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KNOWLEDGE AND AWARENESS LEVEL OF BISPHOSPHONATES IMPLICATIONS FOR PATIENT HEALTH: A CROSS-SECTIONAL STUDY

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Abstract

Background: Anti-resorptive agents used widely for osteoporosis and other bone disorders include bisphosphonates. However, there has been insufficient awareness by dental professionals of the clinical significance, especially with regard to medication related osteonecrosis of the jaw (MRONJ). **Objective:** The purpose of the present study was to assess bisphosphonate knowledge as well as awareness among Saudi senior dental students, dental interns, and general dentists and the implications of this regarding patient health. **Methods:** From July to December 2024, a cross-sectional survey was carried using the validated-on line questionnaire circulated through social media platforms. Dental students, interns and general dentists taking part in the study were from Saudi Arabia. The demographic data and general knowledge regarding bisphosphonates, their indications for use, mechanisms of action, risk factors and side effects were assessed from the questionnaire. **Results:** Fifty-two-point six percent of participants were female and had an average age of 25.6 years with a total of 530 participants. Participants were most familiar with bisphosphonates (78.3%), but only 43.6% named Alendronate and 29.6% were aware of how it works. More than 30 percent positively answered all three knowledge questions, but notably very few correctly identified osteonecrosis of the jaw as a major risk. Moreover, respondents showed low levels of understanding (60.6%) regarding bisphosphonates and they expressed interest (84.7%) in additional training. **Conclusion:** Therefore, the study points out a worrying lack of knowledge about bisphosphonates amongst dental students and practicians in Saudi Arabia. There is a basic knowledge of bisphosphonates, but there was little understanding of how they work and, most importantly, what they mean for patient health, especially with regard to MRONJ. These results highlight the importance of heightened educational efforts incorporated into dental curricula to prepare

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future dental professionals appropriately to address risks associated with bisphosphonate therapy.
Keywords: Bisphosphonate, BRONJ, General dental practitioner, Jaw necrosis, Medication-related osteonecrosis of the jaw.

Introduction:

Bisphosphonates are anti-resorptive substances that inhibit the osteoclastic activity and suppress apoptosis affecting the bone remodeling process and preventing bone loss, leading to their use as a treatment in the 1960s [1]. Patients with osteoporosis and osteopenia can utilize bisphosphonates to treat malignant bone disorders, hypercalcemia, Paget's disease, multiple myeloma, avoid metastatic bone malignancies, and minimize fractures resulting from osteoporosis [2] . There is still much to learn about this class of medications in order to increase the number of potential applications, such as the therapy of neurodegenerative illnesses [3] . The first instance of osteonecrosis of the jaw in patients who are taking Bisphosphonate, which was later called as Bisphosphonate-related osteonecrosis of the jaw (BRONJ), was reported by Marx in 2003 [4]. In 2014, the American Association of Oral and Maxillofacial Surgeons (AAOMS) changed the term to medication-related osteonecrosis of the jaw (MRONJ) to cover a wider range of osteonecrosis cases caused by antiresorptive and antiangiogenic Medications [5]. In individuals receiving dental treatment and using bisphosphonates, a recent systematic review found an overall prevalence of 2.7% of BRONJ, with an intravenous use-specific prevalence of 6.9% [6]. In another study, the prevalence of MRONJ in patients who received intravenous bisphosphonates, ranges from 0.2 to 6.7%, and in patients who take it orally, it varies from 0.004 to 0.2% [7]. The risk factors for MRONJ are mostly medication related, such as dosage, duration, therapeutic indication, and route of administration. However operative procedure, such as extractions, underling disease such as Diabetes, or concurrent use of corticosteroids also increases the risk of MRONJ [8]. This condition is diagnosed only if the patient is currently or previously Treated with antiangiogenic or antiresorptive agents and has a bony exposure unrelated to radiotherapy or a clear metastatic disease to the jaws for more than eight weeks [9]. In a recent study by khinda et al, 65.4% of the dental students and dentist who participated stated that they were familiar with the term MRONJ, however when asked about the clinical appearance, features of the disease, risk factors less than 45% had enough knowledge or were aware of it [10]. A study by Al-mousa et al, shown that even though the majority of the sample had exposure of anti-resorptive and anti-angiogenic drugs during their studies in their undergrade years, the level of knowledge was low Failing to recognize the primary diseases targeted by antiresorptive and antiangiogenic medications, the names of any antiresorptive or antiangiogenic medication and the correct definition of MRONJ [8]. Al-Eid et al found that in order to have adequate prevention and management of MRONJ, a practitioner need a high degree of awareness and information of the condition which was only found in 2.7% of the participants and more than half did not know enough about the condition [11]. Maha Shawky reached the conclusion that while many interviewees were aware of MRONJ, they were unfamiliar with the basic principles involved in its prevention [12] . Due to the insufficient number of studies related to our topic in Saudi Arabia and given the growing number of patients on bisphosphonates and other antiresorptive agents, it is crucial for dentists to have a good knowledge of such medications and their implications for the prevention and management of MRONJ.

