

# Preparedness of newly qualified dentists in Riyadh, Saudi Arabia

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## Research Article

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# Abstract

*Purpose:* To evaluate the self-reported preparedness for the dental practice amongst new dental graduates in Riyadh, Saudi Arabia.

*Methods:* Purposive sampling techniques were used to invite newly qualified dental graduates in Riyadh Saudi Arabia to self-evaluate their preparedness for practise by providing responses to the Dental Undergraduate preparedness assessment scale (DU-PAS).

*Results:* The data highlighted several weakness amongst the participants. Of the 82 participants, less than 40% of participants were able independently to prescribe medications, assess orthodontics needs and perform endodontic treatment on multirooted teeth. In addition, more than 65% indicated low preparedness scores for evaluating new dental materials and products, interpreting new research findings and behavioural management of children. The DU-PAS presented an excellent reliability coefficient ( $\alpha = 0.93$ ).

*Conclusion:* Periodic and longitudinal evaluations of dental students can help identify gaps in knowledge and skills and offer opportunities to address the learning needs of future dentists. Early recognition of weaknesses in future graduates allows dental educators to take appropriate remedial measures. A tailored approach may be used to address the learning needs of individual students through structured feedback, encouraging reflective practice, and providing additional training to help students consolidate their clinical skills.

## Introduction

The primary objectives of dental education include educating learners to provide oral and dental health care of patients and communities, and also to "*prepare students to continue to grow in skill and knowledge over their lifetime in practice*" [1]. Graduate dentists are expected to demonstrate competence in clinical skills, professionalism, communication, management and leadership skills underpinned by scientific knowledge, critical thinking and reflective practice [2, 3].

Competency-based approaches have been adopted in dental education to evaluate the skills and attributes of dental students to ensure that the learners possess the abilities to provide independent care to the patients and community needs [4]. The revised curriculum framework for graduating European dentists identifies a range of competencies for undergraduate dental students [3]. In addition, the students are expected to demonstrate professionalism, follow legal and ethics regulations, and provide evidence-based and patient-centred clinical care with a holistic approach of oral health promotion and disease prevention in society. Periodic and longitudinal assessments of student performance can provide crucial data in a timely fashion to inform curriculum development, teaching, and clinical training models at dental institutions. Moreover, assessment data can be used to identify the learning needs of students to offer structured and timely remediation to weak students [2, 3].

Despite the lack of distinction between 'competence', 'competency' and 'performance' in the dental literature, the former two reflect the dental learner's capability to perform a set of attributes and their staged process to become an expert. In contrast, the latter refers to the actual act of performing a dental skill, respectively [4]. The professional competencies of dental graduates have been discussed thoroughly in the literature within different subspecialties and topics such as cariology, dental public health, endodontics gerontology, oral pathology and medicine, paediatric dentistry, periodontology, prosthodontics, special care dentistry as well as continuing professional development and pre-clinical skills [3]. These studies have consistently identified gaps in undergraduate dental education which may question the ability of new graduates to provide safe and effective clinical care to meet patient and public expectations.

Assessing the preparedness of newly graduated dentists has been reported widely, but most seem to focus exclusively on clinical skills [5, 6]. Similar studies in the Middle East and North African region focused on a specific procedure such as dental extraction [7] and the COVID-19 pandemic and their impact on dental graduates' preparedness [8]. A published study on 300 new dental graduates in Saudi [9] has highlighted several self-reported weaknesses in the clinical procedures among participants such as dental bleaching, surgical teeth extraction and orthodontic emergencies. However, the afore-mentioned studies primarily focused on clinical skills and did not consistently capture data related to behavioural attributes which are crucial in contemporary healthcare.

The aim of the present study was to evaluate the self-reported preparedness of new dental graduates in Riyadh, Saudi Arabia using a validated instrument.

## **Methods**

### **Study design and sampling technique**

A cross-sectional study based on an online survey of new graduates in the first year of their internship using the purposive sampling technique.

#### **Ethics approval**

for the study was obtained from King Saud University's Institutional Review Board (reference: 21/01009/IRB). After that, the data was retrospectively collected and analysed anonymously from the database of the Dental Internship Training Programme.

### **Data collection instrument**

Dental Undergraduate Preparedness Assessment Scale (DU-PAS) which is a valid and reliable scale was used for data collection [10]. It consists of 50 items distributed as follows:

1. Part A: includes 24 items focused on clinical skills scored based on a three-point Likert scale (no experience = 0, with verbal and practical input from a colleague = 1 and on my own, independently = 2).
2. Part B: includes 26 items on cognitive and behavioural attributes scored on a three-point Likert scale (no experience = 0, mostly = 1 and always = 2).

