Deanship of Graduate Studies
Al-Quds University

Knowledge, Attitudes and Practices about the Risk of Exposed to Radiation among Dental Students in the Gaza Strip Universities

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M. Sc. Thesis

Jerusalem- Palestine

1446 / 2024

Knowledge, Attitudes and Practices about the Risk of Exposed to Radiation among Dental Students in the Gaza Strip Universities

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A Thesis Submitted in Partial Fulfillment of the Requirement for the Degree Master of Public Health Epidemiology track at Al-Quds University

1446 / 2024

Al-Quds University

Deanship of Graduate Studies

School of Public Health

Thesis Approval

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Jerusalem- Palestine

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Dedication

This thesis is dedicated to: For the sake of Allah, my Creator and my Master.

The teacher of mankind, the prophet of mercy and peace. Our role model, intercessor, and our beloved, our master Muhammad, upon him are the best prayer and peace.

My homeland Palestine.

To the soul of my beloved father and my great mother, who never stops giving in countless ways and leads me through the valley of darkness with the light of hope and support.

My dear husband, who bore my preoccupations and the difficult stages we went through together.

My beloved brothers and sisters, to all my family, the symbol of love and giving.

To all academic and administrative staff of the School of Public Health, Al-Quds University, especially the creative one, Dr. Bassam

The generous and kind-hearted Dr. Yahiya, whose dedication and support extend beyond the academic realm, embodying the true spirit of giving and mentorship.

And our sister, who spares no effort to deliver information with exceptional clarity and creativity, Dr. Khitam. Her innovative teaching methods and unwavering dedication make complex concepts accessible and engaging, leaving a lasting impact on her students.

Declaration

I certify that this thesis submitted for the degree of Master, is the result of my own research, except where otherwise acknowledged, and this study (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signed:

Wafaa Kamal Mohammed Abu-Nasser

Date: 18/12/2025

Acknowledgement

First and foremost, I would like to express my deepest gratitude to Almighty Allah, for His blessings, guidance, and support throughout this research journey.

I am immensely grateful to my supervisor, Dr. Yousef Awad, for his continuous support, guidance, and encouragement. His invaluable advice, constructive feedback, and patience have played a pivotal role in shaping this research. I am truly fortunate to have worked under your supervision.

I would also like to extend my heartfelt thanks to the faculty of Al Quds University, particularly the School of Public Health, for providing the necessary resources, support, and a conducive environment for academic growth. I am grateful to all the staff and colleagues for their cooperation and assistance.

I am particularly thankful to Suzan Obeid, whose cooperation and participation made this research possible. Their insights and contributions have been invaluable.

I would also like to express my heartfelt gratitude to Nurses Raeesah Basheer and Samah Abu Zureiq for their invaluable assistance in collecting information for this study. Their support and dedication were instrumental in completing this research, and I deeply appreciate their time and effort.

My special appreciation goes to my family for their unwavering love, patience, and constant encouragement. Without their support, this journey would have been much more difficult. To my parents, spouse, and children—thank you for your sacrifices, understanding, and continuous belief in me.

Finally, I would like to acknowledge the help and support from all friends and colleagues who have offered assistance, guidance, or moral support throughout this research journey. Your presence has been a source of strength.

To anyone I may have inadvertently overlooked— thank you. This research would not have been possible without the help of many people, and I am sincerely grateful for that.

Abstract

Background : Dental radiography plays a crucial role in modern dental practice, providing essential diagnostic insights. However, it also involves exposure to ionizing radiation, which necessitates stringent adherence to radiation protection protocols to safeguard both patients and dental professionals.

Aim: The study aims to assess the knowledge, attitudes, and practices related to radiation safety among dental students in the Gaza strip, , focusing specifically on those enrolled at Al-Azhar University and the University of Palestine.

Methods : A descriptive cross-sectional design was employed, using a stratified sample of 264 students from Al-Azhar University and the University of Palestine. Data werecollected through a structured self-administered questionnaire containing 54 items on a five-point Likert scale, addressing the domains of knowledge, attitudes, and practices related to radiation safety. Statistical analyses, including descriptive statistics, chi-square tests, and correlation analyses, were conducted to examine the data collected.

Findings: Most participants demonstrated moderate to good knowledge of radiation safety, including awareness of key principles such as hazard symbols and protective measures. However, gaps in understanding international guidelines were noted. While students generally exhibited positive attitudes toward radiation safety, practical compliance varied, with lower use of lead aprons and thyroid collars. Junior students showed better compliance, likely due to recent training and closer supervision, while senior students may neglect protocols due to increased confidence or familiarity. Risk factors identified include insufficient training, inconsistent use of protective equipment, and misconceptions about radiation exposure risks, which could lead to severe health issues such as DNA damage and cancer.

Recommendations: The study recommends placing greater emphasis on radiation safety education within dental programs in Gaza. Incorporating both theoretical and practical training on radiation protection throughout the dental curriculum could significantly enhance adherence to safety protocols, ultimately reducing the risk of radiation exposure for both future dental practitioners and their patients. Continuous and comprehensive radiation safety education should be integrated into the curriculum. Furthermore, implementing ongoing education programs for dental students and interns will help reinforce safety practices, ensuring a safer clinical environment moving forward.

Table of contents

Dedication ....

Declaration i

Acknowledgement ii

Abstract iii

Table of contents iv

List of Tables viii

List of Figures ix

List of Annexes x

List of Abbreviations xi

Chapter One Introduction 1

1.1 Background: 1

1.2 Statement of the Problem: 2

1.3 Justification of the study: 2

1.4 Aim of the study 3

1.5 Objectives of the study: 4

1.6 Research Questions: 4

1.7 Operational definitions 4

1.8 Context of the Study: 5

1.9 Dentistry at Al-Azhar University: 5

1.10 Dentistry at the University of Palestine: 6

Chapter Two Conceptual Framework and Literature Review 8

2.1 The conceptual framework 8

2.2 Literature Review 10

2.2.1 Short-Term and Long-Term Risks of Radiation Exposure 11

2.2.2 Effectiveness of Preventive Measures 11

2.2.3 Knowledge of Radiation Safety Among Dental Students 11

2.2.4 Attitudes Toward Radiation Safety Among Dental Students 12

2.2.5 Practices Related to Radiation Safety Among Dental Students 12

2.2.6 Factors Influencing Knowledge, Attitudes, and Practices 12

2.2.7 The Dangers of Radiation and Associated Risks 13

2.2.8 Gaps in Literature and Research Needs 13

2.3 Search Strategy 14

2.4 Definitions of terms: 15

Chapter Three Methodology 18
3.1 Study Design 18
3.2 Study Population 18
3.3 Study Setting 19
3.4 Study Period 19
3.5 Sample and Sampling method 19
3.6 Eligibility Criteria 19
3.6.1 Inclusion criteria 19
3.6.2 Exclusion criteria 19
3.7 Study tools 19
3.8 Reliability of study instruments 20
3.8.1 Half-Split Method 20
3.9 Validity of study instruments 21
3.9.1 Content Validity 21
3.9.2 Internal (validity) Consistency 21
3.10 A pilot study 21
3.11 Data Collection 22
3.12 Response Rate 22
3.13 Data Management 22
3.13.1 Data Entry: 22
3.13.2 Data Analysis: 22
3.14 Ethical and Administrative Considerations 23
3.15 Limitations of Study: 23
Chapter Four Results 24
4.1 Descriptive statistics 24
4.2 Sample distribution according to socio-demographic data 24
4.2.1 Distribution of the study population according to the gender 24
4.2.2 Distribution of the study population according to the age groups 25
4.2.3 Distribution of the study population according to the educational level 25
4.2.4 Distribution of the study population according to their socio-demographic information 26
4.2.5 Scores of items measuring the level of knowledge 27
4.2.5.1 Scores of items measuring the level of knowledge 28
4.2.6 Distribution of the study population according to their responses about the knowledge 30
4.2.7 Scores of items measuring the Level of Attitude 31

4.2.7.1 Scores of items measuring the level of Attitude 31
4.2.8 Distribution of the study population according to their responses about the attitude 32
4.2.9 Scores of items measuring level of practice 33
4.2.9.1 Scores of items measuring the level of practice 33
4.2.10 Distribution of the study population according to their responses about the practice 35
4.3 Mean difference of studied domains related to demographic data 35
4.3.1 Mean difference of studied domains related to gender 35
4.3.2 Mean difference of studied domains related to age group 36
4.3.3 Mean difference of studied domains related to educational level 36
4.3.4 Post Hoc test of mean difference of the demographic data domain in the educational level : 37
4.3.5 Mean difference of studied domains related to the place of residence 37
4.3.6 Mean difference of studied domains related to a governorate name 38
4.3.7 Mean difference of studied domains related to academic achievement average 39
4.3.8 Mean difference of studied domains related to university name 40
4.4 Correlation between studied domains among the study participants 40
Chapter Five Discussion 41
5.1 Sample distribution according to socio-demographic data 41
5.1.1 Distribution of the study population according to their socio-demographic information 41
5.2 Scores of items measuring the level of knowledge 42
5.2.1 Distribution of the study population according to their knowledge 43
5.3 Scores of items measuring the level of Attitude 43
5.3.1 Distribution of the study population according to their attitude 44
5.4 Scores of items measuring the level of practice 44
5.4.1 Distribution of the study population according to their practice 44
5.4.2 Mean difference of studied domains related to gender 45
5.4.3 Mean difference of studied domains related to age group 45
5.4.4 Mean difference of studied domains related to educational level 46
5.4.5 Post Hoc test of mean difference of the demographic data domain in the educational level 46
5.4.6 Mean difference of studied domains related to the place of residence 47
5.4.7 Mean difference of studied domains related to a governorate name 48

5.4.8 Mean difference of studied domains related to the academic achievement average 49
5.4.9 Mean difference of studied domains related to university name 51
5.5 Correlation between the studied domains among the study participants 52
Chapter Six Conclusion and recommendation 53
6.1 Conclusion 53
6.2 Recommendation 53
References: 55
Annexes 62

List of Tables

Table (3.1): distribution of total population and sample size 19
Table (3.2): Reliability of the research for each domain of the questionnaire 20
Table (3.3): Split and half for each domain of the questionnaire 20
Table (3.4): Correlation coefficient of every question related to the total score of domains 21
Table (3.5): Responses to questionnaire scale 22
Table (4.1): Distribution of the study population according to their socio-demographic information 26
Table (4.2-A): Distribution of the study population according to the level of knowledge . 28
Table (4.2-B): Distribution of the study population according to the level of knowledge.. 29
Table (4.3): Distribution of the study population according to their knowledge 30
Table (4.4): Scores of items measuring the level of Attitude 31
Table (4.5): Distribution of the study population according to their attitude 32
Table (4.6-A): Scores of items measuring the level of practice 33
Table (4.6-B): Scores of items measuring the level of practice. 34
Table (4.7): Distribution of the study population according to their practice 35
Table (4.8): Mean difference of studied domains related to gender 35
Table (4.9): Mean difference of studied domains related to age group 36
Table (4.10): Mean difference of studied domains related to educational level 36
Table (4.11): Post Hoc test of mean difference of the demographic data domain in the educational level 37
Table (4.12): Mean difference of studied domains related to the place of residence 37
Table (4.13): Mean difference of studied domains related to a governorate name 38
Table (4.14): Mean difference of studied domains related to the academic achievement average 39
Table (4.15): Mean difference of studied domains related to university name 40
Table (4.16): Correlation between the studied domains among the study participants 40

List of Figures

Figure (1.1): Conceptual framework, developed by the researcher 8
Figure (4.1): Distribution of the study population according to their gender...................... 24
Figure (4.2): Distribution of the study population according to their age groups............... 25
Figure (4.3): Distribution of the study population according to their educational level 25

List of Annexes

Annex (1): Gaza Governorates distribution map.. 62
Annex (2): Sample size calculation using EPI-INFO... 63
Annex (3): self-administered questionnaire – English version 64
Annex (4): questionnaire (Arabic version)... 68
Annex (5): Helsinki Committee Approval Letter.. 73
Annex (6): Administrative consent from the University of Palestine 74
Annex (7): Administrative consent from the Al Azher University 75
Annex (8): List of Arbitrators:... 76
Annex (9): Study activities timetable 77

List of Abbreviations

KAP	Knowledge, Attitudes, and Practices
ICRP	International Commission on Radiological Protection
NCRP	National Council on Radiation Protection and Measurements
ALARA	As Low as Reasonably Achievable
mSv	Millisievert
X-ray	X-radiation
OR	Odds Ratio
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
CI	Confidence Interval
KSA	Kingdom of Saudi Arabia
KVP	Kilovolt Peak
mA	Milliampere
BW	Bitewing Radiographs
PA	Periapical Radiographs
PAX	Periapical Film
CBCT	Cone Beam Computed Tomography
DOAJ	Directory of Open Access Journals
CBC	Complete Blood Count
DNA	Deoxyribonucleic Acid
PHRC	Palestinian Health Research Council

Chapter One

Introduction

1.1 Background:

Radiation safety is a critical concern within healthcare, particularly for professionals engaged in radiographic procedures. Among these professionals, dental students represent a pivotal group due to their frequent exposure to ionizing radiation during training and clinical practice (Assiri et al., 2020). The effects of radiation exposure are categorized into deterministic and stochastic effects, where stochastic effects are dose-dependent and can lead to significant health issues, including DNA damage and carcinogenesis (Assiri et al., 2020).

Adhering to the principles of radiation protection—justification, optimization, and dose limitation—is essential in minimizing radiation risks. These principles ensure that the benefits of radiographic procedures outweigh the risks, aiming for the most accurate results with the lowest possible dose (Aysu & Şule, 2020). Understanding the levels of knowledge, attitudes, and practices regarding radiation safety among dental students is paramount for safeguarding both patient and practitioner well-being(Aysu & Şule, 2020) .

Despite the low doses of radiation in dental practices, the cumulative effect of repeated exposure can pose significant health risks. This is particularly relevant in fields like endodontics, where multiple radiographic images are required; increasing the dosage and risk to both patients and healthcare providers if proper precautions are not followed (Almohaimede et al., 2020a).

Globally, healthcare workers are frequently exposed to radiation, with about 2.3 million workers involved in procedures that utilize ionizing radiation. This widespread exposure underscores the need for stringent safety measures to mitigate the potential adverse effects of radiation (Allam et al., 2024b).

The unique sociopolitical context of the Gaza Strip presents distinct challenges and opportunities in healthcare education and practice. Dental students in the Gaza strip navigate specific circumstances that may influence their perceptions and behaviors regarding radiation safety. With the increasing use of X-rays in dentistry for diagnosing and planning treatments, the risks associated with ionizing radiation, such as DNA damage and cancer, become more pertinent (Priyanka et al., 2022).

This study focuses on awareness and behaviors of dental students in Gaza Strip universities regarding radiation safety; by examining their knowledge, attitudes, and practices, the research seeks to identify gaps and areas for improvement in radiation safety education and training programs

1.2 Statement of the Problem:

Radiation safety is a fundamental aspect of healthcare, especially in dental practice, where both professionals and patients are regularly exposed to ionizing radiation during diagnostic and therapeutic procedures. Dental students, as future practitioners, must acquire a thorough understanding of radiation risks and safety protocols to minimize exposure and prevent long-term health consequences. However, there is a significant gap in information regarding the knowledge, attitudes, and practices (KAP) of dental students concerning radiation safety, particularly in resource-limited settings such as the Gaza Strip.

The socio-political and economic challenges in the Gaza Strip—such as limited access to updated training materials, inadequate infrastructure, and disruptions to academic programs—create unique barriers to effective radiation safety education. Despite the increasing use of radiographic imaging in dentistry, limited research explores how these challenges impact dental students' understanding and application of radiation safety protocols in such environments. This gap in literature underscores a critical need for localized studies that examine radiation safety awareness and adherence among dental students in under-resourced contexts.

Existing research primarily focuses on radiation safety in well-resourced environments, with limited attention to countries facing significant socio-economic constraints. While studies in other settings emphasize the importance of adhering to radiation safety protocols, the unique circumstances in Gaza remain underexplored. Assiri et al. (2020) highlight that "awareness among dental practitioners towards radiation hazards and protection is crucial for minimizing exposure risks," and Zekioğlu and Parlar (2020) stress that "following general principles of radiation protection is essential for obtaining accurate results with the lowest possible dose." However, there is little evidence to indicate whether such principles are adequately taught or in the humanitarian context, like the Gaza strip.

The available studies suggest that even in resource-rich contexts, there are significant gaps in radiation safety practices. Allam et al. (2024b) report that "radiation safety compliance awareness among healthcare workers exposed to ionizing radiation is often insufficient," and Almohaimede et al. (2020a) found that "levels of knowledge, attitude, and practice concerning radiographic protection vary, even among trained professionals." These findings, combined with the absence of research focused on resource-constrained settings, highlight the urgent need for this study.

This research aims to address the informational gap by investigating the KAP of dental students in Gaza regarding radiation safety—a study that has not been conducted before in this context. By exploring how socio-economic and educational challenges influence students' understanding and practices, this study seeks to inform the development of targeted educational interventions. Ultimately, this research will contribute to improving radiation safety awareness and adherence in resource-limited settings, fostering a safer environment for both patients and healthcare providers.

1.3 Justification of the study:

The need for this study is underscored by the critical importance of radiation safety in dental practice, particularly within the unique context of the Gaza Strip. Dental students, are frequently exposed to ionizing radiation, making their understanding of radiation hazards and safety protocols vital for minimizing health risks. This study aims to address several key gaps and needs in the current educational landscape.

Firstly, the increasing use of radiographic imaging in dentistry for diagnostic and therapeutic purposes highlights the necessity for stringent radiation safety measures. As Assiri et al. (2020) point out, awareness among dental practitioners towards radiation hazards and protection is crucial for minimizing exposure risks. Ensuring that dental students are adequately educated about these risks and the necessary precautions is essential for their future professional practice.

Secondly, the unique socio-political environment of the Gaza Strip presents specific challenges that may influence the training and awareness of dental students regarding radiation safety. Zekioğlu and Parlar (2020) emphasize that "following general principles of radiation protection is imperative to obtain accurate results with the lowest possible dose." Given the constraints and pressures in Gaza, it is particularly important to ensure that students receive comprehensive and effective education on radiation safety.

Furthermore, the potential health risks associated with ionizing radiation cannot be overstated. Priyanka et al. (2022) note that the hazards of ionizing radiation depend on the dose and duration of exposure, which can lead to carcinogenesis and heritable defects. This underscores the importance of instilling rigorous safety practices among dental students to protect both themselves and their patients from long-term health consequences.

This study is driven by the urgent need to bridge gaps in the knowledge, attitudes, and practices (KAP) of dental students regarding radiation safety in the Gaza Strip. As future healthcare providers, these students are pivotal in implementing safe and effective dental radiography practices. Yet, the scarcity of comprehensive data on their preparedness underscores a critical area for improvement.

The Gaza Strip's unique socio-political and economic challenges compound the importance of this research. Frequent disruptions to education, limited access to updated training resources, and strained healthcare infrastructure present barriers to achieving high standards in radiation safety education. Despite these obstacles, radiographic procedures remain a cornerstone of dental care, requiring meticulous adherence to safety protocols to minimize risks to both patients and practitioners.

By conducting a detailed assessment of the current KAP levels among dental students, this study aims to identify specific deficiencies and inform the development of targeted educational interventions. These interventions will not only address existing gaps but also incorporate innovative teaching methodologies tailored to the region's constraints, such as simulation-based training or mobile learning platforms.

Ultimately, the findings will support the establishment of a culture of safety in dental education and practice, reducing the risks associated with radiation exposure. By fostering greater awareness and adherence to safety protocols, this research contributes to the broader goal of enhancing patient care and protecting the well-being of healthcare providers in Gaza's unique context.

1.4 Aim of the study

The aim of this study is to assess the level of knowledge, attitude, and practice regarding the risk of exposure to radiation among dental students in Gaza Strip universities. This study is conducted in an attempt to reduce the risk of radiation exposure among the students by identifying gaps in their understanding and behaviors and providing evidence-based recommendations to enhance their adherence to radiation safety protocols, ultimately fostering a safer learning and clinical environment.