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Objective:
The main objective of this study was to measure the knowledge and awareness level regarding the bisphosphonates implications for patient health among Saudi senior dental students (SS) and dental interns (IN) and general dentists (GP).

Methodology:

Study design and Setting:
This cross-sectional survey was carried out in Saudi Arabia from July to December 2024, based on a validated questionnaire. this study evaluates Saudi Arabian senior dental students and interns, and general dentists regarding bisphosphonates implication s for patient health.

Subject: Participants, recruitment and sampling procedure:
The Participants in this study consisted of Senior dental students and Interns, and General dentists from around Saudi Arabia. A typical recruitment strategy relies on social media platforms (e.g., Twitter, Snapchat, Instagram, WhatsApp, Facebook).

Sample size:
From July 2024 to December 2024 was the beginning of data collecting. Data collection involved a target sample of 384 respond (confidence level: 95%; margin of error: 5%).The sample size was estimated using the formula: n = P(1-P) * Zα 2 / d 2 with a 95% confidence level.
n: Calculated sample size.
Z: The z-value for the selected level of confidence (1-a) = 1.96.
P: An estimated prevalence of knowledge.
Q: (1 –0.50) = 50%, i.e., 0.50.
D: The maximum acceptable error = 0.05.
Therefore, the calculated minimum sample size was: n = (1.96)2 X 0.50 X 0.50/(0.05) 2 = 384.

Inclusion and Exclusion criteria:
The inclusion criteria were Saudi senior dental students (SS) and dental interns (IN) and general dentists (GP). Exclusion criteria were pre-senior dental student and dental residents, specialists, consultants, and faculty staff.

Method for data collection, instrument and score system:
For data collection, an online questionnaire was used, which was developed with reference to a questionnaire used by other researchers [13]. The questionnaire consisted of three parts. In the first part, there were questions regarding the characterization of the sample, such as the gender, age and the region also the position student or intern or GP if it is GP where is the workplace. The second part of the questionnaire consisted of 6 objective questions and multiple choices regarding general knowledge

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about bisphosphonates and their relevance in history, medical indications and mechanism of action; questions that evaluated students' knowledge about the characteristics, risk factors and prevention strategies, interesting for receiving further information and training In the third part of the questionnaire.

Scoring system:

In all, 19 statements served to assess the participants' degree of knowledge about relevance in history, medical indications and mechanism of action also side effects and risk factors. 5 statements for demographics, 6 for knowledge about relevance in history, medical indications and mechanism of action, and 8 for knowledge about side effects and risk factors. One point is given for correct answers, and zero poinis are given for incorrect answers. The maximum score was 24 and divided as follows: The original Bloom's cut-off points, 80.0%- 100.0%, 60.0%-79%, and 59.0%, The participants divided into three groups based on their scores. 1st knowledge score varied from 0 to 13 points and was classified into three levels as follows: those with a score of 7 or below (≤ 7) were classified as having a low level of knowledge, those with scores between 8 and 9 as having a moderate level of knowledge, and those with scores 10 or above (≥ 10) as a high level of knowledge.

