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Research and Workforce Development among Oral Health Providers in the Kingdom of Saudi Arabia

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Abstract:

Background/Aim: Dental research plays a crucial role in advancing oral health by generating new insights and spreading established knowledge to benefit those in need. This study aimed to quantify participation in dental research-related activities reported by oral healthcare providers in the Kingdom of Saudi Arabia (KSA) and to investigate its association with socio-demographic and professional characteristics, as well as practitioners' perceptions of the Research and Development (R&D) index.

Methods: The study conducted a cross-sectional online survey among 243 oral health providers in Saudi Arabia, comprising 153 (63%) dentists and 90 (37%) dental hygienists and assistants who work in all regions and sectors in KSA. The survey, distributed *via* social media and email from November 2023 to January 2024, was based on a pre-validated R&D cultural index questionnaire aimed at capturing the R&D engagement among oral health providers. Analytical methods included descriptive statistics, one-way ANOVA, t-tests, and multiple regression analyses conducted using SPSS to pinpoint significant predictors of research participation, thereby offering a detailed exploration of factors influencing dental research involvement across the kingdom.

Results: Key findings show that oral health providers (B = 0.203, SE = 0.015, $p = 0.020$) and individuals with a stronger inclination towards research (B = 0.122, SE = 0.017, $p = 0.010$) are more likely to participate in research activities. Findings show age ($p = 0.013$), sector ($p = 0.017$), nationality ($p = 0.005$), income ($p < 0.001$), work location ($p = 0.05$), and education ($p = 0.026$) significantly influence R&D engagement. In contrast, gender ($p = 0.050$), direct patient contact, and patient volume have minimal impact. Notably, dentists ($p = 0.040$), clinical directors, and experienced professionals ($p = 0.017$) show higher R&D involvement.

Conclusion: The study highlighted the essential role of specialized educational and training programs focused on enhancing research skills and their practical application. Such initiatives are vital for improving the involvement of oral health professionals in research within Saudi Arabian oral health providers.

Keywords: Oral health providers, Dental research, R&D index, Research participation, Kingdom of Saudi Arabia, Dental hygienists.

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1. INTRODUCTION

Dental research significantly contributes to the enhancement of oral health through the generation of novel insights and the dissemination of existing knowledge to those in need [1]. Dental research initiatives are important to continually improve oral health status, whether by producing new knowledge or finding new ways of making the existing knowledge available to those who need it [1]. According to the National Research Council, the field of dentistry continually needs researchers to develop new and better dental technologies. However, the field is being threatened by the small number of researchers doing research in the field [2]. Dental research is defined as the formalized acquisition and investigation of topics related to the dental profession [3]. Furthermore, dental research creates new knowledge and information about the latest innovations related to dentistry, the oral cavity, and the associated structures in oral and health diseases. Paul *et al*. studied the factors associated with the involvement of dental faculty in research initiatives and postgraduate research training, both of which emerged as significant influences in state-of-the-art dental research and practice [4]. Despite awareness of the importance of research and development in health care, many professionals remain unengaged [5].

The Kingdom is considered among the top-ranked oil-producing countries globally and relies heavily on the oil industry. Therefore, the country can support and improve the general health of its citizens [6]. From 2009 to 2018, Saudi Arabian scholars published 1,771 dental research studies, equating to an average of about 177 publications per year [7]. These studies have collectively amassed 10,320 citations, yielding a citation impact of 5.83. However, this achievement pales in comparison to the United States, which leads with 20,720 publications, followed by Brazil with 12,908, and China with 7,072.

The Research and Development (R&D) index provides an efficient process for determining the strength of an organization's research and development culture, as it captures the role of both individual practitioners and the organizational environment [8]. The R&D index analysis consists of 16 items in three domains: R&D support, personal skills and aptitude, and intentions toward R&D [9]. The R&D Index can help to determine which units need further encouragement to increase their overall research productivity [5]. Thus, continuous efforts must be made to promote R&D within dental healthcare organizations to address the needs of dental health practitioners as well as their organizations. In addition, R&D has direct implications for the dental health of the general population.

Dental research is a cornerstone for advancing oral healthcare, fostering innovation, and enhancing clinical practices through evidence-based insights. In Saudi Arabia, achieving national healthcare goals and addressing oral health disparities require active research participation from oral health providers. Despite its importance, data on factors influencing research involvement across diverse regions and sectors in the Kingdom remain limited.