The total score on DU-PAS ranges from 0-100 and allows quantification of perceived preparedness in a range of clinical, cognitive and affective skills.

In addition to the DU-PAS scale, the participants were also invited complete two open-ended questions about the perceived goals of the internship training after graduation and the requisite attributes.

## Data collection

Participants were invited to respond to an online questionnaire based on the DU-PAS scale and two open-ended questions by email. The invite was accompanied by a participant information sheet explaining the study's purpose. All participants were asked to sign a consent form to confirm they understood and agreed to the purpose of the study and how their data would be collected, processed and disseminated. A reminder for completion was sent after 2 weeks.

## Statistical Analysis

Means, medians, standard deviations, highest and lowest values and percentages were used to describe the study characteristics and were calculated using IBM Statistical Package for Social Sciences (SPSS) software (version 22.0). Normality of data distribution was tested by the Shapiro-Wilk test [11] and Pearson's or Spearman's correlation coefficient (two-tailed test of significance) was used to measure correlations between the variables [12]. Values were interpreted based on Guilford's interpretation as low [0.20–0.40], moderate [0.40–0.70] or high [ $> 0.70$ ] [13]. The reliability coefficient (Cronbach's alpha) is based on George and Mallery's interpretation as excellent [ $> 0.90$ ], good [ $> 0.80$ ] or acceptable [ $> 0.70$ ] [14].

## Results

A total of 82 responses were received from a pool of 126 potential participants, yielding a response rate of 68%. The participants included 49 males and 33 females were included in the analysis. The responses for parts A and B are shown in Table 1 and Table 2, respectively.

Table 1  
The distribution of participants' scores for Part A (n = 82).

Item	No experience (%)	With help (%)	Independently (%)
<i>Prescribe appropriate dental radiographs</i>	1 (1%)	5 (6%)	76 (93%)
<i>Obtain valid consent from my patients</i>	2 (2%)	5 (6%)	75 (91%)
<i>Obtaining a complete medical history</i>	0 (0%)	8 (74%)	74 (90%)
<i>Restore teeth with tooth coloured fillings</i>	1 (1%)	7 (8%)	74 (90%)
<i>Remove dental caries effectively</i>	1 (1%)	8 (10%)	73 (89%)
<i>Interpret common findings on dental radiographs</i>	1 (1%)	9 (11%)	72 (88%)
<i>Perform endodontic treatment on single rooted teeth</i>	3 (4%)	9 (11%)	70 (85%)
<i>Perform non-surgical periodontal treatment</i>	4 (5%)	9 (11%)	69 (84%)
<i>Administer inferior dental nerve blocks effectively</i>	2 (2%)	12 (15%)	68 (83%)
<i>Undertake a comprehensive, clinical oral examination</i>	2 (2%)	13 (16%)	67 (82%)
<i>Explain the merits and demerits of various treatment options</i>	4 (5%)	13 (16%)	65 (79%)
<i>Carry out patients' treatment sessions in an appropriate order</i>	1 (1%)	18 (22%)	63 (77%)
<i>Provide crowns using principles of tooth preservation</i>	8 (10%)	12 (15%)	62 (76%)
<i>Provide a range of treatment options to my patients</i>	3 (4%)	18 (22%)	61 (74%)
<i>Undertake non-surgical tooth extractions</i>	1 (1%)	23 (28%)	58 (71%)
<i>Undertake bitewing radiographs</i>	6 (7%)	19 (23%)	57 (69%)
<i>Undertake periapical radiographs</i>	6 (7%)	22 (27%)	54 (66%)
<i>Formulate a comprehensive treatment plan</i>	3 (4%)	26 (32%)	53 (65%)
<i>Restore teeth with amalgam fillings</i>	18 (22%)	11 (13%)	53 (65%)

<b>Item</b>	<b>No experience (%)</b>	<b>With help (%)</b>	<b>Independently (%)</b>
<i>Provide mechanically sound partial dentures</i>	14 (17%)	28 (34%)	40 (49%)
<i>Assess the treatment needs of patients requiring orthodontics</i>	17 (21%)	33 (40%)	32 (39%)
<i>Prescribe drugs to my patients appropriately</i>	4 (5%)	47 (57%)	31 (38%)
<i>Provide mechanically sound full denture</i>	12 (16%)	39 (48%)	31 (38%)
<i>Perform endodontic treatment on multirrooted teeth</i>	18 (22%)	35 (43%)	29 (35%)

Table 2  
The distribution of participants' scores for Part B (n = 82).

