Original Article

Knowledge and Attitude Towards Cone Beam Computed Tomography (CBCT) Among Undergraduate Dental Students in Malaysia – A Questionnaire Survey

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Abstract

Introduction: This study investigates the knowledge and attitudes of undergraduate dental students in private universities in Klang Valley, Malaysia, towards cone beam computed tomography (CBCT). **Objective:** The aim of this study was to assess the knowledge and attitude towards cone beam computed tomography (CBCT) among undergraduate dental students in private universities in Klang Valley, Selangor, Malaysia. **Methods:** A questionnaire consisting of 14 close ended questions was given to 250 undergraduate dental students in private universities in Klang Valley. The chi-square test was used to statistically analyse the differences in responses based on educational level. **Results:** A total of 182 participants responded to this study. All of the participants consisting of 39 year 3 students (21.4%), 70 year 4 students (38.5%) and 73 year 5 students (40.1%) were aware of CBCT (100%). 82.4% (n = 152) obtained information regarding CBCT by internet, 69.2% by (n = 119) by faculty lessons and 54.4% (n = 88) through seminars. 64.5% (n = 118) thought that faculty was not providing adequate education regarding CBCT and 97.3% (n = 177) thought that CBCT should be part of the undergraduate curriculum, specifically in the clinical phase (76.4%, n = 139). 78.6% (n = 143) thought that it is necessary for a CBCT unit to be available at their faculty. 60.4% (n = 110) believed that CBCT will be used in all areas of dentistry in the future. 91.8% (n = 167) planned to use CBCT in their future professional career and 79.7% (n = 145) would take the initiative to update themselves regarding information on CBCT from time to time. **Conclusion:** This research suggests more emphasis should be given on CBCT in dental school curriculum and effort should be made to improve student's basic knowledge, understanding and practical training for better interpretation in routine clinical practice.

Keywords: Attitude; Cone Beam Computed Tomography; Dental Students; Knowledge

Introduction

Dental imaging is a crucial diagnostic test for the clinical evaluation of dental patients. Dental radiography has its roots in the discovery of X-rays by a German mechanical engineer and physicist Wilhelm Conrad Roentgen in 1895.

The most common type of radiograph used in dentistry is intraoral x-rays. They fall under the category of conventional 2-D imaging and it is usually a film-based radiography. They provide great details of the tooth, bone and supporting tissues of the mouth. With the use of these x-rays, dentists are able to identify cavities, examine tooth roots, assess the condition of the bony area around the tooth, aid in the

diagnosis of periodontal disease and see the status of developing teeth. The use of a darkroom and chemical handling is necessary for film-based radiography, which is also prone to processing errors. With the development of digital radiography, all these drawbacks can be eliminated. However, a significant limitation of conventional radiography is the superimposition of overlying structures, which covers the object of interest (Reddy *et al* 2013). It eventually leads to the collapse of 3-D structural information onto a 2-D image, which results in the loss of spatial information in the third dimension.

To overcome these limitations, there have been numerous initiatives toward 3-D radiographic imaging, and while CT has been available, its usage in dentistry has been constrained due to issues with cost, accessibility, and dose considerations. The development of Cone Beam Computed Tomography (CBCT), particularly designed for the imaging of the maxillofacial region, marks a true paradigm shift from a 2-D to a 3-D approach of data collection and image reconstruction. 3-D X-ray imaging, as opposed to 2-D X-ray imaging, is developed to help create an understanding of the entire mouth by creating a 3-D rendition of the oral cavity (Patel *et al* 2010). The dentists are able to study the mouth in slices, much like a CT scan, thanks to the 3-D imaging which captures a true 3-D image of the mouth.

The imaging modality CBCT has shown promise for dentomaxillofacial imaging. The limited field of view CBCT systems can give images of numerous teeth from just about the same radiation dose as two periapical radiographs, and they may offer a dose saving over multiple traditional images in complex cases. CBCT provides a complete 3D view of all structures with higher resolution (Stokes *et al* 2021). This will give practitioners a better visualisation for their treatment planning.

In early use of CBCT, the machines used image intensifiers with large fields of view (FOVs), thus exposing patients to higher doses of radiation, even though these doses were still less than those associated with medical CT (Kamburoğlu *et al* 2011). Recently, advances in software provide the optimisation of CBCT scanners via improvements that reduce the radiation dose, such as the incorporation of a small FOV and pulsed radiation exposure (Cheah *et al* 2021). In addition, CBCT exposure should be clinically justified for each patient based on the principle of keeping radiation dose which is "as low as reasonably achievable (ALARA)," that was supported by the American Dental Association

Considering how extensively CBCT can be used in modern dentistry, it is crucial that dentists have the requisite skill set for operating a CBCT unit, choosing the appropriate CBCT views and sections, establishing normal and abnormal features on a CBCT scan (Shah *et al* 2016), and taking into account the information collected into treatment planning.

In relation to this, the use of CBCT possesses more advantages and promotes high quality imaging which should be exposed to dental students (Al Noaman *et al* 2017). With proper and appropriate education, dental students will have more understanding on the uses of CBCT that can be used vastly in various fields of dentistry. They later will be working in the future and will be involved with modern digitised radiographic techniques including CBCT which they need to be aware of and keep updated (Patel *et al* 2018). More experience is needed for the students to increase the implication of CBCT in dental practice. As a result, it appears that assessing dental students' attitude and knowledge of CBCT is critical.