This study aimed to quantify participation in dental research-related activities reported by oral healthcare providers in KSA and to investigate its association with socio-demographic and professional characteristics, as well as practitioners' perceptions of the R&D index. The null hypothesis is that there are no significant differences among healthcare providers in SA in dental research-related activities.

2. MATERIALS AND METHODS

2.1. Study Design and Sample Size

The current study utilized a cross-sectional online survey to collect data on dental research activities among oral health providers (dentists, dental hygienists, and assistants) who work in all regions and sectors in KSA. Ethical approval was obtained from the Institutional Review Board (REC-45/05/889) at Jazan University. This research was conducted in accordance with the Helsinki Declaration (http://ethics.iit.edu/ecodes/node/3931).

The most recent statistics released by the MOH in 2022 do not specify oral health hygienists and dental assistants as stand-alone professional categories [10]. Therefore, it is difficult to estimate the number of oral health providers working in KSA. However, the number of dentists was 21,958 in 2022, distributed among 7,067 in public PHCs and 14,891 in private sectors in 17 major regions in KSA. Using Qualtrics' calculator, assuming a 95% confidence level, 5% margin of error, and a 50% response distribution, the minimum required sample size for this study is 377 participants to ensure representativeness.

2.2. Data Collection Process

An online survey was conducted between Nov 2023 and Jan 2024, and a pre-validated questionnaire *via* Google form was sent to the target sample to collect the data. The online survey link was disseminated through

social media (WhatsApp, Facebook, and Twitter) and *via* e-mail among a convenience sample of oral health providers. The survey was open for three months, and the anonymity of respondents was maintained throughout the process. The post specified that the study targets all oral health providers who work in public and private. The survey included information on the research team and study aims. Before starting the study, participants gave consent by clicking on a button after the consent paragraph with information on the voluntary nature of the study, the risks and benefits of participating, and procedures for maintaining confidentiality.

2.3. Study Instrument

The questionnaire was developed in English with slight modifications from a previously validated and published questionnaire [4]. The questionnaire was based on an R&D cultural index that was initially developed by the University of Northumbria [9]. The questionnaire covered every construct that was helpful in meeting the aims and objectives of the current study. Two dental public health professors at Jazan University were asked to review the questions and then provide suggestions to improve the clarity and accuracy of the questions before distribution to the study sample. In addition, a pre-test was conducted by email among 30 oral providers to confirm the reliability and validity of the questionnaire (ICC = 0.81).

2.4. Study Variables and Measures

The first part of the questionnaire included questions on gender, age, type of dental facility, work location, education level, profession, job title, years of experience, direct contact with patients, involvement in dental research, and presentations at dental-related conferences in the past 12 months. The second part included questions based on the R&D index (support, personal skills and aptitude, and intentions towards R&D), which consists of 16 items graded on a four-point Likert scale: Strongly Disagree/Disagree/Agree/Strongly Agree. The items are worded so as to give a unidirectional response. Possible total scores on the R&D culture index range from 16–64, with higher scores indicating a more positive perception of the organization's R&D culture.

2.5. Data Analysis

Descriptive statistics (percentages and means) were utilized to provide an overview of each variable. One-way ANOVA and t-tests were used to establish factors associated with R&D construct scores. Multiple regression analyses with adjusted effects were conducted to identify the significant predictors for the factors associated with participation in dental research. The significance level was set at 0.05, and all the analyses were performed using the IBM SPSS Statistics V25.0.

3. RESULT

The study sample, comprising 243 oral health providers, offers a nuanced picture of the professional landscape in this sector (Table **1**). The majority of respondents were male (61.3%), and a significant portion was over 35 years old (60.1%). The participants were almost equally divided between those working in governmental (52.7%) and private sectors (47.3%), indicating a balanced representation across different employment settings. A notable majority earned more than 20,000, suggesting a relatively high-income bracket for many in the sample. The geographical distribution of the participants' work locations from southern regions (32.5%) and the origins of their last degree, primarily from KSA (74.5%), highlight the local educational influence alongside international exposure. Most professionals were dentists (63.0%), with a majority holding clinical positions (89.7%), showcasing a strong focus on clinical roles within the sector.

