

**Deanship of Graduate Studies
Al- Quds University**



**Determinants of Periodontal Disease Among 9th-Grade
Students and Their Teachers in the Northern West Bank
and the Effectiveness of an Interactive Oral Health
Education Program in Nablus, Palestine**

Sura Ibrahim Al-Hassan

Ph.D. Dissertation

**Jerusalem- Palestine
2026/1447**

**Determinants of Periodontal Disease Among 9th-Grade
Students and Their Teachers in the Northern West Bank
and the Effectiveness of an Interactive Oral Health
Education Program in Nablus, Palestine**

Prepared by

Sura Ibraheim Al-Hassan

Supervisor: Prof. Elham Kateeb

**A Dissertation submitted in Partial fulfilment of the
Requirements for the Degree of Doctor of Philosophy
(PhD) in Public Health/School of Public Health, Al-Quds
University, Jerusalem, Palestine.**

2026/1447

Deanship of Graduate Studies
Al-Quds University
School of Public Health



Thesis Approval

Determinants of Periodontal Disease Among 9th-Grade Students and Their Teachers in the Northern West Bank and the Effectiveness of an Interactive Oral Health Education Program in Nablus, Palestine

Prepared by: Sura Ibraheim Al-Hassan
Student Number: 22112194

Supervisor: Prof. Elham Kateeb

This doctoral thesis was submitted and accepted on 2026/5/3 by the following committee members:

Head of committee (supervisor): Prof. Elham Kateeb

Signature 

External examiner: Prof. Zuhair Natto

Signature: 

External examiner: Prof. Mahmoud Abu-Taa'

Signature: 

Internal examiner: Prof. Ahmad Amro

Signature: 

Jerusalem-Palestine
2025/1447

Dedication

To the soul of my beloved father,

who taught me the value of knowledge and paved the way for me to reach the highest academic aspirations.

To my mother,

who gave endlessly and devoted her entire life to her children, always placing them before herself.

To my dear husband, Dr. Mazen,

with whom I learned the true meaning of perseverance and struggle, and who has always been my strongest support.

To my sisters, Ghada and Hala,

no matter how distant the paths may seem, I always feel you are close to me, and I find you whenever I need you.

To my dear friends,

with whom I feel happiness, strength, and empowerment, and whose presence makes every challenge lighter.

Finally, to my children, Mohammad and Ibrahim,

the light of my eyes and the vision through which I see the world. I hope you will always be proud of me.

Sura Ibraheim Wahdan Al-Hassan

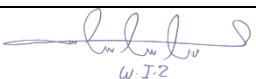
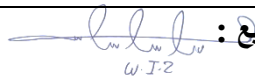
Declaration

I, the undersigned, the author of the dissertation entitled:

Determinants of Periodontal Diseases Among Ninth-Grade Students and Their Teachers in the Northern West Bank, and the Effectiveness of an Interactive Oral Health Education Program in Nablus, Palestine

Hereby, I declare that this dissertation has been submitted to Al-Quds University in partial fulfillment of the requirements for the degree of Doctor of Philosophy (PhD) in Public Health.

I further declare that the work presented in this dissertation is entirely my own, except where appropriate acknowledgment has been made. I also declare that this dissertation, in whole or in part, has not been submitted previously for the award of any academic or research degree or qualification at any other educational or research institution.

Student name: Sura Ibraheim Wahdan Al-Hassan	اسم الطالب: سري إبراهيم وهدان الحسن
The signature : 	التوقيع: 
Date: 2026/5/3	التاريخ : 2026/5/3

Acknowledgements

I want to convey my heartfelt thanks and profound appreciation to my supervisor, Professor Dr. Elham Kateeb, for her outstanding academic mentorship, invaluable knowledge, and consistent support throughout every stage of this dissertation. Her patience, commitment, and scholarly wisdom played a crucial role in the development of this research and in improving its scientific rigor.

I would like to sincerely thank the Faculty of Public Health at Al-Quds University and all academic and administrative staff for their invaluable expertise, guidance, and institutional support, which were essential in completing this study.

I am very thankful to the school administrations in Nablus, Jenin, and Tulkarm Cities for their cooperation and for facilitating the data collection process, which was essential for conducting this research.

My heartfelt appreciation goes to my family.

Lastly, I want to express my heartfelt gratitude to my husband, Dr. Mazen, for his patience, encouragement, and unwavering support during my doctoral studies. His understanding and motivation provided constant strength throughout this journey.

ABSTRACT

Background: Periodontal disease (PD) is one of the most common chronic inflammatory oral conditions globally and poses an emerging public health concern, especially in low- and middle-income regions where preventive oral health programs are limited. In Palestine, evidence on periodontal health among adolescents and school personnel is scarce, and the effectiveness of school-based educational interventions has not been sufficiently explored.

Aims: This dissertation sought to: (1) assess the prevalence of PD among 9th-grade students in the northern governorates of the West Bank; (2) examine socioeconomic, behavioral, and lifestyle determinants associated with PD among students. (3) assess periodontal health status and associated factors among 9th-grade teachers; and (4) evaluate the effectiveness of interactive oral health education on periodontal health outcomes and related behaviors among both students and teachers.

Methods: A mixed-phase design was employed. Phase I used a cross-sectional epidemiological design, employing proportional stratified random sampling of schools, students, and teachers across the Nablus, Jenin, and Tulkarm governorates. Periodontal status was assessed using the Community Periodontal Index for Treatment Needs (CPITN), while oral hygiene status was measured using the Simplified Oral Hygiene Index (S-OHI). Phase II applied a true experimental control design in selected schools in Nablus City to evaluate a structured interactive oral health education program. Baseline and two-month follow-up assessments were conducted for intervention and control groups. Statistical analyses included bivariate testing and multivariable logistic regression to identify predictors of PD. T-tests were used to evaluate the effects of the intervention.

Results: The dissertation demonstrated a substantial burden of PD among both students and teachers. Among students, 86.8% presented with periodontal problems, with gingival bleeding and calculus being the most frequent findings. Oral care habits and inadequate oral hygiene were the most significant predictors of periodontal diseases. Among teachers, only a small proportion exhibited healthy gingiva (11.8%), with oral hygiene practices, smoking, and dietary patterns significantly influencing periodontal outcomes. Following the interactive educational intervention, significant improvements were observed in periodontal health indicators, oral hygiene status, and health behaviors among intervention participants compared with controls. Improvements were evident in CPITN and S-OHI scores, oral hygiene practices, dietary habits, and smoking behaviors in both student and teacher groups.

Conclusion: PD represents a significant public health challenge among Palestinian school communities, driven largely by modifiable behavioral and lifestyle determinants. The results indicate that interactive oral health education in schools can lead to noticeable enhancements in periodontal health and associated behaviors for both adolescents and teachers. The research advocates incorporating comprehensive preventive oral health education into school curricula and emphasizes the importance of policy-level approaches to address

common socio-behavioral factors that contribute to the prevalence of periodontal disease in Palestine.

Keywords: Gingival health; Oral health; Interactive oral health education; Ninth-grade students; Teachers; Palestinian schools; Palestine.

Table of Contents

No.	Contents	Page
	Dedication	i
	Declaration	ii
	Acknowledgements	iii
	Abstract	iv
	Table of Contents	vi
	List of Tables	ix
	List of Figures	xi
	List of Appendices	ix
	Chapter One: Introduction	1
1.1	Introduction	1
1.2	Problem statement	3
1.3	Study Justification	5
1.4	Study Aims	7
1.4.1	Phase one specific objectives of aims 1 and 2:	7
1.4.2	Phase two specific objectives of Aims 3 and 4	8
1.5	Research Questions	8
1.6	Hypotheses	9
	Chapter Two: Literature Review	11
2.1	Definitions and Identifications	11
2.2	Social Determinants and Epidemiology of Periodontal Diseases	12
2.3	Literature Review	15
2.4	Oral Educational Programs in Literature	21
2.5	Evidence brief regarding the selection of oral education	27
2.6	Theoretical Framework	29
2.7	Conceptual Definitions	31
2.8	Operational definitions	32
	Chapter Three: Methodology	34
3.1	Introduction	34
3.2	Description of the socio-demographic and geographic areas	35
3.3	Study Population	36
3.4	Study Design	37
3.5	Sample Frame	37
3.6	Sample Technique and Process	38
3.7	Pilot Study	43
3.8	The Tools and Equipment	43
3.8.1	Description of the questionnaire	43

3.8.2	The components of the students' questionnaire	44
3.8.3	The components of the Teachers' questionnaire	45
3.9	Data Collection Process	46
3.10	Measurements of PD	46
3.11	Simplified Oral Hygiene Index (S-OHI)	48
3.12	Intervention Description	49
3.13	Blinding	51
3.14	Data management and statistical analysis	53
	Chapter Four: Published Articles	55
	Chapter Five: The Results	56
5.1	Introduction	56
5.2	Presentations of the Results	56
5.3	Phase One Goals:	56
5.4	Phase One Results:	57
5.5	Bivariate analysis results	58
5.6	Phase One Results	63
5.7	Bivariate analysis results	64
5.8	Phase Two Results	69
5.9	The effectiveness of an interactive oral health education program on periodontal status, among 9th-grade students in Nablus City	69
5.10	Phase Two Results: The effectiveness of an interactive oral health education program on periodontal status among schoolteachers in Nablus City	76
	Chapter Six: Discussion	83
6.1	Discussion	83
	Chapter Seven: Conclusion	89
7.1	Conclusion	89
7.2	Recommendations	91
	References	93
	Annexes	118
	المخلص	146

List of Tables

No.	Tables	Page
Table 3.1	Sampling Distribution of Governmental and Private Schools by Governorate	38
Table 3.2	The relation between the criteria and scores of (CPITN), treatment category (T), and type of care and time units estimate (TU) per sextant.	47
Table 5.1	Distribution of Periodontal Status Across Examined Sextants Among the Participating Students	57
Table 5.2	Distribution of CPITN Categories in the Participating Students	58
Table 5.3	Sociodemographic Determinants of Students' Periodontal Status: Crude Odds Ratios	59
Table 5.4:	Oral Hygiene Determinants of Students' Periodontal Status: Bivariate Crude OR Analysis	60
Table 5.5	Dietary Habits (Determinants) of Students' Periodontal Status: Crude Odds Ratios	61
Table 5.6	Smoking Behaviors (Determinants) of Students' Periodontal Status: Crude Odds Ratios	61
Table 5.7	Final Multivariable Logistic Regression Model Showing Significant Determinants of Periodontal Status	62
Table 5.8	Distribution of Periodontal Status Across Examined Mouth Regions in Teachers	63
Table 5.9	Distribution of (CPITN) Categories Among Teachers	64
Table 5.10	Crude Odds Ratios for Sociodemographic Determinants of Periodontal Status	65
Table 5.11	Oral Hygiene Determinants of teachers' Periodontal Status (Bivariate Crude OR Analysis)	66
Table 5.12	Bivariate Analysis of Dietary Habits as Determinants of Teachers' Periodontal Status (Crude Odds Ratios)	67
Table 5.13	Smoking Behaviors (Determinants) of Teachers' Periodontal Status Crude Odds Ratios	67
Table 5.14	Final Multivariate Logistic Regression Model for Predictors of Periodontal Health	68
Table 5.15	Socio-demographic Characteristics of the Study Sample at Baseline Phase	70

Table 5.16	The Comparison of Overall Mean of CPITN and S-OHI Scores Between Control and Intervention Groups at Baseline and after 2 Months of Education	71
Table 5.17	Comparison of Mean CPITN Scores Across Mouth Sextants Between Control and Intervention Groups After 2 Months of Education	71
Table 5.18	Comparison of the Mean of S-OHI Scores Across Mouth Sextants Between Control and Intervention Groups After 2 Months of Education	72
Table 5.19	Comparison of Overall Oral Hygiene Practices, Diet Habits, and Smoking Behaviors between Control and Intervention Groups at Baseline and After 2 Months of Education	73
Table 5.20	Comparison of Oral Hygiene and Dental Visit Practices between Control and Intervention Groups	73
Table 5.21	Comparison of Dietary Habits Between Control and Intervention Groups	74
Table 5.22	Comparison of Smoking Habits Between Control and Intervention Group	74
Table 5.23	The net Effect of education on Periodontal and oral hygiene Status and Related Behaviours	75
Table 5.24	Demographic and social characteristics of the study sample (baseline for the control group: 193, baseline for the intervention group: 243)	76
Table 5.25	Comparison of Oral Health Indices (SOHI and CPI) Between Control and Intervention Groups at Baseline and After 2 Months	77
Table 5.26	Comparison of S-OHI Scores by Mouth Sextant Between Control and Intervention Groups Using Mann–Whitney U Test	78
Table 5.27	Comparison of CPITN Scores Between Control and Intervention Groups Across Different Mouth Regions	78
Table 5.28	Comparison of Overall Oral Hygiene Practices, Dietary Habits, and Smoking Behaviors Between Control and Intervention Groups at Baseline and After Two Months by Mann–Whitney analysis test	79
Table 5.29	Comparison of Overall Oral Hygiene Practices, Dietary Habits, and Smoking Behaviors between controls and intervention group (Mann–Whitney U test)	80
Table 5.30	Comparison of Oral Hygiene Practices Between Control and Intervention Groups	80
Table 5.31	Comparison of Dietary Habits Between Control and Intervention Groups	81

Table 5.32 Comparison of Smoking Behaviors Between Control and Intervention Groups

82

List of Figures

No.	Figuers	Page
Fig 2.1	A Conceptual Framework for Action on the Social Determinants of Health	30
Fig. 2.2	Illustrates Phase One of the study	32
Fig. 2.3	Illustrates the conceptual framework for Phase Two of the study	33
Fig 3.1	A multistage sampling strategy across three governorates in the northern West Bank	39
Fig. 3.2	Sampling procedure across governorates, schools, and teachers	40
Fig 3.3	CONSORT flow diagram showing the flow of schools and students selected for the trial	41
Fig 3.4	CONSORT flowchart of the screened teachers for the study	42

List of Appendices

No.	Appendices	Page
Appendix A1	Description of Oral Health Education Sessions: Objectives, Methods, and Evaluation Strategies.	118
Appendix A2	Coding System Used in Teachers' Responses	120
Appendix B	Students' Questionnaire	122
Appendix C	Teachers' Questionnaire	130

Chapter One

Introduction

1.1 Introduction

Oral health refers to a healthy oral cavity free of pain, infection, and disease, thereby enabling normal functions such as mastication, aesthetics, phonetics, and emotional expression (Bennadi & Reddy, 2013; Glick et al., 2016; Spanemberg et al., 2019). It holds considerable significance for overall well-being. (Mitsea et al., 2001; Kaur & Kandelman, 2019). Conversely, poor oral health can impact various aspects of life (Spanemberg et al., 2019).

The periodontium is inherently vulnerable to infection, and the inflammation of these supporting tissues is referred to as periodontal disease (PD). PD is recognized as the most prevalent oral condition (Raitapuro-Murray et al., 2014; Almagabadi et al., 2021). This chronic inflammatory process, driven by microbes, may affect one or more parts of the periodontium. It is mainly triggered by bacteria in dental plaque, which provokes a gradual inflammatory reaction that damages the tissues supporting the teeth (Almagabadi et al., 2021).

The classification of PD is determined by various parameters, including its extent (generalized vs. localized), severity (mild, moderate, or severe), rate of progression (chronic vs. aggressive), and the tissues affected. However, gingivitis, the earliest, less aggressive, and most common form of PD, is characterized by redness, swelling, and bleeding confined to the gums (Mariotti & Hefti, 2015). When inflammation extends into the periodontal ligament and alveolar bone, it leads to apical migration of the junctional epithelium, forming a periodontal pocket. This stage of PD is called periodontitis, during which alveolar bone resorption occurs, leading to tooth mobility and premature tooth loss (Laudenbach, 2020; Neurath & Kesting, 2024).

Variations in PD prevalence exist across countries and demographic groups (Borrell et al., 2004). This variability is attributed to a combination of factors, including genetic predispositions, microbial influences, environmental conditions, and social determinants, all of which collectively shape the prevalence and severity of PD (Kinane et al., 2017). It is

estimated that approximately 80% of the global population is affected by PD, and this figure is projected to rise in the forthcoming years due to an aging population and changing dietary habits (Kingman & Albandar, 2002; Petersen & Bourgeois, 2005; Tonetti & Bottenberg, 2017; Naser et al., 2023). In the United States, mild to moderate forms of PD are most prevalent, with reported rates ranging from 13% to 57% (Corbet & Zee, 2000; Al-Harathi et al., 2013). Notably, only 1% of adults in Germany and Taiwan have been reported with PD. In Poland, over half of the adult population (62%) experiences severe periodontitis (Nazir et al., 2020). Research indicates that over one-third of missing permanent teeth in individuals over the age of 40 in Arab countries have been extracted due to periodontitis. This statistic shows that tooth loss attributable to periodontitis exceeds that attributable to all other causes (Al-Shammari & Al-Ansari, 2006).

The prevalence of PD is also significantly high among older children and adolescents. A global analysis reveals that only 21% of adolescents have not encountered any form of PD. Additionally, approximately 18.8% of this demographic exhibited bleeding upon probing, while 50.3% showed signs of calculus. Among Norwegian adolescents, gingivitis was the most prevalent, recorded at a rate of 66%, followed by 30% in Iran and 15% in Belarus. In Germany and Taiwan, early-stage periodontitis was present in 14% of adolescents (Nazir et al., 2020).

PD imposes a significant economic burden on society. This burden encompasses direct costs, including expenditures for clinical diagnosis, treatment, and follow-up care, as well as indirect costs associated with productivity losses from absences in both work and educational settings. Furthermore, there are substantial intangible costs that are frequently overlooked but have a considerable impact on quality of life. These intangible costs encompass pain, functional limitations that affect essential activities such as biting and chewing, and challenges in verbal communication and emotional expression, including smiling and social interactions. The cumulative effect of these costs extends beyond the individual, placing strain on healthcare systems and diminishing overall societal productivity (Righolt et al., 2018).

As mentioned earlier, the development and progression of PD are influenced by various social determinants that differ across populations. Structural social determinants encompass a country's overall healthcare system and access to dental care services. In contrast, intermediary social determinants are factors that mediate the relationship between structural determinants and health. These factors include social characteristics, such as age, sex, and family income, as well as behavioral and lifestyle factors, such as oral hygiene practices. Lifestyle factors, including oral hygiene practices, tobacco use, and dietary choices, influence the onset and progression of PD among both adolescents and adults. By adopting healthy lifestyle behaviors, individuals can modify the underlying causes of PD. This modification may alter immune responses, thereby reducing susceptibility to periodontal infections and ultimately slowing disease progression (Timmerman & Van der Weijden, 2006; Pulikkotil et al., 2020).

To date, there has been limited attention to PD across the Middle East. Oral health studies within the region have predominantly focused on identifying the relationship between risk factors and oral diseases; only a few investigations have explored the impact of educational initiatives on such conditions, including PD (Al-Harthi et al., 2013; Jepsen et al., 2018).

Data collected from school-aged children (WHO, 2003; Alshammari, 2019) and adult populations (Nazir et al., 2020) are crucial for formulating effective oral health strategies to prevent and manage oral diseases. Consequently, this study was conducted as part of a doctoral dissertation to generate robust and context-specific evidence to inform the prevention and control of PD in the West Bank. This was accomplished through (i) the execution of school-based epidemiological research and (ii) the assessment of an interactive, school-based oral health education program.

1.2 Problem statement

Oral health encompasses the physical, psychological, emotional, and social dimensions that are essential to overall health and well-being (Weyant & Watt, 2020). Maintaining good oral health allows individuals to eat, speak, smile, and engage socially without experiencing discomfort or embarrassment. Furthermore, it can indicate an individual's capacity to adapt to physiological changes (Barranca-Enríquez & Romo-González, 2022). Conversely, poor oral health, often characterized by dental caries or PD, is emerging as a significant global public health challenge, with a rising prevalence in numerous low- and middle-income countries (Petersen et al., 2005; Kassebaum et al., 2017).

In the case of gingivitis, approximately 3.5 billion individuals worldwide are affected by poor oral health (Marcenes et al., 2013), resulting in substantial social, psychological, and economic repercussions that adversely impact individuals, communities, and healthcare systems.

PD is recognized as the second most prevalent oral health condition among humans, impacting approximately 70% of the global population who experience one or more forms of damage to their periodontal supporting tissues (Nazir, 2017, p.72). The reported prevalence of PD varies widely worldwide, ranging from 20% to 50% (Nazir et al., 2020). By 2019, the number of individuals affected by PD had nearly doubled since 1990, with data indicating increases in age-standardized incidence, prevalence, and disability-adjusted life years during 1990-2019 (Zhang et al., 2022).

Symptoms such as bleeding and swelling are typically confined to the marginal gingiva. However, if the inflammation extends to deeper tissues, symptoms may intensify, including gingival recession, tooth mobility, destruction of the periodontal ligament, alveolar bone resorption, and ultimately tooth loss (Papapanou et al., 2018).

Various segments of the population experience disproportionate effects from PD. Individuals with low income exhibit 1.8 times higher odds of enduring severe PD in comparison to their

high-income counterparts (Tadjoedin, 2017). Additionally, there are observable disparities in the prevalence of PD across different age groups, with the severity of the disease escalating with advancing age. Notably, the highest prevalence of chronic periodontitis is observed in the elderly population, where it reaches 82%, followed by adults at 73% and adolescents at 59% (ibid).

On the other hand, PD is associated with several prevalent systemic diseases and conditions, such as diabetes, cardiovascular disease, adverse pregnancy outcomes, rheumatoid arthritis, and chronic obstructive pulmonary disease. The relationship between PD and systemic health is believed to stem from the metastatic dissemination of microorganisms and their byproducts from dental plaque, as well as the transfer of inflammatory mediators from periodontal tissues to other organs (Lim et al., 2020).

In Palestine, few studies have investigated oral health indicators among school-aged populations. For instance, Kateeb et al. (2021) assessed the prevalence of dental caries among adolescents attending marginalized schools in the West Bank and found that 73% had fair oral hygiene. Unfavorable dietary habits, poor brushing practices, and limited access to dental services were major contributing factors. These findings highlight significant behavioural barriers affecting the oral health of Palestinian adolescents. However, despite evidence of the high prevalence of dental caries in Palestine, there is a lack of data on PD and its determinants among both adolescent and adult populations, particularly in the Nablus governorate.

Access to dental care presents significant challenges in many countries, primarily because dental care delivery models are underfunded compared to medical care within public health systems. For instance, in the United States, individuals with low income have limited access to public funding for dental services, resulting in patients often postponing periodontal treatment until their periodontal issues escalate into severe pain and infections (Allareddy et al., 2014). While dental services provided by the Saudi Ministry of Health are offered at no cost, financial barriers do not impede access to treatment at public facilities. However, the Saudi health system lacks a structured approach to regular dental visits, and dentists typically do not monitor and track the dental patients (Al Humaid et al., 2018).

In the West Bank, oral healthcare focused primarily on curative rather than preventive services. Dental care is mainly delivered through private clinics, with minimal integration into the public primary healthcare system. Preventive programs, such as school-based oral health education or routine dental check-ups, are rarely implemented, particularly in public schools located in marginalized or rural areas (Abuhaloob & Petersen, 2018). Furthermore, the limited number of dental professionals within governmental facilities and the lack of a structured national oral health surveillance system restrict regular monitoring and follow-up of periodontal conditions (Zhu et al., 2024). Similar findings have been reported by Kateeb et al. (2020), who noted that the Palestinian oral health system remains under-resourced, with preventive activities often overshadowed by curative care and limited coordination

between public and private sectors. This restricted access to preventive and educational services underscores the importance of investigating PD and its determinants in the West Bank among both adolescents and adults who in turn can influence oral health behaviors across communities.

Socio-behavioural determinants such as SES, oral hygiene practices, dietary habits, and smoking behaviors play a pivotal role in the development and progression of PD (Tadjoedin et al., 2017; Petersen & Ogawa, 2005). In many low- and middle-income settings, including Palestine, these factors are deeply interrelated; poor oral hygiene practices and unhealthy dietary patterns often coincide with limited financial resources and restricted access to preventive dental care (Albandar & Rams, 2002). Among adolescents and adults in the West Bank, such interlinked factors are expected to exacerbate periodontal conditions, especially in the absence of structured oral health education or preventive follow-up programs. Despite their relevance, there is a lack of empirical evidence describing how these determinants collectively influence periodontal health outcomes within the Palestinian context.

In addition, early prevention and management of PD can be effectively achieved through optimal personal dental hygiene practices (Al Jafari, 2015). These practices can be enhanced by well-structured oral disease prevention and educational programs (Al-Kazragi, 2001), which may include training in proper oral hygiene techniques and promoting a nutritious diet. Research demonstrates that oral health education significantly improves dental care practices, reduces plaque accumulation, and ultimately enhances gingival health (Nakre & Harikiran, 2013; Niranjana et al., 2017). Finally, the effectiveness of interactive oral educational programs on the prevalence of PD has not yet been explored in Palestine.

1.3 Study Justification

Oral diseases are among the most common non-communicable conditions worldwide, significantly impacting well-being, quality of life, productivity, and healthcare costs (Peres, 2009; Gambhir et al., 2015). These diseases often lead to pain, limitations in oral functions, impaired nutrition, emotional stress, low self-esteem, and poor academic performance and attendance (Alsumait et al., 2015; Kaur et al., 2017). Despite the high prevalence of oral diseases, they remain a largely neglected global health issue (Marcenes et al., 2013; Kassebaum et al., 2017).

Moreover, oral diseases share several risk factors with other non-communicable diseases, such as high sugar consumption and tobacco use. High sugar intake is the primary cause of dental caries (Bernabe et al., 2016), while tobacco use is a significant risk factor for PD (Bernabe et al., 2017; Wolf et al., 2021). This suggests that efforts to modify risk factors associated with PD may also help prevent certain systemic diseases.

More specifically, PD is one of 42 health topic areas within overall health, and reducing the proportion of the population with periodontitis is the fourth objective of the World Health Organisation (WHO) for oral health (Eke et al., 2020). However, people, oral health care

providers, and public health administrators still pay limited attention to PD in most countries (Petersen & Ogawa, 2005; Peres et al., 2009; World Dental Federation, 2021).

Indeed, adolescents are always susceptible to PD (Califano, 2003, p. 1696; Chang et al., 2021). The prevalence of PD in adolescents globally ranged from 5% to 20%. Calculus and gingival bleeding are the most prevalent periodontal conditions in this age group (Baiju et al., 2019). The 15-year-old group is a key age group in epidemiological surveys, as these teenagers begin to take responsibility for their health and lifestyles (WHO, 2003).

In adults, persistent gingival inflammation is significantly associated with chronic periodontitis and an increased risk of tooth loss. Therefore, identifying the status of periodontal conditions and related factors among both adolescents and adults is essential for preventing PDs (Lang et al., 2009; Haresaku et al., 2023).

PD can be prevented in its early stages through simple, low-cost measures at both the individual and health system levels. Promoting oral health, such as providing education and early treatment, can eliminate or reduce its harmful effects. It has been shown that after periodontal therapy, the average annual rate of tooth loss is 0.1 teeth per patient, which aligns with the preservation of natural teeth for a lifetime in most individuals (Trombelli et al., 2015). However, once the disease advances, treatment becomes much more expensive and often requires complex periodontal procedures that may include surgery.

Oral health education is vital for promoting periodontal health (Tonetti et al., 2017). It teaches individuals about effective oral hygiene practices, such as brushing, flossing, and scheduling regular dental check-ups (Guo et al., 2014). By providing this education, individuals become able to recognise the early signs and symptoms of PDs. Additionally, educating people about the link between oral health and overall systemic health enables them to make informed decisions that protect their well-being. As a result, oral health education can decrease the prevalence of PD, potentially helping reduce healthcare costs associated with dental care. Preventive measures are often more cost-effective than curative treatments (Innes et al., 2019). Oral education has the potential to mitigate the impact of PD on school-aged children and alleviate the challenges associated with this condition. This proactive approach may also contribute to a reduction in the annual hours of school lost (Innes et al., 2019), as inadequate periodontal health can adversely influence academic performance, with affected children being twelve times more likely to encounter difficulties in their studies due to periodontal-related illnesses. Furthermore, poor oral health is responsible for the loss of over 50 million school hours annually (Eke et al., 2020).

Nevertheless, for oral education to be effective, it is essential to incorporate new and innovative approaches and methodologies that can effectively modify and orient individuals' practices towards preferred behaviours. Research has demonstrated that interactive educational methods, such as videos, video games, and computer-based simulations, are highly effective across various health research domains, often surpassing traditional verbal educational programs (Aljafari, 2015).

Despite global evidence of the effectiveness of interactive health education, empirical research on this approach remains limited in the Palestinian context. Most existing studies in Palestine have focused on assessing oral health status, without evaluating the impact of interactive oral education interventions. Furthermore, no prior studies have simultaneously focused on both students and teachers together, two groups whose collaboration is crucial for maintaining healthy oral behaviors in the school environment. Therefore, this study aims to address this significant gap by evaluating the effectiveness of an interactive oral health education program specifically designed for the Palestinian school context.

In summary, this research aimed to address a significant aspect of oral health in the Palestinian context. The study evaluated the impact of an oral education program targeted at 9th-grade students and their teachers, who play a crucial role in Palestinian society. The program consisted of well-structured dental health education sessions, designed to empower both students and teachers to uphold optimal oral health standards. Topics covered in these sessions included identifying periodontal signs and symptoms, the relationship between PD and overall systemic health, and effective practices for maintaining oral hygiene. The educational approach incorporated innovative techniques, such as puzzles and games, to engage participants and enhance their comprehension of the subjects being presented.

1.4 Study Aims

1. To assess the prevalence of PD among 9th-grade students in the North governorates of the West Bank and to examine its relationship with socioeconomic status (SES), oral hygiene status and practices, dietary habits, and smoking behaviors.
2. To assess the prevalence of PD among 9th-grade teachers in the North governorates of the West Bank and to examine its relationship with (SES), oral hygiene status and practices, dietary habits, and smoking behaviors.
3. To evaluate the effectiveness of an interactive oral health education program on periodontal status, oral hygiene status and practices, dietary habits, and smoking behaviors among 9th-grade students in Nablus City.
4. To evaluate the effectiveness of an interactive oral health education program on periodontal health, oral hygiene status and practices, dietary habits, and smoking behaviors among 9th-grade teachers in Nablus City.

1.4.1 Phase one specific objectives of aims 1 and 2:

1. To measure the Community Periodontal Diseases Index for Treatment Needs (CPITN) among 9th-grade students and their teachers in governmental and private schools in the Nablus, Jenin, and Tulkarm governorates.
2. To measure the Simplified Oral Hygiene Index (S-OHI) among 9th-grade students and their teachers in governmental and private schools in the Nablus, Jenin, and Tulkarm governorates.
3. To investigate the association between CPITN and S-OHI among 9th-grade students and their teachers in the Nablus, Jenin, and Tulkarm governorates.

4. To investigate the association between CPITN and socioeconomic status (SES) among 9th-grade students and their teachers in the Nablus, Jenin, and Tulkarm governorates.
5. To investigate the association between CPITN and oral hygiene practices among 9th-grade students and their teachers in the Nablus, Jenin, and Tulkarm governorates.
6. To investigate the association between CPITN and dietary habits among 9th-grade students and their teachers in the Nablus, Jenin, and Tulkarm governorates.
7. To investigate the association between CPITN and smoking behaviours among 9th-grade students and their teachers in the Nablus, Jenin, and Tulkarm governorates.

1.4.2 Phase two specific objectives of Aims 3 and 4

1. To measure the CPITN among 9th-grade students and their teachers two months after implementing an interactive educational program in Nablus City.
2. To measure the S-OHI among 9th-grade students and their teachers two months after implementing an interactive educational program in Nablus City.
3. To assess oral hygiene practices, dietary habits, and smoking behaviours among 9th-grade students and their teachers two months after implementing an interactive educational program in Nablus City.
4. To assess the differences in CPITN scores, S-OHI scores, oral hygiene practices, smoking habits, and dietary habits before and after applying for an interactive educational program among students and their teachers.

1.5 Research Questions

1. What is the relationship between SES, oral hygiene status and practices, dietary habits, smoking behaviors, and the prevalence of PD among 9th-grade students in the North governorates of the West Bank?
2. What is the relationship between SES, oral hygiene status and practices, dietary habits, smoking behaviors, and the prevalence of PD among 9th-grade teachers in the North governorates of the West Bank?
3. Does participation in an interactive oral health education program improve periodontal health, oral hygiene status and practices, dietary habits, and smoking behaviors among 9th-grade students in Nablus City?
4. Does participation in an interactive oral health education program improve periodontal health, oral hygiene status and practices, dietary habits, and smoking behaviors among 9th-grade teachers in Nablus City?

1.6 Hypotheses

The following null hypotheses were tested at the level of significance: $\alpha = 0.05$

Phase one: Determinants of Periodontal Disease

A. Null hypotheses for 9th-grade students:

1. H_{01} : There is no relationship between the prevalence of periodontal disease (PD) among 9th-grade students and their oral hygiene status and practices in the northern governorates of the West Bank.
2. H_{02} : There is no relationship between the prevalence of PD among 9th-grade students and their socioeconomic status (SES) in the northern governorates of the West Bank.
3. H_{03} : There is no relationship between the prevalence of PD among 9th-grade students and their dietary habits in the northern governorates of the West Bank.
4. H_{04} : There is no relationship between the prevalence of PD among 9th-grade students and their smoking behaviors in the northern governorates of the West Bank.

B. Null hypotheses for 9th-grade teachers

1. H_{05} : There is no relationship between the prevalence of periodontal disease among 9th-grade teachers and their oral hygiene status and practices in the northern governorates of the West Bank.
2. H_{06} : There is no relationship between the prevalence of PD among 9th-grade teachers and their socioeconomic status (SES) in the northern governorates of the West Bank.
3. H_{07} : There is no relationship between the prevalence of PD among 9th-grade teachers and their dietary habits in the northern governorates of the West Bank.
4. H_{08} : There is no relationship between the prevalence of PD among 9th-grade teachers and their smoking behaviours in the northern governorates of the West Bank.

Phase two: Intervention Study – Null Hypotheses

A. Null hypotheses for 9th-grade students

1. H_{09} : In Nablus City, there is no difference in CPITN scores after 2 months between 9th-grade students who participated in the interactive oral health education program and those who did not.
2. H_{010} : In Nablus City, there is no difference in S-OHI scores after 2 months between 9th-grade students who participated in the interactive oral health education program and those who did not.
3. H_{011} : In Nablus City, there is no difference in oral hygiene practices, dietary habits, or smoking behaviours after 2 months between 9th-grade students who participated in the interactive oral health education program and those who did not.

B. Null hypotheses for 9th-grade teachers

1. H_{012} : In Nablus City, there is no difference in CPITN scores after 2 months between 9th-grade teachers who participated in the interactive oral health education program and those who did not.
2. H_{013} : In Nablus City, there is no difference in S-OHI scores after 2 months between 9th-grade teachers who participated in the interactive oral health education program and those who did not.
3. H_{014} : In Nablus City, there is no difference in oral hygiene practices, dietary habits, or smoking behaviours after 2 months between 9th-grade teachers who participated in the interactive oral health education program and those who did not.

Chapter Two

Literature review

2.1 Definitions and Identifications

The American Academy of Periodontology (AAP) (2017) describes PD as a persistent infection that can damage the structures that support teeth, such as the gums, periodontal ligament, and alveolar bone, potentially resulting in tooth loss. Additionally, periodontitis is characterized as an inflammatory disease of bacterial origin that causes the detachment of periodontal ligament fibers and the deterioration of the alveolar bone. The AAP has categorized PD into four primary types: 1. Biofilm-Induced Gingivitis, 2. Non-Biofilm-Induced Gingivitis, 3. Necrotizing Periodontal Diseases, and 4. Periodontitis Associated with Systemic Diseases.

Again, PDs have been defined as "a group of lesions affecting the tissues surrounding and supporting the teeth in their sockets." Most PDs can be classified as either gingivitis or periodontitis, which result from bacterial plaque or calculus on the supra-gingival and/or sub-gingival tooth surfaces. It is generally accepted that PDs are gingivitis, which, in most cases, progresses to periodontitis (Carranza, 2006; Kinane, 2017; Zhang et al., 2022).

The word "periodontal" literally means "tissue around the tooth".

PD encompasses a wide array of inflammatory disorders that impact the supporting structures of the teeth, including the gums, bone, and periodontal ligament. These conditions can lead to tooth loss and contribute to systemic inflammation. Chronic periodontitis primarily affects adults, whereas aggressive periodontitis may occasionally occur in the young population. The development and progression of PDs are influenced by an imbalance in the natural oral microbiota (dental plaque), which subsequently triggers the host's immune response, leading to inflammation and disease. (Kinane et al., 2017).

PDs are the primary chronic infectious diseases of the oral cavity. These affect the periodontal supporting tissues of the teeth and include both destructive and non-destructive conditions (Albandar, 2005) .

Gingivitis refers to inflammation of the soft tissues without downward migration of the junctional epithelium; it is a reversible, non-destructive condition that does not affect periodontal tissues (Albandar, 2005).

Periodontitis is the inflammation of the periodontium, which results in the downward movement of the junctional epithelium, causing the loss of connective tissue attachment and the degradation of alveolar bone. (Albandar, 2005).

2.2 Social Determinants and Epidemiology of Periodontal Diseases

Oral health is a crucial determinant of an individual's ability to eat, speak, and engage in social interactions without discomfort or embarrassment (Yewe-Dyer, 1993, p. 224; Bhardwaj et al., 2016). Conversely, oral diseases represent a significant health concern, particularly among children and adolescents (Bhardwaj et al., 2016). Furthermore, the global prevalence rates and patterns of these oral diseases have changed considerably over the past two decades (Taani, 2002; Bhardwaj et al., 2016).

More than 10% of the global population is affected by various forms of periodontitis. Around 60–90% of school-aged children and adolescents exhibit symptoms of gingivitis. Furthermore, around 2% of young individuals may experience aggressive periodontitis, which can result in premature tooth loss (Petersen et al., 2005; James et al., 2018). This indicates that PDs are more prevalent than cardiovascular diseases (Kassebaum et al., 2017). Consequently, oral diseases are emerging as a significant public health concern across all age demographics, paralleling the challenges posed by cardiovascular diseases.

Initially, PD manifests as gingivitis, an inflammation of the periodontal soft tissues that is reversible and characterized by gum swelling and bleeding (Peres et al., 2019). In susceptible individuals with a compromised immune response, gingivitis can progress to periodontitis, gradually destroying the periodontal ligament and alveolar bone supporting the teeth (Chapple, 2014). Periodontitis manifests as clinical attachment loss, the presence of periodontal pocketing, gingival bleeding, and alveolar bone loss. The prevalence of gingivitis is 50%-90% among most populations. However, this high prevalence can be reversed to a healthy gingival condition by controlling structural and intermediary social determinants of PDs, such as health-related practices (Kinane et al., 2017; Peres et al., 2019). In addition, 10–15% of the global adult population suffers from progressive periodontitis, which, if left untreated, results in halitosis, pain, and loss of teeth (Pihlstrom et al., 2005; Madiba & Bhayat, 2018). On the other hand, severe PDs are estimated to affect ~19% of the global adult population, representing over 1 billion cases worldwide (WHO, 2022).

In the past, clinicians and researchers considered all people equally susceptible to PDs (Genco & Borgnakke, 2013; Lang et al., 2015). Nevertheless, many studies have sought to expand understanding of the etiology and pathogenesis of these PDs, and it has become clear that susceptibility to PDs varies across the population. Then, Researchers identified modifiable and non-modifiable determinants for PDs (AlJehani, 2014, p. 19; Tonetti et al., 2015). These determinants begin to be implicated in the manifestation and progression of PDs, such as age, gender, oral hygiene habits, frequency of dental clinic visits, income level, educational attainment, residence place, cigarette smoking, diabetes mellitus, ethnicity, microbiological factors, genetic factors, immunity, social and behavioural factors, and

psychological factors. In turn, oral health studies concentrated on these determinants, especially the modifiable ones (Tonetti et al., 2015).

Most importantly, dental plaque is the principal etiological factor in the pathogenesis of PD. Even though plaque is necessary, it is insufficient to initiate PDs (Zambon, 1996, p. 925; Madiba & Bhayat, 2018). For this, there are various PD patterns, both between individuals and within different sites of the same individual. These varieties can be related to the host response, the modifying effect of various social determinants, and bacterial attack from dental plaque, involving mostly Gram-negative, anaerobic bacteria that grow in subgingival sites (Beirne et al., 2007). On the other hand, calcified plaque (also known as calculus) plays a significant role in the pathogenesis of PD. It acts as a retention web for bacteria and interferes with the ability to perform personal oral hygiene. Studies have shown that microorganisms quickly colonize the tooth surfaces after cessation of oral hygiene practices, and within a few days, microscopic and clinical signs of gingivitis can be observed (Madiba & Bhayat, 2018). Poor oral hygiene leads to an accumulation of pathogenic microbial biofilm (plaque) at and below the gingival margin (Holden, 2018, p. 583; Watt, 2019).

It was reported that destructive periodontitis is consistently more prevalent in males than in females. This trend may be due to the lifestyle choices of males, which include increased alcohol and smoking consumption (Watt & Petersen, 2012). PD has also been reported to be more prevalent among blacks than whites. Blacks have a three times higher risk of periodontal destruction compared with whites of the same age cohort (Gilbert, 2005, p. 1003). The distribution of PD (regarding prevalence and severity) within countries also differs according to race or ethnic group (Madiba & Bhayat, 2018). Other studies have said that biological sex is genetically determined, and there does not seem to be any inherent difference between the two sexes in susceptibility to PD. Occasionally, for decades, it has been recognized that men of all ages, race / ethnic groups, and geographic locations have significantly more PD prevalence than women (Haas et al., 2012). Men had about 50% higher prevalence of periodontitis. Men had 33% more mild, 28% more moderate, and 180% more severe periodontitis than women, and it can be said that men could benefit from being targeted for preventive measures (Genco & Borghnakke, 2013).

To begin with, the relationship between SES and the prevalence of oral diseases. It must be noted that there are over 5 million people globally suffering from severe periodontitis, with a 3.8% increase in the number of all age-disability-adjusted life-years for PD from 1990 to 2016 (Kassebaum et al., 2017; Needleman et al., 2018). Undoubtedly, the prevalence and severity of these PDs follow a social gradient where disadvantaged populations, such as those with fewer years of education, are more commonly affected by oral diseases (Persson, 2008, p. 71). Also, oral conditions disproportionately affect impoverished and socially disadvantaged members of society. Indeed, PDs can be considered a sensitive clinical marker of socially disadvantaged groups and an early indicator of ill health that is linked to deprivation (Watt et al., 2018; Watt & Sheiham, 2012). Those results align with the findings of the studies by Susin et al. (2005) and Madiba and Bhayat (2018). These studies confirmed

that poor gingival health is more prevalent in people with a low SES. For instance, gingival health is better among more highly educated individuals because they are more aware of their gingiva and have greater control over oral hygiene. Reaffirming this result, Moalusi (2018) postulated that individuals with more secure jobs and incomes tend to have better gingival health. Indeed, economic conditions, poor education, and low levels of knowledge can indicate that the prevalence of PDs is likely to increase in the next few years. This dramatic increase in PDs may burden the public oral health sector (Madiba & Bhayat, 2018).

As mentioned earlier, the prevalence of PD is estimated to be the 11th most prevalent disease Worldwide, with an overall prevalence of 7.4% and around 538 million people affected. Indeed, PD can occur at any age (Mârpu et al., 2013; Olubukola Popoola et al., 2015). Those results come in line with findings that gingivitis is almost a universal finding in children and adolescents, and destructive periodontitis is of lower prevalence in younger individuals when compared with adults (Folayan et al., 2015). Similarly, the overall prevalence of periodontitis increases with age, and the incidence rises steeply in adults aged 50-60 (Billings et al., 2018). The burden of periodontitis is expected to continue to increase with the growing ageing population and the subsequent rise in tooth loss (De Pablo, 2009, p. 44; Benjamin, 2010, p. 158). Not only does the prevalence of PD increase with age, but also the extent and severity of PD usually increase with age (Watt & Petersen, 2012). Until the age of 70, the rate of periodontal destruction remains constant throughout adulthood; age per se is not a risk factor for individuals under 70 (Tonetti et al., 2017; Madiba & Bhayat, 2018).