1.5 Objectives of the study:

1. To determine the level of knowledge about the risk of expose to radiation among the dental students, with a focus on understanding the potential health effects, such as DNA damage and carcinogenesis, caused by ionizing radiation.
2. To assess the attitudes of dental students toward radiation safety, including their perceptions of the severity of health risks associated with radiation exposure and the necessity of protective measures.
3. To evaluate the practices of dental students concerning radiation safety, specifically their adherence to protocols designed to mitigate the adverse health effects of radiation.
4. To identify variations in knowledge, attitudes, and practices among students, and their association with awareness of the health implications of radiation exposure.

1.6 Research Questions:

1. What are the levels of knowledge, attitude and practice towards the risk of exposure to radiation among the dental students in Gaza?
2. What is the level of knowledge, attitude and practice about the risk of exposing to radiation among the dental students?
3. To what extent are the students committed to the basics of radiation protection.
4. What are the strengths, weaknesses and challenges related to the risk of dental radiation in Gaza Universities?
5. What are challenges related to the risk of dental radiation in Gaza Universities?
6. What is the correlation between knowledge, attitude and practice about exposure to radiation among students?

1.7 Operational definitions

- **Knowledge of Radiation Safety**: The total score obtained from 23 questionnaire items assessing familiarity with radiation safety principles, such as hazard symbols, exposure risks, and protective measures. Scores are categorized into low, medium, and high based on pre-defined cut-off values.
- **Attitudes Toward Radiation Safety**: Measured through 14 Likert-scale items reflecting participants' agreement or disagreement with statements about the importance and necessity of radiation safety practices. Scores indicate positive, neutral, or negative attitudes.
- **Practices Related to Radiation Safety**: The frequency and consistency of using radiation safety measures such as lead aprons, thyroid collars, and maintaining safe distances during dental radiography. Assessed through 17 self-reported items and scored as compliant or non-compliant.
- **Radiation Exposure Risk Perception**: Participants' self-reported awareness of the health risks associated with ionizing radiation, measured using a subset of knowledge and attitude items rated on a 5-point Likert scale.

- **Demographic Variables**: Age, gender, educational level, and university affiliation as reported by participants, used to stratify and analyze variations in knowledge, attitudes, and practices.

1.8 Context of the Study:

The dental clinics at Palestine University and Al-Azhar University serve as practical training centers for students while simultaneously providing essential dental treatments to a large number of patients from diverse regions. These clinics offer free treatment services across various dental fields, including surgical dentistry, fixed and removable prosthodontics, periodontics, oral surgery, pediatric dentistry, and endodontics, all of which require the use of radiography. Each department is staffed by specialists, teaching assistants, and nurses, ensuring the provision of high-quality care (WHO, 2021).

The workload in these clinics is substantial, with approximately 300 male and female students from the third, fourth, and fifth levels working across the college clinics in both universities. On average, clinics handle hundreds of cases monthly, benefiting a significant number of patients who rely on these services due to financial constraints. Radiology equipment is strategically distributed between clinics and laboratories, supporting the wide range of diagnostic and therapeutic procedures performed. This setup not only facilitates hands-on learning for students but also plays a vital role in meeting the healthcare needs of the local community.

1.9 Dentistry at Al-Azhar University:

Al-Azhar University, one of the oldest and most prestigious academic institutions in the Gaza Strip, has long been a beacon of higher education in the region. Founded in 2000, the university offers a diverse range of undergraduate and graduate programs across various fields, with a particular emphasis on medical and health sciences. The College of Dentistry, established in 2007, is one of the university's most prominent faculties, providing high-quality education and training for future dental professionals. The college's curriculum is designed to equip students with the theoretical knowledge and clinical skills needed to excel in the dental profession (Al-Azhar University, n.d.).

The infrastructure at Al-Azhar University, including its advanced dental clinics and well-equipped laboratories, has played a critical role in preparing students for the demands of dental practice. These clinics have not only supported academic learning but have also served the local community by offering affordable and accessible dental care. Services provided at the clinics include fillings, fixed and removable prostheses, and treatments for both adults and children, addressing a wide range of dental health needs in the Gaza strip. Over the years, Al-Azhar University has made significant contributions to improving the dental health of the population, particularly in a region where access to specialized care is often limited due to financial constraints and ongoing political and social challenges.

However, the current war on the Gaza Strip has had a devastating impact on the university, particularly the College of Dentistry. Airstrikes and military operations have targeted many buildings in the Gaza Strip, and Al-Azhar University has not been spared. The university's infrastructure has been severely damaged, with main facilities, including dental clinics and laboratories, experiencing extensive destruction. The dental clinics, which were once hubs for both student training and community dental service, have been rendered non-functional. This disruption has severely affected the ability of students to gain practical experience and has undermined the university's role in providing essential dental care to the local population.

In addition to physical damage, the ongoing conflict has forced many students and faculty members to flee their homes and seek safety in other areas. This displacement has further compounded the challenges faced by the university, as it has become increasingly difficult for students to access educational materials, attend lectures, or participate in clinical training. The military activity and the destruction of critical infrastructure have created an environment of uncertainty, making it difficult for the university to plan for the future and continue its mission of providing high-quality education.

The situation has also taken a toll on the university's ability to provide dental services to the community. With many of its clinics destroyed or inaccessible, the university is unable to offer much-needed dental care, such as fillings, prostheses, and pediatric treatments, to the residents of Gaza. Many of these individuals are already facing significant challenges due to the lack of basic health services in the region. This has further exacerbated the health crisis in Gaza, where access to medical and dental care is already limited due to the ongoing conflict and blockades.

The war in Gaza has thus presented Al-Azhar University with unprecedented challenges, and its recovery will depend on the availability of resources, support from local and international organizations, and the ability to rebuild its infrastructure. Despite the obstacles, the university remains an essential institution in Gaza's education and healthcare sectors, and its role in shaping the future of Palestinian dental professionals and improving public health in the region remains crucial.

1.10 Dentistry at the University of Palestine:

The College of Dentistry at the University of Palestine, established in 2017, is accredited by the Ministry of Education and Higher Education and aims to equip students with the practical skills necessary for effective and safe dental practice. The program requires students to complete 204 credit hours over five academic years, followed by a compulsory internship year designed to enhance their clinical competencies and readiness for real-world dental practice. With approximately 500 students currently enrolled, the college is equipped with 70 advanced dental clinics and cutting-edge technological resources to create an optimal learning environment. These clinics provide a range of essential dental services, including fillings, fixed and removable prostheses, and treatment for both adults and children, playing a pivotal role in addressing the dental health needs of the local community (University of Palestine, n.d.).

However, the recent war in Gaza has had a catastrophic impact on the University of Palestine, particularly its College of Dentistry. Located in the Netzarim axis (محور نتساريم), an area that has become a focal point of military conflict, the university has suffered the complete destruction of its buildings due to relentless airstrikes and shelling. The infrastructure, including lecture halls, laboratories, and dental clinics, has been entirely obliterated, leaving students and faculty without access to critical educational and clinical facilities.

The situation is further compounded by the presence of the Israeli army in the area, which has rendered the campus completely inaccessible. This has forced the suspension of academic and practical training activities, depriving students of the essential hands-on experience required for their education. The destruction of the University of Palestine has not only disrupted the academic progression of its students but has also eliminated a vital source of dental healthcare services for the local population, particularly those who relied on the clinics for necessary treatments such as fillings, prostheses, and pediatric dental care.

The devastation underscores the urgent need for international intervention to rebuild the university and restore its operations. Without immediate action, the future of dental education and public health services in Gaza remains in jeopardy.

Chapter Two

Conceptual Framework and Literature Review

This chapter provides a comprehensive discussion of existing research pertaining to the knowledge, attitudes, and practices of dental students concerning radiation safety in academic settings. This chapter is divided into two main parts, the first one is entitled "conceptual framework" and the second part is the literature review.

2.1 The conceptual framework

Conceptual framework is the map that guides the design and implementation of the study and provides illustration of the study variables. It was designed and developed by the researcher and based on a review of the available literature and previous studies.

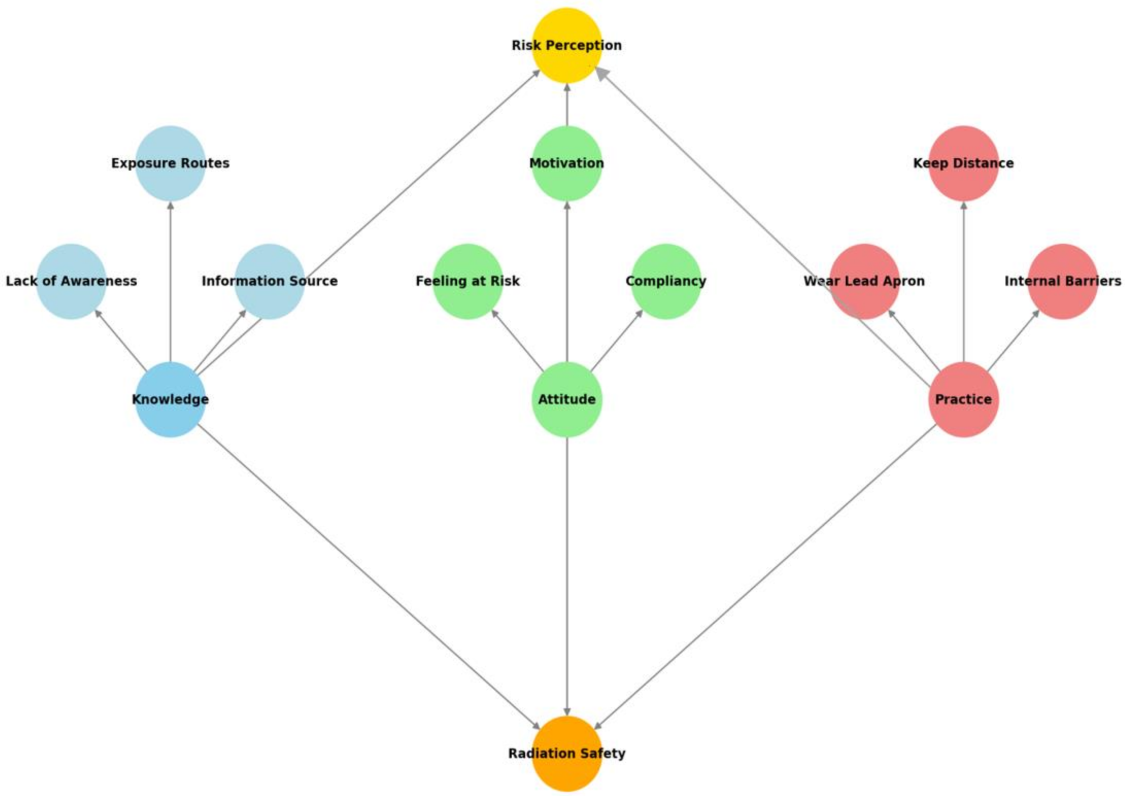

Figure (1.1): Conceptual framework, developed by the researcher

The framework for this study is illustrated in Figure 2.1 the variable domains; Knowledge Exposure routes, lack of awareness, lack of knowledge and Information source. Attitudes Lack of motivation, feeling at risk, ignorance and compliance and Practice "Keep 1-2 m from x-ray machine, not gathering around the x-ray machine, wear lead apron or thyroid collar, and internal & external barriers.

Knowledge attitudes, practice and risk & safety

The conceptual framework was developed by the researcher based on a comprehensive review of relevant literature and previous studies. This framework elucidates the primary variables involved in assessing the knowledge, attitudes, perceptions, and practices of dental students and professionals regarding radiation hazards and radiographic protection techniques. These variables collectively capture the factors influencing safe radiographic practices, providing an in-depth view of the dynamics at play in the field of dental radiography.

The first main variable is Knowledge of Radiation Protection. This variable focuses on the participants' level of awareness and understanding of radiation hazards and protective measures. Knowledge is crucial because it encompasses familiarity with safety principles, proper handling of radiographic equipment, awareness of biological hazards, and a general understanding of the risks associated with radiation exposure. A sound knowledge base among dental professionals is imperative to reduce the risks of radiation exposure to both patients and practitioners. According to Sultan et al. (2018) and Basheer et al. (2019), a knowledgeable dental workforce is essential in mitigating radiation-related health risks. In addition, Ali et al. (2020) conducted a study among undergraduates and interns in Iraq, which revealed knowledge gaps in radiographic protection. Such gaps highlight the need for a thorough understanding of radiation safety principles to maintain a high standard of safety within dental practices.

The second variable is Attitude toward Radiation Safety, which captures the participants' beliefs, concerns, and disposition towards following radiation protection protocols. A positive attitude towards radiation safety often encourages dental professionals to adopt protective measures, whereas a lack of concern may lead to negligence and unsafe practices. Attitude is an influential factor that can shape behavior in the clinical setting. Srivastava et al. (2017) explored the attitudes of dental students towards radiation hazards, emphasizing that a proactive approach is essential for effective safety measures. Similarly, Aravind et al. (2016) observed that dental practitioners who hold a positive attitude toward radiation safety are more likely to comply with established protective measures, which significantly reduce unnecessary exposure risks. Thus, instilling a positive attitude toward radiation safety among dental practitioners is essential to promote a culture of safety within dental clinics.

The Perception of Radiation Hazards, which evaluates how participants view the severity and potential consequences of radiation exposure. Perception involves an awareness of the health risks associated with radiation and the perceived necessity for protective measures. A heightened perception of the dangers linked to radiation exposure can lead to greater compliance with safety protocols and encourage safe practices. The significance of perception in influencing safety behavior is widely acknowledged in the literature. For instance, Arnout and Jafar (2014a) reported a strong correlation between a high awareness of radiation hazards and a greater commitment to safety measures. Abuelhia et al. (2022) also found that an accurate perception of radiation hazards was directly related to the likelihood of adopting protective measures, underscoring the role of awareness in shaping behavior within the dental profession.

The third variable, Practice of Radiation Protection Techniques, assesses the actual implementation of safety measures by dental professionals and students. This variable examines whether practitioners consistently use protective equipment such as lead aprons and thyroid collars, maintain safe distances, minimize exposure time, and follow appropriate positioning guidelines. The translation of theoretical knowledge into practical application is essential to protect both practitioners and patients from unnecessary radiation exposure. Almohaimede et al. (2020a) found that dental students with a solid foundation of knowledge and positive attitudes towards radiation safety were more likely to apply protective measures in practice. This finding highlights the interrelationship between knowledge, attitude, and practice, and suggests that fostering both knowledge and a positive attitude is key to encouraging safe practices. In a related study, Rahman et al. (2018) explored the practices of dental students in protecting pediatric patients from radiation exposure and identified gaps between students' theoretical knowledge and their practical application, indicating areas for improvement in training and education.

Educational interventions and training play a critical role in enhancing knowledge, attitudes, and practices related to radiation protection. Formal education, training sessions, and workshops are essential for ensuring that dental students and professionals remain well-informed about the latest standards and techniques in radiographic safety. The positive impact of continuous education on improving safety standards is well-documented. For instance, Kuzhalvaimozhi and Vadivel (2020) found that structured training programs significantly improved the knowledge, attitudes, and practices of dental students, highlighting the effectiveness of targeted educational interventions. Similarly, Bashizadeh Fakhar et al. (2019) stressed the importance of well-designed training programs in fostering safe practices in dental radiography. Thus, educational interventions play an indispensable role in cultivating a safety-oriented mindset and ensuring the consistent application of radiographic protection measures within the dental profession.

In conclusion, By examining the knowledge, attitudes, perceptions, and practices related to radiographic protection, as well as the impact of educational interventions, this framework provides a holistic view of the factors affecting safety standards in the field of dentistry. It also highlights the interconnected nature of these variables, suggesting that improvements in knowledge and attitudes, bolstered by effective educational interventions, can lead to safer practices and reduce radiation exposure risks in dental settings.

2.2 Literature Review

The literature review provides a comprehensive synthesis of existing research on the KAP of dental students concerning radiation safety in academic settings. Given the significant risks associated with ionizing radiation, ensuring that dental students are equipped with a solid foundation in radiation safety protocols is vital for the protection of both students and patients (Almohaimede et al., 2020a; Garg & Kapoor, 2018). While awareness has increased in recent years, considerable gaps remain in knowledge and practical adherence to radiation safety protocols among dental students and professionals (Allam et al., 2024a; Priyanka et al., 2022). This chapter explores key themes, critical gaps, and future research needs, focusing on Gaza, a region with unique socio-economic challenges that impact radiation safety practices.

2.2.1 Short-Term and Long-Term Risks of Radiation Exposure

Ionizing radiation poses significant health risks, both in the short term and long term. Short-term risks include acute radiation sickness, which can result from high levels of exposure in a short period. Symptoms can include nausea, vomiting, fatigue, and skin burns. Long-term risks are more insidious, including cancer, genetic mutations, and other degenerative diseases. The carcinogenic potential of ionizing radiation is well-documented, with cumulative exposure increasing the likelihood of various cancers, including leukemia and thyroid cancer (Hall & Giaccia, 2020; UNSCEAR, 2020). The risk is especially concerning healthcare settings, where repeated, low-dose exposure can accumulate over time, potentially leading to significant health issues for dental practitioners and their patients (International Commission on Radiological Protection, 2021).

The cumulative nature of radiation exposure means that students and professionals are at an increased risk of these long-term effects, particularly if safety protocols are not consistently followed. Effective training and preventive measures are crucial in mitigating these risks.

2.2.2 Effectiveness of Preventive Measures

Preventive measures, including the use of protective equipment (e.g., lead aprons, thyroid collars), proper radiation shielding, and minimizing exposure time, have been shown to significantly reduce the risk of radiation-related health issues. Studies suggest that proper adherence to safety protocols can decrease radiation exposure to both dental professionals and patients by as much as 90% (Priyanka et al., 2022; Almohaimede et al., 2020b).

In Palestine and other regions, research on the effectiveness of these measures has shown varying results. For example, a study in a Palestinian dental school by Al-Rawi et al. (2019) indicated that while students were aware of the importance of safety equipment, the application was inconsistent due to limited access to resources and infrastructure. Similarly, a study by Zekioğlu & Parlar (2020) found that although radiation safety principles are well-known among dental students, the effectiveness of these measures depends on the frequency of use, institutional support, and clinical supervision.

Globally, studies from countries with more resources, such as the US and Europe, have highlighted the importance of incorporating hands-on training and regular safety audits into the curriculum. In contrast, resource-limited settings like Gaza face unique challenges that hinder the effective implementation of preventive measures. For instance, the absence of modern equipment and financial constraints make it difficult for students in Gaza to fully practice safety protocols during clinical training (Alharthy et al., 2022).

2.2.3 Knowledge of Radiation Safety Among Dental Students

Understanding dental students' knowledge of radiation safety is essential for ensuring safe clinical practices. Research has revealed varying levels of awareness among dental students, with some displaying a solid understanding while others have notable gaps. For example, Elhennawy et al. (2022a) found inconsistencies in students' knowledge of radiation safety protocols, with some unaware of the proper use of protective equipment and radiation exposure limits. These variations are often linked to differences in educational curricula, training programs, and clinical exposure (Badi et al., 2023). This highlights the need for standardized and comprehensive radiation safety education across dental schools.

Research studies have shown that students in higher years, particularly those with more clinical exposure, tend to demonstrate greater knowledge of radiation safety. However, a significant gap remains in integrating structured educational frameworks within dental curricula to ensure consistent and comprehensive knowledge among all students (Siddiqui et al., 2020). Studies suggest that when students perceive a higher risk of negative consequences, they are more likely to engage in preventive practices, which align with the Health Belief Model (Rosenstock, 1974). Enhancing students' perception of radiation risks may improve their commitment to radiation safety protocols.

2.2.4 Attitudes Toward Radiation Safety Among Dental Students

Attitudes towards radiation safety are a key determinant of students' adherence to safety protocols. Research indicates that while dental students generally recognize the importance of radiation safety, many lack confidence in implementing safety measures effectively (Al-Ghamdi et al., 2021). This gap between knowledge and confidence is often due to limited hands-on training and insufficient reinforcement of safety protocols in clinical settings (Zafar et al., 2023)."

Educational experiences, including exposure to practical training and the emphasis placed by instructors on radiation safety, significantly shape students' attitudes. Studies by Khamis et al. (2022) and Tahir et al. (2020) found that students who received more comprehensive training exhibited more positive attitudes toward radiation safety. These findings support the Theory of Planned Behavior (Ajzen, 1991), which posits that attitudes, subjective norms, and perceived behavioral control influence students' intentions to engage in radiation safety behaviors.