<b>Item</b>	<b>No experience (%)</b>	<b>Mostly (%)</b>	<b>Always (%)</b>
<i>Communicate appropriately with my colleagues</i>	0 (0%)	17 (21%)	65 (79%)
<i>Refer patients with complex treatment needs</i>	0 (0%)	17 (20%)	65 (79%)
<i>Recognise personal limitations in clinical practice</i>	0 (0%)	19 (23%)	63 (77%)
<i>Maintain accurate records of clinical notes</i>	0 (0%)	21 (26%)	61 (74%)
<i>Take appropriate measures to protect patient confidentiality</i>	1 (1%)	20 (24%)	61 (74%)
<i>Restrict relations with patients to a professional level</i>	1 (1%)	21 (26%)	60 (73%)
<i>Ask for help from a supervisor or colleague</i>	5 (6%)	18 (22%)	59 (72%)
<i>Communicate effectively with patients</i>	0 (0%)	24 (29%)	58 (71%)
<i>Take responsibility for continuing professional development</i>	2 (2%)	23 (28%)	57 (69%)
<i>Fulfil responsibilities as an effective member of the dental team</i>	1 (1%)	26 (32%)	55 (67%)
<i>Awareness of legal responsibilities as a dental professional</i>	8 (10%)	21 (26%)	53 (65%)
<i>Communicate potential risks of operative procedures to patients</i>	1 (1%)	28 (34%)	53 (64%)
<i>Provide opportunities for patients to express their expectations</i>	1 (1%)	30 (37%)	51 (62%)
<i>Reflect on clinical practice to address personal learning needs</i>	2 (2%)	29 (35%)	51 (62%)
<i>Motivate patients</i>	0 (0%)	32 (39%)	50 (61%)
<i>Address barriers to effective communication with patients</i>	2 (2%)	38 (46%)	42 (51%)
<i>Work within the constraints of clinical appointment schedules</i>	4 (5%)	36 (44%)	42 (51%)

Item	No experience (%)	Mostly (%)	Always (%)
<i>Raise concerns about inappropriate behaviour of colleagues</i>	14 (17%)	26 (31%)	42 (51%)
<i>Refer patients with suspected oral cancer</i>	24 (29%)	20 (24%)	38 (46%)
<i>Sufficient knowledge of scientific principles</i>	1 (1%)	45 (55%)	36 (43%)
<i>Manage anxious patients</i>	10 (12%)	38 (46%)	34 (41%)
<i>Use an evidence-informed approach in clinical practice</i>	12 (15%)	38 (47%)	32 (39%)
<i>Manage peoples' expectations of their treatment</i>	1 (1%)	52 (63%)	29 (35%)
<i>Manage the behaviour of children</i>	9 (11%)	44 (54%)	29 (35%)
<i>Interpret the results of new research</i>	16 (19%)	39 (48%)	27 (33%)
<i>Evaluate new dental materials and products</i>	21 (26%)	39 (48%)	22 (27%)

Reliability assessment for DU-PAS indicated excellent reliability for the overall scale [ $\alpha = 0.93$ ]. Individual reliability for both parts of the scale was also excellent i.e., Part A [ $\alpha = 0.93$ ], and Part -B [ $\alpha = 0.88$ ].

Most participants reported the ability to perform the following skills independently; prescribing dental imaging (93%), obtaining valid consent (91%) as well as obtaining complete medical history and restoring teeth with tooth coloured restorations (90%). In contrast, less than 40% reported the ability to perform endodontic treatment, prescribing drugs, providing mechanically sound complete dentures, and assessing the patient's orthodontic treatment needs independently.

Regarding the behavioural attributes and clinical skills, 100% of participants were 'mostly' or 'always' able to motivate patients, recognise personal limitations, refer patients with complex treatment needs, communicate effectively with patients, confidently communicate with colleagues, and maintain accurate clinical records. Notably, some participants indicated 'no experience' with referring patients with suspected oral lesions (29%), evaluating new dental materials (26%) and interpreting new research results (19%).

The gender-based analysis indicated a similar distribution of scores for PAS and its domains (Fig. 1). Although, the lowest overall DU-PAS mean score was notably lower in females than males (24 and 54,



respectively). This was also reflected by a slightly higher median score of 80 by males compared to 76 by female participants.

Participants responded also responded to the open-ended questions which accompanied the DU-PAS scale. These responses are summarized in Table 3.

Table 3  
Selection of participants' comments.