Above all, systemic diseases can negatively impact the host's defense systems. As a result, these illnesses can serve as a risk factor for PD. Numerous studies validate this connection between oral health and various chronic conditions. The strongest association is between PD and diabetes mellitus (Madiba & Bhayat, 2018). PD is recognized as the sixth most prevalent complication associated with diabetes (ibid). Baudet et al. (2020) suggested that the previously mentioned correlation indicates that bacteria responsible for degrading the tissue supporting teeth and resulting in tooth loss can influence the immune response beyond the oral region and promote the onset of systemic diseases once they enter the bloodstream. "Keystone pathogens" such as *Porphyromonas gingivalis*, *Tannerella forsythia*, *Treponema denticola*, and *Aggregatibacter actinomycetemcomitans* are identified as the main pathogens in periodontitis (PD). These pathogens have also been found in blood, coronary atheromatous plaque, the placenta, and the brains of individuals with Alzheimer's disease. Consequently, periodontitis has been linked to numerous systemic illnesses such as cardiovascular disease, diabetes, negative pregnancy outcomes, Alzheimer's disease, oral and colorectal cancers, respiratory infections, bacterial pneumonia, and rheumatoid arthritis (ibid).

Numerous studies have documented a consistent link between smoking and the loss of periodontal attachment (Haber, 1993, p. 12). Smoking serves as a major risk factor for future tooth loss. The relationship between acute necrotizing ulcerative gingivitis and tobacco use has been noted since 1947. In the following decades, many studies have shown a correlation

between cigarette smoking and various periodontal measures (Bergström & Preber, 1994). Generally, smoking accounts for more than 50% of PD cases. These findings support those of Deutsch (2008, p. 29), who reported that smokers were five times more likely to experience a periodontal emergency compared with non-smokers. PD is more prevalent, extensive, and severe among current smokers and occurs least among those who have never smoked. It has been demonstrated that long-term smokers have higher PD rates, and this is true even with cannabis smoking, indicating that it is the act of smoking itself, rather than any specific trait of tobacco, that is responsible for PD formation and progression (Thomson & Sheihamt, 2012). On the other hand, poor oral hygiene in smokers compared with nonsmokers was proven, and this probably accounts for the prevailing concept that smoking is not a risk factor for periodontitis and oral hygiene, which would account for the differences in the levels of PD between smokers and nonsmokers. This concept was then refuted by multivariate data analysis, with adjustments for confounders such as plaque levels. Indeed, longitudinal studies also confirmed the benefits of smoking cessation on PD. The studies indicated that individuals with periodontitis who did not smoke for the entire duration of the study experienced a notable decrease in probing depths compared to those who continued smoking. Additional follow-up research showed that the advancement of alveolar bone loss was significantly less in participants who had quit smoking during the study as opposed to those who remained smokers. Despite this, there remains a need for extended research concerning nonsmokers and those who have quit smoking to better understand the impact of smoking cessation on periodontal health. However, existing studies on smoking cessation and the contrasts between smokers and nonsmokers strongly indicate that a component of managing periodontal disease should include efforts to promote smoking cessation. (Genco et al., 2013). Finally, Low doses of nicotine cause peripheral vasoconstriction, which is linked to impaired microvascular response. Reduced oxygen tension in the periodontal pocket favors the overgrowth of anaerobes. This can, in turn, lead to decreased gingival bleeding in smokers compared with non-smokers. Additionally, smoking can disrupt neutrophil function, primarily by inducing neutrophil degranulation and increasing their sensitivity to bacterial challenges (ibid).

2.3 Literature Review

In 2004, Nigerian studies indicated a notably high prevalence of deep pockets among young Nigerians (Akpata, 2004, p. 361). Whereas, by 2009, the prevalence of PDs among Nigerian adults was 84.2%. These results align with findings from Benin City, where the prevalence of gingivitis was 99.2% among adolescents, indicating a high prevalence of gingivitis and heavy calculus deposits, accompanied by noticeable harm to the periodontal tissues (Odai et al., 2009). Similarly, Popoola et al. (2015) found that only 0.5% of Nigerian adolescents had a healthy periodontal status, exhibiting a significant occurrence of negative changes in periodontal tissue. The study also confirmed that approximately 90% of the sextants assessed were affected by PD, with the number of sextants involved varying significantly according to SES. Indeed, gingival ill health is widespread among Nigerian adolescents, highlighting the need for oral hygiene education and regular teeth cleaning in these groups. Despite the valuable contributions of these studies in highlighting the substantial burden of PD in

Nigeria, they heavily rely on the CPI index and fail to adequately explore the underlying behavioral, environmental, and socioeconomic factors that may explain the extremely high levels of gingivitis and calculus reported among adolescents and adults. The lack of data on key aspects such as oral hygiene habits, dietary practices, access to preventive dental care, and broader social conditions leaves significant explanatory avenues unaddressed. As a result, although the evidence from Nigeria emphasizes the magnitude of the problem, it does not clarify why these periodontal conditions are so widespread. This reveals a critical gap that warrants further investigation in similar low- and middle-income contexts, including Palestine.

Likewise, Susin et al. (2014) studied the epidemiology and demographics of aggressive periodontitis, revealing that its prevalence in Europe ranges from 0.1% to 0.2%. In North America, the prevalence ranges from 0.5% to 2.7%. In South America, it varies from 0.3% to 3.7%. In Asia, the range is 1.8% to 5.9%, while in Africa, it is 0.7% to 8.6%. The studies above also highlighted two main points: firstly, that periodontitis is a significant health concern across all populations, and secondly, that there is a need for more data on the epidemiology of all types of PD in many parts of the world. The work of Susin et al. (2014) offers valuable global insights into the epidemiology of aggressive periodontitis across various continents. However, the substantial variation in prevalence estimates indicates considerable methodological inconsistencies across studies, particularly in case definitions and diagnostic criteria. This makes it challenging to draw direct comparisons across regions and suggests that the true global burden of the disease may be either underestimated or overestimated, depending on the population studied. Additionally, the review primarily reports prevalence ranges without exploring the behavioral, environmental, or socioeconomic factors that could explain the observed differences between countries.

The case-control study by Ababneh et al. (2019) involved 162 patients attending the Jordan University of Science and Technology in Irbid. The participants included in this study were 14 years or older. The disease group consisted of 81 patients with aggressive periodontitis, while the control group included 81 subjects free of periodontitis. Each participant completed a questionnaire covering age, gender, occupation, education level, family history of periodontal problems, smoking status, and oral hygiene habits. A full-mouth periodontal examination was conducted, including measurements of the Clinical Attachment Level (CAL), the Löe and Silness Gingival Index (GI), and the Silness and Löe Plaque Index (PI). For CAL measurement. The study found that females were four times more likely to have the aggressive type of periodontitis compared to males. The study also confirmed that age was the strongest indicator of periodontitis because subjects over 35 years old were about ten times more likely to have the aggressive type of periodontitis than the younger group under 35 years. Regarding oral hygiene practices and frequency of dental visits, most subjects in both the disease and control groups reported brushing their teeth at least once daily; the highest percentage of patients with periodontitis reported using a vertical (scrub) method. In contrast, the highest percentage of controls reported using a simple circular method. Most subjects reported attending dental clinics only for emergency treatment. About

22% of aggressive periodontitis cases and 8.85% of controls reported attending dental clinics regularly. Sixty percent of aggressive periodontitis patients and 17.3% of controls reported smoking. However, these smokers among patients were light smokers (< 10 cigarettes/day) and had smoked for less than five years. In the control group, 71.4% reported smoking 10 or more cigarettes daily, with about 43% having smoked for over five years. This indicates a significant difference between aggressive periodontitis patients and controls regarding the number of cigarettes smoked daily. Ababneh et al. (2019) offer significant epidemiological insights, but the case-control approach limits causal conclusions, and the clinic-based population restricts its applicability to the general public. Furthermore, depending on self-reported behaviors, such as brushing techniques and smoking habits, can introduce reporting bias. The research primarily examined biological and behavioral aspects, overlooking broader social determinants and leaving key contextual factors regarding periodontal health unaddressed.

Pulikkotil et al. (2020) case-control study in Rajnandgaon in the state of Chhattisgarh, India. The cluster sampling approach was designed to include 3,000 people. Cases and controls were matched concerning age, gender, and income. A total of 851 cases of periodontitis were identified at a prevalence of 28.37%. Moreover, the study identified six predictors of periodontitis: education (less than or equal to 12 years of schooling), alcohol consumption, non-vegetarian diet, non-milk consumption, non-use of a toothbrush to clean one's teeth, and infrequent toothbrushing (less than once a day). Alcohol consumption is reported to affect bone metabolism and play an essential role in extensive bone loss. Consumption of a non-vegetarian diet and non-consumption of milk were significant risk factors for periodontitis. High-meat and high-fat diets may be associated with decreased reactive oxygen species production, reduced oxidative damage to mitochondrial DNA, lower cytokine production, and improved metabolic parameters, such as blood glucose and insulin sensitivity, which may be protective against periodontitis. Finally, this study indicated that dental plaque is the primary etiologic agent in the initiation and progression of gingival and periodontal disease. Daily cleaning of one's teeth was a significant factor in the initiation and progression of periodontitis. Although the study by Pulikkotil et al. (2020) provides important evidence on behavioural and dietary predictors of periodontitis, its cross-sectional design precludes determining whether these factors truly precede disease development. The heavy reliance on self-reported diet and oral hygiene practices may also introduce recall and reporting bias. Additionally, while the large sample size strengthens the findings, the study did not assess other contextual influences, such as access to preventive care, cultural habits, or environmental conditions, which limits understanding of why these predictors vary across different groups.

A cross-sectional study by El Fadl et al. (2021) was a population-based face-to-face survey conducted under the auspices of the Central Administration of Dentistry, Egyptian MOHP (WHO, 2014). The sample size was determined based on Egypt's 2013 Census dataset, provided by the Egyptian Central Agency for Public Mobilisation and Statistics. A total of 10,144 adults aged 20 years participated in this study. This survey employed a stratified multi-stage clustered random sampling approach. A structured questionnaire gathered participants' characteristics and potential risk behaviours for PD. Additionally, the dental

examination was performed using the WHO's basic methods for oral health surveys (Petersen & Baez, 2013). The study found that 26% of Egyptian adults had a mild form of periodontitis, while 3.2% had a severe form. Only 7% exhibited healthy gums with no bleeding or probing. Bleeding and calculus formation were more common among females, whereas periodontal destruction was more frequently observed among males, less-educated participants, and those aged 45 and above. In other words, adult males who smoke and are illiterate face a higher risk of developing periodontitis. Old age was also a significant risk factor, with the Community Periodontal Index score three being 37.69% among adults aged 35 and over. Conversely, young adults had significantly lower odds of having periodontitis than those aged 35–44 years, with $OR = 0.37$. Indeed, multivariate logistic regression identified poor oral hygiene practices, old age, low educational attainment, and smoking as strong predictors of periodontitis within the Egyptian population. This study presented strong evidence regarding periodontal conditions in Egyptian adults; however, its dependence on the CPI restricts the capacity to identify previous periodontal damage or loss of clinical attachment. While the study offered important estimates of prevalence, it primarily concentrated on descriptive patterns and did not thoroughly examine the behavioral and social factors that contribute to these results. Furthermore, the exclusion of adolescents from the survey creates a notable gap in the understanding of periodontal disease patterns among younger demographics in the area.

Periodontitis has been proposed because of chronic heart disease (CHD), and vice versa. CHD is considered a risk factor for all types of PD. Most importantly, these CHD diseases can initiate and exacerbate periodontal conditions. In this context, the purposes of the Vedin et al. (2015) study were to explore the prevalence of self-reported PD indicators in high-risk populations and to investigate their associations. The study population consisted of participants from the global STABILITY trial, which included 15,828 participants from 39 countries globally. All patients had CHD (prior myocardial infarction), prior coronary revascularization, or multivessel CHD without revascularization, with at least one additional risk factor: age 60 years, diabetes mellitus, high-density lipoprotein, current or previous smoker, or significant renal dysfunction. Medical history and fasting blood sample results were obtained from baseline. Participants underwent a physical examination and completed an extensive lifestyle questionnaire. This study found that there was a high prevalence of periodontitis among patients with CHD, even if the heart disease is controlled, compared with healthy individuals, after adjusting for major confounders. This study also confirmed that the differences in CHD risk factor prevalence can explain the regional variation in periodontal prevalence. This study concluded that disagreements in PDs exist between countries and between ethnic groups, indicating a complex relationship in which demographic, genetic, and socioeconomic disparities likely contribute. This study provided valuable global evidence linking periodontal indicators to cardiovascular disease; however, its reliance on self-reported periodontal measures rather than clinical examinations limits the accuracy of the reported periodontal status. Additionally, the sample consisted solely of high-risk (CHD) patients, which restricts the generalizability of the findings to the broader population. While the study highlights important associations, it overlooks behavioral and

socioeconomic factors that may influence both conditions, leaving key explanatory pathways insufficiently explored.

Again, age is acknowledged as a risk factor for periodontitis. Children and adolescents are usually affected by milder forms of PD. Although severe destructive periodontitis is less common among adolescents, this mild form can develop into a more severe form of PD because the inflammatory process can be reversed by modifying socio-behavioural determinants, such as health-related behaviours (Bali et al., 2004). Reaffirming these results is evident in the Baiju et al. study (2019), which aimed to estimate the prevalence of PD among adolescent students and analyze its predictors. Fifteen-year-old school students were examined using the Community Periodontal Index criteria (WHO, 2013) in an oral examination. Sociodemographic data (place of residence, school type, family income, mother's education, and employment) and oral health behavioural data (brushing technique, frequency, timing of last dental visit) were also collected. Multistage cluster sampling was employed across five districts. The study found that the prevalence of gingival bleeding was 42%, and the adolescents who were from rural backgrounds had a significantly higher proportion of gingival bleeding when compared to their urban counterparts. Also, gingival bleeding was more prevalent among adolescents in government schools when compared to students in private schools. On the other hand, sociodemographic factors such as place of residence, type of school, mother's education, frequency and status of oral hygiene emerged as significant predictors of gingival bleeding. Oral hygiene status demonstrated the highest odds ratio with PD (3.34). This, in turn, means that plaque is the primary inducer of gingival inflammation within adolescents. However, the prevalence of periodontal pockets was lower among adolescents than that of gingival bleeding. Nevertheless, 13.8% of participants had pockets measuring more than 4 mm. Only four students (0.4%) reported pockets 6 mm or more in depth. Again, students from a rural background reported more periodontal pockets than those from urban backgrounds. The studies mentioned above provide valuable insights into issues such as gingival bleeding, plaque buildup, and early signs of periodontal changes among adolescents. However, their dependence on the CPI limits their ability to detect prior periodontal damage. Most findings are descriptive and do not explain the reasons behind the behavioral and sociodemographic variations seen across different populations. Moreover, the cross-sectional design of these studies limits our capability to draw causal conclusions, and important cultural or contextual factors are often overlooked. These limitations highlight the need for more comprehensive research on adolescents that incorporates behavioral, social, and clinical elements using standardized methods.

Above all, the 2016 national survey on dental diseases in Japan indicated that 71.6% of young individuals aged 15-24 had gingivitis (pocket depth ≥ 4 mm). More than 50% of individuals at the age of 50 were found to have periodontal disease (PD), showing that the prevalence of PD rises with age. Compared with a 2011 survey, Japan saw an increase in PD prevalence across all age groups (JMoH, 2017). Similarly, the study by Haresaku et al. (2023) assessed the prevalence of PD and its contributing factors among high school students. The study involved participants aged 15-18 from a private high school located in

Fukuoka City, in southwestern Japan. The questionnaire was divided into four sections: participant demographics, subjective oral issues, perceptions of oral health, and oral health practices. Findings revealed that the prevalence rates for gingival bleeding, calculus, pocket depths of 4-5 mm, and pocket depths of 6 mm or more among the students were 44.2%, 42.2%, 11.4%, and 1.6%, respectively. In contrast, the prevalence rates for gingival bleeding, calculus, pocket depths of 4-5 mm, and 6 mm in the posterior teeth were 26.4%, 3.1%, 10.5%, and 1.4%, respectively. The research further showed that the incidence of gingival bleeding was significantly higher among students who did not visit the dentist regularly compared to those who did. The prevalence of calculus was notably higher among male students and among those who feared dental treatment, consumed a lot of sugary foods, and frequently drank sports beverages compared to their counterparts. Furthermore, students who brushed their teeth for 5 minutes or longer and used dental floss showed significantly lower rates of gingival bleeding than those who did not. In other terms, brushing for 5 minutes or more, using dental floss, and maintaining regular dental appointments were found to be negatively correlated with the presence of calculus, with odds ratios of 0.74, 0.72, and 0.70, respectively. Conversely, an 11.6% prevalence of pocket depth of 4 mm or more was recorded among the students, with most pockets being confined to the posterior areas. Additionally, regular visits to the dentist were negatively associated with calculus formations and abnormal pocket depths (4-5 mm). Moreover, both the prevalence of calculus and pocket depths of 4 mm or greater were higher among male students than among female students. These results imply that lower awareness and less adequate behaviors may play a role in the elevated prevalence of PD among males. While Japanese research provides valuable insights into gingivitis and pocket depth in adolescents, its reliance on self-reported behaviors and CPI-based examinations limits the accuracy of periodontal evaluation. Much of the information is descriptive and does not thoroughly clarify why specific behavioral patterns, like infrequent dental visits or treatment anxiety, differ across genders and social groups. Additionally, these studies are conducted in schools and may not accurately reflect the experiences of adolescents nationwide. Consequently, critical contextual and socioeconomic factors influencing periodontal disease remain inadequately examined.

In Norway, over 50% of the adult population aged 20 to 69 years had periodontitis, with a 62% prevalence rate. The prevalence of periodontitis in Norway was mainly linked to two factors: geographical region and oral hygiene practices, rather than ethnic background (Holst et al., 1988). Recent studies in Norway involving individuals aged 35 and older reported a decline in the prevalence of periodontitis among adults aged 20 to 80, dropping from 57% in 1983 to 40% in 2013 (Hugoson et al., 1998; Skudutyte-Rysstad et al., 2007; Wahlin et al., 2018); however, the rates of severe periodontitis have remained relatively stable during the same period, at 16% in 1983 and 11% in 2013 (Wahlin et al., 2018). These findings are consistent with those of Bongo et al. (2020), who examined the prevalence of PD and associated risk factors in Northern Norway. The study found that the majority of respondents brushed their teeth at least twice daily, with only about 10% reporting brushing less than once per day. Bone loss ranged from 15% to 33%. Nevertheless, the prevalence and severity of periodontitis among the Norwegian population tended to rise with age. Conversely, the

incidence of severe periodontitis appeared to decrease with higher educational attainment and longer years of schooling, while men exhibited more aggressive periodontitis than women. Additionally, this study suggested that the likelihood of experiencing severe periodontitis (Stages III/IV) was related to smoking habits and how often individuals visited dental services each year.

While the Norwegian studies provide valuable long-term data on periodontal trends, they are constrained by their focus on high-income populations. The oral health behaviors, access to care, and lifestyle factors characteristic of these populations differ significantly from those in lower-resource settings. Consequently, the findings, although comprehensive, are not readily applicable to regions with distinct social and behavioral profiles. Furthermore, the sole emphasis on clinical indicators fails to adequately address the broader contextual determinants that influence oral health outcomes.

In brief, the etiology of PDs is multifactorial. The accumulation of bacterial plaque that consists of pathogenic bacteria such as *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Prevotella intermedia* is considered the essential factor for the initiation and development of PD (Timmerman & Weijden, 2006). However, bacterial plaque accumulation alone does not lead to disease formation. Indeed, host susceptibility is also a determining factor in whether a person is affected by PDs. Additionally, several social determinants specific to certain populations often influence the development and progression of periodontitis (Timmerman & Weijden, 2006; Pulikkotil et al., 2020). Oral hygiene practices, smoking, and nutrition appear to influence the host's immune response to periodontal infection and determine susceptibility to it. (Van Dyke & Shailesh, 2005). In addition to plaque, diabetes mellitus is a significant risk factor for periodontitis in many populations (Van Dyke & Shailesh, 2005). Other social determinants include gender, race/ethnicity, genetics, socioeconomic status, osteoporosis, and psychological factors (Van Dyke & Shailesh, 2005). Different populations have developed various practices that can influence the development and progression of periodontitis and may serve as risk factors (Pulikkotil, 2012). Researchers must grasp the intricate connection between these risk behaviors and PD in a population. The occurrence of periodontitis differs across various regions globally, probably because of variations in risk factors and the criteria used for case definitions. (Shaju et al., 2011; Pulikkotil, 2012; Pulikkotil et al., 2020).

2.4 Oral Educational programs in Literature

Generally, oral health promotion aims to establish supportive environments, enhance community engagement, develop individual competencies, and realign healthcare services (Niranjan et al., 2017). These programs are typically designed to raise awareness and encourage individuals to adopt practices that contribute to optimal oral health. Oral health promotion efforts often focus on communities, schools, workplaces, and healthcare settings. Common initiatives within oral health promotion usually include:

Educational Campaigns: These initiatives aim to provide comprehensive information regarding proper oral hygiene practices, the importance of regular dental check-ups, and the impact of diet on oral health. Educational materials may encompass brochures, pamphlets, posters, and online resources.

Media Campaigns: These initiatives use multiple media platforms, including television, radio, social media, and websites, to spread oral health messages and encourage the adoption of good oral hygiene practices.

Dental Care Access Initiatives: Initiatives that improve access to affordable dental services, especially for marginalized communities, significantly encourage oral health.

Behaviour Change Interventions: Strategies implemented to encourage individuals to adopt positive oral health behaviours include regular toothbrushing, flossing, and limiting sugary foods and beverages.

School-Based Programs: Initiatives within educational institutions focus on educating children and adolescents about oral hygiene practices, the importance of maintaining a balanced diet, and the prevention of dental issues. Such programs typically involve classroom presentations and dental screenings (Bracksley-O'Grady et al., 2015). One specific effort to enhance adolescents' periodontal health is the implementation of school-based oral health promotion programs (WHO, 2003). Furthermore, these programs can significantly improve access to dental services for children, particularly those from disadvantaged socio-economic backgrounds (Gargano et al., 2019).

Several school-based oral health promotion programs have been proposed, including oral health education, toothbrushing activities, the provision of fissure sealants, and various treatments (Bramantoro et al., 2021). Research shows that children participating in toothbrushing programs with fluoride toothpaste have significantly lower plaque and gingival index scores (Jackson et al., 2005). Additionally, using engaging methods, such as games, to deliver educational content leads to better oral hygiene outcomes and improved knowledge compared with other promotional efforts (Makuch & Reschke, 2001; Bramantoro et al., 2021).

Wu et al. (2021) investigate the effects of oral health education on periodontal health among dental students at Sichuan University in China. A quasi-experimental study with a pre-test and post-test group design was employed for this research. Traditional periodontal health education was arranged as a 90-minute session. In addition to oral hygiene instructions, the education program in this study included a thorough explanation of the aetiology, signs, and symptoms of PD and their relation to systemic conditions in the human body. The study found that all students improved their knowledge of PD and paid greater attention to their gingival bleeding. Additionally, the study found improved brushing skills, which positively affected their periodontal condition.

Oral health education represents a vital primary preventive strategy (Bhardwaj et al., 2016). Effective education is a fundamental prerequisite for achieving optimal oral health and implementing appropriate oral hygiene practices. Typically, oral health education programs aim to enhance and modify oral health care behaviours within the population (Poklepovic et al., 2013). These programs have demonstrated efficacy for both children and adults, establishing sound practices in personal dental care that ultimately reduce the prevalence of oral diseases (Williams, 2014, p. 51; Fraihat et al., 2019).

Preventing PD primarily focuses on two key areas: promoting oral hygiene practices, such as toothbrushing, flossing, and using mouth rinses, and identifying individual determinants and behaviours. Nevertheless, population-based strategies aimed at preventing PD have been relatively scarce both globally and regionally. To date, the only documented approach has been the implementation of "mass awareness" campaigns, which emphasise the importance of oral hygiene and advocate changes in individual practices (Zusman et al., 2015, p. 44).

The study conducted by Almadadi et al. (2021) aimed to examine the impact of an oral health education program as an adjunct to standard routine restorative care on clinical parameters of PD. This investigation was structured as a randomized, examiner-blind clinical trial and took place at the Logan Hospital Oral Health Care Clinics in Queensland, Australia. Participants were recruited from an existing public patient list for routine dental care, as well as those seeking emergency dental attention. Alongside baseline and follow-up assessment data, the researchers collected demographic information, medical histories, and pertinent physical parameters. All participants underwent a baseline oral examination, which included probing pocket depth (PPD) and bleeding on probing assessed at six sites per tooth, in conjunction with a plaque index measurement. Following the initial visit, participants were randomly assigned to either the intervention or control group. Those in the intervention group received referrals to the Personalised Oral Health Education Program prior to undergoing routine dental treatment. Using a layered approach, these participants were provided with oral hygiene instructions encompassing toothbrushing techniques (specifically the Bass Technique) and interdental cleaning methods. The findings indicated a significant reduction in plaque index scores for both intervention and control groups, with scores decreasing from 77.17% to 69.02% and from 80.48% to 72.31%, respectively. Additionally, there was a notable decrease in the percentage of sites with positive BOP between the baseline and subsequent visits in both groups. These results suggest that oral health education programs can enhance BOP and PD management. Nevertheless, the observed changes, though significant, may be influenced by SES, which has been previously identified as a factor affecting health behaviour modification in intervention outcomes (Wilkinson & Marmot, 2003).

Effective dental health education should encompass oral health instructions and strategies designed to eliminate plaque. Numerous studies have demonstrated the effectiveness of health education in managing plaque and associated dental diseases. Thus, health education programs should not be viewed as isolated events; instead, they are integral components of

all curative, preventive, and promotional health initiatives (Ajithkrishnan et al., 2010). This viewpoint is consistent with the results of Bhardwaj et al. (2016), which assessed the effects of oral health education on plaque buildup and gum health in children aged 12 to 15 years enrolled in a government school in Shimla. A total of 300 children of both genders participated in the study, which spanned four months. All children present on the day of the examination and willing to participate were included. In contrast, individuals who received antibiotic treatment within 30 days prior to the examination and those who were absent on the day of assessment were excluded. The study revealed that a substantial majority of school children (93.1%) used toothbrushes, with 220 participants (79.7%) brushing their teeth once daily. Furthermore, it was observed that 89.8% of the children employed toothpaste. Notably, 236 participants (91.8%) practised an incorrect horizontal brushing technique, whereas only 21 individuals (8.2%) adopted the vertical brushing method. The research indicated a significant reduction in both plaque and gingival index scores among the 12 and 15-year-old subjects, regardless of gender. This reduction is likely attributable to increased toothbrushing frequency and the adoption of proper brushing techniques following oral health education.

Short-term oral health education programs have the potential to enhance oral hygiene and gingival health. However, the long-term efficacy of these programs may wane, particularly if oral hygiene resources are not easily accessible to the general population. Therefore, it is advisable to conduct these educational programs annually in schools, while also offering oral hygiene aids at reduced prices. In a related study by Jeihooni et al. (2017), further insights were gained regarding the effects of oral health education, grounded in the Health Belief Model, on the adoption of oral health behaviours among 110 women attending Fasa Health Centres over a five-month period. Participants were randomly allocated into experimental and control groups, and dental educational sessions were organised weekly throughout the study duration. The findings illustrated that providing health education has a significant influence on individuals' perceptions of oral health threats, benefits, barriers, self-efficacy, knowledge, and cues to action. Consequently, the educational interventions demonstrated success in enhancing the knowledge of participants in the experimental group compared to their counterparts in the control group. Post-intervention, a significant number of women in the experimental group expressed an increased awareness of their potential risk for PD. This augmented knowledge empowered them to adopt more appropriate oral health practices.

Additionally, the implementation of educational posters and effective message framing, tailored to cultural contexts (Young et al., 2014), significantly contributed to an improvement in knowledge regarding sound oral hygiene practices. Furthermore, the necessity of repetition and reinforcement of oral hygiene aids, coupled with close monitoring, was emphasised, particularly when introducing unfamiliar oral hygiene protocols (Chandrashekar et al., 2014). Numerous studies have demonstrated the higher effectiveness of model-based education methods compared to traditional ones. Model-based education usually includes the most effective factors in behaviour change (Ghahreman et al., 2014). In other words, well-structured and well-prepared educational sessions can lead to practical training through understanding the causes of the problem, providing an approach to

achieving the goal, and identifying what is to be achieved at the end of the program (Ardekani et al., 2022).

Most studies indicate that intervention programs yield positive outcomes, particularly those that encompass oral hygiene education for children, teachers, and parents, as well as supervised toothbrushing and the provision of fluoride toothpaste and toothbrushes. Engaging school students in oral hygiene instruction through interactive and enjoyable activities, along with active participation from teachers, proves to be highly effective and is critical to the success of these programs. This finding suggests the necessity for oral health training programs specifically designed for educators (Bramantoro et al., 2021).

Subedi et al. (20121) conducted a study to evaluate the effectiveness of oral health education on the knowledge, attitudes, practices, plaque control, and gingival health of school children aged 12 to 15 years. This investigation was designed as a randomized, controlled, concurrent parallel trial and was carried out from October 2017 to September 2018. The participants consisted of students in grades 8 and 9 from both public and private schools located in the Dharan sub-metropolitan area, Nepal. The primary findings of the study revealed a significant increase of 54.58% in overall oral hygiene knowledge, attitudes, and practices within the experimental group, while the control group exhibited negligible changes. This indicates that oral health education effectively enhances good oral hygiene practices, thereby contributing to improved plaque control and gingival health. Moreover, oral hygiene knowledge saw an appreciable increase of 77.51% in the experimental group compared to just 6.6% in the control group, relative to baseline metrics. Notably, the experimental group showed a 57.67% reduction in mean plaque index scores, whereas the control group demonstrated a 4.56% decrease. Additionally, the mean gingival index in the experimental group decreased by 40.90%, in stark contrast to the control group, which exhibited minimal change following six months of oral health education. The study emphasised that the repetition and reinforcement of oral health education programs are essential for sustaining positive verbal health behaviours.

With over 1.1 billion smokers worldwide (WHO, 2018), tobacco has emerged as a substantial public health challenge. One effective health promotion strategy for tobacco control involves implementing interventions through peer education in small groups, facilitating the sharing of experiences and information to encourage positive behaviour change (Golechha, 2016, p. 7). In this context, the study conducted by Al Abdullah et al. (2019) aimed to assess the impact of an oral health education intervention on smoking behaviour among male Saudi adolescents. This interventional research took place with participants drawn from male public high schools (grades 10-12) in Dammam, Saudi Arabia. A multistage random sampling method was employed to select a sample of 492 participants from five schools. The participants engaged in educational sessions that addressed the detrimental effects of smoking on oral health. They provided data regarding their smoking habits, family history of smoking, and awareness of the impact of tobacco on oral health through a baseline questionnaire. The research team meticulously developed and reviewed

this questionnaire, ensuring its face validity by assessing feasibility, consistency, clarity of wording, layout, style, and readability. Data collection occurred after two sessions of oral health education. The findings indicated that 31.7% of the students were smokers, revealing a concerning prevalence of smoking, considering the prohibition of tobacco sales to individuals under the age of 18. Additionally, the study found that 60.6% of the participants had at least one smoker in their family. Despite the educational intervention, the study discovered no significant reduction in smoking prevalence among participants, which may be attributed to the limited number of educational sessions conducted over a brief timeframe. However, there was a notable improvement in awareness regarding the effects of smoking on oral health following the educational intervention.

It is worth mentioning that a diet with low carbohydrates, more omega-3, fatty acids, more vitamins C and D, antioxidants, and fiber can reduce periodontal inflammatory parameters (Chapple, 2009, p.178). In contrast, higher levels of fiber and lower levels of fat in the diet can improve markers of periodontitis in high-risk subjects (Kondo et al., 2014). In general, dietary antioxidants have beneficial effects on gingival and periodontal inflammation by modulating host immune responses (Chapple, 2009, p. 178; Kondo et al., 2014; Mazur et al., 2021). Carbohydrates can alter microbial diversity and directly affect periodontal ligament cells. Saturated fatty acids are suspected of increasing oxidative stress and promoting periodontal damage. In this context, the study of Altun et al. (2021) was to investigate the relationship between dietary practices and the prevalence of PD in a cohort study. In total, 6209 Hamburg City Health Study participants were selected for the study. Before the general and oral examination, all participants answered a questionnaire regarding their lifestyle (e.g., physical condition and dietary habits). The periodontal cohort consisted of 1453 participants with none/mild periodontitis, and 1176 participants had severe periodontitis. To estimate the effects of healthy dietary patterns, the researcher compared a change in the dietary score. Validated questionnaires were used to collect information on dietary intake. The participants received a complete dental examination (excluding wisdom teeth). Ordinal logistic regression models were applied to determine the association between periodontitis (dependent variable) and dietary patterns (independent variable). This study found that participants with bad dietary habits were more often presented with insufficient oral hygiene (higher bleeding on probing and plaque index score) than participants with controlled dietary habits. This study also confirmed that women of all ages are more often concerned about weight control and dieting, eating lower fat and lower sugar foods, and increasing the intake of fruits and vegetables, in contrast to the men who present with lower health literacy. Consequently, the significant association between bad dietary habits and severe periodontitis may be solely because of the accumulation of poor (oral) healthcare choices.

The Damle et al. (2014) study aimed to evaluate the impact of oral health education and supervised toothbrushing training among urban and rural school children in Maharashtra, India. The Department of Pediatric and Preventive Dentistry in Mumbai conducted this comparative study. Before implementation, the institutional ethics committee and the administrative authorities of the Municipal Corporation of Greater Mumbai approved the

study. One urban and one rural school were selected for the study. Two hundred schoolchildren aged 12-15 years were selected from the two schools using a stratified random sampling technique. The students were further divided into groups: Group A (urban school; Mumbai - 100 children) and Group B (rural school; Arnala - 100 children). The groups were again subdivided into a control group and a study group with 50 children (25 girls and 25 boys). The children of the study groups were taught about the proper method of toothbrushing (bass methodology). This study used dental models, charts, and live demonstrations under the supervision of parents. They were instructed to brush their teeth twice daily for 2 minutes using a peanut-sized study dentifrice (containing 1000 ppm of fluoride). Oral care instructions were specified, which included topics on the importance of oral health, etiology and pathogenesis of oral diseases, methods of oral hygiene maintenance, etc. The dentifrices and toothbrushes were provided to all the children who participated in the study at regular intervals. Intra-examiner reliability of the recorded data was assessed by re-examining 10% of the children after two weeks of the initial examination. The oral health examination was conducted in their respective schools, where they were seated on an ordinary chair, ensuring adequate daylight, supplemented with a torch (3.0 V DC) to facilitate the examination. The plaque score and gingival status were assessed using WHO criteria (1997). Clinical examination after one month of baseline examination and further at three-month intervals was carried out to evaluate the plaque scores and gingival status. The data collected were then subjected to statistical analysis using Cronbach's alpha, Chi-square test, paired t-test, and unpaired t-test. The authors said that visualization, active participation, skill training, and reinforcement are paramount in establishing and altering behavior in a child. Also, this study found that mothers strongly influence their children's toothbrushing habits. This study found that the difference in the mean plaque and gingival index scores from baseline to 3 months of intervention in both study and control groups of urban and rural areas was statistically significant. During three months of examination, the reduction in mean plaque and mean gingival index scores was significantly higher in the study groups than in the control groups in both schools. No statistically significant difference was observed between the rural and urban control groups concerning mean plaque and gingival index score reduction at 1 and 3. Moreover, the reduction in mean plaque score was higher in girls in the control group at three months of examination. The reverse interpretation was accurate for the gingival index score, representing a higher reduction in boys in both the control and urban study groups.

2.5 Evidence brief regarding the selection of oral education in this study

The main objective of school-based educational programs is to provide students with essential knowledge about oral health. These initiatives can successfully deliver oral health information to a large audience in a cost-effective manner (Anqaa, 2022). The information typically includes subjects such as the anatomy of the gums, the importance of practicing good oral hygiene, how dietary choices affect oral health, and the negative consequences of poor habits associated with oral diseases (Sanadhya et al., 2014; Angelopoulou et al., 2015; Lai et al., 2016; Haque et al., 2016; Barros et al., 2017). Research indicates that these

educational programs can significantly enhance students' understanding after exposure to various dental topics (Lai et al., 2016; Barros et al., 2017).

Studies show that school students who receive oral health education generally achieve significantly higher mean scores on oral health knowledge than on their baseline assessments (Angelopoulou et al., 2014). The studies also emphasize the importance of a comprehensive understanding of potential changes in behavioral outcomes resulting from implementing such oral health education interventions (Hartono et al., 2002; Angelopoulou et al., 2014, 2015).

In addition, oral health education has a notable impact on toothbrushing habits. There was a marked improvement in several facets of toothbrushing, including toothbrushing technique, the number of tooth surfaces brushed, brushing frequency, brushing duration, and the selection of an appropriate toothbrush and fluoridated toothpaste (Hartono et al., 2002; Gauba & Bal, 2015). After receiving education, practices such as mouth rinsing and regular toothbrush replacement increased (Haque et al., 2016; Barros et al., 2017). Furthermore, the intervention group had a higher proportion of children who regularly flossed than the control group (Jaime et al., 2015; Barros et al., 2017). Additionally, plaque scores were found to be lower in groups that received education in contrast to those that did not (Sanadhya et al., 2014; Lai et al., 2016), and the improvements in levels of plaque and calculus were more pronounced when the educational sessions were conducted repeatedly (ranging from three sessions to six sessions annually) (Vanobbergen et al., 2004). Oral educational initiatives successfully enhanced the gingival health of students. Those who received education exhibited a reduced incidence of periodontal pocketing (Lai et al., 2016) and had a lower gingival index compared to the control group (Nakre & Harikiran, 2013).

School-based oral education also influences students' dietary choices (Hartono et al., 2002; Makhdoom et al., 2022). Additionally, school-based oral education affects students' eating habits (Hartono et al., 2002; Yang et al., 2009). Following participation in oral education sessions, there was a notable reduction in the frequency of consuming carbohydrate-dense foods, such as candies, chocolates, and sweets. Moreover, increased exposure to education led children to bring healthier food options, such as fruits, to school (Livny et al., 2008). School-based oral education can also affect plaque scores.

On the other hand, the methods for delivering oral education to schoolchildren are also significant. These methods differed from conventional methods, such as class lectures using flashcards, charts, and posters, to more interactive and experiential methods, including game-based activities (Vanobbergen et al., 2004; Kumar et al., 2015) and educational videos (Yazdani et al., 2009). Interactive methods achieved better results than traditional methods (Angelopoulou et al., 2014) and can lead to significantly higher oral health knowledge scores than conventional teaching methods (Maheswari et al., 2014; Kumar et al., 2015). Students exposed to interactive educational methods, such as play-way, flashcards, and experiential learning, had lower plaque and calculus scores than those in the control groups (Angelopoulou et al., 2014).

Similarly, oral health literacy is related to individuals' literacy, knowledge, motivation, skills in accessing, understanding, evaluating, and using health information to make decisions about obtaining healthcare and promoting health (Movaseghi Ardekani et al., 2022). Oral health literacy refers to an individual's ability to obtain and process basic oral health information and access the services necessary to make informed health decisions (Yu et al., 2024). Therefore, low levels of health literacy may be associated with fewer preventive services, delays in diagnosing medical conditions, poor adherence to medical guidelines, inadequate self-management skills, and higher dental costs (Baskaradoss, 2018, p. 2). In contrast, adequate oral health literacy was strongly associated with a better oral health status in all groups (Blizniuk et al., 2015). However, a significant relationship exists between oral health status and health literacy. Promoting oral health literacy can reduce disparities in oral health status among groups (Baskaradoss, 2018). In turn, a relationship exists between low oral health literacy and a higher prevalence of PD (Alzeer et al., 2024).

2.6 Theoretical Framework

A risk factor is any characteristic, behavior, or condition that increases an individual's likelihood of developing a disease or health condition. Although periodontal disease (PD) may occur in the absence of identifiable risk factors, exposure to multiple risk factors or engagement in harmful health behaviors increases the probability of developing PD and may negatively affect treatment outcomes (AAP, 2010; Genco & Borgnakke, 2013).

Based on the literature, the risk factors associated with PD can be categorized into biological, behavioral, and social determinants. Lifestyle-related factors play a major role in the development and progression of PD. Smoking, including cigarette and water-pipe smoking, is strongly associated with increased susceptibility to PD and reduced response to periodontal treatment. Poor dietary habits, particularly diets high in sugar and low in essential nutrients such as vitamin C, may contribute to plaque accumulation and periodontal inflammation. In addition, inadequate oral hygiene practices increase the risk of gingival inflammation and periodontal tissue destruction.

Several systemic and individual factors may also influence periodontal health. Stress may impair the body's immune response and reduce its ability to combat infection. Diabetes is a well-established risk factor associated with increased severity of periodontal disease. Hormonal changes during puberty, pregnancy, and menopause may increase gingival sensitivity and inflammation. Certain systemic and autoimmune conditions may also affect periodontal health. Furthermore, demographic characteristics such as age and sex may influence oral health behaviors, host response, and disease progression. The prevalence and severity of periodontal disease may also vary across different racial and ethnic groups due to social, behavioral, and healthcare-related disparities.

The variables examined in this dissertation were conceptually informed by the World Health Organization Conceptual Framework for Action on the Social Determinants of Health and

the Common Risk Factor Approach (Figure 2.1). These frameworks recognize that health outcomes are shaped by the interaction between structural determinants and intermediary behavioral determinants.

Within the context of PD, structural determinants include socioeconomic status and demographic characteristics, which may influence access to resources, oral health literacy, opportunities for prevention, and health-related behaviors. Intermediary determinants include oral hygiene practices, dietary habits, and smoking behaviors, which are directly associated with oral hygiene status and periodontal health outcomes.

Accordingly, this study proposes that socioeconomic and demographic determinants influence oral health behaviors, which subsequently affect oral hygiene status and periodontal health outcomes. Oral hygiene status was assessed using the (S-OHI), while periodontal status and treatment needs were evaluated using (CPITN).

The application of this framework guided the selection of study variables, the development of data-collection instruments, and the analysis of determinants of PD among students and teachers in the northern governorates of the West Bank. Furthermore, the interactive oral health education intervention implemented during Phase Two of the study was designed to address intermediary behavioral determinants by improving oral health literacy, promoting preventive oral hygiene practices, and increasing awareness within the school environment.

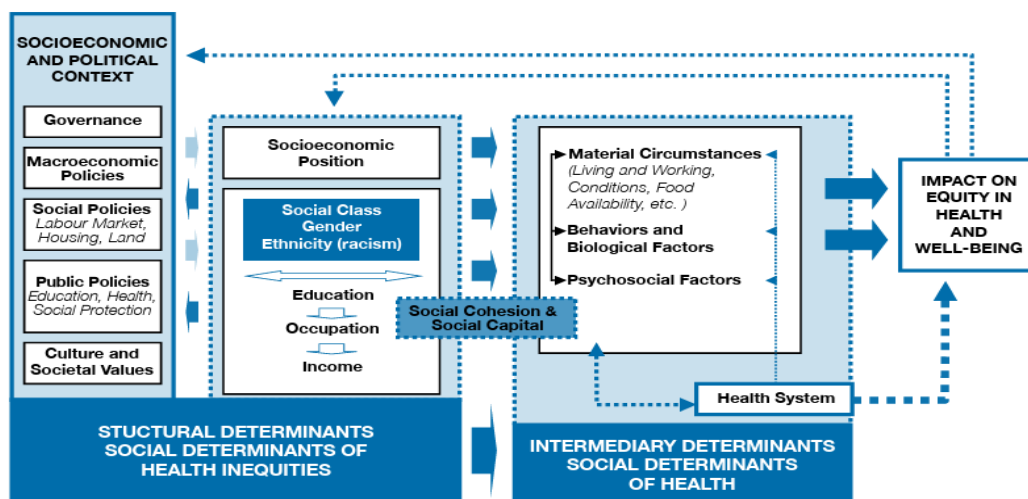


Fig 2.1: A Conceptual Framework for Action on the Social Determinants of Health

2.7 Conceptual Definitions

The study was theoretically informed by the WHO Conceptual Framework for Action on the Social Determinants of Health and the Common Risk Factor Approach. Based on these frameworks, a conceptual framework was developed to illustrate the relationships among the study variables, figure 2.2

A. Predictor Variables

1. Socioeconomic Status (SES): Refers to an individual's or family's social and economic standing within society, typically shaped by income, educational attainment, employment status, and living conditions. SES influences access to resources, health literacy, and the ability to engage in preventive oral-health behaviors.
2. Oral Hygiene Practices: Conceptually defined as routine practices aimed at maintaining oral cleanliness and preventing plaque accumulation, including tooth-brushing frequency, brushing technique, use of fluoridated toothpaste, and interdental cleaning.
3. Dietary Habits: Refers to patterns of food and beverage consumption, particularly the intake of fermentable carbohydrates, sugary snacks, and soft drinks that affect plaque formation and the risk of periodontal inflammation.
4. Smoking Behaviors: Defined as tobacco-related habits, including cigarette or water-pipe smoking—that contribute to systemic inflammation, impaired host response, and increased susceptibility to periodontal disease.
5. Demographic Characteristics: Fundamental participant attributes, such as age and sex, may influence behavioural patterns, host response, and periodontal health.