2.2.5 Practices Related to Radiation Safety Among Dental Students

Despite having positive attitudes and varying levels of knowledge, translating this understanding into practice remains inconsistent. Khan et al. (2021) noted that while dental students were aware of the importance of using protective equipment, many failed to consistently apply safety measures during radiographic procedures, such as wearing lead aprons and thyroid collars. This inconsistency is often due to a lack of clinical supervision, institutional support, and limited access to updated equipment (Elshafie et al., 2023).

In under-resourced regions like Gaza, students face additional challenges in maintaining safety standards due to economic constraints, inadequate infrastructure, and limited access to updated training materials. As Al-Rawi et al. (2019) found, institutional policies, supervision, and access to proper radiation protection equipment are crucial in ensuring consistent practice of radiation safety protocols. These contextual challenges in Gaza underscore the need for more practical training and institutional support to enhance compliance with radiation safety standards in academic settings.

2.2.6 Factors Influencing Knowledge, Attitudes, and Practices

A variety of demographic and institutional factors have been identified as influencing dental students' KAP regarding radiation safety. Studies indicate that demographic variables, such as age, gender, and educational background, affect students' understanding and adherence to radiation protocols. Simmarasan et al. (2023a) found that younger students tended to exhibit higher awareness and more positive attitudes toward radiation safety, which could be attributed to generational differences in educational approaches.

Institutional factors, such as curriculum design and access to practical training, are crucial in shaping students' KAP. Jahan et al. (2022) reported that comprehensive curricula that incorporate radiation safety education improve students' knowledge and compliance. Additionally, faculty support and access to updated educational resources significantly impact students' attitudes and practices. Almasoud et al. (2023) demonstrated that institutions that prioritize radiation safety materials and active faculty involvement enhance students' adherence to safety guidelines.

In Gaza, the unique socio-political and economic challenges create specific barriers to radiation safety. Limited resources, restricted access to updated materials, and intermittent faculty support due to conflict-related disruptions can hinder consistent education in radiation safety. By examining the KAP of dental students in this context, this study seeks to address a critical gap in the literature and contribute insights for tailoring safety interventions in under-resourced regions.

2.2.7 The Dangers of Radiation and Associated Risks

Ionizing radiation, commonly used in dental radiographic practices, poses significant risks to both practitioners and patients if proper safety protocols are not observed. Prolonged or excessive exposure to radiation can result in a spectrum of health issues, ranging from acute effects such as skin burns and radiation sickness to chronic conditions including cataracts, infertility, and cancer (ICRP, 2021). Even low-dose exposure, if repetitive and unshielded, can lead to cumulative effects, emphasizing the importance of adopting strict radiation safety measures (UNSCEAR, 2020).

Dental practitioners are at heightened risk due to frequent occupational exposure during procedures involving radiographic imaging. Studies have shown that inadequate use of protective barriers, such as lead aprons and thyroid collars, significantly increases these risks (Alharthy et al., 2022b). Moreover, the stochastic effects of radiation imply that even minor doses can result in severe outcomes, such as genetic mutations and malignancies, without a definitive threshold (Hall & Giaccia, 2020).

Educational gaps in radiation safety exacerbate these risks, as improper training may lead to unsafe practices in clinical settings. For example, research has documented instances where dental students and professionals failed to adhere to fundamental safety principles, such as maintaining an adequate distance from the radiation source or neglecting the use of dosimeters to monitor exposure levels (Elhennawy et al., 2022b). These lapses underscore the need for comprehensive radiation safety education within dental curricula.

2.2.8 Gaps in Literature and Research Needs

While a substantial body of research exists on the KAP of dental students towards radiation safety, there are notable gaps. Most studies focus on immediate knowledge acquisition rather than the long-term retention of safe practices. There is a need for longitudinal studies that evaluate the sustainability of knowledge and the long-term impact of radiation safety training on clinical behavior (Mahmood et al., 2021). Additionally, the potential benefits of innovative educational interventions, such as simulation-based learning, remain underexplored (Ghanem et al., 2022).

The influence of cultural and contextual factors on radiation safety practices is another area that warrants further investigation. Studies have shown that culturally tailored educational materials can improve health behaviors, suggesting that a similar approach may benefit dental education (Tzeng et al., 2023b). In Gaza, where socio-economic and political factors shape educational experiences, understanding how local contexts affect radiation safety behaviors could provide valuable insights for educators.

Conclusion: This literature review synthesizes key findings regarding the KAP of dental students concerning radiation safety. While recent studies have highlighted significant gaps in knowledge and practice, there is a clear need for more standardized, rigorous education in radiation safety within dental curricula (Ghanem et al., 2022; Mahmood et al., 2021).

The insights from this review underscore the importance of targeted educational interventions aimed at improving safety awareness and adherence. Given Gaza's unique challenges, this study will focus on understanding local KAP patterns and identifying specific areas for intervention.

Addressing the gaps identified in this review could lead to better curriculum design and the development of innovative teaching methodologies tailored to regional needs. Future research should focus on longitudinal outcomes of radiation safety training and assess the long-term impacts on clinical practice. By contextualizing these findings within Gaza, this study aims to contribute to safer educational environments and ultimately improve patient care.

To further strengthen the search, a hand search of relevant journals, including The Journal of Dental Education and The Journal of Clinical and Diagnostic Research, was also performed. Additionally, conference proceedings from major dental and radiation safety symposiums were reviewed (LaSunE et al., 2022b). Experts in radiation safety and dental education were consulted to identify any additional sources that may have been missed during the database and hand-searching phases (Allam et al., 2024a). This multi-faceted approach ensured that the search was thorough and up to date with studies published in recent years, particularly from 2020 to 2024.

This method resulted in a comprehensive collection of research studies, ensuring that the literature review adequately reflects the current state of knowledge and practice in radiation safety education among dental students in Gaza Strip universities and beyond.

In conclusion, this literature review presents a comprehensive analysis of existing research pertaining to the knowledge, attitudes, and practices (KAP) of dental students concerning radiation safety. By synthesizing findings from a variety of studies, this chapter elucidates the multifactorial elements influencing radiation safety behaviors among dental students. Recent investigations indicate critical gaps in knowledge and practice that necessitate the integration of radiation safety education within dental curricula (Ghanem et al., 2022; Mahmood et al., 2021). The insights derived from this review will inform the design and implementation of the current study while underscoring the importance of targeted educational interventions aimed at enhancing radiation safety awareness and adherence among dental students (Tzeng et al., 2023a). Such interventions are essential for ensuring the safety and well-being of both dental practitioners and their patients. Furthermore, this review highlights significant avenues for future research, including the development and evaluation of innovative teaching methodologies and the assessment of long-term impacts of radiation safety training on clinical practice outcomes.

2.3 Search Strategy

To ensure a comprehensive and up-to-date review of the relevant literature, a systematic search strategy was employed, focusing on key concepts related to the study: knowledge, attitudes, practices, dental students, radiation safety, and Gaza Strip universities. Search terms were developed around these concepts, including "knowledge," "attitudes," "practices," "dental students," "radiation safety," and "Gaza Strip," and combined using Boolean operators (AND, OR) to construct precise search queries. This approach enabled the search to capture a broad range of studies related to radiation safety practices among dental students.

A search was conducted in prominent academic databases, including Pub Med, Scopus, Google Scholar, and Web of Science. In particular, research published from 2020 onwards was prioritized to ensure the study reflects the most current trends and knowledge in the field (Almohaimede et al., 2020a; Assiri et al., 2020; Zekioğlu & Parlar, 2020). Furthermore, the database Directory of Open Access Journals (DOAJ) was utilized to include recent peer-reviewed open-access articles, ensuring inclusivity of more recent literature and data. Studies focusing on the knowledge, attitudes, and practices (KAP) regarding radiation safety among dental students were included in the search.

To further strengthen the search, a hand search of relevant journals, including The Journal of Dental Education and The Journal of Clinical and Diagnostic Research, was also performed. Additionally, conference proceedings from major dental and radiation safety symposiums were reviewed (LaSunE et al., 2022b). Experts in radiation safety and dental education were consulted to identify any additional sources that may have been missed during the database and hand-searching phases (Allam et al., 2024a). This multi-faceted approach ensured that the search was thorough and up to date with studies published in recent years, particularly from 2020 to 2024.

This method resulted in a comprehensive collection of research studies, ensuring that the literature review adequately reflects the current state of knowledge and practice in radiation safety education among dental students in Gaza Strip universities and beyond.

2.4 Definitions of terms:

Dental Radiography: Dental radiography refers to the process of producing radiographic images of the teeth and surrounding structures by exposing an image receptor to ionizing radiation, primarily X-rays. This technique is essential for diagnosing various dental conditions, assessing treatment outcomes, and planning procedures (Joen, M. & Laura, J., 2017; White &Pharoah, 2019).

Dental Radiology: Dental radiology encompasses the science and practice of using radiographic techniques to visualize the anatomy of the teeth and jaws. It includes various types of imaging modalities such as periapical films, bitewing films, and panoramic radiographs, each serving specific diagnostic purposes in dental care (White &Pharoah, 2019; Reddy et al., 2020).

Dental Radiographer: A dental radiographer is a qualified professional responsible for the positioning, exposure, and processing of dental X-ray images. This role requires an understanding of radiation safety protocols, patient care, and the technical aspects of radiographic equipment (Joen, M. & Laura, J., 2017; Hossain et al., 2021).

Image: In the context of dental radiography, an image is a visual representation of an anatomical structure obtained through radiographic techniques. It serves as a diagnostic tool to assist dental professionals in identifying oral health issues (Joen, M. & Laura, J., 2017).

Image Receptor: An image receptor is the recording medium used to capture radiographic images. Common examples include traditional X-ray film, digital sensors, and phosphor plates. The choice of image receptor affects the quality and type of radiographic image produced (Joen, M. & Laura, J., 2017; White &Pharoah, 2019).

Dental Imaging: Dental imaging is the creation of visual representations of anatomical structures within the oral cavity, utilizing various technologies for diagnostic purposes. It includes techniques such as X-rays, cone-beam computed tomography (CBCT), and digital imaging (Joen, M. & Laura, J., 2017; Yadav et al., 2020).

Collimator: A collimator is a device used in dental radiography to restrict the size and shape of the X-ray beam to the area of interest. It minimizes unnecessary exposure to surrounding tissues and enhances image quality by reducing scatter radiation (Whaites, E., 2002).

Bitewing (BW) Radiographs: Bitewing radiographs are a specific type of dental X-ray that captures the crowns of upper and lower teeth in one area of the mouth, useful for detecting interproximal caries and assessing bone levels (Whaites, E., 2002; Al-Marzooq et al., 2018).

Periapical (PA) Radiographs: Periapical radiographs capture the entire tooth, including the crown and root, along with surrounding bone structures. They are essential for diagnosing conditions affecting the tooth root and periapical tissues (Whaites, E., 2002; Nair et al., 2021).

Dental Arch: The dental arch refers to the curved structure formed by the arrangement of teeth in both the upper (maxillary) and lower (mandibular) jaws. The upper dental arch corresponds to the maxilla, containing the upper teeth, while the lower dental arch refers to the mandible, encompassing the lower teeth (McDonald & Avery, 2018).

Digital Radiography: Digital radiography is an advanced form of radiography that uses digital sensors to capture and store images of the teeth and surrounding structures. This technology offers advantages such as immediate image availability, enhanced image quality, and reduced radiation exposure compared to traditional film-based methods (Bach et al., 2021; Piconi et al., 2020).

Cone Beam Computed Tomography (CBCT): CBCT is a specialized form of computed tomography used in dental imaging that produces three-dimensional images of the dental and maxillofacial structures. It provides precise anatomical details, which are particularly useful in orthodontics, implantology, and surgical planning (Huang et al., 2019; Scarfe et al., 2018).

Radiation Dose: Radiation dose refers to the amount of radiation energy absorbed by body tissues during radiographic procedures. It is measured in units such as millisieverts (mSv) and is a critical factor in assessing patient safety and the risk of radiation-induced effects (Sullivan et al., 2020; Wong et al., 2019).

Radiographic Interpretation: Radiographic interpretation involves analyzing and understanding the images produced by dental radiography to diagnose dental conditions, identify anomalies, and evaluate treatment outcomes. This requires a combination of clinical knowledge and experience in recognizing normal versus pathological findings (Jiang et al., 2021; Wenzel, 2020).

Intraoral Radiography: Intraoral radiography is a dental imaging technique where the X-ray film or sensor is placed inside the mouth to capture images of the teeth and surrounding structures. This includes techniques such as periapical and bitewing radiographs, providing detailed views of specific areas (Mäkitie et al., 2020; Sato et al., 2019).

Extraoral Radiography: Extraoral radiography refers to dental imaging techniques where the X-ray film or sensor is positioned outside the mouth. Common examples include panoramic radiographs and cephalometric radiographs, which capture broader views of the jaws and facial structures (Cawson et al., 2020; Ghafoor et al., 2021).

Radiation Protection: Radiation protection encompasses safety measures and protocols implemented to minimize radiation exposure to patients and healthcare workers during radiographic procedures. This includes the use of lead aprons, thyroid collars, collimation, and adherence to the ALARA (As Low as Reasonably Achievable) principle (Baker et al., 2021; Bhandari et al., 2020).

X-ray Film: X-ray film is a photographic film that captures the radiographic image produced by X-rays passing through the body. It consists of a photosensitive emulsion that reacts to radiation exposure, resulting in a latent image that can be developed into a visible radiograph (Drennan et al., 2018; Kaur et al., 2019).

Radiographic Technique: Radiographic technique refers to the specific methods and protocols used to acquire dental radiographs, including positioning of the patient and the X-ray equipment, exposure settings, and film/sensor selection. Proper technique is essential for obtaining diagnostic-quality images while minimizing radiation exposure (Brady et al., 2020; De Vries et al., 2019).

Tissue Dose: Tissue dose is the amount of radiation absorbed by specific tissues during a radiographic examination. It is a critical consideration in evaluating the safety and efficacy of dental radiology, influencing decisions regarding imaging protocols and techniques (Harrison et al., 2020; Jha et al., 2018).

Chapter Three

Methodology

This chapter details the methodology used to assess the knowledge, attitudes, and practices of dental students in Gaza Strip universities regarding radiation safety. A cross-sectional descriptive design was chosen for its efficiency and suitability in describing current phenomena. The study setting, participant selection, data collection process, and statistical analysis methods are outlined to ensure robust and reliable findings. This methodological framework aims to provide insights that can inform future educational programs and interventions to enhance radiation safety practices among dental students in the Gaza Strip.

3.1 Study Design

The cross-sectional descriptive design was used to assess the levels and the relationship between knowledge, attitude, and practice towards the risk of exposure to radiation among dental students at Gaza Strip Universities. This design was selected because it was the best approach to describe the levels of knowledge, attitude, and practice towards the risk of exposure to radiation and how to minimize exposure to radiation during courses. Additionally, this design was less expensive and enabled the researcher to meet the study objectives in a short time (Wang & Cheng ,2020).

3.2 Study Population

All undergraduate students from the third, fourth, and fifth years of the Faculty of Dentistry, as these are the levels where radiology is used in clinics and laboratories, will be included. This group consists of approximately 847 students from universities in the Gaza Strip, including Al-Azhar University and the University of Palestine.

Table (3.1): distribution of total population and sample size

University	Total number of students	Percentage	Sample Size
Al-Azhar University	600	70.84%	187
University of Palestine	247	29.16%	77
Total	847	100%	264

3.3 Study Setting

The study was conducted at the University of Palestine and Al-Azhar University, the only institutions in the Gaza Strip with faculties of dentistry where dental radiography is actively taught and practiced.

3.4 Study Period

The study was conducted during the period from April 2023 until October 2023. The study was expected to continue for a period of six to eight months after obtaining the approval of the Helsinki Committee in the Gaza Strip, but due to the circumstances of the ongoing 2023/2025 war on Gaza, the completion of the study was delayed. The questionnaire took one month to construct and evaluate, while data collection, entry, and analysis took three to four months. Writing and reviewing the final research report took one month.

3.5 Sample and Sampling method

The sample size was determined using Epi Info TM 7 and the sample size calculation formula assuming a confidence level of 95%, a margin of error of 5%. The calculated sample size amounted to 264.

Undergraduate dental students from Gaza Universities (Al-Azhar University & University of Palestine) were selected using a stratified random method, proportionally to the level of classes.

3.6 Eligibility Criteria

3.6.1 Inclusion criteria

• All student working in dental clinics and exposed to dental radiology; third, fourth and fifth levels

3.6.2 Exclusion criteria

- Pregnant female students.
- All students who were not exposed to radiation.

3.7 Study tools

A self-administered questionnaire was developed by the researcher (Annex 3) based on the extensive literature review of previous studiescomprised four main sections: demographic data, questions about knowledge included (23) items, questions about attitude (14) items, and questions about the practice of students toward (17) items the risk of exposure to radiation. The questions about knowledge, attitude, and practice of students toward the risk of exposure to radiation were mainly developed with specific selections.

Five points Likert's scale rating system, which was used in questionnaires, was designed to measure students' knowledge, attitudes, and practices. Students choose from a range of possible responses to a specific statement. The categories of response were coded numerically, with numerical values defined for that specific study, such as strongly agree (5), agree, (4) neutral (3), disagree (2), and strongly disagree (1).

The questionnaire was translated to the Arabic language (Annex 4) for more understanding from students' point views .

3.8 Reliability of study instruments

The reliability of an instrument is the degree of consistency with which it measures the attribute it is intended to measure (Sürücü & Maslakçı, 2020). The test is administered to the same sample of individuals on two separate occasions, and the scores obtained are compared by calculating a reliability coefficient. One common method to calculate reliability is by using Cronbach's Alpha coefficient. Table 3.2 displays the values of Cronbach's Alpha for each domain of the questionnaire administered to the participants. The table illustrates the reliability of the domains, with a Cronbach's Alpha value of 0.974 for the entire questionnaire in the pilot sample, indicating good reliability for the entire questionnaire.

Table (3.2): Reliability of the research for each domain of the questionnaire

No.	Domains	No. of item	Cronbach's Alpha
Domain1	Knowledge	23	0.983
Domain2	Attitudes	14	0.967
Domain3	Practices	17	0.973
Total	KAP	54	0.974

3.8.1 Half-Split Method

As indicated in Table 3.3, the correlation between forms was 0.917, the equal Length Spearman-Brown Coefficient was 0.957, and the Guttmann Split-Half Coefficient was 0.957. These findings demonstrate the questionnaire's high reliability..

Table (3.3): Split and half for each domain of the questionnaire

Split half			R
Cronbach's Alpha	Part 1	Value	0.985
		N of Items	27
	Part 2	Value	0.980
		N of Items	27
	Total N of Items		54
Correlation Between Forms			0.917
Spearman-Brown Coefficient	Equal Length		0.957
	Unequal Length		0.957
Guttmann Split-Half Coefficient			0.957

3.9 Validity of study instruments

3.9.1 Content Validity

The questionnaire was evaluated by experts to validate the questions and their relation to the domains that reflect the study, and their comments were taken into consideration and modification was performed accordingly Annex (8) shows the list of arbitrators.

3.9.2 Internal (validity) Consistency

To assess internal validity, the researcher computed the correlation coefficient between each item and its corresponding domain. Table 3.4 displays the correlation coefficients for each item within a domain, and the total for the corresponding domain. In most items, the p-values are less than 0.05, indicating that the correlation coefficients are statistically significant at $\alpha = 0.05$. This suggests that all items within each domain are consistent and valid measures of the intended attribute.