2nd knowledge scores varied from 0 to 11 points and were classified into three levels as follows: those with a score of 6 or below (≤ 6) were classified as having a low level of knowledge, those with scores between 7 and 8 as having a moderate level of knowledge, and those with scores 9 or above (≥ 9) as having a high level of knowledge.

Pilot test:

The questionnaire was delivered to 20 people and requested them to complete it. This was done to assess the questionnaire's simplicity and the study's practicality. The data from the pilot research was omitted from the study's final results.

Analyzes and entry method:

The data was entered into the device using "Microsoft Office Excel Software" for Windows (2021). The acquired data was subsequently uploaded to the Statistical Package for Social Science Software (SPSS) tool, version 25 (IBM SPSS Statistics for Microsoft Windows, Version 25.0), for statistical analysis.

Results:

Table (1) displays various demographic parameters of the participants with a total number of (530). Participants average age is 25.6 years and there is a marked concentration of individuals 24 to 25 years of age (32.8% of sample). This stands as indication to the fact that they are dominated by young professionals, who might affect the planning of the workforce and educational resources. The balance between females and males in this sample is relatively balanced, with 52.6 percent females, and this slight female majority is a repetition of upstream social forces of gender equity in healthcare occupations. Most participants are from the Southern region (50.9%) followed by the Western region (19.4%), thus indicating a possible regional disparity in resource expenditure in the dentals or access to dentals education. Interestingly, potentially useful capacity for early career dentists to contribute to health outcomes of community can be seen in 42.5% of our responses who are junior dental students and dentists at 38.5% of respondents, respectively, while 30.1% of general practitioners report that they

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are unemployed.

Table (1): Sociodemographic characteristics of participants (n=530)

Parameter		***No.***	***Percent (%)***
Age (Mean:25.6, STD:4.6)	23 or less	150	28.3
	24 to 25	174	32.8
	26 to 27	133	25.1
	More than 27	73	13.8
Gender	Female	279	52.6
	Male	251	47.4
Region of residence	Northern region	29	5.5
	Southern region	270	50.9
	Central region	90	17.0
	Eastern region	38	7.2
	Western region	103	19.4
Position	Dental intern	101	19.1
	Dentist (GP)	204	38.5
	Senior dental student	225	42.5
If GP, where do you work? (n=359)	Ministry of Health	107	29.8
	Other government sector	52	14.5
	Private sector	92	25.6
	Unemployed	108	30.1

As shown in figure 1, Insightful trends in the understanding of medical applications for bisphosphonates appear evident based upon the survey data. Overall, over 45.5 % (217) respondents revealed knowledge that bisphosphonates are applicable to treat all of the listed conditions. This concept points to the importance of the drug class for multiple bone related diseases. Such further analysis also shows that osteoporosis was the indication specifically identified by 176 people, some 38.6% of respondents, indicating its prevalence as a first indication in clinical practice. 29 (6.1%) recognized Paget's disease of bone, 23 of whom (5.1%) mentioned hypercalcemia of malignancy, 23 (5.1%) reported metastatic bone disease, and 28 (6.1%) mentioned primary hyperparathyroidism. Interestingly, 63 (13.9 %) people said that there was uncertainty surrounding when and how bisphosphonates should be used.

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Figure (1): Illustrates the medical applications for bisphosphonates among participants.