B. Outcome Variables

1. Periodontal Disease (PD): Conceptually defined as a chronic, plaque-induced inflammatory condition affecting the gingiva and supporting periodontal tissues. PD ranges from reversible gingivitis, characterized by bleeding and inflammation, to periodontitis, which involves connective-tissue attachment loss and destruction of the alveolar bone.
2. Oral Hygiene Status: Refers to the general cleanliness of the oral cavity, represented conceptually by the presence or absence of dental plaque and calculus, which are primary etiological factors in periodontal inflammation.
3. Community Periodontal Index of Treatment Needs (CPITN): A conceptual framework for classifying periodontal conditions based on bleeding, calculus accumulation, and pocket depth, reflecting the level of periodontal health and the required treatment.

4. Simplified Oral Hygiene Index (S-OHI): Conceptually defined as an index that reflects an individual's oral cleanliness based on debris accumulation and calculus deposits on specific index teeth.

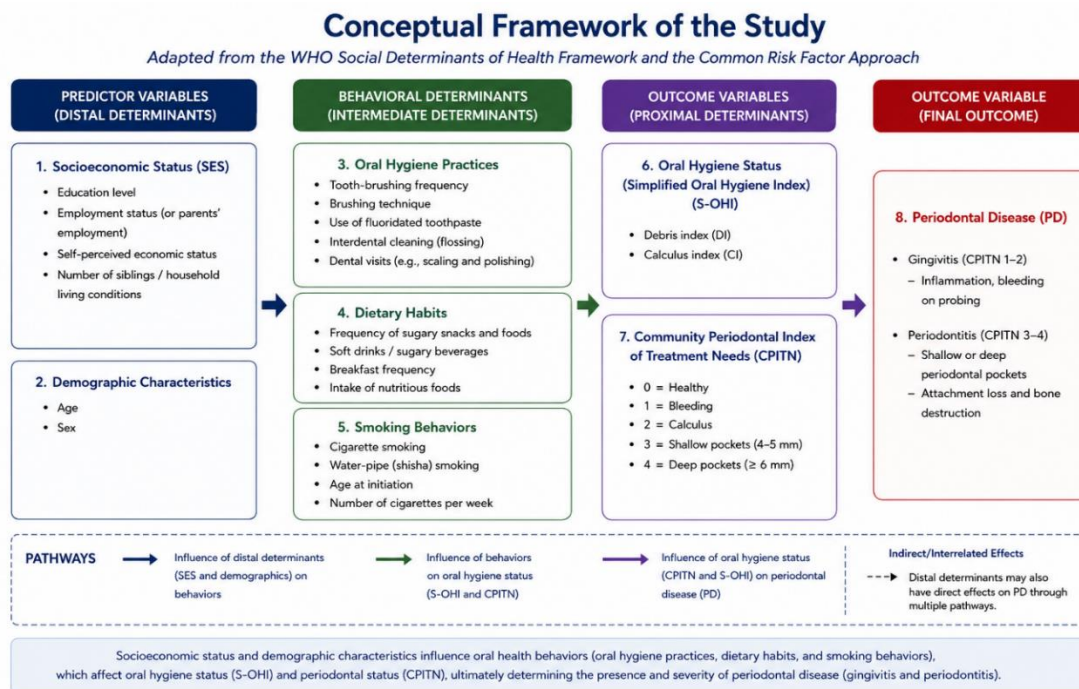


Fig. 2.2 illustrates Phase One of the Study

1. Conceptual Framework of the Study

2.8 Operational definitions

This study assessed the prevalence of PD by utilizing the Community Periodontal Index for Treatment Needs (CPITN), as recommended by the World Health Organization in 2003. In this context, periodontal health was defined as the complete absence of gingivitis and periodontitis at any site, which corresponded to a CPITN score of 0.

Gingivitis was the presence of signs of plaque-induced gingival inflammation in at least one sextant. Signs of gingival inflammation included redness, swelling, and bleeding on probing (CPITN score 1), as well as calculus (CPITN score 2).

Periodontitis was characterized by shallow or deep periodontal pockets, corresponding to CPITN scores 3 and 4, respectively.

Oral hygiene status in this study was measured using the S-OHI.

Oral hygiene practices in this study were defined as all oral care habits and activities that promote good oral health, including the frequency, duration, and techniques of toothbrushing and flossing, as well as regular visits to the dentist's clinic. The questionnaire also assessed

participants' reasons for attending the clinic, including whether they sought regular scaling and polishing.

Smoking behavior refers specifically to the use of tobacco products. A participant was classified as a smoker if they were smoking at the time of data collection. The analysis also considered the age at which participants began smoking and the number of cigarettes they consumed per week. Additionally, the definition of smoking in this study included the active use of water pipes. However, the study did not include smoking of any other substances, such as herbal cigarettes, marijuana, or homegrown tobacco. The use of tobacco products through other methods, such as chewing, was also excluded from this research.

In this study, SES referred to participants' socioeconomic status, determined by their level of education and employment status (or their parents' employment status), the number of siblings living with them, and their self-reported economic situation.

Dietary habits were assessed using part of the Food Frequency Questionnaire and referred to the participants' nutritional practices. Participants were provided with a list of food items and asked to indicate their weekly intake frequency for each item. They were specifically asked how many times they ate breakfast each week, as well as how often they consumed nutritious and non-nutritious foods.

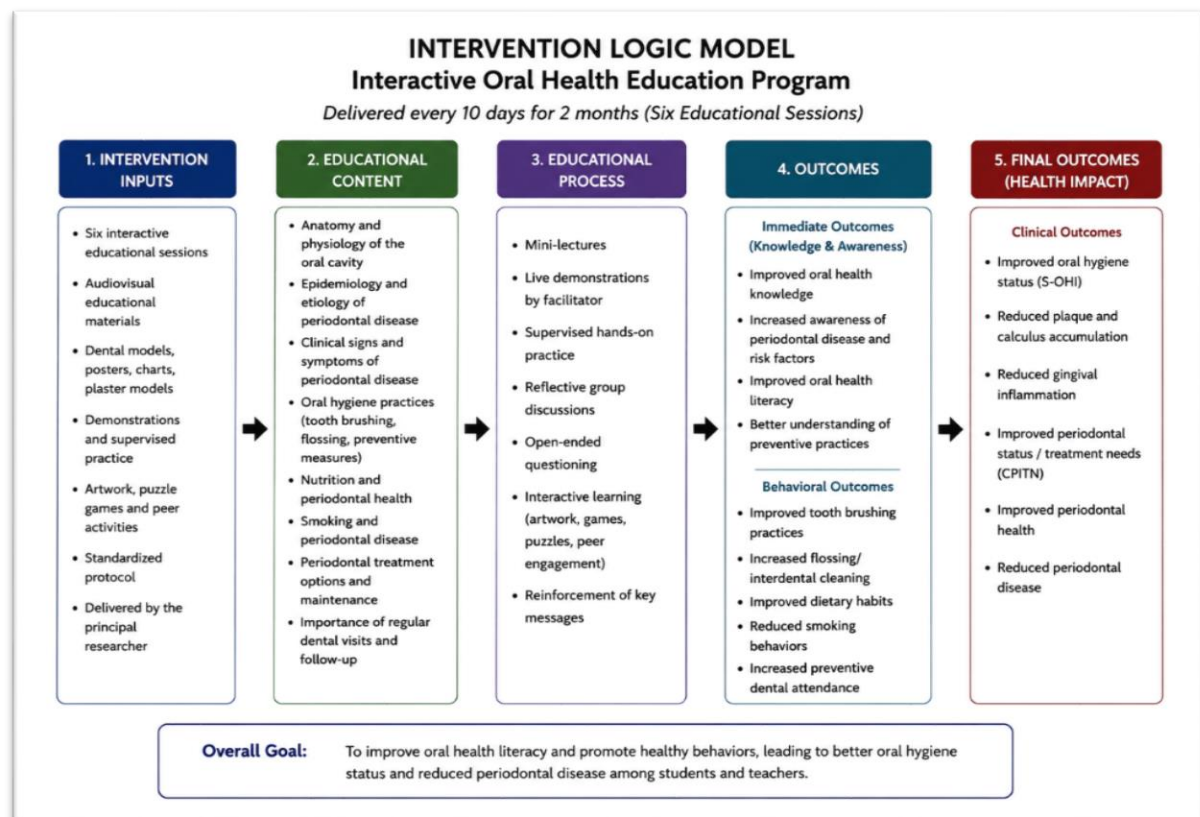


Fig. 2 .3 illustrates the conceptual framework for phase two of the study

Chapter Three

Methodology

3.1 Introduction

This chapter provides an overview of the study area, population, design, sampling process, and research tools. The study was conducted in two phases. The first phase aimed to estimate the prevalence of PD and examine the association between PD and several determinants, including SES, oral hygiene status and practices, dietary habits, and smoking behaviors, among 9th-grade students and their teachers in schools located in the northern governorates of the West Bank. The second phase assessed the effect of interactive oral education on periodontal status, oral hygiene status and practices, dietary habits, and smoking behaviors among 9th-grade students and their teachers in Nablus city schools.

This study included two participant groups: adolescents and adults. The adolescent group consisted of 9th-grade students, while the adult group comprised teachers from the same schools that selected the students.

Improving oral health among adolescents mainly depends on monitoring their oral health status and implementing educational programs in their schools (WHO, 2003). Teachers represent a socially influential segment of the community as they can model and transmit oral health-related behaviors to younger generations (Watt et al., 2017). Their work environment offers a practical platform for implementing and evaluating oral health promotion programs (Tonetti & Sanz, 2017; Nascimento et al., 2024).

Schools are excellent environments for promoting health because they can effectively reach many adolescents and adults (WHO, 2003, 2020). It is also important to note that adolescents spend most of their years in school (WHO, 2020). The school years are crucial for establishing healthy habits, beliefs, and attitudes that tend to last a lifetime (WHO, 2003). Moreover, these years are important for developing personal health skills that support healthier lifestyle choices (WHO, 2003; Khoshnevisan et al., 2017; Gargano et al., 2019). Overall, schools offer a valuable opportunity to advance public health goals for many students and other education personnel at a relatively low cost (Kwan et al., 2005).

3.2 Description of the socio-demographic and geographic areas

The Northern West Bank comprises several governorates, each with distinct geographic and demographic characteristics.

Nablus Governorate is located in the northeastern part of the West Bank and is recognized as one of the largest and most significant governorates in the region. It is situated in a strategic valley between Mount Ebal and Mount Gerizim, approximately 63 kilometers north of Jerusalem. Nablus serves as the capital of the Nablus Governorate and is a significant commercial and cultural hub for the Palestinian people (PCBS, 2007). As of 2023, the total population of Nablus is approximately 431,584, including residents of four refugee camps in the Nablus area (PCBS, 2023).

Jenin Governorate is situated in the northern and northwestern regions of the West Bank.

Tulkarm Governorate is positioned to the northwest of the West Bank, sharing its northern border with Jenin Governorate and its eastern border with Nablus Governorate.

Qalqilya Governorate is found in the northwestern area of the West Bank, bordered to the north by Jenin Governorate.

Salbit Governorate is located to the northwest of the West Bank, with its northern boundary adjacent to Qalqilya Governorate.

The Northern Governorates of the West Bank are part of the administrative framework of the Palestinian Authority and encompass a variety of cities and villages. This region was historically recognized as part of Palestine and came under Israeli occupation in 1967.

The population of the Northern Governorates of the West Bank is approximately 1.1 million residents. The region is served by nearly 16 hospitals, which include six governmental and ten non-governmental facilities. The total capacity of these hospitals is 1,173 beds, yielding an average of 1.1 beds per 1,000 inhabitants.

The poverty rate among individuals in the Northern Governorates of the West Bank is 15.5%, lower than the overall West Bank poverty rate of 17.8%. Furthermore, there are 933 educational institutions within the Northern Governorates: 813 government schools, 38 schools operated by the United Nations Relief and Works Agency (UNRWA), and 82 private schools (PCBS, 2015).

3.3 Study Population

Age is an important systemic factor influencing the prevalence of PD (Huang & Dong, 2022). PD tends to correlate with specific age demographics. Gingival disease is predominantly observed in adolescents, while chronic periodontitis is primarily associated with the early elderly population. Conversely, aggressive periodontitis is commonly seen in late adulthood (Tadjoedin et al., 2017). It is crucial to address PD throughout all stages of human life. However, it is imperative to focus on oral health in the adolescent stage due to the hormonal changes that occur during this stage, which predispose these adolescents to PD (Kisely, 2016). Adolescence is defined as the transitional phase between childhood and adulthood, occurring between ages 10 and 19. This developmental stage is crucial in the human lifespan and is characterized by numerous physical, educational, behavioral, social, and emotional challenges (WHO, 2022). Adolescents represent 16% of the global population (UNICEF, 2023). Specifically, the age of 15 represents a pivotal stage in human development. Additionally, this developmental phase is crucial for oral health, as the risk of PD typically increases compared with that in younger children, primarily due to poor dental hygiene and unhealthy dietary habits. As a result, it is essential to implement targeted preventive strategies tailored to this age group (Kisely, 2016). Moreover, age 15 is significant because it is a global monitoring age for PD development. Consequently, this age can be used for international comparisons and for tracking future trends in PD (WHO, 1987, 2003). In 2010, the WHO established a benchmark for periodontal health among adolescents aged 15 years, designating this age as a reference point for epidemiological studies on oral health. The specific recommendation is that 100% of 15-year-old adolescents should have at least 5 healthy sextants in their oral cavity (Sane & Nikhbakht-Nasrabadi, 2005). For the above, adolescents were selected for this study

The WHO has endorsed teachers' involvement in developing studies that pertain to their students (WHO, 2003, 2016). Engaging teachers in health-related studies alongside their students can yield numerous beneficial outcomes, including increased student compliance. In health-related studies, teachers assume multifaceted roles, including those of health advocates, teachers, trainers, evaluators, and examples to follow (Maganur et al., 2017). Furthermore, teachers can actively participate in implementing oral health programs within educational institutions (Filipponi et al., 2018).

The inclusion of teachers in this study is also grounded in the understanding that they should receive training in oral disease prevention and play a crucial role in monitoring oral health-related injuries and illnesses (WHO, 2003, 2016). Such involvement is essential for fostering students' competencies in practicing proper oral hygiene. Furthermore, teachers have a significant responsibility to promote health awareness and serve as role models by exemplifying healthy behaviors and encouraging their students to embrace a healthy lifestyle (Akeru et al., 2022).

Above all, teachers play a critical role in guiding, reminding, and motivating researchers and students throughout the data collection phase. Furthermore, teachers may facilitate

communication among students, parents, and healthcare providers (Torbjorn & Oddrun, 2012).

On the other hand, a crucial approach to enhancing oral health among individuals is to improve their health literacy. This involves augmenting an individual's capacity to access, evaluate, and comprehend fundamental health information and services necessary to make informed decisions about oral health (Naghbi Sistani et al., 2014). Studies show that oral health literacy is significantly low among adults worldwide (Jones et al., 2007; Lee et al., 2011). It is estimated that approximately fifty percent of American adults require enhanced health literacy to efficiently seek health services and information (Mirzapour et al., 2019). Findings show that nearly twenty percent of British adults' experience challenges in basic health-related skills (National Consumer Council, 2004), and a similar proportion, representing twenty percent of Canadian adults, exhibits low levels of health literacy (Sabbahi et al., 2009). Moreover, a study conducted among Saudi undergraduate students revealed inadequate oral hygiene literacy. It is imperative to implement systematic health education programs, such as regular dental check-ups for college students, to promote better oral health behaviors within this demographic (Kandasamy et al., 2023).

3.4 Study Design

In the first phase, a cross-sectional design was used to determine the prevalence of PD in the North Governorates of the West Bank. Additionally, it also examined the association between PD prevalence and several determinants (SES, oral hygiene status and practices, dietary habits, and smoking behaviors) among 9th-grade students and their teachers. The study was conducted from February 10, 2024, to May 1, 2024.

In the second phase, an experimental (pre-test/post-test control) design was selected to assess the impact of interactive educational sessions on PD conditions among 9th-grade students and their teachers in Nablus City. The true experimental design was chosen because it provided scientific evidence on the effect of education on PD conditions among students and teachers in Nablus City. The random selection of participants aimed to eliminate differences between the groups and create groups that are as similar as possible to reduce bias or confounding that different group characteristics might have on the exposure-outcome relationship this study evaluates, thereby supporting internal validity (Austin, 1965, p. 295; Smith & Pell, 2003; Schulz et al., 2010).

3.5 Sample Frame

The schools that include 9th grade in the three northern governorates of the West Bank.
The 9th-grade students in three northern governorates.
The 9th-grade teachers in the three northern governorates.

3.6 Sample Technique and Process

Phase one: a multistage sampling technique was employed to obtain a representative sample of schools, students, and teachers.

Three governorates—Nablus, Jenin, and Tulkarm—were selected in the first stage based on their high population density and significant concentration of schools and students, ensuring a robust sample size for the study. Additionally, including these governorates allowed for the capture of variations in cultural, economic, and educational factors among participants. Practical considerations, such as accessibility and logistical feasibility, also influenced the governorate selection process.

The Epi Info sample size calculator was used to determine the school's sample size. Schools within each governorate were selected using a proportional stratified random sampling method. Schools were stratified by type (governmental or private) and gender (male or female) to ensure balanced representation. The final sample included 44 schools across three governorates: 15 schools from Nablus (10 governmental and 5 private), 14 schools from Jenin (11 governmental and 3 private), and 15 schools from Tulkarm (11 governmental and 4 private) (see Table 3.1).

Table 3.1: Sampling Distribution of Governmental and Private Schools by Governorate

Governorates Name	No. of Governmental Schools	No. of Private Schools	No. of selected Governmental Schools	No. of selected Private Schools
Nablus	50	15	10	5
Tulkarm	44	11	11	4
Jenin	46	13	11	3

The schools were included in this study if they:

1. Contain the 9th-grade classes.
2. Have the feasibility for data collection.
3. Agreed to participate in this study.
5. Have a satisfactory consent procedure from the students and teachers.

At this stage, the required sample size for each governorate was calculated using the Epi Info sample size calculator. A multistage stratified sampling approach was then employed. Schools were first stratified by governorate, school type (governmental or private), and gender (male or female schools) to ensure adequate representation of the target population. Since the study targeted 15-year-olds, only 9th-grade students were eligible to participate.

Within each stratum, the number of students selected from each school was determined proportionally according to the total number of enrolled 9th-grade students. Subsequently, official lists of 9th-grade students were obtained from the selected schools, and participants were selected using simple random sampling to ensure equal probability of selection for all

eligible students. Therefore, not all students from the selected schools were included in the study (Mithra et al., 2022; Pribadi et al., 2025).

This proportional stratified multistage sampling approach ensured representation across governorates, school sectors, and genders. In Nablus, the sample comprised 518 males and 241 females from governmental schools, and 173 males and 388 females from private schools. In Jenin, 391 males and 215 females were selected from governmental schools, along with 134 males and 271 females from private schools. In Tulkarm, the sample included 350 males and 240 females from governmental schools, and 179 males and 252 females from private schools. The final study sample consisted of 3,352 students (Fig. 3.1).

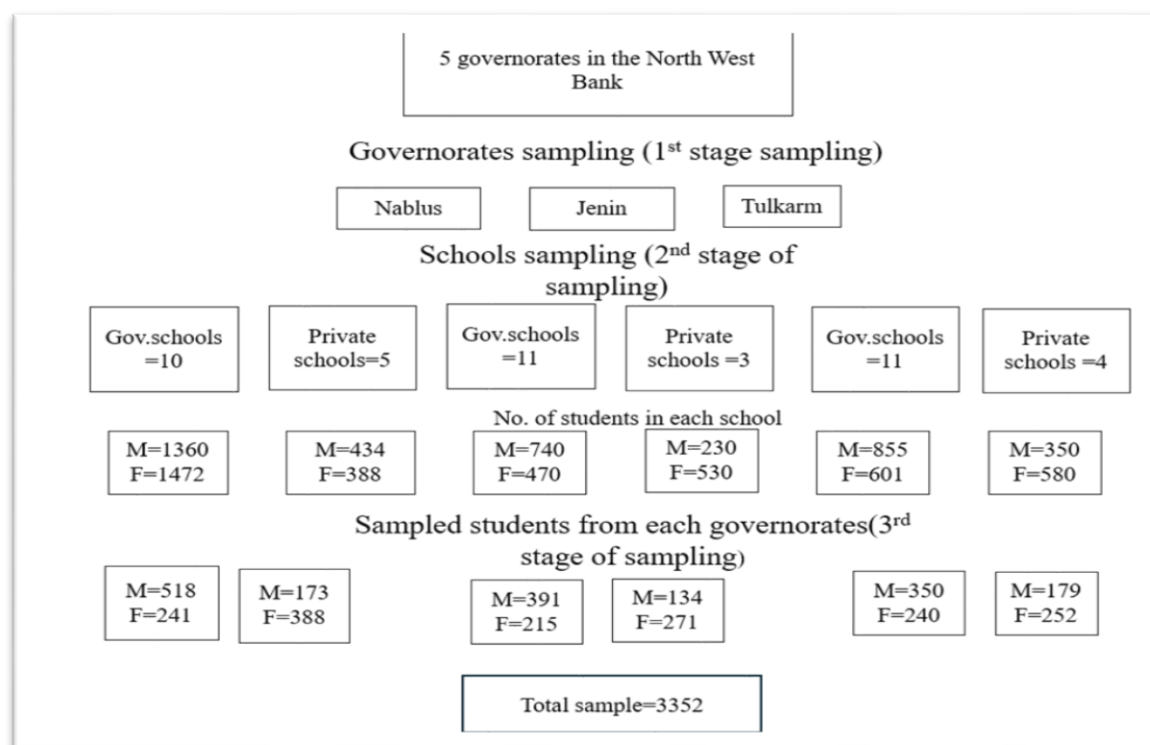


Figure 3.1. A multistage sampling strategy across three governorates in the northern West Bank

At this stage, the number of teachers was also calculated for each governorate using the Epi Info sample size calculator. In Nablus, there were 216 male teachers and 278 female teachers, while in Jenin, there were 210 male teachers and 257 female teachers. In Tulkarm, the totals included 189 males and 201 females. Private schools in each governorate generally range from 45 to 99. A stratified simple random sampling method was used to select a representative sample of teachers from each governorate. From Nablus, the sample included 100 male and 150 female teachers. In Jenin, 108 male and 104 female teachers participated. In Tulkarm, the sample consisted of 96 male and 111 female teachers. Additionally, a small number of teachers from private schools in each governorate were included, with sample

sizes ranging from 16 to 58, depending on school type and size. The total sample size of teachers was 920 (Fig. 3 .2).

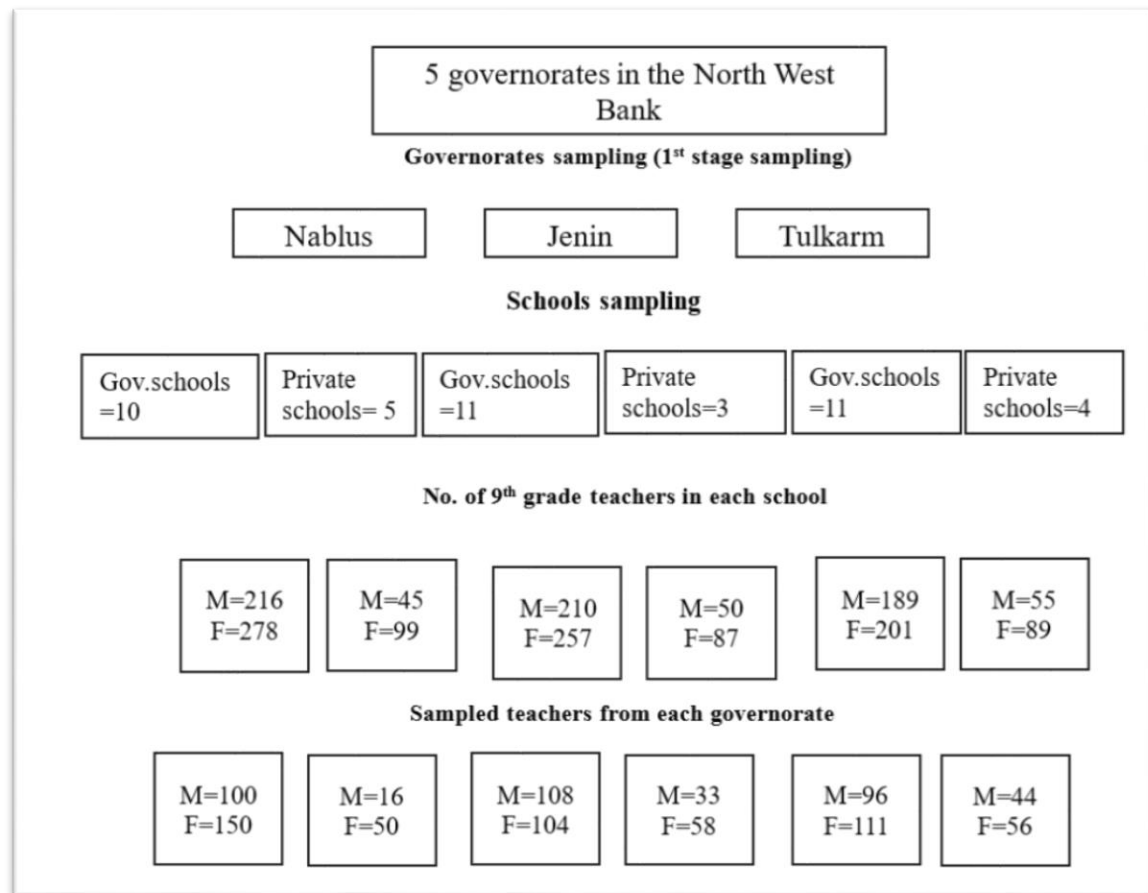


Fig. 3.2: sampling procedure across governorates, schools, and teachers

Phase two: Based on the total count of eligible schools in Nablus (15 schools), randomly selected in the first phase of this study, these schools were divided into two groups: one designated for the intervention and the other for the control. The randomization took place at the school level to minimize contamination while maintaining balance by geography and type. This thorough sampling and allocation method mitigated the potential for selection bias and confounding factors that could influence the relationship between the intervention and the outcomes (Schulz et al.,2010).

Once the study design was established as an interventional study and the utilized test was identified, the G*Power program was used to calculate the required sample size. This assessment adhered to the recommendations outlined by Kang (2015, p. 6) and In et al. (2020). The effect size was set at $d_z = 0.5$, with an alpha error probability (α) established at 0.05. The study's power was determined to be 90% ($1 - \beta$), which aims to balance the likelihood of Type I (false positive) and Type II (false negative) errors. This method guarantees that the study is sufficiently sensitive to identify significant effects and is dependable. A total of 350 male and 357 female students were selected from Nablus governmental schools, and 226 male and 208 female students from private schools.

Following allocation and randomization, participants were assigned to a control group consisting of 464 students and an intervention group of 581 students (Fig. 3.3).

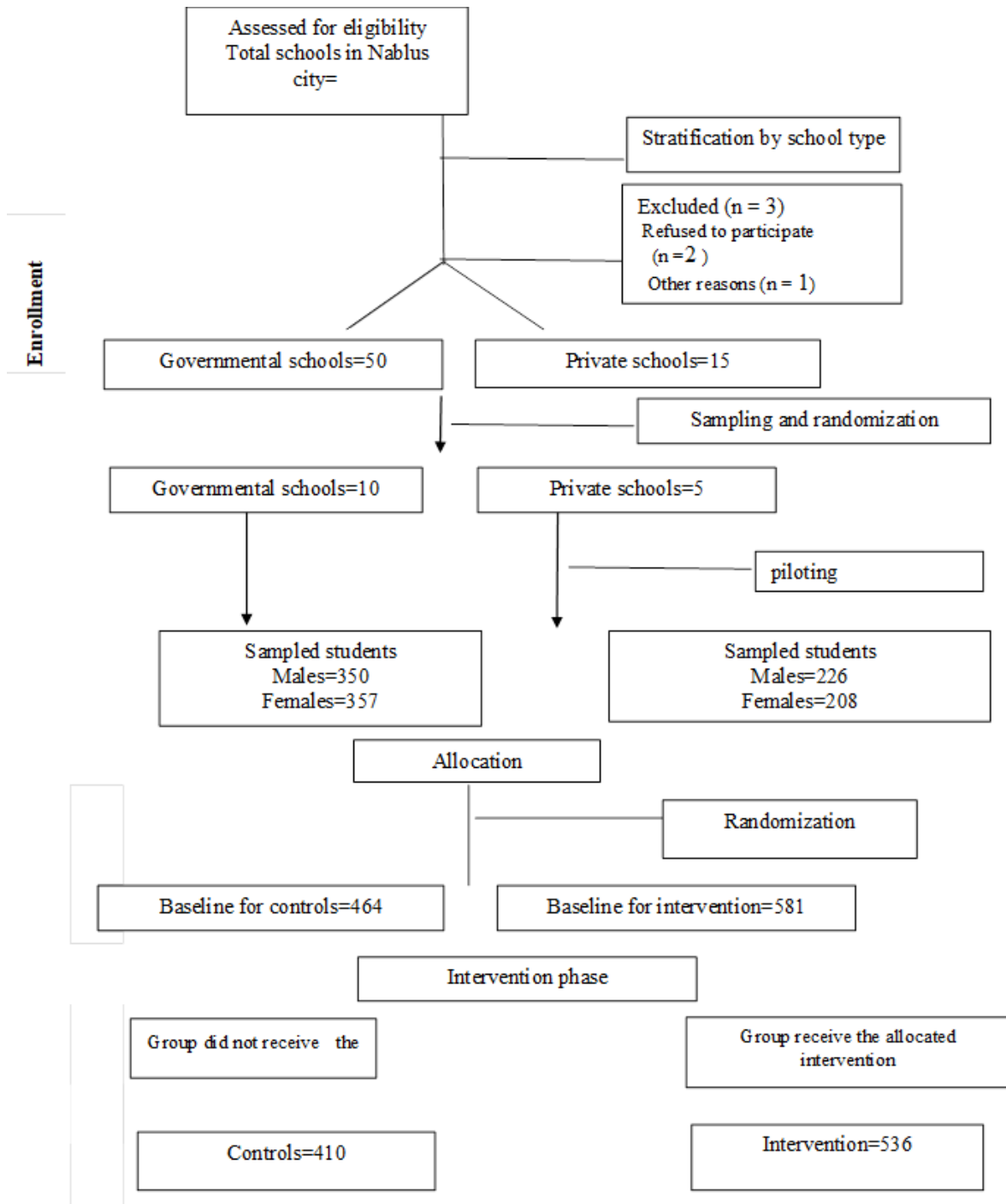


Fig 3.3: CONSORT flow diagram showing the flow of schools and students selected for the trial

The number of 9th-grade teachers in Nablus City was obtained from the educational directorate's records. In 2024, statistical data showed that the number of 9th-grade teachers in governmental schools was 494 (males = 216, females = 278), and the number of teachers

in private schools was 149 (males = 50, females = 99). After establishing the study design as an interventional study and identifying the test to be used, the G*Power program was used to calculate the required sample size. This calculation adhered to the recommendations provided by Kang (2015, p. 6) and In et al. (2020). The effect size was determined to be $d_z = 0.5$, with an alpha error probability (α) of 0.05. The study's power was established at 90% ($1 - \beta$), aiming to mitigate the risks associated with Type I (false positive) and Type II (false negative) errors.

The final sample consisted of 354 teachers from governmental schools and 140 teachers from private schools. This method guarantees that the research is sufficiently sensitive to detect significant effects while maintaining reliability. Subsequently, 230 educators from the intervention schools and 193 from the control schools were included in the study (Fig. 3.4).

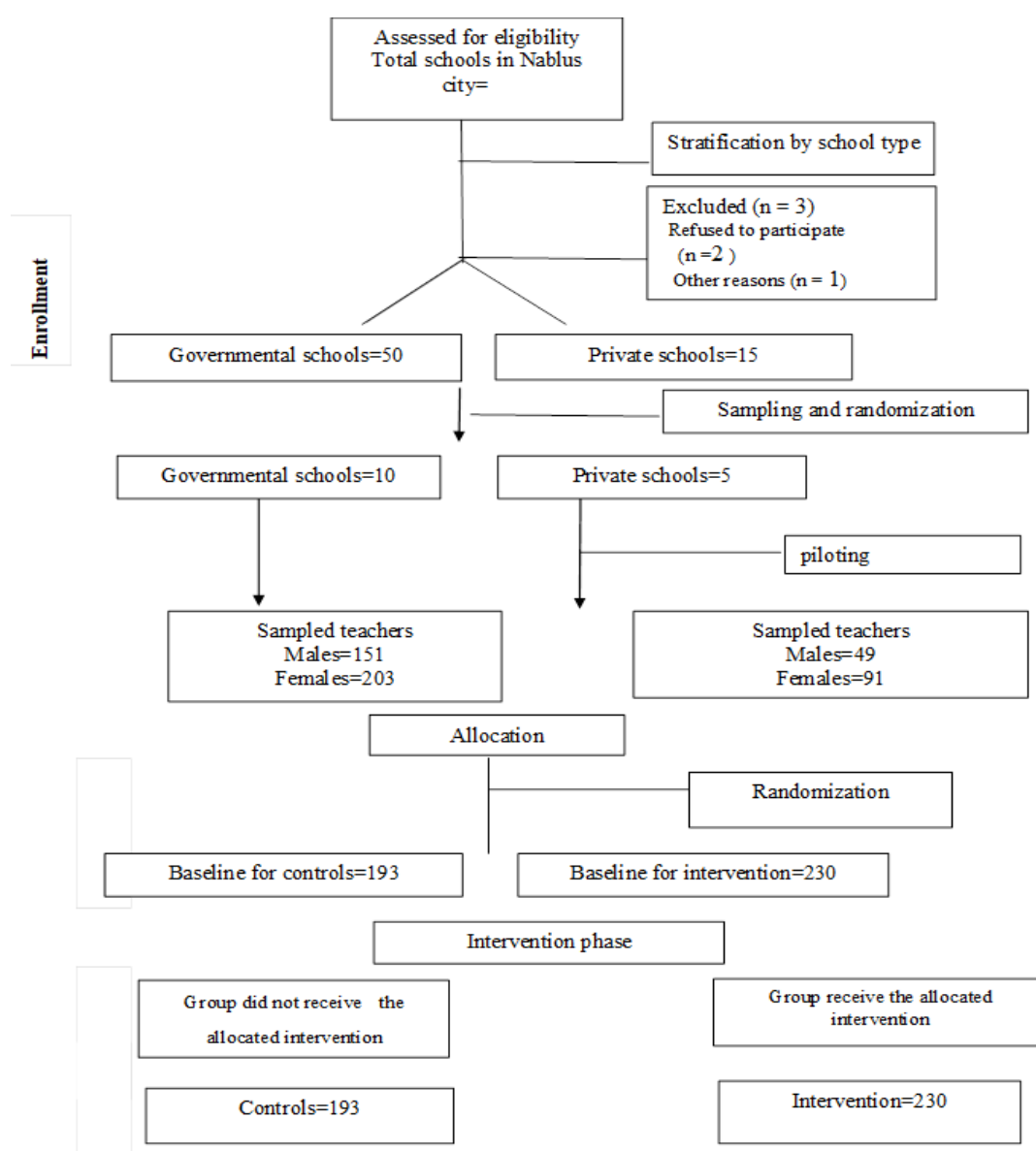


Fig 3.4: Consort flowchart of the screened teachers for the study

3.7 Pilot Study

In accordance with the guidelines for conducting a thorough investigation (Hertzog, 2008, p. 180), a preliminary survey was conducted with approximately 10% of the designated sample (100 students and 100 teachers). The main aim of the pilot study was to evaluate the practicality and feasibility of the research process, assess the participants' understanding and interpretation of the questionnaire items, and identify any ambiguities or difficulties in responding to the survey. In addition, the pilot study was conducted to ensure the cultural adaptation, linguistic clarity, and contextual appropriateness of the questionnaire items for the target population, thereby enhancing the validity and reliability of the data collection process (Lewis et al., 2021).

Following input gathered from the pilot study, the questionnaires were revised into their final version. In addition, piloting the questionnaires with participants helped to establish several forms of validity. Face validity was confirmed by ensuring the questionnaire appeared relevant and understandable to participants (Ranganathan et al., 2024). Content validity was achieved by verifying that the questionnaire comprehensively covered all aspects of the study variables (Roebianto et al., 2023). A Principal Component Analysis was conducted through an Exploratory Factor Analysis (EFA) to assess the instrument's construct validity. The appropriateness of the data for factor analysis was evaluated using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity. The KMO value was 0.70, indicating adequate sampling adequacy, and Bartlett's test was significant ($p < .001$), supporting the factorability of the correlation matrix. Factors were extracted using eigenvalues greater than 1 and the scree plot. The analysis revealed a 4-factor solution that accounted for 71.30% of the total variance. Items were kept if they had factor loadings of 0.50 or above and were considered theoretically relevant. The data gathered during the pilot study were excluded from the final analysis.

3.8 The Tools and Equipment

3.8.1 Description of the questionnaire

The questionnaires utilized in this study were derived from previous research (WHO, 2013; Sbricoli et al., 2022; Soldo et al., 2022). They were explicitly designed to evaluate the participants' SES, oral hygiene practices, dietary habits, and smoking behaviors.

The selection of study variables and the design of the questionnaires were informed by the WHO Conceptual Framework for Social Determinants of Health and the Common Risk Factor Approach. Structural determinants such as socioeconomic status and educational setting, as well as intermediary determinants including oral hygiene practices, dietary habits, smoking behaviors, and oral hygiene status, were incorporated to examine their relationship with periodontal disease among students and teachers. The initial questionnaires were in English, which were then translated into Arabic. Before distributing the questionnaire to participants, a back-translation from Arabic to English was performed to validate the

translation. The questionnaires consisted of standardized, closed-ended questions. To confirm their validity, three experts evaluated the questionnaires, including a specialist in clinical periodontology, a professor and researcher in public health, and a practitioner with academic experience in clinical research.

Each participant completed the questionnaire through individual interviews. Notably, the questionnaires included items that reflected the topics covered in the educational sessions.

3.8.2 The components of the students' questionnaire

Part 1: Student's background

1. School type (governmental school or private school)?
2. School system (mixed or separated schools)?
3. Gender?

Part 2: Student's family background

1. Who has lived with the student in the same house?
2. How many sons and sisters have lived in the student's house?
3. Does the student's father work?
4. Does the student's mother work?
5. What is the educational level of each student's parents?
6. What is the economic situation of the students' families according to the students' opinions?

Part 3: Oral hygiene practices

1. Does the student usually clean his \her teeth?
2. How often does the student clean his \her teeth daily?
3. When does the student clean his \her teeth?
4. How often did the student use dental floss as an adjunct to tooth cleaning?
5. Does the student visit the dentist regularly?
6. What is the main reason for visiting the dentist?
7. When did the last visit the dentist?

Part 4: Dietary habits

1. Weekly, how many students have breakfast (more than a cup of tea or fruit juice)?
2. Weekly, what is the frequency of the student eating fruit, vegetables, and sweets or drinking cola, milk, and meat?

Part 5: Smoking habits

1. In the past, did the student smoke cigarettes (as a minimum of one cigarette)?
2. How many times does the student smoke cigarettes?
3. At what age did the student begin to smoke?
4. How many cigarettes do the student smoke weekly?
5. Did the student smoke Nargileh?
6. How many times did the student smoke nargileh?

3.8.3 The components of the Teachers' questionnaire

Part 1: teacher's background

1. School type (governmental school or private school)?
2. School system (mixed or separated schools)?
3. Gender?

Part 2: teacher's family background

1. How many children does the teacher have, if he/she is married?
2. How many brothers and sisters have lived in the teacher's house, if he/she is unmarried?
3. Does he/she have a house?
4. What is the monthly salary?
5. What is the economic situation of the teachers' families, according to the participants' opinions?

Part 3: oral hygiene practices

1. Does the teacher usually clean his \her teeth?
2. How often does the teacher clean his \her teeth daily?
3. When does the teacher clean his \her teeth?
4. How often did the teacher use dental floss as an adjunct to tooth cleaning?
5. Does the teacher visit the dentist regularly?
6. What is the main reason for visiting the dentist?
7. When did the last visit the dentist?

Part 4: Dietary habits

1. Weekly, how many teachers have breakfast (more than a cup of tea or fruit juice)?
2. Weekly, what is the frequency of the teacher eating fruit, vegetables, and sweets or drinking cola, milk, and meat?

Part 5: Smoking habits

1. In the past, did the teacher smoke cigarettes (as a minimum of one cigarette)?
2. How many times does the teacher smoke cigarettes?
3. At what age did the teacher begin to smoke?
4. How many cigarettes does the teacher smoke weekly?
5. Did the teacher smoke Nargileh?
6. How many times did the teacher smoke a nargileh?

3.9 Data Collection Process

Ethical approval for both the cross-sectional phase (phase one) and the interventional phase (phase two) of the study was granted by the Al-Quds committee (Reference: 13/24). Additionally, phase two of the study has been officially registered at ClinicalTrials.gov under the identifier NCT07055932. Consent forms were subsequently distributed to participants, including parents or guardians of students, students themselves, and teachers involved in the study. Data collection began after all participants had given their consent. To maintain a standardized, calibrated data-collection process, the researcher trained five dentists to conduct interviews and dental examinations effectively. These training sessions were conducted every two weeks throughout the study to ensure uniformity among the data collectors. At the beginning of the baseline phase, all participants received a thorough explanation of the study's main objectives. Baseline data were collected in March 2024. After a two-month educational intervention, follow-up data were obtained from the same schools using the same dental examination protocols (CPITN and S-OHI) and questionnaires as during the baseline phase.

During the pilot phase, inter-examiner reliability was assessed using a two-way random-effects model of the Intraclass Correlation Coefficient (ICC), following the methodology outlined by Koo & Li (2016). Five data collectors independently evaluated 20 students and 20 teachers five times on separate occasions, yielding students' ICC values of 0.83 for CPITN and 0.98 for S-OHI, and teachers' ICC values of 0.79 for CPITN and 0.89 for S-OHI, indicating good inter-examiner reliability. The choice of the ICC model assumed that the raters were randomly selected from a larger population of dentists in the West Bank and consistently participated throughout the study (Portney & Watkins, 2000; Bruton et al., 2000).

3.10 Measurements of PD

The first step in developing effective oral health strategies for children, teenagers, and adults is to assess the prevalence of oral diseases. This assessment is also critical for developing evidence-based intervention programs (Folayan et al., 2015; Popoola et al., 2015). The Community Periodontal Index for Treatment Needs (CPITN) is a significant instrument for evaluating the prevalence of PD. The findings generated by this index are reliable and are

frequently used to inform health policy and to establish strategic frameworks for PD control programs (Sane & Nikhbakht-Nasrabadi, 2005).

Over the past 15 years, the CPITN has emerged as the preferred method for investigating PD (Strohmenger et al., 1991; Miyazaki et al., 1992; WHO, 1997; Bansal et al., 2015; Nazir et al., 2020). Numerous modifications have been introduced to the earlier versions of the index (WHO, 1976, 1978). However, these alterations have not influenced the original diagnostic criteria. The operational characteristics of the CPITN have been thoroughly evaluated against standard examinations and diagnostic criteria. The results indicated that the sensitivity, specificity, positive predictive value, and negative predictive value were 58%, 80%, 87%, and 46.3%, respectively (Bassania et al., 2006). The validity of the CPITN was assessed, revealing its effectiveness in diagnosing both gingivitis and periodontitis, indicating that the CPITN is highly effective for diagnosing PD conditions (Tanik & Gül, 2020).