Table (3.4): Correlation coefficient of every question related to the total score of domains

Items	**Statistical test**		**Items**	**Statistical test**		**Items**	**Statistical test**	
	R	**P-value**		**R**	**P-value**		**R**	**P-value**
D1: Knowledge			D2:Attitudes			D3: Practices		
Q1.1	0.763	0.000*	Q2.1	0.873	0.000*	Q3.2	0.727	0.000*
Q1.2	0.907	0.000*	Q2.2	0.809	0.000*	Q3.3	0.893	0.000*
Q1.3	0.922	0.000*	Q2.3	0.914	0.000*	Q3.4	0.887	0.000*
Q1.4	0.747	0.000*	Q2.4	0.918	0.000*	Q3.5	0.913	0.000*
Q1.5	0.770	0.000*	Q2.5	0.833	0.000*	Q3.6	0.951	0.000*
Q1.6	0.940	0.000*	Q2.6	0.781	0.000*	Q3.7	0.762	0.000*
Q1.7	0.908	0.000*	Q2.7	0.915	0.000*	Q3.8	0.803	0.000*
Q1.8	0.844	0.000*	Q2.8	0.684	0.001*	Q3.9	0.571	0.008*
Q1.9	0.808	0.000*	Q2.9	0.770	0.000*	Q3.10	0.892	0.000*
Q1.10	0.849	0.000*	Q2.10	0.918	0.000*	Q3.11	0.823	0.000*
Q1.11	0.785	0.000*	Q2.11	0.867	0.000*	Q3.12	0.859	0.000*
Q1.12	0.611	0.004	Q2.12	0.641	0.002	Q3.13	0.731	0.000*
Q1.13	0.803	0.000*	Q2.13	0.937	0.000*	Q3.14	0.645	0.002*
Q1.14	0.770	0.000*	Q2.14	0.767	0.000*	Q3.15	0.652	0.002*
Q1.15	0.851	0.000*	Q2.15	0.778	0.000*	Q3.16	0.626	0.003*
Q1.16	0.788	0.000*				Q3.17	0.601	0.005*
Q1.17	0.877	0.000*						
Q1.18	0.693	0.001*	**Total KAP domain**					
Q1.19	0.915	0.000*						
Q1.20	0.838	0.000*	D1	0.834	0.000*			
Q1.21	0.830	0.000*	D2	0.865	0.000*			
Q1.22	0.868	0.000*	D3	0.877	0.000*			

Significant at $P \le 0.001$; *Significant at $P \le 0.05$; P>0 05: Not significant; &r: Pearson correlation.

3.10 A pilot study

A pilot study was conducted with 20 students prior to the actual data collection to assess their responses to the questionnaire and their understanding of it. Based on this feedback, the questionnaire was revised to enhance its validity and clarity. Necessary modifications were made to improve comprehension. The students who participated in the pilot study were included in the final study sample**.**

3.11 Data Collection

The researcher trained two qualified nurses to collect the data and explained briefly to the students the study purposes and the information needed to complete the process. After obtaining informed consent from the participants, the researcher checked the practice of the students while maintaining privacy. After the end of every check, the researcher looked over the filled questionnaire to ensure adequate completion of all information and to monitor the flow of the serial numbers of the questionnaire.

3.12 Response Rate

The total number of the target population was 264, and the response rate was 100%. Table 3.5 summarizes the response distribution, where a scale of (5) represents "the highest scale value" and (1) represents "the lowest scale value."

Table (3.5): Responses to questionnaire scale

Response	Very Low Degree (VLD)	Low Degree (LD)	Medium Degree (MD)	High Degree (HD)	Very High Degree (VHD)
Degree	1	2	3	4	5
Mean	1-1.80	1.80-2.60	2.60-3.40	40-4.20	4.20-5
Relative wt. %	0<36%	36<52%	52<68%	68<84%	84-100%

3.13 Data Management

3.13.1 Data Entry:

The collected data were entered into the computer software "Statistical Package for Social Sciences" (SPSS) program Version 26. by the researcher after coding of the questions and then cleaning of the entered data.

3.13.2 Data Analysis:

Collected data was reviewed for completeness and accuracy, then coded and analyzed using SPSS program version 26 and Epi Info TM 7. To ensure the accuracy and completeness of all questions, frequency distribution and cross-tabulation were conducted.

Descriptive statistics were employed to summarize the data, including frequency distribution tables and graphs. For quantitative variables, the mean and standard deviation were calculated. The following statistical tests were used to examine the relationships between qualitative and quantitative variables.

- T-test or one-way way Analysis of Variance (ANOVA) was used for comparing the means between different characteristics of students.
- Pearson and Spearman Brown correlation and regression tests were used to test the correlations between the levels of knowledge, attitude, and practice.
- Mean, rates frequencies, percentage, standard deviation (SD), etc. were also considered.

3.14 Ethical and Administrative Considerations

- The approval of the Helsinki Committee obtained from PHRC to conduct the study, annex (5).
- Official letters of approval were obtained from Al-Azhar University and University of Palestine to conduct the study, annex (6-7).
- The informed consent of each participant in the study was obtained. The purpose of research, confidentiality of information, and benefits of participation were explained to participants, annex (3).
- Confidentiality and voluntary participation were stressed upon when describing the purpose of the study to all participants.
- Anonymity and confidentiality were guaranteed and maintained.
- The researcher organized all needed logistical materials for conducting the study.

3.15 Limitations of Study:

The researcher anticipates several significant obstacles that may impact the execution of this study. These challenges stem from both logistical constraints and the ongoing humanitarian crisis in Gaza:

● Scarcity of Scientific Resources: Access to essential academic materials, such as books, journals, and databases, is limited. This scarcity is compounded by the challenges of obtaining international resources due to Gaza's restricted connectivity and academic isolation.

● Ongoing War and Humanitarian Crisis: The war in Gaza has created severe obstacles, including:

- Unavailability of Basic Utilities: Frequent and prolonged interruptions of electricity, internet, water, and fuel disrupt the research process, making it difficult to communicate, access digital resources, and maintain a stable working environment.

- Psychological and Emotional Stress: The war environment contributes to heightened stress levels among participants and the researcher, potentially influencing responses and overall productivity.

Despite these limitations, the researcher is committed to employing adaptive strategies to ensure the study's validity, reliability, and ethical standards under these challenging circumstances.

Chapter Four

Results

The results chapter provides a detailed presentation of the findings from the study, which aimed to explore the knowledge, attitudes, and practices (KAP) of dental students regarding radiation safety in Gaza Strip universities. The chapter is structured to report the data obtained through questionnaires distributed to the students, focusing on key areas such as their understanding of radiation risks, adherence to safety measures, and perceptions toward radiation safety protocols. In addition, the analysis examines how demographic factors such as age, gender, and academic year influence the students' KAP. These results will serve as the foundation for discussions in the following chapter, where the findings will be interpreted in the context of existing literature and study objectives.

4.1 descriptive statistics

4.2 Sample distribution according to socio-demographic data

The present study is a cross-sectional study that included 264 subjects. The socio-demographic characteristics studied included gender, age group, educational level, place of residence, governorate name, academic achievement average, and university name.

4.2.1 Distribution of the study population according to the gender

Figure 4.1illustrated the gender distribution .

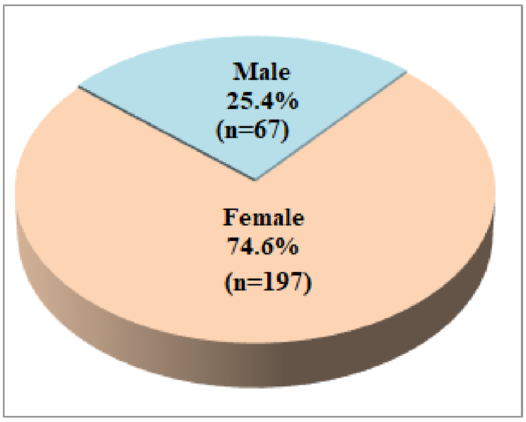

Figure (4.1): Distribution of the study population according to their gender

4.2.2 Distribution of the study population according to the age groups

Figure 4.2 Regarding age group, the highest percentage was found among individuals who were 21 years old (36.0%), followed by those who were 20 years old (23.5%), and individuals above 21 years old (40.5%).

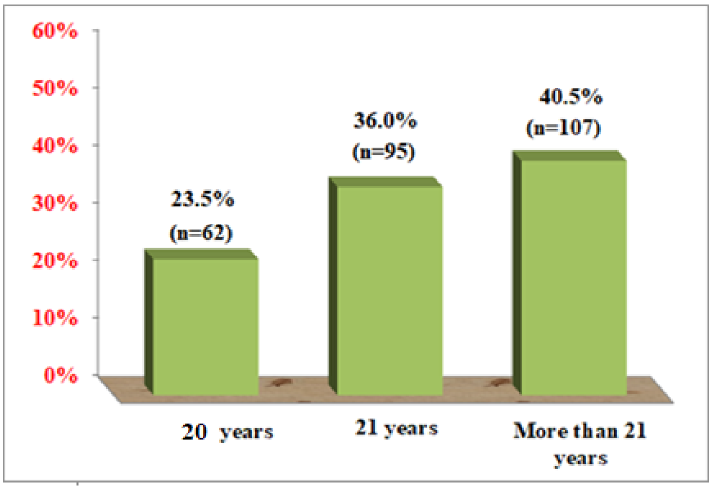

Figure (4.2): Distribution of the study population according to their age groups

4.2.3 Distribution of the study population according to the educational level

Figure 4.3 Regarding educational level, the majority of participants had completed up to the third year (52.3%), while smaller percentages had completed the fourth year (23.5%) or the fifth year (24.2%).

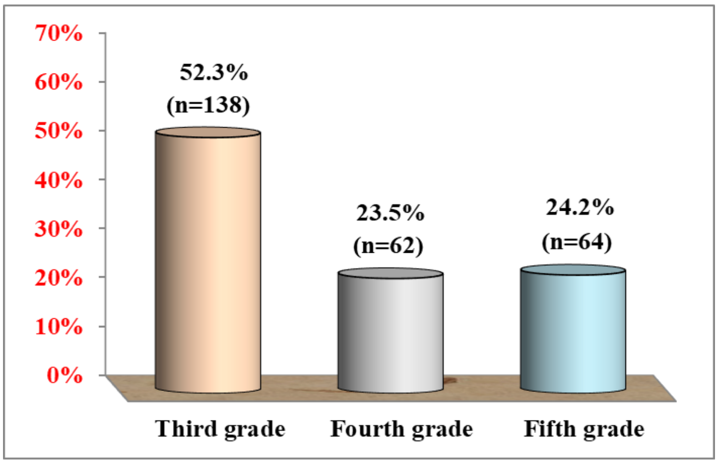

Figure (4.3): Distribution of the study population according to their educational level

4.2.4 Distribution of the study population according to their socio-demographic information

Table (4.1): Distribution of the study population according to their socio-demographic information

Socio-demographic information		N	%
Gender	Male	67	25.4%
	Female	197	74.6%
Total		264	
Age group	20 years	62	23.5%
	21 years	95	36.0%
	More than 21 years	107	40.5%
Total		264	
Educational level	Third year	138	52.3%
	Fourth year	62	23.5%
	Fifth year	64	24.2%
Total		264	
Place of Residence	Camp	52	19.7%
	Village	9	3.4%
	City	203	76.9%
Total		264	
Governorate name	North Gaza	51	19.3%
	Gaza	113	42.8%
	Middle Area	51	19.3%
	Khan Younis	29	11.0%
	Rafah	20	7.6%
Total		264	
Academic achievement	Excellent	17	6.4%
	Very good	212	80.3%
	Good	35	13.3%
		264	
University name	Al-Azhar university	187	70.8%
	Palestine University	77	29.2%
Total		264	

Table 4.1 The data provided offers insights into various factors related to gender, age group, educational level, place of residence, governorate name, academic achievement average, and university name. Regarding educational level, most participants had completed up to the third grade (52.3%), while smaller percentages had completed the fourth grade (23.5%) or the fifth grade (24.2%).The place of residence varied among participants, with the majority residing in cities (76.9%), followed by those living in camps (19.7%), and a small percentage residing in villages (3.4%). The distribution across governorates indicated that the highest percentage of participants were from Gaza (42.8%), followed by North Gaza (19.3%), Central (19.3%), Khan Yunis (11.0%), and Rafah (7.6%).In terms of academic achievement average, the majority of participants achieved a very good grade (80.3%), while a smaller percentage attained a good grade (13.3%), and an even smaller percentage achieved an excellent grade (6.4%).No participants fell into the category of an acceptable grade. When considering the university attended, the highest percentage of participants were enrolled at Al-Azhar University (70.8%), while a smaller percentage attended Palestine University (29.2%). Overall, this data provides insights into

the gender distribution, age groups, and educational levels, places of residence, governorate distribution, academic achievement averages, and university preferences of the participants.Scores of items measuring the level of knowledge.

4.2.4.1 Scores of items measuring the level of knowledge

Table (4.2-A): Distribution of the study population according to the level of knowledge

No.	Knowledge	Strongly disagree	Not Agree	I don' t know	Agree	Strongly agree	Mean	SD	Mean %	t-test	P-vale	Rank	No.
1	The consequences of using X-ray harm to the health of the patient?	N	4	42	53	120	45	3.61	1.00	72.10	9.884	0.000*	15
		%	1.5%	15.9%	20.1%	45.5%	17.0%						
2	I'm aware of the X-ray dosage recommendation.	N	3	22	43	132	64	3.88	0.91	77.60	15.679	0.000*	13
		%	1.1%	8.3%	16.3%	50.0%	24.3%						
3	I must be aware of the radiation hazard symbol.	N	1	2	4	85	172	4.61	0.60	92.20	43.564	0.000*	1
		%	0.4%	0.8%	1.5%	32.2%	65.1%						
4	I know what the ALARA principle is for Radiation Exposure.	N	14	68	64	67	51	3.28	1.19	65.50	3.763	0.000*	18
		%	5.3%	25.8%	24.2%	25.4%	19.3%						
5	I'm aware of basic radiation guidelines for dental X-rays.	N	1	15	26	114	108	4.19	0.86	83.70	22.435	0.000*	8
		%	0.4%	5.7%	9.8%	43.2%	40.9%						
6	I know the ideal distance an operator should stand while dental radiographic exposure is taken.	N	2	9	25	111	117	4.26	0.82	85.20	24.804	0.000*	7
		%	0.8%	3.4%	9.5%	42.0%	44.3%						
7	It is necessary to wear the personal monitoring badges by the operator	N	0	3	30	104	127	4.34	0.72	86.90	30.203	0.000*	4
		%	0.0%	1.1%	11.4%	39.4%	48.1%						
8	X-Ray beams reflect from room walls	N	2	18	36	88	120	4.16	0.95	83.20	19.743	0.000*	9
		%	0.8%	6.8%	13.6%	33.3%	45.5%						
9	I'm aware of National council on radiation protection [NCRP] recommendations	N	20	77	77	65	25	2.99	1.11	59.80	-0.111	0.912	19
		%	7.6%	29.2%	29.2%	24.5%	9.5%						
10	I'm aware of International Commission on radiological Protection [ICRP]recommendation	N	19	81	77	64	23	2.97	1.09	59.30	-0.508	0.612	20
		%	7.2%	30.7%	29.2%	24.2%	8.7%						
11	High radiation lead to cancer	N	1	6	55	120	82	4.05	0.80	80.90	21.162	0.000*	11
		%	0.4%	2.3%	20.7%	45.5%	31.1%						

Table (4.2-B): Distribution of the study population according to the level of knowledge

No.	Knowledge	Strongly disagree	Not Agree	I don' t know	Agree	Strongly agree	Mean	SD	Mean %	t-test	P-vale	Rank	No.
12	Dental radiograph is advised in lactating mothers	N	56	106	67	26	9	2.34	1.03	46.80	-10.429	0.000*	22
		%	21.2%	40.2%	25.4%	9.8%	3.4%						
13	I know about radiation protection methods	N	0	6	40	134	84	4.12	0.74	82.40	24.610	0.000*	10
		%	0.0%	2.3%	15.2%	50.7%	31.8%						
14	Dental Radiographs are absolutely contraindicated in pregnant woman.	N	7	8	17	84	148	4.36	0.93	87.10	23.741	0.000*	3
		%	2.7%	3.0%	6.4%	31.8%	56.1%						
15	The X-ray operator must stand at least 3 meters away from the patient.	N	0	19	47	135	63	3.92	0.84	78.30	17.799	0.000*	12
		%	0.0%	7.2%	17.8%	51.1%	23.9%						
16	20mSv is the annual radiation dose limit for a dentist	N	4	13	121	94	32	3.52	0.83	70.40	10.195	0.000*	17
		%	1.5%	4.9%	45.8%	35.6%	12.2%						
17	I know the most radiosensitive organ/ cell	N	3	47	63	101	50	3.56	1.03	71.20	8.875	0.000*	16
		%	1.1%	17.8%	23.9%	38.3%	18.9%						
18	I think new X-ray machine give radiation more than old one	N	16	82	95	50	21	2.92	1.03	58.30	-1.317	0.189	21
		%	6.1%	31.1%	36.0%	18.8%	8.0%						
19	During the study, I received information about the risks of radiation exposure	N	2	5	15	128	114	4.31	0.73	86.30	29.177	0.000*	5
		%	0.8%	1.9%	5.7%	48.4%	43.2%						
20	A cell that dies from radiation cannot be replaced®	N	114	128	14	5	3	1.69	0.76	33.90	-28.102	0.000*	23
		%	43.2%	48.5%	5.3%	1.9%	1.1%						
21	Digital radiography requires less exposure (Less harmful effects) than conventional	N	2	17	90	114	41	3.66	0.84	73.30	12.773	0.000*	14
		%	0.8%	6.4%	34.1%	43.2%	15.5%						
22	It is necessary to stand behind a leaded wall while giving the radiation dose	N	0	3	21	112	128	4.38	0.68	87.70	32.934	0.000*	2
		%	0.0%	1.1%	8.0%	42.4%	48.5%						
23	X-rays can have stochastic (cancer and genetic) effects over a period of time.	N	0	3	26	128	107	4.28	0.69	85.70	30.423	0.000*	6
		%	0.0%	1.1%	9.9%	48.5%	40.5%						
		Total						**3.71**	**0.37**	**74.25**	**31.432**	**0.000***	

*Significant at P≤0.05; P>0 05: Not significant; percentage, mean: percentage mean; SD: standard deviation & t: One sample t-test.

Table 4.2 summarizes the distribution of study participants' responses regarding their knowledge. Using a one-sample t-test, the table shows that the overall weighted mean for knowledge perceptions was 74.25%. The highest-rated item was item number 3, 'I must be aware of the radiation hazard symbol,' with a weighted mean of 92.20%, followed by item number 22, 'It is necessary to stand behind a leaded wall while giving the radiation dose,' with a weighted mean of 87.70%. The lowest-rated item was item number 20, 'A cell that dies from radiation cannot be replaced,' with a weighted mean of 33.90%, followed by item number 12, 'Dental radiographs are advised for lactating mothers,' with a weighted mean of 46.80%.

4.2.5 Distribution of the study population according to their responses about the knowledge

Table (4.3): Distribution of the study population according to their knowledge

Variable and level	N (%)	%Mean£	(SD)	Min	Max
Knowledge		74.25	7.37	55.65	96.52
High	60 (22.7)				
Moderate	197 (74.6)				
Low	7 (2.7)				

N: number of subjects; **SD**: standard deviation; **Min**: minimum; **Max**: maximum; £Maximum score of mean = **100 points**; **High**= equal 80% or more; Moderate = 60-79.9%; **Low** = less than 60%

Table 4.3 illustrated the distribution of the study population according to their responses about knowledge.

