



ORIGINAL ARTICLE

Public awareness of forensic odontology and willingness to enroll in a prospective dental registry: A survey conducted in Saudi Arabia



Mahmoud Salam ^a, Nedal Al-Rawashdeh ^b, Adel F. Almutairi ^{a,*}

^a King Abdullah International Medical Research Center/King Saud bin Abdulaziz University for Health Sciences, Science and Technology Unit – Ministry of National Guard – Health Affairs, Riyadh, Saudi Arabia

^b The Office of Scientific Affairs and Research, King Hussein Cancer Center, Amman, Jordan

Received 5 March 2019; revised 19 May 2019; accepted 20 May 2019

Available online 28 May 2019

KEYWORDS

Perception;
Knowledge;
National;
Dental;
Registry;
Forensic;
Saudi

Abstract *Background:* The establishment of a national dental registry provides a great opportunity for the healthcare and criminal investigation systems. Its feasibility would rely mainly upon public knowledge and a willingness to contribute dental profiles. The aim of this study was to evaluate the level of awareness among the Saudi public of forensic odontology and to evaluate their willingness to participate in a prospective national dental registry.

Methods: A cross-sectional survey based on a self-administered survey questionnaire was conducted in 2018 at the Al-Janadriyah National Festival in Riyadh, Saudi Arabia. Visitors were questioned about their demographic data and responded to 20 knowledge statements using the alternatives “correct”, “incorrect”, or “don’t know”. Their perception towards registries was assessed using 15 statements and a 5-point Likert scale. The percentage mean score (PMS) of knowledge, the mean positive response rate (MPRR) of participant perception, and their willingness to participate in a prospective dental registry were assessed with respect to their demographic characteristics.

Results: Complete surveys were received from 812 study participants (85.5% response rate). The PMS ± standard deviation of knowledge was 39.8 ± 22.5 and the MPRR of perception was 64.7 ± 25.5. More than two-thirds of the responders (n = 548, 67.5%) indicated a willingness to register in a future national dental registry. Differences in knowledge were identified with regard to sex, marital status, education, and occupation, while differences in perception and willingness to enroll were influenced by sex. After adjustment for possible confounders, female participants and

* Corresponding author at: Science and Technology Unit, King Abdullah International Medical Research Center (Mail Code 1515), Ministry of National Guard Health Affairs, Riyadh 22490, Saudi Arabia.

E-mail addresses: mahmoudsalam@hotmail.com (M. Salam), almutairiad1@nha.med.sa (A.F. Almutairi).

Peer review under responsibility of King Saud University.



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employed participants were 1.7 times (95% confidence interval [CI] = 1.2–2.4) and 1.6 times [95% CI = 1.1–2.5] more likely to enroll in the proposed registry ($P = 0.004$ and $P = 0.03$, respectively). Higher knowledge and perception scores were associated with more willingness to enroll in the national dental registry (adjusted [adj.] $P = 0.03$ and adj. $P < 0.001$, respectively).

Conclusions: A future national dental registry in Saudi Arabia is expected to be well-received by the public. An improvement in the public's knowledge regarding the importance of forensic dentistry is expected to encourage their active enrollment in such a registry. Although women and employed participants were more willing to enroll, it is too early to predict the rates of participation, given the fact that nationwide marketing surveys have yet to be launched.

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1. Introduction

Forensic odontology is a dental specialty that has helped resolve numerous criminal cases (Balachander et al., 2015). A forensic odontologist is a qualified dentist capable of generating evidence by evaluating the characteristics of the teeth, jaws, lips, and palates of human beings (Stark, 2011). Human beings have unique distinctive features with regard to tooth structure (enamel/dentin), lip pattern, and palatal rugae (Patil et al., 2008; Reddy, 2011; Skinner et al., 2008). Age, sex, race, occupation, socioeconomic status, and dental history can be determined by forensic odontologists (Tewari et al., 2016). Therefore, during a criminal investigation, representatives of the justice system frequently consult with odontologists as part of the prosecution process, to protect living victims, and/or to identify dead bodies. Human biometrics are methods that aid the recognition of individuals, such as fingerprints, palm veins, DNA, and iris recognition (Matyas and Riha, 2003). Dental profiles have been successfully used as unique biometrics to identify human remains and individuals involved in mass fatalities. However, despite the fact that governmental databases or registries are used to store fingerprint and facial photographic records for legal purposes, dental records have not received the same attention (Avon, 2004).

