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PROBIOTICS: KNOWLEDGE, PRACTICES, AND ATTITUDES AMONG DENTAL POST-GRADUATE STUDENTS IN PATNA POPULATION

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ABSTRACT:

Background: Probiotics, defined by the World Health Organization (WHO) as live microorganisms that, when administered in adequate amounts, confer health benefits to the host, have gained attention for their role in maintaining oral health. They function by inhibiting pathogenic organisms, thereby enhancing resistance to harmful colonization and supporting metabolic activities.

Aim: This study aims to evaluate the knowledge, practices, and attitudes toward probiotics among dental post-graduate students in Patna, with a focus on their awareness and perceived benefits for oral health.

Study Design: A descriptive, cross-sectional survey was conducted among dental post-graduates from BIDSH, Patna, using a random sampling method. Data were analyzed using the chi-square test for statistical significance.

Methodology: A structured questionnaire, comprising 24 items derived from existing literature on probiotic knowledge, was distributed to first-, second-, an third-year dental post-graduates.

Results: Out of 105 participants, 63.81% were female and 36.19% were male. A substantial majority

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(96.14%) were aware of the term "probiotics," and 66.86% believed that probiotics could positively impact oral health.

Conclusion: The study demonstrates a high level of awareness and knowledge about probiotics among dental post-graduate students in Patna. The positive perception of probiotics' role in oral health suggests the potential for incorporating probiotics into dental practice. Further community-based programs are recommended to explore their clinical implications for oral health improvement.

Key words: Attitude, dentistry, knowledge, practice, probiotics, dental post graduates.

INTRODUCTIONccording to the World Health Organization (WHO), probiotics are live microorganisms that, when administered in adequate quantities, offer health benefits to the host.[1] In dentistry, probiotics have shown potential for preventing and treating conditions such as dental caries, periodontal disease, and halitosis.[2] Their mechanisms include competing for nutrients and adhesion sites, modulating levels of secretory immunoglobulin A (IgA) in saliva, releasing antimicrobial agents, reducing the rate of plaque formation, and influencing salivary secretion.[3] The oral cavity contains a wide variety of microorganisms, and any disruption in this microbial balance, known as oral dysbiosis, can lead to infections caused by the overgrowth of pathogenic bacteria.[4]

Despite the promising effects of probiotics in dentistry, their use remains limited due to a lack of awareness and knowledge among healthcare professionals. This is partly due to the absence of evidence-based recommendations, as the effectiveness of probiotics depends on factors such as bacterial strain, dosage, and duration of administration.[3] The variability in these parameters makes it challenging to recommend probiotics consistently in dental practice.

The aim of our study was to assess the knowledge, practices, and attitudes toward probiotics among dental post-graduate students in Patna, and to compare awareness and understanding between first-, second-, and third-year students.

MATERIAL AND METHOD:

This cross-sectional survey was conducted with approval from the Institutional Ethical Committee (Ref no. 385/BIDSH) at the Buddha Institute of Dental Sciences and Hospital in Patna, Bihar. The survey was carried out between November 2023 and February 2024 among dental post-graduate students. A close-ended questionnaire comprising 24 questions was created and modified based on a thorough literature review of previously published articles regarding knowledge and awareness of probiotics. The questionnaire was distributed to the post-graduates on an individual basis.

The survey was divided into four sections: the first section collected demographic information, including age, sex, and year of education. The second section assessed the respondents' attitudes toward probiotics. In the third section, participants were questioned about their knowledge of probiotics, including their positive effects on oral health, sources, and constituents. The fourth section inquired about the respondents' practices related to probiotics, their perceived effects on overall health, potential side effects, and personal experiences after using probiotics.

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Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 21 (IBM Corp., Armonk, NY). Descriptive statistics were generated for each variable, and summarized data were presented using tables and graphs. The chi-square test was employed for the assessment of categorical variables, with a significance level set at a p-value of less than 0.05.