CPITN categories are Score 0 = healthy periodontium; Score 1 = Gingival bleeding after gentle probing; Score 2 = supra or sub-gingival calculus; Score 3 = pathologic pockets 4-5 mm deep, and Score 4 = pathologic pockets 6 mm and above. Treatment needs were classified according to the highest score recorded in all assessed sextants. TN 0 = No need for treatment, TN 1 = Need for oral hygiene instructions, TN 2 = Need for oral hygiene instructions and professional cleaning, TN 3 = Need for complex treatment (WHO, 2003).

Criteria of CPITN coding

A unique code number was assigned to each sextant within the oral cavity. The condition of the most severely affected site within each sextant was documented. For adults aged 20 years and older, the index teeth examined were as follows: 17, 16, 11, 26, 27, 37, 36, 31, 46, and 47. In contrast, for students, a limited selection of six index teeth was utilized, specifically: 16, 11, 26, 36, 31, and 46 (WHO, 1997, 2005). This distinction was implemented to avoid scoring deepened sulci associated with tooth eruption, which could otherwise be misclassified as periodontal pockets.

Table (3.2): The relation between the criteria and scores of (CPITN), treatment category (T), and type of care and time units estimate (TU) per sextant.

Criteria	CPITN	T	Type of Care	TU (time units)
Healthy	0	T0	None	0
Gingivitis	1	T1	OHE	1
Calculus	2	T2	OHE+Sc**	3(1+2)
Pockets>3mm	3	T2	OHE+Sc	3(1+2)
Pocket<3mm	4	T3	OHE+Sc+C***	7(1+2+4)

*Oral hygiene education, **Scaling and root planning, ***Complex treatment

Advantages of CPITN:

1. It is easy to use
2. It facilitates the rapid assessment of large population groups.
3. Its global applicability enables comparisons across different countries.
4. The CPITN evaluates periodontal conditions as well as treatment needs.
5. Furthermore, it provides insights into public health requirements within the realm of periodontal health, which is crucial for the formulation of the national oral health policies and targeted interventions (Benigeri et al., 2000; Nazir et al., 2020).

Limitations of CPITN:

1. There is a tendency to overestimate treatment needs associated with this index.
2. This index is based on a hierarchical model of PD progression. Therefore, a sextant showing a tooth with periodontal pockets (score 3 or 4) is also expected to show calculus (score 2) and bleeding (score 1).
3. Additionally, the CPITN does not consider dental mobility or attachment loss (ibid).

3.11 Simplified Oral Hygiene Index (S-OHI)

In 1960, John C. Greene and Jack R. Vermillion introduced the Oral Hygiene Index. This index was subsequently modified and renamed the Oral Hygiene Index-Simplified in 1964. It has since been utilized in various research studies (Lin et al., 2001; Abe et al., 2006; Babaei et al., 2020). The Oral Hygiene Index-Simplified comprises two primary components: the Debris Index and the Calculus Index. For the assessment, six indexed teeth are selected, with one surface designated for examination for each component.

Index Teeth

- | | |
|---------------------------------|------------|
| 16- Upper right first molar | - buccal. |
| 11- Upper right central incisor | - labial. |
| 26- Upper left first molar | -buccal. |
| 36- Lower left first molar | - lingual. |
| 31-Lower left central incisor | -labial. |
| 46- Lower right first molar | -lingual. |

Criteria for recording

1. Only fully erupted permanent teeth shall be evaluated.

2. Natural teeth that have received full crown restorations and exhibit a reduction in height due to caries or trauma will not be included in the assessment. In such instances, the second or third molars will be scored, and the central incisor opposite the midline will be utilized as a substitute in the anterior region.

Simplified Debris Index

The estimation of the surface area affected by debris is conducted by guiding the side of an explorer, specifically a shepherd's crook, along the tooth surface under examination.

Scoring System

O. No debris or stains present.

1. Soft debris covering with no more than 1/3rd of the tooth surface being examined or extrinsic stains without debris, regardless of the surface area covered.
2. Soft debris covering more than 1/3rd. But not more than 2/3rd of the exposed tooth surface.
3. Soft debris covering more than 2/3rd of the exposed surface.

Simplified Calculus Index

Scoring System

0. No calculus.

1. Supragingival calculus covering not more than 1/3rd of the exposed tooth surface being examined.
2. Supragingival calculus covering more than 1/3rd but not more than 2/3rd of the exposed tooth surface or individual dots of subgingival calculus around the cervical portion of the tooth.
3. Supragingival calculus covering more than 2/3rd of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth.

Calculation of the Index

For each individual, the scored debris was summed together and then divided by the number of the scored surfaces.

3.12 Intervention Description

The oral education program discussed in this study concentrated on periodontal tissues and their various conditions. The aim of the education was to equip participants with the knowledge and skills needed to manage and prevent periodontal health issues. This program was revised based on earlier studies, with adaptations to align with the specific goals of this

research (Rice, 2009; Roomani et al., 2016). The content of the education was founded on the guidelines established by the WHO (2013). Participants in the control group attended only a single oral educational session, while those in the intervention group attended six educational sessions. These sessions were conducted every 10 days over a 2-month period. Each educational session, lasting between 30 to 45 minutes, used an interactive format and included a variety of audiovisual aids, such as dental forms, models, charts, posters, and plaster models (Table A2). These resources were created to actively engage participants and promote a deeper comprehension of appropriate oral health practices.

Each session was systematically organized into four key components: (1) a concise mini lecture that introduced the fundamental concepts; (2) a live demonstration conducted by the facilitator; (3) a period for supervised hands-on practice, allowing participants to apply skills using dental models or real-life scenarios; and (4) a reflective group discussion that utilized open-ended questions to foster critical thinking. This method prioritized active participation over passive listening. Additionally, various activities, including artwork creation, puzzle-based games, and peer demonstrations, were deliberately integrated to boost engagement, reinforce psychomotor skills, and encourage positive behavioral change.

Standardization and Implementation of the Educational Intervention

The educational intervention was implemented using a highly structured and standardized protocol to ensure consistent delivery across all participating schools and individuals. Prior to implementation, a comprehensive educational framework was established, grounded in evidence-based principles of oral health education and aligned with international recommendations for oral health promotion (WHO, 2005, 2013). The components of the intervention, including content, learning objectives, teaching strategies, educational materials, and session sequencing, were standardized to reduce implementation variability. All educational sessions were conducted by the principal researcher to eliminate variability among educators and ensure consistency in communication style, instructional approach, and interaction with participants. A comprehensive session guide was created and adhered to throughout all sessions to guarantee that the same information, demonstrations, behavioral messages, and reinforcement strategies were delivered consistently across all schools. In addition, we ensured the fidelity of the intervention implementation by continuously monitoring adherence to the established educational protocol during each session. This standardization process improved the internal validity of the study, making it more likely that the observed outcomes were directly attributable to the educational intervention rather than to procedural inconsistencies.

The educational sessions covered the following topics:

1. Anatomy and Physiology of the Oral Cavity

Structures of the teeth, gums, periodontium, and supporting oral tissues.

The role of oral structures in maintaining oral health.

Epidemiology and etiology of periodontal diseases (PDs).

Prevalence, causes, and risk factors of PDs, including poor oral hygiene, smoking, and systemic conditions.

2. Clinical Presentation of Periodontal Diseases: Signs and symptoms of periodontal diseases.

Diagnostic tools and techniques, including clinical examinations and radiographs.

Systemic associations between periodontal diseases and chronic systemic conditions.

Complications and progression of periodontal diseases.

3. Preventive Measures: The importance of maintaining good oral hygiene practices.

Proper tooth brushing techniques, flossing, and other preventive oral hygiene measures.

Use of a pea-sized amount of fluoridated toothpaste (1000 ppm fluoride).

The role of nutrition and lifestyle factors in maintaining periodontal health.

4. Treatment Options: Overview of periodontal treatment modalities, including non-surgical and surgical interventions.

Importance of regular dental check-ups and professional dental cleaning.

5. Maintenance and Follow-up: This section emphasized the importance of maintaining continuous oral care to sustain periodontal health. It elucidated the significance of regular follow-up appointments and ongoing monitoring.

During the initial session, participants engaged in a discussion of their positive and negative beliefs about oral health following a lecture on the topic.

In the second session, attendees were encouraged to create artistic representations related to oral health. Using open-ended questions, participants shared their experiences and emotions regarding their artwork with one another. The third session incorporated oral health games and entertainment, including puzzle-solving activities.

The last sessions addressed the critical role of dietary habits in relation to periodontal health. In addition, the detrimental effects of smoking on periodontal health were examined.

3.13 Blinding

Blinding constitutes an essential methodological component in randomized clinical trials and community-based interventions. The primary objective of blinding is to minimize potential bias and enhance the internal validity of study findings (Karanicolas et al., 2010). Researchers commonly incorporate several forms of blinding into study designs, including participant blinding, examiner (or outcome assessor) blinding, and data analyst/statistician blinding. Depending on the nature of the intervention and study procedures, some studies may achieve triple blinding, whereas others may implement partial or single blinding only (Wartolowska et al., 2017).

Previous evidence suggests that lack of blinding may lead to overestimation of intervention effects, particularly in studies involving behavioral or interventional procedures (Desharnais et al., 1993). This may result from participants' expectations and perceptions regarding the intervention. Therefore, participant blinding is recommended whenever feasible, as it may

reduce performance bias, adherence bias, and differential attrition (Hróbjartsson et al., 2014; Wartolowska et al., 2017). However, in educational and behavioral interventions, full participant blinding is often difficult to achieve due to the nature of the intervention itself (Webster et al., 2021).

In the current study, full participant blinding was not feasible because the intervention consisted of educational sessions delivered directly to students. Nevertheless, several measures were implemented to minimize participants' awareness of group allocation. Students in the intervention group were unaware that another group received only a single educational session, while students in the comparison group were similarly unaware of the intervention structure implemented in other schools. Participants were not informed about the existence of different study groups or differences in the number or type of educational sessions delivered elsewhere. These measures helped reduce the potential for performance bias and reflect the level of participant blinding typically achievable in educational interventions (Schulz & Grimes, 2002; Webster et al., 2021).

In interventional studies, blinding the principal investigator delivering the intervention is not always possible. Accordingly, in this study, the principal researcher responsible for conducting the educational sessions was aware of group allocation.

Blinding outcome assessors and data collectors is important to reduce observer-related bias, detection bias, and expectancy effects such as the Pygmalion effect. In the present study, clinical examiners and data collectors were blinded to participants' group allocation throughout the assessment process. They were not informed about participants' intervention status or school assignment, thereby minimizing ascertainment and detection bias following random allocation (Altman & Schulz, 2001).

In addition, the statistician responsible for data analysis was blinded to group allocation during the analytical process. According to the formal definitions of blinding (Altman & Schulz, 2001; Karanickolas et al., 2010; Monaghan et al., 2021), the current study incorporated partial participant blinding, along with examiner and statistician blinding procedures, to reduce performance, assessment, and analytical bias. Although full double blinding was not feasible due to the educational nature of the intervention, multiple methodological measures were implemented to strengthen the validity and reliability of the study findings

3.14 Data management and statistical analysis

The data were analyzed using IBM SPSS Statistics (Version 25.0). Before the analysis, the data were cleaned and checked for completeness and consistency. Descriptive statistics were used to summarize the participants' characteristics and study variables. Categorical variables were presented as frequencies and percentages, while continuous variables were summarized using means and standard deviations. Statistics were used to summarise participants' characteristics and study variables, with categorical variables presented as frequencies and percentages and continuous variables summarised using means and standard deviations.

For the cross-sectional studies (Phase One), periodontal status was assessed using the CPITN, with the highest sextant score representing each participant's periodontal status (students and teachers). The S-OHI mean scores were calculated according to established criteria. Logistic regression analysis was used to identify factors affecting periodontal health among participants, as the original CPITN scores (the dependent variable) did not follow a normal distribution. The bivariate logistic regression for CPITN data is a widely recognized and accepted method in international peer-reviewed literature. As a result, the CPITN scores were categorized as binary: healthy gums (0) and diseased gums (1). The study used a forward selection procedure for model development in students' models while employing a stepwise forward inclusion procedure for teachers.

A multivariable logistic regression analysis was conducted to develop the final model for identifying predictors of PD. This analysis aimed to evaluate the relationship between several predictors and a binary outcome, reporting adjusted odds ratios (AORs) with 95% confidence intervals (Hidalgo & Goodman, 2013; Ebrahimi et al., 2020).

The final models retained only statistically significant predictors (p -value < 0.05). Adjusted odds ratios were calculated with their respective 95% confidence intervals. The Hosmer-Lemeshow test was used to assess the goodness of fit of the logistic model.

In phase two of the study, paired-sample t -tests were used to compare results within student groups, and independent-sample t -tests to compare results between groups. The normality of the data was assessed using the Kolmogorov–Smirnov test, which supported the use of parametric analyses. Responses from the questionnaires were recoded into scale variables to calculate the mean scores for oral hygiene, dietary habits, and smoking behaviors. To assess the true impact of educational intervention, a net effect (difference-in-differences) approach was also employed, with statistical significance set at $p < 0.05$.

In the teachers' part, non-parametric tests were used. within-group pre–post changes were analyzed using the Wilcoxon signed-rank test, while between-group comparisons were conducted using the Mann–Whitney U test.

Effect sizes were reported alongside the mean values to indicate both the magnitude and practical significance of the observed differences. Ninety-five percent confidence intervals

were included to evaluate the precision and reliability of the estimates. Questionnaire responses were recoded into continuous variables to calculate the mean, median, standard deviation, and interquartile range. Higher scores indicated healthier oral hygiene and dietary behaviors, while lower scores reflected unfavorable behaviors, with adjustments made for smoking variables. Statistical significance was determined at $p < 0.05$.

Chapter four

Published Articles

- 4.1 Prevalence and socio-behavioral determinants of periodontal disease among adolescents in the northern West Bank: a cross-sectional study. Published an article in BMC Oral Health. Available from: <https://doi.org/10.1186/s12903-025-07083-y>
- 4.2 Effectiveness of an Interactive School-Based Oral Health Educational Program on Periodontal Status Among Palestinian Adolescents: An Intervention Study. Published an article in the journal Children (MDPI). Available from: <https://doi.org/10.3390/children12101302>
- 4.3 Prevalence and Socio-Behavioural Determinants of Periodontal Disease Among Adults in the Northern West Bank: A Cross-Sectional Study. Published an article in the Dentistry Journal, MDPI. Available from: <https://www.mdpi.com/2304-6767/14/1/53>. PDF Version: <https://www.mdpi.com/2304-6767/14/1/53/pdf>

Chapter Five

The Results

5.1 Introduction

This chapter presents the study findings and their corresponding statistical analyses. It includes a descriptive analysis of adolescent participants and teachers recruited from the selected schools, as well as an assessment of factors associated with periodontal status in both study groups. The relationships between selected independent variables and the CPITN were examined using appropriate statistical tests and regression analyses. In addition, the chapter presents findings on the effect of the two-month educational intervention on PD outcomes among adolescent participants and teachers.

5.2 Presentations of the Results

The collected data were coded, entered, cleaned, and prepared for statistical analysis using the Statistical Package for the Social Sciences (SPSS) version 24.0 (IBM Corp., Armonk, NY, USA).

5.3 Phase One Goals:

1. To assess the prevalence of PD among 9th-grade students in the North governorates of the West Bank and to examine its relationship with socioeconomic status (SES), oral hygiene status and practices, dietary habits, and smoking behaviors.
2. To assess the prevalence of PD among 9th-grade teachers in the North governorates of the West Bank and to examine its relationship with (SES), oral hygiene status and practices, dietary habits, and smoking behaviors.

Objectives

1. To measure the Community Periodontal Diseases Index for Treatment Needs (CPITN) among 9th-grade students and their teachers in governmental and private schools in the Nablus, Jenin, and Tulkarm governorates.
2. To measure the Simplified Oral Hygiene Index (S-OHI) among 9th-grade students and their teachers in governmental and private schools in the Nablus, Jenin, and Tulkarm governorates.
3. To investigate the association between CPITN and S-OHI among 9th-grade students and their teachers in the Nablus, Jenin, and Tulkarm governorates.
4. To investigate the association between CPITN and socioeconomic status (SES) among 9th-grade students and their teachers in the Nablus, Jenin, and Tulkarm governorates.

5. To investigate the association between CPITN and oral hygiene practices among 9th-grade students and their teachers in the Nablus, Jenin, and Tulkarm governorates.
6. To investigate the association between CPITN and dietary habits among 9th-grade students and their teachers in the Nablus, Jenin, and Tulkarm governorates.
7. To investigate the association between CPITN and smoking behaviours among 9th-grade students and their teachers in the Nablus, Jenin, and Tulkarm governorates.

5.4 Phase One Results:

The prevalence of PD among 9th-grade students in the North governorates of the West Bank and ne its relationship with predictor variables:

The sample comprised slightly more males (52.1%) than females (47.9%), predominantly from governmental schools (58.3%) and the Nablus governorate (39.0%), with most (72.3%) reporting average or low family economic status (Table 5.3). The majority of students exhibited a medium level of oral hygiene (90.6%) (Table 5.4). Dietary habits indicated limited consumption of healthy foods, with fewer than 5% consuming fruits (1.6%), vegetables (3.9%), red meat (3.3%), fish (4.5%), or nuts (1.6%) five or more times per week. Meanwhile, 41.1% frequently consumed milk and dairy products (Table 5.5). Smoking behaviours were prevalent: 46.2% reported cigarette smoking and 85.0% reported water-pipe smoking; 72.0% reported frequent water-pipe sessions overall (~84.8% among water-pipe users) (Table 5.5).

Table 5.1: Distribution of Periodontal Status Across Examined Sextants Among the Participating Students

Examined sextants	Healthy		Bleeding		Calculus	
	n	%	n	%	n	%
Posterior upper (Right)	405	12.1	1946	58.0	821	24.5
Posterior lower (Right)	993	27.8	2062	61.5	306	9.1
Anterior upper (Right)	737	22	2033	60.6	514	15.3
Anterior lower (Left)	578	17.4	1528	46	1182	35.6
Posterior upper (Left)	636	19	1667	49.7	983	29.3
Posterior lower (Left)	1487	44.3	1702	50.8	90	3

The distribution of periodontal status across the examined sextants reveals that healthy gingiva was observed at the highest rate in the posterior lower left sextant (44.3%). In contrast, the posterior upper right sextant showed the lowest percentage of healthy sextants (12.1%). Gingival bleeding was the most prevalent condition among all sextants, with the highest occurrence noted in the posterior lower right sextant (61.5%) and the anterior upper right sextant (60.6%). Calculus formation varied significantly, with the anterior lower left sextant exhibiting the highest proportion (35.6%), while the posterior lower left sextant recorded the lowest (3%) (Table 5.1).

Table 5.2: Distribution of CPITN Categories in the Participant Students

Periodontal status	Students' No.	Percentages%	St. Error	CI (95%)
Healthy gingiva	443	13.2	0.6	12.1 – 14.4
Diseased gingiva (total)	2909	86.8	0.6	85.7 – 88.0
Gingival bleeding	1494	44.6	0.9	42.9 – 46.2
Calculus	1415	42.2	0.9	40.5 – 43.8

Note. Rows indented under “Diseased gingiva (total)” represent its two subcategories: bleeding and calculus

The (CPITN) distribution among the participant students revealed that only 13.2% of the students had healthy gingiva. Most students exhibited PD signs, with 44.6% experiencing gingival bleeding and 42.2% presenting with calculus (Table 5.2).

5.5 Bivariate analysis results

Geographic residence and SES were the strongest predictors of PD in the bivariate analysis results. Students living in Jenin had 68% higher odds of developing PD compared to those in Tulkarm (Crude Odds Ratio [OR]: 1.68), while those in Nablus showed a similar but not statistically significant trend (OR: 1.35). Paternal education (at the university level) and family economic status were also among the sociodemographic determinants of PD (OR: 1.30 and OR: 1.42, respectively) (Table 5.3).

Several oral hygiene practices act as determinants of students' periodontal status in bivariate analysis — namely, brushing status, brushing frequency, brushing duration, use of a medium-bristle toothbrush, interdental-brush use, and dental visits — but the strongest determinant was the (S-OHI), which conferred a roughly 27-fold higher odds of PD as scores increased (OR :26.58). Brushing for only one minute, compared to brushing for two minutes or more, increased the odds by about 60% (OR:1.62) (Table 5.4).

The bivariate analysis also indicated potential associations between students' periodontal status and certain dietary habits, including the frequency of fish consumption (OR: 1.647), red meat consumption (OR: 0.668), and vegetable consumption (OR: 0.704) (Table 5.5). Among the smoking-related behaviors, Smoking status (water pipe) stood out as the dominant risk factor: students who reported water-pipe use had 49 % higher odds of PD than non-users (OR: 1.49). Three additional variables crossed the bivariate screening cutoff ($p \leq 0.25$). They were therefore eligible for multivariable modeling—namely “Smoking status (tobacco) (OR:0.86), Frequency of tobacco smoking (OR:1.24), and Frequency of water pipe smoking (OR:1.22) (Table 5.6).

Table 5.3: Sociodemographic Determinants of Students' Periodontal Status: Crude Odds Ratios

Variable	Categories	Count (% of total)	S.E.	p-value	Crude OR	95% CI	
						Lower	Upper
Gender	Male	1746 (52.1%)	0.102	0.111	1.177	0.963	1.437
	Female [RC]	1607 (47.9%)					
Governorate	Nablus	1320 (39.0%)	0.117	0.079	1.351	0.970	1.699
	Jenin	1012 (30.1%)	0.140	0.000	1.680	1.277	2.210
	Tulkarm [RC]	1020 (30.4%)					
School type	Governmental	1956 (58.3%)	0.103	0.510	0.934	0.763	1.143
	Private [RC]	1397 (41.7%)					
Number of siblings	≤3	1347 (40.2%)	0.105	0.771	0.970	0.789	1.192
	>3 [RC]	2005 (59.8%)					
Fathers' employment status	Yes	2836 (84.4%)	0.137	0.336	1.141	0.872	1.491
	No [RC]	516 (15.6%)					
Mother's Employment Status	Yes	1519 (45.3%)	0.083	0.160	1.123	0.955	1.320
	No [RC]	1833 (54.7%)					
Fathers' education level	Yes	2423 (73.4%)	0.122	0.034	1.296	1.020	1.646
	No [RC]	884 (26.6%)					
Mothers' education level	Yes	2102 (63.3%)	0.106	0.734	1.037	0.842	1.277
	No [RC]	1223 (36.7%)					
Family's economic status	Good or excellent	929 (27.7%)	0.109	< 0.001	1.416	1.143	1.754
	Average or low [RC]	2423 (72.3%)					

Note. RC = Reference category; Crude OR = Crude Odds Ratio; S.E.=Standard Error; Reference group for outcome: Healthy Gingiva. The educational status of the student's father and mother = Study or have completed a university-level program.

Table 5.4: Oral Hygiene Determinants of Students' Periodontal Status: Bivariate Crude OR Analysis

Variable	Categories	Count (% of total)	S.E.	p-value	Crude OR	95% CI	
						Lower	Upper
S-OHI (*)	Good (1.0-1.2)	277 (8.3%)	0.142	< 0.001	26.581	20.114	35.127
	Medium (1.3-3.0)	3037 (90.6%)					
	Bad (3.1-4.0)	25 (0.7%)					
Brushing status	Yes	2638 (78.7%)	0.120	0.111	1.208	0.955	1.528
	No [RC]	714 (21.3%)					
Frequency of brushing(times)	Once	2281 (68.0%)	0.092	0.110	0.878	0.733	1.052
	Twice or more [RC]	360 (10.7%)					
Duration of brushing (minutes)	One	3182 (94.9%)	0.214	0.024	1.621	1.006	2.463
	Two or more [RC]	170 (5.1%)					
Use the Modified Bass technique	Yes	81 (2.4%)	0.328	0.922	1.033	0.543	1.966
	No [RC]	3271 (97.6%)					
Use a medium-bristle toothbrush	Yes	463 (13.8%)	0.134	< 0.001	1.534	1.181	1.994
	No	2889 (86.2%)					
Use an interdental brush	Yes	159 (4.7%)	0.156	< 0.001	3.336	2.458	4.530
	No [RC]	3139 (95.3%)					
Visit dentist	Yes	2848 (85.0%)	0.151	0.107	1.230	0.915	1.653
	No [RC]	504 (15.0%)					
How often does the participant visit the dentist	Regularly	304 (9.1%)	0.071	0.705	0.973	0.847	1.119
	Sometimes [RC]	3048 (90.9%)					

†Note.RC = Reference category; Crude OR = Crude Odds Ratio; S.E.=Standard Error; Continuous variable= (*)

Table 5.5: Dietary Habits (Determinants) of Students' Periodontal Status: Crude Odds Ratios

Variable	Categories	Count (% of total)	S.E.	p-value	Crude OR	95% CI	
						Lower	Upper
Frequency of fruit eating	<5 times	3299 (98.4%)	0.437	0.682	1.196	0.508	2.814
	≥5 times	53 (1.6%)					
Frequency of vegetable eating	<5 times	3221 (96.1%)	0.236	0.136	1.420	0.89	2.26
	≥5 times	131 (3.9%)					
Frequency of consuming dairy products	<5 times	1975 (58.9%)	0.104	0.834	0.979	0.799	1.199
	≥5 times	1377 (41.1%)					
Frequency of red meat eating	<5 times	3243 (96.7%)	0.253	0.110	0.668	0.407	1.096
	≥5 times	109 (3.3%)					
Frequency of fish eating	<5 times	3201 (95.5%)	0.295	0.090	1.647	0.925	2.935
	≥5 times	151 (4.5%)					
Frequency of nut eating	<5 times	2700 (80.5%)	0.436	0.611	1.248	0.531	2.930
	≥5 times	652 (19.5%)					
Frequency of sweet eating	<5 times	3297 (98.4%)	0.130	0.683	0.950	0.817	1.362
	≥5 times	55 (1.6%)					

†Note. All the frequencies were examined as ≥5 times and <5 times per week; Reference category=<5 times ;S.E.=Standard Error

Table 5.6: Smoking Behaviors (Determinants) of Students' Periodontal Status: Crude Odds Ratios

Variable	Categories	Count (% of total)	S.E.	p-value	Crude OR	95% CI	
						Lower	Upper
Smoking status (tobacco)	Yes	1548 (46.2%)	0.103	0.136	0.858	0.701	1.049
	No [RC]	1804 (53.8%)					
Frequency of tobacco smoking	Regularly	485(14.5%)	0.174	0.218	1.239	0.881	1.742
	Rarely [RC]	1078 (32.2%)					
Age of starting smoking(years)	10-12 years	1300 (38.8%)	0.202	0.323	1.220	0.82	1.81
	13-15 years [RC]	250 (7.5%)					
No. of cigarettes smoked/week	1-17	1277 (38.1%)	0.009	0.368	1.008	0.990	1.026
	18-25 [RC]	90 (2.7%)					
Smoking status (water pipe)	Yes	2849 (85.0%)	0.130	0.002	1.490	1.16	1.92
	No [RC]	503 (15.0%)					
Frequency of water pipe smoking	Frequently	2414 (72.0%)	0.110	0.059	1.222	0.985	1.517
	Rarely [RC]	938 (28.0%)					

†Note. RC = Reference category; Crude OR = Crude Odds Ratio; Reference group for outcome: Healthy gingiva; S.E.=Standard Error; The variables (Age of start of tobacco smoking) and (No. of cigarettes per week) represent only the percentages among students who reported smoking tobacco.

Table 5.7: Final Multivariable Logistic Regression Model Showing Significant Determinants of Periodontal Status

Variable	S.E.	Wald	p-value	Adjusted OR	95% CI	
					Lower	Upper
Frequency of brushing (≥ 2 /day vs. < 2 /day)	0.192	14.06	< 0.001	2.05	1.41	2.99
Economic status (Average or low vs Good or excellent)	0.155	10.199	0.001	0.61	0.45	0.83
Medium-sized bristle toothbrush (Yes vs. No)	0.177	10.695	0.001	1.79	1.27	2.53
Governorate (Nablus vs. Tulkarm)	0.178	8.182	0.004	1.66	1.17	2.36
Water-pipe smoking (Yes vs. No)	0.172	7.203	0.007	0.63	0.45	0.88
S-Oral Hygiene Index (Good vs Poor)	0.145	10.605	0.001	1.6	1.20	2.13
Fish-eating frequency (≥ 5 vs < 5)/week	0.356	3.977	0.046	2.04	1.01	4.17

Note. Adjusted OR = Adjusted Odds Ratio, ($p < 0.05$), reference group for outcome: Healthy gingiva. S.E. Standard Error.

The initial multivariate logistic regression model included a wide range of sociodemographic, behavioural, and lifestyle determinants: gender, governorate, father's education level, family economic status, brushing status, brushing frequency, brushing duration, use of a medium-bristled toothbrush, interdental brush use, dental visits, (S-OHI), frequency of fish, red meat, and vegetable consumption, smoking status (tobacco and water pipe), and frequency of tobacco and water pipe smoking.

The final model retained several significant determinants associated with PD among students. Brushing twice daily or more was associated with a higher likelihood of healthy gingiva, with an Adjusted Odds Ratio (AOR) of 2.05. Other determinants that were associated with higher odds of maintaining healthy gingiva included using a medium-bristled toothbrush (AOR: 1.79), having a good (S-OHI) score (AOR:1.60), residing in Nablus (AOR:1.66), and eating fish five or more times a week (AOR:2.04). Conversely, students from average or low economic backgrounds had lower odds of having healthy gingiva compared to those from good or excellent economic status (AOR:0.61). Additionally, students who smoked water pipes had lower odds of healthy gingiva than non-smokers (AOR:0.63) (Table 5.7).

The logistic regression model's goodness of fit was assessed using a likelihood ratio test, yielding a significant chi-square statistic ($\chi^2 = 849.068$, $p = 0.000$). Hosmer-Lemeshow test yielded a non-significant result ($p = 0.077$), suggesting that the model adequately fits the examined variables.

Additionally, the model's pseudo-R² value of 0.524 indicates that it accounts for approximately 52% of the variability in the periodontal outcome, representing a substantial improvement over the null model.

5.6 Phase one results

A total of 920 participants were included in the study, with 43.0% males and 57.0% females. The sample was nearly evenly distributed across the three governorates: Nablus (33.7%), Jenin (32.9%), and Tulkarm (33.4%). The majority of participants attended governmental schools (72.8%), and over half reported owning their homes (52.6%). Regarding perceived economic status, 61.1% rated themselves as having an “average” status, while only 2.3% rated their status as “excellent/very good” (Table 5.10).

Regarding oral hygiene practices, 97.4% of participants had a moderate Simplified Oral Hygiene Index (S-OHI), and only 6.3% reported brushing their teeth twice or more daily. A large proportion (50.3%) brushed for one minute or less, and nearly one-quarter (24.6%) were unsure of the duration of their brushing. The use of the Modified Bass brushing technique was reported by only 2.4%, and just 7.0% used medium-bristled toothbrushes.

Regular dental visits were reported by 43.9% of the sample, while only 3.9% visited the dentist specifically for periodontal cleaning. Most participants replaced their toothbrushes every month (31.5%), but 21.4% selected “none of the above” options and 18.0% had missing responses (Table 5.11).

Regarding dietary habits, the daily consumption of fruits and vegetables was uncommon. Only 1.5% consumed fruits more than once per day, and no participants reported consuming vegetables more than once daily. In contrast, the consumption of sweets, pastries, and soda was high; for example, 73.5% consumed sweets and 65.4% consumed soda 2–4 times per week (Table 5.12)

Tobacco use was prevalent, with 39.5% reporting cigarette smoking and 88.2% reporting water pipe smoking. Among water pipe smokers, 78.4% reported regular use. The most common age to initiate cigarette smoking was between 16 and 20 years (24.3%) (Table 5.13).

Table 5.8: Distribution of Periodontal Status Across Examined Mouth Regions in Teachers

Mouth Region	Healthy N(%)	Bleeding N(%)	Calculus N(%)	Pocket <3mm N(%)	Pocket ≥3mm N(%)
Upper right second molar	298 (32.5)	349 (38.0)	93 (10.1)	61 (6.6)	48 (5.2)
Upper right first molar	201 (21.9)	367 (40.0)	191 (20.8)	105 (11.4)	10 (1.1)
Upper central incisor	176 (19.2)	572 (62.3)	149 (16.2)	21 (2.3)	0 (0.0)
Upper left first molar	115 (12.5)	416 (45.3)	264 (28.8)	72 (7.8)	24 (2.6)
Upper left second molar	103 (11.2)	333 (36.3)	190 (20.7)	215 (23.4)	25 (2.7)
Lower left second molar	423 (46.1)	448 (48.9)	20 (2.2)	1 (0.1)	0 (0.0)
Lower left first molar	501 (54.6)	389 (42.4)	21 (2.3)	7 (0.8)	0 (0.0)
Lower left central incisor	144 (15.7)	418 (45.5)	305 (33.2)	47 (5.1)	3 (0.3)
Lower right first molar	603 (65.7)	277 (30.2)	24 (2.6)	2 (0.2)	1 (0.1)
Lower right second molar	667 (72.7)	214 (23.3)	10 (1.1)	1 (0.1)	1 (0.1)

The distribution of periodontal conditions varies significantly across tooth regions. Notably, the lower right second molar region emerged as the healthiest area, showcasing the highest proportion of healthy gingiva at 72.7%. In contrast, the upper central incisor region exhibited the highest prevalence of gingival bleeding at 62.3%, indicating its vulnerability to bleeding.

Additionally, the lower left central incisor region displayed the highest rate of calculus deposition at 33.2%, reflecting a substantial accumulation of plaque and calculus in this region. Regarding periodontal pockets, the upper left second molar region presented the highest occurrence of shallow pockets (less than 3mm), affecting 23.4% of participants. In comparison, deeper pockets (3mm or greater) were most frequently observed in the upper right second molar region, with a prevalence of 5.2% (Table 5.8).

Table 5.9: Distribution of (CPITN) Categories Among Teachers

Periodontal Status	n	%
Healthy gingiva	108	11.8
Bleeding	194	21.2
Calculus	259	28.2
Pockets < 3 mm	273	29.8
Pockets $\geq$ 3 mm	83	9.1
Total	917	100

Overall Community Periodontal Index score = 3.03 (SE = 0.0382; 95% CI = 2.96–3.11)

The CPITN distribution among the participant teachers shows that only about one in nine (11.8%) had completely healthy gingiva, while a fifth (21.2%) exhibited bleeding on probing. Calculus deposits were present in just over a quarter of participants (28.2 %), and nearly three in ten (29.8 %) had shallow periodontal pockets (< 3 mm). Deep pockets ($\geq$ 3 mm), indicative of more advanced periodontal breakdown, were found in 9.1 % of the sample. The overall mean CPI score was 3.03 (SE = 0.0382; 95% CI = 2.96–3.11), indicating that, on average, teachers' periodontal status fell between calculus presence (CPI = 2) and shallow pocketing (CPI = 3) (Table 5.9).

5.7 Bivariate analysis results

In the bivariate logistic regression analysis, several sociodemographic factors were significantly associated with periodontal status. Participants from Nablus (Crude OR = 2.67) and Jenin (Crude OR = 1.61) were more likely to have PD compared with those from Tulkarm. Participants reporting good/excellent economic status had lower odds of periodontal disease than those reporting average/low economic status (Crude OR = 0.39). The number of children and family members, as well as house ownership, were also significant variables for periodontal status among the participant teachers (Table 5.10).

Teachers with a good oral hygiene status, as assessed by (S-OHI), had significantly higher odds of maintaining a healthy periodontal condition compared with those with poor hygiene (Crude OR = 3.70). Brushing twice or more daily was strongly protective, reducing the odds of periodontal problems by almost 86% compared with those who did not brush (Crude OR = 0.1). Similarly, teachers who brushed for one minute or less were more than twice as likely to present with poor periodontal status compared with those who brushed for two minutes or

more (Crude OR = 2.04). Practicing the Modified Bass technique was highly protective, showing a nearly sevenfold increase in the odds of healthy periodontal status (Crude OR = 6.80). Moreover, the use of a medium-bristle toothbrush was significantly associated with better periodontal health (Crude OR = 2.77). Teachers who reported regular dental visits also had twice the odds of healthier periodontal conditions compared with those who did not (Crude OR = 2.11). Conversely, those who visited the dentist specifically for periodontal cleaning were less likely to present with a healthy periodontal status (Crude OR = 0.38) (Table 5.11).

Teachers' dietary habits are associated with their periodontal health. Specifically, increased fruit consumption significantly correlates with a reduced likelihood of PD (Crude OR = 0.625). This finding suggests that higher fruit intake may contribute to better periodontal outcomes, supported by a small standard error (S.E. = 0.138) and a significant Wald statistic (11.545), affirming the reliability of this result. Additionally, higher frequencies of consumption of fish (Crude OR = 0.705), nuts (Crude OR = 0.737), and red meat (Crude OR = 0.752) are similarly associated with decreased odds of PD. In contrast, a higher frequency of sweet consumption is positively associated with PD (Crude OR = 1.468) (Table 5.12).

Three smoking-related variables showed statistically significant associations with PD. Teachers who smoked 1–35 cigarettes per week had higher odds of PD (Crude OR = 2.27), and those who smoked 36–68 cigarettes per week showed even greater odds (Crude OR = 4.47). In addition, water pipe smoking was significantly associated with PD (Crude OR = 2.20) (Table 5.13).

Table 5.10: Crude Odds Ratios for Sociodemographic Determinants of Periodontal Status

Variable	Categories	Count (%)	S.E.	p-value	Crude OR	95% CI	
						Lower	Upper
Gender	Male	396(43.0%)	0.205	0.079	1.433	0.959	2.143
	Female [RC]	524(57.0%)					
Governorate	Nablus	310(33.7%)	0.268	<0.001	2.67	1.577	4.518
	Jenin	303(32.9%)	0.237	0.044	1.613	1.013	2.568
	Tulkarm [RC]	307(33.4%)					
School type	Governmental	670(72.8%)	0.222	0.276	1.274	0.824	1.968
	Private [RC]	249(27.1%)					
No. of children	≤3	380(41.3%)	0.250	0.005	0.499	0.306	0.813
	>3 [RC]	255(27.7%)					
No. of family members	≤3	55(6.0%)	0.607	<0.001	14.125	4.301	46.387
	>3 [RC]	230(25.0%)					
House Ownership	Yes	484(52.6%)	0.217	<0.001	2.035	1.329	3.115
	No [RC]	436(47.4%)					
Family's economic status	Good or excellent	131(14.2%)	0.242	<0.001	0.394	0.245	0.632
	Average or low [RC]	785(85.7%)					

Table 5.11: Oral Hygiene Determinants of teachers' Periodontal Status (Bivariate Crude OR Analysis)

Variable	Categories	Count (%)	S.E.	p-value	Crude OR	95% CI	
						Lower	Upper
S-OHI	Good	20(2.2%)	0.266	<0.001	3.697	2.197	6.221
	Medium	865(95.3%)					
	Bad [RC]	23(2.5%)					
Frequency of brushing	Once/day	493(53.6%)	0.309	0.052	0.549	0.300	1.006
	Twice or more/day	58(6.3%)	0.390	<0.001	0.142	0.066	0.304
	Occasionally	180(19.6%)	0.428	0.464	1.368	0.591	3.164
	Do not brush [RC]	188(20.5%)					
Morning brushing	Yes	613(69.8%)	0.264	0.056	0.604	0.36	1.013
	No [RC]	265(30.2%)					
Duration of brushing	1 or less min.	484(52.6%)	0.217	<0.001	2.035	1.329	3.115
	Two or more min. [RC]	436(47.4%)					
Use the Modified Bass technique	Yes	22 (2.4%)	0.441	<0.001	6.803	2.864	16.157
	No [RC]	898 (97.6%)					
Use a medium-bristle toothbrush	Yes	64 (7.0%)	0.309	<0.001	2.768	1.51	5.073
	No [RC]	856(93.0%)					
Frequency of toothbrush replacement /months	two	267(36.9%)	0.230	0.380	1.223	0.780	1.918
	three or more [RC]	456(63.1%)					
Visit the dentist regularly	Yes	404(43.9%)	0.209	<0.001	2.109	1.4	3.177
	No [RC]	516(56.1%)					
Reason for dentist visit	Periodontal cleaning	36 (3.9%)	0.399	0.015	0.379	0.173	0.829
	Other [RC]	883(96.1%)					

†Note. RC = Reference category; Crude OR = Crude Odds Ratio; S.E.=Standard Error

Table 5.12: Bivariate Analysis of Dietary Habits as Determinants of Teachers' Periodontal Status (Crude Odds Ratios)

Variable	S.E.	Wald	P value	Crude OR	95% CI	
					Lower	Upper
Frequency of fruit-eating/weekdays	0.138	11.545	0.001	0.625	0.477	0.82
Frequency of vegetable eating/weekdays	0.138	3.502	0.061	0.772	0.589	1.012
Frequency of red meat-eating/weekdays	0.136	4.421	0.035	0.752	0.577	0.981
Frequency of fish-eating/weekdays	0.105	11.096	0.001	0.705	0.574	0.866
Frequency of nut-eating/weekdays	0.103	8.784	0.003	0.737	0.603	0.902
Frequency of sweet eating/weekdays	0.154	6.195	0.013	1.468	1.085	1.986
Frequency of soda consumption/weekdays	0.143	2.449	0.118	1.251	0.945	1.655
Frequency of eating pastries/weekdays	0.165	0.228	0.633	0.924	0.669	1.277

RC = Reference category; Crude OR = Crude Odds Ratio. Reference group for outcome: Healthy gingiva.

Table 5.13: Smoking Behaviors (Determinants) of Teachers' Periodontal Status
Crude Odds Ratios

Variable	Categories	Count (%)	S.E.	p-value	Crude OR	95% CI	
						Lower	Upper
Tobacco smoking status	Yes	363(39.5%)	0.207	0.26	1.262	0.842	1.892
	No [RC]	557(60.5%)					
Frequency of tobacco smoking	Regularly	278(30.2%)	0.219	0.598	1.123	0.73	1.726
	Rarely [RC]	642(69.8%)					
Age of starting smoking(years)	10-20	332(36.1%)	0.753	0.382	1.930	.441	8.442
	21-30 [RC]	26(7.3%)					
No. of cigarettes smoked/week	1-35	211(22.9%)	0.329	0.013	2.273	1.192	4.334
	36-68	49(5.3%)	0.645	0.020	4.472	1.262	15.846
	69 and more [RC]	93(10.1%)					
Smoking status (water pipe)	Yes	811(88.2%)	0.272	0.024	2.2	1.3	3.7
	No [RC]	109(11.8%)					
Frequency of water pipe smoking	Frequently	721(78.4%)	0.283	0.16	0.672	0.386	1.17
	Rarely [RC]	127(13.8%)					

The final logistic regression model demonstrated a good fit to the data. The Omnibus Test of Model Coefficients was statistically significant ($\chi^2 = 47.010$, $df = 8$, $p < 0.001$), indicating that the model with predictors performed significantly better than the null model. Model performance was further evaluated using the Hosmer–Lemeshow goodness-of-fit test, which yielded a non-significant result ($\chi^2 = 3.367$, $df = 8$, $p = 0.909$), suggesting that the model fits the data well. Additionally, the Nagelkerke R^2 was 0.525, indicating that approximately 52.5% of the variance in periodontal health status among participants was explained by the final set of predictors. The -2 Log Likelihood value of 51.082 in the last step further confirms the model's adequacy.

In the final stepwise logistic regression model, some variables were excluded due to a lack of statistical significance ($p > 0.05$). These included the city of residence (Jenin vs. Tulkarm), the mean Simplified Oral Hygiene Index (S-OHI), frequency of sweet consumption, fish intake, the number of family members living with the participant, and self-reported family economic status. Their exclusion indicates that these factors did not significantly contribute to predicting periodontal health outcomes in the studied population.

On the other hand, several significant predictors of periodontal health were identified in the final multivariate regression model. Participants residing in Nablus were significantly more likely to have healthy gingiva than those from Tulkarm (AOR = 2.85).

Frequent toothbrushing was strongly associated with improved periodontal status (AOR = 0.015), as was morning toothbrushing (AOR = 0.015). Regular toothbrush replacement was also a significant predictor of better periodontal health (AOR = 2.514).

Regarding dietary habits, higher red meat consumption was significantly associated with worse periodontal outcomes (AOR = 0.032), whereas more frequent nut consumption appeared to have a protective effect (AOR = 0.227).

Additionally, the number of cigarettes smoked per week was positively associated with PD (AOR = 1.085) (Table 5.14).