There is paucity of literatures regarding awareness and knowledge towards CBCT among undergraduate dental students in Malaysia. In regard to this, we aim to study the awareness and knowledge of CBCT in hope to improve students' mainly theoretical as well as practical knowledge regarding CBCT.

Methodology

Sample Background

The respondents for this study were undergraduate clinical dental students who attended private dental school located in Klang Valley, Selangor, Malaysia. This study was conducted with the aid of a questionnaire conducted in Google Form. We had provided contact information along with the

questionnaire in order to assist the respondents if they faced any difficulties when answering the 14-question survey. They had consented to participate in the study before answering the survey.

Overview of Research Design

An observational cross-sectional study. This study design involved the use of structured questionnaires that were distributed to representatives from each Faculty of Dentistry of private universities in Klang Valley. A pilot survey was conducted with 20 students to validate the questionnaire and the full survey was implemented between June 2023 and December 2023. Those students involved in pilot survey were not included in the final study. Data were analysed using the statistical software package SPSS v29.0 (IBM, New York, NY). Differences between institutions and between undergraduate students of different education levels were evaluated using x2 test (significance level was set at $P \leq 0.05$).

Sampling Design

The sampling method for this study was a structured questionnaire consisting of 14 questions that was adapted from Kamburoglu *et al*. (2011).

Target Population

The target population for this study corresponded to undergraduate clinical dental students from private dental universities in Klang Valley.

Inclusion criteria include:

- Year 3, Year 4 and Year 5 undergraduate dental students
- Students in private dental school in Klang Valley which includes:
  - MAHSA University
  - International Medical University (IMU)
  - SEGi University
  - Lincoln University College (LUC)

Exclusion criteria include:

- Year 1 and Year 2 undergraduate dental students
- Undergraduate dental students from public dental schools in Klang Valley
- Undergraduate dental students from dental schools outside Klang Valley
- Postgraduates, dental clinicians and dental specialists

Sampling Method

The Dean of LUC's Faculty of Dentistry had sent out an official letter of permission to conduct this research to the Deans of MAHSA University, IMU and SEGi University. A link to the questionnaire was distributed via WhatsApp application to a representative from each dental school mentioned above. The representatives would distribute the link to other students from their respective university.

Sample Size

Lists of undergraduate clinical students from all four universities were obtained (Table 1).

Table 1: Undergraduate Clinical Students from Private Universities in Klang Valley

Name of University	Year 3	Year 4	Year 5
MAHSA University	36	41	46
International Medical University (IMU)	15	45	30
SEGi University	21	38	27
Lincoln University College (LUC)	8	13	24

The sum of the students is 344.

To determine the sample size needed for this study, the following formula was used:

$$n = \frac{z^2 \times p(1-p)}{d^2}$$

Where:

n: The number of participants needed

z: Statistic corresponding to confidence level (95%)

p: Expected prevalence (can be obtained from same studies or same pilot study that conducted the research) *(86%)

d: The margin error (5%)

Based on the formula applied, the sample size for this study was 182.

Survey Instrument

Survey instrument for this study was a structured 14-questions format questionnaire.

Response Formatting

The data submitted by participants were automatically recorded in Google Sheets.

Tool of Analysis

The data from Google Sheets were then transferred to IBM Statistical Package for Social Sciences (SPSS) Statistics v29 for further data analysis.

Data Analysis

Data collected and stored in Google Sheets was analysed using SPSS v29. Descriptive data was generated for every variable. The descriptive analysis described the basic features of the data in a study. They provided simple summaries about the sample and the measures. Together with simple graphic analysis, they formed the basis of virtually every quantitative analysis of data. This data played a major role in this research because it explained the underlying basis of the research methodology in order to attain the aim of the research. By using SPSS, the descriptive data was generated and triangulated samples.

The descriptive data generated was analysed as demographic profiling including dental education level. The demographic profiling allows the researchers to investigate and to comprehend how the dental educational level gave effect on the knowledge and attitude towards CBCT among undergraduate clinical dental students from private universities in Klang Valley. The results obtained were discussed later in this research study.

Test of Association

The test of association was done in order to observe the association between selected independent and dependent variables. Given that the data did not follow normal distribution, hence the non-parametric test was used.

Chi-square test of association has been used in order to determine whether there is a significant difference between the expected frequencies and the observed frequencies on one or more categories. The chi-square test does not directly calculate the probability of obtaining the observed results or something more extreme. Instead, like almost all statistical tests, the chi-square test has an intermediate step in which it uses the data to calculate a test statistic that measures how far the observed data are from the null expectation.

Ethical Consideration

The researchers obtained ethical clearance from the Research and Ethics Committee of Lincoln University College, Malaysia with reference number LUCFD/2023/RPA10 on 14 April 2023.

Result

Demographic Profile of Participants

A total of 182 participants (n=182) from 4 private universities in Klang Valley completed the questionnaire (Figure 1-10) for a period from 1st of June 2023 to 30th of December 2023 by distribution of questionnaire's link.

