of periodontitis and peri-implantitis?	No	198	18.0
	Yes	644	58.7
	Don't know	256	23.3
Is there a Difference in the clinical signs of gingivitis and peri-implant mucositis?	No	246	22.4
	Yes	632	57.6
	Don't know	220	20.0
*Select the correct clinical features of Peri-implantitis * *	Itching sensation around the affected region	314	28.6
	Presence of inflammation confined to the soft tissue surrounding a dental implant with no signs of loss of supporting bone	476	43.4
	Burning sensation around the implant	262	23.9
	Includes both soft tissue inflammation and progressive loss of supporting bone	434	39.5
	Don't know	140	12.8
Select the correct types of Peri-	Chronic and Acute	428	39.0

implantitis	Marginal and Retrograde	156	14.2
	Unilateral and Bilateral	234	21.3
	Don't know	280	25.5
Select the correct clinical feature of Peri-implant mucositis	Ulceration and abscess formation around the implant	212	19.3
	Bone loss and implant mobility	228	20.8
	The presence of inflammation is confined to the soft tissue surrounding a dental implant with no signs of loss of supporting bone.	422	38.4
	Systemic symptoms like fever, malaise, and GIT dysfunction, along with severe pain, are present in the affected region.	62	5.6
	Don't know	174	15.8
Assessment of peri-implant mucositis involves	Assessing implant mobility	276	25.1
	Assessing for tenderness on percussion	166	15.1
	Assessing Bleeding on probing (BOP) and suppuration	458	41.7
	Don't know	198	18.0
There is a demand for a particular instrument for the detection of peri-implantitis.	Strongly agree	346	31.5
	Agree	460	41.9
	Undecided	218	19.9
	Disagree	38	3.5
	Strongly disagree	36	3.3
What type of instruments/agents do you use for implant debridement? *	Titanium curettes	444	40.4
	Plastic curettes	430	39.2
	Stainless steel instrument	258	23.5
	Laser	240	21.9
	Hydrogen peroxide	138	12.6
	Chlorhexidine	148	13.5
	Don't know	176	16.0

*Results may overlap

As shown in figure (2), The assessment of peri-implant mucositis is crucial for ensuring optimal implant health and longevity, as evidenced by the provided data. Among the various assessment methods, the evaluation of bleeding on probing (BOP) and suppuration stands out as the most frequently utilized approach, with 458 instances recorded, which represents approximately 48.4% of the total assessments conducted. In contrast, the assessment of implant mobility accounted for 276 evaluations, or about 29.5%, indicating its significance but lesser frequency relative to BOP. Furthermore, tenderness on percussion was assessed in 166 cases, comprising around 17.7% of the total. Notably, a segment of respondents (198 instances, equating to 21.2%) were uncertain about their assessment methods.
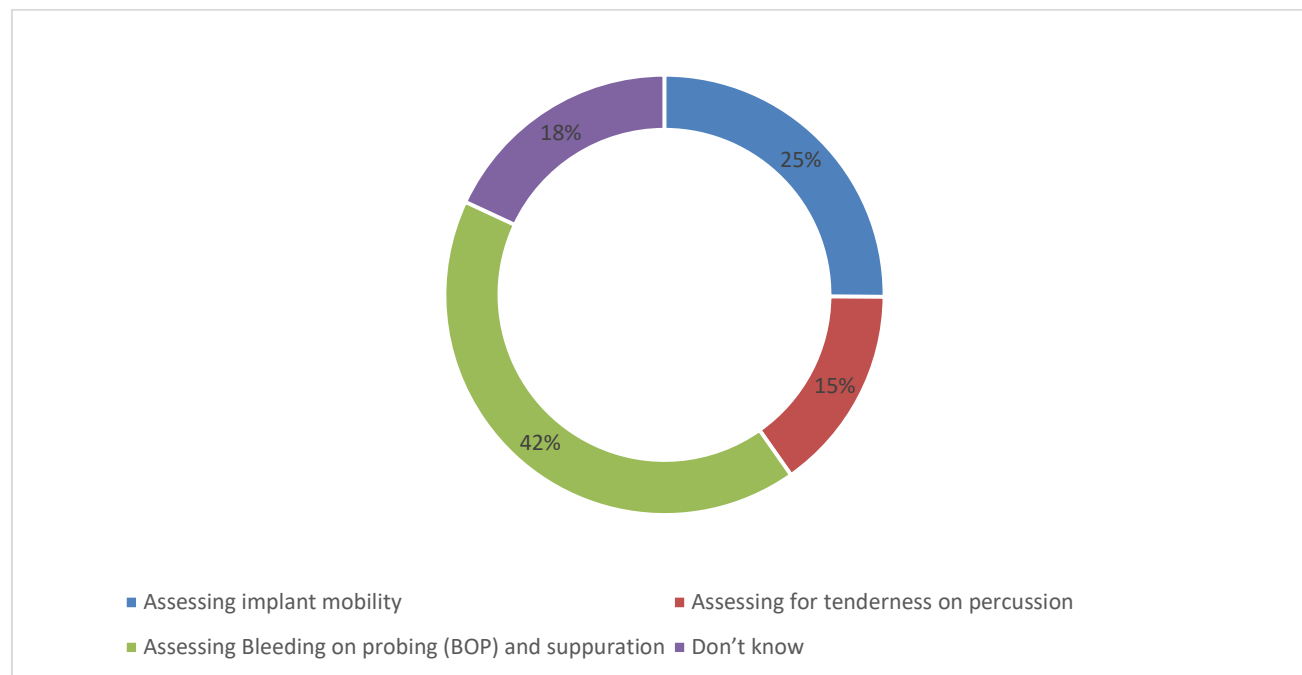
Figure (2): Illustrates assessment of peri-implant mucositis among participants.