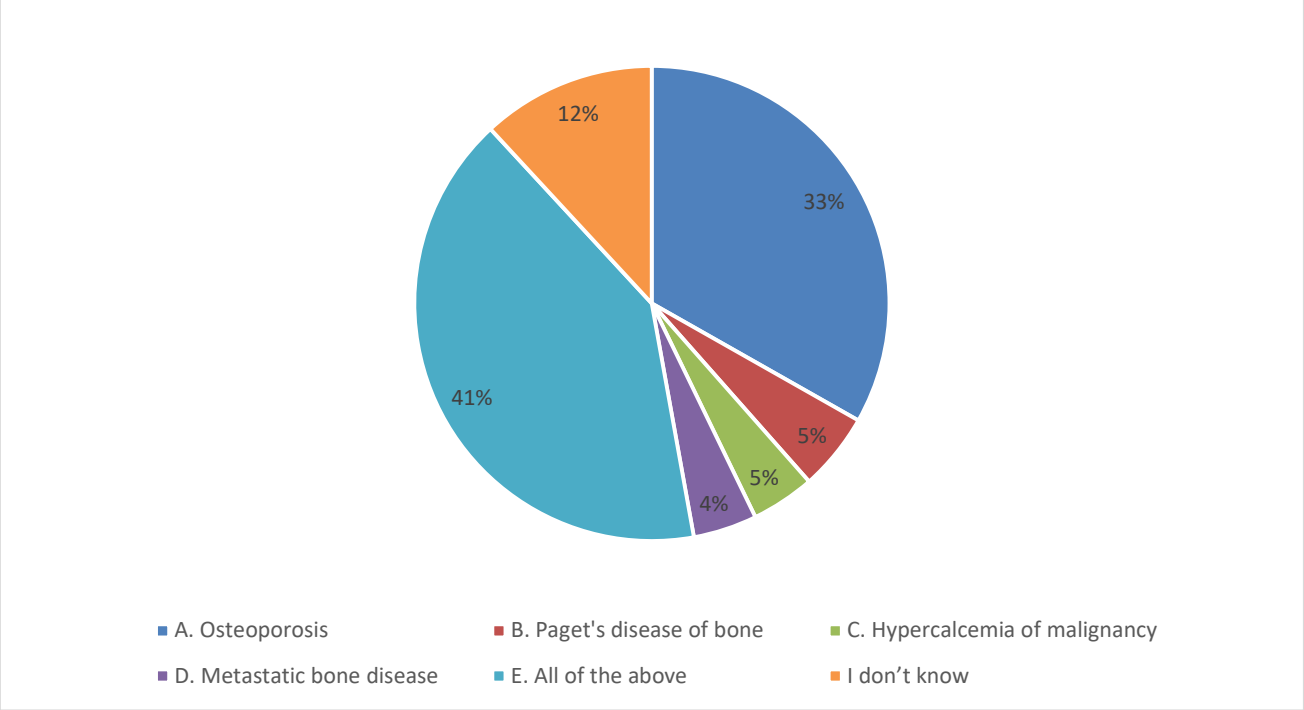

Table 2 depicts the knowledge and awareness of dental students about bisphosphonates, a class of drug very important in the management of bone related disorders. Notably, 78.3% of the 530 is familiar with the bisphosphonates, illustrating a well-established foundational knowledge among the readers. Yet knowledge of selected agents within this class is uneven, with 43.6% recalling Alendronate (Fosamax) while other bisphosphonates are less familiar to students. In addition, prior medical history is unanimously included in the anamnesis, as well as the consideration of patients taking bisphosphonates (89.4%). This emphasizes that the consideration of these medications in dental practice is considered relevant (88.9%). Nevertheless, nearly every student underestimated the number of medical uses of these compounds (40.9%). This suggests a lack of total awareness. Furthermore, the knowledge concerning the mechanism of action shows that only a fraction of 29.6% knew the correct processes indicating necessity of boosting the educational initiates regarding these key pharmacological agents

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Table (2): Parameters related to knowledge of dental students about bisphosphonates and their relevance in history, medical indications and mechanism of action (n=530).

Parameter		***No.***	***Percent (%)***
Are you familiar with the drugs class known as bisphosphonates?	No	115	21.7
	Yes	415	78.3