The mean age of participants was 24 years old ranging from 22 to 31 years old. 29.1% of the participants were male, while 70.9% were female. The highest percentage of participants were from MAHSA University (31.9%), followed by LUC (24.7%), SEGi University (22%), and IMU (21.4). The highest percentage of participants were among Year 5 students (40.1%) while (38.5%) were Year 4 students, and the remaining (21.4%) were composed of Year 3 students. Table 4.1.1 summarised the demographic profile of participants (Table 2).

Table 2: Demographic Profile of Participants

Characteristics	Frequency	Percentage (%)
Age		
22	12	6.6
23	47	25.8
24	50	27.5
25	35	19.2
26	27	14.8
27	7	3.8
28	2	1.1
29	1	0.5
30	0	0
31	1	0.5
Total	182	100
Gender		
Male	53	29.1
Female	129	70.9
Total	182	100
University		
MAHSA University	58	31.9
IMU	39	21.4
SEGi University	40	22
LUC	45	24.7
Total	182	100
Dental Education Level		
Year 3	39	21.4
Year 4	70	38.5
Year 5	73	40.1
Total	182	100

Descriptive Statistics of Variables

Question 1: Are you aware of CBCT used for the dentomaxillofacial region?
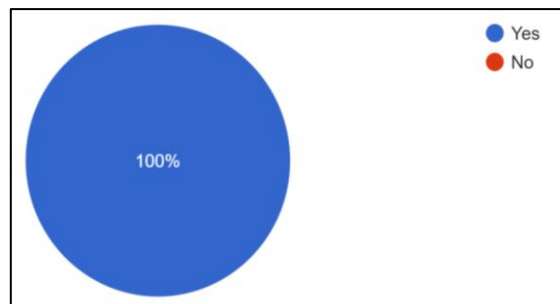
Figure 1: Question 1

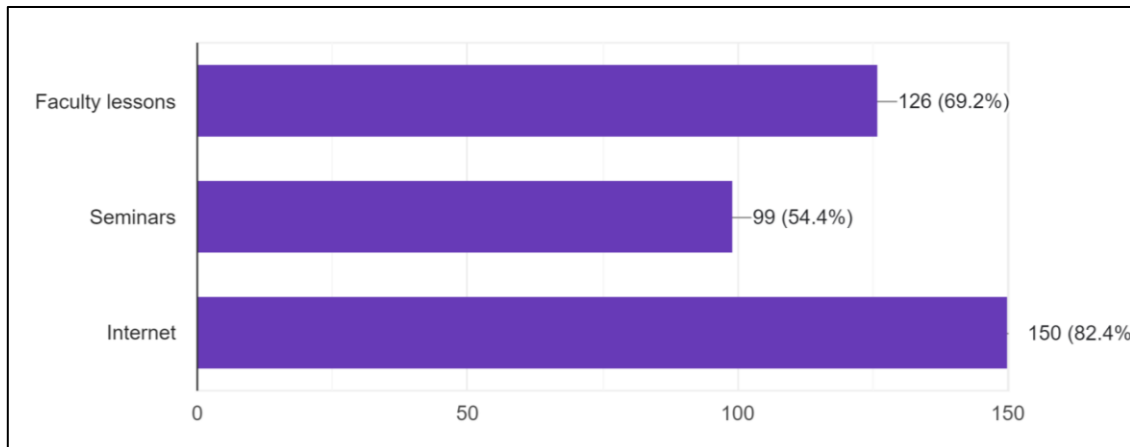*Question 2: How did you obtain information regarding CBCT?*

Figure 2: Question 2

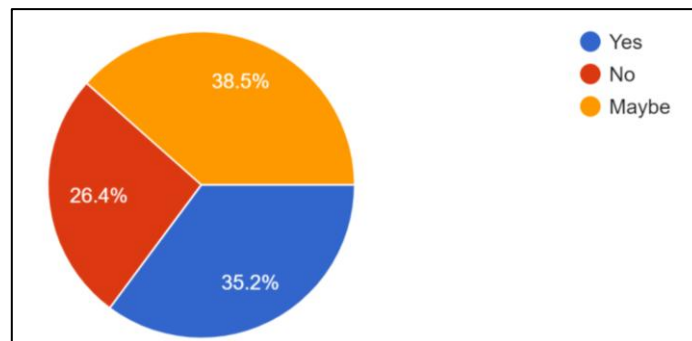*Question 3: Does your faculty provide adequate education regarding CBCT?*

Figure 3: Question 3

Question 4: Do you think CBCT should be part of the undergraduate curriculum?
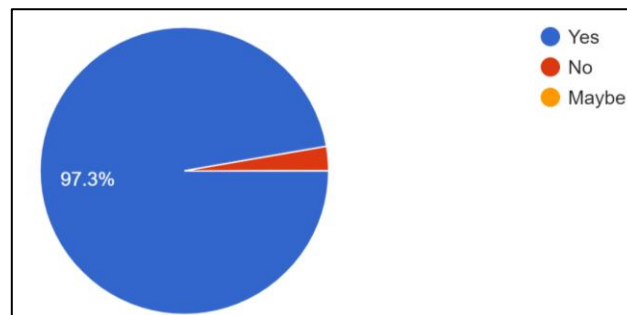