Table 5.14: Final Multivariate Logistic Regression Model for Predictors of Periodontal Health

Predictors	S.E.	Wald	p-value	Adjusted OR	95% CI	
					Lower	Upper
City (Nablus vs. Tulkarm)	1.900	5.193	0.023	3.12	1.15	7.04
Frequency of brushing	1.009	17.551	<0.001	0.015	0.002	0.105
Brushing in the morning (Yes)	1.353	9.784	0.002	0.015	0.001	0.206
Frequency of toothbrush changing	0.354	6.797	0.009	2.514	1.257	5.026
Frequency of red meat eating	1.278	7.210	0.007	0.032	0.003	0.396
Frequency of nut eating	0.619	5.728	0.017	0.227	0.067	0.765
Number of cigarettes smoked per week	0.040	4.094	0.043	1.085	1.003	1.173

Adjusted OR = Adjusted Odds Ratio. Reference group for outcome: Healthy gingiva.

5.8 Phase Two Results

1. To evaluate the effectiveness of an interactive oral health education program on periodontal status, oral hygiene status and practices, dietary habits, and smoking behaviors among 9th-grade students in Nablus City.
2. To evaluate the effectiveness of an interactive oral health education program on periodontal status, oral hygiene status and practices, dietary habits, and smoking behaviors among 9th-grade students in Nablus City.

Specific objectives

1. To measure the CPITN among 9th-grade students and their teachers two months after implementing an interactive educational program in Nablus City.
2. To measure the S-OHI among 9th-grade students and their teachers two months after implementing an interactive educational program in Nablus City.
3. To assess oral hygiene practices, dietary habits, and smoking behaviours among 9th-grade students and their teachers two months after implementing an interactive educational program in Nablus City.
4. To assess the differences in CPITN scores, S-OHI scores, oral hygiene practices, smoking habits, and dietary habits before and after applying for an interactive educational program among students and their teachers.

5.9 The effectiveness of an interactive oral health education program on periodontal status, among 9th-grade students in Nablus City:

At the baseline phase, the sample comprised 53.3% males in the control group and 47.7% in the interventional group. In comparison, females accounted for 46.7% of the control group and 52.3% of the interventional group. Most participants in both groups attended governmental schools, with 74.2% in the control group and 77.5% in the interventional group. The distribution of socioeconomic status among participants (categorized as excellent/very good, good, moderate, and low) indicated that most individuals in both groups reported a moderate socioeconomic status, which comprised 54.1%.

The control and intervention groups were comparable across almost all socio-demographic factors: sex ($p = 0.089$), type of school ($p = 0.247$), socioeconomic status ($p = 0.140$), number of siblings ($p = 0.293$), father's employment status ($p = 0.156$), mother's employment status ($p = 0.175$) and father's education level ($p = 0.978$), all showed no statistically significant differences ($p > 0.05$). The only exception was the mother's education level, which differed significantly between the two groups ($p < 0.001$), indicating that the distribution of maternal education was not equivalent at baseline (Table 5.15).

Table 5.15: Socio-demographic Characteristics of the Study Sample at Baseline Phase.

Variable	Class	Control Group n (%)	Intervention Group n (%)	Chi-Square	p-Value
Sex	Male	244 (53.3)	233 (47.7)	2.889	0.089
	Female	214 (46.7)	255 (52.3)		
Type of School	Governmental	340 (74.2)	378 (77.5)	1.342	0.247
	Private	118 (25.8)	110 (22.5)		
Socioeconomic Status	Excellent/Very Good	36 (7.9)	54 (11.1)	5.472	0.140
	Good	95 (20.7)	79 (16.2)		
	Moderate	248 (54.1)	264 (54.1)		
	Low	79 (17.2)	91 (18.6)		
Number of Siblings	Only participant	46 (10.1)	40 (8.2)	6.141	0.293
	One	37 (8.1)	44 (9.0)		
	Two	104 (22.8)	88 (18.0)		
	Three	92 (20.1)	108 (22.1)		
	Four	145 (31.7)	178 (36.5)		
	Five	33 (7.2)	30 (6.1)		
Father's Employment Status	Yes	360 (84.5)	403 (82.6)	3.712	0.156
	No	30 (6.6)	48 (9.8)		
	Don't know	41 (9.0)	37 (7.6)		
Mother's Employment Status	Yes	207 (45.2)	199 (40.8)	3.483	0.175
	No	217 (47.4)	260 (53.3)		
	Don't know	34 (7.4)	29 (5.9)		
Father's Education Level	No University	159 (34.7)	169 (34.6)	1.001	0.978
	University or Higher	299 (65.3)	319 (65.4)		
Mother's Education Level	No University	160 (34.9)	229 (46.9)	14.033	* 0.000
	University or Higher	298 (65.1)	259 (53.1)		

* $p < 0.05$ is considered statistically significant.

No significant differences between the control and intervention groups were observed in the mean of CPITN and S-OHI scores at baseline ($p = 0.407$ and $p = 0.276$, respectively). After two months of education, the intervention group demonstrated a significantly lower mean CPITN score of 10.00 ± 2.639 , compared to their baseline mean of 10.99 ± 2.766 , and lower than the control group's mean score after the intervention, which was 11.00 ± 2.582 . These results were statistically significant, with a p -value of 0.000. Additionally, for the S-OHI mean scores, the intervention group had a lower mean score of 10.89 ± 2.779 , compared to their baseline mean of 12.90 ± 3.103 , and also lower than the control group's mean score after the intervention, which was 12.53 ± 2.466 (Table 5.16).

Table 5.16: The Comparison of Overall Mean of CPITN and S-OHI Scores Between Control and Intervention Groups at Baseline and after 2 Months of Education

Variable	Group	Control Mean $\pm$ SD	Intervention Mean $\pm$ SD	MD	t-Value	p-Value	CI (95%) (Lower–Upper)	
CPI	Baseline	10.85 $\pm$ 2.85	10.99 $\pm$ 2.766	0.139	0.829	0.407	0.190	0.476
	After 2 months	11.00 $\pm$ 2.582	10.00 $\pm$ 2.639	-1.000	5.700	<0.001	1.314	-0.641
		P = 0.242	P = 0.000					
		T = 1.173	T = 5.595					
		CI (-0.142–0.561)	CI (-0.162–1.225)					
SOHI	Baseline	12.69 $\pm$ 2.619	12.90 $\pm$ 3.103	0.208	1.091	0.276	-0.166	-0.582
	After 2 months	12.53 $\pm$ 2.466	10.89 $\pm$ 2.779	-1.637	-9.424	<0.001	-1.978	-1.296
		P = 0.365	P = 0.000					
		T = 0.906	T = -11.279					
		CI (-0.610–0.188)	CI (-2.355–-1.656)					

Note. MD = Mean Differences.

Table 5.17: Comparison of Mean of CPITN Scores Across Mouth Sextants Between Control and Intervention Groups After 2 Months of Education

Sextant	group	Mean $\pm$ S. D	Mean differences	t	p	95% C. I	
						Lower	Upper
Upper right	control group	2.02 $\pm$ 0.699	-0.018	-0.353	0.724	-0.116	0.080
	intervention group	2.00 $\pm$ 0.805					
Lower right	control group	1.54 $\pm$ 0.617	-0.215	-5.384	<0.001	-0.293	-0.137
	intervention group	1.33 $\pm$ 0.602					
Upper middle	control group	1.94 $\pm$ 0.594	-0.323	-7.621	<0.001	-0.406	-0.240
	intervention group	1.61 $\pm$ 0.682					
Lower middle	control group	2.19 $\pm$ 0.756	-0.176	-3.395	<0.001	-0.278	-0.074
	intervention group	2.02 $\pm$ 0.814					
Upper left	control group	1.86 $\pm$ 0.705	-0.025	-0.522	0.602	-0.120	0.069
	intervention group	1.84 $\pm$ 0.756					
Lower left	control group	1.50 $\pm$ 0.573	-0.221	-5.892	<0.001	-0.295	-0.148
	intervention group	1.28 $\pm$ 0.572					

The comparison of the means of CPITN scores across mouth sextants between the control and intervention groups shows that the intervention group exhibited a statistically significant reduction in several sextants compared to the control group. In the Lower Right Sextant, the control group had a mean score of 1.54 ± 0.617 , while the intervention group recorded a mean score of 1.33 ± 0.602 . The mean difference (MD) between the groups was -0.215.

In the Upper Middle Sextant, the control group had a mean score of 1.94 ± 0.594 , whereas the intervention group presented a lower mean score of 1.61 ± 0.682 , with an MD of -0.323. For the Lower Middle Sextant, the control group had a mean score of 2.19 ± 0.756 , while the intervention group showed a slightly lower mean score of 2.02 ± 0.814 , resulting in a mean difference of -0.176.

In the Lower Left Sextant, the control group's mean score was 1.50 ± 0.573 , while the intervention group achieved a notably lower mean score of 1.28 ± 0.572 . The mean difference was -0.221 (Table 5.17).

Table 5.18: Comparison of the Mean of S-OHI Scores Across Mouth Sextants Between Control and Intervention Groups After 2 Months of Education

Sextant	group	Mean $\pm$ S. D	MD.	t	p	95% C. I	
						Lower	Upper
Upper right	control group	2.27 $\pm$ 0.651	-0.217	-4.532	<0.001	-0.311	-0.123
	intervention group	2.06 $\pm$ 0.786					
Lower right	control group	1.79 $\pm$ 0.639	-0.336	-7.964	<0.001	-0.418	-0.253
	intervention group	1.45 $\pm$ 0.645					
Upper middle	control group	2.06 $\pm$ 0.552	-0.284	-6.541	<0.001	-0.370	-0.199
	intervention group	1.77 $\pm$ 0.736					
Lower middle	control group	2.40 $\pm$ 0.751	-0.379	7.506	<0.001	-0.478	-0.280
	intervention group	2.03 $\pm$ 0.783					
Upper left	control group	2.25 $\pm$ 0.676	-0.154	-3.324	<0.001	-0.245	-0.063
	intervention group	2.10 $\pm$ 0.730					
Lower left	control group	1.75 $\pm$ 0.555	-0.267	-6.620	<0.001	-0.346	-0.188
	intervention group	1.49 $\pm$ 0.656					

The findings indicate that all sextants showed lower mean scores of S-OHI in the intervention group compared to the control group. The most significant reduction was observed in the lower middle sextant, with a mean reduction of 0.379 (control group: 2.40 ± 0.751 , intervention group: 2.03 ± 0.783), indicating the most significant decrease in scores mean. The second-highest reduction occurred in the lower right sextant, with a mean reduction of 0.336 (control: 1.79 ± 0.639 , intervention: 1.45 ± 0.645). Conversely, the upper left sextant showed the least improvement, with a mean reduction of 0.154 (control: 2.25 ± 0.676 , intervention: 2.10 ± 0.730) (Table 5.18).

Table 5.19: Comparison of Overall Oral Hygiene Practices, Diet Habits, and Smoking Behaviours between Control and Intervention Groups at Baseline and After 2 Months of Education.

Variable	Group	Control Mean± S. D	Intervention Mean± S. D	t	P-value
Overall oral hygiene practices	Baseline	14.53±5.426	13.60±6.548	1.968	0.066
	After 2 months	14.69±5.396 P=0.047 T=1.988	17.86±5.931 P=0.001 T=11.921	8.461	<0.001
Overall Diet habits	Baseline	35.36±3.780	35.08±5.2268	0.603	0.563
	After 2 months	35.85±3.655 P=.012 T=2.524	37.20±4.661 P=.001 T=6.304	4.839	<0.001
Overall smoking behaviours	Baseline	6.11±3.429	6.94±3.441	-3.459	0.071
	After 2 months	6.40±3.606 P=.356 T=.924	7.67±3.573 P=.005 T=2.813	5.400	<0.001
The Sum of Overall Practices	Baseline	55.26±8.114	54.75±10.426	0.645	0.519
	After 2 months	56.94±8.168 P=0.000 T=3.741	62.73±9.834 P=0.000 T=17.436	9.644	<0.001

At the baseline, there were no significant differences between the control and intervention groups regarding oral hygiene practices (P=0.066), dietary habits (P=0.563), and smoking behaviours (P=0.071).

The intervention group demonstrated the most substantial improvement in combined practices—encompassing oral hygiene, dietary habits, and smoking behaviours—rising from a score mean of 54.75 ± 10.426 to 62.73 ± 9.834 (P=0.000). In contrast, the control group showed only a minor improvement.

Oral hygiene practices in the intervention group significantly improved after two months, increasing from 13.60 ± 6.548 to 17.86 ± 5.931 (P=0.000). Meanwhile, smoking behaviours in the control group exhibited minimal and non-significant changes, moving from 6.11 ± 3.429 to 6.40 ± 3.606 (P=0.356) (Table 5.19).

Table 5.20: Comparison of Oral Hygiene and Dental Visit Practices between Control and Intervention Groups

Variable	Control Mean± S. D	Intervention Mean± S. D	t	P-value
Brushing status	0.83±0.375	0.93±0.254	4.851	<0.001
Frequency of teeth brushing	0.98±0.593	1.21±0.563	6.140	<0.001
Duration of brushing in minutes	0.70±0.609	1.14±0.859	8.760	<0.001
Use a modified Bass-brushing technique	1.094±0.29242	1.9431±0.4986	-16.396	<0.001
Using a medium-sized bristle toothbrush	1.1471±0.354	1.8212±0.485	-16.377	<0.001
Dentist visiting	1.10±0.294	1.15±0.355	-2.477	0.013
Regular visits to the dentist	1.077±0.268	1.13±0.344	-2.812	0.005

The intervention group demonstrated significant improvements in various oral hygiene practices, particularly in brushing habits. Their mean brushing status score was 0.93 (± 0.254), compared to the control group's score of 0.83 (± 0.375), indicating more consistent brushing habits ($p=0.000$).

Additionally, the intervention group reported brushing their teeth more frequently, with a mean of 1.21 times (± 0.563) per day, whereas the control group averaged 0.98 times (± 0.593) per day ($p = 0.000$). They also brushed for a longer duration, with a mean of 1.14 minutes (± 0.859) compared to the control group's 0.70 minutes (± 0.609) ($p = 0.000$) (Table 5.20).

Table 5.21: Comparison of Dietary Habits Between Control and Intervention Groups

Variable	Control Mean $\pm$ S. D	Intervention Mean $\pm$ S. D	t	P-value
Breakfast Consumption Habits	5.825 $\pm$ 2.346	6.2500 $\pm$ 2.442	-2.703	0.007
Frequency of eating nutritious food	21.000 $\pm$ 2.290	21.278 $\pm$ 3.268	-1.537	0.125
Frequency of eating non-nutritious food	9.046 $\pm$ 0.925	9.067 $\pm$ 1.171	-0.254	0.800

A comparison of dietary habits between the control and intervention groups revealed that breakfast consumption was the only variable that differed statistically. Participants in the intervention group reported higher breakfast consumption (Mean = 6.25 $\pm$ 2.44) compared to the control group (Mean = 5.83 $\pm$ 2.35), with a t-value of -2.703 and a p-value of 0.007 (Table 5.21).

Table 5.22: Comparison of Smoking Habits Between Control and Intervention Group

Variable	Control Mean $\pm$ S. D	Intervention Mean $\pm$ S. D	t	P-value
Cigarette Smoking Status	1.56 $\pm$ 0.501	1.50 $\pm$ 0.500	2.043	0.040
Smoking Frequency	2.663 $\pm$ 0.638	2.6213 $\pm$ 0.713	0.656	0.515
The number of cigarettes	11.05 $\pm$ 4.218	8.04 $\pm$ 3.560	7.800	0.000
Water pipe smoking status	1.14 $\pm$ 0.349	1.13 $\pm$ 0.331	0.740	0.001
Water pipe smoking frequency	2.673 $\pm$ 0.890	2.201 $\pm$ 0.966	7.778	0.000

The smoking status (yes/no) showed a significant reduction in the intervention group (Mean = 1.50, SD = 0.500) compared to the control group (Mean = 1.56, SD = 0.501), $t = 2.043$, $p = 0.040$.

The number of cigarettes smoked per day among participants in the intervention group (Mean = 8.04, SD = 3.560) was significantly lower than that in the control group (Mean = 11.05, SD = 4.218), revealing a statistically significant difference ($t = 7.800$, $p = 0.000$).

Regarding water pipe smoking frequency, the intervention group also reported a lower mean (Mean = 2.201, SD = 0.966) than the control group (Mean = 2.673, SD = 0.890). This difference was statistically significant ($t = 7.778$, $p = 0.000$). Although the difference in water pipe smoking status was minimal (Control Mean = 1.14 vs Intervention Mean = 1.13), it was statistically significant ($t = 0.740$, $p = 0.001$), suggesting a slight but meaningful reduction in the proportion of water pipe smokers in the intervention group (Table 5.22).

Table 5.23 The net Effect of education on Periodontal and oral hygiene Status and Related Behaviours

Index / Domain	Intervention Pre (Mean)	Intervention Post (Mean)	Intervention Change	Control Pre (Mean)	Control Post (Mean)	Control Change	Net Effect
CPITN	10.99	10.00	-0.99	10.85	11.00	0.15	-1.14
S-OHI	12.90	10.89	-2.01	12.69	12.53	-0.16	-1.85
Oral Hygiene practices	13.60	17.86	4.26	14.53	14.69	0.16	4.10
Diet Habits	35.08	37.20	2.12	35.36	35.85	0.49	1.63
Smoking Behaviors	6.94	7.67	0.73	6.11	6.40	0.29	0.44
Sum of All Practices	54.75	62.73	7.98	55.26	56.94	1.68	6.30

The (CPITN) showed a net reduction of -1.14 , while the Simplified Oral Hygiene Index (S-OHI) improved by -1.85 , favoring the intervention group. Regarding health-related practices, the net effect was $+4.10$ for oral hygiene behaviors, $+1.63$ for dietary habits, and $+0.44$ for smoking behaviors. The cumulative improvement across all practice domains reached a net effect of $+6.30$ (Table 5.23).

5.10 Phase Two Results: The effectiveness of an interactive oral health education program on periodontal status among schoolteachers in Nablus City:

Table 5.24: Demographic and social characteristics of the study sample (baseline for the control group: 193, baseline for the intervention group: 243)

Variable	Class	Baseline for the Control Group n (%)	Baseline for Intervention Group n (%)	Pearson Chi-Square	P-Value
Sex	Male	70 (36.3)	104 (45.2)	3.470	0.062
	Female	123 (63.7)	126 (54.8)		
Type of School	Governmental	155 (80.3)	155 (67.4)	8.947	0.03*
	Private	38 (19.7)	75 (32.6)		
The number of children	1-3	71 (55.5)	94 (52.5)	0.733	0.693
	4-5	48 (37.5)	75 (41.9)		
	6-7	9 (7.0)	10 (5.6)		
The number of brothers and sisters	2-4	33 (50.8)	23 (45.1)	4.014	0.134
	5-7	32 (49.2)	25 (49.0)		
	8-10	1 (1.0)	3 (5.9)		
Does the Participant own a house	Yes	96 (45.1)	113 (49.1)	0.53	0.817
	No	96 (49.7)	117 (50.9)		
Socioeconomic Status	Excellent	3 (0.6)	8 (3.5)	2.953	0.111
	Good	10 (5.2)	37 (16.0)		
	Moderate	120 (62.7)	148 (64.3)		
	Low	61 (32.0)	37 (16.1)		

*Note. P-values less than 0.05 were considered statistically significant. The number of children the participants have (if the participant is married). The number of brothers and sisters living with the participant in the same house (if the participant is unmarried). Socioeconomic status was self-reported

In both the control and intervention groups, females make up the larger share, at 63.7% and 54.8%, respectively. Meanwhile, the percentage of males in the intervention group is 45.2%, compared with 36.3% in the control group.

The number of children per family is similar across both groups, with 55.5% in the control group and 52.5% in the intervention group having 1-3 children. Most unmarried participants in both groups have 2-4 siblings living with them. Around 45.1% of control group participants and 49.1% of intervention group participants own a house. Most control and intervention groups had moderate socioeconomic status, with proportions of 62.7 and 64.3, respectively.

Ultimately, the intervention and control groups are similar in nearly all-important sociodemographic factors, such as gender balance, number of children, homeownership, and socioeconomic status. The only notable difference between the two groups was the type of school (Table 5.24).

Table 5.25: Comparison of Oral Health Indices (SOHI and CPI) Between Control and Intervention Groups at Baseline and After 2 Months

Variable		Control Mean± S. D	Intervention Mean± S. D	U	Effect size	Z	P-Value	CI (95%) (Lower–Upper)	
Overall SOHI scores	Baseline	12.97± 2.248 Median=13 IQR=3	13.64±2.335 Median=14 IQR=3						
	After 2 months	13.03± 2.392 P=0.926 Z=-0.1 MR=73.93 SR=5027.5 CI:0.920_0.93 Median=13 IQR=3 effect size=0.007	11.73± 2.545 P=0.000 Z=-7.756 MR=108.49 SR=16816 CI(0.000_0.00) Median=14 IQR=4 effect size=0.51	1793.5	0.151	-3.110	0.06	0.04	0.07
				16060	0.231	-4.783	0.08	0.07	0.09
Overall CPI score	Baseline	18.73± 3.953 Median=19 IQR=6	19.89±4.410 Median=20.5 IQR=7						
	After 2 months	18.84± 4.209 Median=19 IQR=6 P=0.845 Z=-0.203 MR=80.15 SR=7053.5 C.I(.838_0.852) Effect size=0.015	17.33± 4.465 Median=16 IQR=6 P=0.000 Z=-5.700 MR=118.74 SR=17098 C.I(0.000_0.000) Effect size=0.376	18556.5	0.137	-2.831	0.05	0.03	0.06
				17646	0.173	3.563	<0.001	<0.001	<0.001

At baseline, there were no statistically significant differences between the control and intervention groups in terms of SOHI scores ($U = 17932.5$, $Z = -3.110$, $p = 0.06$) or CPITN scores ($U = 18556.5$, $Z = -2.831$, $p = 0.05$), indicating that both groups were comparable before the intervention.

After two months, the SOHI scores in the intervention group decreased significantly from 13.64 ± 2.335 to 11.73 ± 2.545 ($p = 0.000$, $Z = -7.756$), while the control group showed no significant change (from 12.97 ± 2.248 to 13.03 ± 2.392 , $p = 0.926$, $Z = -0.1$). Between-group comparison after 2 months showed a statistically significant difference in favour of the intervention group ($U = 35887.5$, $Z = -4.783$, $p = 0.04$).

Similarly, the CPITN scores in the intervention group showed a significant reduction from 19.89 ± 4.410 to 17.33 ± 4.465 ($p = 0.000$, $Z = -5.700$), whereas the control group had no significant change (from 18.73 ± 3.953 to 18.84 ± 4.209 , $p = 0.845$, $Z = -0.203$). Post-intervention comparison between groups revealed a significant difference ($U = 37084.5$, $Z = -3.563$, $p = 0.03$) (Table 5.25).

Table 5.26: Comparison of S-OHI Scores by Mouth Sextant Between Control and Intervention Groups Using Mann–Whitney U Test

Mouth Sextant	group	Mean Rank	Sum of Ranks	U	W	Z	p	95% C. I	
								Lower	Upper
Upper right posterior	control group	213.22	40725	21541	48016	-0.368	0.713	0.696	0.714
	intervention group	209.16	48106						
Upper middle anterior	control group	240.08	45854.5	16411.50	42976	-5.134	<0.001	0.000	0.000
	intervention group	186.85	42976.5						
Upper left posterior	control group	231.82	44278	17988	44553	-3.462	<0.001	0.000	0.001
	intervention group	193.71	44553						
Lower left posterior	control group	232.63	44433	17833	44398	-4.020	<0.001	0.000	0.000
	intervention group	193.03	44398						
Lower middle anterior	control group	247.37	47248	15018	42583	-6.042	<0.001	0.000	0.000
	intervention group	180.80	41583						
Lower right posterior	control group	214.46	40962	21304	47583	-0.604	0.560	0.540	0.560
	intervention group	208.13	47869						

A comparison of S-OHI scores between control and intervention groups revealed significant differences in most mouth sextants, favouring the intervention group. The upper-middle anterior sextant showed a notable difference ($Z = -5.134$, $p < 0.001$), with the control group having a higher mean rank (240.08) than the intervention group (186.85). Significant differences were also found in the upper-left posterior ($Z = -3.462$, $p < 0.001$), lower-left posterior ($Z = -4.020$, $p < 0.001$), and lower-middle anterior ($Z = -6.042$, $p < 0.001$) sextants. No significant differences were observed in the upper right posterior ($Z = -0.368$, $p = 0.713$) and lower right posterior ($Z = -0.604$, $p = 0.560$) sextants (Table 5.26).

Table 5.27: Comparison of CPITN Scores Between Control and Intervention Groups Across Different Mouth Regions

Mouth regions	group	Mean Rank	Sum of Ranks	U	W	Z	p	95% C. I	
								Lower	Upper
Upper right second molar	control group	209.49	40223	21695	40223	-0.328	0.743	0.732	0.749
	intervention group	213.17	49030						
Upper right first molar	control group	207.39	39819.5	21291	39819.5	-0.667	0.505	0.494	0.514
	intervention group	214.93	49433.5						
Right central incisor	control group	242.43	46546.5	16141.5	42706.5	-5.337	<0.001	0.000	0.000
	intervention group	185.68	42706.5						
Upper Left first molar	control group	225.28	43253	19435	46000	-2.248	0.025	0.022	0.028
	intervention group	200.00	46000						
Upper left second molar	control group	243.61	46773	15915	42480	-5.162	<0.001	0.000	0.000
	intervention group	184.70	42480						
Lower left second molar	control group	228.20	43815	18873	45438	-2.922	0.003	0.002	0.004
	intervention group	197.56	45438						
Lower left first molar	control group	220.08	42254	20433.5	46998.5	-1.560	0.119	0.110	0.122
	intervention group	204.34	46998						
Lower left central incisor	control group	251.55	48298.5	14389.5	40954.5	-6.534	<0.001	0.000	0.000
	intervention group	178.06	40954.5						
Lower right first molar	control group	206.13	39576.5	21048.5	39576.50	-1	0.317	0.303	0.321
	intervention group	215.98	49676.5						
Lower right second molar	control group	191.88	36840.5	18312.5	36840.5	-3.942	<0.001	0.000	0.000
	intervention group	227.88	52412.5						

The Mann-Whitney U test identified statistically significant differences between the control and intervention groups in several areas of the mouth. The most notable differences were found at the lower left central incisor ($Z = -6.534$, $p < .001$), the right central incisor ($Z = -5.337$, $p < .001$), the upper left second molar ($Z = -5.162$, $p < .001$), and the lower right second molar ($Z = -3.942$, $p < .001$) (Table 5.27).

Table 5.28: Comparison of Overall Oral Hygiene Practices, Dietary Habits, and Smoking Behaviors Between Control and Intervention Groups at Baseline and After Two Months by Mann–Whitney analysis test

Variable	Group	Baseline	After 2months	-ve MR(SoR)	+ve MR(SoR)	z	P-value
Overall oral hygiene practices	Control	18.83±7.056	18.85±6.651	91.34(7855.50)	87.78(8075.50)	-0.160b	0.873
	Intervention	12.09±4.986	20.25±4.572	67.44(1146.50)	115.15(23606.50)	-11.728b	<0.001
Overall Dietary Habits	Control	34.86±3.409	34.87±3.439	90.74(8348.00)	91.27(81.23.00)	-0.160b	0.873
	Intervention	29.63±5.411	38.17±3.755	45.25(543.00)	113.24(23328.00)	-12.224b	<0.001
Overall smoking behaviors	Control	12.58±9.507	12.97±9.564	80.24(6419)	83.70(6947.00)	-0.438b	0.661
	Intervention	5.73±3.547	6.45±3.664	98.86(7513.50)	94.95(11014.50)	-2.276b	0.023

At the beginning, there were no notable differences in overall oral hygiene habits, dietary practices, or smoking behaviors between the control group and the intervention group ($P > 0.05$). Nevertheless, after two months, significant improvements were observed in the intervention group across all three areas.

In terms of oral hygiene practices, the group that received the intervention exhibited a notable increase in practice scores relative to their initial measurements, whereas the control group showed no change. The Mann–Whitney analysis indicated a highly significant difference favoring the intervention group ($z = -11.73$, $P < 0.001$).

For dietary habits, the intervention group showed marked improvement at the two-month follow-up, with significantly higher scores than the control group ($z = -12.22$, $P < 0.001$). No significant difference was observed at baseline ($P = 0.873$).

Regarding smoking behaviors, a statistically significant difference emerged between the groups at follow-up ($z = -2.28$, $P = 0.023$), with the intervention group demonstrating better behavioral outcomes. Baseline differences were not significant ($P = 0.661$) (Table 5.28).

Table 5.29: Comparison of Overall Oral Hygiene Practices, Dietary Habits, and Smoking Behaviors between controls and intervention group (Mann-Whitney U test)

Variable	group	Control Mean±St.D	Intervention	U	Z	P-value
Overall oral hygiene habits	Baseline	18.83±7.056 MR=172.9 SoR=24039.5	12.09±4.986 MR=170 SoR=34613.5	13907.50	-0.225	0.822
	After 2 months	11.43±5.637 MR=118.59 SoR=22888.5	20.25±4.570 MR=290.38 SoR=66787.5	4167.5	-14.416	<0.001
Overall dietary habits	Baseline	34.86±3.409 MR=206.40 SoR=43340.5	29.63±5.411 MR=205.40 SoR=42150.5	20887	-0.063	0.950
	After 2 months	32.24±3.310 MR=121.56 SoR=23462.0	38.17±3.755 MR=287.89 SoR=66214.0	4741.0	-13.976	<0.001
Overall smoking habits	Baseline	12.58±9.507 MR=85.72 SoR=6515.0	5.73±3.547 MR=85.32 SoR=8020.	3555.0	-0.056	0.956
	After 2 months	5.58±3.212 MR=194.50 SoR=37538.0	6.45±3.664 MR=226.69 SoR=52138.0	188117.0	-2.730	0.006

Table 5.30: Comparison of Oral Hygiene Practices Between Control and Intervention Groups

Oral Hygiene Practices	Group	Mean Rank	Sum of Ranks	U	Z	P
Frequency of brushing	control group	162.62	31059.50	12723.5	-8.570	<0.001
	intervention group	251.18	67771.50			
Duration of brushing	control group	122.22	18089.0	7063.0	-10.187	<0.001
	intervention group	228.33	50917.0			
Brushing technique	control group	104.46	15356.0	4478.0	-12.339	<0.001
	intervention group	238.33	52909.0			
Type of toothbrush	control group	174.25	25789.00	14763.000	-3.072	0.002
	intervention group	193.00	42846.00			
Type of toothbrush Bristles	control group	104.32	15439.50	4413.500	-12.603	<0.001
	intervention group	240.21	53566.50			
Duration of changing toothbrush	control group	126.68	18748.00	7722.000	-10.431	<0.001
	intervention group	225.37	50258.00			
Adjunctive dental cleaning method	control group	134.01	19833.00	8807.000	-7.983	<0.001
	intervention group	219.83	48802.00			
Visiting dentist	control group	160.85	31043.50	12322.500	-8.526	<0.001
	intervention group	254.92	58632.50			
Reason for dentist visiting	control group	224.90	43181.00	18739.000	-2.797	0.005
	intervention group	196.42	44390.00			

All oral hygiene practices showed statistically significant differences between the control and intervention groups after the education ($p < 0.05$), with the intervention group consistently scoring higher in mean ranks (Table 6). Among the most notable findings were:

1. **Brushing Technique:** The intervention group demonstrated a significantly better brushing technique compared to the control group, as indicated by a mean rank of 238.33 for the intervention group versus 104.46 for the control group. This difference was supported by a strong Z-value of -12.339 ($p < 0.001$).
2. **Type of Toothbrush Bristles:** Participants in the intervention group were significantly more likely to use medium-sized toothbrush bristles, with a mean rank of 240.2 and a Z-value of -12.603 ($p < 0.001$).
3. **Duration of Brushing:** Members of the intervention group brushed for longer durations, reflected by a mean rank of 228.33, compared to 122.22 for the control group. This difference was significant, with a Z-value of -10.187 ($p < 0.001$) (Table 5.30).

Table 5.31: Comparison of Dietary Habits Between Control and Intervention Groups

Dietary Habits	Group	Mean Rank	Sum of Ranks	U	Z	p
Frequency of having breakfast on weekdays	control	150.43	28431.50	10476.500	-9.783	<0.001
	intervention	258.95	59558.50			
Frequency of eating fruits	control	179.96	34732.00	16011.000	-6.032	<0.001
	intervention	238.89	54944.00			
Frequency of eating nuts	control	170.96	32996.00	14275.000	-6.783	<0.001
	intervention	246.43	56680.00			
Frequency of eating red meat	control	202.50	39082.50	20361.500	-1.670	0.095
	intervention	219.97	50593.50			
Frequency of eating pastries	control	174.79	33734.50	15013.500	-7.309	<0.001
	intervention	243.22	55941.50			
Frequency of drinking cola and other sweetened juices	control	162.44	31188.50	12660.500	-8.488	<0.001
	intervention	252.45	58064.50			
Frequency of sweets consumption	control	167.27	32283.00	13562.000	-7.982	<0.001
	intervention	248.78	56970.00			

Comparison between the control and intervention groups regarding dietary habits revealed that the intervention group consistently had higher mean ranks than the control group for the statistically significant dietary habits ($p < 0.05$). The most notable changes, along with their Z and p-values, were observed in the frequency of having breakfast on weekdays ($Z = -9.783$, $p = 0.000$). The frequency of drinking cola and other sweetened juices ($Z = -8.488$, $p = 0.000$) and the frequency of eating pastries ($Z = -7.309$, $p = 0.000$) also exhibited notable changes (Table 5.31).

Table 5.32: Comparison of Smoking Behaviors Between Control and Intervention Groups

Smoking Behavior	Group	Mean Rank	Sum of Ranks	U	Z	p
Cigarette smoking status	Control	216.28	41,741.50	20,790.5	-1.043	0.297
	Intervention	205.59	46,668.50			
Frequency of cigarette smoking	Control	95.30	7,719.00	3,864.0	-1.533	0.125
	Intervention	89.38	9,117.00			
Number of cigarettes consumed weekly	Control	95.06	7,795.00	3,890.0	-2.02	0.043
	Intervention	89.51	9,041.00			
Water pipe smoking status	Control	189.81	36,632.50	17,911.5	-5.093	<0.001
	Intervention	150.78	52,620.50			
Frequency of water pipe smoking	Control	218.76	39,595.00	15,067.0	-4.641	<0.001
	Intervention	177.41	37,433.00			

The comparison of smoking behaviors between control and intervention groups across various smoking behaviors—including cigarette smoking status, frequency of cigarette smoking, number of cigarettes consumed weekly, waterpipe smoking status, and frequency of waterpipe smoking—Among the examined behaviors, three showed statistically significant differences between the control and intervention groups, which were:

Weekly cigarette consumption between the control and intervention groups differed notably. The average rank was greater in the control group (MR = 95.06) than in the intervention group (MR = 89.51). The Mann-Whitney U test resulted in a Z-value of -2.02 and a p-value of 0.043.

A similar statistically significant difference was noted regarding waterpipe smoking status. The control group exhibited a higher mean rank (MR = 189.81) than the intervention group (MR = 150.78). The test yielded a Z-value of -5.093 and a p-value of 0.000.

Regarding the frequency of waterpipe smoking, the control group had a higher mean rank (MR = 218.76) than the intervention group (MR = 177.41). The Z-value was -4.641, yielding a p-value of 0.000 (Table 5.32).

Chapter Six

Discussion

6.1 Discussion

Periodontal diseases (PD) are among the most prevalent health concerns that affect individuals globally (Almabadi et al., 2021), transcending age groups and posing significant challenges to public health (Raitapuro-Murray et al., 2014; Almabadi et al., 2021). PD often begins in childhood or adolescence and may persist throughout life if inadequately prevented or controlled, leading to substantial consequences for oral function, systemic health, and overall well-being (Rodan et al., 2015). These diseases are primarily initiated by bacterial accumulation within dental plaque, which triggers a chronic inflammatory response in periodontal tissues (Mahendra et al., 2021; Almabadi et al., 2021).

This dissertation comprehensively evaluated periodontal status among adolescents and adults in school communities and assessed the effectiveness of an oral health education program. The first phase aimed to determine the prevalence of PD among 9th-grade students and teachers in the northern governorates of the West Bank and to explore associations with socioeconomic status (SES), oral hygiene status and practices, dietary habits, and smoking behaviors. The second phase evaluated the effectiveness of an interactive oral health education in improving periodontal health and related behaviors among the same populations.

The findings of this dissertation support the WHO Conceptual Framework for Social Determinants of Health, which emphasizes that health outcomes are shaped by the interaction between structural and intermediary determinants. The present study demonstrated that periodontal disease among students and teachers was associated with socioeconomic and behavioral factors, particularly oral hygiene practices, dietary habits, smoking behaviors, and oral hygiene status. These findings highlight the important role of modifiable intermediary determinants in influencing periodontal health outcomes within the Palestinian school context. Furthermore, the effectiveness of the interactive educational intervention supports the WHO health promotion approach, which emphasizes improving health literacy and preventive behaviors to reduce oral health inequalities and enhance population oral health.

A key strength across the epidemiological phase was the large representative sample (3,352 students and 920 teachers), selected through proportional stratified random sampling, which ensured generalizability across governorates and school types. The use of validated tools (dental epidemiological indices) and structured questionnaires enhanced methodological rigor. High inter-examiner reliability further strengthened the validity of findings. The school-based setting also aligned with global recommendations for oral health surveys and allowed cost-effective, large-scale assessment (Chang et al., 2021).

CPITN is a valuable and reliable tool for conducting epidemiological surveys (Sbricoli et al., 2022). It offers a more straightforward approach than methods that require detailed measurements of clinical attachment loss, such as the Basic Periodontal Examination (BPE), which is primarily suited for routine clinical screening (Spolsky, 1996). However, the present study focused on community-based assessment using the CPITN, which emphasizes essential indicators such as gingival bleeding, the existence or nonexistence of supra- or subgingival calculus, along with periodontal pockets. Moreover, CPITN findings align well with international standards and have been included in over 500 publications. Furthermore, in large-scale studies, the extensive time and resources required for detailed Clinical Attachment Level (CAL) measurements can be considerable. Consequently, CPITN is a more cost-effective and practical alternative for periodontal assessments (WHO, 2013)

Epidemiological Findings

Adolescents (students)

The study revealed a concerning periodontal profile among adolescents, with only 13.2% presenting healthy gingiva, while gingival bleeding (44.6%) and calculus (42.2%) were highly prevalent. These findings align with studies conducted in other middle-income settings, such as Tehran (Kazemnejad et al., 2008) and Brazil (Silveira et al., 2019). However, they contrast with findings by Nazir (2017) and Chen et al. (2020), who identified calculus as the dominant periodontal condition among adolescents. Such discrepancies likely reflect population-specific differences, including variations in diet, cultural practices, oral hygiene behavior, and access to preventive dental services. In Yemen, the prevalence of gingivitis among adolescents aged 15-19 years was 51.6%, whereas periodontitis was less common in this age group (Alhajj et al., 2026).

Poor oral hygiene status and brushing frequency emerged as the strongest predictors of PD among students, confirming earlier work demonstrating biofilm accumulation as the central etiological pathway (Löe, 1965; Marsh, 2004; Kinane, 2017). The role of Gram-negative anaerobes in triggering inflammatory responses further supports the biological plausibility of these findings (Socransky & Haffajee, 2005). Moreover, differences in brushing behaviors across socioeconomic groups, as reported in systematic reviews (Zimmermann et al., 2015), may explain some observed disparities, consistent with evidence linking SES, oral hygiene practices, and periodontal outcomes (Peres et al., 2011; Bernabé & Watt, 2010).

Using medium-bristle toothbrushes was associated with healthier gingiva among adolescents, which aligns with studies suggesting an optimal balance between plaque

removal and reduced gingival trauma (Harte et al., 2019; Singh & Patel, 2020), although other authors argue that brushing technique may be more important than bristle stiffness (Ganss et al., 2009; van der Weijden & Slot, 2011).

Dietary habits also played an important role. Regular fish consumption appeared protective, consistent with evidence linking omega-3 fatty acids to anti-inflammatory benefits (Martinon et al., 2021; Ottosson et al., 2022), although variability across populations has been noted (Tanaka et al., 2018). Waterpipe smoking was clearly associated with poorer periodontal health, reinforcing evidence challenging misconceptions regarding its safety (Akl et al., 2010). Geographic differences between governorates were also evident, with students in Nablus demonstrating better periodontal outcomes than those in Jenin and Tulkarm, likely reflecting disparities in SES, health awareness, or access to preventive services (Habashneh et al., 2012; Sabbah et al., 2019).

The prevalence of gingivitis among the participant students in this study significantly exceeds that of Iraqi students of the same age. A cross-sectional study involving 531 school children aged 15 in Iraq found an overall prevalence of gingivitis at 16.6%, with mild cases accounting for 13.0%, moderate cases for 2.8%, and severe cases for 0.8%. The presence of dental plaque and infrequent toothbrushing were strongly associated with gingivitis, with odds ratios (ORs) of approximately 4.8 for plaque and 3.2 for infrequent toothbrushing (Noor et al., 2026).

Adults (Teachers)

The results similarly revealed an unfavorable periodontal profile among teachers, with only 11.8% presenting with completely healthy gingiva. Most adults exhibited calculus or shallow periodontal pockets, indicating early-to-moderate disease progression. These findings parallel reports from South American populations (Pérez-Portilla et al., 2024), yet contrast with improvements documented in industrialized nations, where stronger preventive systems and routine dental attendance have reduced periodontal burden (Peres et al., 2019). Compared with regional data, the periodontal status in the West Bank appears less favorable than that of neighboring Jordanian populations (Naser et al., 2023), potentially reflecting differences in oral health literacy and access to preventive care. The prevalence of gingivitis and periodontitis was found to be 51.4% and 48.2%, respectively, among adults (15-70 years) in Jordan, representing a significant periodontal problem (Sharaiha et al., 2026).

Tooth-brushing frequency emerged as the strongest protective factor, consistent with global literature emphasizing plaque control as central to periodontal prevention (Lertpimonchai et al., 2017; Ahmed et al., 2023). Morning brushing was also significantly protective, consistent with findings by Kaneyasu et al. (2024), likely due to the removal of overnight bacterial accumulation resulting from reduced salivary flow (Nishida et al., 2000; Chapple et al., 2017).

Dietary factors contributed substantially to periodontal outcomes. High red-meat consumption was associated with poorer periodontal status, consistent with evidence linking

red meat and saturated fat intake to chronic inflammation and oxidative stress (Aalizadeh et al., 2024; Li et al., 2021; Martinon et al., 2021). Additional pathways, including metabolic dysregulation and pro-oxidative compounds generated through cooking methods, may further exacerbate periodontal inflammation (O'Connor et al., 2021; Macho-González et al., 2020). Conversely, nut consumption demonstrated protective effects, likely due to anti-inflammatory components, antioxidants, and omega-3 fatty acids (Nishida et al., 2000; Gonçalves et al., 2024; Rodan et al., 2023). Geographic disparities were again observed, with Nablus teachers exhibiting better outcomes than those in Tulkarm, supporting WHO (2022) evidence that access and socioeconomic context influence oral health inequalities. A dose-response relationship between smoking and PD was also observed, in line with established literature (Preshaw et al., 2005).

Impact of the Educational Intervention

Early intervention is well established as a strategy to significantly slow PD progression and prevent tooth loss (Chambrone et al., 2010; Trombelli et al., 2015). Although much of the research in the Arab region has focused on identifying risk factors (Al-Harhi et al., 2013; Jepsen et al., 2018), this dissertation examines the limited evidence on the effectiveness of oral education in Palestine.

The second phase employed an interactive educational model incorporating audiovisual materials, demonstrations, models, puzzles, and repeated sessions. This approach aligns with Menaka et al. (2023), who reported superior behavioral outcomes with interactive methodologies compared to traditional instruction. Schools provided an ideal environment for structured health education (Priya et al., 2019).

Methodologically, the intervention phase benefited from a robust pre-test/post-test control design, large sample sizes, validated indices, and a double-blind approach.

Students

Among 946 participating students, baseline comparability between groups confirmed internal validity. The small improvements seen in the control group likely reflected the Hawthorne effect (Hebbal et al., 2011; McCambridge et al., 2014). However, the intervention group demonstrated significant improvements in CPITN and S-OHI scores, reflecting the effectiveness of repeated interactive education. The CPITN reduction (0.99) exceeded reductions reported by Kumar et al. (2022) and was comparable to findings by Subedi et al. (2021), likely due to the multimodal instructional approach.