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Select the bisphosphonates that you know *	• Alendronate (Fosamax)	231	43.6
	• Risedronate (Actonel)	136	25.7
	• Ibandronate (Boniva)	144	27.2
	• Zoledronate (Reclast)	176	33.2
	• Etidronate (Didronel)	92	17.4
	• Pamidronate (Aredia)	115	21.7
	• Clodronate (Bonefos)	94	17.7
	• Tiludronate (Skelid)	70	13.2
	• none of the above	145	27.4
Do you believe it vital to take into account the patient under treatment of bisphosphonates?	No	56	10.6
	Yes	474	89.4
Do you believe it is crucial to include in the anamnesis the patient's previous medical history of bisphosphonate treatment?	No	59	11.1
	Yes	471	88.9
Do you understand the medical applications for bisphosphonates?	A. Osteoporosis	176	33.2
	B. Paget's disease of bone	28	5.3
	C. Hypercalcemia of malignancy	23	4.3
	D. Metastatic bone disease	23	4.3
	E. All of the above	217	40.9
	I don't know	63	11.9
Do you know how bisphosphonates work?	A. Inhibit osteoclast-mediated bone resorption	147	27.7
	B. Stimulate osteoblast-mediated bone formation	48	9.1
	C. Reduce bone blood flow	39	7.4
	D. A and B	157	29.6
	E. All of the above	47	8.9
	I don't know	92	17.4

****Results may overlap***

As shown in figure (2), The results presented show a worrying frequency of oral side effects with bisphosphonate use, particularly osteonecrosis of the jaw reported by 188 of the respondents, and 54.5% of total responses. In addition, 37 percent answered xerostomia (dry mouth) and 23 percent reported taste disturbances. In particular, a considerable number of respondents, 133 (roughly 38%) correctly identified osteonecrosis and xerostomia as side effects, as classified under option D. In addition, 27.7% (97 respondents) said that the option that they are aware of all listed side effects was chosen. Apparently 52 people (14.9%) expressed doubt with these side effects.

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Figure (2): Illustrates the oral side effects induced by phosphonates among participants.

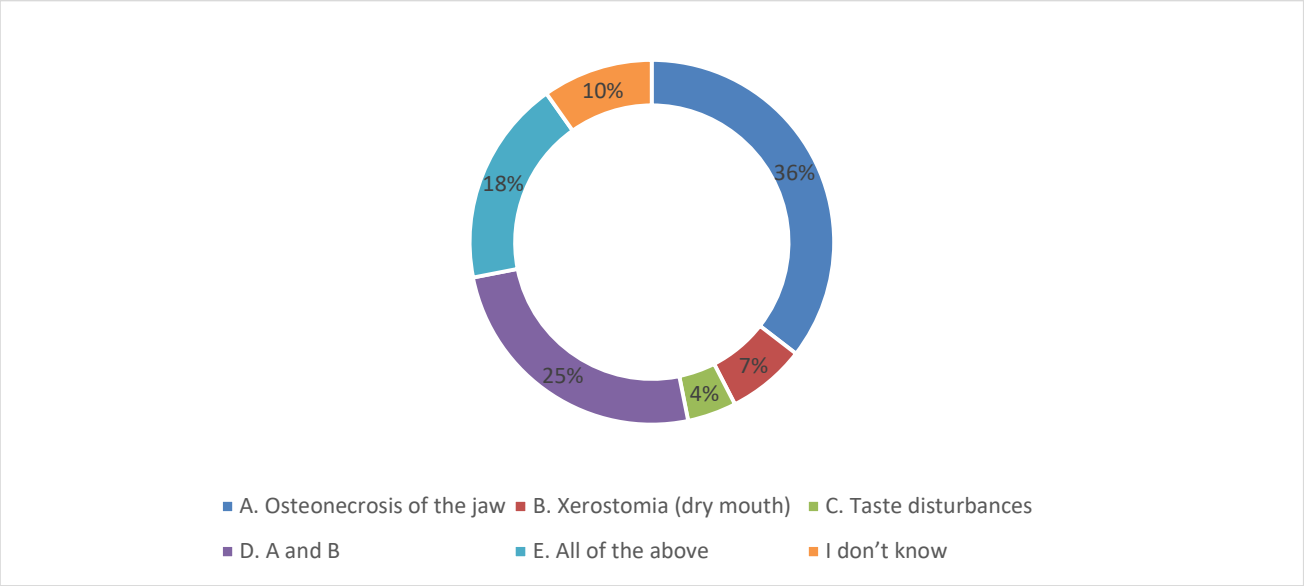

Table 3 presents the given data which presents to an informative data and tells what dental students know about bisphosphonates' side effect and risk factors. Furthermore, 35.5% of respondents mentioned Osteonecrosis of the Jaw as an oral side effect, 25.1% mentioned both Osteonecrosis and xerostomia, and another 22.7% mentioned both as separate side effects. The study also points out that a relatively sizable portion (29.1%) are mindful of the fact that all mentioned factors (duration and route of administration of the therapy) contribute to the appearance of the oral adverse effects. Alongside the findings reveal profound understanding of procedural risks, more than 70.6 percent noted that tooth extractions are the most common dental procedure that increases these risks. Participants, encouragingly, were particularly interested in obtaining additional training on this topic: 84.7% said they were.