Figure 4: Question 4

Question 5: In your opinion, which phase of undergraduate dental education should include lectures on CBCT?
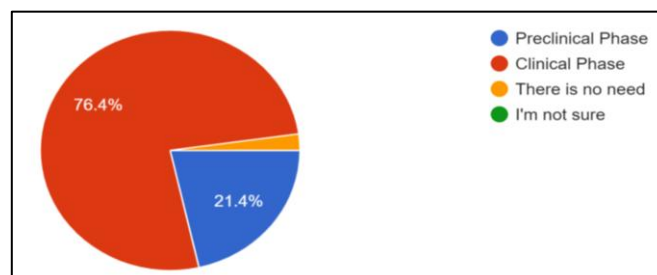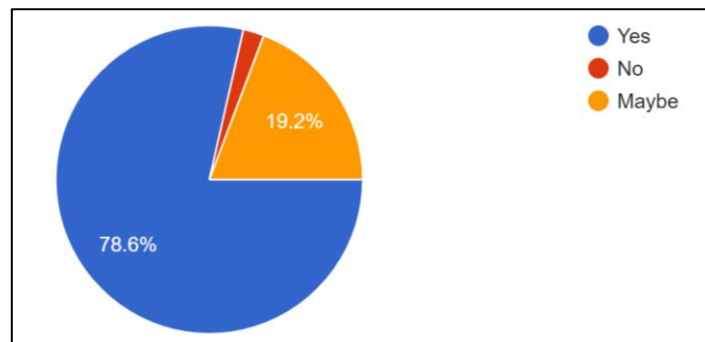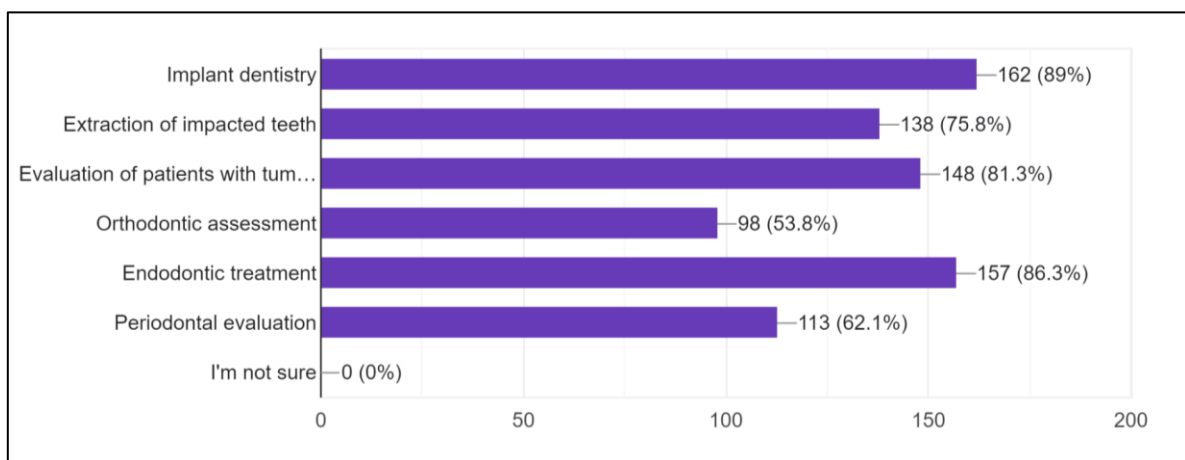

Figure 5: Question 5

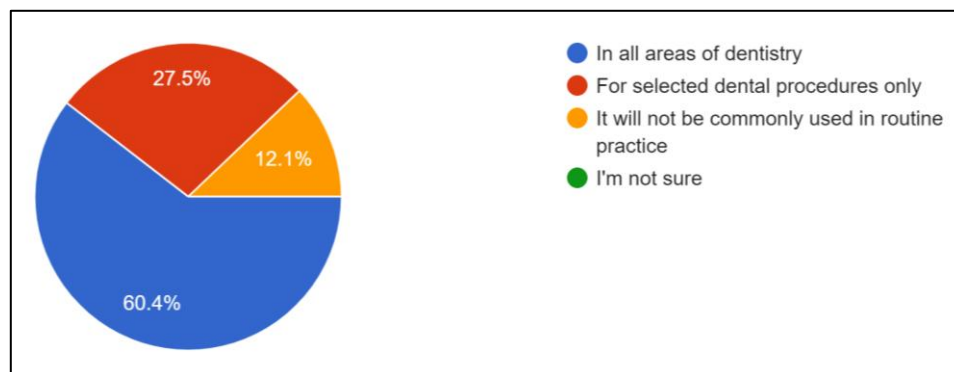**Question 6: Do you think it is necessary for a CBCT unit to be available at your faculty?**

