



UNIVERSITI PUTRA MALAYSIA

**FACTORS ASSOCIATED WITH RISK OF DENTAL CARIES IN PRIMARY
TEETH AMONG PRE-SCHOOLERS IN SEREMBAN, MALAYSIA**

LEE ZHI LING

FPSK(m) 2020 21



**FACTORS ASSOCIATED WITH RISK OF DENTAL CARIES IN PRIMARY
TEETH AMONG PRE-SCHOOLERS IN SEREMBAN, MALAYSIA**

By

LEE ZHI LING

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfilment of the Requirements for the Degree of Master of
Science**

October 2019

All material contained within the thesis, including without limitation text, logos, icons, photographs and all other artwork, is copyright material of Universiti Putra Malaysia unless otherwise stated. Use may be made of any material contained within the thesis for non-commercial purposes from the copyright holder. Commercial use of material may only be made with the express, prior, written permission of Universiti Putra Malaysia.

Copyright © Universiti Putra Malaysia



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in
fulfilment of the requirement for degree of Master of Science

**FACTORS ASSOCIATED WITH RISK OF DENTAL CARIES IN PRIMARY
TEETH AMONG PRE-SCHOOLERS IN SEREMBAN, MALAYSIA**

By

LEE ZHI LING

October 2019

Chair : Gan Wan Ying, PhD
Faculty : Medicine and Health Sciences

Dental caries in primary teeth is a serious public health issue among children and it is the most common chronic disease worldwide. Dental caries in primary teeth brings detrimental impacts on child growth and development, as well as their quality of life. As there are limited studies determining risk factors of dental caries in primary teeth among pre-schoolers in Malaysia, this cross-sectional study aimed to determine the associations between parental factors and child factors with dental caries in primary teeth among pre-schoolers in *Tabika Perpaduan* in Seremban, Negeri Sembilan, Malaysia.

A total of 396 pre-schoolers (boys: 49.5%; girls: 50.5%) with a mean age of 5.50 ± 0.62 years, from 26 randomly selected *Tabika Perpaduan* in Seremban participated in this study. Dental examination was conducted by a dentist from Hospital Tuanku Ja'afar Seremban to record the amount of decayed and filled primary teeth (dft), salivary pH, and presence of visible plaque. Height and weight of the pre-schoolers were measured by the researchers. Information regarding sociodemographic characteristics, feeding practices, oral health knowledge, attitude and behaviours, second-hand smoke exposure, types of sugary food or drinks, as well as frequency and amount of sugar was gathered through a self-administered questionnaire answered by the mothers. A 3-day food record and food frequency questionnaire were also completed by the mothers.

Results showed that nearly two-third of the pre-schoolers (64.4%) had dental caries in primary teeth, in which higher proportion of boys (69.4%) experienced dental caries than girls (59.5%; $\chi^2=4.221$, $p=0.040$). On average, each pre-schooler in this study had nearly four decayed or filled primary teeth (mean \pm SD dft score= 3.66 ± 4.61). Half of the pre-schoolers (52.0%) had visible plaque on

their primary teeth. In term of nutritional status, 14.8% of the pre-schoolers were overweight and obese, while 11.8%, 6.9%, and 7.4% were underweight, stunted, and wasted/thin, respectively. The mean energy intake of the pre-schoolers was 1382 ± 293 kcal, with 37.1% of them did not achieve recommended daily energy intake. One in ten of the pre-schoolers (10.6%) was exposed to sugar for more than six times daily. Bread and bun (63.4%) were the most frequently consumed food, followed by biscuits (62.8%), fruits cordial (50.8%), and flavoured snack (50.4%). Half of the pre-schoolers (51.4%) were living in a household which at least one cigarette was smoked inside the house.

Multiple logistic regression results showed that pre-schoolers with visible plaque on their teeth (AOR=5.64, 95% CI=2.02-10.56), who were Malay (AOR=4.18, 95% CI=1.16-15.06) or Chinese (AOR=7.59, 95% CI=1.57-36.09), who were from household with at least one cigarette smoked inside the house (AOR=2.43, 95% CI=1.15-5.11), total sugar exposure for more than six times daily (AOR=6.40, 95% CI=1.86-22.02), who did not achieve daily recommended energy intake (AOR=2.82, 95% CI=1.50-5.32), daily intake of fruits flavoured drinks or cordial (AOR=4.11, 95% CI=1.50-11.27), and non-daily intake of honey (AOR=3.99, 95% CI=1.13-14.10) had higher risk of developing dental caries in primary teeth. However, the finding on the association of honey and dental caries should be interpreted cautiously because only 4.9% of the pre-schoolers consumed honey daily in this study, which may lead to lower chance of dental caries among this group of pre-schoolers. More *in vitro* and *in vivo* studies are needed to determine the exact mechanism and the potential application of honey in the prevention of dental caries.

In conclusion, a high prevalence of dental caries in primary teeth was found in this study. Promoting good oral hygiene, reducing exposure to second-hand smoke, and practicing healthy eating behaviours may help to reduce risk of dental caries among pre-schoolers. Nutritionists should provide specific dietary guidance for parents of young children, particularly regarding sugary food consumption in order to prevent dental caries in pre-schoolers.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk Ijazah Master Sains

FAKTOR BERKAITAN DENGAN RISIKO KARIES GIGI SUSU DALAM KALANGAN KANAK-KANAK PRASEKOLAH DI SEREMBAN, MALAYSIA

Oleh

LEE ZHI LING

Oktober 2019

Pengerusi : Gan Wan Ying, PhD
Fakulti : Perubatan dan Sains Kesihatan

Karies gigi susu adalah isu kesihatan awam yang serius dalam kalangan kanak-kanak dan ia adalah penyakit kronik yang paling biasa di seluruh dunia. Karies gigi susu membawa impak yang serius kepada perkembangan dan pertumbuhan, dan juga kualiti hidup kanak-kanak. Kajian mengenai faktor berkaitan dengan karies gigi susu dalam kalangan kanak-kanak prasekolah di Malaysia adalah terhad. Oleh itu, tujuan kajian keratan rentas ini adalah untuk menentukan hubungan antara faktor ibu bapa dan faktor kanak-kanak dengan karies gigi susu dalam kalangan kanak-kanak prasekolah di Tabika Perpaduan di Seremban, Negeri Sembilan, Malaysia.

Seramai 396 kanak-kanak prasekolah (lelaki: 49.5%; perempuan: 50.5%) dengan purata umur 5.50 ± 0.62 tahun, dari 26 buah Tabika Perpaduan di Seremban yang dipilih secara rawak telah mengambil bahagian dalam kajian ini. Pemeriksaan pergigian dijalankan oleh seorang pegawai pergigian kanak-kanak dari Hospital Tuanku Ja'afar Seremban untuk merekodkan jumlah gigi susu yang berlubang dan ditampal (dft), pH air liur, dan kehadiran plak pada gigi. Ketinggian dan berat badan kanak-kanak diukur oleh penyelidik. Maklumat tentang ciri-ciri sosiodemografik, amalan penyusuan ibu, pengetahuan, sikap and tingkah laku tentang kesihatan pergigian kanak-kanak, pendedahan kepada asap rokok dalam rumah, jenis makanan dan minuman, dan kekerapan makan makanan dan minum minuman yang manis telah dikumpulkan melalui soal selidik yang diisi oleh ibu kanak-kanak. Rekod makanan tiga hari dan soal selidik kekerapan makanan juga dilengkapkan oleh ibu.

Hasil kajian menunjukkan bahawa hampir dua pertiga kanak-kanak (64.4%) mempunyai masalah karies gigi susu, di mana lebih ramai lelaki (69.4%) mempunyai karies gigi berbanding dengan perempuan (59.5%; $\chi^2=4.221$, $p=0.040$). Secara puratanya, setiap kanak-kanak dalam kajian ini mempunyai

hampir empat gigi susu yang berlubang atau ditampal (min±SD skor dft=3.66±4.61). Separuh kanak-kanak (52.0%) mempunyai plak pada gigi susu. Dari segi status pemakanan, 14.8% kanak-kanak mengalami masalah berlebihan berat badan dan obesiti, manakala 11.8%, 6.9%, dan 7.4% kanak-kanak adalah kurang berat badan, terbantut, dan kurus. Purata pengambilan tenaga kanak-kanak adalah 1382±293 kcal, dengan 37.1% kanak-kanak tidak mencapai pengambilan tenaga harian yang disyorkan. Satu daripada sepuluh orang kanak-kanak (10.6%) terdedah kepada gula lebih daripada enam kali sehari. Roti (63.4%) adalah makanan yang paling kerap dimakan, diikuti oleh biskut (62.8%), kordial buah-buahan (50.8%), dan snek berperisa (50.4%). Separuh kanak-kanak (51.4%) tinggal di rumah yang sekurang-kurangnya satu batang rokok dihisap di dalam rumah.

Hasil regresi pelbagai logistik menunjukkan bahawa kanak-kanak yang terdapat plak pada gigi susu (AOR=5.64, 95% CI=2.02-10.56), berbangsa Melayu (AOR=4.18, 95% CI=1.16-15.06) atau Cina (AOR=7.59, 95% CI=1.57-36.09), berasal dari rumah dengan sekurang-kurangnya satu batang rokok dihisap di dalam rumah (AOR=2.43, 95% CI=1.15-5.11), terdedah kepada gula lebih daripada enam kali sehari (AOR=6.40, 95% CI=1.86-22.02), tidak mencapai pengambilan tenaga harian yang disyorkan (AOR=2.82, 95% CI=1.50-5.32), mengambil minuman atau kordial yang berperisa buah-buahan setiap hari (AOR=4.11, 95% CI=1.50-11.27), dan tidak mengambil madu setiap hari (AOR=3.99, 95% CI=1.13-14.10) terdapat risiko yang tinggi untuk karies gigi susu. Walau bagaimanapun, hasil kajian ini mengenai hubungkait antara pengambilan madu dan karies gigi perlu diinterpretasikan dengan berhati-hati kerana hanya 4.9% kanak-kanak prasekolah yang makan madu setiap hari dalam kajian ini, yang berkemungkinan membawa kepada peluang yang lebih rendah untuk mendapat karies gigi dalam kalangan kumpulan kanak-kanak prasekolah ini. Lebih banyak kajian *in vitro* dan *in vivo* diperlukan untuk menentukan mekanisme dan penggunaan madu dalam pencegahan karies gigi.

Kesimpulannya, prevalen karies gigi susu yang tinggi didapati dalam kajian ini. Penggalakkan kebersihan pergigian yang baik, pengurangan pendedahan kepada asap rokok, dan pengamalan tingkah laku pemakanan yang sihat dapat membantu mengurangkan risiko karies gigi dalam kalangan kanak-kanak. Pakar pemakanan harus menyediakan panduan diet yang spesifik untuk ibu bapa, khususnya mengenai pengambilan makanan manis untuk mencegah karies gigi dalam kalangan kanak-kanak prasekolah.

ACKNOWLEDGEMENTS

First of all, I would like to express my sincere thanks and appreciation to my supervisor, Associate Professor Dr. Gan Wan Ying for her guidance, encouragement, support and patience throughout my master journey. She was always there to provide guidance whenever I faced problems in my research or writing. Also, I would like to extend my gratitude to my co-supervisors, Dr. Lim Poh Ying and Dr. Ruhaya Hasan for their valuable ideas, encouragement and continuous support, making this research better. Not to forget Dr. Lim Sing Ying, paediatric dental specialist from Hospital Tuanku Ja'afar Seremban who volunteer to conduct oral examination for the research. Her dedication to the research is very much appreciated.

Moreover, I would like to thank Universiti Putra Malaysia for funding this research through Putra Graduate Initiative (IPS) Grant (Grant No.: GP-IPS/2018/9652600). I feel deeply grateful to receive scholarship from Graduate Research Fellowship (GRF) from Universiti Puta Malaysia for the financial support throughout my master journey. In addition, I would like to thank Oral Health Division, Ministry of Health and Department of National Unity and Integration (JPNIN) for allowing me to conduct the research among pre-schoolers in *Tabika Perpaduan* in Seremban, Negeri Sembilan. Not forgetting to thank the teachers in the participating pre-schools for their kind assistance in my data collection. Million thanks to all pre-schoolers and parents who have participated in the research. Special thanks to enumerators who have helped in the data collection.

Lastly, I would like to give my special thanks to my family and friends for their endless support, understanding, and love. They are always my best listeners whenever I need an ear. I could not have completed this research without anyone mentioned above. Sincere gratitude to all of them.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Gan Wan Ying, PhD

Associate Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Chairman)

Lim Poh Ying, PhD

Senior Lecturer
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Member)

Ruhaya Hasan, PhD

Senior Lecturer
School of Dental Sciences
Universiti Sains Malaysia
(Member)

ZALILAH MOHD SHARIFF, PhD

Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been fully referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature: _____ Date: _____

Name and Matric No: Lee Zhi Ling (GS49599)

TABLE OF CONTENTS

	Page
ABSTRACT	i
ABSTRAK	iii
ACKNOWLEDGEMENTS	v
APPROVAL	vi
DECLARATION	viii
LIST OF TABLES	xiii
LIST OF FIGURES	xvi
LIST OF APPENDICES	xvii
LIST OF ABBREVIATIONS	xviii
GLOSSARY OF TERMS	xix
CHAPTER	
1 INTRODUCTION	1
1.1 Introduction	1
1.2 Problem Statement	3
1.3 Significance of the Study	6
1.4 Research Objectives	6
1.4.1 General objective	6
1.4.2 Specific objectives	6
1.5 Research Hypothesis	7
1.6 Conceptual Framework	7
2 LITERATURE REVIEW	9
2.1 Oral Health	9
2.2 Primary Teeth and Dental Caries	9
2.3 Associations between Parental Factors and Dental Caries in Primary Teeth	14
2.3.1 Age of parents	15
2.3.2 Marital status	15
2.3.3 Parental educational level	16
2.3.4 Monthly household income	17
2.3.5 Feeding practices	18
2.3.6 Maternal oral health knowledge and attitude	20
2.4 Associations between Child Factors and Dental Caries in Primary Teeth	21
2.4.1 Age	22
2.4.2 Sex	22
2.4.3 Ethnicity	23
2.4.4 Birth order	24
2.4.5 Birthweight	25
2.4.6 Oral health behaviours	26
2.4.7 Second-hand smoke exposure	29
2.4.8 Dietary intake	32
2.4.9 Growth status	34
2.4.10 Oral hygiene	38

3	METHODOLOGY	43
3.1	Study Design	43
3.2	Study Location	43
3.3	Respondents	43
3.4	Sample Size Determination	44
3.5	Sampling Method	46
3.6	Translation of Questionnaires	46
3.7	Study Instruments	47
	3.7.1 Mother-administered questionnaire	47
	3.7.2 Anthropometric measurements	52
	3.7.3 Salivary pH	52
	3.7.4 Dental examination	53
3.8	Study Approval	53
3.9	Pre-Test	54
3.10	Data Collection	54
3.11	Statistical Analysis	55
4	RESULTS	57
4.1	Screening and Recruitment	57
4.2	Sociodemographic Characteristics	57
4.3	Dental Caries in Primary Teeth	60
4.4	Oral Hygiene	60
4.5	Feeding Practices	60
4.6	Maternal Oral Health Knowledge and Attitude	62
4.7	Oral Health Behaviours	65
4.8	Second-Hand Smoke Exposure	66
4.9	Growth Status	66
4.10	Sugar Exposure	67
4.11	Frequency of Sugary Food and Drinks Consumption	68
4.12	Nutrient Intake	73
4.13	Bivariate Analysis of Sociodemographic Characteristics and Dental Caries in Primary Teeth	74
4.14	Bivariate Analysis of Oral Hygiene and Dental Caries in Primary Teeth	76
4.15	Bivariate Analysis of Feeding Practices and Dental Caries in Primary Teeth	76
4.16	Bivariate Analysis of Oral Health Knowledge, Attitude, and Behaviours of Parents and Dental Caries in Primary Teeth	78
4.17	Bivariate Analysis of Second-Hand Smoke Exposure and Dental Caries in Primary Teeth	79
4.18	Bivariate Analysis of Growth Status and Dental Caries in Primary Teeth	80
4.19	Bivariate Analysis of Sugar Exposure and Dental Caries in Primary Teeth	81
4.20	Bivariate Analysis of Frequency of Sugary Food and Drinks with Dental Caries in Primary Teeth	82
4.21	Bivariate Analysis of Nutrient Intake and Dental Caries in Primary Teeth	85
4.22	Logistic Regression Analysis	85

5	DISCUSSION	98
5.1	Dental Caries in Primary Teeth	98
5.2	Associations of Sociodemographic Characteristics and Dental Caries in Primary Teeth	100
5.3	Association of Oral Hygiene and Dental Caries in Primary Teeth	101
5.4	Associations of Feeding Practices and Dental Caries in Primary Teeth	102
5.5	Associations of Oral Health Knowledge, Attitude, Behaviours and Dental Caries in Primary Teeth	104
5.6	Association of Second-Hand Smoke Exposure and Dental Caries in Primary Teeth	106
5.7	Association of Growth Status and Dental Caries in Primary Teeth	106
5.8	Association of Sugar Exposure and Dental Caries in Primary Teeth	108
5.9	Associations of Frequency of Sugary Food and Drinks and Dental Caries in Primary Teeth	109
5.10	Association of Nutrient Intake and Dental Caries in Primary Teeth	110
5.11	Multiple Logistic Regression Model	111
6	CONCLUSION AND RECOMMENDATIONS	114
6.1	Conclusion	114
6.2	Limitations and Strengths of the Study	115
6.3	Recommendations	116
	REFERENCES	119
	APPENDICES	147
	BIODATA OF STUDENT	182
	LIST OF PUBLICATIONS	183