Table (3): Knowledge of dental students about side effects and risk factors associated with bisphosphonates (n=530).

Parameter		***No.***	***Percent (%)***
Do you know of any oral side effects induced by bisphosphonates?	A. Osteonecrosis of the jaw	188	35.5
	B. Xerostomia (dry mouth)	37	7.0
	C. Taste disturbances	23	4.3
	D. A and B	133	25.1
	E. All of the above	97	18.3
	I don't know	52	9.8

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What risk factors associated with bisphosphonate can lead to the development of oral side effects?	A. Duration of bisphosphonate therapy	72	13.6
	B. Route of administration (oral vs intravenous)	56	10.6
	C. Presence of dental infection or trauma	53	10.0
	D. A and B	128	24.2
	E. All of the above	154	29.1
	I don't know	67	12.6
What is the most common dental procedure that can increase the risk of developing oral side effects related to bisphosphonate use?	A. Tooth extractions	374	70.6
	B. Root canal treatment	32	6.0
	C. Dental cleanings	32	6.0
	D. Dental fillings	14	2.6
	I don't know	78	14.7
What kind of oral diseases can increase the chance of developing oral adverse effects from bisphosphonates?	A. Periodontal disease	77	14.5
	B. Dental caries	27	5.1
	C. Oral infections	71	13.4
	D. A and C	217	40.9
	E. All of the above	58	10.9
	I don't know	80	15.1
Which procedures can stop the oral adverse effects that come with using bisphosphonates?	A. Comprehensive dental examination and treatment prior to initiating bisphosphonate therapy	83	15.7
	B. Routine dental cleanings and checkups during bisphosphonate treatment	50	9.4
	C. Avoidance of invasive dental procedures like tooth extractions during bisphosphonate treatment	61	11.5
	D. A and B	103	19.4
	E. All of the above	162	30.6
	I don't know	71	13.4
Have you taken any classes related to this topic?	Yes	346	65.3
	No	184	34.7
When was the last time you attended to a lecture on pathology/oral medicine?	Less than 1 year ago	165	31.1
	1 year ago	120	22.6
	More than 2 years ago	157	29.6
	Never watched but I'm interested	46	8.7

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	Never watched and I have no interest	42	7.9
Are you interested in obtaining further information and training?	Yes, I want	449	84.7
	No, I'm not interested	81	15.3

Table 4, however, shows an alarming trend about how little dental students know about bisphosphonates, a class of medicines commonly used to treat variety of bone disorders. This is interesting because a mere 7.4 percent of respondents had a high level of understanding while 9.1 percent had a moderate level of knowledge. Unfortunately, their level of knowledge about bisphosphonates was alarmingly low as 83.6% of the majority tested poorly.

Table (4): Shows knowledge of dental students about bisphosphonates and their relevance in history score results.

	Frequency	**Percent**
High level of knowledge	39	7.4
Moderate level	48	9.1
Low level of knowledge	443	83.6
Total	530	100.0

Table 5 above presents concerning knowledge about the side effects and risk factors of bisphosphonates among dental students. Notably too, a whopping 60.6 percent of students were at a low level of knowledge when it comes to this critical subject, while only 10.4 percent achieved high level of understanding. 29.1% of students are in the moderate knowledge group, which shows that a fairly large number of students do not possess adequate comprehensive knowledge about the significance of the bisphosphate therapy.

Table (5): Shows knowledge of dental students about side effects and risk factors associated with bisphosphonates score results.