Regarding their professional engagement, the data shows a varied pattern of direct patient contact: 41.6% had no direct contact, while others ranged from half a day to five days a week, indicating diverse roles and responsibilities within oral health provision. The number of patients seen daily also varied, with 48.1% seeing less than 8 patients, 43.2% serving exactly 8 patients, and a smaller group (8.6%) seeing more than 8 patients, reflecting differences in workload and patient interaction. Engagement in dental research over the past 12 months was clear, with 50.2% of respondents involved in research activities, indicating a strong research orientation among the sample. Additionally, 45.7% were named on a research funding application, and 54.7% presented a research paper at a conference, underscoring the active involvement of the sample in advancing dental knowledge and practice.

The findings from a survey of oral health providers in KSA, as presented in Table **2**, highlight critical aspects of research engagement and professional development within the dental sector. A promising 34.6% of respondents see significant opportunities for developing their practice, indicating a supportive environment for professional growth. Moreover, 31.3% highlighted the importance of incorporating evidence-based practice into their work, affirming a commitment to research-informed dental care.

Despite this positive finding, several challenges are evident. A notable 26.7% of providers lack confidence in integrating research findings into their practice, with a similar proportion, 28.4%, unsure of how research directly affects their clinical decisions. Additionally, about a quarter of the participants struggle with research terminology (24.3%) and lack the necessary skills to effectively leverage library and digital resources (24.7%).

Yet, the interest in research utilization remains strong, with 32.5% of respondents keen on applying research in their clinical settings and 30.9% expressing a desire to enhance their understanding of research activities. This demonstrates a clear eagerness among dental professionals to overcome barriers and integrate research into practice, highlighting the potential for growth in research literacy and application in the dental sector.

Table 1. Descriptive statistics of study participants (n=243).

-	Variables	N (%)
Gender	Male	149 (61.3)
	Female	94 (38.7)
Age	≤35 years	97 (39.9)
	>35 years	146 (60.1)
Nationality	Saudi	136(65.0)
	Non Saudi	107(44.0)
Sector Type	Governmental	128 (52.7)
	Private	115 (47.3)
Monthly Income	10,000 or less	28 (11.5)
	10,000 - 20,000	73 (30.0)
	More than 20. 000	142 (58.4)
Current Work Location (Region)	North	29(11.9)
	Central	68(28.0)
	Southern	79(32.5)
	Eastern	36(14.8)
	Western	31(12.8)
Education Level	< Bachelors	53 (21.8)
	= Bachelors	84 (34.6)
	> Bachelors	106 (43.6)
Country of the Last Degree	KSA	181 (74.5)
	Australia	8 (3.3)
	Canada,	5 (2.1)
	Egypt	7 (2.9)
	Sudan	10 (4.1)
	Sweden	3 (1.2)
	UK	11 (4.5)
	USA	18 (7.4)
Professional Type	Dentist	153 (63.0)
	Non-Dental (Hygienists or Assistants)	90 (37.0)
Job Title	Clinician	218 (89.7)
	Clinical Director	14(5.8)
	Administrative	11(4.5)
Years of Experience	≤10 years	71(62.8)
	>10 years	42(37.2)
Direct Contact with Patients through Your Position	Yes	142 (58.4)
	No	101 (41.6)
Number of Days/Week have Direct Contact with Patients	Non	101 (41.6)
	½ Day	27 (11.1)
	1-2 Day	33 (13.6)
	3-4 Days	36 (14.8)
	5 days	46 (19.0)
Number of Patient Everyday	< 8 Patients	117 (48.1)
	8 Patients	105 (43.2)
	> 8 Patients	21 (8.6)
Involved in Dental Research Activities in Past 12 Months	Yes	122 (50.2)
	No	121 (49.8)
Named on a Research Funding Application in the Past 12 Months	Yes	111(45.7)
	No	132(54.3)
Presented a Conference Research Paper in the Past 12 Months?	Yes	133 (54.7)
	No	110 (45.3)

Table 2. Descriptive statistics of participation in dental research, R&D support, R&D skills/aptitude, and R&D intention as predictors of dental research activity (n= 243).