LIST OF TABLES

Table		Page
2.1	Codes for dentition status of primary and permanent teeth	12
2.2	Prevalence of dental caries in primary teeth in different countries	13
2.3	Salivary constituents and function	38
2.4	Colour indication based on TPID colour changes	41
3.1	Inclusion and exclusion criteria for the selection of respondents	44
3.2	Categories of liquid, solid and total sugar exposure	50
3.3	Classifications of WAZ, HAZ and BAZ for children	52
4.1	Socio-demographic characteristics of the mother-child pairs	58
4.2	Prevalence of dental caries in primary teeth and dft score of pre-schoolers	60
4.3	Mean value and distributions of oral hygiene of pre-schoolers	60
4.4	Breastfeeding and bottle feeding practices of mother of pre-schoolers	61
4.5	Distribution of oral health knowledge of mothers of pre-schoolers	62
4.6	Distribution of oral health attitude of pre-schoolers	64
4.7	Distribution of oral health behaviours of pre-schoolers	65
4.8	Distribution of second-hand smoke exposure of pre-schoolers	66
4.9	Mean values and distribution of birthweight and other anthropometry indices of pre-schoolers by sex	67
4.10	Mean values and distribution of liquid, solid, total sugar exposure and dietary caries risk score of the pre-schoolers	68

4.11	Frequency of sugary food and drinks consumption among pre-schoolers	69
4.12	Food consumption frequency score	72
4.13	Implausible reporting of energy intake among the pre-schoolers	73
4.14	Mean values and distribution of energy and nutrient intakes of the pre-schoolers	74
4.15	Bivariate analysis of sociodemographic characteristics of parents and pre-schoolers and dental caries in primary teeth of pre-schoolers	75
4.16	Bivariate analysis of oral hygiene with dental caries in primary teeth of pre-schoolers	76
4.17	Bivariate analysis of breastfeeding practices with dental caries in primary teeth of pre-schoolers	76
4.18	Bivariate analysis of bottle-feeding practices with dental caries in primary teeth of pre-schoolers	77
4.19	Bivariate analysis of oral health knowledge, attitude, behaviours of parents with dental caries in primary teeth of pre-schoolers	78
4.20	Bivariate analysis second-hand smoke exposure with dental caries in primary teeth of pre-schoolers	80
4.21	Bivariate analysis of growth status with dental caries in primary teeth of pre-schoolers	80
4.22	Bivariate analysis of liquid, solid, total sugar exposure and dietary caries risk score with dental caries in primary teeth	81
4.23	Bivariate analysis of frequency of sugary food and drinks with dental caries in primary teeth	82
4.24	Bivariate analysis of energy intake, total carbohydrate intake and total sugar intake with dental caries in primary teeth among pre-schoolers	85
4.25	Variables that were tested in multiple logistic regression	86
4.26	Associations between parental and child factors with dental caries in primary teeth in simple logistic regression model	95

4.27	Factors associated with dental caries in primary teeth in multiple logistic regression model	96
------	--	----



LIST OF FIGURES

Figure		Page
1.1	Conceptual framework of this study	8
2.1	Tooth surfaces	10
2.2	Anatomy of tooth	10
2.3	Anatomy of primary teeth	11
2.4	Stephan curve	39
3.1	Flow chart of sampling design	46
3.2	Colour chart provided by Macherey-Nagel	53
3.3	Flowchart of data collection procedures	55
4.1	Screening and recruitment process of this study	57

LIST OF APPENDICES

Appendix		Page
A	Ethics approval from JKEUPM	147
B	Approval letter from Oral Health Division, Ministry of Health	150
C	Approval letter from Department of National Unity and Integration Putrajaya	152
D	Approval letter from Department of National Unity and Integration Seremban	159
E	Information sheet and consent form	160
F	Questionnaire	164
G	Dental examination chart	180
H	Results by ethnicity	181

LIST OF ABBREVIATIONS

AAP	American Academy of Paediatrics
AAPD	American Academy of Paediatric Dentistry
AOR	Adjusted Odds Ratio
BAZ	BMI-for-age z score
BMR	Basal Metabolic Rate
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
dft	decayed and filled primary teeth
dmft	decayed, missing, and filled primary teeth
dt	Decayed primary teeth
ECC	Early childhood caries
EI	Energy intake
FFQ	Food frequency questionnaire
ft	Filled primary teeth
HAZ	Height-for-age z score
IOTF	International Obesity Task Force
IPH	Institute for Public Health
JPNIN	Department of National Unity and Integration
MANS	Malaysian Adults Nutrition Survey
NCCFN	National Coordinating Committee for Food and Nutrition
NHMS	National Health and Morbidity Survey
RNI	Recommended Nutrient Intakes
SD	Standard deviation
S-ECC	Severe early childhood caries
SSBs	Sugar-sweetened beverages
UNICEF	United Nations International Children's Emergency Fund
USA	United States of America
USDA	United States Department of Agriculture
WAZ	Weight-for-age z score
WHO	World Health Organization

GLOSSARY OF TERMS

dmft index	Total number of decayed, missing and filled primary teeth (WHO, 2013).
DMFT index	Total number of decayed, missing and filled permanent teeth (WHO, 2013).
Dental caries in primary teeth	Presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth (AAPD, 2008).
Early childhood caries	Presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child younger than 71 months old (AAPD, 2008).
Severe early childhood caries	Happens when children younger than 3 years old have any sign of smooth surface caries. For children aged 3 through 5 years, one or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or a dmft score of ≥ 4 (age 3), ≥ 5 (age 4), or ≥ 6 (age 5) (AAPD, 2008).
Sugar exposure	Frequency of solid and liquid sugar consumption in a day (Palmer & Boyd, 2016).

CHAPTER 1

INTRODUCTION

1.1 Background

Primary teeth, also known as baby teeth or deciduous teeth, usually erupt between 6 months after birth to around 4 years (Friedman, 2017). The teeth erupt in the sequence of primary central incisors, lateral incisors, first molars, canines to second molars (Friedman, 2017). By 2 or 3 years old, all 20 primary teeth come in. Before the eruption of permanent teeth, primary teeth play an important role in reserving space for permanent teeth and the development of clear speech (Friedman, 2017). However, primary teeth usually come with immature enamel (Gussy, Waters, Walsh, & Kilpatrick, 2006). Hence, appropriate dental care should be applied as primary teeth with immature or underdeveloped enamel may have higher risk of developing caries (Caulfield, Li, & Bromage, 2012).

The period after emergence of first tooth until its complete maturation is the period when it is the most vulnerable to caries development (Vadiakas, 2008). Enamel of primary teeth is specifically susceptible to the presence of cariogenic bacteria (Geddes, 1975). These bacteria release acidic substances, hydrogen ions during the metabolic activities of fermenting carbohydrate (such as glucose, sucrose, fructose or cooked starch) and form biofilm on the teeth (Geddes, 1975). The hydrogen ions dissolve the carbonated hydroxyapatite crystal lattice of enamel, cementum, and dentin (Featherstone, Nelson, & McLean, 1981; LeGeros, 1991). Cavitated enamel which results from demineralization further supports growth of bacteria, as it is difficult to remove biofilm from rough cavitated enamel (Kawashita, Kitamura, & Saito, 2011). When the caries balance on the enamel is disrupted in a way that demineralization is more than remineralization, the development of caries occurs (Featherstone, 2000).

Dental caries (also known as tooth decay or dental cavities) in primary teeth is a serious public health issue among children and it is the most common non-communicable disease worldwide (WHO, 2018a). Among 5- to 17-year-old children in the United States of America (USA), dental caries is five times more common than asthma and seven times than hay fever (U.S. Department of Health and Human Services, 2000). In 2010, almost 9% of the children worldwide affected by untreated caries in primary teeth (Kassebaum et al., 2015). The prevalence of dental caries in primary teeth in some developed countries such as the USA (23%) and the United Kingdom (UK; 28%) are relatively low compare to the prevalence in developing countries such as Philippines (88%) and Laos (89%) (Duangthip, Gao, Lo, & Chu, 2017; Dye, Thornton-Evans, Li, & Iafolla, 2015; Holmes et al., 2015). Dental caries in primary teeth is also prevalent in some Middle Eastern countries, such as Palestine (76%) and the United Arab Emirates (83%) (Azizi, 2014; El-Nadeef, Hassab, & Al-Hosani, 2010).

In most of the Southeast Asia countries, such as Philippines (88%), Laos (89%) and Cambodia (90 – 93%), the prevalence of dental caries in primary teeth was more than 85%, except for Brunei (59%) and Singapore (49%) (Duangthip et al., 2017). In addition, children from other countries in Asia, such as Hong Kong (51%), China (66%), and India (54%) have relatively lower prevalence of caries in comparison with countries in Southeast Asia (Department of Health, 2011; Hu, Hong, & Li, 2011; Mahejabeen, Sudha, Kulkarni, & Anegundi, 2006). The disparities between prevalence of caries in developed and developing countries could be a result of distinct risk profiles across Southeast Asia countries, such as low number of dentistry personnel (WHO, 2011), insufficient equipment, lower fluoride coverage, poor socio-economic status, and possibly lack of political attention, particularly in low-income and middle-income countries (Benzian et al., 2011). Furthermore, the density of dentist per 10 000 population in Southeast Asia Region (0.7) was the lowest among the WHO regions, compared to Region of the Americas (12.0) and European Region (4.9) (WHO, 2011). This indicates that countries in Southeast Asia do not have enough oral health workforce who are able to provide oral health care for all populations, which then leads to high caries prevalence among the countries. Another interesting phenomenon is that, although Brunei (59%) and Singapore (49%) are developed countries (Duangthip et al., 2017), the prevalence in both countries are still considered high compared to other developed countries such as USA (23%) and the United Kingdom (UK; 28%) (Dye et al., 2015; Holmes et al., 2015). This could be due to the cultural differences as countries in Southeast Asia tend to have higher carbohydrates intake, which might be cariogenic, compared to dietary pattern in Western countries.

Moving back to the context of Malaysia, the national oral health survey reported a notable decrease in the prevalence of dental caries among Malaysian children, especially those in pre-school age. The survey reported that caries prevalence decreased from 87.1% in 1995 to 76.2% in 2005 among 5-year-old Malaysian children (Oral Health Division Ministry of Health Malaysia, 2007), whereas, among the 6-year-old Malaysian children, caries prevalence decreased from 80.9% in 1997 (Oral Health Division & Ministry of Health Malaysia, 1998) to 74.5% in 2007 (Oral Health Division Ministry of Health Malaysia, 2009). Although the prevalence of dental caries in children has decreased, it is still considered a serious public health issue. The disease burden remains significant among children especially those in the socioeconomically disadvantaged groups due to their changing lifestyle and dietary pattern (Khairiyah, Wan Mohd Nasir, Yaw, & Norliza, 2013) .

Although dental caries in primary teeth is transmissible, it is preventable by routine dental check-up, good oral hygiene, and healthy eating behaviours. In order to create evidence-based effective prevention strategies, it is important for researchers to examine the factors related to the disease at different levels such as community, family, and individual levels. Identifying risk factors of dental caries among pre-schoolers would be especially valuable in order to develop prevention programs and update clinical practice guidelines. Most importantly, prevention and early treatment of dental caries would improve oral health as well as overall health of children.

1.2 Problem Statement

Caries is ranked as the fourth most expensive chronic disease to treat according to WHO (Petersen, 2008), where it is one of the most prevalent chronic diseases among children (Nakayama & Mori, 2015a). It was estimated that yearly direct treatment cost on dental disease worldwide was 298 billion US dollar in 2010 (Listl, Galloway, Mossey, & Marcenes, 2015). Furthermore, the estimated indirect cost, such as loss of productivity, due to dental disease amounted to 144 billion US dollar yearly (Listl et al., 2015). This showed that the total amount of direct and indirect costs was 442 billion US dollar for 2010 alone. However, there is no record of cost spent on dental disease in Malaysia.

Beyond the economic impact, untreated caries on primary teeth also bring serious impacts to the general health, as well as quality of life of the children (Martins-Júnior et al., 2013). Children with caries experienced difficulty in eating and sleeping due to the unbearable pain and soreness (Gilchrist, Marshman, Deery, & Rodd, 2015). In turn, the children may change their diet and avoid some food that is difficult to chew. The chewing problem and pain affect their nutrients intake lead to poor growth and development (Van Cauter & Plat, 1996). Furthermore, as the disease progresses without any intervention, teeth of the children loss inevitably and this may influence their speech development (Kumarihamy, Subasinghe, Jayasekara, Kularatna, & Palipana, 2011). These children would develop low self-esteem. If it is not treated well, caries might end up fatal (Duangthip et al., 2017). A previous cohort study reported that children with caries in their primary teeth were three times more likely to develop caries in their permanent teeth (Li & Wang, 2002). Undoubtedly, dental caries is a major oral health problem in childhood that warrants further attention.

Dental caries is a multifactorial disease involving various risk and protective factors. Managing multiple factors occurs during pre-school years are crucial in maintaining the caries balance and preventing dental caries. These factors included parental and child factors, such as dental plaque, frequent contact with fermentable carbohydrates through improper feeding practices, as well as a series of sociodemographic factors such as parental educational level, employment status, and monthly household income (Hong, Levy, Warren, & Broffitt, 2014; Mattheus, Gandhi, Lim, & Shannon, 2017; Tanner et al., 2011). Only two published studies were conducted to examine risk factors of dental caries in primary teeth among pre-schoolers in Malaysia (Ruhaya et al., 2012; Zahara, Fashihah, & Nurul, 2010). These two studies mainly focused on body mass index (BMI), frequency of sugary food and drinks consumption and dental caries. Other local studies have mainly focused on measuring dental caries and its associated factors such as BMI, sugar consumption, oral health practice and oral hygiene among primary school children (Kaur, Maykanathan, & Ng, 2015; Masood, Yusof, Hassan, & Jaafar, 2012). The current study aimed to fill in the knowledge gap on the associations between multiple factors such as feeding practices, birth weight, sugar exposure, oral health knowledge, attitude and behaviours with dental caries in primary teeth among pre-schoolers.

Improper feeding practices included late initiation of breastfeeding, early/late introduction of complementary food, prolonged breastfeeding, breast- or bottle-feeding before bedtime, sleep with bottle in mouth, affect children's health and development. Previous studies have shown that improper feeding practices such as prolonged breastfeeding (breastfeed for more than 24 months), breast- or bottle-feeding before bedtime or sleep with bottle in mouth were found to be associated with dental caries in primary teeth (Nakayama & Mori, 2015a; Prakash, Subramaniam, Durgesh, & Konde, 2012; Slabšinskienė et al., 2010; Wong et al., 2017). However, the relationship of shorter or longer duration of breastfeeding with dental caries in primary teeth is still inconclusive (Hong et al., 2014; Tanaka & Miyake, 2012; Zhou, Lin, Lo, & Wong, 2011). Nevertheless, most of the studies did not address the frequency of breastfeeding in a day. In contrast, some studies found insignificant association between feeding practices and dental caries in children (Nunes et al., 2012; Tham et al., 2015). Prolonged feeding and bottle feeding before sleep were prevalent among Malaysian mothers (IPH, 2016b). However, the association of these improper feeding practices (prolong breastfeeding, breast- or bottle-feeding before bedtime or sleep with bottle in mouth) and dental caries in primary teeth of pre-schoolers has not been examined by local researchers.

Parents play a crucial role in constructing their children's good oral health behaviours. Mothers' knowledge and attitudes about oral health (Li et al., 2011; Wulaerhan, Abudureyimu, Bao, & Zhao, 2014) as well as children's practices related to tooth brushing (Kaur et al., 2015; Kowash, Alkhabuli, Dafaalla, Shah, & Khamis, 2017; Li et al., 2011; Slabšinskienė et al., 2010) and dental visit (Huong et al., 2017; Kumarihamy et al., 2011) are usually parts of the factors that researchers would focus on. However, inconsistent findings were reported. Furthermore, there was only one published study in Malaysia focused on maternal oral health related knowledge, attitude and behaviours (Mani, John, Ping, & Noorliza Mastura, 2012). Therefore, study examining maternal oral health knowledge, attitude and behaviours and its association with dental caries of pre-schoolers is much needed.

Young children are not likely to smoke actively, but three out of five young children were exposed to the effects of second-hand smoke (Mattheus et al., 2017; WHO, 2008). It is suggested that exposure to second-hand smoke in house increase risk of caries among children by increasing the attachment of cariogenic bacteria on teeth surfaces and decreasing immune function (Hanioka, Ojima, Tanaka, & Yamamoto, 2011; Mattheus et al., 2017; Nakayama & Mori, 2015b; Watanabe et al., 2014) but several studies found no association (Paglia et al., 2016; Wulaerhan et al., 2014). In addition, evidence on the association of maternal smoking during first trimester or throughout the pregnancy period with caries among children is insufficient (Tanaka, Miyake, Nagata, Furukawa, & Arakawa, 2015). Most of the previous studies that examined factors of caries in primary teeth did not take into account of second-hand smoke exposure, which is an important factor to be investigated further. The role of second-hand smoke exposure in dental caries was poorly examined among Malaysian pre-schoolers.