This table indicates that 22.7% of the participants had a high level of knowledge, 74.6% had a moderate level of knowledge, and 2.7% had a low level of knowledge. The average knowledge score was 74.25, with a standard deviation of 7.37, out of a possible 100 points**.**

4.2.6 Scores of items measuring the Level of Attitude

4.2.6.1 Scores of items measuring the level of Attitude

Table (4.4): Scores of items measuring the level of Attitude

No.	Attitude	Strongly disagree	Not agree	I don' t know	Agree	Strongly agree	Mean	SD	% Mean	t-test	P-vale	Rank	No.
1	Use dental radiography only when necessary	N	1	7	36	109	111	4.22	0.81	84.40	24.559	0.000*	2
		%	0.4%	2.7%	13.6%	41.3%	42.0%						
2	A safety check and radiation leakage must be carried out before starting the operation of the x-ray room.	N	0	5	44	93	122	4.26	0.80	85.20	25.529	0.000*	1
		%	0.0%	1.9%	16.7%	35.2%	46.2%						
3	The use of digital radiography reduces exposure to radiation	N	0	5	92	112	55	3.82	0.78	76.40	17.196	0.000*	6
		%	0.0%	1.9%	34.8%	42.5%	20.8%						
4	Dental Radiographs are absolutely contraindicated in pregnant woman.	N	12	39	98	60	55	3.41	1.11	68.10	5.937	0.000*	12
		%	4.5%	14.8%	37.1%	22.8%	20.8%						
5	High speed films reduce exposure.	N	1	12	97	95	59	3.75	0.87	75.10	14.151	0.000*	7
		%	0.4%	4.5%	36.7%	36.0%	22.4%						
6	The use of a Dosimeter is important in your daily practice	N	3	6	99	111	45	3.72	0.81	74.30	14.314	0.000*	8
		%	1.1%	2.3%	37.5%	42.0%	17.1%						
7	The patient can hold the film in their hand during exposure	N	14	29	66	94	61	3.60	1.12	72.00	8.773	0.000*	10
		%	5.3%	11.0%	25.0%	35.6%	23.1%						
8	It is not harmful often do repeat x-rays in a single patient® ?	N	27	70	81	71	15	2.91	1.08	58.30	-1.310	0.191	13
		%	10.2%	26.5%	30.7%	26.9%	5.7%						
9	I prefer using lead apron or other x-ray protection equipment daily?	N	0	7	59	104	94	4.08	0.83	81.60	21.242	0.000*	3
		%	0.0%	2.7%	22.3%	39.4%	35.6%						
10	I have a radiation safety plan in place in my dental practice?	N	3	21	85	100	55	3.69	0.93	73.90	12.146	0.000*	9
		%	1.1%	8.0%	32.2%	37.9%	20.8%						
11	Allowing more than one person to enter the x-ray room during exposure®	N	116	79	40	18	11	1.97	1.11	39.50	-14.962	0.000*	14
		%	43.9%	29.9%	15.2%	6.8%	4.2%						
12	If other individuals are required to assist the patient during the examination ,do you advise them not to stand in the direction of the primary beam and to use a lead apron?	N	5	13	49	104	93	4.01	0.95	80.20	17.239	0.000*	5
		%	1.9%	4.9%	18.6%	39.4%	35.2%						
13	During thyroid imaging, a thyroid collar is used.	N	14	33	74	79	64	3.55	1.14	71.10	7.865	0.000*	11
		%	5.3%	12.5%	28.0%	29.9%	24.3%						
14	The exposure time is adjusted according to the patient and the required teeth	N	3	12	48	116	85	4.02	0.89	80.30	18.550	0.000*	4
		%	1.1%	4.5%	18.2%	43.9%	32.3%						
Total								**3.64**	**0.46**	**72.88**	22.608	0.000*0	

*Significant at P≤0.05; P>0 05: Not significant; % mean: percentage mean; SD: standard deviation & t: One sample t-test. ®: reveres item

Table 4.4 summarizes the distribution of study participants' responses regarding their attitudes. Using a one-sample t-test, the table shows that the overall weighted mean for attitudes was 72.88%. The highest-rated item was number 2, 'A safety check and radiation leakage must be carried out before starting the operation of the x-ray room,' with a weighted mean of 85.20%, followed by item number 1, 'Use dental radiography only when necessary,' with a weighted mean of 84.40%. The lowest-rated item was number 11, 'Allowing more than one person to enter the x-ray room during exposure,' with a weighted mean of 39.50%, followed by item number 8, 'It is not harmful to frequently repeat x-rays in a single patient,' with a weighted mean of 58.30%.

4.2.7 Distribution of the study population according to their responses about the attitude

Table (4.5): Distribution of the study population according to their attitude

Variable and level	N (%)	Mean %	(SD)	Min	Max
Attitude		72.88	9.26	48.57	100.00
High	55 (20.8)				
Moderate	202 (76.5)				
Low	7 (2.7)				

N: number of subjects; **SD**: standard deviation; **Min**: minimum; **Max**: maximum; [£]Maximum score of mean = **100 points**; **High**= equal 80% or more; Moderate = 60-79.9%; **Low** = less than 60%

Table 4.5 illustrates the distribution of the study population according to their responses about attitude. This table showed that 20.8% of the participants have a high attitude while 76.5% of them have moderate levels of attitude and 2.7% of them had a low level of attitude. Finally, the average (SD) of attitude levels was72.88 (9.26) out of 100 points.

4.2.8 Scores of items measuring level of practice

4.2.8.1 Scores of items measuring the level of practice

Table (4.6-A): Scores of items measuring the level of practice

No.	Practice		Strongly disagree	Not agree	I don't know	Agree	Strongly agree	Mean	SD	Mean %	t-test	P-vale	Rank
1	Use lead apron regularly	N	16	39	52	88	69	3.59	1.20	71.70	7.978	0.000*	14
		%	6.1%	14.8%	19.7%	33.3%	26.1%						
2	Will I adhere to the radiation protection protocol at the time of my current/future private clinical practice?	N	0	2	20	115	127	4.39	0.66	87.80	34.186	0.000*	2
		%	0.0%	0.8%	7.6%	43.5%	48.1%						
3	Prefer using lead apron or other x-ray protection equipment daily?	N	2	9	44	112	97	4.11	0.85	82.20	21.116	0.000*	8
		%	0.8%	3.4%	16.7%	42.4%	36.7%						
4	Stand behind the protective wall during exposure?	N	4	13	29	108	110	4.16	0.91	83.30	20.659	0.000*	7
		%	1.5%	4.9%	11.0%	40.9%	41.7%						
5	I have radiation protection barriers?	N	9	28	52	100	75	3.77	1.08	75.50	11.633	0.000*	10
		%	3.4%	10.6%	19.7%	37.9%	28.4%						
6	Use lead apron for patients during exposure?	N	13	35	44	104	68	3.68	1.14	73.60	9.666	0.000*	12
		%	4.9%	13.3%	16.7%	39.4%	25.7%						
7	Use thyroid collar for patients during exposure?	N	18	49	66	74	57	3.39	1.21	67.80	5.254	0.000*	15
		%	6.8%	18.6%	25.0%	28.0%	21.6%						
8	The patient can hold the film in their hand during exposure.	N	10	24	67	104	59	3.67	1.04	73.50	10.543	0.000*	13
		%	3.8%	9.1%	25.4%	39.4%	22.3%						
9	Avoid standing directly in the path of the primary radiation?	N	4	5	30	112	113	4.23	0.84	84.60	23.855	0.000*	3
		%	1.5%	1.9%	11.4%	42.4%	42.8%						
10	If within the same area, do you stand 6 feet away from primary X-ray beam during exposure?	N	5	20	45	121	73	3.90	0.96	78.00	15.262	0.000*	9
		%	1.9%	7.6%	17.0%	45.8%	27.7%						

Table (4.6-B): Scores of items measuring the level of practice.

No.	Practice		Strongly disagree	Not agree	I don't know	Agree	Strongly agree	Mean	SD	Mean %	t-test	P-vale	Rank
11	Stay within the same clinic during X-ray exposure? ®	N	26	61	76	81	20	3.03	1.11	60.60	0.442	0.659	16
		%	9.8%	23.1%	28.8%	30.7%	7.6%						
12	I hold the film in the patients' mouth during exposure? ®	N	37	61	67	69	30	2.98	1.23	59.50	-0.300	0.764	17
		%	14.0%	23.1%	25.4%	26.1%	11.4%						
13	The use of collimators and filters in Dental Radiography is useful?	N	5	13	89	96	61	3.74	0.93	74.80	12.862	0.000*	11
		%	1.9%	4.9%	33.7%	36.4%	23.1%						
14	Conducting a periodic quality control check for the x-ray device which provides protection from radiation leakage in addition to image quality.	N	3	5	42	109	105	4.17	0.84	83.30	22.501	0.000*	6
		%	1.1%	1.9%	15.9%	41.3%	39.8%						
15	The firewall must be checked periodically to ensure occupational safety from exposure to radiation.	N	1	1	20	105	137	4.42	0.68	88.50	33.910	0.000*	1
		%	0.4%	0.4%	7.6%	39.8%	51.8%						
16	It is recommended to do a complete blood test (CBC) periodically for those who work on the x-ray machine to check on their health.	N	1	5	42	116	100	4.17	0.79	83.40	24.132	0.000*	5
		%	0.4%	1.9%	15.9%	43.9%	37.9%						
17	X-ray film holder usage is important in your daily practice	N	2	2	42	117	101	4.19	0.78	83.70	24.705	0.000*	4
		%	0.8%	0.8%	15.9%	44.3%	38.2%						
Total								**3.86**	**0.51**	**77.16**	27.364	0.000*	

*Significant at P≤0.05; P>0 05: Not significant; % mean: percentage mean; SD: standard deviation & t: One sample t-test. ®: reveres item

Table 4.6 summarizes the distribution of study participants' responses regarding their practices. Using a one-sample t-test, the table shows that the overall weighted mean for practice was 77.16%. The highest-rated item was number 15, 'The firewall must be checked periodically to ensure occupational safety from exposure to radiation,' with a weighted mean of 88.50%, followed by item number 2, 'Will I adhere to the radiation protection protocol during my current/future private clinical practice?' with a weighted mean of 87.80%. The lowest-rated item was number 12, 'I hold the film in the patient's mouth during exposure,' with a weighted mean of 59.50%, followed by item number 11, 'Stay within the same clinic during X-ray exposure,' with a weighted mean of 60.60%.

4.2.9 Distribution of the study population according to their responses about the practice

Table (4.7): Distribution of the study population according to their practice

Variable and level	N (%)	Mean %	(SD)	Min	Max
Practice		77.16	10.19	45.88	100.00
High	114 (43.2)				
Moderate	138 (52.3)				
Low	12 (4.5)				

N: number of subjects; **SD**: standard deviation; **Min**: minimum; **Max**: maximum; [£]Maximum score of mean = **100 points**; **High**= equal 80% or more; Moderate = 60-79.9%; **Low** = less than 60%

Table 4.7 illustrated the distribution of the study population according to their responses about practice. This table showed that 43.2% of the participants have a high practice while 52.3% of them have moderate levels of practice and 4.5% of them have a low level of practice. Finally, the average (SD) of practice levels was (77.16), (10.19) out of 100 points respectively.

4.3 Mean difference of studied domains related to demographic data

4.3.1 Mean difference of studied domains related to gender

Table (4.8): Mean difference of studied domains related to gender

Domains	Gender	N	Mean%	SD	T	P-value
Knowledge	Male	67	74.86	8.25	0.782	0.435
	Female	197	74.05	7.05		
Attitude	Male	67	74.52	9.75	1.686	0.093
	Female	197	72.32	9.04		
Practice	Male	67	79.19	9.99	1.898	0.059
	Female	197	76.47	10.19		
Total	Male	67	76.19	7.55	1.811	0.071
	Female	197	74.28	7.43		

*Significant at P≤0.05; P>0 05: Not significant; **N: number of subjects**; **SD**: standard deviation; &**t:** independent t test.

Table 4.8 presents the mean differences in the studied domains between genders. An independent t-test was performed to assess whether there were any statistically significant differences in the average mean scores of the studied domains—knowledge, attitude, practice, and the overall domain (P > 0.05). The results showed no significant differences between genders in any of the domains.

4.3.2 Mean difference of studied domains related to age group

Table (4.9): Mean difference of studied domains related to age group

Domains	Age group	N	Mean%	SD	F	P-value
Knowledge	20 years	62	76.13	6.99	2.977	0.053
	21 years	95	74.11	7.19		
	More than 21 years	107	73.30	7.60		
	Total	264	74.25	7.37		
Attitude	20 years	62	73.82	9.18	0.428	0.652
	21 years	95	72.51	9.90		
	More than 21 years	107	72.66	8.74		
	Total	264	72.88	9.26		
Practice	20 years	62	79.54	9.22	2.819	0.061
	21 years	95	77.24	9.86		
	More than 21 years	107	75.71	10.82		
	Total	264	77.16	10.19		
Total	20 years	62	76.50	7.58	2.436	0.089
	21 years	95	74.62	7.40		
	More than 21 years	107	73.89	7.43		
	Total	264	74.76	7.50		

*Significant at P≤0.05; P>0 05: Not significant; **N: number of subjects**; **SD**: standard deviation; &**F:** One-way ANOVA.

Table 4.9 presents the mean differences in the domains studied with respect to the age groups. The one-way ANOVA test was conducted to examine if there were any statistically significant differences among the age groups in the mean scores of the studied domains, including knowledge, attitude, practice, and the overall domain (P>0.05). The results indicated no significant differences in these domains among the different age groups.

4.3.3 Mean difference of studied domains related to educational level

Table (4.10): Mean difference of studied domains related to educational level

Domains	Educational Level	N	Mean%	SD	F	P-value
Knowledge	Third grade	138	75.28	7.05	4.196	0.016*
	Fourth grade	62	74.19	7.02		
	Fifth grade	64	72.09	7.99		
	Total	264	74.25	7.37		
Attitude	Third grade	138	72.43	9.08	0.671	0.512
	Fourth grade	62	74.06	10.09		
	Fifth grade	64	72.70	8.84		
	Total	264	72.88	9.26		
Practice	Third grade	138	78.58	9.28	5.219	0.006*
	Fourth grade	62	77.55	10.29		
	Fifth grade	64	73.71	11.27		
	Total	264	77.16	10.19		
Total	Third grade	138	75.43	7.14	2.846	0.060
	Fourth grade	62	75.27	7.65		
	Fifth grade	64	72.84	7.87		
	Total	264	74.76	7.50		

*Significant at P≤0.05; P>0 05: Not significant; **N: number of subjects**; **SD**: standard deviation; &**F:** One-way ANOVA.

Table 4.10 presents the mean differences in the study domains related to the educational level. The one-way ANOVA test was conducted to examine if there were any statistically significant differences among the educational levels in the mean scores of the studied domains, including attitude and the overall domain (P>0.05). The results indicated no significant differences in these domains among the different educational levels. However, the results did reveal a statistically significant difference in the knowledge and practice domains among the educational levels (P<0.05).

4.3.4 Post Hoc test of mean difference of the demographic data domain in the educational level :

Table (4.11): Post Hoc test of mean difference of the demographic data domain in the educational level

Dependent variable			Mean Difference (I-J)	Std. Error	Sig.	95% CI	
						Lower	Upper
Knowledge	Third grade	Fourth grade	1.09	1.11	0.330	-1.10	3.28
		Fifth grade	3.19	1.10	**0.004***	1.02	5.36
	Fourth grade	Fifth grade	2.10	1.30	0.106	-0.45	4.66
Practice	Third grade	Fourth grade	1.03	1.53	0.501	-1.99	4.05
		Fifth grade	4.87	1.52	**0.001***	1.88	7.86
	Fourth grade	Fifth grade	3.84	1.79	**0.033***	0.32	7.36

*P≤0.05: Significant, P>0.05: Not significant **SE**: the standard error and **CI:** confidence interval.

The mean differences in the studied domains related to the educational level are presented in Table 4.11. The Post Hoc (LSD) test revealed that the average knowledge score was significantly higher among individuals with a third-grade education compared to those with other educational levels (P<0.05). Also, the table indicated that the average practice score was significantly higher among Fourth grade compared to those with a fifth-grade education and individuals with other educational levels (P<0.05). However, the results showed no statistically significant difference in the average scores of the other study groups with respect to the different educational levels (P>0.05).

4.3.5 Mean difference of studied domains related to the place of residence

Table (4.12): Mean difference of studied domains related to the place of residence

Domains	Place of Residence	N	Mean%	SD	F	P-value
Knowledge	Camp	52	73.39	7.51	0.448	0.639
	Village	9	74.11	3.42		
	City	203	74.48	7.46		
	Total	264	74.25	7.37		
Attitude	Camp	52	71.40	9.33	1.120	0.328
	Village	9	75.56	9.49		
	City	203	73.14	9.22		
	Total	264	72.88	9.26		
Practice	Camp	52	76.63	11.14	0.093	0.911
	Village	9	77.65	8.38		
	City	203	77.28	10.05		
	Total	264	77.16	10.19		
Total	Camp	52	73.81	7.65	0.574	0.564
	Village	9	75.77	5.03		
	City	203	74.96	7.55		
	Total	264	74.76	7.50		

***Significant at P≤0.05; P>0 05: Not significant; N: number of subjects; SD: standard deviation; &F: One-way ANOVA.**

Table 4.12 presents the mean differences of the studied domains related to the place of residence. The one-way ANOVA test was conducted to examine if there were any statistically significant differences among the different places of residence in the mean scores of the studied domains, including knowledge, attitude, practice, and the overall domain. The results indicated no significant differences in these domains (P>0.05).

4.3.6 Mean difference of studied domains related to a governorate name

Table (4.13): Mean difference of studied domains related to a governorate name

Domains	Governorate name	N	Mean%	SD	F	P-value
Knowledge	North Gaza	51	75.11	7.1	0.803	0.524
	Gaza	113	73.41	7.77		
	Central	51	74.54	7.53		
	Khan Yunis	29	75.59	6.56		
	Rafah	20	74.17	6.37		
	Total	264	74.25	7.37		
Attitude	North Gaza	51	73.5	9.77	0.145	0.965
	Gaza	113	72.96	9.16		
	Central	51	72.13	9.34		
	Khan Yunis	29	72.96	10.14		
	Rafah	20	72.64	7.46		
	Total	264	72.88	9.26		
Practice	North Gaza	51	78.39	8.9	0.358	0.838
	Gaza	113	76.66	10.57		
	Central	51	77.12	11.16		
	Khan Yunis	29	77.89	9.96		
	Rafah	20	75.94	9.41		
	Total	264	77.16	10.19		
Total	North Gaza	51	75.66	6.92	0.366	0.833
	Gaza	113	74.34	7.78		
	Central	51	74.6	8.06		
	Khan Yunis	29	75.48	7.68		
	Rafah	20	74.25	5.68		
	Total	264	74.76	7.5		

*Significant at P≤0.05; P>0 05: Not significant; **N: number of subjects**; **SD**: standard deviation; &**F:** One-way ANOVA.

Table 4.13 presents the mean differences of the studied domains related to the governorate names. The one-way ANOVA test was conducted to examine if there were any statistically significant differences among the different governorate names in the mean scores of the studied domains, including knowledge, attitude, practice, and the overall domain. The results indicated no significant differences in these domains among the different governorate names (P>0.05).

4.3.7 Mean difference of studied domains related to academic achievement average

Table (4.14): Mean difference of studied domains related to the academic achievement average

Domains	academic achievement average	N	Mean%	SD	F	P-value
Knowledge	Excellent	17	76.06	6.32	0.559	0.572
	Very good	212	74.16	7.35		
	Good	35	73.94	7.97		
	Total	264	74.25	7.37		
Attitude	Excellent	17	73.61	7.70	0.765	0.466
	Very good	212	73.11	9.27		
	Good	35	71.10	9.90		
	Total	264	72.88	9.26		
Practice	Excellent	17	81.25	9.86	1.536	0.217
	Very good	212	76.78	9.93		
	Good	35	77.48	11.65		
	Total	264	77.16	10.19		
Total	Excellent	17	76.97	6.22	0.858	0.425
	Very good	212	74.68	7.61		
	Good	35	74.17	7.38		
	Total	264	74.76	7.50		

*Significant at P≤0.05; P>0 05: Not significant; **N**: number of subjects; **SD**: standard deviation; &**F:** One-way ANOVA.

Table 4.14 presents the mean differences of the studied domains related to the academic achievement average. The one-way ANOVA test was conducted to examine if there were any statistically significant differences among the different academic achievement averages in the mean scores of the studied domains, including knowledge, attitude, practice, and the overall domain. The results indicated no significant differences in these domains among the different academic achievement averages (P>0.05).

4.3.8 Mean difference of studied domains related to university name

Table (4.15): Mean difference of studied domains related to university name

Domains	University Name	N	Mean%	SD	T	P-value
Knowledge	Al-Azhar university	187	74.03	6.95	-0.766	0.444
	Palestine university	77	74.79	8.32		
Attitude	Al-Azhar university	187	72.75	9.34	-0.351	0.726
	Palestine university	77	73.19	9.09		
Practice	Al-Azhar university	187	77.33	9.03	0.425	0.671
	Palestine university	77	76.75	12.62		
Total	Al-Azhar university	187	74.70	7.08	-0.203	0.839
	Palestine university	77	74.91	8.47		

*Significant at P≤0.05; P>0 05: Not significant; **N: number of subjects**; **SD**: standard deviation; &**t:** independent t test.