<b>ID</b>	<b>What are your goals for your internship year?</b>	<b>Which skills can help you achieve your goals?</b>
P02	<i>To improve my skills and to raise my self confidence</i>	<i>Confidence</i>
P04	<i>To develop and improve both my clinical and research skills</i>	<i>Guidance, self-confidence, practice, and time</i>
P08	<i>Develop excellent clinical skills in all dental aspects.</i>	
P13	<i>Learning more about different specialities in order to find my interest, more experience in clinical independent practice, knowledge and application of research</i>	<i>Communication skills and motivation</i>
P27	<i>Improve clinical skills</i>	<i>Multi rooted endo, crown preparation and fixed [prosthodontic] treatment plan</i>
P31	<i>To master simple and surgical extractions, pulp extirpation, documentation, and treatment planning</i>	<i>Time management, interpretation of radiographic images, different suturing techniques</i>
P40	<i>Learn more</i>	<i>Endo treatment</i>
P61	<i>To see more cases and to work faster, to improve my work in endo, and pass the licence examination</i>	<i>More training</i>
P82	<i>To improve my clinical decision to do [the] most appropriate treatment for every case, to learn more [about] how to manage the patient behaviour, get maximum exposure to different specialities to determine [the] most appropriate dental discipline to pursue [a] specialisation</i>	<i>How to interpret the latest research and complete improve my time management skills during clinical treatments</i>

## Discussion

The present study explored self-reported competence by new dental graduates in Saudi Arabia. While preparedness of dental graduates from several countries is reported, there is limited data to gauge the preparedness of Saudi Dental graduates. A safe dental practitioner recognises their limitations and seeks assistance upon encountering them [15]. Thus, ascertaining attributes of low competence could then be used to highlight areas that need improvement in a dental curriculum to conduct safe dental practice [3].

Examples include adopting a student-based learning approach (e.g. flipped and problem-based learning), providing a supportive environment for learning (e.g. counselling and feedback/feedforward), and promoting the lifelong learning skills of students/future dentists (e.g. critical thinking), training staff and mentors [3, 16, 17].

In comparison with other similar studies, the participants presented similar mean self-reported preparedness (DU-PAS) total score of 79 to that found among final-year dental students in Malaysia [79] [18], but slightly higher than reported by a similar study in Pakistan [65] [19]. Also, the mean score given by participants for clinical skills items (DU-PAS part A) was similar to that reported in Mat Yudin et al. [2020] study. Similar to other studies [18–20], a high self-reported competence noted in conducting basic dental work independently (e.g. obtaining medical history, prescribing and interpreting radiographs, caries control and using tooth coloured fillings). Similarly, a lower competence was noted presently as well as in these studies with more complex clinical tasks such as performing endodontic treatment of multirrooted teeth, assessing orthodontic treatment needs, prescribing medications

However, other studies noted lower independence scores for undertaking periapical and bitewing radiographs [19] and interpreting radiographic findings [20].

A general dental practitioner's low confidence in formulating a treatment plan may act as a deterrent to providing specific interventions [21], which might be encountered among the 35% of present participants who indicated no experience or needed help to formulate a comprehensive treatment plan. This was demonstrated by participants in the present study, who indicated improving treatment planning skills as a goal for the internship year [P27 and 31]. Furthermore, around 35% of 106 dental graduates in Malaysia noted a low level of preparedness regarding oral rehabilitation [17]. This is likely to be mirrored presently with 45 and 51 out of the 82 study participants indicating no experience or need help to provide sound partial or complete dentures, respectively.

The reported low-competent tasks and procedures can be addressed by employing case and simulation-based training using virtual reality and physical simulation exercises to improve psychomotor skills in the pre-clinical courses. Examples include using hardware simulators and stereoscopic 3-dimension glasses and augmented reality headsets for complex operative and surgical procedures and software simulations like that used for aviation safety exercises [22, 23]. For medication prescription, there is a need to implement the generic [24] and dental [25] or antimicrobial-related [26] prescription guidelines and checklists within the curriculum and electronic health systems to maintain a practical usage and safe and error-free dental prescriptions.

Regarding the behavioural and cognitive attributes (DU-PAS part B), self-reported preparedness scores were notably lower than those presented to clinical skills. None of these attributes was scored as "always" by 80% or more of study participants presently and among other studies [18, 19]. Although, some attributes obtained slightly higher "always" scores compared to a recent study that included 245 final-year dental students [18]. For instance, communicating with colleagues, referring patients with complex treatment needs and recognising personal limitations (> 77% and < 70). Both studies indicated similar

areas of low preparedness for managing children's behaviour and anxious individuals, evaluating new dental materials, and interpreting new research findings. Accordingly, the participants indicated their goals of the internship to improve both clinical and research skills [P04], learn about interpreting [P82] and implement research findings [P13].