Early childhood is an important period in forming dietary habit, which is a denotation of later health of a child. Dietary practices such as frequent consumption of sugar-sweetened beverages (SSBs), sucrose intake (sugary juices, baby formula, snacks, or candies) between meals or free sugar (added sugars in food or drinks) consumption before bedtime were found to be associated with the increasing risk of dental caries (Do, Ha, & Spencer, 2015; Goodwin et al., 2017; Nunes et al., 2012). On the contrary, two local studies did not find any association between frequency of sugary food and drink consumption with caries (Kaur et al., 2015; Zahara et al., 2010). Since there are a variety of dietary practices in different ethnic groups in Malaysia, there is a need to examine the associations of sugary food, drinks or snack intake and dental caries among pre-schoolers.

Obesity and caries are health problems that exist concurrently in many populations, mostly due to common risk factors, including consumption of food with high calorie, increased stress, and low socioeconomic status (Chi, Luu, & Chu, 2017). The findings on the association between BMI and dental caries are still inconclusive as some of the studies found positive association (Alm et al., 2011; Docimo et al., 2014; Pikramenou, Dimitraki, Zoumpoulakis, Verykouki, & Kotsanos, 2016) while other studies found negative association (Alkarimi, Watt, Pikhart, Sheiham, & Tsakos, 2014; Dimaisip-Nabuab et al., 2018; Norberg, Hallström Stalin, Matsson, Thorngren-Jerneck, & Klingberg, 2012). However, some studies have found insignificant findings (Kaur et al., 2015; Ruhaya et al., 2012; Yen & Hu, 2013). As a developing country facing double burden of malnutrition, a study that determining the relationship between BMI and dental caries among pre-schoolers is very much needed.

Understanding the salivary environment is critical in achieving long-term oral health of children. Oral hygiene such as saliva pH and visible plaque may affect dental caries (Animireddy et al., 2014; Tanner et al., 2011; Zhou et al., 2011). Children with lower salivary pH (Animireddy et al., 2014; El-Kwatehy & Youssef, 2016; Makawi, El-masry, & El-din, 2017) and more visible plaque (Parisotto et al., 2015; Tanner et al., 2011; Zhou et al., 2011) were found to have higher prevalence of dental caries. Nevertheless, null findings regarding pH were shown in other studies (Normastura, Norhayani, Azizah, & Mohd Khairi, 2013; Nunes et al., 2012; Paglia et al., 2016). As oral hygiene could be possible early indicator of dental caries and there was lack of study in oral hygiene among Malaysian pre-schoolers, these suggest the needs to include these variables in this study.

In general, it is crucial to determine risk factors of dental caries in primary teeth among Malaysian children as limited local studies have been conducted. The Oral Health Division, Malaysia has been advocating local researchers to identify predictors of dental caries in children (Oral Health Division, 2008). Additionally, diet, nutrition and dental caries are linked but very few studies investigated this link. Hence, this study aimed to determine the associations between parental factors and child factors with dental caries in primary teeth among pre-schoolers

in Seremban, Negeri Sembilan, Malaysia. There are a few research questions to be addressed in this study:

- 1) What is the prevalence of dental caries in primary teeth among pre-schoolers in *Tabika Perpaduan* at Seremban?
- 2) Are parental factors and child factors associated with dental caries in primary teeth among pre-schoolers in *Tabika Perpaduan* at Seremban?

1.3 Significance of the Study

Dental caries in primary teeth is a multifactorial disease. Different parental and child factors influence the development of this disease. The findings of this study could fill in the gap of knowledge, as there was limited study regarding dental caries in primary teeth in Malaysia. Moreover, multiple factors but not a single factor has been included in the current study to determine their associations with dental caries in primary teeth among pre-schoolers. Extensive understanding on the factors associated with dental caries in primary teeth of pre-schoolers is important in order to develop appropriate prevention strategies on dental caries as well as intervention programs on oral health. Furthermore, this study provides baseline data for future research related to dental caries in children.

Findings of this study could help policy makers to develop targeted policy and guidelines for healthcare personnel and parents to improve oral health of children, and eventually decrease the prevalence and severity of dental caries among children. Healthcare personnel such as nutritionists, dietitians, dentists or any other authorities could also make use of the findings of this study to develop effective intervention programs for children and parents by educating them about proper oral health behaviours and healthy eating behaviours. As this study focused on parental factors, particularly feeding practices, oral health knowledge and attitude, dental care professionals and parents can work together to create an oral health care plan to improve and prevent the development of dental caries in primary teeth among children.

1.4 Research Objectives

1.4.1 General objective

To determine the factors associated with dental caries in primary teeth among pre-schoolers in *Tabika Perpaduan* in Seremban.

1.4.2 Specific objectives

- 1) To examine parental factors (age, marital status, parental education level, monthly household income level, feeding practices, maternal oral health knowledge and attitudes) and child factors (sex, age, birth order,

- birth weight, oral health behaviours, second-hand smoke exposure, dietary intake, growth status and oral hygiene) of pre-schoolers.
- 2) To determine the prevalence of dental caries in primary teeth among pre-schoolers.
 - 3) To determine the associations of parental factors and child factors with dental caries in primary teeth among pre-schoolers.
 - 4) To determine the contributions of parental and child factors toward dental caries in primary teeth among pre-schoolers.

1.5 Research Hypotheses

- 1) There are significant associations of parental factors and child factors with dental caries in primary teeth among pre-schoolers in *Tabika Perpaduan* in Seremban.
- 2) There are significant contributions of parental factors and child factors toward dental caries in primary teeth among pre-schoolers in *Tabika Perpaduan* in Seremban.

1.6 Conceptual Framework

As shown in Figure 1.1, dental caries in primary teeth is the dependent variable while parental factors and child factors are the independent variables of this study.

Several studies have found that being a female, older age, being first-born or lower parental education level were associated with higher prevalence of dental caries among children (Hong et al., 2014; Kaur et al., 2015; Kumarihamy et al., 2011; Yen & Hu, 2013). There are more children experienced caries when their mothers practiced improper feeding practices, such as prolonged breastfeeding (more than 24 months), nocturnal breast- or bottle-feeding (Nakayama & Mori, 2015; Slabšinskienė et al., 2010; Wong et al., 2017). Mothers with poor oral health knowledge and attitude were more likely to have children with dental caries (Bennadi et al., 2014; Li et al., 2011).

Children who did not follow recommendations of oral health practices, such as shorter time of teeth brushing, did not start tooth brushing after eruption of first teeth, older age of commencing tooth brushing, had higher risk of dental caries (Kaur et al., 2015; Kowash et al., 2017; Li et al., 2011; Slabšinskienė et al., 2010). Moreover, second-hand smoke exposure was found to increase the risk of dental caries among children (Mattheus et al., 2017; Watanabe et al., 2014). Furthermore, dietary intake such as frequent consumption of sugar-sweetened beverages and sucrose intake between meals found to increase the risk of dental caries (Do et al., 2015; Hong et al., 2014; Nunes et al., 2012). Palacios et al. (2010) found that higher intake of total carbohydrates, total sugar, sucrose, fructose and inositol were associated with higher odds of caries. Furthermore, Parisotto et al. (2010) also showed that pre-schoolers who exposed to sugar for more than six times daily had higher risk of caries in primary

teeth. On the other hand, Chopra et al. (2015) stated that children who were underweight, overweight and obese had higher risk of developing caries in comparison with normal weight children. Low pH of saliva and high plaque index were found to increased risk of dental caries among children (Animireddy et al., 2014; Tanner et al., 2011; Zhou et al., 2011).

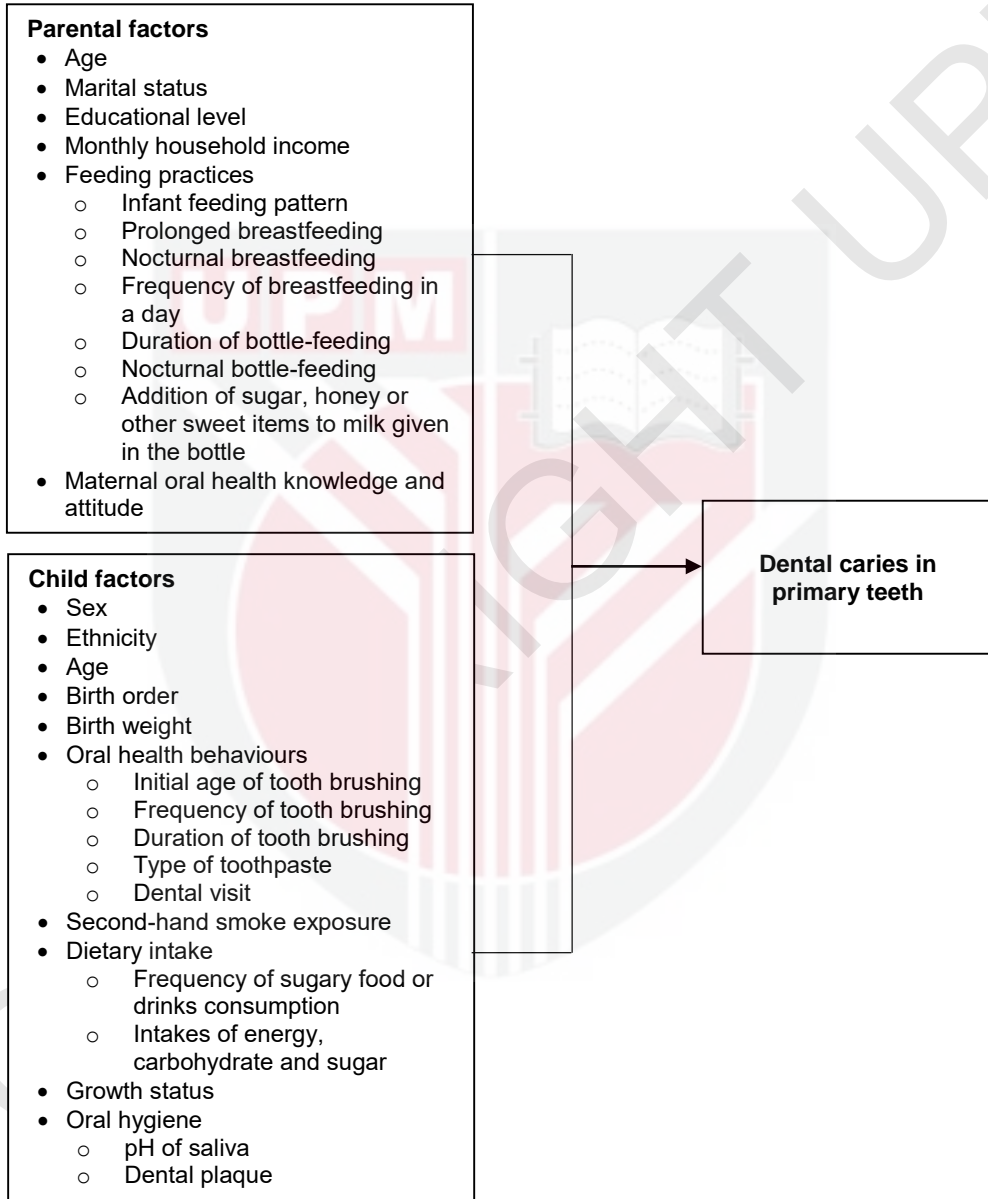


Figure 1.1: Conceptual framework of this study

REFERENCES

- Abarca-Gómez, L., Abdeen, Z. A., Hamid, Z. A., Abu-Rmeileh, N. M., Acosta-Cazares, B., Acuin, C., ... Ezzati, M. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *The Lancet*, *390*(10113), 2627–2642. [https://doi.org/10.1016/S0140-6736\(17\)32129-3](https://doi.org/10.1016/S0140-6736(17)32129-3)
- Abou El-Yazeed, M., Taha, S., El-Shehaby, F., & Salem, G. (2009). Relationship between salivary composition and dental caries among a group of Egyptian Down Syndrome children. *Australian Journal of Basic and Applied Sciences*, *3*(2), 720–730.
- Ahmadi-Motamayel, F., Hendi, S. S., Alikhani, M. Y., & Khamverdi, Z. (2013). Antibacterial activity of honey on cariogenic bacteria. *Journal of Dentistry (Tehran, Iran)*, *10*(1), 10–15.
- Ainamo, J., & Bay, I. (1975). Problems and proposals for recording gingivitis and plaque. *International Dental Journal*, *25*, 229–235.
- Al-Meedani, L. A., & Al-Dlaigan, Y. H. (2016). Prevalence of dental caries and associated social risk factors among preschool children in Riyadh , Saudi Arabia. *Pakistan Journal of Medical Science*, *32*(2), 452–456.
- Al-Omiri, M. K., Al-Wahadni, A. M., & Saeed, K. N. (2006). Oral health attitudes, knowledge, and behavior among school children in North Jordan. *Journal of Dental Education*, *70*(2), 179–187.
- Alkarimi, H. A., Watt, R. G., Pikhart, H., Sheiham, A., & Tsakos, G. (2014). Dental caries and growth in school-age children. *Pediatrics*, *133*(3), e616–e623. <https://doi.org/10.1542/peds.2013-0846>
- Alm, A., Isaksson, H., Fåhraeus, C., Koch, G., Andersson-Gäre, B., Nilsson, M., ... Lill-Kari, W. (2011). BMI status in Swedish children and young adults in relation to caries prevalence. *Swedish Dental Journal*, *35*, 1–8.
- Almerich-Torres, T., Montiel-Company, J. M., Bellot-Arcís, C., & Almerich-Silla, J. M. (2017). Relationship between caries, body mass index and social class in Spanish children. *Gaceta Sanitaria*, *31*(6), 499–504. <https://doi.org/10.1016/j.gaceta.2016.09.005>
- American Academy of Pediatric Dentistry. (2008). Definition of early childhood caries (ECC). *American Academy of Pediatric Dentistry*.
- American Academy of Pediatric Dentistry. (2016). Policy on early childhood caries (ECC): classification, consequences, and preventive strategies. *Oral Health Policies*, *40*(6), 60–62.
- American Academy of Pediatric Dentistry. (2018). Fluoride therapy. *Reference Manual*, *40*(6), 250–253.
- American Academy of Pedodontics, & American Academy of Pediatrics. (2014). Policy on early childhood caries (ECC): Classification, consequences, and preventive strategies. *Oral Health Policies*, *37*(6), 50–52.

- Aminabadi, N. A., Ghoreishizadeh, A., Ghoreishizadeh, M., Oskouei, S. G., & Ghojzadeh, M. (2014). Can child temperament be related to early childhood caries? *Caries Research*, *48*(1), 3–12. <https://doi.org/10.1159/000351636>
- André Kramer, A. C., Pivodic, A., Hakeberg, M., & Östberg, A. L. (2019). Multilevel analysis of dental caries in Swedish children and adolescents in relation to socioeconomic status. *Caries Research*, *53*(1), 96–106. <https://doi.org/10.1159/000489570>
- Animireddy, D., Reddy Bekkem, V., Vallala, P., Kotha, S., Ankireddy, S., & Mohammad, N. (2014). Evaluation of pH, buffering capacity, viscosity and flow rate levels of saliva in caries-free, minimal caries and nursing caries children: An in vivo study. *Contemporary Clinical Dentistry*, *5*(3), 324. <https://doi.org/10.4103/0976-237X.137931>
- Araujo, D. S., Marquezin, M. C. S., Barbosa, T. S., Fonseca, F. L. A., Fegadolli, C., & Castelo, P. M. (2016). Assessment of quality of life, anxiety, socio-economic factors and caries experience in Brazilian children with overweight and obesity. *International Journal of Dental Hygiene*, *15*(4), e156–e162. <https://doi.org/10.1111/idh.12248>
- Arora, A., Manohar, N., & John, J. R. (2017). Factors associated with dental caries in primary dentition in a non-fluoridated rural community of New South Wales, Australia. *International Journal of Environmental Research and Public Health*, *14*(12), 1444. <https://doi.org/10.3390/ijerph14121444>
- Ash, M. M., & Nelson, S. J. (2015). *Wheeler's Dental Anatomy, Physiology, and Occlusion 10th Edition*. St. Louis: Elsevier Health Sciences.
- Ashkanani, F., & Al-Sane, M. (2013). Knowledge, attitudes and practices of caregivers in relation to oral health of preschool children. *Medical Principles and Practice*, *22*(2), 167–172. <https://doi.org/10.1159/000341764>
- Atwa, A. D. A., AbuShahba, R. Y., Mostafa, M., & Hashem, M. I. (2014). Effect of honey in preventing gingivitis and dental caries in patients undergoing orthodontic treatment. *Saudi Dental Journal*, *26*(3), 108–114. <https://doi.org/10.1016/j.sdentj.2014.03.001>
- Avila, W. M., Pordeus, I. A., Paiva, S. M., & Martins, C. C. (2015). Breast and bottle feeding as risk factors for dental caries: A systematic review and meta-analysis. *PLoS ONE*, *10*(11), e0142922. <https://doi.org/10.1371/journal.pone.0142922>
- Avşar, A., Darka, Ö., Topaloğlu, B., & Bek, Y. (2008). Association of passive smoking with caries and related salivary biomarkers in young children. *Archives of Oral Biology*, *53*(10), 969–974. <https://doi.org/10.1016/j.archoralbio.2008.05.007>
- Avşar, Aysun, Darka, Ö., Bodrumlu, E. H., & Bek, Y. (2009). Evaluation of the relationship between passive smoking and salivary electrolytes, protein, secretory IgA, sialic acid and amylase in young children. *Archives of Oral Biology*, *54*(5), 457–463. <https://doi.org/10.1016/j.archoralbio.2009.01.017>
- Azizi, Z. (2014). The prevalence of dental caries in primary dentition in 4- to 5-year-old preschool children in Northern Palestine. *International Journal of*