Table (3) presents important insights into the views of participants on pre-implant diseases, much of it based on both awareness and misconceptions about dental implants and the complications that may arise with implants. An impressive majority, 74%, states that missing teeth should be replaced, reflecting a powerful strong preference for restorative dentistry. However, only 35.5 percent of respondents feel you 'very well' informed about the implants meaning there are places in education that might not be helping patients making decisions for them or for the outcomes. Additionally, 43.7 percent of the subjects identify peri-implantitis as originating from poor oral hygiene following implantation, implying sufficiently strong emphasis on patient education concerning maintenance techniques. Moreover, the data is interesting in that it shows a range of opinion about the frequency of recall in patients who have had a dental implant, with 36.8 percent suggesting every 3 to 4 months indicating that people know that patients need to be recalled periodically in order to prevent problems.

Table (3): participants' attitude towards pre-implant diseases (n=1098).

Parameter		*No.*	*Percent (%)*
Should missing teeth be replaced?	No	158	14.4
	Yes	812	74.0
	Don't know	128	11.7
How well-informed do you feel about dental implants?	Very well	390	35.5
	Moderately well	482	43.9
	Poorly	134	12.2
	Not at all	92	8.4

What do you think leads to Peri-implantitis?	Differs from person to person	268	24.4
	Due to a dentist's error while placing the implant	90	8.2
	It starts with its own	136	12.4
	Not maintaining proper oral hygiene after implant placement	480	43.7
	Don't know	124	11.3
What is a possible treatment plan for peri-implantitis? (more than one answer) *	Laser	492	44.8
	GBR	686	62.5
	Implant cleaning	576	52.5
To avoid peri-implant disease, must the recall frequency for dental implant patients be...?	Annually	56	5.1
	Every 1-2 months	216	19.7
	Every 3-4 months	404	36.8
	Every 1-6 months in the first year, once a year after that	306	27.9
	No idea	116	10.6

*Results may overlap

The data presented in Table 4 illustrates a concerning trend regarding knowledge and awareness of pre-implant disease among the surveyed population. With only 6.7% demonstrating a high level of knowledge, the majority exhibit either moderate (35.5%) or low (57.7%) levels of awareness. This indicates a significant gap in understanding, as more than half of the respondents fall into the low knowledge   category.

Table (4): Shows knowledge and awareness about pre-implant diseases score results.