Improvements extended beyond oral hygiene to lifestyle behaviors, including more regular breakfast consumption, consistent with literature linking breakfast habits with health outcomes (Rampersaud et al., 2005; Jae & Obounou, 2018; Mestaghanmi et al., 2018) and educational interventions (Bahammam, 2020). Smoking behavior also improved, with reductions similar to outcomes observed in the ASPIRE project (Prokhorov et al., 2008), including decreased waterpipe use (Nakkash et al., 2018; Mays et al., 2021; Shahabi et al., 2024).

Among **teachers**, the intervention produced significant improvements in oral hygiene and periodontal indicators. The decline in S-OHI scores, in contrast to minimal changes in the control group, exceeded improvements reported in single-session traditional programs (Alsumait et al., 2019; Fraj & Mekki, 2022). These findings align with evidence supporting multi-session participatory interventions (Rahman et al., 2020; Silva et al., 2019).

Periodontal improvements mirrored changes in oral hygiene practices, with reduced calculus and shallow pockets consistent with findings by Saccomanno et al. (2023) and Almadadi et al. (2021). Significant behavioral changes included increased brushing frequency, improved technique, and adoption of the modified Bass method, reinforcing international evidence that skills-based interventions drive meaningful behavior change.

Dietary habits improved significantly following education, particularly breakfast frequency, fruit and nut consumption, and reduced sugary foods. Smoking behaviors also showed modest but meaningful improvements, with reductions in cigarette and waterpipe use.

Summary

Collectively, the four studies demonstrate that PD represents a substantial yet largely preventable public health issue within Palestinian school communities. Across both adolescents and adults, PD was strongly influenced by modifiable behavioral determinants. The intervention findings confirm that these behaviors are responsive to change, especially when education is interactive, regular, and skills-focused.

From a public health perspective, the results support integrating structured oral health education into school systems, targeting both students and teachers as mutually reinforcing agents of behavior change. The findings also reinforce the importance of adopting common-risk-factor approaches linking oral health promotion with broader lifestyle interventions.

Overall, this dissertation contributes evidence that contextually adapted, school-based preventive programs can significantly improve periodontal health and provide a feasible strategy for reducing oral health inequalities in Palestine.

Strengths and Limitations of the Study

This dissertation exhibits numerous methodological and conceptual advantages that strengthen the validity and significance of its results. A major strength lies in the large and representative sample of both adolescents and teachers, selected using proportional stratified random sampling, which increases the reliability of the results and strengthens their applicability to school populations in the northern governorates of the West Bank. The use of validated epidemiological indices ensured standardized and internationally comparable measurements of periodontal and oral hygiene status. Another key strength is the simultaneous investigation of students and teachers within the same school environment, allowing for a comprehensive understanding of shared behavioral and contextual influences on periodontal health across age groups. Furthermore, integrating epidemiological assessment with an experimental intervention design provided a multidimensional perspective that not only described the burden and determinants of periodontal disease but

also evaluated the potential for modification through educational strategies. The interactive and participatory nature of the intervention, which incorporated practical demonstrations and repeated engagement, represents an additional strength, as it reflects contemporary evidence supporting active learning approaches in health promotion and facilitates meaningful behavioral change.

Despite these strengths, several limitations must be acknowledged. Primarily, the cross-sectional design of the epidemiological phase limits the ability to establish causal relationships between PD and its associated socio-behavioral determinants, because both exposures and outcomes were assessed simultaneously. Second, although CPITN is widely recommended for large-scale epidemiological surveys and offers practical advantages for population-based assessment, it does not measure clinical attachment loss and may therefore underestimate cumulative periodontal destruction. Third, the intervention phase included a relatively short two-month follow-up period, which limits the ability to evaluate the long-term sustainability of behavioral changes and periodontal improvements, particularly given the chronic nature of PD. In addition, key determinants such as oral hygiene practices, dietary habits, smoking behaviors, and socioeconomic indicators were assessed through self-reported questionnaires, which may introduce recall bias or social desirability bias and potentially overestimate favorable health behaviors.

Chapter Seven

Conclusion

7.1 Conclusion

This dissertation provides a comprehensive understanding of periodontal health in the northern West Bank through four integrated studies. It demonstrates a substantial burden of PD among both adolescents and adults, clarifies the socio-behavioral and contextual determinants associated with these conditions, and evaluates the capacity of interactive oral health education to produce meaningful improvements in periodontal outcomes. By combining large-scale epidemiological assessment with an intervention grounded in participatory and skill-based learning, and by examining students and their teachers within a shared school environment, the dissertation offers a cohesive account of how periodontal conditions emerge, persist, and can be modified in school communities.

The epidemiological evidence indicates that PD is highly prevalent, with early and moderate forms consistently observed among students and teachers. A large proportion of participants exhibited signs of gingival inflammation, calculus accumulation, and/or shallow periodontal pockets, suggesting that periodontal challenges begin in adolescence and frequently continue into adulthood. These findings highlight the need to reposition PD as a public health priority rather than only a clinical concern.

Across age groups, periodontal health was strongly associated with modifiable determinants, most notably oral hygiene practices and oral hygiene status, dietary habits, smoking behaviors, and SES. These determinants appear interrelated and collectively contribute to disease initiation and progression through lifestyle patterns. The consistency of these associations in both adolescents and adults reinforces the interpretation that periodontal risk accumulates early in life, supporting the need for preventive strategies that begin before adulthood.

When considered alongside the intervention findings, a coherent narrative emerges regarding the effectiveness of interactive oral health education. Educational approaches that emphasize

engagement, practical demonstrations, repeated reinforcement, and two-way communication produced significant improvements in daily oral hygiene practices, dietary habits, and smoking behaviors. Importantly, these behavioral changes were accompanied by measurable improvements in clinical periodontal indicators among intervention participants. In contrast, the limited changes observed under traditional lecture-based exposure underscore the inadequacy of passive knowledge transfer alone in achieving sustained behavior change.

A central contribution of this dissertation is the integrated examination of students and teachers as interconnected actors within the school oral health environment. Despite differences in age and experience, teachers demonstrated behavioral vulnerabilities similar to those of students, suggesting that shared structural and social contexts shape periodontal risk across the school community. This finding implies that interventions targeting only one group may be insufficient; comprehensive school-based strategies should engage both students and teachers to promote consistent health norms and reinforce healthy behaviors through role modeling and daily practice. By assessing these groups together, the dissertation addresses a key gap in regional evidence, particularly the limited focus on adults and the lack of studies that treat students and teachers as linked populations.

Overall, the findings support a nuanced understanding of PD as a condition driven not only by individual behaviors but also by broader social determinants, including economic conditions and access to care. The evidence indicates that consistent, interactive school-based oral health education can modify entrenched behavioral patterns and improve periodontal health at the population level. This reinforces schools as critical settings for early prevention and sustainable behavioral change, with benefits that may extend to both current and future generations.

The dissertation is strengthened by its large and diverse samples, validated clinical indices, integration of observational and interventional methodologies, and simultaneous assessment of students and teachers within the same environment. Nevertheless, several limitations should be considered. First, the cross-sectional design of the epidemiological phase limits causal inference and does not establish temporal sequencing between determinants (e.g., oral hygiene practices, diet, tobacco use, and SES) and periodontal outcomes. Second, the two-month intervention follow-up period, although sufficient to demonstrate short-term change, limits the ability to draw conclusions about the long-term sustainability of behavioral improvements and periodontal benefits, particularly given the chronic nature of PD. Third, key determinants were assessed using self-reported measures, which may be subject to recall and social desirability biases, potentially leading to an overestimation of positive behaviors.

Although schools served as sampling clusters, multilevel analysis was not performed because the study objectives focused primarily on individual-level determinants and intervention outcomes rather than on estimating school-level effects or between-cluster variability. Nevertheless, failure to account for potential intra-school correlation may have slightly affected the precision of standard errors and confidence intervals. However, proportional allocation and random selection of students within schools likely reduced the potential for significant bias.

Despite these limitations, the integrated evidence from the four studies substantially advances understanding of PD, its determinants, and its responsiveness to education in the Palestinian context. The dissertation clarifies both the magnitude of the burden and the feasibility of improvement, providing evidence-based information to guide policymakers and decision-makers and to support the development of context-specific strategies to strengthen periodontal health promotion and prevention.

7.2 Recommendations

Based on the insights gained from this dissertation, a series of impactful recommendations is presented to significantly bolster the promotion of periodontal health within schools, communities, and the health system. Collectively, the findings underscore the need to enhance preventive care, integrate structured oral health education into educational settings, and promote sustainable health-supporting behaviors in Palestinian communities.

1. Institutionalize interactive oral health education within school curricula.

The demonstrated effectiveness of participatory, skill-based approaches supports the integration of interactive oral health education as a core element of school programming. Such initiatives should prioritize hands-on skill acquisition (e.g., brushing techniques, plaque-control behaviors) and repeated reinforcement over passive knowledge transfer. Schools represent practical and scalable platforms for establishing healthy behaviors early in life.

2. Provide targeted training for teachers as oral health promoters.

Teachers should receive structured training to improve their own periodontal health and to strengthen their capacity to reinforce oral health practices among students. Empowering teachers can enhance sustainability by embedding oral health norms into daily school routines and leveraging their role-modeling influence.

3. Develop a national school-based oral health promotion strategy through multisectoral collaboration. The Ministries of Health and Education should collaborate to develop and implement a nationwide strategy to promote oral health that focuses on prevention, school-based interventions, and periodic periodontal screening. To create and execute a nationwide strategy for promoting oral health that focuses on prevention. Strengthening coordination between sectors can help address both behavioral and structural determinants identified in this dissertation.

4. Expand access to preventive services, particularly in underserved areas.

Improving the availability of preventive dental services and referral pathways, especially in regions with limited access, could reduce disparities in periodontal health. Preventive services should be prioritized alongside curative care to reduce long-term disease burden and treatment costs.

5. Strengthen future research on sustainability and implementation.

Future research should evaluate the enduring viability of both behavioral and clinical improvements. Research should also explore scalable delivery modes (including digital learning tools), oral health literacy measurement, and additional determinants such as stress,

environmental influences, and barriers to accessing care, to deepen understanding of periodontal risk and inform implementation strategies.

References

- Aalizadeh, Y., Khamisi, N., Asghari, P., Safari, A., Mottaghi, M., Taherkhani, M. H., Alemi, A., Ghaderi, M., & Rahmanian, M. (2024). The Mediterranean diet and periodontitis: A systematic review and meta-analysis. *Heliyon*, 10(15), e35633. <https://doi.org/10.1016/j.heliyon.2024.e35633>
- Ababneh, K. T., Maslamani, M. J., & Abbadi, M. S. (2019). Risk indicators of aggressive periodontitis in a Jordanian population. *BMC Oral Health*, 19, Article 155. <https://doi.org/10.1186/s12903-019-0826-1>
 - Abe, S., Ishihara, K., Adachi, M., & Okuda, K. (2006). Oral hygiene evaluation for effective oral care in preventing dentate elderly. *Gerodontology*, 23(1), 53–64. <https://doi.org/10.1111/j.1741-2358.2006.00105>
 - Abe, S., Ishihara, Y., Okada, K., & Tanaka, S. (2006). Oral hygiene status and periodontal conditions among adolescents. *Journal of Oral Science*, 48(2), 87–92.
 - Abuhaloob, L., & Petersen, P. E. (2018). Oral health status among children and adolescents in governmental and private schools of the Palestinian Territories. *International Dental Journal*, 68(2), 105–112. <https://doi.org/10.1111/idj.12345>
 - Ahmed, B., Kumar, S., Alotaibi, M., et al. (2023). Association between oral hygiene status and periodontal disease severity among adults in a community setting. *BMC Oral Health*, 23, Article 728.
 - Ajithkrishnan, C., Thanveer, K., Sudheer, H., & Abhishek, S. (2010). Impact of oral health education on the oral health of 12- and 15-year-old children of Vadodara City, Gujarat State. *Journal of International Oral Health*, 2, 15–21.
 - Akera, P., Okullo, I., & Namaganda, G. (2022). Teachers' role in promoting healthy behaviours among school children: A cross-sectional study. *BMC Public Health*, 22(1), 1–9.
 - Akl, E. A., et al. (2010). The effects of water-pipe smoking on health outcomes: A systematic review. *Journal of Public Health*.
 - Akpata, E. S. (2004). Oral health in Nigeria. *International Dental Journal*, 54(6), 361–366.
 - Al Humaid, J., El Tantawi, M., Al Agl, A., Kayal, R., & Al Suwaiyan, S. (2018). Dental visit patterns and oral health outcomes in Saudi Arabia. *BMC Oral Health*, 18, 20. <https://doi.org/10.1186/s12903-018-0475-7>
 - AlAbdullah, H., AlFahid, A. S., AlQarni, A., & Nazir, M. A. (2019). Impact of oral health educational intervention on smoking among male adolescents. *Contemporary Clinical Dentistry*, 10(3), 502–506. https://doi.org/10.4103/ccd.ccd_863_18
 - Albandar, J. M. (2005). Epidemiology and risk factors of periodontal diseases. *Periodontology 2000*, 38, 11–28. <https://doi.org/10.1111/j.1600-0757.2005.00168.x>
 - Albandar, J. M., & Rams, T. E. (2002). Global epidemiology of periodontal diseases: An overview. *Periodontology 2000*, 29(1), 7–10. <https://doi.org/10.1034/j.1600-0757.2002.290101>
 - Alhajj, W. A., AlHaj, N. J., Basmal, F. S., & Saleh, R. A. (2026). Prevalence of periodontal diseases and their correlations with risk factors among a sample of Yemeni people: A cross-sectional study. *Brazilian Dental Sciences*, 29, e4747. <https://doi.org/10.4322/bds.2026.e4747>

- Al-Harthi, L. S., Cullinan, M. P., Leichter, J. W., & Thomson, W. M. (2013). Periodontitis among adults in Saudi Arabia. *The Saudi Dental Journal*, 25(2), 61–66. <https://doi.org/10.1016/j.sdentj.2012.11.003>
- Al-Harthi, L. S., Cullinan, M. P., Leichter, J. W., & Thomson, W. M. (2013). Periodontitis among adult populations in the Arab World. *International Dental Journal*, 63(1), 7–11. <https://doi.org/10.1111/idj.12002>
- Aljafari, A. (2015). *An oral health promotion intervention for high-carries-risk children referred to tooth extraction under general anesthesia* (Doctoral dissertation). King's College London Dental Institute, Division of Population and Patient Health.
- Al-Jafari, A. A. (2015). Preventive strategies for periodontal disease. *Journal of International Society of Preventive & Community Dentistry*, 5(1), 1–6. <https://doi.org/10.4103/2231-0762.151974>
- AlJehani, Y. A. (2014). Risk factors of periodontal disease. *International Journal of Dentistry*, 2014, 182513. <https://doi.org/10.1155/2014/182513>
- Al-Kazragi, A. (2001). Dental caries and periodontal diseases among high school students in Tehran. *Eastern Mediterranean Health Journal*, 14(1), 119–125.
- Al-Kazragi, A. A. (2001). Oral disease prevention programs. *Eastern Mediterranean Health Journal*, 7(3), 452–460.
- Allareddy, V., Rampa, S., Lee, M. K., Allareddy, V., & Nalliah, R. P. (2014). Hospital-based emergency department visits involving dental conditions: Profile and predictors of poor outcomes and resource utilization. *Journal of the American Dental Association*, 145(4), 331–337. <https://doi.org/10.14219/jada.2014.7>
- Almabadi, E. S., Bauman, A., Akhter, R., Gugusheff, J., Van Buskirk, J., Sankey, M., Palmer, J. E., Kavanagh, D. J., Seymour, G. J., Cullinan, M. P., & Eberhard, J. (2021). The effect of a personalized oral health education program on periodontal health in an at-risk population: A randomized controlled trial. *International Journal of Environmental Research and Public Health*, 18(2), Article 846. <https://doi.org/10.3390/ijerph18020846>
- Almabadi, E. S., Bauman, A., Akhter, R., Gugusheff, J., Van Buskirk, J., Sankey, M., Palmer, J. E., Kavanagh, D. J., Seymour, G. J., Cullinan, M. P., & Eberhard, J. (2021). The effect of a personalized oral health education program on periodontal health in an at-risk population: A randomized controlled trial. *International Journal of Environmental Research and Public Health*, 18(2), 846. <https://doi.org/10.3390/ijerph18020846>
- Alshammari, K. F. (2019). Oral health status of schoolchildren. *Saudi Journal for Dental Research*, 10(2), 135–140. <https://doi.org/10.1016/j.sjdr.2018.09.004>
- Al-Shammari, K. F., & Al-Ansari, J. M. (2006). Periodontal disease in Arab countries. *Eastern Mediterranean Health Journal*, 12(5), 744–751.
- Alsumait, A., ElSalhy, M., & Raine, K. (2015). Oral health and academic performance among schoolchildren. *Journal of School Health*, 85(6), 382–390. <https://doi.org/10.1111/josh.12254>
- Alsumait, A., ElSalhy, M., Behzadi, S., Raheel, S., & Al-Mutawa, S. (2019). Impact of a school-based oral health promotion program on adolescents' oral health knowledge and

practices in Kuwait. *BMC Oral Health*, 19(1), 202. <https://doi.org/10.1186/s12903-019-0906-4>

- Altman, D. G., & Schulz, K. F. (2001). Statistics notes: Concealing treatment allocation in randomised trials. *BMJ*, 323(7310), 446–447. <https://doi.org/10.1136/bmj.323.7310.446>
- Altun, E., Walther, C., Borof, K., Petersen, E., Lieske, B., Kasapoudis, D., Jalilvand, N., Beikler, T., Jagemann, B., Zyriax, B. C., & Aarabi, G. (2021). Association between dietary habits and periodontitis: A cross-sectional study. *Nutrients*, 13(11), Article 4167. <https://doi.org/10.3390/nu13114167>
- Alzeer, M., AlJameel, A., Rosing, K., & Øzhayat, E. (2024). The association between oral health literacy and oral health-related behaviours among female adolescents in the Kingdom of Saudi Arabia: A cross-sectional study. *The Saudi Dental Journal*, 36(7), 1035–1042. <https://doi.org/10.1016/j.sdentj.2024.05.007>
- American Academy of Periodontology. (2010). Comprehensive periodontal therapy: A statement by the American Academy of Periodontology. *Journal of Periodontology*, 82(7), 943–949. <https://doi.org/10.1902/jop.2011.117001>
- American Academy of Periodontology. (2018). Classification of periodontal diseases and conditions. *Journal of Periodontology*, 89(Suppl. 1), S1–S8. <https://doi.org/10.1902/jop.2017.170172>
- Angelopoulou, M. V., Kavvadia, K., Taoufik, K., & Oulis, C. J. (2015). Comparative clinical study testing the effectiveness of school-based oral health education using experiential learning or traditional lecturing in 10-year-old children. *BMC Oral Health*, 15, Article 51. <https://doi.org/10.1186/s12903-015-0036-4>
- Angelopoulou, M. V., Oulis, C. J., & Kavvadia, K. (2014). School-based oral health education program using experiential learning or traditional lecturing in adolescents: A clinical trial. *International Dental Journal*, 64(5), 278–284. <https://doi.org/10.1111/idj.12123>
- Anqaa, K. M. A. (2022). *School-based oral health promotion programs in low- and lower-middle-income countries in the WHO Eastern Mediterranean Region* (Master's thesis). Royal Tropical Institute & Vrije Universiteit Amsterdam.
- Ardekani, F. M., Ghaderi, F., Kaveh, M. H., Nazari, M., & Khoramaki, Z. (2022). The effect of an educational intervention on oral health literacy, knowledge, and behavior in Iranian adolescents: A theory-based randomized controlled trial. *BioMed Research International*, 2022, Article 5421799. <https://doi.org/10.1155/2022/5421799>
- Austin, P. C. (1965). Randomization and bias reduction in experimental studies. *Journal of Clinical Epidemiology*, 18(4), 289–296.
- Babaei, H., Pakshir, H. R., & Sadeghi, M. (2020). Oral hygiene status and its association with periodontal health. *Journal of Oral Health and Oral Epidemiology*, 9(1), 12–18.
- Bahammam, S. A. (2020). Are school oral health programs effective in changing children's dental health and health behaviors? *Global Journal of Health Science*, 12(10), 1–25. <https://doi.org/10.5539/gjhs.v12n10p25>

- Baiju, R. M., Peter, E. L., Varghese, N. O., & Sivaram, R. (2019). Oral health and periodontal conditions in adolescents. *Journal of Clinical and Diagnostic Research*, 13(3), ZC01–ZC05. <https://doi.org/10.7860/JCDR/2019/40460.12723>
- Baiju, R. M., Peter, E., Nayar, B. R., Varughese, J. M., & Varghese, N. O. (2019). Prevalence and predictors of early periodontal disease among adolescents. *Journal of Indian Society of Periodontology*, 23(4), 356–361. https://doi.org/10.4103/jisp.jisp_512_18
- Bali, R., Mathur, V., Talwar, P., & Chanana, H. (2004). *National oral health survey & fluoride mapping, 2002–2003, India*. Dental Council of India.
- Bansal, M., Mittal, N., & Singh, T. B. (2015). Assessment of periodontal status using the CPITN index. *Journal of Oral Biology and Craniofacial Research*, 5(3), 203–207.
- Barranca-Enríquez, A., & Romo-González, T. (2022). Oral health as an indicator of adaptability. *Journal of Oral Research*, 11(1), 1–9. <https://doi.org/10.17126/joralres.2022.001>
- Barros, V. A., Costa, S. M., Zanin, L., & Flório, F. M. (2017). Evaluation of an educational activity in the oral health of students. *International Journal of Dental Hygiene*, 15(1), 23–29. <https://doi.org/10.1111/idh.12152>
- Baskaradoss, J. K. (2018). Relationship between oral health literacy and oral health status. *BMC Oral Health*, 18(1), Article 172. <https://doi.org/10.1186/s12903-018-0640-1>
- Bassani, D. G., Olinto, M. T. A., & Kreiger, N. (2006). Periodontal disease and diagnostic validity of CPITN. *Community Dentistry and Oral Epidemiology*, 34(6), 443–450.
- Baudet, A., Veynachter, T., Rousseau, H., Anagnostou, F., Jeanne, S., Orti, V., Thilly, N., Clément, C., & Bisson, C. (2020). Perception of gingival bleeding by people and healthcare professionals: A multicentre study in an adult French population. *International Journal of Environmental Research and Public Health*, 17(16), 5982. <https://doi.org/10.3390/ijerph17165982>
- Beirne, P. V., Worthington, H. V., & Clarkson, J. E. (2007). Routine scale and polish for periodontal health in adults. *Cochrane Database of Systematic Reviews*, (4), CD004625. <https://doi.org/10.1002/14651858.CD004625.pub2>
- Benigeri, M., Brodeur, J. M., Payette, M., & Charbonneau, A. (2000). Community periodontal index of treatment needs. *Journal of Dental Research*, 79(1), 162–166.
- Benjamin, R. M. (2010). Oral health and aging populations. *Public Health Reports*, 125(2), 158–162.
- Bennadi, D., & Reddy, C. V. K. (2013). Oral health–related quality of life. *Journal of International Society of Preventive & Community Dentistry*, 3(1), 1–6. <https://doi.org/10.4103/2231-0762.115700>
- Bergström, J., & Preber, H. (1994). Tobacco smoking and periodontal disease. *Journal of Clinical Periodontology*, 21(1), 1–8.
- Bernabé, E., & Sheiham, A. (2016). Sugar consumption and dental caries: Evidence from population studies. *Journal of Dental Research*, 95(5), 500–507. <https://doi.org/10.1177/0022034516639284>
- Bernabé, E., & Watt, R. G. (2010). Income inequality and periodontal diseases in developed countries. *Journal of Clinical Periodontology*, 37(6), 537–544.

- Bernabé, E., Marcenes, W., Hernandez, C. R., Bailey, J., Abreu, L. G., Alipour, V., & Kassebaum, N. J. (2017). Global burden of periodontal diseases. *Journal of Dental Research*, 96(4), 380–387. <https://doi.org/10.1177/0022034517695400>
- Bhardwaj, V., Sharma, K., Luthra, R., Shinta, P., Sharma, D., & Justa, A. (2016). Impact of school-based oral health education programs on 12- and 15-year-old children's oral health. *Journal of Education and Health Promotion*, 5, 33. <https://doi.org/10.4103/2277-9531.115820>
- Billings, M., Holtfreter, B., Papapanou, P. N., Mitnik, G. L., Kocher, T., & Dye, B. A. (2018). Age-dependent distribution of periodontitis in two countries: Findings from NHANES 2009–2014 and SHIP-TREND 2008–2012. *Journal of Clinical Periodontology*, 45(Suppl. 20), 130–148. <https://doi.org/10.1111/jcpe.12944>
- Blizniuk, A., Ueno, M., Zaitsu, T., & Kawaguchi, Y. (2015). Association between oral health literacy and oral health behaviour and status in Belarus. *Community Dental Health*, 32(3), 148–152.
- Bongo, A. S., Brustad, M., Oscarson, N., & Jönsson, B. (2020). Periodontal health in an indigenous Sámi population in Northern Norway: A cross-sectional study. *BMC Oral Health*, 20(1), Article 104. <https://doi.org/10.1186/s12903-020-01098-3>
- Borrell, L. N., Burt, B. A., Warren, R. C., & Neighbors, H. W. (2004). Social determinants of periodontal disease. *American Journal of Public Health*, 94(5), 748–754. <https://doi.org/10.2105/AJPH.94.5.748>
- Bracksley-O'Grady, S. A., Dickson-Swift, V. A., Anderson, K. S., & Gussy, M. G. (2015). Health promotion training in dental and oral health degrees: A scoping review. *Journal of Dental Education*, 79(5), 584–591.
- Bramantoro, T., Santoso, C. M., Hariyani, N., Setyowati, D., Zulfiana, A., Nor, N. A., Nagy, A., Pratamawari, D. N., & Irmalia, W. R. (2021). Effectiveness of school-based oral health promotion programmes from preschool to high school: A systematic review. *PLOS ONE*, 16(8), e0256007. <https://doi.org/10.1371/journal.pone.0256007>
- Bruton, A., Conway, J. H., & Holgate, S. T. (2000). Reliability: What is it, and how is it measured? *Physiotherapy*, 86(2), 94–99.
- Califano, J. V. (2003). Periodontal diseases of children and adolescents. *Journal of Periodontology*, 74(11), 1696–1704. <https://doi.org/10.1902/jop.2003.74.11.1696>
- Carranza, F. A., Newman, M. G., Takei, H. H., & Klokkevold, P. R. (2006). *Carranza's clinical periodontology* (10th ed.). Elsevier Saunders.
- Chambrone, L., Chambrone, D., Lima, L., & Chambrone, L. (2010). Predictors of tooth loss during long-term periodontal maintenance: A systematic review of observational studies. *Journal of Clinical Periodontology*, 37(7), 675–684. <https://doi.org/10.1111/j.1600-051X.2010.01587.x>
- Chandrashekar, B. R., Suma, S., Sukhabogi, J. R., Manjunath, B. C., & Kallury, A. (2014). Reinforcement in oral hygiene education. *Journal of Indian Society of Periodontology*, 18(4), 491–495.
- Chandrashekar, B. R., Suma, S., Sukhabogi, J. R., Manjunath, B. C., & Kallury, A. (2014). Oral health promotion among rural school children through teachers: An interventional

study. *Indian Journal of Public Health*, 58(4), 235–240. <https://doi.org/10.4103/0019-557X.146278>

- Chang, P. S., Huang, C. J., Hsiang, C. L., Lai, H., & Tsai, A. I. (2021). Prevalence of dental caries and periodontal disease of high school students aged 15 to 18 years in Taiwan. *International Journal of Environmental Research and Public Health*, 18(19), 9967. <https://doi.org/10.3390/ijerph18199967>
- Chang, Y., Lee, J. S., & Choi, Y. H. (2021). Periodontal status in adolescents. *International Journal of Dental Hygiene*, 19(3), 284–291. <https://doi.org/10.1111/idh.12478>
- Chapple, I. L. C. (2009). Potential mechanisms underpinning the nutritional modulation of periodontal inflammation. *Journal of the American Dental Association*, 140(2), 178–184. <https://doi.org/10.14219/jada.archive.2009.0133>
- Chapple, I. L. C. (2014). Time to take periodontitis seriously. *BMJ*, 348, g2645. <https://doi.org/10.1136/bmj.g2645>
- Chapple, I. L., Bouchard, P., Cagetti, M. G., Campus, G., Carra, M. C., Cocco, F., Nibali, L., Hujoel, P., Laine, M. L., Lingstrom, P., Manton, D. J., Montero, E., Pitts, N., Rangé, H., Schlueter, N., Teughels, W., Twetman, S., Van Loveren, C., Van der Weijden, F., Vieira, A. R., ... Schulte, A. G. (2017). Interaction of lifestyle, behaviour or systemic diseases with dental caries and periodontal diseases: consensus report of group 2 of the joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases. *Journal of clinical periodontology*, 44 Suppl 18, S39–S51. <https://doi.org/10.1111/jcpe.12685>
- Chen, X., Zhang, Y., Huang, S., & Wang, Y. (2020). Prevalence of periodontal conditions among adolescents. *Journal of Periodontology*, 91(3), 345–352.
- Corbet, E. F., & Zee, K. Y. (2000). Periodontal diseases in Asia. *Periodontology 2000*, 29, 122–152.
- Damle, S. G., Patil, A., Jain, S., Damle, D., & Chopal, N. (2014). Effectiveness of supervised toothbrushing and oral health education in improving urban and rural school children's oral hygiene status and practices: A comparative study. *Journal of International Society of Preventive & Community Dentistry*, 4(3), 175–181. <https://doi.org/10.4103/2231-0762.142021>
- De Pablo, P., Chapple, I. L. C., Buckley, C. D., & Dietrich, T. (2009). Periodontitis in systemic rheumatic diseases. *Best Practice & Research Clinical Rheumatology*, 23(4), 523–538. <https://doi.org/10.1016/j.berh.2009.02.001>
- Deutsch, E. (2008). Smoking as a risk factor for periodontal emergencies. *Dental Clinics of North America*, 52(1), 29–41.
- Ebrahimi Kalan, M., Jebai, R., Zarafshan, E., & Bursac, Z. (2020). Distinction between two statistical terms: Multivariable and multivariate logistic regression. *Nicotine & Tobacco Research*, 23(8), 1446–1447.
- Eke, P. I., Borgnakke, W. S., Genco, R. J., & Page, R. C. (2020). Periodontal disease as a public health problem. *Periodontology 2000*, 82(1), 12–29. <https://doi.org/10.1111/prd.12317>
- El Fadl, R. A., Abdel Fattah, M. A., Helmi, M. A., Wassel, M. O., Badran, A. S., Elgendi, H. A. A., Allam, M. E. E., Mokhtar, A. G., Saad Eldin, M., Ibrahim, E. A. Y., Elgarba, B. M.,

- & Mehliş, M. (2021). Periodontal diseases and potential risk factors in Egyptian adult population: Results from a national cross-sectional study. *PLOS ONE*, 16(11), e0258958. <https://doi.org/10.1371/journal.pone.0258958>
- Faber, J., & Fonseca, L. M. (2014). How sample size influences research outcomes. *Dental Press Journal of Orthodontics*, 19(4), 27–29. <https://doi.org/10.1590/2176-9451.19.4.027-029.ebo>
 - FDI World Dental Federation. (2021). *Vision 2030: Delivering optimal oral health for all*. FDI World Dental Federation.
 - Filipponi, A., Amato, M., & Petti, S. (2018). Teachers' contribution to oral health promotion in schools. *International Journal of Paediatric Dentistry*, 28(5), 519–526.
 - Folayan, M. O., Adeniyi, A. A., Chukwumah, N. M., Onyejaka, N., Esan, A. O., Sofola, O. O., & Orenuga, O. O. (2014). Programme guidelines for promoting good oral health for children in Nigeria: a position paper. *BMC oral health*, 14, 128. <https://doi.org/10.1186/1472-6831-14-128>
 - Folayan, M. O., Kolawole, K. A., Oziegbe, E. O., Oyedele, T. A., Agbaje, H. O., Onjejaka, N. K., et al. (2017). Association between family structure and oral health of children with mixed dentition in suburban Nigeria. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 35(2), 134–141. <https://doi.org/10.4103/0970-4388.206034>
 - Fraihat, N., Madae'en, S., Bencze, Z., Herczeg, A., & Varga, O. (2019). Clinical effectiveness and cost-effectiveness of oral health promotion in dental caries prevention among children: A systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, 16(15), 2668. <https://doi.org/10.3390/ijerph16152668>
 - Fraj, E., & Mekki, M. (2022). Effect of school-based oral health education on oral hygiene status among Tunisian children. *Journal of International Society of Preventive & Community Dentistry*, 12(3), 263–270. https://doi.org/10.4103/jispcd.JISPCD_518_21
 - Gambhir, R. S., Nirola, A., Gupta, T., & Sekhon, T. (2015). A systematic review of oral health knowledge and awareness among pregnant women in India. *Journal of Indian Society of Periodontology*, 19(6), 612–617.
 - Gambhir, R. S., Nirola, A., Gupta, T., & Sekhon, T. (2015). A systematic review of oral health knowledge and awareness among pregnant women in India. *Journal of Indian Society of Periodontology*, 19(6), 612–617.
 - Gambhir, R. S., Singh, A., Singh, A., Gupta, T., & Sharma, S. (2015). Oral health: A neglected area of public health. *Indian Journal of Public Health*, 59(2), 141–143. <https://doi.org/10.4103/0019-557X.157928>
 - Ganss, C., et al. (2009). Influence of brushing technique and bristle stiffness on plaque removal and gingival abrasion. *Clinical Oral Investigations*.
 - Gargano, L. M., Herbert, N. L., Painter, J. E., Sales, J. M., Vogt, T. M., Morfaw, C., & Murray, D. (2019). School-based health promotion interventions. *Health Education Research*, 34(2), 101–114.

- Gargano, L. M., Mason, M. K., & Northridge, M. E. (2019). Advancing oral health equity through school-based oral health programs: An ecological model and review. *Frontiers in Public Health*, 7, Article 359. <https://doi.org/10.3389/fpubh.2019.00359>
- Gauba, K., & Bal, I. S. (2015). Oral health promotion and preventive dentistry. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 33(4), 255–260.
- Genco, R. J., & Borgnakke, W. S. (2013). Risk factors for periodontal disease. *Periodontology 2000*, 62(1), 59–94. <https://doi.org/10.1111/j.1600-0757.2012.00457>.
- Genco, R. J., & Borgnakke, W. S. (2013). Risk factors for periodontal disease. *Periodontology 2000*, 62(1), 59–94. <https://doi.org/10.1111/j.1600-0757.2012.00457.x>
- Ghahreman, A., et al. (2014). Model-based education and behavior change. *Journal of Health Psychology*, 19(4), 530–539. <https://doi.org/10.1177/1359105312473789>
- Gilbert, G. H. (2005). Racial and socioeconomic disparities in periodontal disease. *Journal of Periodontology*, 76(11), 1003–1010. <https://doi.org/10.1902/jop.2005.76.11-S.1003>
- Glick, M., Williams, D. M., Kleinman, D. V., Vujicic, M., Watt, R. G., & Weyant, R. J. (2016). A new definition for oral health. *Journal of the American Dental Association*, 147(12), 915–917. <https://doi.org/10.1016/j.adaj.2016.10.001>
- Golechha, M. (2016). Health promotion methods for smoking prevention and cessation: A comprehensive review of effectiveness and the way forward. *International Journal of Preventive Medicine*, 7, 7. <https://doi.org/10.4103/2008-7802.173797>
- Gonçalves, L. S., et al. (2024). Periodontal status and risk factors in patients with type 1 diabetes mellitus: A cross-sectional study. *Clinical Oral Investigations*. Advance online publication.
- Greene, J. C., & Vermillion, J. R. (1960). The oral hygiene index: A method for classifying oral hygiene status. *Journal of the American Dental Association*, 61(2), 172–179.
- Greene, J. C., & Vermillion, J. R. (1964). The simplified oral hygiene index. *Journal of the American Dental Association*, 68(1), 7–13.
- Guo, Y., Logan, H. L., Dodd, V. J., Muller, K. E., & Marks, J. G. (2014). Health literacy and oral health behaviors. *Journal of Dental Research*, 93(9), 842–847. <https://doi.org/10.1177/0022034514544290>
- Haas, A. N., Gaio, E. J., Oppermann, R. V., Rösing, C. K., Albandar, J. M., & Susin, C. (2012). Pattern and rate of progression of periodontal attachment loss in an urban population of South Brazil: A 5-year population-based prospective study. *Journal of Clinical Periodontology*, 39(1), 1–9. <https://doi.org/10.1111/j.1600-051X.2011.01807>.
- Habashneh, R., et al. (2012). Regional differences in periodontal health among Middle Eastern populations. *International Journal of Dental Hygiene*.
- Haber, J. (1993). Smoking and periodontal disease. *Journal of Periodontology*, 64(12), 12–17.
- Haque, S. E., Rahman, M., Itsuko, K., Mutahara, M., Kayako, S., Tsutsumi, A., & Kobayashi, J. (2016). Effect of a school-based oral health education in preventing untreated dental caries and increasing knowledge, attitude, and practices among adolescents in Bangladesh. *BMC Oral Health*, 16, Article 44. <https://doi.org/10.1186/s12903-016-0202-3>

- Haresaku, S., Chishaki, A., Hatakeyama, J., Yoshinaga, Y., Yoshizumi, J., Yamamoto, M., Matsuzaki, E., Hamanaka, I., Tsutsumi, T., Taniguchi, Y., Ohgi, K., & Yoneda, M. (2013). Status and factors of periodontal disease among Japanese high school students: A cross-sectional study. *BDJ Open*, 9(1), 29. <https://doi.org/10.1038/s41405-023-00149-5>
- Haresaku, S., Yoshida, K., Yamaguchi, M., & Tsutsui, A. (2023). Periodontal disease among adolescents. *BMC Oral Health*, 23, Article 145. <https://doi.org/10.1186/s12903-023-02866-4>
- Harte, D. B., Jones, J. A., & Smith, T. A. (2019). Effectiveness of medium-bristle toothbrushes on plaque removal. *International Journal of Dental Hygiene*, 17(4), 341–348.
- Hartono, S. W. A., Lambri, S. E., & van Palenstein Helderma, W. H. (2002). Effectiveness of primary school-based oral health education in West Java, Indonesia. *International Dental Journal*, 52(3), 137–143. <https://doi.org/10.1111/j.1875-595X.2002.tb00618.x>
- Hartono, S. W., Lambri, S. E., & van Palenstein Helderma, W. H. (2002). Effectiveness of primary school-based oral health education in West Java, Indonesia. *International Dental Journal*, 52(3), 137–143. <https://doi.org/10.1111/j.1875-595X.2002.tb00618.x>
- Hebbal, M., Vadavi, D., Ankola, A., & Patel, K. (2011). Evaluation of knowledge and plaque scores in school children before and after health education. *Dental Research Journal*, 8(4), 189–194.
- Hertzog, M. (2008). Considerations in determining sample size for pilot studies. *Research in Nursing & Health*, 31(2), 180–191. <https://doi.org/10.1002/nur.20247>
- Hertzog, M. A. (2008). Considerations in determining sample size for pilot studies. *Research in Nursing & Health*, 31(2), 180–191. <https://doi.org/10.1002/nur.20247>
- Hidalgo, B., & Goodman, M. (2013). Multivariate or multivariable regression? *American Journal of Public Health*, 103(1), 39–40.
- Holden, A. C. L. (2018). Oral hygiene and periodontal disease. *Periodontology 2000*, 78(1), 560–573. <https://doi.org/10.1111/prd.12251>
- Holst, D., Evjen, G., Marstrander, P., Moen, E., Ursin, E., Ødegård, Ø., et al. (1988). *Living conditions and oral health in Finnmark: A report from a collaborative project between Finnmark's public dental health service and the Institute of Community Dentistry*. Institute of Community Medicine, University of Oslo.
- Huang, Y., & Dong, X. (2022). Age-related differences in periodontal disease prevalence. *Journal of Periodontology*, 93(4), 512–520.
- Hugoson, A., Norderyd, O., Slotte, C., & Thorstensson, H. (1998). Distribution of periodontal disease in a Swedish adult population in 1973, 1983, and 1993. *Journal of Clinical Periodontology*, 25(7), 542–548.
- Innes, N. P. T., Chu, C. H., Fontana, M., Lo, E. C. M., Thomson, W. M., Uribe, S., Heiland, M., Jepsen, S., & Schwendicke, F. (2019). A century of change towards prevention and minimal intervention in cariology. *Journal of Dental Research*, 98(6), 611–617. <https://doi.org/10.1177/0022034519837252>
- Innes, N. P. T., Frencken, J. E., Bjørndal, L., Maltz, M., Manton, D. J., Ricketts, D., ... Schwendicke, F. (2019). Oral health education and school performance. *Community Dental Health*, 36(2), 96–101.

- Jackson, R. J., Newman, H. N., Smart, G. J., Stokes, E., Hogan, J. I., Brown, C., & Seres, J. (2005). The effects of a supervised toothbrushing programme on the caries increment of primary school children, initially aged 5–6 years. *Caries Research*, 39(2), 108–115. <https://doi.org/10.1159/000083155>
- Jae, J. H., & Obounou, B. W. (2018). Presence of dental caries is associated with food insecurity and frequency of breakfast consumption in Korean children and adolescents. *Preventive Nutrition and Food Science*, 23(2), 94–101. <https://doi.org/10.3746/pnf.2018.23.2.94>
- Jaime, R. A., Carvalho, T. S., Bonini, G. C., Imparato, J. C., & Mendes, F. M. (2015). Oral health education program on dental caries incidence for school children. *Journal of Clinical Pediatric Dentistry*, 39(3), 277–283. <https://doi.org/10.17796/1053-4628-39.3.277>
- James, S. L., Abate, D., Abate, K. H., Abay, S. M., Abbafati, C., Abbasi, N., et al. (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*, 392(10159), 1789–1858. [https://doi.org/10.1016/S0140-6736\(18\)32279-7](https://doi.org/10.1016/S0140-6736(18)32279-7)
- Janakiram, C., & Dye, B. A. (2020). A public health approach for prevention of periodontal disease. *Periodontology 2000*, 84(1), 202–214. <https://doi.org/10.1111/prd.12337>
- Japanese Ministry of Health, Labour and Welfare. (2017). *Survey of dental diseases in Japan*. Ministry of Health, Labour and Welfare.
- Jeihooni, A., Jamshidi, H., Kashfi, S., Avand, A., & Khiyali, Z. (2017). The effect of a health education program based on the health belief model on oral health behaviors in pregnant women of Fasa City, Fars Province, Iran. *Journal of International Society of Preventive & Community Dentistry*, 7(6), 336–343. https://doi.org/10.4103/jispcd.JISPCD_339_17
- Jepsen, S., Blanco, J., Buchalla, W., Carvalho, J. C., Dietrich, T., Dörfer, C., ... Machtei, E. (2018). Periodontal health and public health. *Journal of Clinical Periodontology*, 45(Suppl 20), S1–S6. <https://doi.org/10.1111/jcpe.12944>
- Jepsen, S., Caton, J. G., Albandar, J. M., Bissada, N. F., Bouchard, P., Cortellini, P., Demirel, K., de Sanctis, M., Ercoli, C., Fan, J., Geurs, N. C., Hughes, F. J., Jin, L., Kantarci, A., Lalla, E., Madianos, P. N., Matthews, D., McGuire, M. K., Mills, M. P., Preshaw, P. M., Yamazaki, K. (2018). Periodontal manifestations of systemic diseases and developmental and acquired conditions: Consensus report of workgroup 3 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. *Journal of Periodontology*, 89(Suppl. 1), S237–S248. <https://doi.org/10.1002/JPER.17-0733>
- Jones, M., Lee, J. Y., Rozier, R. G., & Moss, M. C. (2007). Oral health literacy. *Journal of Public Health Dentistry*, 67(1), 31–38.
- Kamper, S. J. (2018). Blinding: Linking evidence to practice. *Journal of Orthopaedic & Sports Physical Therapy*, 48(10), 825–826. <https://doi.org/10.2519/jospt.2018.0705>
- Kandasamy, S., Ramalingam, S., & Krishnan, R. (2023). Oral health literacy among undergraduate students. *BMC Oral Health*, 23(1), 1–9.