- Dentistry*, 2014, 839419. <https://doi.org/10.1155/2014/839419>
- Bakardjiev, P., & Doichinova, L. (2018). Changing oral health knowledge and habits of kindergarten educators within the oral health promotion program for preschool children. *MedInForm*, 5(2), 823–830. <https://doi.org/10.18044/medinform.201742.823>
- Baliga, S., Muglikar, S., & Kale, R. (2013). Salivary pH : A diagnostic biomarker. *Journal of Indian Society of Periodontology*, 17(4), 7–10. <https://doi.org/10.4103/0972-124X.118317>
- Basu, S., McKee, M., Galea, G., & Stuckler, D. (2013). Relationship of soft drink consumption to global overweight, obesity, and diabetes: A cross-national analysis of 75 countries. *American Journal of Public Health*, 103(11), 2071–2077. <https://doi.org/10.2105/AJPH.2012.300974>
- Bennadi, D., Reddy, C. V. K., Sunitha, S., & Kshetrimayum, N. (2014). Oral health status of 3-6 year old children and their mother's oral health related knowledge, attitude and practices in Mysore City, India. *Asian Journal of Medical Sciences*, 6(2), 2–7. <https://doi.org/10.3126/ajms.v6i2.11097>
- Benzian, H., Hobdell, M., Holmgren, C., Yee, R., Monse, B., Barnard, J. T., & Van Palenstein Helderma, W. (2011). Political priority of global oral health: An analysis of reasons for international neglect. *International Dental Journal*, 61(3), 124–130. <https://doi.org/10.1111/j.1875-595X.2011.00028.x>
- Bernabé, E., Macritchie, H., Longbottom, C., Pitts, N. B., & Sabbah, W. (2016). Birth weight, breastfeeding, maternal smoking and caries trajectories. *Journal of Dental Research*, 96(2), 171–178. <https://doi.org/10.1177/0022034516678181>
- Biehl, A., Hovengen, R., Grøholt, E. K., Hjelmesæth, J., Strand, B. H., & Meyer, H. E. (2014). Parental marital status and childhood overweight and obesity in Norway: A nationally representative cross-sectional study. *BMJ Open*, 4(6), 1–8. <https://doi.org/10.1136/bmjopen-2013-004502>
- Blanco, M., Pérez-Ríos, M., Santiago-Pérez, M. I., & Smyth, E. (2016). Oral health and hygiene status in Galician schoolchildren. *Anales de Pediatría (English Edition)*, 85(4), 204–209. <https://doi.org/10.1016/j.anpede.2015.10.013>
- Bowen, W. H., & Lawrence, R. A. (2005). Comparison of the cariogenicity of cola, honey, cow milk, human milk, and sucrose. *Pediatrics*, 116(4), 921–926. <https://doi.org/10.1542/peds.2004-2462>
- Bucak, I. H., Çalıřır, M., Almis, H., Ozturk, A. B., & Turgut, M. (2015). Early childhood caries with the perspective of pediatrician. *Journal of Clinical and Analytical Medicine*, 7(5), 614–617. <https://doi.org/10.4328/JCAM.3810>
- Canadian Council on Social Development. (2006). *The Progress of Canada's Children and Youth*. Ottawa: Canadian Council on Social Development.
- Carolina Population Center, National Institute for Nutrition and Health (NINH), & Chinese Center for Disease Control and Prevention (CCDC). (2013). *Chinese Nutrition and Health Surveillance (2010-2012)*. Beijing, China.

- Caufield, P. W., Li, Y., & Bromage, T. G. (2012). Hypoplasia-associated severe early childhood caries—a proposed definition. *Journal of Dental Research*, 91(6), 544–550. <https://doi.org/10.1177/0022034512444929>
- Centers for Disease Control and Prevention (CDC), & National Center for Health Statistics (NCHS). (2012). *National Health and Nutrition Examination Survey Data. 2011-2012*. Hyattsville, MD: U.S. Department of Health and Human Services, CDC.
- Centers for Disease Control and Prevention (US). (2006). *The health consequences of involuntary exposure to tobacco smoke: A report of the surgeon general. Publications and Reports of the Surgeon General*. <https://doi.org/10.1016/j.amepre.2007.02.026>
- Chaffee, B. W., Feldens, C. A., & Vítolo, M. R. (2014). Association of long-duration breastfeeding and dental caries estimated with marginal structural models. *Annals of Epidemiology*, 24(6), 448–454. <https://doi.org/10.1016/j.annepidem.2014.01.013>
- Chee, S. S., Zawiah, H., Ismail, M. N., & Ng, K. K. (1996). Anthropometry, dietary patterns and nutrient intakes of Malaysian estate workers. *Malaysian Journal of Nutrition*, 2, 112–126.
- Chen, C., He, W., & Wang, Y. (2012). *Nutritional status of children aged 0-5 Years old in China (2010) - national (38 nutrition surveillance sites from 25 provinces)*. Beijing, China.
- Chen, K. J., Gao, S. S., Duangthip, D., Kar, S., Li, Y., Chin, E., & Lo, M. (2017). Dental caries status and its associated factors among 5-year-old Hong Kong children: A cross-sectional study. *BMC Oral Health*, 17, 121. <https://doi.org/10.1186/s12903-017-0413-2>
- Cheng, Y. C., Huang, H. K., Wu, C. H., Chen, C. C., & Yeh, J. I. (2014). Correlation between dental caries and diet, oral hygiene habits, and other indicators among elementary school students in Xiulin Township, Hualien County, Taiwan. *Tzu Chi Medical Journal*, 26(4), 175–181. <https://doi.org/10.1016/j.tcmj.2014.08.003>
- Chi, D. L., Luu, M., & Chu, F. (2017). A scoping review of epidemiologic risk factors for pediatric obesity: Implications for future childhood obesity and dental caries prevention research. *Journal of Public Health Dentistry*, 77, S8–S31. <https://doi.org/10.1111/jphd.12221>
- Chiappin, S., Antonelli, G., Gatti, R., & De Palo, E. F. (2007). Saliva specimen: A new laboratory tool for diagnostic and basic investigation. *Clinica Chimica Acta*, 383(1–2), 30–40. <https://doi.org/10.1016/j.cca.2007.04.011>
- Chopra, A., Rao, N. C., Gupta, N., Vashisth, S., & Lakhanpal, M. (2015). The predisposing factors between dental caries and deviations from normal weight. *North American Journal of Medical Sciences*, 7(4), 151–159. <https://doi.org/10.4103/1947-2714.156011>
- Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*, 320, 1240–1243. <https://doi.org/10.1136/bmj.320.7244.1240>

- Cooke, L. J., & Wardle, J. (2005). Age and gender differences in children's food preferences. *British Journal of Nutrition*, 93(5), 741–746.
- Curson, M. E. J., & Duggal, M. S. (2003). Structure of teeth. In *Encyclopedia of food sciences and nutrition: Volumes 1-10*. Amsterdam: Elsevier Science BV.
- Darby, M. L., & Walsh, M. (2014). *Dental hygiene: Theory and practice*. Philadelphia: Saunders.
- DePaola, P. F., Soparker, P. M., Tavares, M., Allukian, M., & Peterson, H. (1982). A dental survey of Massachusetts schoolchildren. *Journal of Dental Research*, 61(Special Issue), 1346–1251.
- Department of Health. (2011). *Oral Health Survey 2011*. Hong Kong: Department of Health.
- Department of National Unity and Integration. (2018). Tabika Perpaduan (RT). Retrieved from <https://www.perpaduan.gov.my/ms/komuniti/tabika-perpaduan-rt>
- Department of Science and Technology-Food and Nutrition Research Institute (DOST-FNRI). (2016). *Philippine nutrition facts and figures 2015: Updating of nutritional status of Filipino children and other population groups overview*. Manila: DOST-FNRI.
- Department of Statistics Malaysia. (2016). Statistics of Negeri Sembilan. Retrieved October 19, 2017, from https://www.dosm.gov.my/v1/index.php?r=column/cone&menu_id=dE1BS2RzYnZFcIA3SVhTTS84WDI2UT09
- Dimaisip-Nabuab, J., Duijster, D., Benzian, H., Heinrich-Weltzien, R., Homsavath, A., Monse, B., ... Kromeyer-Hauschild, K. (2018). Nutritional status, dental caries and tooth eruption in children: A longitudinal study in Cambodia, Indonesia and Lao PDR. *BMC Pediatrics*, 18, 300. <https://doi.org/10.1186/s12887-018-1277-6>
- Do, L. G., Ha, D. H., & Spencer, A. J. (2015). Factors attributable for the prevalence of dental caries in Queensland children. *Community Dentistry and Oral Epidemiology*, 43(5), 397–405. <https://doi.org/10.1111/cdoe.12162>
- Docimo, R., Costacurta, M., De Lorenzo, A., DiRenzo, L., Sicuro, L., & Gratteri, S. (2014). Dental caries and childhood obesity: analysis of food intakes, lifestyle. *European Journal of Paediatric Dentistry*, 15(4), 343–348.
- dos Santos Junior, V. E., de Sousa, R. M. B., Oliveira, M. C., de Caldas Junior, A. F., & Rosenblatt, A. (2014). Early childhood caries and its relationship with perinatal, socioeconomic and nutritional risks: a cross-sectional study. *BMC Oral Health*, 14(1), 47. <https://doi.org/10.1186/1472-6831-14-47>
- Drummond, A. M. A., Ferreira, E. F., Gomes, V. E., & Marcenes, W. (2015). Inequality of experience of dental caries between different ethnic groups of Brazilians aged 15 to 19 years. *PLoS ONE*, 10(12), 1–9. <https://doi.org/10.1371/journal.pone.0145553>
- Drury, T. F., Horowitz, A. M., Ismail, A. I., Maertens, M. P., Rozier, R. G., &

- Selwitz, R. H. (1999). Diagnosing and reporting early childhood caries for research purposes. *Journal of Public Health Dentistry*, 59(3), 192–197.
- Duangthip, D., Gao, S. S., Lo, E. C. M., & Chu, C. H. (2017). Early childhood caries among 5- to 6-year-old children in Southeast Asia. *International Dental Journal*, 67(2), 98–106. <https://doi.org/10.1111/idj.12261>
- Dye, B. A., Thornton-Evans, G., Li, X., & Iafolla, T. J. (2015). Dental caries and sealant prevalence in children and adolescents in the United States, 2011 – 2012. *NCHS Data Brief, No. 191*, 1–8.
- Economic Planning Unit Malaysia. (2017). *Median monthly household gross income by ethnic group, strata and state, Malaysia, 1970-2016*. Putrajaya: Economic Planning Unit Malaysia. Retrieved from www.epu.gov.my
- El-Kwatehy, W. M., & Youssef, A. R. (2016). Salivary biomarkers in caries affected and caries free children. *International Journal of Dentistry and Oral Science*, 3(10), 348–352. <https://doi.org/10.19070/2377-8075-1600071>
- El-Nadeef, M. A. I., Hassab, H., & Al-Hosani, E. (2010). National survey of the oral health of 5-year-old children in the United Arab Emirates. *Eastern Mediterranean Health Journal*, 16(1), 51–55.
- Elidrissi, S. M., & Naidoo, S. (2016). Prevalence of dental caries and toothbrushing habits among preschool children in Khartoum State, Sudan. *International Dental Journal*, 66(4), 215–220. <https://doi.org/10.1111/idj.12223>
- Elison, S., Norgate, S., Dugdill, L., Pine, C., Elison, S., Norgate, S., ... Pine, C. (2014). Maternally perceived barriers to and facilitators of establishing and maintaining tooth-brushing routines with infants and preschoolers. *International Journal of Environmental Research and Public Health*, 11(7), 6808–6826. <https://doi.org/10.3390/ijerph110706808>
- Erikson, P. R., & Mazhari, E. (1999). Investigation of the role of human breast milk in caries development. *Pediatric Dentistry*, 21, 86–90.
- Etter, J. F., & Bullen, C. (2011). Electronic cigarette: Users profile, utilization, satisfaction and perceived efficacy. *Addiction*, 106(11), 2017–2028. <https://doi.org/10.1111/j.1360-0443.2011.03505.x>
- Evans, E. W., Hayes, C., Palmer, C. A., Bermudez, O. I., Cohen, S. A., & Must, A. (2013). Dietary intake and severe early childhood caries in low-income, young children. *Journal of the Academy of Nutrition and Dietetics*, 113(8), 1057–1061. <https://doi.org/10.1016/j.jand.2013.03.014>
- Fan, C., Wang, W., Xu, T., & Zheng, S. (2016). Risk factors of early childhood caries among children in Beijing: A case-control study. *BMC Oral Health*, 16(1), 1–7. <https://doi.org/10.1186/s12903-016-0289-6>
- FAO/WHO/UNU. (2004). *Human energy requirements Report of a Joint FAO/WHO/UNU Expert Consultation. Food And Nutrition Technical Report Series*. Rome: FAO. <https://doi.org/10.1007/s13398-014-0173-7.2>
- Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, 41(4), 1149–1160.

<https://doi.org/10.3758/BRM.41.4.1149>

- FDI. (1982). Global goals for oral health in the year 2000. *International Dental Journal*, 32(1), 74–77.
- Featherstone, J. D. B. (2000). The science and practice of caries prevention. *The Journal of the American Dental Association*, 131(7), 887–899. <https://doi.org/10.14219/jada.archive.2000.0307>
- Featherstone, J. D., Nelson, D. G., & McLean, J. D. (1981). An electron microscope study of modifications to defect regions in dental enamel and synthetic apatites. *Caries Research*, 15(4), 278–288.
- Fejerskov, O., & Kidd, E. (2008). *Dental caries: the disease and its clinical management* (2nd ed.). Oxford: Blackwell Munksgaard.
- Feldens, C A, Giugliani, E. R. J., Vigo, Á., & Vítolo, M. R. (2010). Early feeding practices and severe early childhood caries in four-year-old children from Southern Brazil: A birth cohort study. *Caries Research*, 44, 445–452. <https://doi.org/10.1159/000319898>
- Feldens, Carlos Alberto, Rodrigues, P. H., de Anastácio, G., Vítolo, M. R., & Chaffee, B. W. (2018). Feeding frequency in infancy and dental caries in childhood: a prospective cohort study. *International Dental Journal*, 68(2), 113–121. <https://doi.org/10.1111/idj.12333>
- Field, A. (2017). *Discovering Statistics Using IBM SPSS Statistics*. SAGE Publications Ltd.
- Flouris, A. D., Chorti, M. S., Poulianiti, K. P., Jamurtas, A. Z., Kostikas, K., Tzatzarakis, M. N., ... Koutedakis, Y. (2013). Acute impact of active and passive electronic cigarette smoking on serum cotinine and lung function. *Inhalation Toxicology*, 25(2), 91–101. <https://doi.org/10.3109/08958378.2012.758197>
- Folayan, M. O., Kolawole, K. A., Chukwumah, N. M., Oyedele, T., Agbaje, H. O., Onyejaka, N., ... Oshomiji, O. V. (2016). Use of caries prevention tools and associated caries risk in a suburban population of children in Nigeria. *European Archives of Paediatric Dentistry*, 17(3), 187–193. <https://doi.org/10.1007/s40368-016-0227-y>
- Folayan, M O, Kolawole, K. A., Oziegbe, E. O., Oyedele, T., Oshomiji, O. V, Chukwumah, N. M., & Onyejaka, N. (2015). Prevalence, and early childhood caries risk indicators in preschool children in suburban Nigeria. *BMC Oral Health*, 15(1), 72. <https://doi.org/10.1186/s12903-015-0058-y>
- Folayan, Morenike Oluwatoyin, Owotade, F., Oziegbe, E. O., & Fadeyibi, R. (2010). Effect of birth rank on the caries experience of children from a suburban population in Nigeria. *Journal of Dentistry and Oral Hygiene*, 2(3), 27–30.
- Foo, L. L., Quek, S. J. S., Ng, S. A., Lim, M. T., & Deurenberg-Yap, M. (2005). Breastfeeding prevalence and practices among Singaporean Chinese, Malay and Indian mothers. *Health Promotion International*, 20(3), 229–237. <https://doi.org/10.1093/heapro/dai002>
- Food and Nutrition Service USDA. (2013). About WIC.