The establishment of a national dental registry provides a great opportunity for both the healthcare and criminal investigation systems. Dental profiles, if combined with other medical records in a single national data base, constitute a large amount of data. This could provide researchers with an improved perspective with regard to the prevalence and correlates of dental disorders, for use in rigorous evidence-based studies. Furthermore, individuals who supply these registries with their dental profiles are keeping their unique biometrics in a national database that could be used by legal authorities as evidence if the need for a forensic dental investigation arises. In some countries, where mass fatalities occur, resulting for example from floods, volcanoes, hurricanes, or wildfires, forensic odontologists refer to these national dental registries to identify the victims and provide relief for their grieving families. Furthermore, in Saudi Arabia, the annual religious Hajj season has been associated with incidents of overcrowding that sometimes develop into mass crushing incidents. In additions, individuals that become lost in remote locations and die are often not easily identifiable after some time elapses. Although the advantages of establishing a national dental registry are significant, its feasibility relies on the level of public willingness to consent to contribute their dental profiles, because the crim-

inal investigation system does not mandate their participation in such national registries.

The willingness of the public to participate in clinical databases or registries has previously been investigated, but few surveys have been conducted regarding forensic odontology. However, one study reported that breast cancer patients were willing to participate in registries and biobanks (Lee et al., 2012) and another showed that the majority of asthmatic patients were willing to participate in disease-specific registries (Schippers et al., 2016). The national dental practice-based research network was commissioned to conduct dental practice-based research and to serve dental professionals through education and collegiality, and could recruit up to 40,000 patients (Oates, 2014).

However, these previous studies have mainly focused on the willingness of individuals with active sickness or chronic diseases to participate in registries (Lee et al., 2012; Oates, 2014; Schippers et al., 2016), rather than members of the wider healthy community. A national dental registry is likely to be largely composed of data from individuals who are free of chronic diseases, meaning that people are not encouraged to participate in order to seek advances in treatment. Therefore, prior to attempting to establish a national dental registry, there is a need to evaluate the public's awareness of forensic odontology and to question their willingness to participate by sharing their dental profiles. To our knowledge, no previous studies have been published on this subject. Thus, the aim of this study was to evaluate the level of awareness among the Saudi public about forensic odontology and to evaluate their willingness to participate in a proposed national dental registry. This was achieved by assessing their knowledge of various aspects of forensic odontology, their perception of forensic odontology, and their willingness to participate in a Saudi national dental registry.

2. Material and methods

A cross-sectional study based on an anonymous Arabic language survey was conducted in 2018 of visitors to Al-Janadriyah, Saudi Arabia, where a cultural heritage festivity is held annually. This event is popular with Saudis, who visit it over the course of 3 weeks, in total numbers exceeding 1.2 million. The Saudi showed that the national population in 2016 was over 30 million, with a median age of 30.2 years (Kingdom of Saudi Arabia General Authority for Statistics, 2018).

Ethical approval for this study was granted by the Institutional Review Board at the Saudi Ministry of National Guard Health Affairs (RC17/190). A self-explanatory letter of invitation to participate was handed to each of the participants. Written obtained consent was provided by each participant, which indicated their agreement to provide information for this research study.

Data collection was conducted by a team of four research coordinators. This team was trained on how to properly invite participants to enroll in the study, how to explain the objectives, and how to respond to further queries, without influencing the answers. Data collectors were also trained on the proper methods of keeping the contributions of the participants confidential. The participants were advised to actively contribute, because the information they provided would be used as an indicator of the feasibility of establishing a Saudi national dental registry. Four interview booths (three fixed and one mobile) were distributed at various points within the target location, mainly on pedestrian routes. These booths were designed for data collection purposes for a number of ongoing research studies.