Figure 6: Question 6

Question 7: For what cases would you choose to use CBCT?
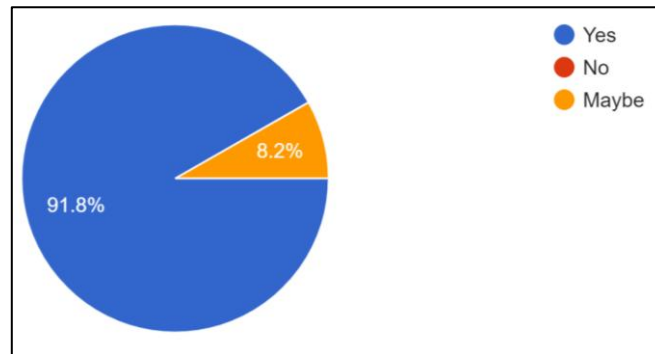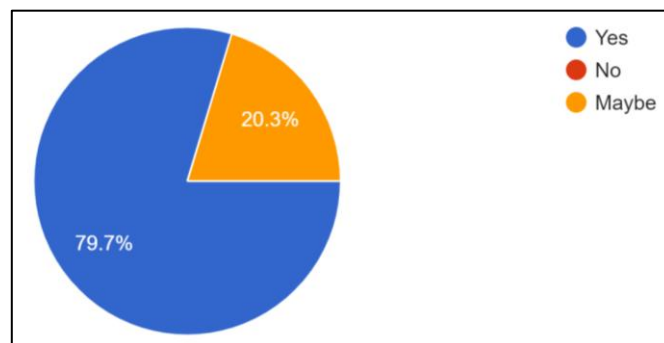

Figure 7: Question 7

Question 8: To what extent do you think CBCT will be used in routine dental practice in the future?

Figure 8: Question 8

Question 9: Would you choose to use CBCT in your future professional career?

Figure 9: Question 9

Question 10: Would you take the initiative to update yourself regarding information on CBCT from time to time?

Figure 10: Question 10

Association between Variables

There was a significant association between dental educational level and their attitude towards obtaining information regarding CBCT (x^2 = 12.2404, *df* = 4, *p* = 0.01565) (Table 3).

Table 3: Chi-Square Test for Question 2

Q2	Value	Degree of Freedom	Asymptomatic Significance (2-sided)
Pearson Chi-Square	12.2404	4	0.01565

There was an insignificant association between dental educational level and their attitude towards faculty providing CBCT education (x^2 = 3.674, *df* = 4, *p* = 0.452) (Table 4-5).

Table 4: Association Between Dental Educational Level and Attitude Towards Faculty Providing CBCT Education

Does Your faculty provide adequate education regarding CBCT?					
		May be	No	Yes	Total
Dental Education Level	Year 3	16	6	17	39
	Year 4	26	22	22	70
	Year 5	28	20	25	73
Total		70	48	64	182

Table 5: Chi-Square Test for Question 3

Q3	Value	Degree of Freedom	Asymptomatic Significance (2-sided)
Pearson Chi-Square	3.674	4	0.452

There was an insignificant association between dental educational level and their attitude towards inclusion of CBCT in undergraduate curriculum (x^2 = 1.722, *df* = 2, *p* = 0.423) (Table 6-7).

Table 6: Association Between Dental Educational Level and Attitude Towards Including CBCT in the Undergraduate Curriculum

Do you think CBCT should be a part of the undergraduate curriculum?		No	Yes	Total
Dental Education Level	Year 3	0	39	39
	Year 4	3	67	70
	Year 5	2	71	73
Total		5	177	182

Table 7: Chi-Square Test for Question 4

Q4	Value	Degree of Freedom	Asymptomatic Significance (2-sided)
Pearson Chi-Square	1.722	2	0.423

There was an insignificant association between dental educational level and their attitude towards which phase of undergraduate dental education should CBCT be included (x^2 = 6.594, *df* = 4, *p* = 0.159) (Table 8-9).

Table 8: Association Between Dental Educational Level and Attitude Towards Including CBCT in the Undergraduate Curriculum

Which phase of undergraduate dental education should include lectures on CBCT?		Clinical Phase	CBCT Preclinical Phase	There is no need	Total
Dental Education Level	Year 3	30	9	0	39
	Year 4	52	14	4	70
	Year 5	57	16	0	73
Total		139	39	4	182

Table 9: Chi-Square Test for Question 5

Q5	Value	Degree of Freedom	Asymptomatic Significance (2-sided)
Pearson Chi-Square	6.594	4	0.159

There was an insignificant association between dental educational level and their attitude towards availability of CBCT machines at their faculty (x^2 = 3.299, *df* = 4, *p* = 0.509) (Table 10-11).

Table 10: Association Between Dental Educational Level and Attitude Towards the Necessity of a CBCT Unit at the Faculty

Do you think it is necessary for a CBCT unit to be available at your faculty?		May be	No	Yes	Total
Dental Education Level	Year 3	9	0	30	39
	Year 4	14	3	53	70
	Year 5	12	1	60	73
Total		35	4	143	182

Table 11: Chi-Square Test for Question 6

Q6	Value	Degree of Freedom	Asymptomatic Significance (2-sided)
Pearson Chi-Square	3.299	4	0.509

There was an insignificant association between dental educational level and their knowledge towards usage of CBCT in dental cases (x^2 = 7.239, df = 10, p = 0.8847) (Table 7).

Table 11: Chi-Square Test for Question 7

Q7	Value	Degree of Freedom	Asymptomatic Significance (2-sided)
Pearson Chi-Square	7.239	10	0.8847

There was an insignificant association between dental educational level and their knowledge towards the extent of CBCT usage in the future (x^2 = .608, df = 4, p = 0.962) (Table 12-13).