- Friedman, M. (2017). Dental Health and your child's teeth. Retrieved August 30, 2017, from <https://www.webmd.com/oral-health/guide/dental-health-your-childs-teeth#1>
- Gao, X. L., Hsu, C. Y., Xu, Y., Hwang, H. B., Loh, T., & Koh, D. (2010). Building caries risk assessment models for children. *Journal of Dental Research*, *89*(6), 637–643.
- Geddes, D. A. (1975). Acids produced by human dental plaque metabolism in situ. *Caries Research*, *9*(2), 98–109.
- Geiss, O., Bianchi, I., Barahona, F., & Barrero-Moreno, J. (2015). Characterisation of mainstream and passive vapours emitted by selected electronic cigarettes. *International Journal of Hygiene and Environmental Health*, *218*(1), 169–180. <https://doi.org/10.1016/j.ijheh.2014.10.001>
- George, D., & Mallery, P. (2010). *SPSS for Windows Step by Step: A Simple Guide and Reference, 17.0 update*. Pearson (10th ed.). Boston: Allyn & Bacon.
- Ghazal, T., Levy, S. M., Childers, N. K., Broffitt, B., Cutter, G. R., Wiener, H. W., ... Cavanaugh, J. E. (2015). Factors associated with early childhood caries incidence among high caries-risk children. *Community Dentistry and Oral Epidemiology*, *43*(4), 366–374. <https://doi.org/10.1111/cdoe.12161>
- Gilchrist, F., Marshman, Z., Deery, C., & Rodd, H. D. (2015). The impact of dental caries on children and young people: What they have to say? *International Journal of Paediatric Dentistry*, *25*(5), 327–338. <https://doi.org/10.1111/ipd.12186>
- Gishti, O., Gaillard, R., Felix, J. F., Bouthoorn, S., Steegers, E., Raat, H., ... Jaddoe, V. W. V. (2015). Early origins of ethnic disparities in cardiovascular risk factors. *Preventive Medicine*, *76*, 84–91. <https://doi.org/10.1016/j.ypmed.2015.03.027>
- Goettems, M. L., Ardenghi, T. M., Demarco, F. F., Romano, A. R., & Torriani, D. D. (2012). Children's use of dental services: influence of maternal dental anxiety, attendance pattern, and perception of children's quality of life. *Community Dentistry and Oral Epidemiology*, *40*(5), 451–458. <https://doi.org/10.1111/j.1600-0528.2012.00694.x>
- Goldberg, M. (2017). Deciduous tooth and dental caries. *Annals Pediatrics & Child Health*, *5*(1), 1120–1125.
- González-Valero, L., Montiel-Company, J. M., Bellot-Arcís, C., Almerich-torres, T., Iranzo-corte, E., & Almerich-silla, M. (2018). Association between passive tobacco exposure and caries in children and adolescents. A systematic review and meta-analysis. *PLoS ONE*, *13*(8), e0202497.
- Goodwin, M., Patel, D. K., Vyas, A., Khan, A. J., Mcgrady, M. G., Boothman, N., & Pretty, I. A. (2017). Sugar before bed: A simple dietary risk factor for caries experience. *Community Dental Health*, *34*, 8–13. https://doi.org/10.1922/CDH_3926Goodwin06
- Greene, J. C., & Vermillion, J. R. (1964). The simplified oral hygiene index. *Journal of the American Dental Association*, *64*, 7–13.

<https://doi.org/10.14219/jada.archive.1964.0034>

- Greer, F. R., Tsang, R. C., Levin, R. S., Searcy, J. E., Wu, R., & Steichen, J. J. (1982). Increasing serum calcium and magnesium concentrations in breast-fed infants: Longitudinal studies of minerals in human milk and in sera of nursing mothers and their infants. *The Journal of Pediatrics*, *100*(1), 59–64. [https://doi.org/10.1016/S0022-3476\(82\)80235-7](https://doi.org/10.1016/S0022-3476(82)80235-7)
- Gupta, P., Gupta, N., Pawar, A. P., Birajdar, S. S., Natt, A. S., & Singh, H. P. (2013). Role of sugar and sugar substitutes in dental caries: A review. *ISRN Dentistry*, *2013*, 1–5. <https://doi.org/10.1155/2013/519421>
- Gussy, M. G., Waters, E. G., Walsh, O., & Kilpatrick, N. M. (2006). Early childhood caries: Current evidence for aetiology and prevention. *Journal of Paediatrics and Child Health*, *42*, 37–43. <https://doi.org/10.1111/j.1440-1754.2006.00777.x>
- Hagen, E. H., Garfield, M. J., & Sullivan, R. J. (2016). The low prevalence of female smoking in the developing world: Gender inequality or maternal adaptations for fetal protection? *Evolution, Medicine and Public Health*, *2016*(1), 195–211. <https://doi.org/10.1093/EMPH/EOW013>
- Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2017). *Prevalence of obesity among adults and youth: United States, 2015–2016*. NCHS Data Brief, No. 288. Hyattsville, MD: National Center for Health Statistics.
- Haliza, T., Normastura, A. R., Azizah, Y., & Mohd Khairi, M. D. (2016). Oral health knowledge, practice and dental plaque maturity status of hearing-impaired children. *Sains Malaysiana*, *45*(5), 761–768.
- Hallett, K. B., & O'Rourke, P. K. (2006). Pattern and severity of early childhood caries. *Community Dentistry and Oral Epidemiology*, *34*(1), 25–35. <https://doi.org/10.1111/j.1600-0528.2006.00246.x>
- Han, D. H., Kim, D. H., Kim, M. J., Kim, J. B., Jung-Choi, K., & Bae, K. H. (2014). Regular dental checkup and snack-soda drink consumption of preschool children are associated with early childhood caries in Korean caregiver/preschool children dyads. *Community Dentistry and Oral Epidemiology*, *42*(1), 70–78. <https://doi.org/10.1111/cdoe.12065>
- Hanioka, T., Ojima, M., Tanaka, K., & Yamamoto, M. (2011). Does secondhand smoke affect the development of dental caries in children? A systematic review. *International Journal of Environmental Research and Public Health*, *8*, 1503–1519. <https://doi.org/10.3390/ijerph8051503>
- Hashim, R., Williams, S., & Thomson, W. (2013). Oral hygiene and dental caries in 5- to 6-year-old children in Ajman, United Arab Emirates. *International Journal of Dental Hygiene*, *11*(3), 208–215. <https://doi.org/10.1111/idh.12011>
- Hayden, C., Bowler, J. O., Chambers, S., Freeman, R., Humphris, G., Richards, D., & Cecil, J. E. (2013). Obesity and dental caries in children: a systematic review and meta-analysis. *Community Dentistry and Oral Epidemiology*, *41*(4), 289–308. <https://doi.org/10.1111/cdoe.12014>
- Hisano, K., Tanaka, K., Nagata, C., Arakawa, M., & Miyake, Y. (2018). High

birthweight is associated with increased prevalence of dental caries in Japanese children. *International Journal of Dental Hygiene*, 16(3), 404–410. <https://doi.org/10.1111/idh.12337>

Hobdell, M., Petersen, P. E., Clarkson, J., & Johnson, N. (2003). Global goals for oral health 2020. *International Dental Journal*. <https://doi.org/10.1111/j.1875-595X.2003.tb00761.x>

Hoffman, D. J. (2004). Upper limits in developing countries: Warning against too much in lands of too little. *Journal of the American College of Nutrition*, 23(6 Suppl), 610S–615S. <https://doi.org/10.1080/07315724.2004.10719431>

Hoffmeister, L., Moya, P., Vidal, C., & Benadof, D. (2016). Factors associated with early childhood caries in Chile. *Gaceta Sanitaria*, 30(1), 59–62. <https://doi.org/10.1016/j.gaceta.2015.09.005>

Holmes, R., Porter, J., Vernazza, C., Tsakos, G., Ryan, R., & Dennes, M. (2015). *Children's dental health survey 2013. Country specific report: England* (Vol. 1.0). Leeds: Health and Social Care Information Centre.

Hong, C. H. L., Bagramian, R. A., Hashim Nainar, S. M., Straffon, L. H., Shen, L., & Hsu, C. S. (2014). High caries prevalence and risk factors among young preschool children in an urban community with water fluoridation. *International Journal of Paediatric Dentistry*, 24(1), 32–42. <https://doi.org/10.1111/ipd.12023>

Hong, L., Levy, S. M., Warren, J. J., & Broffitt, B. (2014). Infant breast-feeding and childhood caries: A nine-year study. *Pediatric Dentistry*, 36(4), 171–176.

Hooley, M., Skouteris, H., Boganin, C., Satur, J., & Kilpatrick, N. (2012). Body mass index and dental caries in children and adolescents: A systematic review of literature published 2004 to 2011. *Systematic Reviews*, 1(1), 57. <https://doi.org/10.1186/2046-4053-1-57>

Hooley, Merrilyn, Skouteris, H., Boganin, C., Satur, J., & Kilpatrick, N. (2012). Parental influence and the development of dental caries in children aged 0 – 6 years: A systematic review of the literature. *Journal of Dentistry*, 40(11), 873–885. <https://doi.org/10.1016/j.jdent.2012.07.013>

Hosmer, D. W., & Lemeshow, S. (1989). *Applied logistic regression*. New York: John Wiley & Sons, Inc.

Hu, D. Y., Hong, X., & Li, X. (2011). Oral health in China - Trends and challenges. *International Journal of Oral Science*, 3(1), 7–12. <https://doi.org/10.4248/IJOS11006>

Huang, R., Li, M., & Gregory, R. L. (2012). Effect of nicotine on growth and metabolism of *Streptococcus mutans*. *European Journal of Oral Sciences*, 120(4), 319–325. <https://doi.org/10.1111/j.1600-0722.2012.00971.x>

Huebner, C. E., & Riedy, C. A. (2010). Behavioral determinants of brushing young children's teeth: implications for anticipatory guidance. *Pediatric Dentistry*, 32(1), 48–55.

Huong, D. M., Hang, L. T. T., Nhu Ngoc, V. T., Anh, L. Q., Son, L. H., Chu, D. T., & Le, D. H. (2017). Prevalence of early childhood caries and its related risk

- factors in preschoolers: Result from a cross sectional study in Vietnam. *Pediatric Dental Journal*, 27(2), 79–84. <https://doi.org/10.1016/j.pdj.2017.03.001>
- Huse, O., Hettiarachchi, J., Gearon, E., Nichols, M., Allender, S., & Peeters, A. (2018). Obesity in Australia. *Obesity Research and Clinical Practice*, 12(1), 29–39. <https://doi.org/10.1016/j.orcp.2017.10.002>
- Institute for Public Health (IPH). (2014). *National health and morbidity survey 2014: Malaysian Adult Nutrition Survey (MANS). Volume II: Survey Findings*. Kuala Lumpur: IPH, National Institutes of Health, Ministry of Health Malaysia. <https://doi.org/10.1017/CBO9781107415324.004>
- Institute for Public Health (IPH). (2015). *National health & morbidity survey (NHMS) 2015. Volume II: Non-communicable diseases, risk factors & other health problems*. Institute for Public Health. Kuala Lumpur: IPH, National Institutes of Health, Ministry of Health Malaysia.
- Institute for Public Health (IPH). (2016a). *National Health and Morbidity Survey (NHMS) 2016: Maternal and Child Health. Volume One: Methodology and General Findings*. Kuala Lumpur: IPH, National Institutes of Health, Ministry of Health Malaysia.
- Institute for Public Health (IPH). (2016b). *National health and morbidity survey (NHMS) 2016: Maternal and child health. Volume two: Maternal and child health findings*. Kuala Lumpur: IPH, National Institutes of Health, Ministry of Health Malaysia.
- International Institute for Population Sciences (IIPS), & ICF. (2017). *National Family Health Survey (NFHS-4), 2015-16*. India, Mumbai: IIPS.
- Iorgulescu, G. (2009). Saliva between normal and pathological. Important factors in determining systemic and oral health. *Journal of Medicine and Life*, 2(3), 303–307.
- Jain, R., Oswal, K., & Chitguppi, R. (2014). Knowledge, attitude and practices of mothers toward their children's oral health: A questionnaire survey among subpopulation in Mumbai (India). *Journal of Dental Research and Scientific Development*, 1(2), 40. <https://doi.org/10.4103/2348-3407.135073>
- Jakhete, N., & Gitterman, B. A. (2012). Environmental smoke exposure associated with increased prevalence of dental caries in low-income children. *International Journal on Disability and Human Development*, 11(4), 315–320. <https://doi.org/10.1515/ijdhhd-2012-0049>
- Jayaraj, D., & Ganesan, S. (2015). Salivary pH and buffering capacity as risk markers for early childhood caries: A clinical study. *International Journal of Clinical Pediatric Dentistry*, 8(3), 167–171.
- Johansson, I., Lif Holgerson, P., Kressin, N. R., Nunn, M. E., & Tanner, A. C. (2010). Snacking habits and caries in young children. *Caries Research*, 44(5), 421–430. <https://doi.org/10.1159/000318569>
- Kassebaum, N. J., Bernabé, E., Dahiya, M., Bhandari, B., Murray, C. J. L., & Marcenes, W. (2015). Global burden of untreated caries. *Journal of Dental Research*, 94(5), 650–658. <https://doi.org/10.1177/0022034515573272>

- Kato, H., Tanaka, K., Shimizu, K., Nagata, C., Furukawa, S., Arakawa, M., & Miyake, Y. (2017). Parental occupations, educational levels, and income and prevalence of dental caries in 3-year-old Japanese children. *Environmental Health and Preventive Medicine*, 22, 1–7. <https://doi.org/10.1186/s12199-017-0688-6>
- Kato, I., Vasquez, A., Moyerbrailean, G., Land, S., Djuric, Z., Sun, J., ... Ram, J. L. (2017). Nutritional Correlates of Human Oral Microbiome. *Journal of the American College of Nutrition*. <https://doi.org/10.1080/07315724.2016.1185386>
- Kato, N., Takimoto, H., Yokoyama, T., Yokoya, S., Tanaka, T., & Tada, H. (2014). Updated Japanese growth references for infants and preschool children, based on historical, ethnic and environmental characteristics. *Acta Paediatrica*, 103(6), e251–e261. <https://doi.org/10.1111/apa.12587>
- Kaur, S., Maykanathan, D., & Ng, K. L. (2015). Factors associated with dental caries among selected urban school children in Kuala Lumpur, Malaysia. *Archives of Orofacial Sciences*, 10(1), 24–33.
- Kaur, S., Tung, S., Maykanathan, D., & Lim, Y. Y. (2017). The association of the hydration status and parental knowledge on fluid consumption with children's weight status in Malaysia. *Sri Lanka Journal of Child Health*, 46(3), 222–229. <https://doi.org/10.4038/sljch.v46i3.8322>
- Kawashita, Y., Kitamura, M., & Saito, T. (2011). Early childhood caries. *International Journal of Dentistry*. <https://doi.org/10.1155/2011/725320>
- Khairiyah, A. M., Wan Mohd Nasir, W. O., Yaw, S. L., & Norliza, I. (2013). Country Report on Dental Caries Epidemiology and Relevant Interventions. In *International Dental Conference on 'Caries Control throughout Life in Asia* (pp. 214–230).
- Khanh, L. N., Ivey, S. L., Sokal-Gutierrez, K., Barkan, H., Ngo, K. M., Hoang, H. T., ... Thai, N. (2015). Early childhood caries, mouth pain, and nutritional threats in Vietnam. *American Journal of Public Health*, 105(12), 2510–2517. <https://doi.org/10.2105/AJPH.2015.302798>
- Khanolkar, A. R., Wedrén, S., Essén, B., Sparén, P., & Koupil, I. (2015). Preterm and postterm birth in immigrant- and Swedish-born parents: a population register-based study. *European Journal of Epidemiology*, 30(5), 435–437. <https://doi.org/10.1007/s10654-014-9986-0>
- Khor, G. L. (2012). Food availability and the rising obesity prevalence in Malaysia. *International E-Journal of Science, Medicine & Education*, 6(supp 1), S61–S68.
- Kowash, M. B., Alkhabuli, J. O., Dafaalla, S. A., Shah, A., & Khamis, A. H. (2017). Early childhood caries and associated risk factors among preschool children in Ras Al-Khaimah, United Arab Emirates. *European Archives of Paediatric Dentistry*, 18(2), 97–103. <https://doi.org/10.1007/s40368-017-0278-8>
- Kum-Nji, P., Meloy, L., & Herrod, H. (2006). Environmental tobacco smoke exposure: Prevalence and mechanisms of causation of infections in children. *Pediatrics*, 117(5), 1745–1754.