Eligible participants were mainly Saudi Arabian nationals and adults (≥ 18 years of age), who were both willing and capable of responding to the survey statements. Visitors who were students of or graduates in dentistry were excluded. A sample size calculation was conducted using the method of [Sadik et al. \(2010\)](#), using the equation

$$n = Z^2pqN/e^2(N - 1) + Z^2pq,$$

where (n) is the sample size, (N) is the population size, (Z) is the standard normal distribution (set at 1.96, corresponding to the 95% confidence level), (p) is the probability of success (0.5), (q) is the probability of failure (0.5), and (e) is the precision level (0.05).

This yielded a required sample size of 800.

The survey was self-administered, and was composed of an introductory letter explaining the study objectives, an informed consent page, and the data collection tool. The introductory letter explained the purpose of the study and invited the participants to contribute voluntarily at their own leisure. The two main operational definitions “dental profile” and “dental registry” were defined. An illustration of the oral cavity was inserted into the introduction to help define the anatomic terms used. Written informed consent was provided by participants signing an “agreement to participate” statement. The contact information of the principal investigator was stated as a reference, in case any further clarification was needed by the participant. The tool was designed to collect the participants’ general characteristics (age, sex, marital status, educational level, occupation, and financial status) and dental information (dental abnormalities, dental coverage, nature of the dental service provider [private or government], and the frequency of use of dental services [times per year]).

The two main study domains were originally identified in the published literature: knowledge ([Ali et al., 2016](#); [Bhakhri et al., 2017](#); [Sahni et al., 2016](#)) and perception ([Astekar et al., 2011](#); [Bhakhri et al., 2017](#); [Stow and Higgins, 2018](#); [Torres et al., 2006](#)). The knowledge domain questioned the participants about the general benefits of forensic odontology and the significance of its use. This domain consisted of 20 statements, of which correct statements were scored one if

the participants responded “yes” and scored zero if the participants responded “no” or “don’t know”. False statements were scored in a complementary fashion. The perception domain was composed of 15 statements that covered various aspects of forensic odontology, such as the competence and knowledge of Saudi dentists and the perception of privacy with regard to dental profiles stored in a prospective registry. Responses to perception statements, which were all phrased positively, were rated on a five-point Likert scale. “Strongly disagree”, “disagree”, and “neutral” were classified as negative responses, while “agree” and “strongly agree” were classified as positive responses. From these responses, the mean positive response rate of perception was calculated. The last statement in this domain was a straightforward question about the willingness of participants to enroll in a national dental registry.

The knowledge and perception statements were used in previous studies to address similar research objectives in dental practitioners, rather than in the general population. No previously published studies have used this tool to assess the awareness of forensic odontology among the public community, so the text used was revised and complex medical terms were simplified by an experienced social science researcher. The tool was translated into Arabic and back-translated into English, with minimal discrepancies. The tool was also piloted in two face-to-face interviews conducted a week apart; the test-retest reliabilities of the knowledge and perception components were 0.78 and 0.75, respectively.

SPSS software v.25 (IBM, Inc., Armonk, NY, USA) was used for data entry and analyses. Descriptive statistics, such as the means and standard deviations of the scores, and the frequencies and percentages of all the independent variables are presented. Responses in the knowledge and perception domains are presented as frequencies and percentages, and then converted to percentage mean \pm standard deviation scores and MPRR. Analytic statistics were applied to test the associations between knowledge or perception and participant characteristics. Student’s *t*-test was used for normally distributed data and the Mann Whitney test for non-normally distributed data. To predict the significant factors associated with willingness to participate in a national dental registry, binary logistic regression analysis was performed. The statistical significance level was set at $P < 0.05$.