Sampl Size Estimation

The sample size was determined using N Master Software (version 2.0). Based on a calculated proportion of 0.45 (Mahendra et al.), a precision level of 5%, a confidence level of 95%, and a power of 80%, the minimum sample size was calculated to be 86. The formula for sample size estimation was applied accordingly.

$$n = \frac{\left\{Z_{1-\alpha/2}\sqrt{P_o(1-P_o)} + Z_{1-\beta}\sqrt{P_a(1-P_a)}\right\}^2}{(P_a - P_o)^2}$$

RESULT

A total of 105 dental post-graduate students participated in the study, of whom 67 (63.81%) were females and 38 (36.19%) were males, with a mean age of 27.98 ± 2.784 years (age range: 25-41 years). The difference in gender distribution was statistically insignificant (p = 0.988).

In our findings, 87.88% of third-year students, 77.14% of second-year students, and 81.08% of first-year students reported that undergraduate students should be informed about the benefits of probiotics (p = 0.002). Furthermore, 93.94% of third-year students, 68.57% of second-year students, and 78.38% of first-year students indicated that probiotics should not be administered with the same frequency to adults and children. This difference was statistically significant when compared across the different year groups (p = 0.001).

Questionnaire		First year	N 37	Second year	N 35	Third year	N 39	Total	N 105	P Value
		N	%	N	%	N	%	N	%	
Do you feel that probiotic should be prescribed as an adjuvant	Yes	31	83.78	31	88.57	31	93.94	93	88.57	0.210, NS
	No	2	5.41	0	0.00	1	3.03	3	2.86	
	May be	4	10.81	4	11.43	0	0.00	8	7.62	
Do you feel that undergraduate should be aware of the benefits of probiotic	Yes	30	81.08	27	77.14	29	87.88	86	81.90	0.002*, sig
	No	6	16.22	0	0.00	0	0.00	6	5.71	
	May be	1	2.70	8	22.86	4	12.12	13	12.38	
Do you feel that probiotic can improve oral flora	Yes	22	59.46	25	71.43	28	84.85	75	71.43	0.094, NS
	No	2	5.41	0	0.00	0	0.00	2	1.90	
	May be	13	35.14	10	28.57	5	15.15	28	26.67	

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Do you think that probiotic should be taken as supplement in regular basis	Yes	30	81.08	30	85.71	27	81.82	87	82.86	0.418, NS
	No	5	13.51	1	2.86	2	6.06	8	7.62	
	May be	2	5.41	4	11.43	4	12.12	10	9.52	
Do you think that efficacy of probiotic in 'tablet' and 'sachet' form are same	Yes	13	35.14	10	28.57	19	57.58	42	40.00	0.143, NS
	No	15	40.54	14	40.00	9	27.27	38	36.19	
	May be	9	24.32	11	31.43	5	15.15	25	23.81	
Do you think that probiotic should be prescribed in both adult and child in equal frequency	Yes	8	21.62	3	8.57	0	0.00	11	10.48	0.001*, sig
	No	29	78.38	24	68.57	31	93.94	84	80.00	
	May be	0	0.00	8	22.86	2	6.06	10	9.52	

Table 1: Assessment of attitude towards probiotics among first, second and third year dental post graduates.

A total of 56.1% (N = 59) of respondents indicated that their knowledge of probiotics was acquired from healthcare professionals (p = 0.009). When asked about the route of administration for probiotics, a significantly higher proportion of third-year post-graduate students reported that probiotics should be administered orally compared to their peers in other years (p = 0.001).

Furthermore, 81.82% of third-year students, 54.29% of second-year students, and 21.62% of first-year students correctly identified live microorganisms as the constituents of probiotics. This difference in correct responses was statistically significant across the various year groups (p = 0.001).