	Frequency	**Percent**
High knowledge level	74	6.7
Moderate level	390	35.5
Low knowledge level	634	57.7
Total	1098	100.0

The observed attitudes of the surveyed population towards pre implant disease scores are pretty interesting and reflected in Table 5. The findings also indicate that 21.5 per cent of respondents have a high attitude towards these scores indicating a high level of awareness or concern among a minority with a total of 1,098 respondents. However, a relatively large 46.4% harbor a more moderate attitude, indicating in balance a slight awareness of the value of pre-implant disease assessment but perhaps not further commitment or prevention. Moreover, 32.1% of the participants show a low attitude and this might be due to not understanding or valuing the pre implant disease risks.

Table (5): Shows attitude about pre-implant diseases score results.

	Frequency	**Percent**
High attitude	236	21.5
Moderate attitude	510	46.4
Low attitude	352	32.1
Total	1098	100.0

Table (6) shows that knowledge level about pre-implant disease has statistically significant relation to age (P value=0.0001), educational qualification (P value=0.015), years of experience (P value=0.003), and current GPA (P value=0.0001). It also shows statistically insignificant relation to gender, and residential region.

Table (6): Relation between knowledge level about pre-implant disease and sociodemographic characteristics.

Parameters		*Knowledge level*		*Total (N=1098)*	*P value**
		High or moderate level	**Low knowledge level**		
Gender	Female	260	372	632	0.382
		56.0%	58.7%	57.6%	
	Male	204	262	466	
		44.0%	41.3%	42.4%	
Age	less than 23 years	42	174	216	0.0001
		9.1%	27.4%	19.7%	
	23 to 24	156	171	327	
		33.6%	27.0%	29.8%	
	25 to 27	198	168	366	
		42.7%	26.5%	33.3%	
	28 to 35	58	81	139	
		12.5%	12.8%	12.7%	
	more than 35 years	10	40	50	
		2.2%	6.3%	4.6%	
Residential region	Northern region	12	24	36	0.231
		2.6%	3.8%	3.3%	
	Southern region	236	348	584	
		50.9%	54.9%	53.2%	
	Central region	52	66	118	
		11.2%	10.4%	10.7%	
	Eastern Region	46	68	114	
		9.9%	10.7%	10.4%	
	Western Region	118	128	246	
		25.4%	20.2%	22.4%	

Educational qualification	Undergraduate	166	262	428	0.015
		35.8%	41.3%	39.0%	
	Dental Intern	92	98	190	
		19.8%	15.5%	17.3%	
	Resident	28	62	90	
		6.0%	9.8%	8.2%	
	General Dentist	150	172	322	
		32.3%	27.1%	29.3%	
	Specialist	16	16	32	
		3.4%	2.5%	2.9%	
	Consultant	12	24	36	
		2.6%	3.8%	3.3%	
Years of experience	0 to 2 years	162	218	380	0.003
		34.9%	34.4%	34.6%	
	3 to 4 years	154	201	355	
		33.2%	31.7%	32.3%	
	5 to 7 years	92	97	189	
		19.8%	15.3%	17.2%	
	more than 7 years	30	40	70	
		6.5%	6.3%	6.4%	
	No experience	26	78	104	
		5.6%	12.3%	9.5%	
Current GPA	Not student	44	42	86	0.0001
		9.5%	6.6%	7.8%	
	Satisfactory (from 1.00 to 1.74 out of 4.00) OR (from 2.00 to 2.74 out of 5.00)	0	18	18	
		0.0%	2.8%	1.6%	
	Good (from 1.75 to 2.74 out of 4.00) OR (from 2.75 to 3.74 out of 5.00)	26	54	80	
		5.6%	8.5%	7.3%	
	Very good (from 2.75 to 3.49 out of 4.00) OR (from 3.75 to 4.49 out of 5.00)	148	210	358	
		31.9%	33.1%	32.6%	
	Excellent (no less than 3.50 out of 4.00) OR (no less than 4.50 out of 5.00)	246	310	556	
		53.0%	48.9%	50.6%	

P value was considered significant if ≤ 0.05.