Other studies also suggest that many dental graduates may find difficulties in implementing evidence-based clinical practice [18, 27]. This might be attributed to the limited ability to search, access and critically appraise the literature [28, 29]. Barriers to implementing an evidence-based care approach could be related to patient factors (e.g. access to health information and financial aspects), health care service team and provider (e.g. availability of clinical decision-making tools) and literature (e.g. complexity and actionability of clinical guidelines) [30].

Dental schools may therefore consider using big data analysis to analyse the student's performance and present predictive conclusions to provide efficient patient care tailored to needs and expectations [31]. Examples can include clinical information data repositories, such as BigMouth Dental Data Repository [32], accessed and analysed by dental students to maintain evidence-based dental care. Nevertheless, using these data sets to inform dental practice and optimise clinical outcomes is presently limited due to their inadequate availability for oral health research [31]. Thus, dental educators could reduce this gap by developing interdisciplinary information technology courses or assignments to support the student's capacity to access and appraise oral health research needed to solve the day-to-day clinical queries [29].

Moreover, around 30% of respondents of both studies indicated no experience referring patients with suspicious oral lesions, which could affect the early detection of these lesions and their malignant transformation [33]. Thus, dental educators may consider integrating the evidence from systematic reviews regarding the diagnostic accuracy of clinical assessments for oral suspicious lesions [34] with new trends in oral cancer risk calculation to recognise high-risk individuals. Based on the demographics and clinical information these tools can assist risk stratification by dental students and graduates to avoid "false alarm" and the unnecessary use of health care resources [34, 35]. Image classification algorithms and tele-diagnosis tools of oral mucosal suspicious lesions, which can inform clinicians when to refer or not refer [36, 37], can also be incorporated into dental curricula.

The present study is limited by using self-reported views of preparedness with no objective assessment of competence, performance, or knowledge. However, the instrument used (DU-PAS) was developed using qualitative methods. The Rasch model demonstrated its adequate construct validity and test-retest reliability [18–20]. Moreover, the relatively low response rate of 65% was comparable to those reported in similar quantitative studies of 60% [17] and 66% [5]. Another limitation was the lack of items assessing the competence to manage patients with dental/medical emergencies and special needs and report neglect, as noted in a mixed-method study to determine the preparedness for dental practice in Australia [2].

Dental educators may consider qualitative methods (e.g. in-depth interviews) and the available measures along with DU-PAS to gain a deeper understanding about the perceptions, experiences and

recommendations by relevant stakeholders. For instance, a 11-item trainer-rated instrument (rated by 10 cm visual analogue scale) was developed and validated specifically to assess the dental student's performance for dental extraction [7]. Also, researchers at the University of Liverpool have recently developed a 19-criteria tool to assess the complexity of root canal treatment based on three tiers: class I (complicated), class II (moderately complicated) and class III (highly complicated) [38]. The competence of dental graduates/students to implement evidence-based practice specifically can be assessed using generic measures such as Berlin Questionnaire or its revised version for evidence-based dentistry [39]. Future studies may also consider comparative analysis between self-assessment, trainer assessment and peer assessment of performance, which is another reliable quality assurance of learning and professional development as autonomous trainee and practitioner [40].

## Conclusion

The present findings ascertained the clinical and behavioural attributes with low self-reported preparedness among a sample of new dental graduates in Saudi Arabia, which can help local dental educators to evaluate the identified gaps and implement strategies to address these limitations through additional teaching and training.

## Abbreviations

DU-PAS

Dental Undergraduate Preparedness Assessment Scale

## Declarations

### *Ethics and consent to participate*

Ethical approval for the present study was obtained from The Institutional Review Board's Sub-Committee for Health Sciences Colleges Research on Human Subjects at King Saud University (reference no: 21/01009/IRB). The data was collected and analysed retrospectively from an anonymous database, thus, informed consent was not required by the abovementioned ethics committee (reference no: 21/01009/IRB). All the study activities were in line with the ethical principles of the Declaration of Helsinki for health research involving human subjects [41] and the Privacy and Data Protection Regulation in Saudi Arabia [42].

### *Consent for publication*

Not applicable.

### *Availability of data and materials*

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

### *Competing interests*

The authors declare no competing interests.

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### *Authors' contributions*

AA contributed to the study conceptualisation, methodology, data curation, formal analysis and writing of the original draft. KA contributed to the study methodology, validation, and final draft revisions.