Questionnaire		First year	N 37	Second year	N 35	Third year	N 39	Total	N 105	P value
		N	%	N	%	N	%	N	%	
Are you aware of the term "probiotic"	Yes	34	91.89	35	100.00	32	96.97	101	96.19	0.191 ns
	No	3	8.11	0	0.00	1	3.03	4	3.81	
	May be	0	0.00	0	0.00	0	0.00	0	0.00	
If YES, from	Health care	11	29.7	21	60.00	27	81.8	59	56.1	0.009*

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where did you get the information	personal		3				2		9	sig
	Different health related articles and news	20	54.05	13	37.14	5	15.15	38	36.19	
	From audio – visual aid (TV and Radio)	1	2.70	0	0.00	0	0.00	1	0.95	
	Social media or internet.	2	5.41	1	2.86	0	0.00	3	2.86	
Probiotics can be administered.	Orally	24	64.86	33	94.29	32	96.97	89	84.76	0.001*, sig
	Intravenously	2	5.41	0	0.00	0	0.00	2	1.90	
	Both “a” and “b”	11	29.73	1	2.86	1	3.03	13	12.38	
	Do not know	0	0.00	1	2.86	0	0.00	1	0.95	
Which among these are constituent of probiotic	Live microorganism	8	21.62	19	54.29	27	81.82	54	51.43	0.001*, sig
	Selectively fermented ingredients in dairy products	11	29.73	3	8.57	0	0.00	14	13.33	
	Both: a” and “b”	18	48.65	13	37.14	6	18.18	37	35.24	
	Do not know		0.00		0.00		0.00	0	0.00	
Probiotics are best consumed with.	Food and drinks	7	18.92	14	40.00	12	36.36	33	31.43	0.159 NS
	Supplements	3	8.11	2	5.71	5	15.15	10	9.52	
	Both “a” and “b”	27	72.97	19	54.29	16	48.48	62	59.05	
	Do not know		0.00		0.00		0.00	0	0.00	
Which among these are source of probiotic	Diary product	29	78.38	30	85.71	32	96.97	91	86.67	0.020*, sig
	Cereals and pulses	5	13.51	0	0.00	1	3.03	6	5.71	
	Both “a” and	3	8.11	5	14.29	0	0.00	8	7.62	

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	"b"									
	Do not know		0.00		0.00		0.00	0	0.00	
Which of the following compounds are produced by probiotic	Bacteriocins and lactic acid	8	21.62	3	8.57	4	12.12	15	14.29	0.173 NS
	Lactobacillus	6	16.22	4	11.43	3	9.09	13	12.38	
	Both "a" and "b"	23	62.16	22	62.86	22	66.67	67	63.81	
	Do not know	0	0.00	6	17.14	6	18.18	12	11.43	
Which among the following factor improve in smoker's after probiotic treatment consisting S.Salivaris	Plaque index	10	27.03	4	11.43	1	3.03	15	14.29	0.02*, sig
	Probing depth	5	13.51	0	0.00	3	9.09	8	7.62	
	Both "a" and "b"	17	45.95	22	62.86	23	69.70	62	59.05	
	Do not know	5	13.51	9	25.71	6	18.18	20	19.05	
Which among these is an effective probiotic bacterium in reducing CFU's of S. mutans in dental caries?	Bifidobacterium	7	18.92	5	14.29	3	9.09	15	14.29	0.220 NS
	Lactobacillius	2	5.41	0	0.00	1	3.03	3	2.86	
	Both "a" and "b"	22	59.46	17	48.57	23	69.70	62	59.05	
	Do not know	6	16.22	13	37.14	6	18.18	25	23.81	
Earliest probiotic strain that target the oral malodaor	S. Salivarius K12	9	24.32	18	51.43	17	51.52	44	41.90	0.012*, sig
	Bifidobacterium	7	18.92	3	8.57	0	0.00	10	9.52	
	Both "a" and "b"	14	37.84	7	20.00	14	42.42	35	33.33	
	None of the	7	18.9	7	20.00	2	6.06	16	15.2	