<https://doi.org/10.1542/peds.2005-1886>

- Kumarihamy, S. L. M., Subasinghe, L. D., Jayasekara, P., Kularatna, S. M., & Palipana, P. D. (2011). The prevalence of Early Childhood Caries in 1-2 yrs olds in a semi-urban area of Sri Lanka. *BMC Research Notes*, 4, 336. <https://doi.org/10.1186/1756-0500-4-336>
- Lagerlöf, F., & Oliveby, A. (1994). Caries-protective factors in saliva. *Advances in Dental Research*, 8(2), 229–238.
- Lebouder, E., Rey-nores, J. E., Raby, A., Affolter, M., Vidal, K., Thornton, C. A., & Labeta, M. O. (2006). Modulation of neonatal microbial recognition : TLR-mediated modulated by human milk. *The Journal of Immunology*, 176(6), 3742–3752. <https://doi.org/10.4049/jimmunol.176.6.3742>
- Lee, H. J., Guo, H. Y., Lee, S. K., Jeon, B. H., Jun, C. D., Lee, S. K., ... Kim, E. C. (2005). Effects of nicotine on proliferation, cell cycle, and differentiation in immortalized and malignant oral keratinocytes. *Journal of Oral Pathology and Medicine*, 34, 436–443. <https://doi.org/10.1111/j.1600-0714.2005.00342.x>
- LeGeros, R. Z. (1991). Calcium phosphates in oral biology and medicine. In H. M. Myers (Ed.), *Monographs in oral science* (pp. 1–201). Switzerland: Karger.
- Lemeshow, S., Hosmer Jr, D. W., Klar, J., & Lwanga, S. K. (1990). *Adequacy of sample size in health studies*. Hoboken, NJ: Wiley.
- Leroy, R., Bogaerts, K., Martens, L., & Declerck, D. (2012). Risk factors for caries incidence in a cohort of Flemish preschool children. *Clinical Oral Investigations*, 16(3), 805–812. <https://doi.org/10.1007/s00784-011-0579-y>
- Li, L., Wong, H. M., Peng, S., & Mcgrath, C. P. (2015). Anthropometric measurements and dental caries in children: A systematic review of longitudinal studies. *Advances in Nutrition*, (13), 52–63. <https://doi.org/10.3945/an.114.006395.52>
- Li, Y., Zhang, Y., Yang, R., Zhang, Q., Zou, J., & Kang, D. (2011). Associations of social and behavioural factors with early childhood caries in Xiamen city in China. *International Journal of Paediatric Dentistry*, 21, 103–111. <https://doi.org/10.1111/j.1365-263X.2010.01093.x>
- Liang, J., Zhang, Z., Chen, Y., Mai, J., Ma, J., Yang, W., & Jing, J. (2016). Dental caries is negatively correlated with body mass index among 7-9 years old children in Guangzhou, China. *BMC Public Health*, 16(1), 638. <https://doi.org/10.1186/s12889-016-3295-3>
- Listl, S., Galloway, J., Mossey, P. A., & Marcenes, W. (2015). Global economic impact of dental diseases. *Journal of Dental Research*, 94(10), 1355–1361. <https://doi.org/10.1177/0022034515602879>
- Liu, S., Wu, T., Zhou, X., & Zhang, B. (2018). Nicotine is a risk factor for dental caries: An in vivo study. *Journal of Dental Sciences*, 13(1), 30–36. <https://doi.org/10.1016/j.jds.2017.09.006>
- Liu, Y., Ahmed, S., & Long, C. (2013). Ethnobotanical survey of cooling herbal drinks from southern China. *Journal of Ethnobiology and Ethnomedicine*, 9,

82. <https://doi.org/10.1186/1746-4269-9-82>

- Lukacs, J. R. (2011). Gender differences in oral health in South Asia: Metadata imply multifactorial biological and cultural causes. *American Journal of Human Biology*, 23(3), 398–411. <https://doi.org/10.1002/ajhb.21164>
- Lwanga, S. K., & Lemeshow, S. (1991). *Sample size determination in health studies: A practical manua*. World Health Organization. Geneva, Switzerland: World Health Organization.
- Mahejabeen, R., Sudha, P., Kulkarni, S., & Anegundi, R. (2006). Dental caries prevalence among preschool children of Hubli: Dharwad city. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 24(1), 19. <https://doi.org/10.4103/0970-4388.22829>
- Majorana, A., Cagetti, M. G., Bardellini, E., Amadori, F., Conti, G., Strohmenger, L., & Campus, G. (2014). Feeding and smoking habits as cumulative risk factors for early childhood caries in toddlers, after adjustment for several behavioral determinants: A retrospective study. *BMC Pediatrics*, 14(1), 45. <https://doi.org/10.1186/1471-2431-14-45>
- Makawi, Y., El-masry, E., & El-din, H. M. (2017). Salivary carbonic anhydrase, pH and phosphate buffer concentrations as potential biomarkers of caries risk in children. *Journal of Unexplored Medical Data*, 2, 9–15. <https://doi.org/10.20517/2572-8180.201>
- Manavi, K. R., Alston-mills, B. P., Thompson, M. P., & Allen, J. C. (2015). Effect of serum cotinine on vitamin D serum concentrations among American females with different ethnic backgrounds. *Anticancer Research*, 35(2), 1211–1218. <https://doi.org/10.1177/00220345740530021201>
- Mandel, I. D. (1974). Relation of saliva and plaque to caries. *Journal of Dental Research*, 53(2), 246–266.
- Mani, S. A., John, J., Ping, W. Y., & Noorliza Mastura, I. (2012). Early childhood caries: Parent's knowledge, attitude and practice towards its prevention in Malaysia. *Oral Health Care - Pediatric, Research, Epidemiology and Clinical Practices, Prof Mandeep Viridi (Ed.)*, 3–19.
- Marcenes, W., Muirhead, V. E., Murray, S., Redshaw, P., Bennett, U., & Wright, D. (2013). Ethnic disparities in the oral health of three- to four-year-old children in East London. *British Dental Journal*, 215(2), 1–5. <https://doi.org/10.1038/sj.bdj.2013.687>
- Marsh, P. D., & Martin, M. V. (2009). *Oral microbiology* (5th ed.). London: Chapman and Hall. <https://doi.org/10.1007/978-1-4615-7556-6>
- Martins-Júnior, P. A., Vieira-Andrade, R. G., Corrêa-Faria, P., Oliveira-Ferreira, F., Marques, L. S., & Ramos-Jorge, M. L. (2013). Impact of early childhood caries on the oral health-related quality of life of preschool children and their parents. *Caries Research*, 47(3), 211–218. <https://doi.org/10.1159/000345534>
- Masood, M., Yusof, N., Hassan, M. I. A., & Jaafar, N. (2012). Assessment of dental caries predictors in 6-year-old school children - results from 5-year retrospective cohort study. *BMC Public Health*, 12(1), 989.

<https://doi.org/10.1186/1471-2458-12-989>

- Masumo, R., Bårdsen, A., & Åstrøm, A. N. (2013). Developmental defects of enamel in primary teeth and association with early life course events: a study of 6 – 36 month old children in Manyara, Tanzania. *BMC Oral Health*, 13(1), 21.
- Masumo, R., Bardsen, A., Mashoto, K., & Astrom, A. N. (2012). Prevalence and socio-behavioral influence of early childhood caries, ECC, and feeding habits among 6-36 months old children in Uganda and Tanzania. *BMC Oral Health*, 12, 24. <https://doi.org/10.1186/1472-6831-12-24>
- Matsuo, G., Rozier, R. G., & Kranz, A. M. (2015). Dental caries: Racial and ethnic disparities among North Carolina kindergarten students. *American Journal of Public Health*, 105(12), 2503–2509. <https://doi.org/10.2105/AJPH.2015.302884>
- Mattheus, D., Gandhi, K., Lim, E., & Shannon, M. (2017). Exposure to secondhand smoke and the development of childhood caries: NHANES (2011-2012). *Journal of Health Disparities Research and Practice*, 10(2), 75–88.
- Mbulo, L., Palipudi, K. M., Andes, L., Morton, J., Bashir, R., Fouad, H., ... Tursan d'Espaignet, E. (2016). Secondhand smoke exposure at home among one billion children in 21 countries: findings from the Global Adult Tobacco Survey (GATS). *Tobacco Control*, 25(e2), e95 LP-e100. <https://doi.org/10.1136/tobaccocontrol-2015-052693>
- McCarthy, H. D., Cole, T. J., Fry, T., Jebb, S. A., & Prentice, A. M. (2006). Body fat reference curves for children. *International Journal of Obesity*, 30(4), 598–602. <https://doi.org/10.1038/sj.ijo.0803232>
- McGrath, C., Yeung, C. Y. Y. J., & Bedi, R. (2002). Are single mothers in Britain failing to monitor their oral health? *Postgraduate Medical Journal*, 78(918), 229–232. <https://doi.org/10.1136/pmj.78.918.229>
- Mehta, N. K., Lee, H., & Ylitalo, K. R. (2013). Child health in the United States: Recent trends in racial/ethnic disparities. *Social Science and Medicine*, 95, 6–15. <https://doi.org/10.1016/j.socscimed.2012.09.011>
- Memarpour, M., Golkari, A., & Ahmadian, R. (2014). Association of characteristics of delivery and medical conditions during the first month of life with developmental defects of enamel. *BMC Oral Health*, 14, 122. <https://doi.org/10.1186/1472-6831-14-122>
- Menaker, L. (1980). *The biologic basis of dental caries*. New York: Harper & Row.
- Merkiel-Pawłowska, S., & Chalcarz, W. (2017). Gender differences and typical nutrition concerns of the diets of preschool children-the results of the first stage of an intervention study. *BMC Pediatrics*, 17(1), 207. <https://doi.org/10.1186/s12887-017-0962-1>
- Ministry of Health and Population [Egypt], El-Zanaty and Associates [Egypt], & ICF International. (2015). *Egypt demographic and health survey 2014*. Cairo, Egypt and Rockville, Maryland, USA: Ministry of Health and Population and ICF International.

- Ministry of Health Brunei Darussalam. (2013). *2nd National Health and Nutritional Survey (NHANSS) Phase 1: 0-5 Years Old, 2009–2011*. Brunei Darussalam: Ministry of Health Brunei Darussalam.
- Ministry of Health Indonesia. (2014). *National report on basic health research-RISKESDAS*. Jakarta: Badan Litbangkes.
- Ministry of Human Resources. (2013). *Malaysia Standard Classification of Occupation*. Putrajaya: Ministry of Human Resources.
- Mohebbi, S. Z., Virtanen, J. I., Vahid-Golpayegani, M., & Vehkalahti, M. M. (2006). Early childhood caries and dental plaque among 1-3-year-olds in Tehran, Iran. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 24, 177–181.
- Muller-Bolla, M., & Courson, F. (2013). Toothbrushing methods to use in children: a systematic review. *Oral Health & Preventive Dentistry*, 11(4), 341–347. <https://doi.org/10.3290/j.ohpd.a30602>
- Naidu, R. S., & Davis, L. (2008). Parents' views on factors influencing the dental health of Trinidadian pre-school children. *Community Dental Health*, 25(1), 44–49. https://doi.org/10.1922/CDH_2112Naidu06
- Nair, V., Pal, N., Jain, A., & Das, S. (2018). Achieving oral health the natural way: Part Iv-honey. *Researchgate.Net*, 3(1), 8–15. Retrieved from https://www.researchgate.net/profile/Vineet_Nair2/publication/323627989_ACHIEVING_ORAL_HEALTH_THE_NATURAL_WAY_PART_IV_HONEY/links/5aa0d9ce45851543e638ee94/ACHIEVING-ORAL-HEALTH-THE-NATURAL-WAY-PART-IV-HONEY.pdf
- Nakayama, Y., & Mori, M. (2015a). Association between nocturnal breastfeeding and snacking habits and the risk of early childhood caries in 18- to 23-month-old Japanese children. *Journal of Epidemiology*, 25(2), 142–147. <https://doi.org/10.2188/jea.JE20140097>
- Nakayama, Y., & Mori, M. (2015b). Association of environmental tobacco smoke and snacking habits with the risk of early childhood caries among 3-year-old Japanese children. *Journal of Public Health Dentistry*, 75(2), 157–162. <https://doi.org/10.1111/jphd.12085>
- Narksawat, K., Boonthum, A., & Tonmukayakul, U. (2011). Roles of parents in preventing dental caries in the primary dentition among preschool children in Thailand. *Asia-Pacific Journal of Public Health*, 23(2), 209–216. <https://doi.org/10.1177/1010539509340045>
- Nassar, H. M., Li, M., & Gregory, R. L. (2012). Effect of honey on *Streptococcus mutans* growth and biofilm formation. *Applied and Environmental Microbiology*, 78(2), 536–540. <https://doi.org/10.1128/AEM.05538-11>
- National Bureau of Statistics (NBS) Nigeria, & United Nations Children's Fund. (2018). *Nigeria Multiple Indicator Cluster Survey (MICS5) 2016-17, Fifth round*. Abuja: NBS Nigeria.
- National Coordinating Committee on Food and Nutrition (NCCFN), & Ministry of Health Malaysia. (2013). *Malaysian Dietary Guidelines for Children and Adolescents*. Putrajaya: Ministry of Health.

- National Coordinating Committee on Food and Nutrition (NCCFN). (2017). *Recommended Nutrient's Intake's for Malaysia 2017. A Report of The Technical Working Group on Nutritional Guidelines*. Putrajaya: Ministry of Health.
- National Institute of Population Research and Training (NIPORT), Mitra and Associates, & ICF International. (2016). *Bangladesh Demographic and Health Survey 2014*. Dhaka, Bangladesh.
- National Institute of Statistics, Directorate General for Health, & ICF International. (2015). *Cambodia Demographic and Health Survey 2014*. Phnom Penh, Cambodia, and Rockville, Maryland, USA: National Institute of Statistics, Directorate General for Health, and ICF International.
- Natland, S. T., Andersen, L. F., Nilsen, T. I. L., Forsmo, S., & Jacobsen, G. W. (2012). Maternal recall of breastfeeding duration twenty years after delivery. *BMC Medical Research Methodology*, 12(1), 179. <https://doi.org/10.1186/1471-2288-12-179>
- Nelson, S., Albert, J. M., Geng, C., Curtan, S., Lang, K., Miadich, S., ... Milgrom, P. (2013). Increased enamel hypoplasia and very low birthweight infants. *Journal of Dental Research*, 92(9), 788–794. <https://doi.org/10.1177/0022034513497751>
- Newens, K. J., & Walton, J. (2016). A review of sugar consumption from nationally representative dietary surveys across the world. *Journal of Human Nutrition and Dietetics*, 29(2), 225–240. <https://doi.org/10.1111/jhn.12338>
- Ng, M., Fleming, T., Robinson, M., Thomson, B., & Graetz, N. (2014). Global, regional and national prevalence of overweight and obesity in children and adults 1980-2013: A systematic analysis. *Lancet*, 384. [https://doi.org/10.1016/S0140-6736\(14\)60460-8](https://doi.org/10.1016/S0140-6736(14)60460-8).Global
- Nobile, C. G., Fortunato, L., Bianco, A., Pileggi, C., & Pavia, M. (2014). Pattern and severity of early childhood caries in Southern Italy: a preschool-based cross-sectional study. *BMC Public Health*, 14(1), 1–12. <https://doi.org/10.1186/1471-2458-14-206>
- Norberg, C., Hallström Stalin, U., Matsson, L., Thorngren-Jerneck, K., & Klingberg, G. (2012). Body mass index (BMI) and dental caries in 5-year-old children from southern Sweden. *Community Dentistry and Oral Epidemiology*, 40(4), 315–322. <https://doi.org/10.1111/j.1600-0528.2012.00686.x>
- Normastura, A. R., Norhayani, Z., Azizah, Y., & Mohd Khairi, M. D. (2013). Saliva and dental caries in down syndrome children. *Sains Malaysiana*, 42(1), 59–63.
- Nunes, A. M. M., Alves, C. M. C., Araujo, F. B., Ortiz, T. M. L., Ribeiro, M. R. C., Silva, A. A. M., & Ribeiro, C. C. C. (2012). Association between prolonged breast-feeding and early childhood caries: a hierarchical approach. *Community Dentistry and Oral Epidemiology*, 40, 542–549. <https://doi.org/10.1111/j.1600-0528.2012.00703.x>
- Nur Nadia, M., Loy, S. L., Man, C. N., Abdullah, A.-M., & Hamid Jan, J. M. (2016).

- Higher hair nicotine level in children compared to mother living with smoking father in Malaysia. *Environmental Health and Preventive Medicine*, 21(6), 572–578. <https://doi.org/10.1007/s12199-016-0584-5>
- Nwosu, B. U., & Kum-Nji, P. (2018). Tobacco smoke exposure is an independent predictor of Vitamin D deficiency in US children. *PLoS ONE*, 13(10), e0205342. <https://doi.org/10.1371/journal.pone.0205342>
- Okada, M., Kawamura, M., Oda, Y., Yasuda, R., Kojima, T., & Kurihara, H. (2012). Caries prevalence associated with *Streptococcus mutans* and *Streptococcus sobrinus* in Japanese schoolchildren. *International Journal of Paediatric Dentistry*, 22(5), 342–348. <https://doi.org/10.1111/j.1365-263X.2011.01203.x>
- Olatosi, O. O., & Sote, E. O. (2014). Association of early childhood caries with breastfeeding and bottle feeding in Southwestern Nigerian children of preschool age. *Journal of the West African College of Surgeons*, 4(1), 31–53.
- Oliveira, L. B., Sheiham, A., & Bönecker, M. (2008). Exploring the association of dental caries with social factors and nutritional status in Brazilian preschool children. *European Journal of Oral Sciences*, 116(1), 37–43. <https://doi.org/10.1111/j.1600-0722.2007.00507.x>
- Oral Health Division. (2008). *The National Oral Health Research Initiative Malaysia*. Ministry of Health Malaysia. Putrajaya: Oral Health Division, Ministry of Health Malaysia. <https://doi.org/10.1017/CBO9781107415324.004>
- Oral Health Division, & Ministry of Health Malaysia. (1998). *National Oral Health Survey of School Children 1997 (NOHSS '97)*. Putrajaya: Oral Health Division Ministry of Health Malaysia.
- Oral Health Division Ministry of Health Malaysia. (2007). *National oral health survey of preschool children 2005 (NOHPS 2005): Oral health status and treatment needs*. Kuala Lumpur: Malaysia National Printer.
- Oral Health Division Ministry of Health Malaysia. (2009). *National Oral Health Survey of Schoolchildren 2007 (NOHSS 2007): 6-year-olds*. Putrajaya: Oral Health Division Ministry of Health Malaysia.
- Oral Health Division, & Ministry of Health Malaysia. (2011). *National oral health plan for Malaysia 2011-2020*. Putrajaya: Oral Health Division Ministry of Health Malaysia.
- Oral Health Division Ministry of Health Malaysia. (2016). *Annual Report 2016. Oral Health Programme*. Putrajaya: Oral Health Division Ministry of Health Malaysia.
- Paglia, L., Scaglioni, S., Torchia, V., De Cosmi, V., Moretti, M., Marzo, G., & Giuca, M. R. (2016). Familial and dietary risk factors in early childhood caries. *European Journal of Paediatric Dentistry*, 17(2), 93–99.
- Paisi, M., Kay, E., Kaimi, I., Witton, R., Nelder, R., Potterton, R., & Laphorne, D. (2018). Obesity and caries in four-to-six year old English children: a cross-sectional study. *BMC Public Health*, 18, 267.