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## **References**

1. Field MJ. The Mission of Research. In: Dental education at the crossroads: challenges and change. edn. Washington: National Academies Press; 1995. pp. 144–73.
2. Mariño R, Delaney C, Manton D, Reid K, Satur J, Wong R: Preparation for practice of newly qualified dental practitioners in Australia. In. Melbourne: Melbourne Dental School, The University of Melbourne; 2021.
3. Field JC, Cowpe JG, Walmsley AD. The graduating European dentist: a new undergraduate curriculum framework. *Eur J Dent Educ*. 2017;21(S1):2–10.
4. Chuenjitwongsa S, Oliver RG, Bullock AD: Competence, competency-based education, and undergraduate dental education: a discussion paper. *Eur J Dent Educ* 2018, 22(1):1–8.
5. Yiu CKY, McGrath C, Bridges S, Corbet EF, Botelho MG, Dyson JE, Chan LK. Self-perceived preparedness for dental practice amongst graduates of The University of Hong Kong's integrated PBL dental curriculum. *Eur J Dent Educ*. 2012;16(1):e96–105.
6. Yiu CKY, McGrath C, Bridges S, Corbet EF, Botelho M, Dyson J, Chan LK. Graduates' perceived preparedness for dental practice from PBL and traditional curricula. *J Dent Educ*. 2011;75(9):1270–9.
7. Majid OW. Assessment of clinical ability in the removal of teeth among undergraduate dental students: a longitudinal comparative study. *Br J Oral Maxillofac Surg*. 2018;56(9):870–6.
8. Hattar S, AlHadidi A, Sawair FA, Alraheem IA, El-Ma'aita A, Wahab FK. Impact of COVID-19 pandemic on dental education: online experience and practice expectations among dental students at the

- University of Jordan. *BMC Med Educ.* 2021;21(1):1–10.
9. Aldegheishem A, Azam A, Alfahed B, Aldegheishem G, Aldryhim H, Alshami A, Anwaigi L. Practice with confidence: Analyzing confidence level of final year dental students from four Saudi dental colleges in Riyadh. *Saudi J Biol Sci.* 2021;28(4):2175–9.
  10. Ali K, Slade A, Kay EJ, Zahra D, Chatterjee A, Tredwin C. Application of Rasch analysis in the development and psychometric evaluation of dental undergraduates preparedness assessment scale. *Eur J Dent Educ.* 2017;21(4):e135–41.
  11. Shapiro SS, Wilk MB. An analysis of variance test for normality (complete samples). *Biometrika.* 1965;52(3–4):591–611.
  12. Overholser BR, Sowinski KM. Biostatistics primer: part 2. *Nutr Clin Pract.* 2008;23(1):76–84.
  13. Guilford JP. *Fundamental statistics in psychology and education.* 2nd ed. New York: McGraw-Hill; 1950.
  14. George D, Mallery P. *SPSS for windows step by step: a simple guide and reference (11.0 update).* 4th ed. Boston: Allyn & Bacon; 2003.
  15. Ali K, Tredwin C, Kay EJ, Slade A, Pooler J. Preparedness of dental graduates for foundation training: a qualitative study. *Br Dent J.* 2014;217(3):145–9.
  16. Chuenjitwongsa S, Oliver RG, Bullock AD. Developing educators of European undergraduate dental students: towards an agreed curriculum. *Eur J Dent Educ.* 2018;22(3):179–91.
  17. Mohd Yani AA, Ahmad MS, Ngah NA, Md Sabri BA. The relationship of educational environment and preparedness to practice-perceptions of Malaysian dental graduates. *Eur J Dent Educ* 2022.
  18. Mat Yudin Z, Ali K, Wan Ahmad WMA, Ahmad A, Khamis MF, Brian Graville Monteiro NA, Che A. Aziz ZA, Saub R, Rosli TI, Alias A. Self-perceived preparedness of undergraduate dental students in dental public universities in Malaysia: A national study. *Eur J Dent Educ.* 2020;24(1):163–8.
  19. Ali K, Cockerill J, Zahra D, Qazi HS, Raja U, Ataullah K. Self-perceived preparedness of final year dental students in a developing country—A multi-institution study. *Eur J Dent Educ.* 2018;22(4):e745–50.
  20. Ali K, Slade A, Kay E, Zahra D, Tredwin C. Preparedness of undergraduate dental students in the United Kingdom: a national study. *Br Dent J.* 2017;222(6):472–7.
  21. Patel PM, Lynch CD, Sloan AJ, Gilmour ASM. Treatment planning for replacing missing teeth in UK general dental practice: current trends. *J Oral Rehabil.* 2010;37(7):509–17.
  22. Towers A, Field J, Stokes C, Maddock S, Martin N. A scoping review of the use and application of virtual reality in pre-clinical dental education. *Br Dent J.* 2019;226(5):358–66.
  23. Sohmura T, Hojo H, Nakajima M, Wakabayashi K, Nagao M, Iida S, Kitagawa T, Kogo M, Kojima T, Matsumura K. Prototype of simulation of orthognathic surgery using a virtual reality haptic device. *Int J Oral Maxillofac Surg.* 2004;33(8):740–50.
  24. De Vries TPG, Henning RH, Hogerzeil HV, Fresle DA, Policy M, World Health O: *Guide to good prescribing: a practical manual.* In. Geneva: World Health Organization; 1994.