Table (7) shows attitude level of pre-implant disease has statistically significant relation to age (P value=0.0001), residential region (P value=0.026), and educational qualification (P value=0.009). It also shows statistically insignificant relation to gender, years of experience, and current GPA.

Table (7): Attitude level of pre-implant disease in association with sociodemographic characteristics.

Parameters		Attitude level		Total (N=1098)	P value*
		High or moderate attitude	Low attitude		
Gender	Female	440	192	632	0.165
		59.0%	54.5%	57.6%	
	Male	306	160	466	
		41.0%	45.5%	42.4%	
Age	less than 23 years	130	86	216	0.0001
		17.4%	24.4%	19.7%	
	23 to 24	252	75	327	
		33.8%	21.3%	29.8%	
	25 to 27	262	104	366	
		35.1%	29.5%	33.3%	
	28 to 35	82	57	139	
		11.0%	16.2%	12.7%	
	more than 35 years	20	30	50	
		2.7%	8.5%	4.6%	
Residential region	Northern region	20	16	36	0.026
		2.7%	4.5%	3.3%	
	Southern region	410	174	584	
		55.0%	49.4%	53.2%	
	Central region	68	50	118	
		9.1%	14.2%	10.7%	
	Eastern Region	74	40	114	
		9.9%	11.4%	10.4%	
	Western Region	174	72	246	
		23.3%	20.5%	22.4%	
Educational qualification	Undergraduate	306	122	428	0.009
		41.0%	34.7%	39.0%	
	Dental Intern	138	52	190	
		18.5%	14.8%	17.3%	
	Resident	54	36	90	
		7.2%	10.2%	8.2%	
	General Dentist	200	122	322	
		26.8%	34.7%	29.3%	
	Specialist	26	6	32	
		3.5%	1.7%	2.9%	
	Consultant	22	14	36	
		2.9%	4.0%	3.3%	
Years of experience	0 to 2 years	248	132	380	0.112
		33.2%	37.5%	34.6%	
	3 to 4 years	252	103	355	

		33.8%	29.3%	32.3%	
	5 to 7 years	136	53	189	
		18.2%	15.1%	17.2%	
	more than 7 years	48	22	70	
		6.4%	6.3%	6.4%	
	No experience	62	42	104	
		8.3%	11.9%	9.5%	
Current GPA	Not student	66	20	86	0.060
		8.8%	5.7%	7.8%	
	Satisfactory (from 1.00 to 1.74 out of 4.00) OR (from 2.00 to 2.74 out of 5.00)	12	6	18	
		1.6%	1.7%	1.6%	
	Good (from 1.75 to 2.74 out of 4.00) OR (from 2.75 to 3.74 out of 5.00)	46	34	80	
		6.2%	9.7%	7.3%	
	Very good (from 2.75 to 3.49 out of 4.00) OR (from 3.75 to 4.49 out of 5.00)	234	124	358	
		31.4%	35.2%	32.6%	
	Excellent (no less than 3.50 out of 4.00) OR (no less than 4.50 out of 5.00)	388	168	556	
		52.0%	47.7%	50.6%	

*P value was considered significant if ≤ 0.05.

Discussion:

Dental implant treatment is sprouting as the preferred method of tooth replacement not only for partially edentulous but also for completely edentulous cases. Proper utilization of this treatment modality by the dentists has resulted in improvement in oral health-related quality of life in patients. This, in turn, has helped to restore normal function, speech, appearance, and health of the people with missing teeth, even in challenging situations [13]. Implant dentistry, once a specialty practice, has now been widely practiced by a number of general dental practitioners. However, successful implant practice requires in-depth knowledge of anatomy, biomechanics, and clinical skills among the practitioners. The clinical success of implants is influenced by many factors such as patient's age, systemic and periodontal health, implant site, bone quality, oral hygiene of the patient, and deleterious habits [14]. Although the success rates reported with dental implant treatment are relatively high, complications do occur as a result of improper treatment planning, surgical and prosthetic execution, material failure, and maintenance [15]. Bacterial infection and inflammation of the surrounding tissue (peri-implant mucositis and peri-implantitis) are the most common causes of implant failure. Peri-implant mucositis is an inflammatory condition of the soft tissues surrounding an endosseous implant; whereas peri-implantitis is defined as the presence of inflammation in the soft tissues in addition to the loss of supporting bone around an osseointegrated implant [16]. Various clinical protocols have been developed for the prevention and treatment of peri-implantitis, which include nonsurgical/surgical debridement, use of antiseptic agents, local or systemic antibiotics [17]. Thus, we aimed in this study to assess the knowledge, awareness, and attitude level of dental practitioners and students in KSA regarding the aetiology, diagnosis and treatment of peri-implant diseases.