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	above		2						4	
Probiotic improves colonization of pathogenic bacteria in oral cavity by reducing the pathogenic bacteria, biofilm, and inflammatory response. This phenomena is known as	Symbiosis	28	75.68	25	71.43	25	75.76	78	74.29	0.064 NS
	Eubiosis	4	10.81	2	5.71	0	0.00	6	5.71	
	Both 'a' and 'b'	3	8.11	4	11.43	0	0.00	7	6.67	
	None of the above	2	5.41	4	11.43	8	24.24	14	13.33	
A combination of probiotic and prebiotic is termed as	Microbiome therapy	24	64.86	30	85.71	29	87.88	83	79.05	0.023*, sig
	Multibiome therapy	9	24.32	2	5.71	2	6.06	13	12.38	
	Both "a" and "b"	3	8.11	0	0.00	0	0.00	3	2.86	
	Do not know	1	2.70	3	8.57	2	6.06	6	5.71	

Table 2: Assessment of knowledge towards Probiotics Among first, second, and third Dental Post Graduate Students.

A substantial number of respondents recognized dairy products as the most common source of probiotics, with 96.97% of third-year post-graduates, 85.71% of second-year post-graduates, and 78.38% of first-year post-graduates indicating this ($p = 0.020$). Additionally, a significantly higher percentage of respondents reported improvements in both plaque index and probing depth in smokers following probiotic treatment with *S. salivarius*, with figures of 69.70% for third-year, 62.86% for second-year, and 45.95% for first-year students ($p = 0.02$).

Furthermore, 51.52% of third-year post-graduates and 51.43% of second-year post-graduates identified *S. salivarius* as the earliest strain of probiotics aimed at addressing oral malodor ($p = 0.012$). In terms of microbiome therapy, which combines prebiotics and probiotics, 79.05% of respondents accurately recognized this concept, while 5.71% reported being unaware of it ($p = 0.023$).

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Regarding practical application, 93.94% of third-year, 77.14% of second-year, and 83.78% of first-year post-graduates stated that they had utilized probiotics in their practice (p = 0.031). Among these respondents, 54.55% of third-year students consumed probiotics daily, while 68.57% of second-year students and 35.14% of first-year students reported occasional use (p = 0.002).

In terms of their experiences with probiotics, 42.86% of third-year and 48.60% of first-year post-graduates reported an excellent experience, while 88.57% of second-year students described their experience as satisfactory (p = 0.001). Additionally, a significant majority (87.62%) stated that they had not encountered any adverse drug reactions (p = 0.006).

Lastly, 62.86% of respondents indicated that they would recommend using probiotics to improve overall health (p = 0.002).

		First year	N 37	Second year	N 35	Third year	N 39	Total	N 105	P value
		N	%	N	%	N	%	N	%	
Have you ever tried probiotic	Yes	31	83.78	27	77.14	31	93.94	89	84.76	0.031 * sig
	No	2	5.41	2	5.71	0	0.00	4	3.81	
	Occasionally	1	2.70	6	17.14	0	0.00	7	6.67	
	Only when your doctor prescribed	3	8.11	0	0.00	2	6.06	5	4.76	
If YES, what was the frequency of consumption	Once a day	12	32.43	4	11.43	18	54.55	34	32.38	0.002 * sig
	Weekly	10	27.03	5	14.29	5	15.15	20	19.05	
	Occasionally	13	35.14	24	68.57	10	30.30	47	44.76	
When did you use probiotic as a therapeutic agent?	Gastrointestinal infection	30	81.08	30	85.71	33	100.00	93	88.57	0.100 NS
	As an anti-inflammatory	5	13.51	4	11.43	0	0.00	9	8.57	
	As an immunomodulator	2	5.41	0	0.00	0	0.00	2	1.90	
	Oral health	0	0.00	1	2.86	0	0.00	1	0.95	
How was	Excellent	18	48.6	4	11.4	23	69.70	45	42.86	0.00*

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your experience after using probiotic as a therapeutic agent			5		3					sig
	Satisfactory	18	48.65	31	88.57	6	18.18	55	52.38	
	Bad	1	2.70	0	0.00	4	12.12	5	4.76	
Did you ever encountered any adverse drug reaction after using probiotic	Yes	3	8.11	0	0.00	8	24.24	11	10.48	0.00* sig
	No	34	91.89	33	94.29	25	75.76	92	87.62	
	Sometimes	0	0.00	2	5.71	0	0.00	2	1.90	
Will you advice to use probiotic to improve overall health?	Yes	17	45.95	4	11.43	11	33.33	32	30.48	0.00* sig
	No	5	13.51	1	2.86	1	3.03	7	6.67	
	May be	15	40.54	30	85.71	21	63.64	66	62.86	

Table 3: Assessment of practice towards Probiotics Among first, second and third year Dental Post-Graduate Students.