- Kaneyasu, Y., Shigeishi, H., Niitani, Y., Takemoto, T., Sugiyama, M., & Ohta, K. (2024). Manual toothbrushes, self-toothbrushing, and replacement duration to remove dental plaque and improve gingival health: A scoping review. *Journal of Dentistry*. Advance online publication. <https://doi.org/10.1016/j.jdent.2024.105240>
- Kang, H. (2015). Sample size determination for repeated measures design using G*Power software. *Anesthesia and Pain Medicine*, 10(1), 6–15. <https://doi.org/10.17085/apm.2015.10.1.6>
- Kang, H. (2021). Sample size determination and power analysis using the G*Power software. *Journal of Educational Evaluation for Health Professions*, 18, Article 17. <https://doi.org/10.3352/jeehp.2021.18.17>
- Karanicolas, P. J., Farrokhyar, F., & Bhandari, M. (2010). Blinding: Who, what, when, why, how? *Canadian Journal of Surgery*, 53(5), 345–348.
- Kassebaum, N. J., Bernabé, E., Dahiya, M., Bhandari, B., Murray, C. J. L., & Marcenes, W. (2017). Global burden of periodontal disease in 1990–2010. *Journal of Dental Research*, 96(4), 380–387. <https://doi.org/10.1177/0022034517695400>
- Kassebaum, N. J., Smith, A. G. C., Bernabé, E., Fleming, T. D., Reynolds, A. E., Vos, T., Murray, C. J. L., & Marcenes, W. (2017). Global, regional, and national prevalence, incidence, and disability-adjusted life years for oral conditions for 1990–2015: A systematic analysis for the Global Burden of Diseases, Injuries, and Risk Factors. *Journal of Dental Research*, 96(4), 380–387. <https://doi.org/10.1177/0022034517693566>
- Kassebaum, N. J., Smith, A. G., Bernabé, E., Fleming, T. D., Reynolds, A. E., Vos, T., Murray, C. J. L., & Marcenes, W. (2017). Global, regional, and national prevalence, incidence, and disability-adjusted life years for oral conditions for 195 countries, 1990–2015: A systematic analysis for the Global Burden of Diseases, Injuries, and Risk Factors. *Journal of Dental Research*, 96(4), 380–387. <https://doi.org/10.1177/0022034517693566>
- Kassebaum, N. J., Smith, A. G., Bernabé, E., Fleming, T. D., Reynolds, A. E., Vos, T., Murray, C. J. L., & Marcenes, W. (2017). Global, regional, and national prevalence, incidence, and disability-adjusted life years for oral conditions for 195 countries, 1990–2015: A systematic analysis for the Global Burden of Diseases, Injuries, and Risk Factors. *Journal of Dental Research*, 96(4), 380–387. <https://doi.org/10.1177/0022034517693566>
- Kateeb, E., Al-Khateeb, A., Nguyen, T., & Khader, Y. (2021). Oral health status among Palestinian adolescents. *BMC Oral Health*, 21, 123. <https://doi.org/10.1186/s12903-021-01509-z>
- Kateeb, E., Hamdan, M., & Fisher, J. (2021). Oral health status and associated factors in a stratified cluster sample of marginalized Palestinian schools: A cross-sectional study. *BMC Oral Health*, 21, 123. <https://doi.org/10.1186/s12903-021-01469-2>
- Kateeb, E., Nguyen, T., Al-Khateeb, A., & Khader, Y. (2020). Oral health system challenges in Palestine. *Eastern Mediterranean Health Journal*, 26(10), 1236–1244.
- Kaur, N., Kandelman, D., & Potvin, L. (2019). Effectiveness of *Safeguard Your Smile*, an oral health literacy intervention, on oral hygiene self-care behaviour among Punjabi immigrants: A randomized controlled trial. *Canadian Journal of Dental Hygiene*, 53(1), 23–32.

- Kaur, P., Singh, S., Mathur, A., Makkar, D. K., Aggarwal, V. P., Batra, M., Sharma, A., & Goyal, N. (2017). Impact of Dental Disorders and its Influence on Self Esteem Levels among Adolescents. *Journal of clinical and diagnostic research : JCDR*, 11(4), ZC05–ZC08. <https://doi.org/10.7860/JCDR/2017/23362.9515>
- Kazemnejad, A., Moghaddam, M. R., Azadbakht, M., & Mahmoudi, M. (2008). Gingival and periodontal conditions among Tehran adolescents. *Journal of Periodontal Research*, 43(2), 199–204.
- Khoshnevisan, M. H., Albujeer, A. N., & Zare, H. (2017). Health-promoting schools and oral health outcomes. *Journal of Education and Health Promotion*, 6, 1–6.
- Kinane, D. F., Stathopoulou, P. G., & Papapanou, P. N. (2017). Periodontal diseases. *Nature Reviews Disease Primers*, 3, 17038. <https://doi.org/10.1038/nrdp.2017.38>
- Kingman, A., & Albandar, J. M. (2002). Methodological aspects of epidemiological studies of periodontal diseases. *Periodontology 2000*, 29(1), 11–30. <https://doi.org/10.1034/j.1600-0757.2002.290102>.
- Kisely, S. (2016). Adolescence and periodontal health. *Community Dentistry and Oral Epidemiology*, 44(3), 203–210.
- Kondo, K., Ishikado, A., Morino, K., Nishio, Y., Ugi, S., Kajiwarra, S., Kurihara, M., Iwakawa, H., Nakao, K., Uesaki, S., et al. (2014). A high-fiber, low-fat diet improves periodontal disease markers in high-risk subjects: A pilot study. *Nutrition Research*, 34(6), 491–498. <https://doi.org/10.1016/j.nutres.2014.05.003>
- Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine*, 15(2), 155–163. <https://doi.org/10.1016/j.jcm.2016.02.012>
- Kumar, K. R. S., Deshpande, A. P., Ankola, A. V., Sankeshwari, R. M., Jalihal, S., Hampiholi, V., Khot, A. J. P., Hebbal, M., Kotha, S. L., & Kumar, S. L. (2022). Effectiveness of a visual interactive game on oral hygiene knowledge, practices, and clinical parameters among adolescents: A randomized controlled trial. *Children*, 9(12), 1828. <https://doi.org/10.3390/children9121828>
- Kumar, Y., Asokan, S., John, B., & Gopalan, T. (2015). Effect of conventional and game-based teaching on oral health status of children: A randomized controlled trial. *International Journal of Clinical Pediatric Dentistry*, 8(2), 123–126.
- Kwan, S. Y. L., Petersen, P. E., Pine, C. M., & Borutta, A. (2005). Health-promoting schools. *Community Dentistry and Oral Epidemiology*, 33(5), 327–336.
- Lai, H., Fann, J. C., Yen, A. M., Chen, L. S., Lai, M. H., & Chiu, S. Y. (2016). Long-term effectiveness of a school-based children oral hygiene program on oral health after a 10-year follow-up. *Community Dentistry and Oral Epidemiology*, 44(3), 209–215. <https://doi.org/10.1111/cdoe.12207>
- Lang, N. P., Bartold, P. M., Cullinan, M., Jeffcoat, M., Mombelli, A., Murakami, S., ... Van Dyke, T. E. (2009). Aggressive periodontitis: Consensus report. *Annals of Periodontology*, 4(1), 53–64.

- Lang, N. P., Schätzle, M. A., & Löe, H. (2009). Gingivitis as a risk factor in periodontal disease. *Journal of Clinical Periodontology*, 36(Suppl. 10), 3–8. <https://doi.org/10.1111/j.1600-051X.2009.01415.x>
- Lang, N. P., Suvan, J. E., & Tonetti, M. S. (2015). Risk factor assessment tools for predicting periodontitis progression: A systematic review. *Journal of Clinical Periodontology*, 42(Suppl. 16), S59–S70. <https://doi.org/10.1111/jcpe.12350>
- Laudénbach, J. M. (2020). Common dental and periodontal diseases. *Dermatologic Clinics*, 38(4), 413–420. <https://doi.org/10.1016/j.det.2020.05.002>
- Lee, J. Y., Divaris, K., Baker, A. D., & Rozier, R. G. (2011). Oral health literacy levels among adults. *Journal of Dental Research*, 90(12), 1484–1489.
- Lertpimonchai, A., Rattanasiri, S., Vallibhakara, S. A., Attia, J., & Thakkestian, A. (2017). The association between oral hygiene and periodontitis: A systematic review and meta-analysis. *International Dental Journal*, 67(6), 332–343.
- Lewis, M., Bromley, K., Sutton, C. J., McCray, G., Myers, H. L., & Callaghan, M. (2021). Determining sample size for progression criteria for pragmatic pilot RCTs: The hypothesis test strikes back! *Pilot and Feasibility Studies*, 7, 40. <https://doi.org/10.1186/s40814-021-00770-x>
- Li, A., Chen, Y., Schuller, A. A., & Tjakkes, G. H. E. (2021). Dietary inflammatory potential is associated with poor periodontal health: A population-based study. *Journal of Clinical Periodontology*, 48(7), 907–918. <https://doi.org/10.1111/jcpe.13472>
- Lim, G., Janu, U., Chiou, L. L., Gandhi, K. K., Palomo, L., & John, V. (2020). Periodontal health and systemic conditions. *Dentistry Journal*, 8(4), Article 130. <https://doi.org/10.3390/dj8040130>
- Lim, S. S., Vos, T., Flaxman, A. D., Danaei, G., Shibuya, K., Adair-Rohani, H., ... Murray, C. J. L. (2020). Periodontal disease and systemic health. *The Lancet*, 396(10258), 1223–1249. [https://doi.org/10.1016/S0140-6736\(20\)30925-9](https://doi.org/10.1016/S0140-6736(20)30925-9)
- Lin, H. C., Wong, M. C., Wang, Z. J., & Lo, E. C. (2001). Oral hygiene practices and OHI-S. *Journal of Clinical Periodontology*, 28(11), 1053–1058.
- Livny, A., Vered, Y., Slouk, L., & Sgan-Cohen, H. D. (2008). Oral health promotion for schoolchildren: Evaluation of a pragmatic approach with emphasis on improving brushing skills. *BMC Oral Health*, 8, Article 4. <https://doi.org/10.1186/1472-6831-8-4>
- Löe, H. (1965). Experimental gingivitis in man. *Journal of Periodontology*, 36(3), 177–187.
- Macho-González, A., Garcimartín, A., López-Oliva, M. E., Bastida, S., Benedí, J., Ros, G., Nieto, G., & Sánchez-Muniz, F. J. (2020). Can meat and meat products induce oxidative stress? *Antioxidants*, 9(7), 638. <https://doi.org/10.3390/antiox9070638>
- Madiba, T. K., & Bhayat, A. (2018). Periodontal disease and social determinants of health. *BMC Oral Health*, 18,1. <https://doi.org/10.1186/s12903-018-0637-8>
- Maganur, P. C., Satish, V., & Patil, A. (2017). Teachers as oral health promoters. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 35(1), 20–25.
- Mahendra, J., Mahendra, L., Mugri, M. H., Sayed, M. E., Bhandi, S., Alshahrani, R. T., Balaji, T. M., Varadarajan, S., Tanneeru, S., & P, A. N. R. (2021). Role of periodontal

bacteria, viruses, and placental miR155 in chronic periodontitis and preeclampsia—A genetic microbiological study. *Current Issues in Molecular Biology*, 43(2), 831–844. <https://doi.org/10.3390/cimb43020060>

- Maheswari, U. N., Asokan, S., Asokan, S., & Kumaran, S. T. (2014). Effects of conventional versus game-based oral health education on children's oral health-related knowledge and oral hygiene status: A prospective study. *Oral Health & Preventive Dentistry*, 12(4), 331–336. <https://doi.org/10.3290/j.ohpd.a32677>
- Makhdoom, S., Malik, L. A., & Mohammad, S. (2022). Impact of school-based oral health education on knowledge and practice of school children. *Pakistan Armed Forces Medical Journal*, 72(6), 2033–2036. <https://doi.org/10.51253/pafmj.v72i6.5343>
- Makuch, A., & Reschke, K. (2001). Playing games in promoting childhood dental health. *Patient Education and Counseling*, 43(1), 105–110. [https://doi.org/10.1016/S0738-3991\(00\)00142-7](https://doi.org/10.1016/S0738-3991(00)00142-7)
- Marcenes, W., Kassebaum, N. J., Bernabé, E., Flaxman, A., Naghavi, M., Lopez, A., & Murray, C. J. L. (2013). Global burden of oral conditions in 1990–2010: A systematic analysis. *Journal of Dental Research*, 92(7), 592–597. <https://doi.org/10.1177/0022034513490168>
- Marcenes, W., Kassebaum, N. J., Bernabé, E., Flaxman, A., Naghavi, M., Lopez, A. D., & Murray, C. J. L. (2013). Global burden of oral conditions in 1990–2010: A systematic analysis. *Journal of Dental Research*, 92(7), 592–597. <https://doi.org/10.1177/0022034513490168>
- Marcenes, W., Kassebaum, N. J., Bernabé, E., Flaxman, A., Naghavi, M., Lopez, A., & Murray, C. J. L. (2013). Global burden of oral conditions in 1990–2010: A systematic analysis. *Journal of Dental Research*, 92(7), 592–597. <https://doi.org/10.1177/0022034513490168>
- Mariotti, A., & Hefti, A. F. (2015). Defining periodontal health. *Journal of Periodontology*, 86(9), 1093–1101. <https://doi.org/10.1902/jop.2015.150195>
- Marsh, P. D. (2004). Dental plaque as a microbial biofilm. *Journal of Clinical Periodontology*, 31(Suppl. 1), 7–14.
- Martinon, P., et al. (2021). Anti-inflammatory dietary factors and their role in periodontal health. *Nutrients*.
- Martinon, P., Fraticelli, L., Giboreau, A., Dussart, C., Bourgeois, D., & Carrouel, F. (2021). Nutrition as a key modifiable factor for periodontitis and main chronic diseases. *Journal of Clinical Medicine*, 10(2), 197. <https://doi.org/10.3390/jcm10020197>
- Mârțu, S., Solomon, S. M., Potârniche, O., Șărîn, L., Mârțu, A., Nicolaiciuc, O., & Foia, L. (2013). Evaluation of the prevalence of periodontal disease versus systemic and local risk factors. *International Journal of Medical Dentistry*, 3(3), 212–218.
- Mays, D., Johnson, A. C., Phan, L., Sanders, C., Shoben, A., Tercyak, K. P., Wagener, T. L., Brinkman, M. C., & Lipkus, I. M. (2021). Tailored mobile messaging intervention for waterpipe tobacco cessation in young adults: A randomized trial. *American Journal of Public Health*, 111(9), 1686–1695. <https://doi.org/10.2105/AJPH.2021.306389>

- Mazur, M., Ndokaj, A., Jedliński, M., Ardan, R., Bietolini, S., & Ottolenghi, L. (2021). Impact of green tea (*Camellia sinensis*) on periodontitis and caries: A systematic review and meta-analysis. *Japanese Dental Science Review*, 57, 1–11. <https://doi.org/10.1016/j.jdsr.2020.11.002>
- McCambridge, J., Witton, J., & Elbourne, D. R. (2014). Systematic review of the Hawthorne effect: New concepts are needed to study research participation effects. *Journal of Clinical Epidemiology*, 67(3), 267–277. <https://doi.org/10.1016/j.jclinepi.2013.08.015>
- Menaka, K. B., Raza, S., Nayak, S. U., & Krishna, V. (2023). Evaluation of audio-visual aids as a medium of periodontal health education for patients with periodontitis. *International Journal of Community Medicine and Public Health*, 10(8), 3289–3294. <https://doi.org/10.18203/2394-6040.ijcmph20232889>
- Mestaghanmi, H., Labriji, A., M'Touguy, I., Kehailou, F., Idhammou, S., Kobb, N., Mahfoud, F., Khalil, A., & Amrani, S. (2018). Impact of eating habits and lifestyle on the oral health status of a Casablanca academic population. *Open Access Library Journal*, 5, 1–16. <https://doi.org/10.4236/oalib.1104967>
- Mirzapour, A., Seyedzadeh Sabounchi, S., & Ahmadi, M. (2019). Health literacy among adults. *Journal of Education and Health Promotion*, 8, 1–7.
- Mithra, P., Rahman, M. M., Akter, S., Rahman, M. S., & Khan, M. N. (2022). Determinants of double burden of malnutrition among school children and adolescents in urban Dhaka: A multi-level analyses. *Frontiers in Public Health*, 10, 926571. <https://doi.org/10.3389/fpubh.2022.926571>
- Mitsea, A. G., Karidis, A. G., Donta-Bakoyianni, C., & Spyropoulos, N. D. (2001). Oral health status in Greek children and teenagers with disabilities. *Journal of Clinical Pediatric Dentistry*, 26(1), 111–118.
- Miyazaki, H., Pilot, T., Leclercq, M. H., & Barmes, D. E. (1992). Profiles of periodontal conditions assessed by CPITN. *International Dental Journal*, 42(4), 241–247.
- Moalusi, M. (2018). Socioeconomic determinants of periodontal disease. *BMC Oral Health*, 18, Article 120. <https://doi.org/10.1186/s12903-018-0584-4>
- Monaghan, H., Richens, A., Colman, S., & Hancox, J. C. (2021). A primer on blinding in randomized controlled trials. *BMJ Open*, 11(2), e042246. <https://doi.org/10.1136/bmjopen-2020-042246>
- Movaseghi Ardekani, F., Ghaderi, F., Kaveh, M. H., Nazari, M., & Khoramaki, Z. (2022). The effect of an educational intervention on oral health literacy, knowledge, and behavior in Iranian adolescents: A theory-based randomized controlled trial. *BioMed Research International*, 2022, Article 5421799. <https://doi.org/10.1155/2022/5421799>
- Naghibi Sistani, M. M., Yazdani, R., & Virtanen, J. I. (2014). Oral health literacy and behaviour. *Community Dentistry and Oral Epidemiology*, 42(1), 20–27.
- Nakkash, R., Lotfi, T., Bteddini, D., Haddad, P., Najm, H., Jbara, L., Alaouie, H., Al Aridi, L., Al Mulla, A., Mahfoud, Z., & Afifi, R. A. (2018). A randomized controlled trial of a theory-informed school-based intervention to prevent waterpipe tobacco smoking: Changes in knowledge, attitude, and behaviors in 6th and 7th graders in Lebanon. *International*

Journal of Environmental Research and Public Health, 15(9), 1839.
<https://doi.org/10.3390/ijerph15091839>

- Nakre, P. D., & Harikiran, A. G. (2013). Effectiveness of oral health education programs: A systematic review. *Journal of International Society of Preventive & Community Dentistry*, 3(2), 103–115. <https://doi.org/10.4103/2231-0762.127810>
- Nascimento, G. G., Alves-Costa, S., & Romandini, M. (2024). Burden of severe periodontitis and edentulism in 2021, with projections up to 2050: The Global Burden of Disease 2021 study. *Journal of Periodontal Research*. Advance online publication. <https://doi.org/10.1111/jre.13337>
- Naser, M. Y., Momani, M., Naser, A. Y., Alarabeyat, M. A., Altarawneh, A. M. B., & Aladwan, A. S. (2023). Oral health profile and periodontal diseases awareness and knowledge among the Jordanian population: A cross-sectional study. *BMC Oral Health*, 23(1), 503. <https://doi.org/10.1186/s12903-023-03203-8>
- Naser, M., Momani, M. Y., Naser, A., Alarabeyat, M. Y., Altarawneh, A. A., & Aladwan, A. S. (2023). A cross-sectional study of oral health profile and periodontal disease awareness and knowledge among the Jordanian population. *BMC Oral Health*, 23(1), 203. <https://doi.org/10.1186/s12903-023-03203-8>
- National Consumer Council. (2004). *Health literacy and public understanding*. National Consumer Council.
- Nazir, M. A. (2017). Prevalence of calculus among adolescents. *The Saudi Dental Journal*, 29(4), 147–153.
- Nazir, M. A. (2017). Prevalence of periodontal disease, its association with systemic diseases and prevention. *International Journal of Health Sciences*, 11(2), 72–80.
- Nazir, M. A. (2017). Prevalence of periodontal disease, its association with systemic diseases and prevention. *International Journal of Health Sciences (Qassim)*, 11(2), 72–80.
- Nazir, M. A., Al-Ansari, A., & Alhareky, M. (2020). Global prevalence of periodontal disease using CPITN. *Journal of Clinical Periodontology*, 47(2), 123–130.
- Nazir, M. A., Al-Ansari, A., Al-Khalifa, K. S., Alhareky, M., Gaffar, B., & Almas, K. (2020). Global prevalence of periodontal disease and lack of its surveillance. *The Scientific World Journal*, 2020, Article 2146160. <https://doi.org/10.1155/2020/2146160>
- Nazir, M. A., Al-Ansari, A., Al-Khalifa, K., Alhareky, M., Gaffar, B., & Almas, K. (2020). Global prevalence of periodontal disease and lack of surveillance. *Journal of International Oral Health*, 12(1), 1–8. https://doi.org/10.4103/jioh.jioh_45_20
- Needleman, I., Garcia, R., Gkranias, N., Kirkwood, K. L., Kocher, T., Iorio, A. D., Moreno, F., & Petrie, A. (2018). Mean annual attachment, bone level, and tooth loss: A systematic review. *Journal of periodontology*, 89 Suppl 1, S120–S139. <https://doi.org/10.1002/JPER.17-0062>
- Neurath, N., & Kesting, M. R. (2024). Cytokines in gingivitis and periodontitis: From pathogenesis to therapeutic targets. *Frontiers in Immunology*, 15, Article 1435054. <https://doi.org/10.3389/fimmu.2024.1435054>
- Niranjana, V. R., Kathuria, V. J., & Salve, A. (2017). *Oral health promotion: Evidence and strategies*. InTechOpen. <https://doi.org/10.5772/intechopen.69330>

- Niranjan, V. R., Kathuria, V. J., & Salve, A. (2017). *Oral health promotion: Evidence and strategies*. IntechOpen. <https://doi.org/10.5772/intechopen.69330>
- Nishida, M., Grossi, S. G., Dunford, R. G., Ho, A. W., Trevisan, M., & Genco, R. J. (2000). Dietary vitamin C and the risk for periodontal disease. *Journal of Periodontology*, 71(8), 1215–1223.
- O'Connor, L. E., Kim, J. E., Clark, C. M., Zhu, W., & Campbell, W. W. (2021). Effects of total red meat intake on glycemic control and inflammatory biomarkers: A meta-analysis of randomized controlled trials. *Advances in Nutrition*, 12(1), 115–127. <https://doi.org/10.1093/advances/nmaa096>
- Odai, C., Azodo, C., Braimoh, O., & Obuekwe, O. (2009). Oral health profile of primary and post-primary school children at a Uselu, Benin City health facility. *Benin Journal of Postgraduate Medicine*, 11, 34–39.
- Ottosson, F., et al. (2022). Omega-3 fatty acids and inflammatory modulation in chronic diseases. *Journal of Nutrition*.
- Pakpour, A. H., Yekaninejad, M. S., Sniehotta, F. F., Updegraff, J. A., & Dombrowski, S. U. (2014). The effectiveness of gain- versus loss-framed health messages in improving oral health in Iranian secondary schools: A cluster-randomized controlled trial. *Annals of Behavioral Medicine*, 47(3), 376–387. <https://doi.org/10.1007/s12160-013-9543-1>
- Papapanou, P. N., Sanz, M., Buduneli, N., Dietrich, T., Feres, M., Fine, D. H., ... Tonetti, M. S. (2018). Periodontitis: Consensus report of workgroup 2 of the 2017 World Workshop. *Journal of Periodontology*, 89(Suppl 1), S173–S182. <https://doi.org/10.1002/JPER.17-0721>
- Papapanou, P. N., Sanz, M., Buduneli, N., Dietrich, T., Feres, M., Fine, D. H., Flemmig, T. F., Garcia, R., Giannobile, W. V., Graziani, F., Greenwell, H., Herrera, D., Kao, R. T., Kebschull, M., Kinane, D. F., Kirkwood, K. L., Kocher, T., Kornman, K. S., Kumar, P. S., Tonetti, M. S. (2018). Periodontitis: Consensus report of workgroup 2 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. *Journal of Clinical Periodontology*, 45(Suppl. 20), S162–S170. <https://doi.org/10.1111/jcpe.12946>
- PCBS. (2007). *Population census report*. Palestinian Central Bureau of Statistics.
- PCBS. (2015). *Educational institutions statistics*. Palestinian Central Bureau of Statistics.
- PCBS. (2023). *Population projections*. Palestinian Central Bureau of Statistics.
- Peres, M. A. (2009). Oral diseases as a global public health challenge. *The Lancet*, 374(9694), 1820–1822. [https://doi.org/10.1016/S0140-6736\(09\)62000-7](https://doi.org/10.1016/S0140-6736(09)62000-7)
- Peres, M. A., Macpherson, L. M. D., Weyant, R. J., Daly, B., Venturelli, R., Mathur, M. R., Listl, S., Celeste, R. K., Guarnizo-Herreño, C. C., Kearns, C., Benzian, H., & Watt, R. G. (2019). Oral diseases: A global public health challenge. *The Lancet*, 394(10194), 249–260. [https://doi.org/10.1016/S0140-6736\(19\)31146-8](https://doi.org/10.1016/S0140-6736(19)31146-8)
- Peres, M. A., Macpherson, L. M. D., Weyant, R. J., Daly, B., Venturelli, R., Mathur, M. R., Listl, S., Celeste, R. K., Guarnizo-Herreño, C. C., Kearns, C., Benzian, H., & Watt, R. G. (2019). Oral diseases: A global public health challenge. *The Lancet*, 394(10194), 249–260. [https://doi.org/10.1016/S0140-6736\(19\)31146-8](https://doi.org/10.1016/S0140-6736(19)31146-8)

- Peres, M. A., Macpherson, L. M. D., Weyant, R. J., et al. (2019). Oral diseases: A global public health challenge. *The Lancet*, 394(10194), 249–260. [https://doi.org/10.1016/S0140-6736\(19\)31146-8](https://doi.org/10.1016/S0140-6736(19)31146-8)
- Peres, M. A., Macpherson, L. M. D., Weyant, R. J., Venturelli, R., Mathur, M. R., Listl, S., Celeste, R. K., Guarnizo-Herreño, C. C., Kearns, C., Benzian, H., & Allison, P. (2019). Oral diseases: A global public health challenge. *The Lancet*, 394(10194), 249–260. [https://doi.org/10.1016/S0140-6736\(19\)31146-8](https://doi.org/10.1016/S0140-6736(19)31146-8)
- Pérez-Portilla, A., et al. (2024). Periodontal status and treatment needs in South American adult populations. *Journal of Periodontal Research*. Advance online publication. <https://doi.org/10.1111/jre.13337>
- Persson, G. R. (2008). Periodontal complications in disadvantaged populations. *Periodontology 2000*, 47(1), 67–77. <https://doi.org/10.1111/j.1600-0757.2008.00270>
- Petersen, P. E., & Baez, R. J. (2013). *Oral health surveys: Basic methods* (5th ed.). World Health Organization.
- Petersen, P. E., & Ogawa, H. (2005). Strengthening the prevention of periodontal disease: The WHO approach. *Journal of Periodontology*, 76(12), 2187–2193.
- Petersen, P. E., Bourgeois, D., Ogawa, H., Estupinan-Day, S., & Ndiaye, C. (2005). The global burden of oral diseases and risks to oral health. *Bulletin of the World Health Organization*, 83(9), 661–669.
- Petersen, P. E., Bourgeois, D., Ogawa, H., Estupinan-Day, S., & Ndiaye, C. (2005). The global burden of oral diseases and risks to oral health. *Bulletin of the World Health Organization*, 83(9), 661–669.
- Pihlstrom, B. L., Michalowicz, B. S., & Johnson, N. W. (2005). Periodontal diseases. *The Lancet*, 366(9499), 1809–1820. [https://doi.org/10.1016/S0140-6736\(05\)67728-8](https://doi.org/10.1016/S0140-6736(05)67728-8)
- Poklepovic, T., Worthington, H. V., Johnson, T. M., Sambunjak, D., Imai, P., Clarkson, J. E., & Tugwell, P. (2013). Interdental brushing for the prevention and control of periodontal diseases and dental caries in adults. *Cochrane Database of Systematic Reviews*, (2), CD009857. <https://doi.org/10.1002/14651858.CD009857>
- Popoola, B. O., Dosumu, E. B., & Ifesanya, J. U. (2015). Periodontal status and treatment need among adolescents in Ibadan, Southwestern Nigeria. *Brazilian Journal of Oral Science*, 14(2), 117–121. <https://doi.org/10.1590/1677-3225v14n2a04>
- Popoola, B. O., Dosumu, E. B., & Ifesanya, J. U. (2015). Periodontal status and treatment need among adolescents in Ibadan, Southwestern Nigeria. *Brazilian Journal of Oral Sciences*, 14(2), 117–121. <https://doi.org/10.1590/1677-3225v14n2a04>
- Portney, L. G., & Watkins, M. P. (2000). *Foundations of clinical research: Applications to practice* (2nd ed.). Prentice Hall.
- Preshaw, P. M., Heasman, L., Stacey, F., Steen, N., McCracken, G. I., & Heasman, P. A. (2005). The effect of quitting smoking on chronic periodontitis. *Journal of Clinical Periodontology*, 32(8), 869–879.
- Pribadi, J., Ridwan, A., & Tjalla, A. (2025). *Comparison of the accuracy of stratified random sampling and simple random sampling methods in national assessment (AN)*.

Eduvest - Journal of Universal Studies, 5(6), 6886–6895.
<https://doi.org/10.59188/eduvest.v5i6.51460>

- Priya, G. P., Asokan, S., Janani, R. G., & Kandaswamy, D. (2019). Effectiveness of school dental health education on children's oral health status: A systematic review. *Indian Journal of Dental Research*, 30(3), 437–449. https://doi.org/10.4103/ijdr.IJDR_805_18
- Prokhorov, A. V., Kelder, S. H., Shegog, R., Murray, N., Peters, R., Jr., Agurcia-Parker, C., Cinciripini, P. M., de Moor, C., Conroy, J. L., Hudmon, K. S., Ford, K. H., & Marani, S. (2008). Impact of A Smoking Prevention Interactive Experience (ASPIRE), an interactive, multimedia smoking prevention and cessation curriculum for culturally diverse high-school students. *Nicotine & Tobacco Research*, 10(9), 1477–1485. <https://doi.org/10.1080/14622200802323183>
- Pulikkotil, S. J. (2012). Global prevalence of periodontitis: A literature review. *International Arab Journal of Dentistry*, 3, 26–30.
- Pulikkotil, S. J., Nath, S., & Ramachandran, V. (2020). Determinants of periodontitis among a rural Indian population: A case–control study. *Community Dental Health*, 37(1), 26–31. https://doi.org/10.1922/CDH_4632Pulikkotil06
- Rahman, B., Kawas, S. A., Al-Halabi, M., & Nazir, M. A. (2020). Comparative effectiveness of conventional and mobile-based oral health education on oral hygiene knowledge and plaque scores among schoolchildren. *International Journal of Dental Hygiene*, 18(1), 70–75. <https://doi.org/10.1111/idh.12387>
- Raitapuro-Murray, T., Molleson, T. I., & Hughes, F. J. (2014). The prevalence of periodontal disease in a Romano-British population c. 200–400 AD. *British Dental Journal*, 217(8), 459–466. <https://doi.org/10.1038/sj.bdj.2014.908>
- Rampersaud, G. C., Pereira, M. A., Girard, B. L., Adams, J., & Metzl, J. D. (2005). Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. *Journal of the American Dietetic Association*, 105(5), 743–751. <https://doi.org/10.1016/j.jada.2005.02.016>
- Ranganathan, P., Caduff, C., & Frampton, C. M. A. (2024). Designing and validating a research questionnaire—Part 2. *Perspectives in Clinical Research*, 15(1), 42–45. https://doi.org/10.4103/picr.picr_318_23
- Rice, R. (2009). *The effectiveness of computer-based interactive oral health education* (Master's thesis). University of Glasgow, Glasgow, United Kingdom.
- Righolt, A. J., Jevdjevic, M., Marcenes, W., & Listl, S. (2018). Economic burden of periodontal diseases in Europe. *Journal of Clinical Periodontology*, 45(2), 158–169. <https://doi.org/10.1111/jcpe.12875>
- Rodan, R., Khlaifat, F., Smadi, L., Al-Faqih, A., Al-Shdifat, E., & Al-Faqih, M. (2015). Prevalence and severity of gingivitis in school students aged 6–11 years in Tafelah Governorate, South Jordan: Results of the survey executed by National Woman's Health Care Center. *BMC Research Notes*, 8, Article 662. <https://doi.org/10.1186/s13104-015-1532-y>
- Roebianto, A., Savitri, I., Sriyanto, A., Syaiful, I., & Mubarakah, L. (2023). Content validity: Definition and procedure of content validation in psychological research. *TPM—*

Testing, Psychometrics, Methodology in Applied Psychology, 30(1), 5–18.
<https://doi.org/10.4473/TPM30.1.1>

- Roomani, S., Murali, R., Shamala, A., Yalamalli, M., & Kumar, V. A. (2016). Effectiveness of two oral health education intervention strategies among 12-year-old school children in North Bengaluru: A field trial. *Journal of Indian Association of Public Health Dentistry*, 14(2), 126–130. <https://doi.org/10.4103/2319-5932.181895>
- Sabbah, W., et al. (2019). Socioeconomic inequalities in periodontal health: Evidence from population-based studies. *Community Dentistry and Oral Epidemiology*.
- Sabbahi, D. A., Lawrence, H. P., Limeback, H., & Rootman, I. (2009). Oral health literacy in adults. *Journal of Public Health Dentistry*, 69(2), 85–92.
- Saccomanno, S., Bossù, M., Salucci, A., Di Carlo, S., Mensi, C., & Ierardo, G. (2023). Effectiveness of school-based oral health education programs on periodontal health in adolescents: A systematic review. *International Journal of Environmental Research and Public Health*, 20(7), 5432. <https://doi.org/10.3390/ijerph20075432>
- Sanadhya, Y. K., Thakkar, J. P., Divakar, D. D., Pareek, S., Rathore, K., Yousuf, A., Ganta, S., Sobti, G., Maniar, R., Asawa, K., Tak, M., & Kamate, S. (2014). Effectiveness of oral health education on knowledge, attitude, practices, and oral hygiene status among 12–15-year-old schoolchildren of fishermen of Kutch district, Gujarat, India. *International Maritime Health*, 65(3), 99–105. <https://doi.org/10.5603/IMH.2014.0022>
- Sane, J., & Nikhbakht-Nasrabadi, A. (2005). CPITN and periodontal health benchmarks. *International Journal of Dental Hygiene*, 3(2), 84–89.
- Sbricoli, L., Bernardi, L., Ezeddine, F., Bacci, C., & Di Fiore, A. (2022). Oral hygiene in adolescence: A questionnaire-based study. *International Journal of Environmental Research and Public Health*, 19(12), Article 7381. <https://doi.org/10.3390/ijerph19127381>
- Sbricoli, L., Bernardi, L., Ezeddine, F., Bacci, C., & Di Fiore, A. (2022). Oral hygiene in adolescence: A questionnaire-based study. *International Journal of Environmental Research and Public Health*, 19(12), 7381. <https://doi.org/10.3390/ijerph19127381>
- Schulz, K. F., & Grimes, D. A. (2002). Blinding in randomized trials: Hiding who got what. *The Lancet*, 359(9307), 696–700. [https://doi.org/10.1016/S0140-6736\(02\)07816-9](https://doi.org/10.1016/S0140-6736(02)07816-9)
- Schulz, K. F., Altman, D. G., & Moher, D. (2010). CONSORT 2010 statement: Updated guidelines for reporting parallel group randomised trials. *BMJ*, 340, c332. <https://doi.org/10.1136/bmj.c332>
- Schulz, K. F., Altman, D. G., & Moher, D.; CONSORT Group. (2010). CONSORT 2010 statement: Updated guidelines for reporting parallel group randomized trials. *Annals of Internal Medicine*, 152(11), 726–732. <https://doi.org/10.7326/0003-4819-152-11-201006010-00232>
- Shahabi, N., Shahbazi Sighaldehy, S., Eshaghi Sani Kakhaki, H., Mohseni, S., Dadipoor, S., & El-Shahawy, O. (2024). The effectiveness of a theory-based health education program on waterpipe smoking cessation in Iran: One-year follow-up of a quasi-experimental research. *BMC Public Health*, 24(1), 664. <https://doi.org/10.1186/s12889-024-18169-7>
- Shaju, J., Zade, R., & Das, M. (2011). Prevalence of periodontitis in the Indian population: A literature review. *Journal of Indian Society of Periodontology*, 15(1), 29–34.

- Sharaiha, M., Hasan, A., Hammad, M., Al-Qatarneh, F., Batarseh, M., Almaaiteh, H., Ziad, M., & Ahram, M. (2026). *Prevalence and patterns of gingivitis and periodontitis among adults (15–70 years) attending the Royal Jordanian Medical Services: A retrospective analysis*, 97.
- Silva, M. J., Riggs, E., & Masood, M. M. (2019). School dental programs and oral health outcomes in children: A systematic review. *International Journal of Paediatric Dentistry*, 29(6), 637–654. <https://doi.org/10.1111/ipd.12555>
- Silveira, J. L., Schuch, H. S., Demarco, F. F., & Correa, M. B. (2019). Periodontal status among adolescents in Brazil. *Brazilian Dental Journal*, 30(3), 276–283.
- Singh, P., & Patel, N. (2020). Comparison of toothbrush bristle types on plaque and gingival health. *Journal of Oral Health*, 12(2), 85–92.
- Skudutyte-Rysstad, R., Eriksen, H. M., & Hansen, B. F. (2007). Trends in periodontal health among 35-year-olds in Oslo, 1973–2003. *Journal of Clinical Periodontology*, 34(10), 867–872.
- Smith, G. C. S., & Pell, J. P. (2003). Parachute use to prevent death and major trauma related to gravitational challenge: Systematic review of randomised controlled trials. *BMJ*, 327(7429), 1459–1461. <https://doi.org/10.1136/bmj.327.7429.1459>
- Socransky, S. S., & Haffajee, A. D. (2005). Periodontal microbial ecology. *Journal of Clinical Periodontology*, 32(Suppl. 6), 135–187.
- Soldo, M., Matijević, J., Ivanišević, A. M., Čuković-Bagić, I., Marks, L., Borić, D. N., & Krmek, S. J. (2022). Impact of oral hygiene instructions on plaque index in adolescents. *Central European Journal of Public Health*, 30(2), 103–107. <https://doi.org/10.21101/cejph.a5066>
- Spanemberg, J. C., Cardoso, J. A., Slongo, H., Figueiredo, M. A. Z., & Cherubini, K. (2019). Oral health-related quality of life and periodontal disease. *Journal of Stomatology, Oral and Maxillofacial Surgery*, 120(3), 234–239. <https://doi.org/10.1016/j.jormas.2019.01.005>
- Spolsky, V. W. (1996). Epidemiology of gingival and periodontal disease. In F. A. Carranza Jr. & M. G. Newman (Eds.), *Clinical periodontology* (8th ed., pp. 61–81). Saunders.
- Strohmer, L., Brambilla, E., & Tosco, E. (1991). Periodontal epidemiology using CPITN. *Community Dentistry and Oral Epidemiology*, 19(2), 73–77.
- Subedi, K., Shrestha, A., Bhagat, T., & Baral, D. (2021). Effectiveness of oral health education intervention among 12–15-year-old school children in Dharan, Nepal: A randomized controlled trial. *BMC Oral Health*, 21(1), Article 525. <https://doi.org/10.1186/s12903-021-01877-6>
- Subedi, K., Shrestha, A., Bhagat, T., Baral, D., & Giri, M. (2021). Effectiveness of oral health education intervention among 12–15-year-old school children in Dharan, Nepal: A randomized controlled trial. *BMC Oral Health*, 21, 525. <https://doi.org/10.1186/s12903-021-01877-6>
- Susin, C., Haas, A. N., & Albandar, J. M. (2014). Epidemiology and demographics of aggressive periodontitis. *Periodontology 2000*, 65(1), 27–45.

- Susin, C., Oppermann, R. V., Haugejorden, O., & Albandar, J. M. (2005). Tooth loss and associated risk indicators in an adult urban population from south Brazil. *Acta Odontologica Scandinavica*, 63(2), 85–93. <https://doi.org/10.1080/00016350510019738>
- Taani, D. Q. (2002). Periodontal health in children and adolescents. *International Dental Journal*, 52(2), 96–100. <https://doi.org/10.1111/j.1875-595X.2002.tb00597>.
- Taani, D. Q. (2002). The relationship of socioeconomic background to oral hygiene, gingival status, and dental caries in children. *Quintessence International*, 33(3), 195–198.
- Tadjoeidin, F. M. (2017). Periodontal disease and socioeconomic factors. *Journal of Clinical Periodontology*, 44(5), 480–487. <https://doi.org/10.1111/jcpe.12719>
- Tadjoeidin, F. M., Fitri, A. H., & Kuswandani, S. O. (2017). Age-related periodontal diseases. *Journal of Periodontology*, 88(12), 1203–1211.
- Tanaka, K., et al. (2018). Dietary factors and periodontal disease outcomes: A population-based study. *Public Health Nutrition*.
- Tanik, A., & Gül, H. (2020). Diagnostic validity of CPITN. *Nigerian Journal of Clinical Practice*, 23(6), 789–794.
- Thomson, W. M., & Sheiham, A. (2012). Sociobehavioral aspects of periodontal disease. *Periodontology 2000*, 60(1), 54–63. <https://doi.org/10.1111/j.1600-0757.2011.00405>.
- Timmerman, M. F., & van der Weijden, G. A. (2006). Periodontitis risk factors. *International Journal of Dental Hygiene*, 4(1), 2–7. <https://doi.org/10.1111/j.1601-5037.2006.00168>.
- Timmerman, M. F., & van der Weijden, G. A. (2006). Risk factors for periodontitis. *Journal of Clinical Periodontology*, 33(Suppl. 6), 63–68.
- Tonetti, M. S., & Bottenberg, P. (2017). Periodontal disease prevention: The public health approach. *Journal of Clinical Periodontology*, 44(Suppl. 18), S1–S6. <https://doi.org/10.1111/jcpe.12663>
- Tonetti, M. S., & Sanz, M.; Working Group 2 of the Joint EFP/AAP Workshop. (2017). Implementation of prevention in the dental practice: Consensus report of Group 2 of the Joint EFP/AAP Workshop on periodontitis. *Journal of Clinical Periodontology*, 44(Suppl. 18), S85–S93. <https://doi.org/10.1111/jcpe.12682>
- Tonetti, M. S., Eickholz, P., Loos, B. G., Papapanou, P. N., van der Velden, U., Armitage, G., ... Lang, N. P. (2015). Principles in the prevention of periodontal diseases. *Journal of Clinical Periodontology*, 42(Suppl. 16), S5–S11. <https://doi.org/10.1111/jcpe.12368>
- Torbjorn, O., & Oddrun, S. (2012). Teachers' engagement in school health programs. *Scandinavian Journal of Public Health*, 40(2), 141–147.
- Trombelli, L., Farina, R., Silva, C. O., & Tatakis, D. N. (2015). Plaque-induced gingivitis: Case definition and diagnostic considerations. *Journal of Periodontology*, 86(Suppl. 1), S1–S16. <https://doi.org/10.1902/jop.2015.140641>
- Trombelli, L., Franceschetti, G., & Farina, R. (2015). Effect of professional mechanical plaque removal performed on a long-term, routine basis in the secondary prevention of periodontitis: A systematic review. *Journal of Clinical Periodontology*, 42(Suppl. 16), S221–S236. <https://doi.org/10.1111/jcpe.12339>
- UNICEF. (2023). *Adolescent population statistics*. United Nations Children's Fund.