Table 12: Association Between Dental Educational Level and Attitude Towards the Future Use of CBCT in Routine Dental Practice

To what extent do you think CBCT will be used in routine dental practice in the future?					
		For selected dental procedure only	In all areas of dentistry	It will not be commonly used in routine practice	Total
Dental Education Level	Year 3	10	24	5	39
	Year 4	21	40	9	70
	Year 5	19	46	8	73
Total		50	110	22	182

Table 13: Chi-Square Test for Question 8

Q8	Value	Degree of Freedom	Asymptomatic Significance (2-sided)
Pearson Chi-Square	0.608	4	0.962

There was an insignificant association between dental educational level and their attitude towards their usage of CBCT in their future professional career (x^2 = 1.627, df = 2, p = 0.443) (Table 14-15).

Table 14: Association Between Dental Educational Level and Attitude Towards the Use of CBCT in Future Professional Careers

Would you choose to use CBCT in your future professional career?				
		May be	Yes	Total
Dental Education Level	Year 3	2	37	39
	Year 4	8	62	70
	Year 5	5	68	73
Total		15	167	182

Table 15: Chi-Square Test for Question 9

Q9	Value	Degree of Freedom	Asymptomatic Significance (2-sided)
Pearson Chi-Square	1.627	2	0.443

There was an insignificant association between dental educational level and their attitude towards updating information on CBCT (x^2 = 1.360, df = 2, p = 0.507) (Table 16-17).

Table 16: Association Between Dental Educational Level and Attitude Towards the Use of CBCT in Future Professional Careers

Would you take the initiative to update yourself regarding information on CBCT from time to time?				
		May be	Yes	Total
Dental Education Level	Year 3	8	31	39
	Year 4	17	53	70
	Year 5	12	61	73
Total		37	145	182

Table 17: Chi-Square Test for Question 10

Q10	Value	Degree of Freedom	Asymptomatic Significance (2-sided)
Pearson Chi-Square	1.360	2	0.507

Summary

Overall, the data suggested that there was an insignificant relationship between knowledge and attitude towards CBCT and dental education level among undergraduate private dental students in Klang Valley since the p-value is more than 0.05.

Discussion

The research aimed to study the relationship between knowledge and attitude towards CBCT and dental education level among undergraduate private dental students in Klang Valley.

Overall, the data suggested there was an insignificant relationship between knowledge towards CBCT and dental education level as well as between attitude towards CBCT and dental education level. Based on the results, all students from every dental education level were aware of CBCT used for the dentomaxillofacial region.

There was a significant association between dental educational level and their attitude towards obtaining information regarding CBCT, $p = 0.01565$ ($p < 0.05$). This suggested that the higher the dental education level, the more effort put to obtain information regarding CBCT. Most Year 5 students picked three sources to obtain information compared to Year 3 students who mostly picked one source.

There was an insignificant association between dental educational level and their attitude towards faculty providing CBCT education, $p = 0.452$ ($p < 0.05$). This suggested that there was no notable difference between dental education level and their opinion on whether their faculty provided adequate education regarding CBCT. Less than half of the respondents thought that faculty provided adequate education regarding CBCT.

There was an insignificant association between dental educational level and their attitude towards inclusion of CBCT in undergraduate curriculum, $p = 0.423$ ($p < 0.05$). This suggested that there was no notable difference between dental education level and their opinion on whether CBCT should be included in the undergraduate curriculum. Almost all of the participants thought that CBCT should be included in the undergraduate curriculum and only five of participants thought there was no need for CBCT to be included in the undergraduate curriculum.

There was an insignificant association between dental educational level and their attitude towards which phase of undergraduate dental education should CBCT be included, $p = 0.159$ ($p < 0.05$). This suggested that there was no notable difference between dental education level and their opinion on which phase of undergraduate dental education should CBCT be included. More than half of the participants opted clinical phase and the rest opted for preclinical phase as well as some thought that there was no need for lectures on CBCT to be included in any phase of undergraduate dental education.

There was an insignificant association between dental educational level and their attitude towards availability of CBCT machines at their faculty, $p = 0.509$ ($p < 0.05$). This suggested that there was no notable difference between dental education level and their thought of the necessity of a CBCT unit at their faculty. Majority of the participants thought that it was necessary for a CBCT unit to be available at their faculty.

There was an insignificant association between dental educational level and their knowledge towards usage of CBCT in dental cases, $p = 0.8847$, ($p < 0.05$). This suggested that there was no notable difference between dental education level and their favoured cases to use CBCT in. Overall, most of the students chose more than two cases to use CBCT in. However, almost half of Year 3 students only picked one case and almost half of Year 5 students picked all of the cases.

There was an insignificant association between dental educational level and their knowledge towards the extent of CBCT usage in the future, $p = 0.962$ ($p < 0.05$). This suggested that there was no notable difference between dental education level and their opinion on the extent of CBCT usage in the future. More than half of the participants thought that CBCT would be used in all areas of dentistry in the future.

There was an insignificant association between dental educational level and their attitude towards their usage of CBCT in their future professional career, $p = 0.443$ ($p < 0.05$). This suggested that there was no notable difference between dental education level and their desire to use CBCT in their future professional career. Overwhelming majority of the participants wanted to use CBCT in their future professional career and only five of the participants were still thinking whether to use it or not.

There was an insignificant association between dental educational level and their attitude towards updating information on CBCT, $p = 0.507$ ($p < 0.05$). This suggested that there was no notable difference between dental education level and their initiative to update themselves regarding information on CBCT. Most of them would take the initiative to update themselves regarding information on CBCT from time to time.