3. Results

3.1. Characteristics of the participants

A total of 950 surveys were initially collected, but after the exclusion of those with $>20\%$ missing responses to statements, 812 (85.5%) were analyzed. The values of cronbach’s alpha for the knowledge and perception domains were 0.830 and 0.832, respectively. The majority of the study participants were from the Central region of the country (73.5%), followed by the Western region (11.1%), the Eastern region (6.9%), the Northern region (4.9%), and the Southern region (3.6%). An approximately equal sex distribution was obtained, with men comprising 53.4% of the sample. Participants of <26 years of age constituted 46.2% of the sample, which had a mean \pm standard deviation age of 28.4 ± 9.0 years. Almost 38% of the participants were married, and more than 73% had obtained a university education. Half of the participants were

employed (50.2%) and > 74% were comfortable in their financial status. Almost 50% of the participants paid for their own dental health care services and 72.9% attended private dental clinics. Twenty-nine-point-eight percent of the participants visited a dental clinic more than twice a year (Table 1).

3.2. Outcome characteristics

The responses to individual knowledge statements are listed in Table 2. Most participants answered incorrectly when they were asked if everyone has a unique palatal rugae (86.5%). In addition, most participants didn't realize that each individual has a unique teeth imprint (85.3%). Furthermore, although each individual has a unique lip print or lines, the majority (82.4%) were not aware of this fact. Forensic odontology determines the nature of an individual's occupation and socioeconomic status, but most participants failed to answer this question correctly (77.7% and 72.8%, respectively). When asked if forensic odontology estimates the age of an individual, more than two-thirds (69%) of participants responded correctly. The overall percentage mean \pm standard deviation of the knowledge scores was $39.8 \pm 22.5\%$.

The positive response rates to the perception statements are listed from the highest to lowest in Table 3. Almost 61% of the

study participants had concerns about their dental profile remaining confidential in a national dental registry. A majority of the participants (55.7%) said that they have the right to refuse registration with a national dental registry and 56.4% said that they have the right to withdraw their dental records from a national dental registry if they enrolled in future. More than half of the study participants (58.5%) agreed that forensic odontology is an accurate and sensitive means of identifying criminals. In addition, 59.6% of study participants believed that the national dental registry could assist with law enforcement. When asked about the accuracy and sensitivity of forensic odontology to identify unknown disaster victims, 61.6% of participants responded positively. Most of the study participants (81.2%) believed that their dental records should be linked to their medical and personal profiles, and 73.4% gave a positive response to the statement that the dental registry should be maintained and controlled by the government. The mean positive response rate regarding the participants' perception of a national dental registry was $64.7 \pm 25.5\%$. Finally, two-thirds of the surveyed participants (548, 67.5%) said that they would enroll in a national dental registry.

3.3. Factors associated with the responses to the test statements

Regarding their knowledge regarding forensic odontology, female study participants (PMS \pm SD = 45.3 ± 20.2) and participants with higher level of formal education (PMS \pm SD = 40.8 ± 22.5) had better knowledge than male or less well-educated participants ($P < 0.001$ and $P = 0.014$, respectively). However, married couples (PMS \pm SD = 36.8 ± 22.9) and those who were employed (PMS \pm SD = 37.5 ± 23.8) had poorer knowledge scores than unmarried participants or those who were not employed ($P = 0.003$ and $P = 0.005$, respectively). Female participants (MPRR \pm SD = 68.3 ± 24.7) also had more positive perception rates than males (MPRR \pm SD = 61.6 ± 25.8 ; $P < 0.001$) (Table 4).

Initial bivariate analysis showed that women (277, 73.3%) were also more likely to participate in a national dental registry than men (271, 62.4%; $P = 0.001$). Participants who were willing to enroll in a national dental registry had both higher knowledge scores (PMS \pm SD = 42.6 ± 22.1) and mean positive perception scores (MPRR \pm SD = 70.8 ± 22.2) ($P < 0.001$ for both) (Table 5). A binary logistic regression analysis showed that female participants and employed participants were 1.7 times [95% CI = 1.2–2.4] and 1.6 times [95% CI = 1.1–2.5] more likely to enroll in the registry ($P = 0.004$ and $P = 0.03$, respectively). Higher knowledge and perception scores were also associated with a greater willingness to enroll in a national dental registry (adj. $P = 0.031$ and adj. $P < 0.001$, respectively) (Table 6).