25. Scottish Dental Clinical Effectiveness Programme. Drug prescribing for dentistry: dental clinical guidance. 3rd ed. Dundee: NHS Scotland; 2016.
26. Palmer N, Seoudi N, Ide M, Randall C, Hyland L, Patrick A. Antimicrobial Prescribing in Dentistry: Good Practice Guidelines. In. 3rd ed. London: Royal College of Surgeons of England; 2020.
27. Weyant RJ. Teaching evidence-based practice: considerations for dental education. *Dent Clin North Am.* 2019;63(1):97–117.
28. Caspi O, McKnight P, Kruse L, Cunningham V, Figueredo AJ, Sechrest L. Evidence-based medicine: discrepancy between perceived competence and actual performance among graduating medical students. *Med Teach.* 2006;28(4):318–25.
29. Levine AE, Bebermeyer RD, Chen JW, Davis D, Harty C. Development of an interdisciplinary course in information resources and evidence-based dentistry. *J Dent Educ.* 2008;72(9):1067–76.
30. Spallek H, Song M, Polk DE, Bekhuis T, Frantsve-Hawley J, Aravamudhan K. Barriers to implementing evidence-based clinical guidelines: a survey of early adopters. *J Evid Based Dent Pract.* 2010;10(4):195–206.
31. Finkelstein J, Zhang F, Levitin SA, Cappelli D. Using big data to promote precision oral health in the context of a learning healthcare system. *J Public Health Dent.* 2020;80:43–58.
32. Walji MF, Kalenderian E, Stark PC, White JM, Kookal KK, Phan D, Tran D, Bernstam EV, Ramoni R. BigMouth: a multi-institutional dental data repository. *J Am Med Inform Assoc.* 2014;21(6):1136–40.
33. Chiang T-E, Lin Y-C, Wu C-T, Yang C-Y, Wu S-T, Chen Y-W. Comparison of the accuracy of diagnoses of oral potentially malignant disorders with dysplasia by a general dental clinician and a specialist using the Taiwanese Nationwide Oral Mucosal Screening Program. *PLoS ONE.* 2021;16(1):e0244740.
34. Walsh T, Liu JLY, Brocklehurst P, Glenny AM, Lingen M, Kerr AR, et al. Clinical assessment to screen for the detection of oral cavity cancer and potentially malignant disorders in apparently healthy adults. *Cochrane Database of Systematic Reviews [Internet].* 2013 [cited 21 November 2013]; Issue 11. Art. No.: CD010173. Available from: doi: 10.1002/14651858.CD010173.pub2.
35. Krishna Rao S, Mejia GC, Logan RM, Kulkarni M, Kamath V, Fernandes DJ, Ray S, Roberts-Thomson K. A screening model for oral cancer using risk scores: development and validation. *Community Dent Oral Epidemiol.* 2016;44(1):76–84.
36. Welikala RA, Remagnino P, Lim JH, Chan CS, Rajendran S, Kallarakkal TG, Zain RB, Jayasinghe RD, Rimal J, Kerr AR: Fine-tuning deep learning architectures for early detection of oral cancer. In: *International Symposium on Mathematical and Computational Oncology (ISMCO)*. San Diego, California, USA: Springer; 2020: 25–31.
37. Fonseca BB, Perdoncini NN, da Silva VC, Gueiros LAM, Carrard VC, Lemos CA Jr, Schussel JL, Amenábar JM, Torres-Pereira CC. Telediagnosis of oral lesions using smartphone photography. *Oral Dis.* 2021;28(6):1573–9.
38. Essam O, Boyle EL, Whitworth JM, Jarad FD. The Endodontic Complexity Assessment Tool (E-CAT): A digital form for assessing root canal treatment case difficulty. *Int Endod J.* 2021;54(7):1189–99.