DISCUSSION

In our study a total of 105 dental post graduates responded to the questionnaire in whom 67 were females and 38 were males. The mean age of respondents was 27.98±2.784 years (range, 25-41 years). In the present study, 101 respondents (96.19%) were aware of the term probiotic and 4 respondents (3.81%) who were not aware of the term probiotics were excluded from the study. So moving ahead, the study comprised 101 respondents who were aware of probiotics. The findings of our study showed that majority of respondents were aware of probiotics and lion's share of respondents (56.19%) procure their information from the health care personals and 36.19% of respondents from different health related articles which enlightened the crucial role of doctors, health care personal and health magazines & articles in flourishing the information regarding probiotics.

The principle constituent of probiotics are Live micro-organisms, among which lactic acid bacteria and bifidobacteria are the most commonly used micro-organism. Lactobacillus is often used as probiotic products for example Lactobacillus acidophilus, L. rhamnosus. Bifidobacterium contains various Gram-positive non- motile anaerobic bacteria such as Bifidobacterium infantis, B. adolescentis.[9] 51.43% of respondent in our study correctly submitted their response while 35.34% of respondents believed that probiotics constitute both live micro-organism and selectively fermented ingredients in dairy products. In a study conducted by Al Hossana A.A et al (2024)[5], 56% of students answered correctly that probiotics are

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live microorganism which is in accordance with our result. Fizan S et al (2019)[6] conducted a cross-sectional study where 82.2% of the respondents correctly answered that probiotics are live micro-organism which is very high in contrast to our study.

86.67% of dental post graduates in our study given correct answer that dairy products are the common source of probiotics. Rajput S et al (2016)[7] reviewed literature and summarized that milk and milk products are the most popular carriers of probiotics. Parichat P et al (2023)[8] reviewed paper and concluded that the sources of probiotics can be isolated chiefly from three main sources: (1) human and animals, (2) food and (3) the environment. Human gastrointestinal tract is an important source of probiotics in the region of intestine and stomach. Probiotics can be found in raw foods (milk, dairy products, meat). In the environment, probiotics can be found in water (Pseudoalteromonas mariniglutinosa, Bacillus safensis) and soil (Bacillus spp., Enterobacter sp).

Indira M et al (2019)[9] reviewed paper where he mentioned that the gut bacteria play a pivotal role in metabolic activities of the system gets disturbed under the influence of external stimuli like stress, antibiotics etc leading to a diseased state. This diseased state can be eliminated by the use of probiotic strain which produce therapeutic molecules such as amino acids, vitamins, bacteriocins, enzymes, immunomodulatory compounds and short-chain fatty acids. The beneficial bacteria present in the gut environment produce bacteriocins which is bactericidal in nature and confined in the cytoplasmic membrane region of receptor binding on bacterial surface. Parichat P et al (2023)[8] stated that for probiotic lactic acid bacteria, Lactobacillus and Bifidobacterium genera are the most prevalent probiotic. 63.18% of respondents in our study submitted correct response as bacteriocins, lactic acid and lactobacillus are produced by probiotics.

In our study 59.05% of respondents responded that both plaque index and probing depth improved in smoker's after being treated with probiotic consisting S. Salivarius. Rad A.H (2023)[10] in his study stated that Probiotics prevent plaque formation by reducing the pH of saliva and producing antioxidants that use free electrons used in plaque mineralization which prevent carcinogenic bacteria to form plaque. Hardan L et al (2022)[11] in his systematic review and meta-analysis of clinical trial stated that by using probiotic as an adjuvant therapy the periodontal pocket depth cab be improved due to decrease bacterial translocation through the pocket recuperation stage. It also helps in maintaining protein expression which prevent mucous membrane apoptosis and thus protect the gingival epithelial barrier. Patait MR et al (2022)[1] mentioned that 56.9% respondent in his study responded that both plaque index and probing depth improved in smoker's treated with probiotic consisting L. Salivarius which is in accordance with our study.