Variable	Strongly Agree N (%)	Agree N (%)	Disagree N (%)	Strongly Disagree N (%)
R&D Support				
There are people around to help and support me to change/develop practice in my work	50 (20.6)	74 (30.5)	49 (20.2)	70 (28.8)
There are opportunities to reflect on my practice in my work	60 (24.7)	62 (25.5)	68 (28.0)	53 (21.8)
There is an opportunity to develop practice in my area	47 (19.3)	84 (34.6)	56 (23.0)	56 (23.0)
There is strong professional leadership in my work	45 (18.5)	64 (26.3)	69 (28.4)	65 (26.7)
My discipline here works as equal partners with other disciplines in order to change or develop practice in my work	50 (20.6)	75 (30.9)	59 (24.3)	59 (24.3)
There are regular staff meetings to explore ideas in my work	50 (20.6)	72 (29.6)	62 (25.5)	59 (24.3)
I have access to training and development opportunities which give me the skills to question and investigate practice in my work	50 (20.6)	74 (30.5)	72 (29.6)	47 (19.3)
The development work that I do links with the organization's plans	56 (23.0)	60 (24.7)	76 (31.3)	51 (21.0)
Development of evidence-based practice is valued as part of my job	65 (26.7)	76 (31.3)	49 (20.2)	53 (21.8)
R&D Skills/Aptitude				
I feel confident about using research in my practice	57 (23.5)	60 (24.7)	65 (26.7)	61 (25.1)
I know how practice is influenced by research	59 (24.3)	67 (27.6)	69 (28.4)	48 (19.8)
I understand research terminology	65 (26.7)	64 (26.3)	59 (24.3)	55 (22.6)
I have the skills to use the library and learning facilities within my work digital resources	69 (28.4)	65 (26.7)	60 (24.7)	49 (20.2)
R&D Intention				
I would like more opportunities to share practice development ideas/research/information across my organization.	68 (28.0)	64 (26.3)	55 (22.6)	56 (23.0)
I would like to learn about research activity.	55 (22.6)	75 (30.9)	66 (27.2)	47 (19.3)
I am very keen to use research in practice	62 (25.5)	79 (32.5)	46 (18.9)	56 (23.0)

Table 3 presents the results of independent t-tests and one-way ANOVA tests used to determine differences in the mean scores of the R&D index domains based on demographic details (such as gender, age, nationality), professional characteristics (including sector type, professional type, job title, years of experience, direct contact with patients), and work-related aspects (like monthly income, current work location, education level, number of working days, the average time of any treatment procedure for each patient, and the number of patients seen every day). The analysis of the associations between the R&D index domain scores and the participants' characteristics in dental research activities revealed varied findings across different variables. The findings indicate that gender differences do not significantly impact most R&D domains, except in R&D support, where males score marginally lower ($p = 0.050$). Age is a factor, with participants 35 years and younger demonstrating lower R&D intentions than those older, marked by a significant p-value ($p = 0.013$). Individuals working in government sectors exhibit higher R&D intentions compared to their private sector counterparts ($p = 0.017$), and non-Saudi nationals score significantly higher in R&D skills/aptitude than Saudi nationals ($p = 0.005$), although nationality does not significantly affect other domains. Income levels are related to R&D engagement, with those earning 10,000 or less exhibiting higher scores in R&D support ($p = 0.003$) and skills/aptitude ($p = 0.021$), and the most substantial intentions toward R&D ($p < 0.001$). Work location influences R&D intentions, particularly in the central and southern areas showing higher scores compared to other regions ($p = 0.05$). Higher education levels correlate with enhanced R&D intentions, notably for individuals with a bachelor's degree ($p = 0.026$). Professionally, dentists score significantly higher in R&D support ($p = 0.040$), skills/aptitude ($p = 0.024$), and intentions ($p = 0.011$) than non-dental professionals. Clinical directors rank higher in almost all domains *versus* clinicians and administrators, highlighting the significant impact of job roles on R&D engagement. Experience also plays a role, with a positive association between years of experience and R&D intentions ($p = 0.017$). Direct patient contact does not markedly influence R&D domains. Yet, those working five days a week report higher R&D intentions ($p = 0.013$) than those working fewer days. The average treatment time impacts R&D intentions ($p = 0.014$), but the daily patient volume does not significantly affect R&D domains.