<https://doi.org/10.1186/s12889-018-5156-8>

- Palacios, C., Rivas-Tumanyan, S., Morou-Bermúdez, E., Colón, A. M., Torress, R. Y., & Elías-Boneta, A. R. (2016). Association between type, amount and pattern of carbohydrate consumption with dental caries in 12-year-olds in Puerto Rico. *Caries Research*, 50(6), 560–570. <https://doi.org/10.1159/000450655>
- Palmer, C. A., & Boyd, L. D. (2016). *Diet and nutrition in oral health* (3rd ed.). New York: Pearson.
- Pälvärinne, R., Widström, E., Forsberg, B. C., Eaton, K. A., & Birkhed, D. (2018). The healthcare system and the provision of oral healthcare in European Union member states. Part 9: Sweden. *British Dental Journal*, 224(8), 647–651. <https://doi.org/10.1038/sj.bdj.2018.269>
- Parisotto, T. M., Steiner-Oliveira, C., Duque, C., Peres, R. C. R., Rodrigues, L. K. A., & Nobre-dos-Santos, M. (2010). Relationship among microbiological composition and presence of dental plaque, sugar exposure, social factors and different stages of early childhood caries. *Archives of Oral Biology*, 55(5), 365–373. <https://doi.org/10.1016/j.archoralbio.2010.03.005>
- Parisotto, T. M., Stipp, R., Rodrigues, L. K. A., Mattos-Graner, R. O., Costa, L. S., & Nobre-Dos-Santos, M. (2015). Can insoluble polysaccharide concentration in dental plaque, sugar exposure and cariogenic microorganisms predict early childhood caries? A follow-up study. *Archives of Oral Biology*, 60(8), 1091–1097. <https://doi.org/10.1016/j.archoralbio.2015.04.003>
- Pattanaporn, K., Saraithong, P., Khongkhunthian, S., Aleksejuniene, J., Laohapensang, P., Chhun, N., ... Li, Y. (2013). Mode of delivery, mutans streptococci colonization, and early childhood caries in three- to five-year-old Thai children. *Community Dentistry and Oral Epidemiology*, 41(3), 212–223. <https://doi.org/10.1111/cdoe.12013>
- Peltzer, K., & Mongkolchat, A. (2015). Severe early childhood caries and social determinants in three-year-old children from Northern Thailand: a birth cohort study. *BMC Oral Health*, 15(1), 108. <https://doi.org/10.1186/s12903-015-0093-8>
- Percival, T., Edwards, J., Barclay, S., Bidyadhar, S., & Majumder, M. A. A. (2019). Early childhood caries in 3 to 5 year old children in Trinidad and Tobago. *Dentistry Journal*, 7(1), E16. <https://doi.org/10.3390/dj7010016>
- Perera, P. J., Fernando, M. P., Warnakulasooriya, T. D., & Ranathunga, N. (2014). Effect of feeding practices on dental caries among preschool children: A hospital based analytical cross sectional study. *Asia Pacific Journal of Clinical Nutrition*, 23(2), 272–277. <https://doi.org/10.6133/apjcn.2014.23.2.13>
- Peres, K. G., Chaffee, B. W., Feldens, C. A., Flores-Mir, C., Moynihan, P., & Rugg-Gunn, A. (2018). Breastfeeding and oral health: Evidence and methodological challenges. *Journal of Dental Research*, 97(3), 251–258. <https://doi.org/10.1177/0022034517738925>
- Peres, K. G., Nascimento, G. G., Peres, M. A., Mittinty, M. N., Demarco, F. F.,

- Santos, I. S., ... Barros, A. J. D. (2017). Impact of prolonged breastfeeding on dental caries : a population-based birth cohort study. *Pediatrics*, 140(1), e20162943. <https://doi.org/10.1542/peds.2016-2943>
- Petersen, P. E. (2003). *The World Oral Health Report 2003: Continuous improvement of oral health in the 21st century - The approach of the WHO Global Oral Health Programme*. World Health Organization. Geneva: World Health Organization. <https://doi.org/10.1046/j..2003.com122.x>
- Petersen, P. E. (2008). Root canal medicaments. *International Dental Journal*, 58, 5–11. <https://doi.org/10.1922/IDJ>
- Pikramenou, V., Dimitraki, D., Zoumpoulakis, M., Verykouki, E., & Kotsanos, N. (2016). Association between dental caries and body mass in preschool children. *European Archives of Paediatric Dentistry*, 17(3), 171–175. <https://doi.org/10.1007/s40368-016-0222-3>
- Piovesan, C., Mendes, F. M., Ferreira, F. V., Guedes, R. S., & Ardenghi, T. M. (2010). Socioeconomic inequalities in the distribution of dental caries in Brazilian preschool children. *Journal of Public Health Dentistry*, 70, 319–326. <https://doi.org/10.1111/j.1752-7325.2010.00191.x>
- Plutzer, K., & Keirse, M. J. N. C. (2011). Incidence and prevention of early childhood caries in one- and two-parent families. *Child: Care, Health and Development*, 37(1), 5–10. <https://doi.org/10.1111/j.1365-2214.2010.01114.x>
- Prabhu, A., Rao, A. P., Reddy, V., Ahamed, S. S., Muhammad, S., & Thayumanavan, S. (2013). Parental knowledge of pre-school child oral health. *Journal of Community Health*, 38(5), 880–884. <https://doi.org/10.1007/s10900-013-9693-x>
- Prakash, P., Subramaniam, P., Durgesh, B. H., & Konde, S. (2012). Prevalence of early childhood caries and associated risk factors in preschool children of urban Bangalore, India: A cross-sectional study. *European Journal of Dentistry*, 6(2), 141–152.
- Primasari, A., & Octiara, E. (2018). Salivary characteristics in children aged 2 years old and under with severe early childhood caries (SECC). In *International Dental Conference of Sumatera Utara 2017 (IDCSU 2017)* (Vol. 8, pp. 22–25). North Sumatra: Atlantic Press.
- Public Health England. (2018). *National dental epidemiology programme for England: oral health survey of five-year-old children 2017. A report on the inequalities found in prevalence and severity of dental decay*. Public Health England.
- Pullishery, F., Panchmal, G. S., Siddique, S., & Palliyal, S. (2015). Status of water fluoridation- an update from the Asian countries. *Archives of Dentistry*, 1(1), 24–29.
- Puwastien, P., Burlingame, B. Raroengwichit, M., & Sungpuag, P. (2000). *ASEAN food composition tables*. Bangkok, Thailand: Institute of Nutrition, Mahidol University (INMU), ASEAN FOODS Coordinator and INFOODS Regional Database Centre.

- Ramos-Jorge, J., Alencar, B. M., Pordeus, I. A., Soares, M. E. C., Marques, L. S., Ramos-Jorge, M. L., & Paiva, S. M. (2015). Impact of dental caries on quality of life among preschool children: Emphasis on the type of tooth and stages of progression. *European Journal of Oral Sciences*, 123(2), 88–95. <https://doi.org/10.1111/eos.12166>
- Raqib, R., Alam, D. S., Sarker, P., Ahmad, S. M., Ara, G., Yunus, M., ... Fuchs, G. (2007). Low birth weight is associated with altered immune function in rural Bangladeshi children: A birth cohort study. *The American Journal of Clinical Nutrition*, 85(3), 845–852.
- Ribeiro, C. C. C., Silva, M. C. B. da, Nunes, A. M. M., Thomaz, E. B. de A. F., Carmo, C. D. S., Ribeiro, M. R. C., & Silva, A. A. M. da. (2017). Overweight, obese, underweight, and frequency of sugar consumption as risk indicators for early childhood caries in Brazilian preschool children. *International Journal of Paediatric Dentistry*, 27(6), 532–539. <https://doi.org/10.1111/ipd.12292>
- Risnes, K. R., Vatten, L. J., Baker, J. L., Jameson, K., Sovio, U., Kajantie, E., ... Bracken, M. B. (2011). Birthweight and mortality in adulthood: A systematic review and meta-analysis. *International Journal of Epidemiology*, 40(3), 647–661. <https://doi.org/10.1093/ije/dyq267>
- Rugg-Gunn, A. J. (1983). Diet and dental caries. In *The Prevention of Dental Disease* (pp. 3–82). Oxford: Oxford University Press.
- Ruhaya, H., Jaafar, N., Jamaluddin, M., Ismail, A. R., Ismail, N. M., Badariah, T. C., ... Mohamed, S. Z. (2012). Nutritional status and early childhood caries among preschool children in Pasir Mas, Kelantan, Malaysia. *Archives of Orofacial Sciences*, 7(2), 56–62.
- Ruhaya, H., Wan Muhammad Amir, W. A., Mohamad Shafiq, M. I., Nor Azlida, A., Munisamy, H., & Zalila, A. (2017). A scenario of sugar added food and beverage consumption among preschool children in Kelantan, Malaysia. *International Journal of Multidisciplinary Research and Modern Education*, 3(1), 163–170.
- Ruxton, C. H. S. (2013). The suitability of caffeinated drinks for children: A systematic review of randomised controlled trials, observational studies and expert panel guidelines. *Journal of Human Nutrition and Dietetics*, 27(4), 342–357. <https://doi.org/10.1111/jhn.12172>
- Saldūnaitė, K., Bendoraitienė, E. A., Slabšinskienė, E., Vasiliauskienė, I., Andruškevičienė, V., & Zūbienė, J. (2014). The role of parental education and socioeconomic status in dental caries prevention among Lithuanian children. *Medicina*, 50(3), 156–161. <https://doi.org/10.1016/j.medici.2014.07.003>
- Scheid, R. C., & Weiss, G. (2016). *Woelfel's dental anatomy* (9th ed.). Philadelphia: Wolters Kluwer.
- Schofield, W. N. (1985). Predicting basal metabolic rate, new standards and review of previous work. *Human Nutrition. Clinical Nutrition*, 39 C(Suppl 1), 5–41.
- Schroth, R. J., Brothwell, D. J., & Moffatt, M. E. K. (2007). Caregiver knowledge

- and attitudes of preschool oral health and early childhood caries (ECC). *International Journal of Circumpolar Health*, 66(2), 153–167. <https://doi.org/10.3402/ijch.v66i2.18247>
- Schroth, R. J., Halchuk, S., & Star, L. (2013). Prevalence and risk factors of caregiver reported Severe Early Childhood Caries in Manitoba First Nations children: Results from the RHS Phase 2 (2008-2010). *International Journal of Circumpolar Health*, 72(SUPPL.1), 0–10. <https://doi.org/10.3402/ijch.v72i0.21167>
- Schwartz, S. S., Rosivack, R. G., & Michelotti, P. (1993). A child's sleeping habit as a cause of nursing caries. *ASDC Journal of Dentistry for Children*, 60(1), 22–25.
- Senesombath, S., Nakornchai, S., Banditsing, P., & Lexomboon, D. (2010). Early childhood caries and related factors in Vietiane, Lao PDR. *The Southeast Asian Journal of Tropical Medicine and Public Health*, 41(3), 717–725.
- Seow, W. K. (2012). Environmental, maternal, and child factors which contribute to early childhood caries: A unifying conceptual model. *International Journal of Paediatric Dentistry*, 22(3), 157–168. <https://doi.org/10.1111/j.1365-263X.2011.01186.x>
- Shaffer, J. R., Leslie, E. J., Feingold, E., Govil, M., McNeil, D. W., Crout, R. J., ... Marazita, M. L. (2015). Caries Experience Differs between Females and Males across Age Groups in Northern Appalachia. *International Journal of Dentistry*, 2015. <https://doi.org/10.1155/2015/938213>
- Shi, C., Faris, P., McNeil, D. A., Patterson, S., Potestio, M. L., Thawer, S., & McLaren, L. (2018). Ethnic disparities in children's oral health: Findings from a population-based survey of grade 1 and 2 schoolchildren in Alberta, Canada. *BMC Oral Health*, 18(1), 1–11. <https://doi.org/10.1186/s12903-017-0444-8>
- Shivakumar, S., Srivastava, A., & Shivakumar, G. C. (2018). Body mass index and dental caries: A systematic review. *International Journal of Clinical Pediatric Dentistry*, 11(3), 228–232. <https://doi.org/10.5005/jp-journals-10005-1516>
- Slabšinskienė, E., Milčiuvienė, S., Narbutaitė, J., Vasiliauskienė, I., Andruškevičienė, V., Bendoraitienė, E.-A., & Saldūnaitė, K. (2010). Severe early childhood caries and behavioral risk factors among 3-year-old children in Lithuania. *Medicina*, 46(2), 135–141.
- Slade, G. D., Sanders, a E., Bill, C. J., & Do, L. G. (2006). Risk factors for dental caries in the five-year-old South Australian population. *Australian Dental Journal*, 51(2), 130–139. <https://doi.org/10.1111/j.1834-7819.2006.tb00416.x>
- So, M., Ellenikiotis, Y. A., Husby, H. M., Paz, C. L., Seymour, B., & Sokal-Gutierrez, K. (2017). Early childhood dental caries, mouth pain, and malnutrition in the Ecuadorian Amazon region. *International Journal of Environmental Research and Public Health*, 14, 550. <https://doi.org/10.3390/ijerph14050550>
- Stephan, R. M. (1944). Intra-oral hydrogen-ion concentrations associated with

- dental caries activity. *Journal of Dental Research*, 23(4), 257–266. <https://doi.org/10.1177/00220345440230040401>
- Stephen, A., Krishnan, R., & Chalakkal, P. (2017). The association between cariogenic factors and the occurrence of early childhood caries in children from Salem district of India. *Journal of Clinical and Diagnostic Research*, 11(7), ZC63–ZC66. <https://doi.org/10.7860/JCDR/2017/25574.10217>
- Stephensen, C. B. (1999). Burden of infection on growth failure. *The Journal of Nutrition*, 129(2S SUPPL), 534-S-538S. <https://doi.org/0022-3166/99>
- Su, H., Yang, R., Deng, Q., Qian, W., & Yu, J. (2018). Deciduous dental caries status and associated risk factors among preschool children in Xuhui District of Shanghai, China. *BMC Oral Health*, 18(1), 111. <https://doi.org/10.1186/s12903-018-0565-8>
- Sukhabogi, J. R., Parthasarathi, P., Anjum, S., & Chandra, B. R. (2013). Prevalence of dental caries and dental fluorosis among 12 and 15 year-old school children in an endemic fluoride area of Nalgonda district, Andhra Pradesh, India. *Annals of Tropical Medicine and Public Health*, 6(4), 422–429. <https://doi.org/http://dx.doi.org/10.4103/1755-6783.127785>
- Sun, X., Bernabé, E., Liu, X., Gallagher, J. E., & Zheng, S. (2017). Early life factors and dental caries in 5-year-old children in China. *Journal of Dentistry*, 64, 73–79. <https://doi.org/10.1016/j.jdent.2017.06.007>
- Syed Jaymal, Z. (2018). Budget 2019: 40 sen per litre sugar tax on sodas, juice drinks. *Malay Mail*. Retrieved from <https://www.malaymail.com/news/malaysia/2018/11/02/budget-2019-40-sen-tax-on-sodas-and-juice-drinks/1689353>
- Tanaka, K., & Miyake, Y. (2012). Association between breastfeeding and dental caries in Japanese children. *Journal of Epidemiology*, 22(1), 72–77. <https://doi.org/10.2188/jea.JE20110042>
- Tanaka, K., & Miyake, Y. (2014). Low birth weight, preterm birth or small-for-gestational-age are not associated with dental caries in young Japanese children. *BMC Oral Health*, 14, 38.
- Tanaka, K., Miyake, Y., Nagata, C., Furukawa, S., & Arakawa, M. (2015). Association of prenatal exposure to maternal smoking and postnatal exposure to household smoking with dental caries in 3-year-old Japanese children. *Environmental Research*, 143, 148–153. <https://doi.org/10.1016/j.envres.2015.10.004>
- Tanaka, S., Shinzawa, M., Tokumasu, H., Seto, K., Tanaka, S., & Kawakami, K. (2015). Secondhand smoke and incidence of dental caries in deciduous teeth among children in Japan: Population based retrospective cohort study. *BMJ (Online)*, 351, 1–8. <https://doi.org/10.1136/bmj.h5397>
- Tanner, A. C. R., Mathney, J. M. J., Kent, R. L., Chalmers, N. I., Hughes, C. V., Loo, C. Y., ... Dewhirst, F. E. (2011). Cultivable anaerobic microbiota of severe early childhood caries. *Journal of Clinical Microbiology*, 49(4), 1464–1474. <https://doi.org/10.1128/JCM.02427-10>
- Tee, E. S., Mohd Ismail, N., Mohd Nasir, A., & Khatijah, I. (1997). *Nutrient*

Composition of Malaysian Foods (4th ed.). Kuala Lumpur: Institute for Medical Research.