	Frequency	**Percent**
High level of knowledge	55	10.4
Moderate level	154	29.1
Low level of knowledge	321	60.6
Total	530	100.0

Table (6) shows that knowledge level of bisphosphonates and their relevance in history has statistically significant relation to region of residence (P value=0.0001). It also shows statistically insignificant relation to gender, age, and position.

Table (6): Relation between knowledge level of bisphosphonates and their relevance in history and sociodemographic characteristics.

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Parameters		***Knowledge level of bisphosphonates and their relevance in history***		***Total (N=530)***	***P value****
		High or moderate knowledge	Low level of knowledge		
Gender	Female	50	229	279	0.324
		57.5%	51.7%	52.6%	
	Male	37	214	251	
		42.5%	48.3%	47.4%	
Age	23 or less	31	119	150	0.394
		35.6%	26.9%	28.3%	
	24 to 25	24	150	174	
		27.6%	33.9%	32.8%	
	26 to 27	21	112	133	
		24.1%	25.3%	25.1%	
	More than 27	11	62	73	
		12.6%	14.0%	13.8%	
Region of residence	Northern region	12	17	29	0.0001
		13.8%	3.8%	5.5%	
	Southern region	33	237	270	
		37.9%	53.5%	50.9%	
	Central region	15	75	90	
		17.2%	16.9%	17.0%	
	Eastern region	13	25	38	
		14.9%	5.6%	7.2%	
	Western region	14	89	103	
		16.1%	20.1%	19.4%	
Position	Dental intern	15	86	101	0.877
		17.2%	19.4%	19.1%	
	Dentist (GP)	35	169	204	
		40.2%	38.1%	38.5%	
	Senior dental student	37	188	225	
		42.5%	42.4%	42.5%	

****P value was considered significant if ≤ 0.05.***

Table (7) shows knowledge of dental students about side effects and risk factors associated with bisphosphonates has statistically significant relation to gender (P value=0.013), and region of residence (P value=0.0001). It also shows statistically insignificant relation to age and position.

Table (7): knowledge of dental students about side effects and risk factors associated with

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bisphosphonates in association with sociodemographic characteristics.

Parameters		***knowledge of dental students about side effects and risk factors associated with bisphosphonates***		***Total (N=530)***	***P value****
		High or moderate knowledge	Low level of knowledge		
Gender	Female	124	155	279	0.013
		59.3%	48.3%	52.6%	
	Male	85	166	251	
		40.7%	51.7%	47.4%	
Age	23 or less	61	89	150	0.158
		29.2%	27.7%	28.3%	
	24 to 25	73	101	174	
		34.9%	31.5%	32.8%	
	26 to 27	55	78	133	
		26.3%	24.3%	25.1%	
	More than 27	20	53	73	
		9.6%	16.5%	13.8%	
Region of residence	Northern region	17	12	29	0.0001
		8.1%	3.7%	5.5%	
	Southern region	73	197	270	
		34.9%	61.4%	50.9%	
	Central region	44	46	90	
		21.1%	14.3%	17.0%	
	Eastern region	22	16	38	
		10.5%	5.0%	7.2%	
	Western region	53	50	103	
		25.4%	15.6%	19.4%	
Position	Dental intern	35	66	101	0.419
		16.7%	20.6%	19.1%	
	Dentist (GP)	79	125	204	
		37.8%	38.9%	38.5%	
	Senior dental student	95	130	225	
		45.5%	40.5%	42.5%	

****P value was considered significant if ≤ 0.05.***

Discussion

Bisphosphonates are one of the most common drugs used to treat Paget's disease, osteoporosis, multiple myeloma, and tumour metastases in the bones. This group of drugs is still widely studied to expand the