4. Discussion

The commission of any national medical or dental registry requires a massive effort at the governmental level (Blumenthal, 2017). Dental registries require the establishment of a secure infrastructure for data servers, an efficient network for data acquisition and transfer, nationwide training of dental practitioners, suitable equipment for obtaining imprints, and a competent team of data analysts (St. Sauver et al., 2017). However, such planning should not fail to consider the actual

Table 1 Participant characteristics.

	n(%)
Sex	
Male	434(53.4%)
Female	378(46.6%)
Age	
< 26	375(46.2%)
≥ 26	437(53.8%)
Mean \pm Standard deviation	28.4 ± 9.0
Marital status	
Single/Separated	504(62.1%)
Married	308(37.9%)
Education	
School	212(26.1%)
University	600(73.9%)
Employment	
Employed	408(50.2%)
Not Employed	404(49.8%)
Self-Payer	
Yes	405(49.9%)
No	407(50.1%)
Source of treatment	
Private sector	592(72.9%)
Government sector	220(27.1%)
Number of clinic visits annually	
None	119(14.7%)
1–2 times	451(55.5%)
More than 2 times	242(29.8%)
Financial status	
Comfortable	605(74.5%)
Uncomfortable	207(25.5%)

n: frequency, %: percentage.

Table 2 Responses to knowledge statements.

	Yes n(%)	No n(%)
Each individual has unique palate rogues.	110(13.5%)	702(86.5%)
Each individual has a unique teeth imprint.	119(14.7%)	693(85.3%)
Each individual has the same lip prints or lines.*	669(82.4%)	143(17.6%)
Forensic odontology aids in determining the nature of someone's occupation	181(22.3%)	631(77.7%)
Forensic odontology aids in determining the socioeconomic status of an individual.	221(27.2%)	591(72.8%)
Forensic odontology doesn't aid with parental neglect of children's teeth.*	576(70.9%)	236(29.1%)
Forensic odontology doesn't apply to live survivors of accidents.*	570(70.2%)	242(29.8%)
Forensic odontology aids in investigating sexual abuse.	269(33.1%)	543(66.9%)
Forensic odontology aids in determining race.	285(35.1%)	527(64.9%)
DNA cannot be extracted from dead bodies.*	522(64.3%)	290(35.7%)
Forensic odontology helps in medico-legal cases.	351(43.2%)	461(56.8%)
DNA can be extracted from the teeth of live individuals.	380(46.8%)	432(53.2%)
Forensic odontology aids in determining some social health-related lifestyle factors.	384(47.3%)	428(52.7%)
Forensic odontology aids in investigating physical abuse (domestic violence).	386(47.5%)	426(52.5%)
Forensic odontology can identify the sex of an individual.	389(47.9%)	423(52.1%)
Forensic odontology aids in investigating the victims of fatal accidents.	433(53.3%)	379(46.7%)
All individuals have the same jaw structures.*	351(43.2%)	461(56.8%)
Forensic odontology can determine the dental disease history of an individual.	470(57.9%)	342(42.1%)
Forensic odontology aids in investigating bite attacks.	546(67.2%)	266(32.8%)
Forensic odontology aids in estimating the age of an individual.	560(69.0%)	252(31.0%)

n: percentage, %: percentage, *: signifies incorrect statements.

Table 3 Responses to the perception statements.

	Positive response n(%)	Negative response n(%)
Cronbach's alpha = 0.832		
I think the retention of my dental profile in a dental national registry is safe with regard to an invasion of my privacy.	314(38.7%)	498(61.3%)
I should have the right to refuse to register in a national dental registry.	452(55.7%)	360(44.3%)
I should have the right to withdraw my dental record from a national dental registry if I enroll in the future.	458(56.4%)	354(43.6%)
I believe that forensic odontology is an accurate and sensitive method for the identification of criminals.	475(58.5%)	337(41.5%)
I believe that a national dental registry can assist with law enforcement.	484(59.6%)	328(40.4%)
I believe that forensic odontology is an accurate and sensitive method for the identification of unknown victims of disasters or emergencies (Hajj crush, flood, earthquake, crime).	500(61.6%)	312(38.4%)
I believe that forensic odontology is an accurate and sensitive method for the identification of victims.	516(63.5%)	296(36.5%)
I believe that Saudi dentists would be competent at creating a record of my dental profile in a national dental registry.	555(68.3%)	257(31.7%)
I am willing to provide my dental profile in case I am involved in a legal case.	561(69.1%)	251(30.9%)
I believe that the results of forensic odontology are scientifically reliable.	565(69.6%)	247(30.4%)
I believe Saudi dentists have the knowledge to assess my dental profile.	573(70.6%)	239(29.4%)
I believe Saudi dentists have the skills to assess my dental profile.	582(71.7%)	230(28.3%)
I believe Saudi dentists are able to maintain my privacy and confidentiality in a national dental registry.	595(73.3%)	217(26.7%)
A dental registry should be maintained and controlled by the government.	596(73.4%)	216(26.6%)
I believe dental records should be linked to my medical and personal profile.	659(81.2%)	153(18.8%)
I am willing to register in a future national dental registry database.		548(67.5%)