Our study findings — that 87.8% of participants were aware of such implants, while 80.5% recognized peri-implant diseases — give valuable insight to the status of dental education among patients at present. Interestingly, 19.5% of subjects did not recognize peri-implantitis and peri-implant mucositis, and they may be representative of previous observations. For example, Madi et al. [18] observed that 81.6% of participants understood peri – implantitis as an inflammatory disease but 77.9% awareness of bacterial plaque as an etiological factor suggests both a parallel error in understanding fundamental dental implant care. Additionally, our discovery that not more than 58.5 % of participants correctly diagnosed periimplant mucositis as reversible reconfirm the findings of other studies that have shown that there is no significant correlation between demographic variables with knowledge [19], as opposed to our finding of an educational deficiency towards affecting patients' perception of implant health. Our respondents' robust belief in the necessity of replacement of missing teeth (74%) is a signal of attitudinal alignment with dental solution desire, yet tells against themselves a strikingly low percentage (35.5%) who reported feeling 'very well' informed about dental implants. The existence of such a discrepancy point to important educational gaps that extend to patient care as well as the need to develop educational initiatives that are far more sophisticated. In contrast, Moghaddam et al. [20] demonstrated that, while the demographic factors such as age and experience had no bearing on knowledge levels among dentists (less than 20% rated as having 'good' knowledge) we confirmed that knowledge deficits were not limited to select groups. From an etiological awareness standpoint, most participants blamed the poor etiology of peri-implantitis on poor post implant hygiene. This aligns with Madi et al. [18], which identified smoking (identified by 82% of respondents) and periodontitis (80.5%) as significant risk factors. Both findings indicate a need for a stronger focus on educating both patients and practitioners about the influences of lifestyle and maintenance practices on implant success. The emphasis placed by our respondents on hygiene as a contributing factor presents an important area for educational intervention. Further, Rinky Tripathi et al. [21] highlighted that dentist who trained in non-standard environments had subpar knowledge, suggesting that standards of education directly impact overall knowledge and practice behaviors. This corroborates with our findings that knowledge levels were related to education and experience, begging for improvements in educational frameworks within both dental and patient communities. Our results, revealing strong correlations between attitudes and demographic factors, particularly education and age, further reinforce the notion that strategic adjustments to educational programs could enhance understanding and care practices related to dental implants. Similarly, a study focusing on general practitioners found that while 91.9% had moderate knowledge of peri-implant diseases, there was a notable deficiency (89.4%) in understanding implant maintenance programs [22]. This resonates with our findings regarding the general lack of awareness of peri-implantitis and reveals a prevalent trend across studies that highlights the necessity for consistent knowledge improvement strategies.

Conclusion:

In conclusion, our study reveals significant gaps in the knowledge, awareness, and attitudes of dental practitioners and students in Saudi Arabia regarding peri-implant diseases. While a majority (87.8%) demonstrate awareness of dental implants, a concerning 19.5% lack familiarity with critical conditions such as peri-implantitis and peri-implant mucositis. Furthermore, only 58.5% correctly identified peri-implant mucositis as reversible, indicating a need for enhanced educational efforts. The findings suggest that knowledge levels correlate positively with age, educational qualifications, and years of experience, highlighting the importance of targeted educational interventions. Despite a strong belief in the necessity of replacing missing teeth (74%), only 35.5% of participants felt "very well" informed about dental implants, emphasizing the need for improved educational frameworks. Addressing these

deficiencies through comprehensive training programs could significantly enhance the understanding and management of peri-implant diseases, ultimately leading to better patient outcomes and dental care practices in Saudi Arabia.

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.

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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