The generalisability of the results was limited by the participant group in this research study. Only responses from undergraduate private dental students in Klang Valley were collected, so it cannot represent every dental student in Malaysia.

Limitation

The sample comprised undergraduate clinical students which are year 3, year 4 and year 5, rather than the whole undergraduate students. Therefore, it provides no information on the rest of undergraduate students. Another point of limitation is that by not including postgraduate students and other dental schools, the results gathered were not varied and we could not see a significant difference in the results. Therefore, expanding the sample size and inclusion criteria consisting of undergraduate and postgraduate students as well as adding other dental schools might increase the variety of the results. Due to time constraint, this research was only done on a small population group which was undergraduate clinical students from private universities in Klang Valley.

Conclusion

This research is not the first and fundamental research conducted on this research topic. Globally, the same topic has been the subject of countless researches. However, our research is different from other studies as we exclusively gather data from four private universities in Klang Valley which are MAHSA University, IMU, SEGi University, and LUC. The implication of this study will provide a baseline information of reference for future studies on this topic. The information acquired from this study also acts as a useful tool in increasing knowledge regarding CBCT.

This study offers conclusive information on undergraduate dental students' knowledge and attitudes regarding CBCT, despite all of its limitations and obstacles. It is recommended that future research conducted must widen the sample size by involving a greater number of students and schools to participate which will improve the precision level.

Conflict of Interest

The authors declare that there have no conflict of interest.

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References

Alharbi, H. H. O., Al-Dubai, S. A. R., Almutairi, R. M. H., & Alharbi, M. H. (2022). Stigmatization and discrimination against people living with HIV/AIDS: Knowledge, attitudes, and practices of healthcare workers in the primary healthcare centers in Madinah, Saudi Arabia, 2022. *Journal of Family and Community Medicine, 29*(3), 230-237. https://doi.org/10.4103/jfcm.jfcm_136_22

Asrina, A., Ikhtiar, M., Idris, F. P., Adam, A., & Alim, A. (2023). Community stigma and discrimination against the incidence of HIV and AIDS. *Journal of Medicine and Life*, *16*(9), 1327. https://doi.org/10.25122/jml-2023-0171

Bin Ahmad, M. Z., Md. Yasin, M., Mat Nasir, N., & Mohamad, M. (2024). The association between HIV-related stigma, HIV knowledge and HIV late presenters among people living with HIV (PLHIV) attending public primary care clinic settings in Selangor. *Plos One*, *19*(7), https://doi.org/10.1371/journal.pone.0306904

Chan, H. N., Mohamad, A., Rashid, A. A., Ho, B. K., Cooper, A. A. A., Aajamer, H. M., ... & Hwee, G. N. L. (2022). Assessing knowledge, acts of discrimination, stigmatizing attitudes and its associated factors towards people living with HIV (PLHIV) among Family Medicine trainees in Malaysia. *Malaysian Family Physician: the Official Journal of the Academy of Family Physicians of Malaysia*, *17*(3), 33. https://doi.org/10.51866/oa1298

Chan, Y. C., binti Mawardi, M., & Ismail, A. H. (2021). Stigmatizing attitudes toward people living with HIV/AIDS (PLWHA) among primary health care providers in Kinta District, Perak. *Malaysian Family Physician: The Official Journal of the Academy of Family Physicians of Malaysia*, *16*(1), 31–38. https://doi.org/10.51866/oa0001

Chew, B. H., & Cheong, A. T. (2013). Assessing HIV/AIDS knowledge and stigmatizing attitudes among medical students in Universiti Putra Malaysia. *The Medical Journal of Malaysia, 68*(1), 24-29. Retrieved from: https://europepmc.org/article/med/23466762. Accessed on 18th July 2024.

Fauk, N. K., Hawke, K., Mwanri, L., & Ward, P. R. (2021a). Stigma and discrimination towards people living with HIV in the context of families, communities, and healthcare settings: a qualitative study in Indonesia. *International Journal of Environmental Research and Public Health*, *18*(10), 5424. https://doi.org/10.3390/ijerph18105424

Fauk, N. K., Ward, P. R., Hawke, K., & Mwanri, L. (2021b). Cultural and religious determinants of HIV transmission: A qualitative study with people living with HIV in Belu and Yogyakarta, Indonesia. *PLoS One*, *16*(11). https://doi.org/10.1371/journal.pone.0257906

Fauk, N. K., Ward, P. R., Hawke, K., & Mwanri, L. (2021c). HIV stigma and discrimination: perspectives and personal experiences of healthcare providers in Yogyakarta and Belu, Indonesia. *Frontiers in Medicine*, *8*. https://doi.org/10.3389/fmed.2021.625787

Frescura, L., Godfrey-Faussett, P., Feizzadeh, A., El-Sadr, W., Syarif, O., Ghys, P. D., & 2025 Testing Treatment Target Working Group. (2022). Achieving the 95 95 95 targets for all: A pathway to ending AIDS. *PloS One*, *17*(8). https://doi.org/10.1371/journal.pone.0272405

Gao, X., Wu, Y., Zhang, Y., Zhang, N., Tang, J., Qiu, J., Lin, X., & Du, Y. (2012). Effectiveness of school-based education on HIV/AIDS knowledge, attitude, and behaviour among secondary school students in Wuhan, China. *PloS One, 7*(9). https://doi.org/10.1371/journal.pone.0044881

Garett, R., & Young, S. D. (2022). The impact of misinformation and health literacy on HIV prevention and service usage. *Journal of the Association of Nurses in AIDS Care*, *33*(1), e1-e5. https://doi.org/10.1097/JNC.0000000000000298

Goh, K. L., Chua, C. T., Chiew, I. S., & Soo-Hoo, T. S. (1987). The acquired immune deficiency syndrome: A report of the first case in Malaysia. *The Medical Journal of Malaysia, 42*(1), 58–60. Retrieved from: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=e9aadf61cc88080cbb8658002f9b52c69b235201. Accessed on 28th August 2024.