A multiple linear regression analysis was conducted to identify factors that influenced dental research participation among oral health providers in the past year, with a particular focus on the effects of R&D index domain scores, as detailed in Table 4. The analysis showed that R&D support was not a significant factor in research participation ($p = 0.707$). However, R&D skills/aptitude and R&D intention emerged as significant predictors of participation, with p-values of 0.020 and 0.010, respectively. These findings indicate that improvements in R&D skills/aptitude and fostering a strong intention towards research significantly enhance the likelihood of engaging in dental research. Collectively, these variables accounted for a modest portion of the variance in research participation, with an adjusted R^2 value of 0.005. Specifically, a unit increase in R&D skills/aptitude and R&D intention scores was associated with a 20.3% and 12.2% increase in the likelihood of dental research participation, respectively.

Table 3. Associations of the R&D index domain scores with participants' characteristics.

-	Variables	N (%)	Dental Research Activities in Past 12 Month		R&D Support		R&D Skills/Aptitude		R&D Intention	
			Mean (SD)	*p*	Mean (SD)	*p*	Mean (SD)	*p*	Mean (SD)	*p*
Gender	Male	149 (61.3)	1.49 (0.50)	0.960 [a]	22.05 (3.56)	**0.050**[a]	10.21 (2.26)	0.866 [a]	7.66 (2.03)	0.276 [a]
	Female	94 (38.7)	1.50 (0.50)		23.01 (3.95)		10.27 (2.37)		7.94 (1.77)	
Age	≤35 years	97 (39.9)	1.52(0.50)	0.481 [a]	23.13(2.85)	0.192 [a]	10.33 (3.33)	0.067 [a]	7.24(3.12)	**0.013**[a]
	>35 years	146 (60.1)	1.50(0.50)		26.59(4.57)		11.76 (0.43)		8.73(2.13)	
Sector Type	Governmental	128 (52.7)	1.55 (0.50)	0.62 [a]	22.34 (3.83)	0.74 [a]	10.44 (2.25)	0.15 [a]	8.05 (1.86)	**0.017**[a]
	Private	115 (47.3)	1.43 (0.50)		22.50 (3.66)		10.01 (2.35)		7.45 (1.97)	
Nationality	Non-Saudi	107 (44.0)	1.50 (0.50)	0.85 [a]	21.78 (3.27)	0.19 [a]	9.77 (2.12)	**0.005** [a]	7.60 (1.82)	0.232 [a]
	Saudi	136 (56.0)	1.49 (0.50)		22.92 (4.01)		10.60 (2.38)		7.90 (2.02)	
Monthly Income (SR)	10,000 or less	28 (11.5)	1.68 (0.48)	0.101 [b]	24.68 (4.14)	**0.003**[b]	11.36 (2.11)	**0.021**[b]	9.03 (1.35)	**<.001**[b]
	10,000 - 20,000	73 (30.1)	1.51 (0.50)		22.00 (3.67)		10.16 (2.08)		7.93 (1.85)	
	More than 20,000	142 (58.4)	1.45 (0.50)		22.19 (3.56)		10.05 (2.40)		7.43 (1.97)	
Current Work Location (Region)	Central	68 (28.0)	1.45 (0.50)	0.314 [b]	22.53 (3.67)	0.062 [b]	9.75 (2.06)	0.062 [b]	8.04 (2.15)	**0.053**[b]
	Eastern	36 (14.8)	1.50 (0.51)		22.25 (2.64)		9.86 (2.38)		7.05 (1.87)	
	North	29 (11.9)	1.48 (0.51)		20.93 (4.37)		10.21 (2.48)		7.31 (1.83)	
	Southern	79 (32.5)	1.47 (0.50)		23.19 (3.82)	-	10.81 (2.34)	-	8.02 (1.82)	
	Western	31 (12.7)	1.68 (0.47)		21.81 (3.84)	-	10.29 (2.27)	-	7.74 (1.71)	