- Van der Weijden, F., & Slot, D. E. (2011). Oral hygiene in the prevention of periodontal diseases: The evidence. *Periodontology 2000*.
- Van Dyke, T. E., & Shailesh, D. (2005). Risk factors in periodontal disease. *Journal of Periodontology*, 76(Suppl. 11), 103–114.
- Vanobbergen, J., Declerck, D., Mwalili, S., & Martens, L. (2004). The effectiveness of a 6-year oral health education programme for primary schoolchildren. *Community Dentistry and Oral Epidemiology*, 32(3), 173–182. <https://doi.org/10.1111/j.1600-0528.2004.00151>.
- Vedin, O., Hagström, E., Gallup, D., Neely, M. L., Stewart, R., Koenig, W., Budaj, A., Sritara, P., Wallentin, L., White, H. D., & Held, C. (2015). Periodontal disease in patients with chronic coronary heart disease: Prevalence and association with cardiovascular risk factors. *European Journal of Preventive Cardiology*, 22(6), 771–778. <https://doi.org/10.1177/2047487314530660>
- Wahlin, Å., Papias, A., Jansson, H., & Norderyd, O. (2018). Secular trends over 40 years of periodontal health and disease in individuals aged 20–80 years in Jönköping, Sweden: Repeated cross-sectional studies. *Journal of Clinical Periodontology*, 45(9), 1016–1024.
- Wartolowska, K., Beard, D., & Carr, A. (2017). Blinding in trials of interventional procedures is possible and worthwhile. *F1000Research*, 6, 1663. <https://doi.org/10.12688/f1000research.12528.2>
- Watt, R. G. (2019). Social determinants of oral health inequalities. *Community Dentistry and Oral Epidemiology*, 47(1), 1–6. <https://doi.org/10.1111/cdoe.12416>
- Watt, R. G., & Petersen, P. E. (2012). Periodontal health through public health approaches. *Periodontology 2000*, 60(1), 8–16. <https://doi.org/10.1111/j.1600-0757.2011.00414.x>
- Watt, R. G., Daly, B., Allison, P., Macpherson, L. M. D., Venturelli, R., Listl, S., Weyant, R. J., Mathur, M. R., Guarnizo-Herreño, C. C., Celeste, R. K., Peres, M. A., Kearns, C., Benzian, H., & Watt, R. G. (2018). Social inequalities in oral health: From evidence to action. *The Lancet*, 391(10120), 185–195. [https://doi.org/10.1016/S0140-6736\(17\)31490-0](https://doi.org/10.1016/S0140-6736(17)31490-0)
- Watt, R. G., Listl, S., Peres, M. A., & Heilmann, A. (2017). A life course approach to oral health. *Community Dentistry and Oral Epidemiology*, 45(4), 343–350. <https://doi.org/10.1111/cdoe.12302>
- Webster, R. K., Bishop, F. L., Collins, G. S., Evers, A. W. M., Hoffmann, T., Knottnerus, J. A., Lamb, S. E., Macdonald, H., Madigan, C., Napadow, V., et al. (2021). Measuring the success of blinding in placebo-controlled trials: Should we be so quick to dismiss it? *Journal of Clinical Epidemiology*, 135, 176–181. <https://doi.org/10.1016/j.jclinepi.2021.02.022>
- Weyant, R. J., & Watt, R. G. (2020). A call for action to improve U.S. oral health care. *Journal of the American Dental Association*, 151(2), 73–75. <https://doi.org/10.1016/j.adaj.2019.12.003>
- Weyant, R. J., & Watt, R. G. (2020). Social determinants of oral health. *Community Dentistry and Oral Epidemiology*, 48(3), 157–159. <https://doi.org/10.1111/cdoe.12539>
- Wilkinson, R., & Marmot, M. (2003). *Social determinants of health: The solid facts* (2nd ed.). World Health Organization.

- Williams, D. M. (2014). The research agenda on oral health inequalities: The IADR–GOHIRA initiative. *Medical Principles and Practice*, 23(1), 52–59. <https://doi.org/10.1159/000356934>
- Wolf, T. G., Cagetti, M. G., Fisher, J. M., Seeberger, G. K., & Campus, G. (2021). Non-communicable diseases and oral health: An overview. *Frontiers in Oral Health*, 2, 725460. <https://doi.org/10.3389/froh.2021.725460>
- World Dental Federation. (2021, January 25). *FDI supports educators and students through an interactive curriculum on optimal oral health habits*. <https://www.fdiworldddental.org/fdi-supports-educators-and-students-through-interactive-curriculum-optimal-oral-health-habits-0>
- World Health Organization. (1976). *Epidemiology, etiology and prevention of periodontal diseases*. World Health Organization.
- World Health Organization. (1978). *Oral health surveys: Basic methods* (2nd ed.). World Health Organization.
- World Health Organization. (1987). *Oral health surveys: Basic methods* (3rd ed.). World Health Organization.
- World Health Organization. (1997). *Oral health surveys: Basic methods* (4th ed.). World Health Organization.
- World Health Organization. (2003). *The World Oral Health Report 2003: Continuous improvement of oral health in the 21st century*. World Health Organization.
- World Health Organization. (2003). *The world oral health report*. World Health Organization.
- World Health Organization. (2005). *Oral health surveys: Basic methods* (5th ed.). World Health Organization.
- World Health Organization. (2013). *Oral health surveys: Basic methods* (5th ed.). World Health Organization.
- World Health Organization. (2013). *Oral health surveys: Basic methods* (5th ed.). World Health Organization. <https://www.who.int/publications/i/item/oral-health-surveys-basic-methods-5th-ed>
- World Health Organization. (2016). *Promoting oral health in schools*. World Health Organization.
- World Health Organization. (2020). *Global school health policies*. World Health Organization.
- World Health Organization. (2020). *Oral health*. <https://www.who.int/news-room/fact-sheets/detail/oral-health>
- World Health Organization. (2022). *Adolescent health overview*. World Health Organization.
- World Health Organization. (2022). *Global oral health status report: Towards universal health coverage for oral health by 2030*. <https://www.who.int/publications/i/item/9789240061484>

- World Health Organization. (2022). *Global oral health status report: Towards universal health coverage for oral health*. World Health Organization. <https://www.who.int/publications/i/item/9789240061484>
- World Health Organization. (2022). *Global oral health status report: Towards universal health coverage for oral health by 2030*. World Health Organization.
- Wu, Z., Li, M., Zhu, F., Lei, L., Cheng, R., & Hu, T. (2021). The effects of oral health education regarding periodontal health on non-dental undergraduates in southwestern China: Exploring the feasibility of an e-learning course for oral health promotion. *BMC Oral Health*, 21(1), Article 119. <https://doi.org/10.1186/s12903-021-01476-5>
- Yang, H. L., Xiao, L., Zhang, S., Deepal, G., & Ye, X. (2017). Epidemic trend of periodontal disease in the elderly Chinese population, 1987–2015: A systematic review and meta-analysis. *Scientific Reports*, 7, Article 14800. <https://doi.org/10.1038/s41598-017-15008-3>
- Yazdani, R., Vehkalahti, M. M., Nouri, M., & Murtomaa, H. (2009). School-based education to improve oral cleanliness and gingival health in adolescents in Tehran, Iran. *International Journal of Paediatric Dentistry*, 19(4), 274–281. <https://doi.org/10.1111/j.1365-263X.2009.00972.x>
- Yewe-Dyer, M. (1993). The definition of oral health. *British Dental Journal*, 174(7), 224–225. <https://doi.org/10.1038/sj.bdj.4808122>
- Yu, S., Huang, S., Song, S., Lin, J., & Liu, F. (2024). Impact of oral health literacy on oral health behaviors and outcomes among older adults: A scoping review. *BMC Geriatrics*, 24(1), Article 858. <https://doi.org/10.1186/s12877-024-05469-1>
- Zambon, J. J. (1996). Periodontal diseases: Microbial factors. *Annals of Periodontology*, 1(1), 879–925. <https://doi.org/10.1902/annals.1996.1.1.879>
- Zhang, X., Wang, X., Wu, J., Wang, M., Hu, B., Qu, H., Zhang, J., & Li, Q. (2022). The global burden of periodontal diseases in 204 countries and territories from 1990 to 2019. *Oral Diseases*. <https://doi.org/10.1111/odi.14436>
- Zhou, X., Xu, X., Li, J., Hu, D., Hu, T., Yin, W., Fan, Y., & Zhang, X. (2018). Oral health in China: From vision to action. *International Journal of Oral Science*, 10(1), Article 1. <https://doi.org/10.1038/s41368-017-0006-6>
- Zimmermann, H., Hagenfeld, D., Diercke, K., El-Sayed, N., Fricke, J., Greiser, K. H., & Schlagenhauf, U. (2015). Association between oral hygiene and periodontal health: A systematic review. *Journal of Periodontology*, 86(1), 22–36.

Annexes

Table A1: Description of Oral Health Education Sessions: Objectives, Methods, and Evaluation Strategies.

No.	Session Title	Learning Objectives & Content	Teaching Methods	Instructional Tools	Evaluation Strategy
1	Anatomy & Physiology of the Oral Cavity and Clinical Presentation of PD.	Objectives: Identify the major anatomical structures of the oral cavity; Explain the normal function of periodontal tissues. Content: Overview of teeth, gingiva, periodontal ligament, alveolar bone; Signs and clinical presentation of PD.	Interactive lecture & Q&A	Smartboard, photographs, PowerPoint, dental models	Prepare a brief report on a family member's oral condition
2	Prevention and Treatment of PD	Objectives: Describe primary preventive measures against PD; Compare non-surgical treatment options. Content: Oral hygiene techniques (brushing, flossing, mouthwash); Professional measures (scaling, polishing).	Group discussion & live demonstration under supervision	Whiteboard & markers, photographs, PowerPoint	Compile a list of barriers to effective oral hygiene
3	Maintenance and Follow-Up of Preventive Measures	Objectives: Outline a maintenance schedule for periodontal health; Apply problem-solving strategies to common barriers. Content: Recall intervals and re-evaluation Protocols.	Brainstorming & group discussion	Photos, preventive devices (toothbrush, floss, mouthwash), posters, puzzles	Develop a list of solutions to overcome identified barriers.
4	Daily Preventive Practices	Objectives: Practice correct brushing and interproximal cleaning techniques; Reinforce daily oral-care routines. Content: Live demonstrations of toothbrush and floss use; Hands-on practice with models and peer feedback.	Live demonstration under supervision & mini-lecture	Whiteboard, PowerPoint, tooth models, preventive devices (brush, floss, mouthwash)	Create a resource list for daily oral health information

5	Smoking and Its Harmful Effects on Periodontal Tissues	Objectives: Explain how tobacco smoking damages periodontal tissues; List short- and long-term oral health effects of smoking. Content: Chemical effects of nicotine and tar; Epidemiology of PD in smokers vs. non-smokers.	Live demonstration under supervision & lecture	Colourful PowerPoint slides with photos	Compile a resource list on the oral health impacts of smoking
6	Nutrition and Its Impact on Supportive Periodontal Tissues	Objectives: Analyse how different foods affect periodontal health; Recommend dietary adjustments to support periodontal tissues. Content: Role of sugars, acids, and antioxidants; Nutritional guidelines and examples of tooth-friendly diets.	Group discussion & live demonstration	Colourful PowerPoint slides with photos	Prepare a list of dietary guidelines and resources on nutrition and oral health.

Table A2: Coding System Used in Teachers' Responses

The question	Responses	New scores
B.1 – How often do you typically brush your teeth?	Twice a day or more	3
	Once a day	2
	Occasionally	1
	I do not brush	0
B.1.1 - How long do you spend brushing your teeth?	A minute or less	1
	Two minutes	2
	More than two minutes	3
B.1.2 - How do you brush your teeth?	Bass method	2
	Scrubbing method	1
	Modified Bass method	3
	Other	0
B.1.3 - What kind of bristles does your toothbrush have?	Soft bristles	2
	Medium bristles	3
	Hard bristles	1
	I am not sure	0
B.1.4 - How often do you change your toothbrush?	Every month	3
	Every two months	2
	Every three months	1
	Other	0
B.1.5 - Do you use other oral and dental cleaning tools besides the toothbrush?	Dental floss	3
	Interdental brush	2
	Mouthwash	1
	Do not use	0
B.1.6 - Do you visit the dentist in your life?	Yes.	1
	No.	0
B.1.7- How did you visit the dentist?	Regularly	3
	Sometime	2
	Pain	1
B.1.8 - When was the last time you visited the dentist?	Before 6 months	3
	Before 6-12 months	2
	Before 1-2 years	1
	Before 3-5 years	0
B.1.9 - If you visited the dentist, what was the purpose of your visit?	Pain	0
	Recommendation from a friend or relative	1
	Recommendation from another dentist	2
	Routine dental check-up	3
	Teeth and gum cleaning	4
C.1.1 - Do you eat breakfast on weekdays?	Never	0
	Once a week	1
	Twice a week	2
	Three times a week	3
	Four times a week	4
	Every day	5
C.2.1-Do you have breakfast on weekends?	Never	0
	Once a week	1
	Every weekend	2

C.2 - How often do you eat or drink the following items? (Tick one box for each item by marking an "X" under the option that applies to you in each row):

Item	Never	Less than once a week	Once a week	2-4 times a week	6 times a week	Once a day	More than once a day
Fruits	0	1	2	3	4	5	6
Vegetables	0	1	2	3	4	5	6
Sweets (e.g., candy or chocolate)	6	5	4	3	2	1	0
Milk and dairy products	0	1	2	3	4	5	6
Red meat	0	1	2	3	4	5	6
Fish	0	1	2	3	4	5	6
Water	0	1	2	3	4	5	6
Nuts	0	1	2	3	4	5	6
Pastries	6	5	4	3	2	1	0

The question	Responses	New scores
D.1- Do you currently smoke (at least one cigarette)?	Yes	0
	No	1
D.2 - How frequently do you smoke cigarettes or use other tobacco products?	Every day	1
	At least once a week, but not every day	2
	Less than once a week	3
	I don't smoke	4
D.2.2 - If you smoke cigarettes, how many cigarettes do you usually smoke per week?	26 and over	0
	21-25 cigarettes	1
	16-20cigarettes	2
	11-15cigarettes	3
	6-10cigarettes	4
	0-5cigarettes	5
D.3 - Have you ever smoked a waterpipe (hookah)?	Yes	0
	No	1
D.4 - How often do you currently smoke a water pipe?	Every day	1
	At least once a week, but not every day	2
	Less than once a week	3
	I don't smoke waterpipe	4

Appendix B

Students Questionnaire



بسم الله الرحمن الرحيم

جامعة القدس

كلية الدراسات العليا

برنامج الدكتوراه في الصحة العامة

إستمارة

تقوم الباحثة بإجراء دراسة بعنوان

" أمراض دواعم الأسنان ومؤشرات اختطاره لدى الطلبة البالغة أعمارهم 15 سنة ومدرسينهم

في محافظات شمال الضفة الغربية"

وذلك ضمن متطلبات برنامج الدكتوراه في الصحة العامة - جامعة القدس .

يهدف البحث الى الكشف عن حالات أمراض الانسجة الداعمه للأسنان ومؤشرات اختطاره بين طلبة الصف التاسع ومدرسينهم وذلك لتقييم مدى امتداد مثل هذه الأمراض ومن ثم ربط هذه الأمراض مع العوامل المخطره لها وبالتالي التفكير بالحلول المناسبة للتقليل من هذه الأمراض التي تقود إلى صحة الفم والأسنان .

الرجاء الإجابة على أسئلة الاستمارة بكل صدق وموضوعية، علماً بأن المعلومات التي سيتم جمعها سوف تستخدم فقط لأغراض البحث العلمي ، وستعامل بسرية تامة .

وشكراً لتعاونكم

الطالبة : سري إبراهيم الحسن

بإشراف : د الهام الخطيب

أولاً : خلفية المبحوث

1. اسم المشارك / ة:

2 . اسم المدرسة :

3. الجنس : ☐ أ. ذكر ☐ ب. أنثى

4. نوع المدرسة: ☐ أ. حكومية ☐ ب. خاصة

5. نظام التعليم في المدرسة : ☐ أ. غير مختلط ☐ ب. مختلط

ثانياً: محاور الدراسة

المحور الأول : العائلة

A.1 - كم أخ وأخت يسكنون معك في نفس البيت؟

1. أنت فقط ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐ 10. ☐ 11. ☐ 12. ☐ 13. ☐ 14. ☐ 15. ☐ 16. ☐ 17. ☐ 18. ☐ 19. ☐ 20. ☐ 21. ☐ 22. ☐ 23. ☐ 24. ☐ 25. ☐ 26. ☐ 27. ☐ 28. ☐ 29. ☐ 30. ☐ 31. ☐ 32. ☐ 33. ☐ 34. ☐ 35. ☐ 36. ☐ 37. ☐ 38. ☐ 39. ☐ 40. ☐ 41. ☐ 42. ☐ 43. ☐ 44. ☐ 45. ☐ 46. ☐ 47. ☐ 48. ☐ 49. ☐ 50. ☐ 51. ☐ 52. ☐ 53. ☐ 54. ☐ 55. ☐ 56. ☐ 57. ☐ 58. ☐ 59. ☐ 60. ☐ 61. ☐ 62. ☐ 63. ☐ 64. ☐ 65. ☐ 66. ☐ 67. ☐ 68. ☐ 69. ☐ 70. ☐ 71. ☐ 72. ☐ 73. ☐ 74. ☐ 75. ☐ 76. ☐ 77. ☐ 78. ☐ 79. ☐ 80. ☐ 81. ☐ 82. ☐ 83. ☐ 84. ☐ 85. ☐ 86. ☐ 87. ☐ 88. ☐ 89. ☐ 90. ☐ 91. ☐ 92. ☐ 93. ☐ 94. ☐ 95. ☐ 96. ☐ 97. ☐ 98. ☐ 99. ☐ 100. ☐

A.3 - هل تعمل الوالدة ؟

1. ☐ نعم
2. ☐ لا
3. ☐ لا اعرف
4. ☐ لا ألتقي بأبي بتاتا

A.2 هل يعمل الوالد؟

1. ☐ نعم
2. ☐ لا
3. ☐ لا أعرف
4. ☐ لا ألتقي بأبي بتاتا

A.5 - ما هو تحصيل والدتك العلمي؟

1. ☐ لم تنهي المدرسة الثانوية
2. ☐ أنهت الثانوية (التوجيهي)
3. ☐ أكملت دراستها بعد المدرسة الثانوية ولكن دون مستوى البكالوريوس
4. ☐ تدرس في الجامعة أو تخرجت منها

A.4 - ما هو تحصيل والدك العلمي؟

1. ☐ لم ينهي المدرسة الثانوية
2. ☐ أنهى الثانوية (التوجيهي)
3. ☐ أكمل دراسته بعد المدرسة الثانوية ولكن دون مستوى البكالوريوس
4. ☐ يدرس في الجامعة أو تخرج منها

A.6 - حسب رأيك، ما هو الوضع الاقتصادي لعائلتك؟

1. ☐ ممتاز او جيد جداً
2. ☐ جيد
3. ☐ متوسط
4. ☐ منخفض

المحور الثاني : عادات تنظيف الفم والاسنان

B.1 – هل تنظف أسنانك عادةً ؟

1. نعم ☐ 2. لا ☐

* إذا كانت الإجابة في السؤال السابق (لا) ، أذهب إلى سؤال B.3 في الصفحة التالية

B.1.1 - إذا كنت تنظف أسنانك ، فكم مره في اليوم تنظف أسنانك؟

1- مره واحده يوميا أو أقل ☐ 2- مرتين يوميا ☐

3- أكثر من مرتين في اليوم ☐

B.1.2 - إذا كنت تنظف أسنانك ، فمتى يكون ذلك ؟ (يمكنك اختيار أكثر من أجا به)

1- في الصباح ☐ 2- بعد تناول طعام الغداء ☐

3- قبل النوم ☐ 4- في أحيان أخرى (أذكرها)----- ☐

B.1.3 - كم من الوقت تستغرق في تنظيف أسنانك؟

1- دقيقه أو أقل ☐ 2- دقيقتين ☐

3- أكثر من دقيقتين ☐ 4- لا اعرف ☐

B.1.4 كيف تفرش (تفرشي) اسنانك؟

1- طريقه باس ☐ 2- طريقه الفك ☐

3- طريقه باس المعدله ☐ 4- ليس كل ماذكر ☐

B.1.5 مانوع فرشاه الاسنان التي تستعملها؟

1- فرشاه ذات شعيرات ناعمه ☐ 2- فرشاه ذات شعيرات متوسطه ☐

3- فرشاه ذات شعيرات شبه صلبه ☐ 4- ليس كل ماذكر ☐

B.1.6 كم مره تقوم بتغيير فرشاه اسنانك؟

1- كل شهر ☐ 2- كل شهرين ☐

3- كل 3 شهور ☐ 4- ليس كل ماذكر ☐

B.1.7 هل تستخدم وسائل اخرى لتنظيف الفم والاسنان (غير فرشاه الاسنان)؟

1- خيط الاسنان 2- فرشاة الاسنان الخاصة لتنظيف ما بين الاسنان

3- غسول الفم 4- لا استخدم

B.1.8 - هل قمت بزيارة طبيب الأسنان (على الأقل مرة واحدة) في حياتك؟

1. نعم 2- لا

B.1.9- إذا كنت تقوم بزيارة طبيب الأسنان ، كيف يحدث ذلك ؟

1- مره أو مرتين بالسنة (بصوره منتظمة) 2- أحيانا 3- عندما يكون عندي ألم في الاسنان

B.1.10- إذا قمت بزيارة طبيب الأسنان ، متى كانت آخر مره:

1- قبل 6 أشهر 2- قبل 6-12 شهر

3- قبل سنه-سنتين 3- قبل 2-5 سنوات

5- قبل أكثر من خمس سنوات

B.1.11- إذا قمت بزيارة طبيب الأسنان ، ما سبب زيارتك عادة:

1- أوجاع 2- توصيه من صديق أو قريب

3- توصيه من طبيب أسنان آخر 4- الكشف على أسناني

5- تنظيف أسناني واللثة 6- سبب آخر (يرجى تسجيل) -----

المحور الثالث : التغذية وعادات تناول الطعام

C.1 - كم مرة في الأسبوع تتناول عادةً وجبة الإفطار (أكثر من كأس حليب أو شاي أو عصير فواكه) ؟

الرجاء الإجابة بما يتعلق بأيام الأسبوع وأخرى تتعلق بالعطلة الأسبوعية بوضع دائرة حول الحالة التي تنطبق عليك :

C.1.1	في أيام الأسبوع ، هل تتناول وجبة الإفطار:	C.2.1	في العطلة الأسبوعية، هل تتناول وجبة الإفطار:
1. 1	ولا مرة	1. 1	ولا مرة
2. 2	في يوم واحد اسبوعيا	2. 2	عادةً يوم واحد فقط
3. 3	في يومين اسبوعيا	3. 3	كل يوم عطلة
4. 4	في 3 أيام اسبوعيا		

□ 5. في 4 أيام اسبوعيا

□ 6. في 5 أيام اسبوعيا

□ 7. في 6 أيام اسبوعيا

□ 8. كل يوم

C.2

- كل كم من الوقت أنت تأكل أو تشرب الأشياء التالية: (أشر إلى خانة واحدة بوضع إشارة (×) تحت الحالة التي تنطبق عليك في كل سطر) :

الرقم	الفقرة	لا أتناولها أبداً	أقل مرة في الأسبوع	مرة واحدة فقط في الأسبوع	2-4 مرات في الأسبوع	6 مرات في الأسبوع	مرة واحدة في كل يوم	أكثر من مرة واحدة في كل يوم
C.1.2	فواكه							
C.2.2	خُضراوات							
C.3.2	حلويات (مثل ملبس أو شوكولاتة)							
C.4.2	كولا أو أي مشروبات تحتوي على سكر							
C.5.2	حليب ومشتقاته							
C.6.2	اللحوم الحمراء							
C.7.2	اسماك							
C.8.2	ماء							
C.9.2	مكسرات							
C.10.2	تناول المعجنات التجارية (وليس محلية الصنع) مثل البسكويت أو الكعك							

1

المحور الرابع : التدخين

D.1 - هل تدخن حالياً ؟ (على الأقل سيجارة واحدة)

□ نعم □ 2. لا

D.2- كم مره تدخن حالياً سجائر أو اي من منتجات التبغ؟

□ 1. كل يوم

□ 2. على الأقل مرة في الأسبوع، ولكن ليس بشكل يومي

□ 3. أقل من مرة في الأسبوع

□ 4. أنا لا أدخن

* إذا كانت الإجابة في السؤال السابق (لا أدخن) ، أذهب إلى سؤال D.3

D.1.2 - إذا كنت مدخناً للسجائر، في أي عمر بدأت بتدخين سيجارة لأول مرة (أكثر من نفخة واحدة) ؟ العمر

D.2.2 - إذا كنت مدخناً للسجائر ، كم سيجارة تُدخن عادة في الأسبوع؟

1. إذا كنت تدخن أقل من سيجارة في الأسبوع ، رجاءاً سجل (0)

الإجابة :

2. إذا كنت تدخن أكثر من سيجارة في الأسبوع ، رجاءاً اكتب عدد السجائر في الأسبوع

الإجابة :

3. D - هل حدث بالماضي أن دخنت أرجيلة؟

□ 1. نعم □ 2. كلا

4. D - كم مره تدخن اليوم أرجيلة؟

□ 1. كل يوم

□ 2. على الأقل مرة في الأسبوع، ولكن ليس بشكل يومي

□ 3. أقل من مرة في الأسبوع

□ 4. أنا لا أدخن الأرجيلة

انتهت

Name of the student:

Name of the student:

other date:

Sex : M ☐ F ☐

Periodontal status (CPITN)

16	11	26
46	31	36

0=healthy

1=bleeding

2=calculus

X=excluded sextant

Oral hygiene status (OHIS)

0 =no debris

1=debris on one-third of the tooth surface.

2= debris on two-thirds of the tooth surface.

3=debris on the all-tooth surface.

16	11	26
46	31	36

Appendix C

Teachers Questionnaire



جامعة القدس

كلية الدراسات العليا

برنامج الدكتوراه في الصحة العامة

إستمارة

تقوم الباحثة بإجراء دراسة بعنوان

" أمراض دواعم الأسنان ومؤشرات اختطاره لدى الطلبة البالغة أعمارهم 15 سنة ومدرسينهم

في محافظات شمال الضفة الغربية"

وذلك ضمن متطلبات برنامج الدكتوراه في الصحة العامة - جامعة القدس .

يهدف البحث الى الكشف عن حالات أمراض دواعم الأسنان ومؤشرات اختطاره بين طلبة الصف التاسع ومدرسينهم وذلك لتقييم مدى امتداد مثل هذه الأمراض وربط هذه الأمراض مع العوامل المخطره لها وبالتالي التفكير بالحلول المناسبة للتقليل من هذه الأمراض التي تقود إلى صحة الفم والأسنان .

الرجاء الإجابة على أسئلة الاستمارة بكل صدق وموضوعية، علماً بأن المعلومات التي سيتم جمعها سوف تستخدم فقط لأغراض البحث العلمي ، وستعامل بسرية تامة .

وشكراً لتعاونكم

الطالبة : سري إبراهيم الحسن

بإشراف : د الهام الخطيب

أولاً : خلفية المبحوث

1. اسم المشارك / ة:
2. اسم المدرسة:
3. الجنس : ☐ أ. ذكر ☐ ب. أنثى
4. نوع المدرسة: ☐ أ. حكومية ☐ ب. خاصة
5. نظام التعليم في المدرسة : ☐ أ. غير مختلط ☐ ب. مختلط

ثانياً: محاور الدراسة

المحور الأول : العائلة

A.1 - كم أخ وأخت يسكنون معك في نفس البيت؟

1. أنت فقط ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐ 10. ☐

A.5 - هل تملك سياره؟

1. ☐ نعم املك سياره عاديه
2. ☐ نعم املك سياره حديثه
3. ☐ كلا لا املك سياره

A.4 - ما هو تحصيلك الدراسي؟

1. ☐ لم تُنهي المدرسة الثانوية
2. ☐ أنهت الثانوية (التوجيهي)
3. ☐ أكملت دراستها بعد المدرسة الثانوية
ولكن دون مستوى البكالوريوس
4. ☐ تدرس في الجامعة أو تخرجت منها

A.6 - حسب رأيك، ما هو الوضع الاقتصادي لك ولعائلتك؟

1. ☐ جيد جداً ☐ 2. ☐ جيد
3. ☐ متوسط ☐ 4. ☐ ضعيف

المحور الثاني : عادات تنظيف الفم والاسنان

B.1 - هل تنظف أسنانك عادةً ؟

1. ☐ نعم ☐ 2. ☐ لا

* إذا كانت الإجابة في السؤال السابق (لا) ، أذهب إلى سؤال B.3 في الصفحة التالية

B.1.1 - إذا كنت تنظف أسنانك ، فكم مره في اليوم تنظف أسنانك؟

□ 1- مره واحده يوميا أو أقل □ 2- مرتين يوميا

□ 3- أكثر من مرتين في اليوم

B.1.2 - إذا كنت تنظف أسنانك ، فمتى يكون ذلك ؟ (يمكنك اختيار أكثر من أجاهه)

□ 1-في الصباح □ 2- بعد تناول طعام الغداء

□ 3- قبل النوم □ 4- في أحيان أخرى (أذكرها)-----

B.1.3 - كم من الوقت تستغرق في تنظيف أسنانك؟

□ 1 - دقيقه أو أقل □ 2 - دقيقتين

□ 3 - أكثر من دقيقتين □ 4- لا اعرف

B.1.4 كيف تفرش اسنانك؟

□ 1- طريقه باس □ 2- طريقه الفك

□ 3- طريقه باس المعدله □ 4- ليس كل ماذكر

مانوع فرشاه الاسنان التي تستعملها؟ B.1.5

□ 1- فرشاه ذات شعيرات ناعمه □ 2- فرشاه ذات شعيرات متوسطه

□ 3- فرشاه ذات شعيرات شبه صلبه □ 4- ليس كل ماذكر

كم مره تقوم بتغيير فرشاه اسنانك؟ B.1.6

□ 1- كل شهر □ 2- كل شهرين

□ 3- كل 3 شهور □ 4- ليس كل ماذكر

هل تستخدم وسائل اخرى لتنظيف الفم والاسنان (غير فرشاه الاسنان)؟ B.1.7

□ 1- خيط الاسنان □ 2- فرشاه الاسنان لتنظيف ما بين الاسنان

□ 3- غسول الفم □ 4- لا استخدم

B.1.8 - هل قمت بزيارة طبيب الأسنان (على الأقل مرة واحدة) في حياتك؟

□ 1. نعم □ 2- لا

B.1.9- إذا كنت تقوم بزيارة طبيب الأسنان ، كيف يحدث ذلك ؟

□ 1- مره أو مرتين بالسنة (بصوره منتظمة) □ 2- أحيانا □ 3- عندما يكون عندي الم في الاسنان

B.1.10- إذا قمت بزيارة طبيب الأسنان ، متى كانت آخر مره:

□ 1- قبل 6 أشهر □ 2- قبل 6-12 شهر

□ 3- قبل سنه-سنتين □ 3- قبل 2-5 سنوات

□ 5- قبل أكثر من خمس سنوات

B.1.11- إذا قمت بزيارة طبيب الأسنان ، ما سبب زيارتك عادة:

□ 1- أوجاع □ 2- توصيه من صديق أو قريب

□ 3- توصيه من طبيب أسنان آخر □ 4- الكشف على أسناني

□ 5- تنظيف أسناني واللثة □ 6- سبب آخر (يرجى تسجيل) -----

المحور الثالث : التغذية وعادات تناول الطعام

C. - كم مرة في الأسبوع تتناول عادةً وجبة الإفطار (أكثر من كأس حليب أو شاي أو عصير فواكه)؟
جاء الإجابة بما يتعلق بأيام الأسبوع وأخرى تتعلق بالعطلة الأسبوعية بوضع دائرة حول الحالة التي
تتطبق عليك:

C.1.1 في أيام الأسبوع	C.2.1 في العطلة الأسبوعية
□ 1. ولا مرة أتناول وجبة الإفطار في أيام الأسبوع	□ 1. ولا مرة أتناول وجبة الإفطار في العطلة الأسبوعية
□ 2. في يوم واحد	□ 2. عادةً أتناول وجبة الإفطار في أحد أيام العطلة الأسبوعية
□ 3. في يومين	□ 3. عادةً أتناول وجبة الإفطار في يومي العطلة الأسبوعية
□ 4. في 3 أيام	
□ 5. في 4 أيام	
□ 6. ، 5 أيام	
□ 7. في 6 أيام	
□ 8. في 7 أيام	

C.2 - كل كم من الوقت أنت تأكل أو تشرب الأشياء التالية: (أشر إلى خانة واحدة بوضع إشارة (×) تحت الحالة التي
تتطبق عليك في كل سطر) :

الرقم	الفقرة	لا تناولها أبداً	أقل مرة في الأسبوع	مرة واحدة فقط في الأسبوع	2-4 مرات في الأسبوع	6 مرات في الأسبوع	مرة واحدة في كل يوم	أكثر من مرة واحدة في كل يوم
C.1.2	فواكه							
C.2.2	خضراوات							
C.3.2	حلويات (مثل ملابس أو شوكولاتة)							
C.4.2	كولا أو أي مشروبات تحتوي على سكر							
C.5.2	حليب ومشتقاته							
C.6.2	اللحوم الحمراء							
C.7.2	اسماك							
C.8.2	ماء							
C.9.2	مكسرات							
C.10.2	تناول المعجنات التجارية (وليست محلية الصنع) مثل البسكويت أو الكعك							

المحور الرابع : التدخين

D.1 - هل تدخن حالياً ؟ (على الأقل سيجارة واحدة)

1. نعم ☐ 2. لا ☐

D.2- كم مره تدخن حالياً سجائر أو اي من منتجات التبغ؟

1. كل يوم ☐

2. على الأقل مرة في الأسبوع، ولكن ليس بشكل يومي ☐

3. أقل من مرة في الأسبوع ☐

4. أنا لا أدخن ☐

* إذا كانت الإجابة في السؤال السابق (لا أدخن) ، أذهب إلى سؤال D.3

D.1.2 - إذا كنت مدخناً للسجائر ، في أي عمر بدأت بتدخين سيجارة لأول مرة (أكثر من نفخة واحدة) ؟ العمر

D.2.2 - إذا كنت مدخناً للسجائر ، كم سيجارة تُدخن عادة في الأسبوع؟

1. إذا كنت تدخن أقل من سيجارة في الأسبوع ، رجاءً سجل (0)

الإجابة :

2. إذا كنت تدخن أكثر من سيجارة في الأسبوع ، رجاءً اكتب عدد السجائر في الأسبوع

الإجابة :

3.D - هل حدث بالماضي أن دخنت أرجيلة؟

□ 1. نعم □ 2. كلا

4.D - كم مره تدخن اليوم أرجيلة؟

- 1. كل يوم
□ 2. على الأقل مرة في الأسبوع، ولكن ليس بشكل يومي
□ 3. أقل من مرة في الأسبوع
□ 4. أنا لا أدخن الأرجيلة

انتهت

Name of the teacher:

other date:

Sex

: M

☐

F

☐

Periodontal status (CPITN)

17 16 11	26 27
47 46	31 36 37

0=healthy

1=bleeding

2=calculus

3= Pockets>3mm

4= Pocket<3mm

X=excluded sextant

Oral hygiene status (OHIS)

=no debris

1=debris on one-third of the tooth surface.

2= debris on two-thirds of the tooth surface.

3=debris on the all-tooth surface.

16 11	26
46 31	36

Appendix D

The names of the Selected Governmental and Private Schools

Governorate	Names of Selected Governmental Schools	Names of Selected Private Schools
Nablus	Ibn Al-Haytham Basic School	Rosary Sisters School – St. Joseph
	Abu Bakr Al-Siddiq School	Rowad Al-Ma'rifa School
	Al-Ghazali Boys School	Modern English School
	Ma'zoza Al-Masri Girls School	Cambridge School
	Al-Hajj Rashda School	Islamic School
	Fadwa Tuqan School	
	Abdul Hamid Al-Sayeh School	
	Ibrahim Sanobar School	
	Omar Ibn Al-Khattab School	
	Amr Ibn Al-Aas School	
Jenin	Mithloun Girls Basic School	Al-Zaytouna Private School
	Patriarchal School	Al-Israa Model Private School
	Jaba' Girls Secondary School	Modern Knowledge Private School
	Al-Silah Boys Secondary School	Jenin National School
	Qabatiya Girls Secondary School	
	Martyr Ezz Eldien Qassam Boys School	
	Faqqua Boys School	
	Al-Ibrahimiya Girls Basic School	
	Jenin Mixed Basic School	
	Al-Mustaqbal Boys Secondary School	
	Al-Ibdaa Basic Girls School	
Tulkarm	Hafez Hamdallah Boys Basic School	Al-Riyada Private School

	Irtah Boys School	Al-Nokhba Educational Private School
	Shweika Boys School	Al-Amal International Private School
	Deir Al-Ghusoun Girls School	Al-Mustaqbal Academy Private School
	Far'un Girls School	
	Far'un Girls School	
	Ibrahim Hassan Al-Khawaja Girls School	
	Kafr Zibad School	
	Islamic Waqf Boys School	
	Al-Qadisiyah Girls Secondary School	
	Tulkarm Governmental Boys Secondary School	

العوامل المحددة لأمراض اللثة والانسجة الداعمة بين طلاب الصف التاسع ومعلميهم في شمال الضفة الغربية وفعالية برنامج تفاعلي للتثقيف الصحية الفموية في مدينة نابلس، فلسطين

إعداد: سري إبراهيم وهدان الحسن

إشراف: أ.د. الهام الخطيب

ملخص

الخلفية: يُعدّ مرض دواعم السن حالة شائعة في الفم على مستوى العالم. وهو عبارة عن عملية التهابية مزمنة ناتجة عن الميكروبات، ويمكن أن تُصيب واحدًا أو أكثر من مكونات دواعم السن. على الرغم من إمكانية الوقاية من هذه الأمراض، لا سيما في مراحلها المبكرة، إلا أن انتشار التهاب دواعم السن المزمن أخذ في الازدياد على الصعيدين الإقليمي والعالمي. وقد طُرحت مجموعة متنوعة من التدخلات للوقاية من هذه الأمراض والسيطرة عليها، وتشمل طيفًا واسعًا من الممارسات الأساسية لنظافة الفم، بالإضافة إلى الرعاية السنية المهنية الشاملة.

الأهداف: هدفت هذه الدراسة إلى تقييم مدى انتشار أمراض دواعم الاسنان، ودراسة العلاقة بين بعض العوامل المحددة وانتشار هذا الاضطراب بين طلاب المدارس الذين يبلغون من العمر 15 عامًا ومعلميهم في المحافظات الشمالية للضفة الغربية. كما تم تقييم أثر التعليم الشفهي التفاعلي في مدارس محددة بمدينة نابلس.

المنهجية: قُدمت الدراسة إلى لجنة أخلاقيات البحث بجامعة القدس.

واستُخدم في هذه الدراسة أسلوب المعاينة العشوائية الطبقية النسبية لاختيار المدارس والطلاب والمعلمين في محافظات نابلس وجنين وطولكرم. واعتمدت دراسة مقطعية في المرحلة الأولى من الدراسة، حيث قام كل مشارك بتعبئة استبيان مُعد مسبقًا بشكل طوعي ومنفرد. واستُخدم مؤشر احتياجات علاج أمراض اللثة المجتمعي للتحقق من انتشار أمراض اللثة، كما استُخدم مؤشر النظافة الفموية المبسط للتحقق من حالة النظافة الفموية للمشاركين. وفي المرحلة الثانية، استُخدمت دراسة تجريبية حقيقية مضبوطة لتقييم فعالية التثقيف الفموي التفاعلي على حالة اللثة لدى الطلاب ومدرسيهم في المدارس المختارة بمدينة نابلس. وجمعت البيانات نفسها في كلتا المجموعتين التجريبية والضابطة قبل وبعد التدخل.

التحليل: استُخدمت تحليلات ثنائية المتغيرات ومتعددة المتغيرات اللوجستية (ريجريشن) لتوضيح العلاقة بين ممارسات الفرد وحاله الصحيه لانسجه دواعم السن. بالإضافة إلى ذلك، استُخدمت اختبارات بارامترية وغير بارامترية قبلية وبعديه لتقييم مدى فعالية التدخل على نتائج صحة دواعم السن لدى المشاركين.

النتائج: كشفت نتائج هذه الدراسة عن انتشار كبير لأمراض اللثة بين المراهقين والبالغين في شمال الضفة الغربية. فقد كانت أمراض اللثة منتشرة بشكل كبير بين طلاب الصف التاسع، حيث أصابت 86.8% من المشاركين، مع ملاحظة نزيف اللثة لدى 44.6% وتراكم الجير لدى 42.2%، بينما لم تتجاوز نسبة من يتمتعون بلثة سليمة تمامًا 13.2%. كانت ممارسات نظافة الفم وسوء حالة نظافة الفم أقوى المؤثرات على الإصابة بأمراض اللثة لدى المراهقين، حيث بلغت نسبة الأرجحية المعدلة 2.05 و 1.60 على التوالي. بالمقارنة، أظهر استخدام فرشاة أسنان متوسطة الشعيرات (نسبة الأرجحية المعدلة = 1.79) وتناول الأسماك بشكل متكرر (نسبة الأرجحية المعدلة = 2.04) ارتباطات وقائية مع أمراض اللثة. وارتبط تدخين النارجيلة سلبًا بصحة اللثة (نسبة الأرجحية المعدلة = 0.63).

وبالمثل، لوحظ انتشار مرتفع لأمراض اللثة بين معلمي الصف التاسع، حيث لم تتجاوز نسبة من يتمتعون بلثة سليمة 11.8%. وتراوحت حالة اللثة المتوسطة بين وجود الجير وجيوب اللثة. كانت ممارسات نظافة الفم هي المحددات الأكثر تأثيراً، حيث كان تنظيف الأسنان المتكرر (نسبة الأرجحية المعدلة = 0.015)، وتنظيف الأسنان في الصباح (نسبة الأرجحية المعدلة = 0.015)، واستبدال فرشاة الأسنان بانتظام (نسبة الأرجحية المعدلة = 2.51) عوامل وقائية قوية.

بعد تطبيق برنامج تفاعلي للتنظيف الصحي الفموي في المدارس، لوحظ تحسن ملحوظ لدى الطلاب في المجموعة التجريبية.

انخفض متوسط درجات مؤشر احتياجات علاج أمراض اللثة المجتمعي من 10.99 عند خط الأساس إلى 10.00 بعد شهرين من التنظيف، بينما تحسنت متوسطات درجات مؤشر النظافة الفموية من 12.90 إلى 10.89. وسُجلت تغييرات إيجابية ملحوظة في ممارسات نظافة الفم، والعادات الغذائية، وسلوكيات التدخين، بينما لم تُلاحظ أي تغييرات ملحوظة في المجموعة الضابطة من الطلاب. بعد شهرين، أظهرت المجموعة التي خضعت لتدخل المعلمين انخفاضاً ملحوظاً في متوسط درجات مؤشر نظافة الفم (من 13.64 إلى 11.73) ومتوسط درجات مؤشر سلوكيات التدخين (من 19.89 إلى 17.33). بينما لم تُلاحظ أي تغييرات ملحوظة في المجموعة الضابطة. تحسنت متوسطات درجات ممارسات نظافة الفم من 12.09 إلى 20.25، وتحسنت درجات العادات الغذائية من 29.63 إلى 38.17 في المجموعة التجريبية. كما لوحظ انخفاض ملحوظ في سلوكيات التدخين، لا سيما في استهلاك السجائر أسبوعياً وتكرار تدخين النارجيلة.

الخلاصة: تُبرز هذه الرسالة أن أمراض اللثة تُشكل مشكلة صحية عامة خطيرة في شمال الضفة الغربية، سواءً للمراهقين أو البالغين، وتتأثر بشكل كبير بسلوكيات وعوامل نمط الحياة القابلة للتعديل. وتوجد أوجه قصور ملحوظة في نظافة الفم، والعادات الغذائية، وتعاطي التبغ بين هذه الفئات. وتُظهر الدراسة أن صحة اللثة يُمكن تحسينها من خلال برامج التنظيف الصحي الفموي في المدارس، والتي أظهرت تحسناً ملحوظاً في حالة صحة الفم والسلوكيات خلال فترة وجيزة. وتؤكد النتائج على أهمية برامج التنظيف الصحي الفموي الشاملة في المدارس وبين البالغين، مُشددةً على الحاجة إلى استراتيجيات وقائية تُعالج العوامل الاجتماعية والسلوكية المشتركة للحد من أمراض اللثة وتعزيز صحة الفم في السياق الفلسطيني.

الكلمات المفتاحية: أمراض دواعم الأس صحة اللثة؛ صحة الفم والأسنان؛ التثقيف الصحي التفاعلي؛
طلبة الصف التاسع؛ المعلمون؛ المدارس الفلسطينية؛ فلسطين