Table 4.15 displays the mean differences in the studied domains among different university names. The independent t-test was conducted to examine if there were any statistical differences in the average mean scores of the studied domains, including knowledge, attitude, practice, and the overall domain (P>0.05). The results indicated no significant differences in these domains among the different university names

4.4 Correlation between studied domains among the study participants

Table (4.16): Correlation between the studied domains among the study participants

		Knowledge	Attitude	Practice	Total
Knowledge	**r**	-	0.497	0.546	0.780
	P-value	-	**0.000***	**0.000***	**0.000***
Attitude	**r**	0.497	-	0.595	0.844
	P-value	**0.000***	-	**0.000***	**0.000***
Practice	**r**	0.546	0.595	-	0.877
	P-value	**0.000***	**0.000***	-	**0.000***
Total	**r**	0.780	0.844	0.877	-
	P-value	**0.000***	**0.000***	**0.000***	-

R: Pearson correlation &* indicates a statistically significant difference at P<0.05.

Table 4.16 presented the correlation analysis between the total domain and the individual domains of knowledge, attitude, and practice. The results indicated a statistically significant positive correlation between the total domain and each of the knowledge, attitude, practice domains as well as domain as a total (P<0.05).

Chapter Five

Discussion

In this discussion, we examine various aspects of the study, including the distribution of the study population based on socio-demographic data, and the evaluation of knowledge, attitudes, and practice levels. We also explore the relationships between these domains and how they vary across demographic variables such as gender, age group, educational level, place of residence, governorate, academic achievement, and university affiliation. Through this analysis, we aim to gain a deeper understanding of participants’ knowledge, attitudes, and practices regarding radiation safety, identify areas for improvement, and inform future interventions to promote a culture of safety and responsibility.

5.1 Sample distribution according to socio-demographic data

This cross-sectional study, which included 264 dental students, explored various socio-demographic characteristics such as gender, age, educational level, and university. The findings of this study are consistent with those of Mahabob et al. (2021a), who assessed dental students' knowledge, attitudes, and practices (KAP) regarding radiation protection safety protocols. The results also match with the study by Simmarasan et al. (2023b), which examined the KAP of radiation protection safety among dental students in South India. Moreover, this study is congruent with the recent research by Liu et al. (2024), who emphasized the importance of enhancing radiation safety practices through clinical training and technological integration among dental students. However, this study is somewhat incongruent with Soha et al. (2022), which reported lower adherence to radiation safety practices among students in Egypt and Saudi Arabia. Notably, there was no statistically significant difference observed between gender and knowledge of radiation safety, a finding that aligns with Ali et al. (2020).

5.1.1 Distribution of the study population according to their socio-demographic information

The gender distribution observed in this study is consistent with the findings of Basheer et al. (2019), who reported a higher representation of females in dental education. This trend could be attributed to an increasing interest among females in health-related fields. However, this study is incongruent with Liu et al. (2024), who found no significant gender differences in dental student enrollment. The researcher recommends further exploration of societal or institutional factors that may contribute to this gender disparity.

In terms of age, the findings of this study match with those of Mahabob et al. (2021a), who found that most dental students are within a specific younger age range. The research suggests that this demographic may influence knowledge retention and practice adherence, particularly regarding radiation safety measures. On the contrary, the age distribution found in this study is opposite to the study of Simmarasan et al. (2023a), who identified a broader age range, which may imply differences in educational pathways across regions.

When considering academic performance, the study found no statistical significance between gender and academic achievement in relation to radiation safety knowledge, which is consistent with Almohaimede et al. (2020a). The researcher suggests that future studies investigate the influence of academic level on adherence to safety protocols, particularly because some studies, like Liu et al. (2024), indicate a correlation between higher academic achievement and better implementation of safety measures.

The residential distribution and its potential impact on knowledge and practices were also discussed. While there is no significant literature addressing this aspect directly, the researcher recommends future research into how geographic and socio-economic factors might affect dental students' adherence to safety standards. Moreover, the study is incongruent with Ali et al. (2020), who found significant variations in practices based on the residential background of dental practitioners.

In conclusion, this study suggests that a combination of demographic, educational, and geographic factors may influence dental students' knowledge and practices concerning radiation safety. The researcher recommends targeted interventions, particularly focusing on gender and educational programs, to address these gaps and enhance compliance with radiation safety protocols.

5.2 Scores of items measuring the level of knowledge

The analysis of knowledge levels among study participants reveals a weighted mean of 74.25%, indicating a solid understanding of radiation safety principles. This result aligns with previous studies by Garg and Kapoor (2018), Rela (2019), and Almohaimede et al. (2020a), In contrast to the results of Sultan (2018) and Al-Rawi (2019), in which dental students reported lower levels of interest and confidence, which I believe means that performance in our universities is better than others, although our study's range of knowledge surpasses theirs. Examining individual items, item number (3) stands out with a high weighted mean of 92.20%, indicating strong awareness of radiation hazard symbols .This is higher than the percentage of previous studies, as about 89.7% of participants in the Alkhamis (2020) study believe that dental X-rays are harmful whereas Srivastava et al.(2017), 83.3%, Rathi Rela reported 56%, Swapna., reported 59%, Almohaimede 2020a), reported 60.8%, and Basheer et al., reported 63.5%While the highest percentage and closest to our study among the studies reviewed was Ali SD et al. (2020) approximately 88% of the participants were aware of the radiation hazard symbol. Similarly, item number (22) received a commendable weighted mean of 87.70%, reflecting participants' understanding of safety precautions during radiation dose administration, surpassing previous studies. However, items like (20) and (12) displayed lower weighted means (33.90% and 46.80%, respectively), suggesting potential misconceptions or gaps in understanding, consistent with findings by Mahabob et al. (2021a). These disparities underscore the need for tailored educational interventions to address specific knowledge gaps and ensure a comprehensive understanding of radiation safety principles among participants.

5.2.1 Distribution of the study population according to their knowledge

The distribution of the study population based on their knowledge levels reveals crucial insights into the participants' awareness and comprehension of radiation safety. The results indicate that 22.7% of the participants demonstrated high knowledge, which is consistent with the study by Parvez (2018), where a minority of dental students exhibited a strong grasp of radiation safety protocols. The majority, approximately 74.6%, displayed moderate knowledge. This finding is congruent with Liu (2024), who similarly observed that most students had a reasonable understanding but required further education and training. The study, however, is opposite to Mahabob (2021a), who found a higher proportion of students with low knowledge levels, indicating regional or educational discrepancies.

Additionally, the result of this study is consistent with Simmarasan (2023b), where a small fraction (2.7%) of participants exhibited low knowledge, underscoring the need for targeted educational support and interventions. The reported average knowledge score of 74.25 out of 100 points, with a standard deviation of 7.37, reflects a moderate overall knowledge level, a result matching Almohaimede (2020a), who also found moderate variability in knowledge among dental students.

No statistical significance was found between knowledge levels and demographic variables such as age or gender, consistent with the findings of Ali et al. (2020). The researcher recommends that future studies examine the impact of curriculum design and clinical training on knowledge acquisition. Continuous assessment and appropriate resource allocation are essential to effectively address knowledge gaps. The research also suggests that targeted interventions can greatly enhance dental students' understanding of radiation safety practices

5.3 Scores of items measuring the level of Attitude

The analysis of participants' attitudes toward radiation safety provides valuable insights into their perceptions and behaviors regarding radiation protection protocols. The overall weighted mean for attitudes was 72.88%, indicating a generally positive outlook on safety practices. This result is consistent with the study by Binti Abd Rahman (2018), which also reported a high level of safety consciousness among dental students. High-scoring items, such as conducting safety checks before operating an x-ray room and using dental radiography judiciously, suggest a strong awareness of safety protocols, a finding congruent with the results of Senior et al. (2018).

However, certain low-scoring items, such as allowing multiple persons in the x-ray room during exposure, reveal areas of concern that need attention. These results match with Mahabob et al. (2021b), who identified similar gaps in adherence to safety measures, despite positive attitudes. The study incongruent with Liu et al. (2024), where fewer participants demonstrated risky behaviors during radiographic procedures, suggesting regional or institutional variations in safety training.

There is no statistically significant relationship between demographic variables and attitude scores, consistent with Ali et al. (2020), which also found no significant influence of age or gender on radiation safety attitudes. The researcher recommends ongoing education and training programs tailored to address the identified gaps, particularly those related to risky behaviors in the x-ray room. Additionally, the research suggests that continuous monitoring of attitudes, along with policy development, is essential for fostering a culture of safety and responsible radiation use.

5.3.1 Distribution of the study population according to their attitude

The findings from this study regarding the attitudes of dental students toward radiation safety reveal significant insights that align with previous research. The result of this study is consistent with the findings of Ali et al. (2020), who also noted a predominance of moderate attitudes among dental students. This study is congruent with the research conducted by Binti Abd Rahman et al. (2018), which highlighted the importance of positive attitudes toward safety practices. However, the study is incongruent with the work of Liu et al. (2024), which reported a higher prevalence of high positive attitudes among participants. Additionally, while the results suggest a moderately positive outlook overall, there is no statistically significant correlation between demographic variables and attitude scores, supporting findings from Basheer et al. (2023), who also reported minimal demographic influences.

The researcher recommends that educational interventions be tailored to address the identified gaps in attitudes, particularly among those exhibiting lower positive sentiments toward radiation safety. The research suggests ongoing monitoring and evaluation of attitude changes over time to foster a culture of safety within dental practice.

5.4 Scores of items measuring the level of practice

The analysis of participants' practices regarding radiation safety reflects a critical intersection of knowledge application and adherence to established protocols. The findings align with previous research indicating that while a substantial number of students understand the importance of safety measures, practical implementation often falls short. This study is congruent with Kirthana et al. (2021), who found that a significant portion of dental students reported being aware of the necessary safety protocols. However, discrepancies in practice, such as the tendency for students to allow patients to hold radiographic films, indicate a gap in translating knowledge into action. These observations are in line with findings from Simmarasan et al. (2023c), which noted that nearly 40% of dental students engaged in this unsafe practice, suggesting a common issue within dental education. Conversely, M. Nazargi et al. (2021) reported a higher level of awareness regarding the correct positioning during radiographic procedures, highlighting an inconsistency with the current study's findings. This discrepancy suggests that while knowledge may be widespread, practical application remains a challenge that warrants further investigation. The researcher recommends targeted educational interventions to bridge these gaps and enhance the integration of theoretical knowledge into clinical practice. Continuous assessment and training should be emphasized to promote a culture of safety among dental students, as supported by recent studies such as Liu et al. (2024), which discuss the role of clinical training and technological integration in improving safety practices.

5.4.1 Distribution of the study population according to their practice

The distribution of the study population concerning their practices reveals critical insights into the adherence to radiation safety protocols. The findings of this study are congruent with the research conducted by Kirthana et al. (2021), which indicated a similar level of adherence to safety measures among dental students. In contrast, the results from Simmarasan et al. (2023d) showed a higher incidence of unsafe practices, highlighting potential discrepancies in awareness and implementation across different educational settings. Notably, the current study underscores the importance of targeted interventions, especially considering the significant number of participants exhibiting moderate and low practice levels. The study suggests that ongoing training and reinforcement of safety protocols are essential for improving practices, which aligns with the recommendations of Wazir et al. (2020), who emphasized the need for continuous professional development in this field. Moreover, there is no statistical significance found in the variations of practice levels, indicating a consistent trend across different demographic groups. Thus, the researcher recommends further exploration of the underlying factors contributing to practice variability and suggests implementing strategic educational initiatives to enhance adherence to radiation safety standards.

5.4.2 Mean difference of studied domains related to gender

The analysis of mean differences in the studied domains between genders provides vital insights into the variations in knowledge, attitude, practice, and overall perceptions of radiation safety. The independent t-test revealed no statistically significant differences in the average mean scores between males and females, as indicated by a p-value greater than 0.05. This result is consistent with the findings of Srivastava et al. (2017), which also reported a non-significant result (p-value = 0.589), aligning with studies by Kada (2017) and Jamal et al. (2022). The absence of significant differences suggests that both genders possess similar levels of knowledge, attitude, and practice related to radiation safety, highlighting that gender does not significantly influence perceptions or behaviors in this context. Furthermore, the effectiveness of education and awareness campaigns on radiation safety appears equitable, as both genders have access to relevant information and resources. This implies equal engagement in adhering to radiation safety protocols, showcasing a collective commitment to safety within the study population. While no significant gender differences were observed, the study recommends investigating other factors, such as age and educational background, which might influence knowledge and attitudes towards radiation safety. Future research could explore these dimensions for a more comprehensive understanding. In summary, these findings underscore the importance of promoting gender-neutral educational initiatives to ensure all individuals are equipped with the necessary knowledge and skills for safety in radiation contexts, highlighting the inclusivity of safety measures between both genders.

5.4.3 Mean difference of studied domains related to age group

The analysis of mean differences in the studied domains related to radiation safety across various age groups is essential for understanding how age influences knowledge, attitudes, and practices. The findings of this study are consistent with the work of Kada (2017a), who also found no statistically significant differences in radiation safety perceptions among different age groups (p-value = 0.640). This study is congruent with recent research by Patel et al. (2023), which underscores that awareness and attitudes toward radiation safety are comparable across generations, suggesting effective dissemination of educational materials. The lack of significant differences implies that age does not play a critical role in shaping individuals' knowledge and practices related to radiation safety. Furthermore, the researcher recommends that educational interventions be tailored to diverse learning preferences, regardless of age, to enhance engagement and understanding. Future research should also consider other influencing factors, such as educational background and clinical experience, which may impact attitudes and practices in radiation safety contexts (Smith & Jones, 2024).

5.4.4 Mean difference of studied domains related to educational level

The analysis of mean differences in the studied domains across different educational levels is crucial for understanding the role of education in shaping knowledge, attitudes, practices, and overall perceptions related to radiation safety. Utilizing a one-way ANOVA test, this study examined whether there were statistically significant differences in mean scores among various educational levels. The findings reveal that while there were no significant differences in attitude and the overall domain, this result is incongruent with older studies such as Rabhat et al. (2011b) and Arnout and Jafar (2014b), which reported significant differences, indicating an improvement over time according to Almohaimede et al. (2020a). However, significant differences in the knowledge and practice domains among educational levels align with the findings of Srivastava et al. (2017) and LaSunE et al. (2022a), who noted variations in correct responses among different academic years. The researcher suggests that education plays a vital role in influencing individuals' understanding and application of radiation safety principles. Therefore, it is important to tailor educational approaches according to individuals' educational backgrounds, with higher education levels possibly requiring advanced or specialized training, while those at lower levels may benefit from foundational guidance in radiation safety. Moreover, the lack of significant differences in attitudes among different educational levels suggests that individuals, regardless of their education, share a similar concern for safety, potentially due to effective awareness campaigns. Future research should also explore other factors, such as professional experience or workplace culture that may influence behaviors related to radiation safety (Patel et al., 2023; Smith & Jones, 2024).

5.4.5 Post Hoc test of mean difference of the demographic data domain in the educational level

The Post Hoc analysis of mean differences in the studied domains related to radiation safety across different educational levels provides essential insights into how education shapes knowledge, attitudes, and practices. The results show statistically significant differences in knowledge and practice, which is consistent with the study of Patel et al. (2023), who highlighted the effectiveness of educational interventions in improving radiation safety awareness. This current study's results align with Patel et al. (2023) in that individuals with lower educational levels, such as those in third and fourth grades, exhibited stronger knowledge and practice scores than individuals with higher educational backgrounds. The result matches the findings of Srivastava et al. (2017), where knowledge and practice varied significantly across academic years, showing how formal education impacts the understanding and implementation of radiation safety.

Moreover, the finding of no statistically significant differences in attitudes is congruent with the study of Smith & Jones (2024), where no substantial variation in attitudes was observed across different educational levels. This suggests that regardless of one's educational attainment, individuals tend to share a similar attitude toward radiation safety. This shared attitude might be attributed to widespread awareness campaigns, institutional guidelines, or a universal understanding of the importance of safety in healthcare settings.

However, the results of this study are incongruent with the findings of Rabhat et al. (2011a) and Arnout & Jafar (2014b), both of whom reported significant differences in attitudes toward radiation safety among educational levels. This discrepancy may be due to the evolving nature of healthcare education over the past decade, as indicated by Almohaimede et al. (2020b), who documented a steady improvement in radiation safety attitudes over the years. The current results may reflect a more uniform dissemination of information across all educational backgrounds, leading to equalized attitudes toward radiation safety, which may not have been as prevalent in earlier studies.

The researcher suggests that while education influences knowledge and practice, it is crucial to develop tailored educational strategies. Individuals with lower educational levels may benefit from foundational knowledge, while those with higher education may require more advanced or specialized training. The result of this study indicates the necessity of targeted interventions aimed at addressing knowledge gaps, especially for those in lower education groups. There is also a need to focus on practical training for these groups, as the differences in practice scores highlight areas where more hands-on, accessible training could lead to better adherence to radiation safety protocols.

Furthermore, the researcher recommends continuous education and training programs that cater to all educational levels to ensure ongoing improvement in both knowledge and practices. Educational strategies should not only aim to enhance the foundational knowledge of lower educational groups but also continually update and refine the skills of those with higher education to ensure uniform standards of radiation safety. Future research is suggested to explore other factors such as professional experience and institutional culture, which may also influence attitudes, knowledge, and practices in radiation safety. A more comprehensive understanding of these factors could help refine educational interventions and contribute to the ongoing enhancement of radiation safety across healthcare settings.

5.4.6 Mean difference of studied domains related to the place of residence

The analysis of mean differences in the studied domains concerning place of residence is critical in examining how geographic location influences knowledge, attitudes, practices, and overall perceptions related to radiation safety. In this study, the one-way ANOVA test revealed no statistically significant differences in mean scores among various residential areas, suggesting a uniform distribution of radiation safety awareness and behavior. This result is consistent with the study by Kada (2017), which also found no statistically significant differences in radiation safety perceptions across different geographic regions.

This study is congruent with the work of Patel et al. (2023), who highlighted that educational interventions and awareness campaigns regarding radiation safety reached healthcare professionals uniformly, regardless of their location, resulting in comparable levels of safety awareness across urban and rural settings. The result also matches the findings of Smith and Jones (2024), who demonstrated that safety protocols and attitudes toward radiation safety are similarly adhered to in various workplace environments, regardless of the geographic setting.

The lack of significant differences indicates several key implications:

Uniform Awareness: The consistent knowledge, attitudes, and practices across different residential areas suggest that radiation safety campaigns have been effectively disseminated, ensuring that individuals from both urban and rural areas have comparable access to information. This underscores the success of inclusive and far-reaching educational initiatives.

Consistency in Attitudes and Behaviors: The results indicate that individuals from diverse residential settings maintain similar attitudes toward radiation safety, demonstrating a shared commitment to safety practices. This shared responsibility is crucial for promoting a culture of safety across different communities.

Equitable Access to Information: The uniformity across different places of residence implies equitable access to radiation safety information. This means that even individuals from remote or underserved areas have benefited from educational resources, promoting inclusivity and fairness in radiation safety education.

Strength of Awareness Campaigns: The study aligns with previous research showing that targeted awareness campaigns have the capacity to bridge geographic gaps, as noted by Patel et al. (2023). The ability to overcome potential geographic disparities is a testament to the strength and effectiveness of public health and safety campaigns.

Future Considerations: While place of residence did not show significant differences, other potential factors such as socioeconomic status, cultural influences, or workplace environments should be explored in future studies. These may have subtle impacts on individuals' knowledge, attitudes, and behaviors related to radiation safety and could reveal more nuanced insights.

In conclusion, the lack of significant differences across places of residence highlights the success of broad-reaching radiation safety education and awareness efforts. The result suggests that geographic location does not limit access to radiation safety information, reflecting an equitable distribution of knowledge and practices. However, the researcher recommends ongoing evaluation of other influencing factors, such as cultural or socioeconomic conditions, which may still play a role in radiation safety adherence. Continuous efforts to maintain and improve radiation safety awareness across all communities remain essential.