Education Level	< Bachelors	53 (21.8)	1.45 (0.50)	0.322 [b]	21.94 (3.50)	0.22 [b]	9.70 (1.90)	0.109 [b]	7.23 (1.86)	**0.026**[b]
	= Bachelors	84 (34.6)	1.55 (0.50)		23.31 (3.65)		10.55 (2.54)		8.15 (2.03)	
	> Bachelors	106 (43.6)	1.50 (0.50)		21.95 (3.84)		10.25 (2.26)		7.73 (1.85)	
Professional Type	Dentist	153 (63.0)	1.52 (0.50)	0.457 [a]	22.80 (3.76)	**0.040**[a]	10.49 (1.97)	**0.024**[a]	8.01 (1.97)	**0.011**[a]
	Non-Dental (Hygienists or Assistants)	90 (37)	1.47 (0.50)		21.78 (3.64)		9.80 (2.05)		7.35 (1.82)	
Job Title	Clinician	218 (89.8)	1.49 (0.50)	0.525 [b]	22.38 (3.69)	0.442 [b]	10.15 (2.25)	**0.009**[b]	7.68 (1.90)	**0.015**[b]
	Clinical Director	14 (5.7)	1.64 (0.50)		23.57 (5.03)		12.00 (2.60)		8.21 (2.33)	
	Administrative	11 (4.5)	1.45 (0.52)		21.82 (2.82)		9.63 (2.11)		7.54 (1.44)	
Years of Experience	≤10 years	156 (35.8)	1.50 (0.50)	0.932 [a]	22.61 (3.95)	0.292 [a]	10.35 (2.22)	0.286 [a]	7.99 (1.88)	**0.017**[a]
	>10 years	101 (41.6)	1.46 (0.50)		21.96 (2.17)		10.30 (2.18)		7.68 (1.85)	
Direct Contact with Patients through Your Position	No	101 (41.6)	1.46 (0.50)	0.393 [a]	21.96 (3.53)	0.107 [a]	10.30 (2.17)	0.680 [a]	7.68 (1.85)	0.578 [a]
	Yes	142 (58.4)	1.52 (0.50)		22.75 (3.87)		10.18 (2.39)		7.82 (2.00)	
Number of Working Days / Week	Non	101 (41.6)	1.47 (0.50)	0.481 [b]	22.09 (3.74)	0.576 [b]	10.36 (2.24)	0.665 [b]	7.72 (1.89)	**0.013**[b]
	1-2 days	27 (11.1)	1.48 (0.51)		23.12 (2.98)		10.27 (2.59)		8.09 (1.72)	
	½ days	33 (13.6)	1.55 (0.51)		23.00 (2.87)		9.81 (2.15)		6.81 (2.09)	
	3-4 days	36 (14.8)	1.42 (0.50)		22.11 (3.51)		9.89 (2.30)		7.53 (2.14)	
	5 days	46 (19.0)	1.60 (0.49)		22.55 (4.79)		10.44 (2.36)		8.38 (1.72)	
Aaverage Time of any Treatment Procedure for each Patient	< 30 minutes	115 (47.3)	0.146 (0.50)	0.533 b	21.94 (3.62)	0.18 b	10.06 (2.27)	0.029 b	7.56 (2.00)	**0.014**[b]
	>30 minutes	112 (46.1)	1.53 (0.50)		22.59 (3.74)		10.20 (2.27)		7.78 (1.86)	
	30 minutes	16 (6.6)	1.50 (0.52)		24.69 (3.89)		11.69 (2.44)		9.06 (1.48)	
Number of Patients Every Day	<8 Patients	117 (48.1)	1.51 (0.50)	0.777 [b]	22.65 (3.87)	0.527 [b]	10.13 (2/24)	0.723 [b]	7.51 (1.96)	0.137 [b]
	> 8 Patients	105 (43.2)	1.49 (0.50)		22.30 (3.75)		10.37 (2.43)		8.03 (1.92)	
	8 Patients	21 (8.7)	1.43 (0.51)		21.71 (2.92)		10.14 (2.03)		7.86 (1.71)	

Abbreviations: SD, Standard deviation, R&D, Research and Development index, SR, Saudi Riyals.
Notes: a, t-test used for significance; b, ANOVA test used to test for significance.

Table 4. Adjusted estimates for participation in dental research in the past year as predicted by R&D index domain scores (n=243).

Variable	B	SE (B)	t	*p*
R&D Support	-0.003	.009	-.377	.707
R&D Skills/Aptitude	0.203	.015	.228	**.020**
R&D Intention	0.122	.017	1.257	**.010**

Abbreviations: R&D, Research and Development index.
Notes: R^2 = 0.008; Adjusted R^2=0.005; N= 243.