39. Imorde L, Möltner A, Runschke M, Weberschock T, Rüttermann S, Gerhardt-Szép S. Adaptation and validation of the Berlin questionnaire of competence in evidence-based dentistry for dental students: a pilot study. *BMC Med Educ.* 2020;20(1):1–13.
40. Evans AW, Leeson RMA, Petrie A. Reliability of peer and self-assessment scores compared with trainers' scores following third molar surgery. *Med Educ.* 2007;41(9):866–72.
41. General Assembly of the World Medical A. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *J Am Coll Dent.* 2014;81(3):14–8.
42. National Data Management Office. Data Management and Personal Data Protection Standards. In. Edited by NDMO. Saudi Arabia; 2021.

## Figures

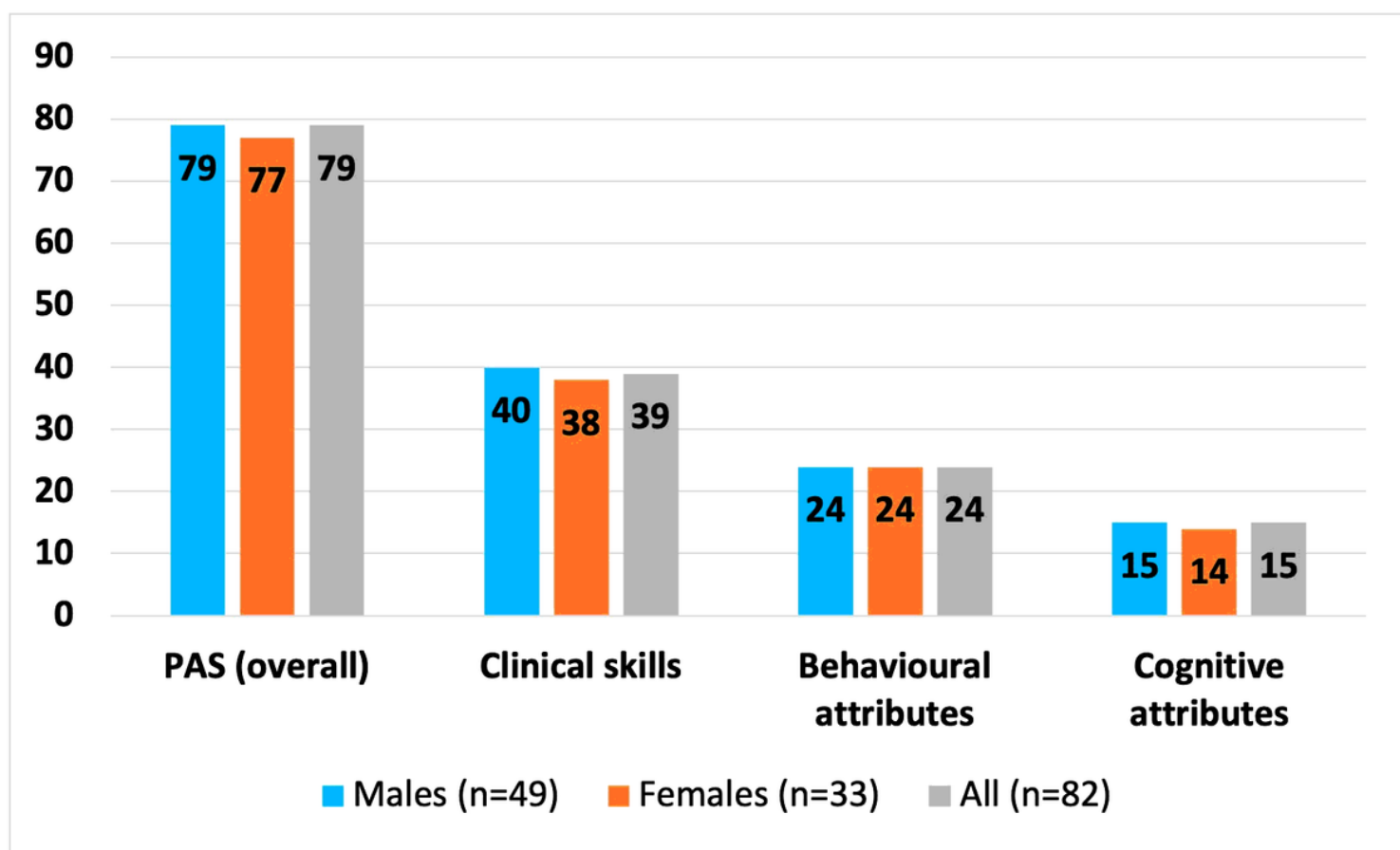


Figure 1

The mean scores for DU-PAS among study participants (n=82).