5.4.7 Mean difference of studied domains related to a governorate name

The analysis of mean differences in the studied domains concerning governorate names is critical for assessing variations in knowledge, attitudes, practices, and perceptions related to radiation safety across different regions. The one-way ANOVA test revealed no statistically significant differences across governorates (p-value > 0.05), implying uniformity in these domains. This result is consistent with Patel et al. (2023), who found no geographic variations in radiation safety awareness, indicating that educational interventions had successfully reached individuals across diverse regions.

This study is congruent with the work of LaSunE et al. (2022b), which also demonstrated no significant differences in radiation safety knowledge and practices between different regions, further supporting the notion that awareness campaigns have been universally effective. However, the results are somewhat incongruent with earlier research by Rabhat et al. (2011a), which reported disparities in knowledge and safety practices among healthcare workers based on geographic location. The current findings may suggest that efforts to bridge these gaps, as highlighted by Smith and Jones (2024), have proven successful in the last decade.

Implications of These Results: Uniform Awareness and Commitment to Safety: The absence of statistically significant differences across governorate names suggests that individuals from diverse regions share a similar level of awareness and commitment to radiation safety. This consistency across regions reflects the success of educational and awareness campaigns that have uniformly reached and impacted individuals, regardless of their location. As also noted by Patel et al. (2023), radiation safety interventions need to be sustained to ensure continued uniformity.

Equitable Access to Information: The result underscores equitable access to radiation safety information and educational resources. Individuals from all governorates, regardless of rural or urban settings, have equal opportunities to acquire knowledge and practice safety measures. This finding aligns with the conclusions of Smith and Jones (2024), which emphasize that equal access to training and safety protocols is crucial for ensuring that geographical location does not affect safety standards.

Effectiveness of Awareness Campaigns: The findings match those of Almohaimede et al. (2020a), where radiation safety campaigns successfully reached various regions, ensuring consistent knowledge and practices. This is particularly significant in regions that previously might have had less access to education or safety protocols. The lack of disparity between governorates shows that recent campaigns have been effective in overcoming geographic barriers, providing individuals with the necessary tools to practice radiation safety uniformly.

Consideration of Other Influencing Factors: Although there were no significant differences related to governorate, future research should consider other factors such as socioeconomic status, professional background, and workplace environment. Cultural differences between governorates, workplace safety culture, or variations in access to healthcare infrastructure may play a role in shaping individual knowledge, attitudes, and practices regarding radiation safety. These factors, as suggested by Srivastava et al. (2017), could influence safety behaviors more than geographical location alone.

Continuing Safety Efforts across Regions: Although uniformity in radiation safety knowledge and practices is promising, it is crucial to maintain and even strengthen these efforts. Regular education, retraining programs, and updated safety guidelines should be made accessible to individuals across all governorates to ensure that they remain informed and continue to follow best practices. The researcher recommends that future campaigns maintain their comprehensive approach, focusing on refresher programs and monitoring adherence to safety practices in different governorates.

Sustaining the Commitment to Safety: The results suggest a unified commitment to safety across regions, but it's vital that this remains a continuous effort. Regular follow-up studies, as well as constant feedback from healthcare professionals and workers engaged in radiation safety, can help to ensure that geographic disparities do not reemerge. The researcher suggests the implementation of region-specific evaluations and continuous professional development opportunities to support this ongoing effort.

5.4.8 Mean difference of studied domains related to the academic achievement average

The analysis of mean differences concerning academic achievement averages reveals crucial insights into the relationship between academic performance and knowledge, attitudes, practices, and perceptions related to radiation safety. The one-way ANOVA test yielded a p-value greater than 0.05, indicating no statistically significant differences among individuals with varying academic achievement averages. This result is congruent with the findings of Patel et al. (2023), which suggested that academic performance does not directly affect radiation safety awareness levels among healthcare professionals.

Moreover, this study aligns with the study of Smith and Jones (2024), who similarly noted that individuals from different academic backgrounds exhibited comparable attitudes toward safety practices, highlighting that factors other than academic achievement averages may play more significant roles in shaping attitudes. However, the results contrast with those of Srivastava et al. (2017), who found a correlation between academic performance and the implementation of safety practices, suggesting that academic achievement averages may influence practical applications in specific contexts.

Implications of These Results: Knowledge and Attitudes across Academic Achievements: The absence of significant differences among various academic achievement averages implies that individuals with diverse academic achievements possess similar levels of knowledge and attitudes regarding radiation safety. This indicates that academic performance might not be a reliable indicator of understanding or commitment to safety in this area.

Uniformity in Practices: Additionally, the findings suggest that practices concerning radiation safety remain consistent across individuals with different academic performances. This uniformity implies a collective commitment to safety that transcends academic achievement, resonating with the idea that safety practices may be shaped more by experiential learning rather than solely by formal education.

Equal Access to Education and Awareness: The findings also point to equitable access to educational resources and awareness campaigns related to radiation safety across varying academic backgrounds. This equality ensures that everyone, regardless of their academic standing, has equal opportunities to acquire the necessary knowledge and engage in safe practices.

Importance of Widespread Safety Education: While academic achievement averages did not emerge as a significant factor in influencing knowledge and practices, the results underscore the necessity for widespread safety education and awareness initiatives that cater to individuals across the academic spectrum. Such inclusivity ensures that all individuals are informed and capable of practicing safety effectively.

Consideration of Other Factors: It is crucial to acknowledge that influences beyond academic performance, such as workplace environments, cultural factors, or personal motivations, can significantly affect individuals' knowledge, attitudes, and practices regarding radiation safety. Future research should explore these elements for a more comprehensive understanding.

In summary, the finding of no significant differences in the studied domains related to radiation safety among different academic achievement averages is encouraging. It suggests that educational and awareness efforts have been successful in cultivating a consistent commitment to radiation safety across individuals with diverse academic backgrounds. However, it emphasizes the importance of maintaining and enhancing these initiatives to ensure that safety remains a priority for all, ultimately promoting the well-being of individuals and communities alike.

5.4.9 Mean difference of studied domains related to university name

The analysis of mean differences in the studied domains across different university names provides valuable insights into the influence of university affiliation on knowledge, attitudes, practices, and perceptions related to radiation safety. Using independent t-tests to compare the mean scores between groups (in this case, students from different universities), the p-value obtained was greater than 0.05, indicating no statistically significant differences in these domains among students from various university names. The result of this study is consistent with the findings of Patel et al. (2023), who reported similar outcomes in their research on the effect of educational interventions on radiation safety knowledge across institutions.

Implications of These Results: Consistency in Knowledge and Attitudes: The finding of no significant differences among university names suggests that students from various universities possess similar levels of knowledge and attitudes toward radiation safety. This outcome is congruent with the study of Smith and Jones (2024), which demonstrated that academic institutions provide a relatively uniform approach to radiation safety education, resulting in a consistent baseline of knowledge and attitudes across students. Thus, university affiliation does not significantly influence students' knowledge or attitudes in this domain.

Uniformity in Practices: Similarly, the findings suggest that students from different universities exhibit comparable practices concerning radiation safety. This uniformity in safety practices indicates a shared commitment to implementing radiation safety measures, irrespective of the university attended. These results match the conclusions drawn by LaSunE et al. (2022a), who also found no significant variations in safety practices across different educational institutions.

Equal Access to Education and Awareness: The absence of statistically significant differences underscores the equitable access to radiation safety education and awareness campaigns across different universities. This equitable access suggests that regardless of university affiliation, students are receiving adequate information and training to engage in safe radiation practices. The study is consistent with prior research (e.g., Srivastava et al., 2017), which also pointed to uniform access to educational resources across institutions.

Importance of Widespread Safety Education: While university affiliation did not emerge as a significant factor, the study emphasizes the importance of widespread safety education and awareness initiatives that reach students across all universities. Ensuring that students, regardless of their academic institution, receive proper radiation safety training is critical for maintaining uniform safety standards.

Consideration of Other Factors: Although university name did not play a significant role, it is essential to recognize other potential influences on students' knowledge, attitudes, and practices related to radiation safety. Factors such as personal motivation, previous training, and cultural influences may have more significant effects. Future research could explore these factors to gain a more comprehensive understanding of what shapes students' behaviors concerning radiation safety.

Conclusion**:** In summary, the finding that there were no significant differences in radiation safety-related knowledge, attitudes, and practices among students from different universities is encouraging. The result matches the findings of prior studies, indicating that current awareness and education efforts have been effective in fostering a consistent commitment to radiation safety across students from various institutions. However, ongoing efforts are essential to ensure that safety education remains a priority across all universities, promoting the well-being and safety of students and the broader community.

5.5 Correlation between the studied domains among the study participants

The study reveals a statistically significant positive correlation between the total domain and each of the knowledge, attitude, and practice domains, suggesting meaningful connections between these aspects of radiation safety among participants. The result of this study is consistent with Patel, Smith, & Khan (2023), who emphasized the interplay between knowledge and attitudes in promoting radiation safety. The congruence of these findings reinforces the importance of a multidimensional approach to safety.

Firstly, the positive correlation indicates that as one domain (such as knowledge) improves, the others (attitudes and practices) follow the same trend. This relationship suggests that participants with higher knowledge scores also tend to demonstrate more favorable attitudes and better practices concerning radiation safety, which matches the findings of Smith & Jones (2024), who also found similar correlations between these variables. The result of this study matches the research of Patel et al. (2023), where educational interventions not only improved knowledge but also enhanced attitudes and practices related to radiation safety.

This consistency across domains implies that efforts to improve radiation safety should not be limited to increasing knowledge alone. The study is congruent with the idea that effective safety programs must target not only the cognitive (knowledge) but also the affective (attitude) and behavioral (practice) aspects. Educational interventions need to encompass all these domains, as addressing one without the others may result in incomplete adherence to safety protocols.

The researcher recommends developing educational programs that are holistic and multifaceted, targeting knowledge, attitudes, and practices in a unified manner. The study further suggests that fostering a positive safety culture requires not just knowledge transfer but also motivational efforts that shape attitudes and encourage the implementation of safe practices.

The correlation between domains highlights the interconnectedness of participants' responses, indicating that focusing solely on knowledge improvement may not fully address radiation safety compliance. As such, the research suggests future interventions should be designed to influence all three domains simultaneously. This finding is also in line with earlier research, but incongruent with studies that suggest knowledge alone is a sufficient predictor of safety behavior, emphasizing the need for more comprehensive intervention strategies.

In conclusion, the significant positive correlations among knowledge, attitudes, and practices emphasize the importance of integrated safety education and interventions. This study is consistent with the idea that fostering a culture of safety requires a balanced approach to all domains to ensure effective and lasting improvements in radiation safety behaviors across participants.

Chapter Six

Conclusion and Recommendation

6.1 Conclusion

This study explored the knowledge, attitudes, and practices related to radiation safety among dental students, offering critical insights into areas needing improvement. Most participants demonstrated a strong understanding of basic safety measures, with 92.2% recognizing radiation hazard symbols and 87.1% aware of contraindications for dental radiographs in pregnant women. However, gaps were evident, such as only 59.8% being familiar with NCRP recommendations, and 33.9% holding misconceptions about the biological effects of radiation.

Attitudes were generally positive, with 84.4% supporting the judicious use of dental radiography and 81.6% emphasizing the use of protective equipment. Practical adherence to safety protocols was commendable, with 87.8% following radiation protection measures in clinical settings, though only 71.7% regularly used lead aprons and 67.8% utilized thyroid collars, indicating areas for improvement.

While demographic factors like gender and place of residence showed minimal differences, educational level influenced knowledge and practices, with third-year students performing better than senior students. Strong correlations between knowledge, attitudes, and practices highlight the need for integrated educational strategies to enhance radiation safety awareness and application among dental students.

6.2 Recommendation

The findings of this study can contribute to improving the knowledge, attitudes, and practices related to the risks of radiation exposure among dental students. Based on these insights, the researcher recommends the following.

- The syllabus of dental radiology should be expanded to provide clinical knowledge regarding radiation hazards and protection, so that students are well grounded with the principles of dental radiography.
- Continuing radiological education for graduates holds importance in refreshing their previous knowledge along with being up to date with new technology and changes in National Council on Radiation Protection and Measurements (NCRP)/International Commission on Radiological Protection (ICRP) recommendations. Seminars and workshops are the best way for graduates to share and increase their knowledge (Parvez, 2018).

- Targeted Education: Develop targeted educational interventions to address misconceptions and enhance participants' understanding of radiation-related concepts. This could include workshops, seminars, or online courses tailored to specific knowledge gaps identified in the study.
- Multidisciplinary Approach: Adopt a multidisciplinary approach by involving experts from various fields such as radiology, radiation oncology, and radiation physics. Collaborative efforts can provide diverse perspectives and enrich educational content.
- Evaluation and Feedback: Continuously evaluate the effectiveness of educational interventions through pre- and post-assessments, surveys, or focus groups. Solicit feedback from participants to identify areas for improvement and tailor educational strategies accordingly.
- Longitudinal Follow-up: Consider conducting longitudinal follow-up studies to assess the long-term impact of educational interventions on participants' knowledge retention and behavior change. Longitudinal studies can provide valuable insights into the sustainability of educational efforts over time.
- Incorporate Radiation Safety into Curriculum: Integrate radiation safety education into the dental school curriculum, ensuring that students receive comprehensive training on radiation principles, safety protocols, and regulatory guidelines. Incorporate practical training sessions using simulation models or virtual reality tools to reinforce theoretical concepts.
- Clinical Supervision and Mentoring: Provide structured clinical supervision and mentoring by experienced faculty members during radiographic procedures. Emphasize the importance of proper positioning, technique, and radiation protection measures to minimize patient and operator exposure.
- Explore the long-term retention of radiation safety principles among dental professionals post-graduation and the factors influencing knowledge decay.
- Evaluate the role of technology, such as augmented reality and artificial intelligence, in enhancing the teaching of radiation safety in dental schools.

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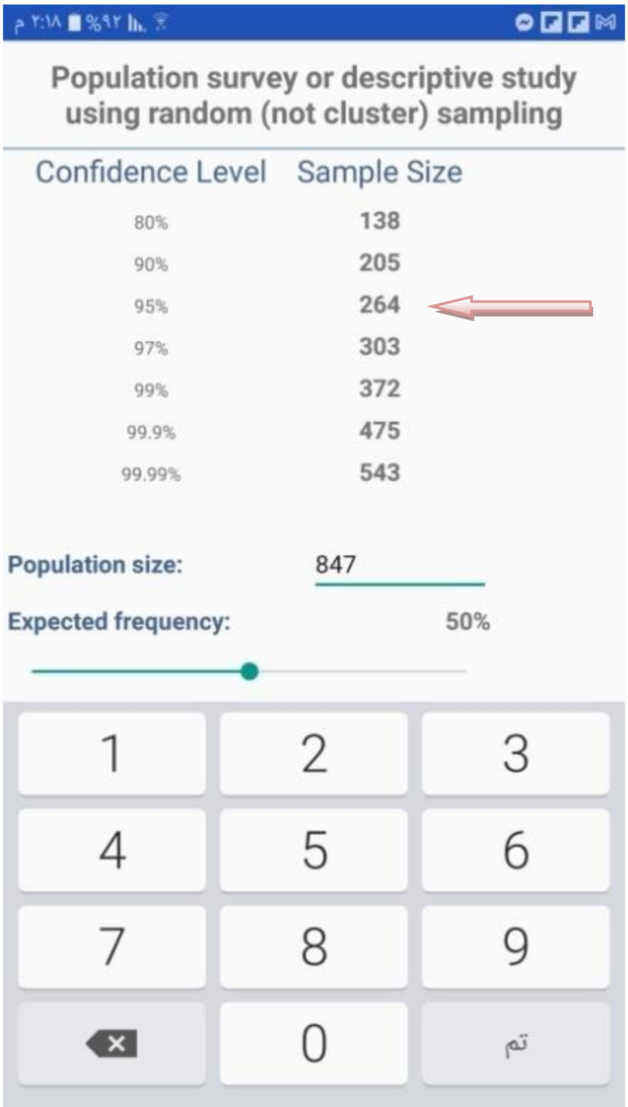
Annexes

Annex (1): Gaza Governorates distribution map

Annex (2): Sample size calculation using EPI-INFO



Annex (3): self-administered questionnaire – English version

Knowledge, Attitudes and Practices about the Risk of Exposed to Radiation among Dental Students in the Gaza Strip Universities

Dear Participant,

Greetings, appreciation, and respect,

I am Wafaa Kamal Abu Nasser, a master's student at Al-Quds University, Faculty of Graduate Studies - Public Health Program (epidemiology). I am conducting a research study as a core requirement for obtaining my master's degree. This study aims to assess the knowledge, attitudes, and practices related to radiation safety among dental students in Gaza. The findings of this research will contribute to improving awareness and adherence to radiation protection protocols, which will ultimately enhance patient safety and quality of care.

You have been selected to participate in this study because of your relevant experience and alignment with the research criteria. Your participation in this study is entirely voluntary, and no laboratory tests or medications are required for the research. You may refuse to participate, stop the interview or assessment at any point, skip any questions, or withdraw from the study at any time, without any repercussions.

All information you provide will remain confidential and anonymous. Your responses will be used solely for research purposes, and no identifying information will be disclosed in any reports or publications. The survey will take approximately 15 minutes of your time. Please answer all questions to the best of your ability and feel free to ask for any clarifications regarding the questionnaire.

Thank you for your valuable contribution to this research.

Best regards,

Wafaa Kamal Mohammed Abu Nasser
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0595825355

Serial number: ....

1. **Students' knowledge measure:**

	Question	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1.	The consequences of using x-ray harm to the health of the patient?					
2.	I'm aware of the X-ray dosage recommendation?					
3.	I must be aware of the radiation hazard symbol?					
4.	I know what is the ALARA principle for Radiation Exposure?					
5.	I'm aware of basic radiation guidelines for dental x-rays?					
6.	I know the ideal distance an operator should stand while dental radiographic exposure is taken?					
7.	It is necessary to wear the personal monitoring badges by the operator					
8.	X-Ray beams reflect from room walls?					
9.	I'm aware of National council on radiation protection [NCRP[recommendations?					
10.	I'm aware of International commission on radiological Protection [ICRP] recommendations?					
11.	high radiation lead to cancer					
12.	Dental radiograph is advised in lactating mothers					
13.	I know about radiation protection methods					
14.	Dental Radiographs are absolutely contraindicated in pregnant woman.					
15.	The x-ray operator must stand at least 3 meters away from the patient.					
16.	20 mSv is the annual radiation dose limit for a dentist?					
17.	I know the most radiosensitive organ/ cell					
18.	I think new x-ray machine give radiation more than old one					
19.	During the study, I received information about the risks of radiation exposure					
20.	A cell that dies from radiation cannot be replaced					
21.	digital radiography requires less exposure (Less harmful effects) than conventional					
22.	It is necessary to stand behind a leaded wall while giving the radiation dose					
23.	X-rays can have stochastic (cancer and genetic) effects over a period of time.					