4. DISCUSSION

This study was carried out to provide insights into participation in research activities among oral health providers who work in all regions and sectors in KSA. Findings demonstrated that half of oral health providers had participated in dental research activities in the past 12 months. This is also supported by studies conducted by Paul *et al*. [4] and Kruger *et al*. [11], which found that one-third of participants are involved in dental research activities.

The null hypothesis is partially accepted as there are no significant differences among healthcare providers in KSA in dental research-related activities.

While the study presents promising outcomes, significant challenges remain unaddressed, impacting the effective integration of research findings into clinical practice. A notable concern is the evident lack of confidence among a substantial proportion of oral healthcare providers in applying research outcomes to their daily practice. This is mirrored by a similar fraction of participants who are uncertain about the direct implications of research on their clinical decisions, suggesting a disconnect between research findings and practical application in clinical settings. The lack of confidence in integrating research into practice highlighted the need for targeted educational initiatives that bridge the gap between theoretical knowledge and practical application. This is supported by Wang *et al*., who emphasize the importance of reforming educational methods to achieve better academic performance and demonstrate greater accuracy in diagnosing patient conditions and formulating treatment plans among dental students [12].

Furthermore, approximately one-quarter of the study participants reported difficulties in comprehending research terminology, as well as a lack of proficiency in utilizing library and digital resources to their advantage. This highlights a critical gap in the necessary skills required to navigate and leverage the wealth of available research, which could otherwise inform and enhance clinical practice significantly. Integrating research methodology and digital literacy training into the core curriculum of medical education could significantly enhance the ability of future healthcare providers to engage with and apply research findings effectively [13, 14].

Gender emerges as a critical determinant, with female dentists, particularly those earning a monthly income of less than 10,000 SAR, demonstrating higher levels of R&D support compared to their male counterparts. This observation may reflect a broader trend within the research community where female researchers often exhibit strong inclinations towards research activities. This could be due to gender-specific motivations or perceptions of research as a means of professional advancement in traditionally male-dominated fields. The observation of significant disparities in R&D support and intentions among dental research participants based on demographic and professional variables aligns with the findings that females had more positive perceptions of participating in dental research [11]. Additionally, dental schools should continue to recruit and support women faculty and consider programming aimed at encouraging academic productivity and advancement for women in academic dentistry [15].

Age and professional experience further differentiate R&D support and intentions, with younger dentists and those with less than 10 years of experience reporting greater engagement. This could be attributed to the more recent exposure of younger professionals to current educational practices that emphasize the importance of research in clinical excellence and increase support of research in KSA [16], as well as a possibly greater enthusiasm for new knowledge and innovations in the early stages of their careers [17]. The impact of age and professional experience on R&D intentions concurs with the findings of the study conducted in Malaysia that found that more positive perceptions of R&D skills and aptitude was statistically significantly associated with older respondents by the longitudinal study [4].

Educational level plays a significant role, with those holding a bachelor's degree showing higher R&D intentions. This finding supports the notion that foundational education in research principles and methodology can lay the groundwork for ongoing engagement in research activities throughout one’s career. It also suggests that advanced degrees might not be the only pathway to high R&D engagement, pointing instead to the importance of integrating research components within undergraduate curricula. Regarding the role of educational attainment, the analysis by Amir *et al*. and Yu *et al*. on the influence of undergraduate research experiences on professional research engagement offers insight [18, 19]. They argue that early exposure to research methodologies and principles can instill a lasting interest and capability in research activities, underscoring the value of integrating research components within undergraduate health science curricula.

The study also identifies the work setting as a key factor, with dentists working in the central region and in government sectors demonstrating higher R&D support and intentions. This could be reflective of regional disparities in research infrastructure and funding, as well as differences in organizational culture between government and private sectors, where government institutions may offer more support or opportunities for research activities. The influence of the work setting on R&D support and intentions among dentists, particularly in the central region and government sectors, parallels findings by Khayat (2022) [20], which indicated that the highest research activity occurred in the central region as Riyadh region and most productive corresponding government institution was King Saud University.