n: percentage, %: percentage.

contributor to such databases, the general public. The performance of any dental procedure, such as the collection of a dental imprint, requires the informed consent of the participants, involving the clear statement of the participants' rights and obligations (Di Lorenzo et al., 2018). The authors of this study believe that a major influence on the decision to enroll or not is the awareness of potential participants of the importance of such national dental registries. This study has sought to identify the perspective of the public regarding dental registries in advance, to identify any frequent gaps in personal knowledge,

and to help resolve any misperceptions. Thus, this study presents a preliminary feasibility assessment, with respect to public attitudes, prior to the establishment of a national dental registry.

The willingness of study participants to enroll in a future national dental registry was not overwhelming, and the rate cannot be compared to similar surveys, because no equivalents have previously been published. However, one study has described the motivation of a Mid-western US population regarding dental clinical trials (Friesen and Williams, 2016).

Table 4 Relationships between level of knowledge and perception of forensic odontology and participant characteristics.

	Knowledge	Perception
	PMS + SD	MPRR + SD
	39.8 ± 22.5	64.7 ± 25.5
Sex		
Male	34.9 ± 23.2	61.6 ± 25.8
Female	45.3 ± 20.2	68.3 ± 24.7
	t = 6.780, P < 0.001*	Z = - 3.938, P < 0.001*
Age		
< 26	42.4 ± 20.9	64.2 ± 26.4
≥ 26	37.5 ± 23.5	65.2 ± 24.8
	t = 3.141, P = 0.104	Z = - 0.239, P = 0.811
Marital status		
Single/ Separated	41.6 ± 22.0	65.3 ± 25.4
Married	36.8 ± 22.9	63.8 ± 25.8
	t = 2.945, P = 0.003*	Z = - 0.851, P = 0.395
Education		
School	36.5 ± 22.0	63.8 ± 26.5
University	40.8 ± 22.5	65.1 ± 25.1
	t = -2.467, P = 0.014*	Z = - 0.464, P = 0.642
Occupation		
Not Employed	42.0 ± 20.8	63.5 ± 26.2
Employed	37.5 ± 23.8	66.0 ± 24.8
	t = 2.821, P = 0.005*	Z = - 1.213, P = 0.225
Source of treatment		
Private	39.8 ± 22.2	64.4 ± 26.0
Government	39.7 ± 23.3	65.7 ± 24.3
	t = 0.072, P = 0.943	Z = - 0.413, P = 0.680

PMS: percentage mean score, MPRR: mean positive response rate, SD: standard deviation, t: independent Student's *t*-test, Z: Mann-Whitney, *P*: *P*-value, *: statistically significant at < 0.05.

In this study, the leading misconception identified was regarding the anatomic features of the oral cavity (palate, teeth imprint and lip print). The authors stated that they did not expect the public's knowledge of forensic dentistry to be high, relative to their knowledge of other aspects of dentistry, such as regarding hygiene or caries. Although the public could obtain information regarding forensic dentistry from the internet, the authors speculated that they were unlikely to access this information unless driven by curiosity. The data collectors in this study believed that the study participants were encouraged to learn more about the topic while participating in the survey, which could enhance their level of knowledge and encourage future participation. Although crime movies and documentaries are available on television, not every member of the public will be exposed to these. A previous study has also investigated the requirements for the development of a successful national registry of auditory implants, collecting the opinions of both the patients and stakeholders

Table 5 Relationships between willingness to register in a dental registry and participant characteristics.