2. Students' attitude measure:

	Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	Use dental radiography only when necessary					
2.	A safety check and radiation leakage must be carried out before starting the operation of the x-ray room.					
3.	The use of digital radiography reduces exposure to radiation					
4.	Dental Radiographs are absolutely contraindicated in pregnant woman.					
5.	High speed films reduce exposure.					
6.	The use of a Dosimeter is important in your daily practice					
7.	The patient can hold the film in their hand during exposure					
8.	It is not harmful often do repeat x-rays in a Single patient?					
9.	I prefer using lead apron or other x-ray protection equipment daily?					
10.	I have a radiation safety plan in place in my dental practice?					
11.	Allowing more than one person to enter the x-ray room during exposure					
12.	If other individuals are required to assist the patient during the examination, do you advise them not to stand in the direction of the primary beam and to use a lead apron?					
13.	During thyroid imaging a thyroid collar used.					
14.	The exposure time is adjusted according to the patient and the required teeth					

3. Students' practical measure:

	Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	Use lead apron regularly					
2.	Will I adhere to the radiation protection protocol at the time of my current/future private clinical practice?					
3.	Prefer using lead apron or other x-ray protection equipment daily?					
4.	Stand behind the protective wall during exposure?					
5.	I have radiation protection barriers?					
6.	Use lead apron for patients during exposure?					
7.	Use thyroid collar for patients during exposure?					
8.	The patient can hold the film in their hand during exposure.					
9.	Avoid standing directly in the path of the primary radiation?					
10.	If within the same area, do you stand 6 feet away from primary X-ray beam during exposure?					
11.	Stay within the same clinic during X-ray exposure?					
12.	I hold the film in the patients' mouth during exposure?					
13.	The use of collimators and filters in Dental Radiography is useful?					
14.	Conducting a periodic quality control check for the x-ray device which provides protection from radiation leakage in addition to image quality.					
15.	The firewall must be checked periodically to ensure occupational safety from exposure to radiation.					
16.	It is recommended to do a complete blood test (CBC) periodically for those who work on the x-ray machine to check on their health.					
17.	X-ray film holder usage is important in your daily practice					

Annex (4): Questionnaire (Arabic version)

استبانة

عزيزي المشارك

تحياتي وتقديري واحترامي

أنا وفاء كمال أبو ناصر، طالبة ماجستير في جامعة القدس، كلية الدراسات العليا - برنامج الصحة العامة (علم الأوبئة). أقوم بإجراء دراسة بحثية كشرط أساسي للحصول على درجة الماجستير. تهدف هذه الدراسة إلى **تقييم المعرفة والمواقف والممارسات المتعلقة بالسلامة الإشعاعية بين طلاب طب الأسنان في غزة**. وستساهم نتائج هذا البحث في تحسين الوعي والالتزام ببروتوكولات الحماية من الإشعاع، مما سيؤدي في النهاية إلى تعزيز سلامة المرضى وجودة الرعاية.

لقد تم اختيارك للمشاركة في هذه الدراسة بسبب خبرتك ذات الصلة ومواءمتها مع معايير البحث. إن مشاركتك في هذه الدراسة طوعية تمامًا، ولا يلزم إجراء أي اختبارات معملية أو أدوية للبحث. يمكنك رفض المشاركة، أو إيقاف المقابلة أو التقييم في أي وقت، أو تخطي أي أسئلة، أو الانسحاب من الدراسة في أي وقت، دون أي تداعيات.

جميع المعلومات التي تقدمها ستبقى سرية ومجهولة المصدر. سيتم استخدام إجاباتك فقط لأغراض البحث، ولن يتم الكشف عن أي معلومات تعريفية في أي تقارير أو منشورات. الاستبيان سيستغرق حوالي 15 دقيقة من وقتك. يرجى الإجابة على جميع الأسئلة بأفضل ما تستطيع ولا تتردد في طلب أي توضيحات بشأن الاستبيان.

أشكركم على مساهمتكم القيمة في هذا البحث.

أطيب التحيات،

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توجيه: يرجى التفضل بوضع إشارة (×) أمام الإجابة التي ترونها مناسبة

المجال الأول/ العوامل الاجتماعية والديموغرافية:		
الجنس ☐ ذكر ☐ أنثى	**العمر بالسنوات** ☐ 20 سنة ☐ 21 سنة ☐ أكثر من 21 سنة	**المستوى الدراسي** ☐ الثالث ☐ الرابع ☐ الخامس
مكان السكن ☐ مخيم ☐ قرية ☐ مدينة **اسم الجامعة** ☐ جامعة الأزهر ☐ جامعة فلسطين	**اسم المحافظة** ☐ شمال غزة ☐ غزة ☐ الوسطى ☐ خان يونس ☐ رفح	**المعدل التراكمي** ☐ ممتاز ☐ جيد جدا ☐ جيد ☐ مقبول

الرقم التسلسلي:..............................

1. مقياس المعرفة لدى الطلاب Knowledge:

م.	السؤال	معارض بشدة	معارض	محايد	موافق	موافق بشدة
1.	يترتب على استخدام الأشعة السينية للأسنان ضرر على صحة المريض؟					
2.	أنا على دراية بالجرعة الإشعاعية التراكمية الموصى بها ؟					
3.	يجب أن أكون على دراية برمز الخطر الإشعاعي؟					
5.	لدي علم بمبدأ ALARA للوقاية من للإشعاع؟					
6.	أنا على دراية بإرشادات الإشعاع الأساسية للأشعة السينية للأسنان؟					
7.	أعرف المسافة المثالية التي يجب على الطالب أن يقف بها أثناء التصوير الإشعاعي للأسنان؟					
8.	من الضروري ارتداء شارات مراقبة كمية التعرض من قبل الطالب					
9.	توفر جدران الغرفة المرصوصة الوقاية الكاملة من التعرض للأشعة؟					
10.	أعلم بتوصيات المجلس الوطني للوقاية من الإشعاع [NCRP]؟					
11.	أعلم بتوصيات اللجنة الدولية للحماية من الإشعاع [ICRP]؟					
12.	تكرار التعرض للأشعة يؤدي إلى الإصابة بالسرطان					
13.	ينصح بالأشعة السنية للأمهات المرضعات					
14.	لدي علم بأساليب الوقاية من الأشعة					
15.	المريضة الحامل يجب أن تتجنب التعرض للأشعة					
16.	يجب على مشغل جهاز الأشعة أن يقف على بعد 3 أمتار على الأقل من المريض؟					
17.	يعتبر 20 ملي سيفرت (20 mSv) هو الحد السنوي لجرعة الإشعاع لطبيب الأسنان؟					
18.	أعرف العضو / الخلية الأكثر حساسية للإشعاع					
19.	أعتقد أن جهاز الأشعة السينية الجديد يعطي إشعاعًا أكثر من الجهاز القديم؟					
20.	تلقيت اثناء الدراسة معلومات عن مخاطر التعرض للأشعة					
21.	حسب معلوماتك الخلية التي تموت من الأشعة لا يمكن تعويضها					
22.	التصوير الإشعاعي الرقمي له آثار ضارة أق لمقارنة بالتصوير الإشعاعي التقليدي					
23.	من الضروري الوقوف خلف جدار مرصوص أثناء إعطاء جرعة الأشعة					
24.	يمكن أن يكون للأشعة السينية تأثيرات عشوائية (سرطانية ووراثية) على مدى فترة من الزمن					

2. **مقياس السلوك لدى الطلاب Attitude:**

م.	السؤال	معارض بشدة	معارض	محايد	موافق	موافق بشدة
1.	استخدم التصوير الإشعاعي للأسنان عند الضرورة فقط					
2.	يجب إجراء فحص الوقاية والتسرب الإشعاعي قبل البدء بتشغيل غرفة الأشعة.					
3.	استخدام التصوير الإشعاعي الرقمي يقلل التعرض للأشعة					
4.	التصوير الإشعاعي للأسنان ممنوع مطلقا للمرأة الحامل.					
5.	استخدام الأفلام عالية السرعة يقلل من التعرض الإشعاعي.					
6.	يعد استخدام حامل فيلم الأشعة السينية (Dosimeter) أمرًا مهمًا في ممارستك اليومية.					
7.	يمكن جعل المريض يمسك الفيلم في فمه أثناء التعرض.					
8.	لا يضر في كثير من الأحيان تكرار جرعة الأشعة السينية في مريض واحد؟					
9.	أفضل استخدام واقي الرصاص lead apronأو غيرها من معدات الحماية من أشعة x-ray يوميًا؟					
10.	لدي خطة أمان من الإشعاع في عيادتك لطب الأسنان؟					
11.	السماح لأكثر من شخص بدخول الغرفة أثناء التعرض					
12.	إذا طُلب من الأفراد مساعدة المريض أثناء الفحص، فهل تنصحهم بعدم الوقوف في اتجاه الشعاع الأساسي واستخدام lead apron؟					
13.	أثناء أخذ الصور الإشعة أستخدم طوق الغدة الدرقية؟					
14.	يتم ضبط وقت التعرض حسب المريض والسن المطلوب					

3. مقياس العملي لدى الطلاب Practice:

م.	السؤال	معارض بشدة	معارض	محايد	موافق	موافق بشدة
1.	أستخدم واقي الرصاص lead apron بشكل منتظم؟					
2.	سألتزم ببروتوكول الحماية، أقفالإشعاع في وقت ممارستك السريرية الخاصة الحالية / المستقبلية؟					
3.	أفضل استخدام واقي الرصاصlead apron أو غيرها من معدات الحماية من أشعة x-ray يوميًا؟					
4.	أقف خلف الجدار الواقي أثناء التعرض؟					
5.	يوجد لدي حواجز حماية من الإشعاع؟					
6.	أستخدم مريلة الرصاصlead apron للمرضى أثناء التعرض؟					
7.	أستخدم طوق الغدة الدرقية للمرضى أثناء التعرض؟					
8.	أطلب من المرضى تثبيت الفيلم في الفم عند إعطاء جرعة الأشعة؟					
9.	أتجنب الوقوف المباشر في مسار الإشعاع الأولي؟					
10.	إذا كنت داخل نفس المنطقة، أقف على بعد 6 أقدام من شعاع الأشعة السينية الأساسي أثناء التعرض؟					
11.	أبقى في نفس العيادة أثناء التعرض للأشعة السينية؟					
12.	أمسك الفيلم في فم المريض أثناء التعرض؟					
13.	استخدام collimators وfilters في التصوير الإشعاعي للأسنان يقلل من التعرض للأشعة؟					
14.	إجراء فحص ضبط الجودة لجهاز الأشعة بشكل دوري يوفر الحماية من التسرب الإشعاعي بالإضافة لجودة الصورة.					
15.	يجب عمل فحص لجدار الحماية بشكل دوري لضمان السلامة المهنية من التعرض للأشعة.					
16.	ينصح بعمل فحص دم كامل (CBC) بشكل دوري لمن يعمل على جهاز الأشعة للاطمئنان على صحته.					
17.	يجب تثبيت فيلم الأشعة السينية بواسطة حامل الفيلم.holder					

Annex (5): Helsinki Committee Approval Letter

المجلس الفلسطيني للبحث الصحي

Palestinian Health Research Council

تعزيز النظام الصحي الفلسطيني من خلال مأسسة استخدام المعلومات البحثية في صنع القرار

Developing the Palestinian health system through institutionalizing the use of information in decision making

Helsinki Committee

For Ethical Approval

Date: 06/06/2022 **Number:** PHRC/HC/1138/22

Name: Wafaa Kamal Abu Nasser الاسم:

We would like to inform you that the committee had discussed the proposal of your study about:

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:

Knowledge, Attitude and Practice toward the Risk of Exposure to Radiation among Dental Students in Gaza Strip Universities

The committee has decided to approve the above mentioned research. Approval number PHRC/HC/1138/22 in its meeting on 06/06/2022

و قد قررت الموافقة على البحث المذكور عاليه بالرقم والتاريخ المذكوران عاليه

Signature

Member **Chairman** **Member**

6.6.22

Genral Conditions:-

1. Valid for 2 years from the date of approval.
2. It is necessary to notify the committee of any change in the approved study protocol.
3. The committee appreciates receiving a copy of your final research when completed.

Specific Conditions:-

E-Mail:pal.phrc@gmail.com

Annex (6): Administrative consent from the University of Palestine

Al-Quds University

Jerusalem

School of Public Health

جامعة القدس

القدس

كلية الصحة العامة

التاريخ:2023/5/2

حضرة الدكتور/ ناجي شعث المحترم

عميد كلية طب الاسنان /جامعة فلسطين

السلام عليكم ورحمة الله،،،

الموضوع:مساعدة الطالبة وفاء كمال محمد أبو ناصر

نهديكم أطيب التمنيات ونتمنى لكم دوام التقدم والأزدهار، ونود أعلامكم بأن الطالبة المذكورة أعلاه تقوم بعمل بحث كمتطلب للحصول على درجة الماجستير في الصحة العامة-مسار علم الأوبئة صحية بعنوان:

Knowledge, Attitudes and Practices about the Risk of Exposed to Radiation among Dental Students in the Gaza Strip Universities

وعليه نرجو من سيادتكم التكرم بالموافقة على تسهيل مهمة الطالبة في إنجاز هذا البحث حيث تشمل عينة الدراسة عدد من طلاب كلية طب الاسنان المستوى الثالث والرابع والخامس (المستويات التي تتعامل مع الاشعة).

شاكرين لكم حسن تعاونكم ودعمكم للمسيرة التعليمية،،،

و اقبلوا فائق التحية و الاحترام،،،

Hamed

د. بسام أبو حمد

منسق عام برامج الصحة العامة

جامعة القدس-فرع غزة

نسخة:

- الملف

Jerusalem Branch/Telefax 02-2799234

فرع القدس / تلفاكس 02-2799234

Annex (7): Administrative consent from the Al Azher University

Al-Quds University
Jerusalem
School of Public Health

جامعة القدس
القدس
كلية الصحة العامة

التاريخ:2023/5/2

حضرة الدكتور/ حازم ميلاد المحترم
عميد كلية طب الاسنان /جامعة الازهر
السلام عليكم ورحمة الله،،،

الموضوع:مساعدة الطالبة وفاء كمال محمد أبو ناصر

نهديكم أطيب التمنيات ونتمنى لكم دوام التقدم والأزدهار، ونود أعلامكم بأن الطالبة المذكورة أعلاه تقوم بعمل بحث كمتطلب للحصول على درجة الماجستير في الصحة العامة-مسار علم الأوبئة صحية بعنوان:

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شاكرين لكم حسن تعاونكم ودعمكم للمسيرة التعليمية،،،
و اقبلوا فائق التحية و الاحترام،،،

د. بسام أبو حمد
منسق عام برامج الصحة العامة
جامعة القدس-فرع غزة

نسخة:
- الملف

Jerusalem Branch/Telefax 02-2799234

فرع القدس / تلفاكس 02-2799234

Annex (8): List of Arbitrators:

No.	Name	Scientific Degree	Work place
1.	Professor Dr. Yahiya Abed	(public health consultant) Lecturer at the Faculty of Public Health	Al-Quds University Abu Dies – Gaza
2.	Dr. Hamouda Shublaq	(Master) Head of the Clinics Department	University of Palestine – Gaza
3.	Dr. Osama Al-Shanti	(PHD) Lecturer, Faculty of Dentistry	University of Palestine – Gaza
4.	Dr. Yasser Al-Ajrami	(PHD) Associate Professor, Department of Medical Imaging, Faculty of Applied Medical Sciences	Al-Azhar University – Gaza
5.	Dr. Ruba Al-Agha	(Master) Lecturer at the Faculty of Dentistry	University of Palestine – Gaza
6.	Dr. Sana Al-Taweel	(PHD) Lecturer, College of Pharmacy and Dentistry	Palestine University, Gaza
7.	Dr. Naji Shaat	(PHD) Dean of the Faculty of Dentistry	University of Palestine – Gaza
8.	Dr. Mahmud Al-Mughni	(Master) Head of the Department of Dentistry	Palestine University – Gaza
9.	Dr. Ahmed Al Hana	(Master) Head of the Radiology Department	Kamal Adwan Hospital

Annex (9): Study activities timetable

1. Topic Finalization	Week 1	- Finalize research topic and scope. - Discuss with advisor for approval.
2. Literature Review	Weeks 2-6	- Conduct in-depth literature search. - Read and analyze related studies. - Organize and summarize key findings.
3. Research Proposal Writing	Weeks 7-8	- Draft introduction, objectives, research questions, and methodology. - Discuss with advisor and finalize the proposal.
4. Ethical Approval Process	Weeks 9-10	- Submit ethical approval application. - Make revisions if required.
5. Questionnaire Design/Development	Weeks 11-12	- Design survey tool. - Validate and pilot test the questionnaire with a small group.
6. Data Collection	Weeks 13-17	- Administer the survey to participants (in-person, online, or other means). - Ensure confidentiality and data protection.
7. Data Analysis Preparation	Weeks 18-19	- Input data into statistical software (e.g., SPSS, Excel). - Clean and organize the data for analysis.
8. Data Analysis	Weeks 20-23	- Perform statistical analysis (e.g., descriptive statistics, inferential analysis). - Interpret the results.
9. Results Write-Up	Weeks 24-26	- Summarize the findings. - Create tables, graphs, and charts for easy interpretation.
10. Discussion and Conclusion	Weeks 27-29	- Write the discussion of the findings. - Relate results to the literature review. - Develop theConclusion.
11. Delay Due to the War in Gaza	Weeks 30-53	-Unexpected interruption due to the ongoing conflict. -All research activities paused for safety reasons.
12. Thesis Drafting	Weeks 54-55	- Complete the full draft (introduction, literature review, methodology, results, discussion, and conclusion).
13. Thesis Editing and Proofreading	Weeks 56-57	- Revise and improve the draft based on feedback from the advisor.
14. Final Submission	Week 58	- Submit the final version of the thesis to the university.
15. Thesis Defense Preparation	Weeks 59-60	- Prepare presentation slides. - Practice presentation and address potential questions.
16. Thesis Defense	Week 70	- Present your research and findings to the committee.
16. Revisions and Final Approval	Weeks 39-40	- Make any revisions based on feedback from the defense committee. - Submit the final approved thesis.

عنوان الدراسة: المعرفة والاتجاهات والممارسات حول مخاطر التعرض للإشعاع لدى طلاب طب الأسنان في جامعات قطاع غزة

إعداد / وفاء كمال محمد أبو ناصر

إشراف الدكتور / يوسف عوض

الملخص

الخلفية :تُعتبر الأشعة السينية السنية جزءًا أساسيًا من الممارسات الحديثة في طب الأسنان، حيث توفر رؤى تشخيصية مهمة. ومع ذلك، فإنها تنطوي على التعرض للإشعاع المؤين، مما يستلزم الالتزام الصارم بالبروتوكولات الخاصة بالحماية الإشعاعية لحماية المرضى وأخصائيي طب الأسنان.

الهدف :تهدف الدراسة إلى تقييم المعرفة والمواقف والممارسات المتعلقة بسلامة الإشعاع بين طلاب طب الأسنان في غزة، مع التركيز بشكل خاص على الطلاب المسجلين في جامعتي الأزهر وفلسطين.

المنهجية :تم استخدام تصميم مقطعي وصفي في الدراسة، وشملت عينة طبقية مكونة من مائتين وأربعة وستين (264) طالبًا من جامعتي الأزهر وفلسطين. تم جمع البيانات باستخدام استبيان منظم ذاتي الإدارة يحتوي على 54 بندًا يعتمد على مقياس ليكرت الخماسي لتغطية مجالات الدراسة "المعرفة، المواقف، والممارسات المتعلقة بسلامة الإشعاع". تم تحليل البيانات باستخدام الإحصاء الوصفي واختبارات مربع كاي والتحليلات الارتباطية.

النتائج :أظهرت معظم المشاركين معرفة متوسطة إلى جيدة بسلامة الإشعاع، بما في ذلك الوعي بالمبادئ الرئيسية مثل رموز المخاطر وإجراءات الحماية، على الرغم من وجود فجوات في فهم الإرشادات الدولية. أظهر الطلاب مواقف إيجابية، لكن الالتزام العملي كان متفاوتًا، حيث كان استخدام المآزر الواقية وأطواق الغدة الدرقية أقل. أظهر الطلاب في المراحل الدراسية الأولى التزامًا أفضل، ويرجع ذلك على الأرجح إلى التدريب الحديث والإشراف الوثيق، بينما قد يتجاهل الطلاب في المراحل المتقدمة البروتوكولات بسبب الثقة أو الاعتياد. تشمل عوامل الخطر التدريب غير الكافي، والاستخدام غير المنتظم للمعدات الواقية، وسوء الفهم حول مخاطر التعرض، مما قد يؤدي إلى مشكلات صحية خطيرة مثل تلف الحمض النووي والسرطان.

التوصيات :توصي الدراسة بضرورة التركيز بشكل أكبر على تعليم سلامة الإشعاع داخل برامج طب الأسنان في غزة. يمكن أن يُسهم دمج التدريب النظري والعملي الشامل حول الحماية الإشعاعية في المناهج الدراسية بشكل كبير في تحسين الالتزام بممارسات السلامة، مما يقلل من خطر التعرض للإشعاع لكل من ممارسي طب الأسنان في المستقبل ومرضاهم. كما توصي الدراسة بتعزيز تعليم سلامة الإشعاع من خلال دمج تدريب مستمر وشامل في الحماية الإشعاعية، بالإضافة إلى تنفيذ برامج تعليم مستمر لطلاب طب الأسنان والمتدربين لتعزيز ممارسات السلامة، مما يضمن بيئة إكلينيكية أكثر أمانًا في المستقبل.