Additionally, the operational dynamics within the clinical setting, such as the number of working days and the average time spent with each patient, are shown to impact R&D intentions. Specifically, dentists who work 5 days a week and allocate approximately 30 minutes per patient exhibit stronger research intentions, potentially indicating that a balanced workload and sufficient patient interaction time can facilitate engagement in research activities without detracting from clinical responsibilities. This finding was opposite to the study results indicating that fewer workloads

and adequate patient interaction times can significantly enhance healthcare professionals' capacity and inclination to engage in research, advocating for workplace adjustments to support research engagement [11].

This study found that R&D skills/aptitude and the intention to participate are key predictors of oral health providers' involvement in dental research activities within the past 12 months. Specifically, intention shows as a more significant factor than R&D support in determining research participation. To enhance engagement in dental research among oral health providers, it is essential to focus on areas such as increasing active participation through ongoing training for existing staff, expanding opportunities for research training and activities such as research writing and mentorship, and developing support for postgraduate programs that foster R&D initiatives among new oral health practitioners. Additionally, the study shows a considerable number of providers in KSA do not take part in research activities, which align with the findings of Paul *et al*. [4] and Shubayr *et al*. [11].

This research provides significant insights into the factors affecting oral health providers' participation in dental research within KSA, characterized by its comprehensive scope and valid methodology. By covering all regions in the KSA and sectors and employing a pre-validated questionnaire, the study ensures a broad and reliable understanding of the current research and development culture among dental professionals. The utilization of the R&D index offers an in-depth analysis, identifying R&D skills/aptitude and intentions as important predictors of research participation. However, the study is not without limitations, including potential response bias due to the online survey format and the cross-sectional design, which limits the ability to explore causality. Furthermore, the difficulty in accurately estimating the number of non-dentist oral health providers might lead to an incomplete picture of the sector. Despite these limitations, the study marks a significant step towards enhancing dental research engagement, suggesting a need for targeted strategies that focus on improving R&D skills and improving research intentions among oral health practitioners in KSA. Future research could build on these findings by exploring specific interventions and conducting longitudinal studies to address the identified gaps and further strengthen the dental research infrastructure.

CONCLUSION

This study represents a significant advancement in understanding the engagement of oral health providers in dental research within KSA. It has identified R&D skills/aptitude and intentions as crucial predictors of participation. Clearly, older dental professionals working in government sectors, earning a monthly income of less than 10,000 SAR, based in the central region, holding a bachelor's degree, in roles as dentists or clinical directors, with less than 10 years of experience, working five days a week and spending 30 minutes with each patient, exhibit a higher inclination towards participating in dental research.

The findings highlighted the importance of conducting and implementing specialized educational and training programs. These programs should emphasize research skills and their practical application to improve research involvement among oral health providers in the country. Additionally, fostering a research-supportive environment within dental institutions, enhancing mentorship programs, and integrating research methodologies into undergraduate and postgraduate curricula are essential steps to sustain and increase research engagement.

Moreover, efforts should be directed toward increasing funding opportunities, improving access to research resources, and encouraging interdisciplinary collaboration between universities, healthcare institutions, and policymakers. Raising awareness about the impact of research on clinical practice and patient outcomes is also crucial in motivating dental professionals to participate actively in research initiatives. Future studies should focus on longitudinal assessments to evaluate the effectiveness of research training programs and identify additional barriers to research participation among oral health providers in KSA.

AUTHORS' CONTRIBUTIONS

M.S. and M.M.: Designed and implemented the study, acquired the data, drafted the article, and critically revised it for important intellectual content; A.M., A.F., L.H., and A.H.: Were responsible for data collection and data entry; M.S., A.B., and A.A.: Conducted the analyses and interpretation of the data; M.S., A.G., K.A., M.A., A.S., and N.A.: Contributed to writing and proofreading the manuscript; M.S. and M.A.: Were involved in revising the manuscript and giving final approval for publication. All authors read and approved the final manuscript.

LIST OF ABBREVIATIONS

KSA	=	Kingdom of Saudi Arabia
R&D	=	Research and Development

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study received approval from the Institutional Review Board (REC-45/05/889) at Jazan University, Saudi Arabia.

HUMAN AND ANIMAL RIGHTS

All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from the participants.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article will be available from the corresponding author [M.A.M.] upon reasonable request.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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