	Willing to register in a future national dental registry	
	No n(%)	Yes n(%)
	264(23.5%)	548(67.5%)
Sex		
Male	163(37.6%)	271(62.4%)
Female	101(26.7%)	277(73.3%)
	$\chi^2 = 10.816,$ P = 0.001*	
Age		
< 26	126(33.6%)	249(66.4%)
≥ 26	138(31.6%)	299(68.4%)
	$\chi^2 = 3.76,$ P = 0.540	
Marital status		
Single/Separated	171(33.9%)	333(66.1%)
Married	93(30.2%)	215(69.8%)
	$\chi^2 = 1.215,$ P = 0.270	
Education		
School	75(35.4%)	137(64.6%)
University	188(31.5%)	408(68.5%)
	$\chi^2 = 1.047,$ P = 0.308	
Occupation		
Not Employed	143(35.4%)	261(64.6%)
Employed	121(29.7%)	287(70.3%)
	$\chi^2 = 3.047,$ P = 0.081	
Source of treatment		
Private	199(33.6%)	393(66.4%)
Government	65(29.5%)	155(70.5%)
	$\chi^2 = 1.211,$ P = 0.271	
Knowledge (PMS + SD)	33.8 ± 22.1	42.6 ± 22.1
	t = -5.373, P < 0.001*	
Perception (MPRR ± SD)	52.2 ± 27.4	70.8 ± 22.2
	Z = -9.282, P < 0.001*	

n: percentage, %: percentage, χ^2 : Pearson's chi-square statistic, PMS: percentage mean score, MPRR: mean positive response rate, SD: standard deviation, t: independent Student's *t*-test, Z: Mann-Whitney, *P*: *P*-value, *: statistically significant at < 0.05.

(Mandavia et al., 2018). Of the 18 themes emerging from the patient group, the most important factor identified for a registry was the advertising of the benefits of the registry (Mandavia et al., 2018). This is the reason why the authors believe that a vital component in the successful establishment of a national dental registry is its marketing, involving the dissemination of knowledge regarding forensic dentistry, via social media, television, and healthcare facilities.

The perception of the public is a reflection of how they feel and what they fear and/or prefer. Increasing the knowledge of

Table 6 Factors significantly associated with willingness to enroll in national dental registry.

	B	SE	Adj. P-value	Adj. OR [95% CI]
Sex	0.52	0.18	0.004*	1.7[1.2–2.4]
Female vs. Male				
Age group (years)	0.17	0.23	0.460	1.2[0.8–1.9]
≥26 vs. < 26				
Marital status	0.34	0.21	0.114	1.4[0.9–2.2]
Married vs. Single				
Education	0.12	0.18	0.501	1.1[0.8–1.6]
University vs. School				
Occupation	0.47	0.22	0.030*	1.6[1.1–2.5]
Employed vs. Unemployed				
Knowledge (PMS)	0.01	0.01	0.031*	1.1[1.1–1.2]
Perception (MPRR)	1.06	0.17	< 0.001*	2.9[2.1–4.0]
Constant	–1.03	0.42	0.015	0.35

B: beta coefficient of determination, SE: standard error, adj: adjusted, P: P-value, OR: odds ratio, CI: confidence interval, MPRR: mean positive response rate.

potential participants is one important way that any misconceptions can be corrected and expectations set appropriately. The authors believe that each perception statement used in the present survey represents an opportunity to improve knowledge. For instance, the largest negative response rate among the participants was regarding their feeling that the retention of their dental records represents an invasion of their privacy. Several studies have evaluated the views of people about the use of information for research purposes (Barrett et al., 2006), but none were related to dental registries or the use of information for forensic purposes. In general, the great majority of people considered the use of their personal information in registries, such as cancer registries, not to be an invasion of privacy (Barrett et al., 2006). Addressing this concern would require extensive cyber-security measures to be put in place, which is more feasible when managed at a governmental level. This explains why the majority of participants (73.4%) in this study prefer that such a registry is maintained and controlled by a government agency.