- Thakare, V., Krishnan, A., & Chaware, S. (2012). Parents' perceptions of factors influencing the oral health of their preschool children in Vadodara city, Gujarat: A descriptive study. *European Journal of General Dentistry*, 1(1), 44. <https://doi.org/10.4103/2278-9626.101359>
- Tham, R., Bowatte, G., Dharmage, S. C., Tan, D. J., Lau, M. X. Z., Dai, X., ... Lodge, C. J. (2015). Breastfeeding and the risk of dental caries: a systematic review and meta-analysis. *Acta Paediatrica*, 104(467), 62–84. <https://doi.org/10.1111/apa.13118>
- Turton, B., Durward, C., Manton, D., Bach, K., & Yos, C. (2015). Socio-behavioural risk factors for early childhood caries (ECC) in Cambodian preschool children: a pilot study. *European Archives of Paediatric Dentistry*, 17(2), 97–105. <https://doi.org/10.1007/s40368-015-0215-7>
- U.S. Department of Health and Human Services. (2000). *Oral Health in America: A Report of the Surgeon General*. Rockville, MD: U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health.
- U.S. Department of Health and Human Services and U.S. Department of Agriculture. (2015). *2015 – 2020 Dietary Guidelines for Americans*. 2015 – 2020 Dietary Guidelines for Americans (8th ed.).
- UNICEF. (2014). Undernourishment in the womb can lead to diminished potential and predispose infants to early death. Retrieved April 4, 2018, from <https://data.unicef.org/topic/nutrition/low-birthweight/>
- United Nations Children's Fund, & National Statistical Office. (2017). *Thailand Multiple Indicator Cluster Survey 2015-2016*. Bangkok: UNICEF.
- United Nations International Children's Emergency Fund (UNICEF), & World Health Organization (WHO). (2019). *UNICEF-WHO Low birthweight (LBW) estimates. Levels and trends 2000–2015*. Geneva: WHO.
- United Nations International Children's Emergency Fund (UNICEF), World Health Organization (WHO), & World Bank. (2018). *UNICEF/WHO/World Bank joint child malnutrition estimates: Stunting*. New York.
- United States Department of Agriculture [USDA]. (2016). What are added sugars? Retrieved February 3, 2018, from <https://www.choosemyplate.gov/what-are-added-sugars>
- Vadiakas, G. (2008). Case definition, aetiology and risk assessment of early childhood caries (ECC): a revisited review. *European Archives of Paediatric Dentistry*, 9(3), 114–125. <https://doi.org/10.1007/BF03262622>
- Van Cauter, E., & Plat, L. (1996). Physiology of growth hormone secretion during sleep. *Journal of Pediatrics*, 128(5), S32-37.
- Van der Weijden, F., Echeverria, J. J., Sanz, M., & Lindhe, J. (2008). Mechanical supragingival plaque control. In *Clinical Periodontology and Implant Dentistry* (5th ed.). Oxford: Blackwell Munksgaard.

- van Houte, J. (1994). Role of micro-organisms in caries etiology. *Journal of Dental Research*, 73(3), 672–681. <https://doi.org/10.1177/00220345940730031301>
- Van Loveren, C. (2019). Current topic sugar restriction for caries prevention: Amount and frequency. Which is more important? *Caries Research*, 53, 168–175. <https://doi.org/10.1159/000489571>
- van Palenstein Helderma, W. H., Soe, W., & van't Hof, M. A. (2006). Risk factors of early childhood caries in a Southeast Asian population. *Journal of Dental Research*, 85(1), 85–88.
- Vanderlaan, A. F. (2011). Birth Order. In S. Goldstein & J. A. Naglieri (Eds.), *Encyclopedia of Child Behavior and Development* (pp. 256–257). Boston, MA: Springer US. https://doi.org/10.1007/978-0-387-79061-9_359
- Vargas-Ferreira, F., Salas, M. M. S., Nascimento, G. G., Tarquinio, S. B. C., Faggion, C. M., Peres, M. A., ... Demarco, F. F. (2015). Association between developmental defects of enamel and dental caries: A systematic review and meta-analysis. *Journal of Dentistry*, 43(6), 619–628. <https://doi.org/10.1016/j.jdent.2015.03.011>
- Velló, M. A., Martínez-Costa, C., Catalá, M., Fons, J., Brines, J., & Guijarro-Martínez, R. (2010). Prenatal and neonatal risk factors for the development of enamel defects in low birth weight children. *Oral Diseases*, 16(3), 257–262. <https://doi.org/10.1111/j.1601-0825.2009.01629.x>
- Viet Nam National Institute of Nutrition, United Nations Children's Fund, & Alive & Thrive. (2015). *Nutrition surveillance profiles 2015*. Hanoi.
- Wan Salina, W. S., Nizam, A., & Naing, L. (2007). The association of birth order and sociodemographic factors with caries experience among adolescents in Tumpat. *Archives of Orofacial Sciences*, 2, 45–50.
- Warren, J. J., Weber-gasparoni, K., Marshall, T. a, Drake, D. R., Dehkordi-vakil, F., & Dawson, D. V. (2009). A longitudinal study of dental caries risk among very young low SES children. *Community Dentistry and Oral Epidemiology*, 37(2), 166–122. <https://doi.org/10.1111/j.1600-0528.2008.00447.x.A>
- Watanabe, M., Wang, D. H., Ijichi, A., Shirai, C., Zou, Y., Kubo, M., ... Ogino, K. (2014). The influence of lifestyle on the incidence of dental caries among 3-year-old Japanese children. *International Journal of Environmental Research and Public Health*, 11(12), 12611–12622. <https://doi.org/10.3390/ijerph111212611>
- Wellappuli, N., & Amarasena, N. (2012). Influence of family structure on dental caries experience of preschool children in Sri Lanka. *Caries Research*, 46(3), 208–212. <https://doi.org/10.1159/000337399>
- WHO Multicentre growth reference study group. (2006). WHO Child Growth Standards based on length/height, weight and age. *Acta Paediatrica, Suppl* 450, 76–85. <https://doi.org/10.1080/08035320500495548>
- Wigen, T I, & Wang, N. J. (2010). Caries and background factors in Norwegian and immigrant 5-year-old children. *Community Dentistry and Oral Epidemiology*, 38, 19–28. <https://doi.org/10.1111/j.1600->

0528.2009.00502.x

- Wigen, Tove I, Espelid, I., Skaare, A. B., & Wang, N. J. (2011). Family characteristics and caries experience in preschool children. A longitudinal study from pregnancy to 5 years of age. *Community Dentistry and Oral Epidemiology*, 39, 311–317. <https://doi.org/10.1111/j.1600-0528.2010.00596.x>
- Wilson, K. M., Finkelstein, J. N., Blumkin, A. K., Best, D., & Klein, J. D. (2011). Micronutrient levels in children exposed to secondhand Tobacco smoke. *Nicotine and Tobacco Research*, 13(8), 800–808. <https://doi.org/10.1093/ntr/ntr076>
- Wong, P. D., Birken, C. S., Parkin, P. C., Venu, I., Chen, Y., Schroth, R. J., & Maguire, J. L. (2017). Total breast-feeding duration and dental caries in healthy urban children. *Academic Pediatrics*, 17(3), 310–315. <https://doi.org/10.1016/j.acap.2016.10.021>
- World Health Organization (WHO). (1997). *Oral Health Surveys. Basic Methods*. World Health Organization. Geneva.
- World Health Organization (WHO). (2002a). *Diet, nutrition and the prevention of chronic diseases: report of a joint WHO/FAO expert consultation*. Geneva: WHO.
- World Health Organization (WHO). (2002b). Infant and young child nutrition. In *55th World Health Assembly. WHA55.25* (pp. 1–3).
- World Health Organization (WHO). (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organisation*, 85(10), 812–819. <https://doi.org/10.2471/BLT>.
- World Health Organization (WHO). (2008). *The global burden of disease: 2004 update*. World Health Organization. Switzerland. <https://doi.org/10.2471/BLT.09.070565>
- World Health Organization (WHO). (2009). *WHO AnthroPlus for personal computers manual: software for assessing growth of the world's children and adolescents*. Geneva: WHO.
- World Health Organization (WHO). (2011). *World Health Statistics 2011* (Vol. 1). Geneva: WHO. https://doi.org/978_92_4_156419_9
- World Health Organization (WHO). (2013). *Oral health surveys. Basic methods*. World Health Organization. Geneva: WHO.
- World Health Organization (WHO). (2017a). Obesity and overweight. Retrieved November 17, 2017, from <http://www.who.int/mediacentre/factsheets/fs311/en/>
- World Health Organization (WHO). (2017b). *Sugars and dental caries*. Geneva: World Health Organization.
- World Health Organization (WHO). (2017c). Tobacco. Retrieved February 5, 2018, from <http://www.who.int/mediacentre/factsheets/fs339/en/>
- World Health Organization (WHO). (2017d). Tobacco fact sheet. Retrieved October 29, 2017, from

<http://www.who.int/mediacentre/factsheets/fs339/en/>

- World Health Organization (WHO). (2018a). Oral health. Retrieved September 27, 2019, from <https://www.who.int/news-room/fact-sheets/detail/oral-health>
- World Health Organization (WHO). (2018b). World health statistics data visualizations dashboard. Child stunting. Retrieved February 28, 2019, from <http://apps.who.int/gho/data/node.sdg.2-2-viz-1?lang=en>
- Wulaerhan, J., Abudureyimu, A., Bao, X.-L., & Zhao, J. (2014). Risk determinants associated with early childhood caries in Uygur children: a preschool-based cross-sectional study. *BMC Oral Health*, *14*(1), 136. <https://doi.org/10.1186/1472-6831-14-136>
- Xavier, A., Bastos, R. D. S., Arakawa, A. M., Caldana, M. D. L., & Bastos, J. R. d M. (2013). Correlation between dental caries and nutritional status: Preschool children in a Brazilian municipality. *Revista de Odontologia Da UNESP*, *42*(5), 378–383.
- Yadav, R.J. Das, Shobha. Kumar, R. . (2001). Letter to the editor: Dental caries and dietary habits in school going children. *Indian Journal of Physiology and Pharmacology*, *45*(2), 258–260.
- Yang, S., Tilling, K., Martin, R., Davies, N., Ben-shlomo, Y., & Kramer, M. S. (2011). Pre-natal and post-natal growth trajectories and childhood cognitive ability and mental health. *International Journal of Epidemiology*, *40*(5), 1215–1226. <https://doi.org/10.1093/ije/dyr094>
- Yen, C. E., & Hu, S. W. (2013). Association between dental caries and obesity in preschool children. *European Journal of Paediatric Dentistry*, *14*(3), 185–189.
- Yen, I. H., & Moss, N. (1999). Unbundling education: A critical discussion of what education confers and how it lowers risk for disease and death. *Annals of the New York Academy of Sciences*, *896*(1), 350–351. <https://doi.org/10.1111/j.1749-6632.1999.tb08138.x>
- Zahara, A. M., Fashihah, M. H., & Nurul, A. Y. (2010). Relationship between frequency of sugary food and drink consumption with occurrence of dental caries among preschool children in Titiwangsan, Kuala Lumpur. *Malaysian Journal of Nutrition*, *16*(1), 83–90.
- Zaitso, T., Saito, T., & Kawaguchi, Y. (2018). The oral healthcare system in Japan. *Healthcare*, *6*(3), 79. <https://doi.org/10.3390/healthcare6030079>
- Zero, D. T., Fu, J., Anne, K. M., Cassata, S., McCormack, S. M., & Gwinner, L. M. (1992). An improved intra-oral enamel demineralization test model for the study of dental caries. *Journal of Dental Research*, *71 Spec No*, 871–878. <https://doi.org/10.1177/002203459207100017>
- Zhou, Y., Lin, H. C., Lo, E. C. M., & Wong, M. C. M. (2011). Risk indicators for early childhood caries in 2-year-old children in southern China. *Australian Dental Journal*, *56*, 33–39. <https://doi.org/10.1111/j.1834-7819.2010.01280.x>
- Zhou, Y., Yang, J. Y., Lo, E. C. M., & Lin, H. C. (2012). The contribution of life

course determinants to early childhood caries: A 2-year cohort study.
Caries Research, 46(2), 87–94. <https://doi.org/10.1159/000335574>

Zubrick, S. R., Williams, A. A., Silburn, S. R., & Vimpani, G. (2000). *Indicators of social and family functioning*. Canberra: Department of Family and Community Services.



BIODATA OF STUDENT

Lee Zhi Ling was born in Penang on 19th December 1993. Growing up in a health-conscious family, she always believes that best nutrition brings the best body and mind. Hence, she decided to pursue her bachelor's degree in Nutrition and Community Health at Universiti Putra Malaysia (UPM) and completed it in 2017 with First Class Honour. She won an award, named *Pingat Emas Alumni*, as she graduated. She continued to pursue her master's degree in Community Nutrition, under the supervision of Assoc. Prof. Dr. Gan Wan Ying. Her field of research focused on childhood nutrition and dental caries. She presented her findings in national and international conferences such as Asian Congress of Nutrition 2019, which was held at Bali International Convention Center, from 4 to 7 August 2019. The experiences and knowledge gained through the process prepared her for future career pathway.

LIST OF PUBLICATIONS

- Lee, Z. L.,** Gan, W. Y., Lim, P. Y., Ruhaya, H., & Lim, S. Y. (2019). Associations of nutritional status, sugar and second-hand smoke exposure with dental caries among Malaysian pre-schoolers. *BMC Public Health*. (submitted)
- Lee, Z. L.,** Gan, W. Y., Lim, P. Y., & Ruhaya, H. (2019). Factors associated with dental caries in primary teeth among Malaysian pre-schoolers. *Annals of Nutrition and Metabolism*, 75(Suppl 3), 115.
- Lee, Z. L.,** Gan, W. Y., Ruhaya, H., & Lim, P. Y. (2019). Ethnicity and duration of breastfeeding associated with the risk of overweight and obesity among pre-schoolers in *Tabika Perpaduan* in Seremban. *Malaysia Association for the Study of Obesity (MASO) 2019 Scientific Conference on Obesity*, 15 – 16 October 2019, Kuala Lumpur, Poster Presentation. (*Best Poster Award – Consolation Prize*)
- Lee, Z. L.,** Gan, W. Y., Lim, P. Y., & Ruhaya, H. (2019). Factors associated with dental caries in primary teeth among Malaysian pre-schoolers. *13th Asian Congress of Nutrition*, 4–7 August 2019, Bali, Oral Presentation.
- Lee, Z. L.,** Gan, W. Y., Ruhaya, H., & Lim, P. Y. (2019). Low daily energy intake, household smoke and sugar exposure increased the risk of dental caries in pre-schoolers. *Nutrition Society of Malaysia (NSM) 34th Scientific Conference 2019*, 3–4 July 2019, Kuala Lumpur, Oral Presentation. (*Young Researcher's Symposium – Consolation Prize*)



UNIVERSITI PUTRA MALAYSIA

STATUS CONFIRMATION FOR THESIS / PROJECT REPORT AND COPYRIGHT

ACADEMIC SESSION : First Semester 2019/2020

TITLE OF THESIS / PROJECT REPORT :

FACTORS ASSOCIATED WITH RISK OF DENTAL CARIES IN PRIMARY TEETH
AMONG PRE-SCHOOLERS IN SEREMBAN, MALAYSIA

NAME OF STUDENT: LEE ZHI LING

I acknowledge that the copyright and other intellectual property in the thesis/project report belonged to Universiti Putra Malaysia and I agree to allow this thesis/project report to be placed at the library under the following terms:

1. This thesis/project report is the property of Universiti Putra Malaysia.
2. The library of Universiti Putra Malaysia has the right to make copies for educational purposes only.
3. The library of Universiti Putra Malaysia is allowed to make copies of this thesis for academic exchange.

I declare that this thesis is classified as :

*Please tick (✓)

CONFIDENTIAL

(Contain confidential information under Official Secret Act 1972).

RESTRICTED

(Contains restricted information as specified by the organization/institution where research was done).

OPEN ACCESS

I agree that my thesis/project report to be published as hard copy or online open access.

This thesis is submitted for :

PATENT

Embargo from _____ until _____
(date) (date)

Approved by:

(Signature of Student)
New IC No/ Passport No.:

Date :

(Signature of Chairman of Supervisory Committee)
Name:

Date :

[Note : If the thesis is **CONFIDENTIAL** or **RESTRICTED**, please attach with the letter from the organization/institution with period and reasons for confidentially or restricted.]