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possibilities of its use, for example, in the treatment of neurodegenerative diseases. Bisphosphonates are prescribed due to their main property - inhibition of bone resorption [14]. The mechanism of action of these drugs involves the induction of osteoclast apoptosis, resulting in the inhibition of bone reabsorption [15]. Although these drugs are very safe and effective, they also hold the potential to precipitate serious side effects such as necrosis of the jaws, or so-called bisphosphonate related osteonecrosis of the jaw [16]. The risk factors for BRONJ include the use of intravenous bisphosphonates, higher dose and prolonged duration of exposure, pre-existing dental disease, dental implants, dental extraction, and poorly fitting dentures. The use of glucocorticoids and anticancer therapy, history of diabetes, smoking, and cancer may be other risk factors. Well-informed dentists are essential in identifying risks, making appropriate clinical decisions, and educating patients about necessary precautions, which not only enhances dental care but also contributes to patients' overall health, preventing unwanted complications, and hence we wished to assess the level of knowledge and awareness of bisphosphonates among dental students, interns and dentists.

Our study of dental students' knowledge of bisphosphonates found strengths and weaknesses when it comes to current educational efforts. A quite substantial 78.3% of participants recognized bisphosphonates, however only 43.6% knew the name of Alendronate (Fosamax), a disparity comparable to other studies. Paredes et al [17] reported that 79% of dental students and dentists had received some information of bisphosphonates but only 68% of them have been aware about the possible link between bisphosphonates and bisphosphonate-related osteonecrosis of the jaw. A worrying trend in dental education is highlighted by our findings: 88.9% understood the role of bisphosphonates in dental practice whereas 40.9% underestimated their medical use. Exactly like Almousa et al [18], they report an inconsistent practice of including relevant education in different institutions, during they noted that if there are such educational initiative, they are not applied properly. The problem here was only just compounded by the fact that in our study only 29.6% understood the mechanism of action of bisphosphonates (paralleled by 34.5% by Ahmad S Assari et al. [19] who also noted a lack of awareness as to jaw osteonecrosis amongst their respondents). This highlights a pervasive gap in understanding that has clear implications for patient safety, particularly when procedures such as tooth extractions—recognized by over 70.6% of our participants as increasing risks—are performed. Previous studies, including one by Migliorati CA et al. [20], revealed that awareness of potential side effects is alarmingly low, with only 28% recalling relevant information provided to them. Moreover, our findings revealed that that only 35.5% identified osteonecrosis of the jaw as a significant oral side effect, coupled with 60.6% exhibiting low levels of knowledge on critical side effects. This level of awareness is echoed in other research, such as that by Lima-Souza et al. [21], who noted a startling 90.8% of participants did not know about bisphosphonates, which may stem from insufficient education both for patients and dental professionals. Studies have consistently demonstrated that awareness about side effects, such as those by Singh J. et al. and Lopez-Jornet et al. [22], point to a significant majority, including 76% and 86.7% of study participants, completely unaware or misinformed on the topic. The statistical association found in our study between knowledge of bisphosphonates and both the region of residence and gender ($P = 0.0001$ for both) provides critical insight into potential trends, although we noted no significant correlation with age or academic level. This contrasts with findings from Hajmohammadi E et al. [23], which indicated higher awareness among postgraduate students, further emphasizing the need for better-

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targeted educational strategies for undergraduate programs. Our participants overwhelmingly expressed a desire for additional training (84.7%), which aligns with calls for more robust educational curriculums as highlighted by López-Jornet et al. [24] and others advocating for proactive efforts in improving knowledge and preparedness among dental professionals.

Conclusion:

Finally, in the conclusion of this cross sectional study, there are significant gap in knowledge and awareness of bisphosphonates between Saudi senior dental students, interns, and general dentists. A majority (78.3%) knew the term 'bisphosphonates' but only 43.6% could name Alendronate and 29.6% understood how they work. Additionally, rates of awareness of critical side effects, namely, bisphosphonate related osteonecrosis of the jaw (BRONJ), were incredibly low with only 35.5% of participants considering it to be a potential risk. The findings highlight the imperative of strengthened educational efforts with respect to bisphosphonate implications in dental practice, such as uses, mechanism and risks. Additionally, a substantial proportion of participants demonstrated interest in continued training, thus creating an obvious area for curriculum development. Ensuring patient safety, and resulting improved health outcomes in dental care settings, requires addressing these educational deficiencies in order to improve care for patients who are undergoing bisphosphonate therapy.

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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.

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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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