Hasanah, C. I., Zaliha, A., & Mahiran, M. (2011). Factors influencing the quality of life in patients with HIV in Malaysia. *Quality of Life Research, 20*(1), 91–100. https://doi.org/10.1007/s11136-010-9729-y

Lazarus, J. V., Safreed-Harmon, K., Kamarulzaman, A., Anderson, J., Leite, R. B., Behrens, G., ... & Waters, L. (2021). Consensus statement on the role of health systems in advancing the long-term well-being of people living with HIV. *Nature Communications*, *12*(1), 4450. https://doi.org/10.1038/s41467-021-24673-w

Li, L., Liang, L., Lin, C., Wu, Z., & Wen, Y. (2009). Individual attitudes and perceived social norms: Reports on HIV/AIDS-related stigma among service providers in China. *International Journal of Psychology, 44*(6), 443–450. https://doi.org/10.1080/00207590802644774

Ministry of Health Malaysia (MOH). (2023). *2023 Global AIDS Monitoring.* Ministry of Health Malaysia Disease Control Division. Retrieved from: https://www.moh.gov.my/moh/resources/Penerbitan/Laporan/Umum/Laporan_Global_AIDS_Monitoring_2023.pdf. Accessed on 10th July 2023.

Mohammadifirouzeh, M., Oh, K. M., & Tanner, S. (2021). HIV stigma reduction interventions among health care providers and students in different countries: A systematic review. *Current HIV Research, 20*(1), 20–31. https://doi.org/10.2174/1570162X19666211206094709

Peña Donati, A., & Laufer, M. (2020). Acquired Immune Deficiency Syndrome. *Pediatric Respiratory Diseases: A Comprehensive Textbook*, 517-528. https://doi.org/10.1007/978-3-030-26961-6_51

Sallam, M., Alabbadi, A. M., Abdel-Razeq, S., Battah, K., *et al*. (2022). HIV Knowledge and Stigmatizing Attitude towards People Living with HIV/AIDS among Medical Students in Jordan. *International Journal of Environmental Research and Public Health, 19*(2), 745. https://doi.org/10.3390/ijerph19020745

Shrestha, P. W., Visudtibhan, P. J., & Kiertiburanakul, S. (2024). Factors associated with HIV-related stigma among healthcare providers at a university hospital in Nepal. *Journal of the International Association of Providers of AIDS Care (JIAPAC), 23*. https://doi.org/10.1177/23259582241282583

Spence, A. B., Wang, C., Michel, K., Ocampo, J. M., Kharfen, M., Merenstein, D., ... & Kassaye, S. (2022). HIV related stigma among healthcare providers: opportunities for education and training. *Journal of the International Association of Providers of AIDS Care (JIAPAC)*, *21*. https://doi.org/10.1177/23259582221114797

Sun, X., Feng, C., Feng, L., Xiao, T., Zhao, X., Liu, H., ... & Zhou, D. (2022). An exploratory transmission mode of HIV/AIDS among older people based on data from multiple sources in China. *Scientific Reports*, *12*(1). https://doi.org/10.1038/s41598-022-20146-2

Swinkels, H. M., Vaillant, A. A. J., Nguyen, A. D., & Gulick, P. G. (2024). HIV and AIDS. *StatPearls - NCBI Bookshelf, US*. Retrieved from: https://www.statpearls.com/point-of-care/22914. Accessed on 27th August 2024.

Turan, B., Budhwani, H., Fazeli, P. L., Browning, W. R., Raper, J. L., Mugavero, M. J., & Turan, J. M. (2017). How does stigma affect people living with HIV? The mediating roles of internalized and anticipated HIV stigma in the effects of perceived community stigma on health and psychosocial outcomes. *AIDS and Behavior*, *21*, 283-291. https://doi.org/10.1007/s10461-016-1451-5

World Health Organization (WHO). (2024). HIV and AIDS: key facts. *World Health Organization.* Retrieved from: https://www.who.int/news-room/fact-sheets/detail/hiv-aids. Accessed on 29th August 2024.

Yapıcı, O., & Çağlar, Y. (2024). The Relationship Between HIV/AIDS Knowledge and Stigmatizing Attitudes Towards People Living with HIV/AIDS: An Educational Intervention Study. *Risk Management and Healthcare Policy*, 2755-2762. https://doi.org/10.2147/RMHP.S489989

Youssef, L., Hallit, S., Sacre, H., Salameh, P., Cherfan, M., Akel, M., & Hleyhel, M. (2021). Correction: Knowledge, attitudes and practices towards people living with HIV/AIDS in Lebanon. *PloS One*, *16*(10). https://doi.org/10.1371/journal.pone.0259359