The recruitment and retention of the participants are essential to the success of any registry. Almost half of the participants in this study stated that they should have the right to refuse to register and the right to withdraw from a national dental registry. Participation in registries for research purposes is completely voluntary (Gliklich et al., 2014), but the criteria for enrollment in governmentally-controlled databases for personal identification are usually different. In some countries, it is mandatory for citizens to register their personal identification, but the registration of dental imprints is not obligatory, in contrast to fingerprints or facial photographs (Kindt, 2013). The author believe that any newly-launched registry will be regarded with caution by the public and they are likely to be conservative regarding their voluntary participation, probably because the concept is not clear to them. Therefore, a strategy aimed at increasing the public's knowledge regarding the importance of forensic odontology should help alleviate their concerns and encourage active participation.

When asked about their perceptions of the roles of Saudi dentists in a national dental registry, the majority of participants were willing to trust them with regards to their ability to maintain the confidentiality, and with regard to their skills

and knowledge. Furthermore, the participants generally accepted that forensic dentistry is a reliable discipline. This is extremely important, because the patient-physician relationship relies on trust, integrity, communication, and respect (Chandra et al., 2018). The authors believe that if the public is confident in the services provided at dental clinics, the registration rate with a national dental registry is likely to be higher. Furthermore, being a certified site for the registration of dental imprints could benefit both the dental clinic and the government. Members of the Saudi public would visit such clinics not only for registration, but also for other dental services (check-ups, hygiene, and treatments). Therefore, it should be beneficial for dental clinics to ensure that their practitioners are fully trained and competent in the methods for the registration of dental imprints.

Active participation of the Saudi Ministry of the Interior in a national registry would be required. Participants in this study had concerns regarding the importance of such registries for the resolution of criminal cases, and regarding the sensitivity and accuracy of forensic dentistry. Therefore, any marketing campaign would require combined input from the dental profession and the criminal investigation department to promote the importance of such a registry. The present study has investigated which groups of the public community have poorer knowledge and perceptions of a prospective dental registry, and these groups should be specifically targeted by awareness campaigns. For instance, Saudi men could be approached through social media, forums, and blogs that focus on sports, whose followers are mainly male. Other factors, such as marital status, educational level, and occupation, are also important to address, but efforts should be mainly focused on modifiable factors that directly influence willingness to participate in a national dental registry, namely public knowledge and perception.

The inter-rater reliability of data collection tool in this study was good (0.83–0.832), which implies that a high level of consistency has been achieved in the evaluation of the levels of knowledge and perception of forensic odontology. However, there were a few limitations to this study. Some anatomic names of the oral cavity might not have been clear for some participants, even when translated into the local dialect. However, the authors included a visual illustration of the oral

cavity to help with this. The authors suspect that some of the participants might have been distracted by the surrounding festivities, which could have affected the accuracy of responses to the questionnaire. Finally, although participants who were dental students or practitioners were excluded, some participants might have gained extra knowledge from documentaries or movies, which was not controlled for as a confounder in the present study.

5. Conclusions

A national dental registry in Saudi Arabia is expected to be well perceived by the public. However, improving the public's knowledge regarding the importance of forensic dentistry is expected to enhance their awareness and encourage their active enrollment in such a registry. A preliminary assessment to determine the level of knowledge among the Saudi Arabian public and to anticipate barriers to participation is a crucial step. Although women and employed participants said that they were more willing to enroll, it is too early to predict the rates of participation, given the fact that nationwide marketing and promotion of the registry have yet to be launched.

Ethics approval and consent to participate

A self-explanatory letter of invitation to participate was handed to each of the participants. Written obtained consents were sought from participants indicating their agreement to provide their feedback for this research study. Study was approved by the Institutional Review Board of the Ministry of National Guard Health Affairs, Riyadh, Saudi Arabia (Protocol # RC17/190).

Declaration of Competing Interest

The authors declare that they have no competing interests. Special thanks to Mr. Ala'a Banimustafa for his support in editing the manuscript.

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