The foul and disagreeable odour that comes from the mouth due to volatile sulphur compounds (VSC) is known as halitosis or oral malodor. P. gingivalis, P. intermedia, T. denticola, and Fusobacterium nucleatum are the bacteria responsible for the formation of VSC.[16] Allaker RP et al (2017)[12] stated that one of the earliest probiotic strains that target oral malodour was the bacteriocin producing strain S. salivarius K12. In our study 41.9% of respondents believed that S. Salivarius K12 is the earliest strain of probiotic which target oral malodor.

Patait MR et al (2022)[1] stated that 39.2% of respondents submitted their answer that microbiome therapy is the combination of probiotic and prebiotic therapy. In our study 79.05% of respondents submitted the correct answer which is very high.

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SOME COMMON PROBIOTICS USED IN INDIA:

The first FDA-approved probiotic-supplemented infant formula, "Good Start Supreme" with Natural Cultures, was developed by Nestlé and contains BIFIDUS BL (*B. lactis* BB12) . Gum Perio Balance, produced by Sunstar (Etoy, Switzerland), is the first probiotic specifically formulated to combat periodontal diseases, featuring a combination of two strains of *L. reuteri*. Each lozenge contains 2 x 10^8 living cells of *L. reuteri* and is recommended for daily consumption either after meals or following tooth brushing.

Bifidumbacterin, Acilact, and Vitanar (Alfram Ltd., Moscow, Russia) consist of a combination of five live lyophilized lactic acid bacteria that aid in both clinical and microbiological improvements in gingivitis and periodontitis. It is advised to take two tablets after mechanical debridement, allowing them to dissolve in the oral cavity three times daily for a duration of 20 to 30 days.

Yakult is one of the most widely available probiotics, produced by fermenting a blend of skimmed milk with the strain *Lactobacillus casei* Shirota. In India, ViBact represents a newer probiotic option, consisting of genetically modified *Bacillus mesentricus* and serving as an alternative to B-complex capsules. The recommended dosage for probiotics is once daily, ideally containing 10^8 probiotic bacteria per gram or milliliter, with a total daily intake of 1.5-2 dl/l .

Probiotic therapy offers a natural, non-invasive method for inhibiting the growth of pathogens; however, consumption should be closely monitored in patients with stomach disorders. Foods and dietary supplements cannot claim to function as biological drug products for the treatment, prevention, cure, mitigation, or diagnosis of specific human diseases, as therapeutic probiotics are regulated by the US FDA. According to Kashwani et al. , integrating emerging technologies such as the metaverse, AI, and AR/VR into dental education can significantly enhance dental post-graduate students' understanding and application of probiotics. These technologies can facilitate immersive learning experiences, simulate clinical scenarios, and provide real-time interactive training, ultimately improving knowledge and practical skills while refining their attitudes toward the incorporation of probiotics in dental care.

LIMITATIONS AND FUTURE PROSPECTS:

The present cross-sectional study was a hospital-based study conducted in a dental college in Patna. Since dental post graduates are still in the learning phase so their knowledge can’t be equalize with the faculties as the knowledge of the faculties seems to be par with dental postgraduates. To capitalize on the potential benefits of probiotics for oral health, it is crucial to do survey including faculties for a better result. So future study should be conducted on a larger scale basis including dental postgraduates and faculties.

CONCLUSION:

Probiotics is surging as charismatic field in general and oral health. The people should be aware of the health benefit of probiotics It is paramount important that people should made aware of the positive effect of probiotics on oral health as it has shown very promising effect in oral health, so there should be a community-based program to make people understand its effects on oral health and also training to the oral health practitioners from WHO so that oral health care providers should genuinely prescribe it whenever required.

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