Caries prevalence amongst pre-school children in Windhoek, Namibia.

By

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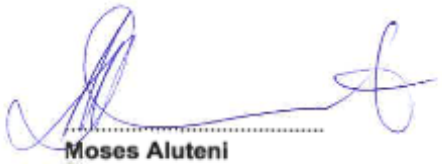
DECLARATION

I, Moses Aluteni, the undersigned, hereby declare that the work contained in this dissertation Caries prevalence amongst pre-school children in Windhoek, Namibia is my original work and that it has not been previously in its entirety or in part submitted at any university for a degree. I also declare that all sources or information used in the writing of this thesis has been appropriately referenced.



Moses Aluteni

09/06/20

Date

DEDICATION

I dedicate this work to my Creator, the One who gives wisdom and direction in serving and helping those in need of care.

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Abstract:

Background: Early Childhood Caries (ECC) has been recognised as a disease of serious consequences in both industrialised as well as undeveloped nations of the world. Its widespread prevalence among children makes it ideal for assessing the risk factors and identifying specific strategies that could be implemented to prevent the disease.

Aim: The aim of the present study was to determine the prevalence of dental caries and its untreated consequences among 2-6-year-old preschool children in Windhoek, Namibia.

Objectives: The objectives were;

(i) To determine the prevalence of caries amongst 2-6-year-old children attending selected crèches in Windhoek, Namibia.
(ii) To assess the clinical consequences of untreated tooth decay amongst 2-6-year-old children attending selected crèches in Windhoek using the pufa index.
(iii) To investigate the strength of correlation between the dmft and pufa indices amongst 2-6years-old children attending selected creches in Windhoek, Namibia.
(iv) To evaluate the correlation between oral hygiene practices and early childhood caries amongst 2-6-year-old children attending selected crèches in Windhoek, Namibia.

Methods: The study design used was cross-sectional and descriptive. A random sample was used to select children between the age group of 2-6 years attending selected creches represented within the 9 urban constituencies of Windhoek, Namibia. The sample size comprised 250 children whose parents had consented to be part of the study. Data was collected by means of a dental clinical examination which focused on the diagnosis of dental caries using a World health organization (WHO) criteria for caries through the dmft and pufa indices. The dental examination was conducted at the respective crèches of the participants. An accompanying complementary oral health questionnaire was completed by the parents/care givers

of the participants prior to the clinical dental examination and data was collated accordingly.

The examinations were done by a single examiner and the examiner was calibrated by a team from the Department of Community Dentistry at the Wits Oral Health Sciences School. Ten percent of each examination sample was randomly selected and re-examined as a means of ensuring intra examiner reliability and consistent clinical judgment.

Results: The caries and pufa prevalence amongst the study cohort was established at 55.77% and 6.54% respectively. The mean age of the children was 4.7 years, the mean dmft index score was 2.38 and the mean pufa score was 0.11. There was an increase in caries prevalence from 30.77% amongst the 2-year-old children to 66.67% amongst the 6-year-old children thus indicating an increase in caries prevalence with increasing age in both girls and boys.

Conclusion: The caries and pufa prevalence of 55.77% and 6.54% for pre-school children of Windhoek is high compared to similar studies from other countries and it was directly proportional to increasing age.

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List of abbreviations:

AFRO:	African region.
AMRO:	American region.
CI:	Confidence Interval
EURO:	Europe region.
dmft:	Count of decayed, missing and filled deciduous teeth.
DMFT:	Count of decayed, missing and filled permanent teeth.
ECC:	Early childhood caries.
HREC:	Human Research Ethics Committee.
MI:	Motivational interviews.
MoHSS:	Ministry of Health and Social Services in Namibia
MS:	Mutans Streptococci.
OR:	Odds Ratio
pufa:	pulp, ulcer, fistula and abscess formation due to untreated deciduous tooth decay.
SEARO:	Southern Eastern Asian Region.
Wits:	University of the Witwatersrand.

Chapter 1. Introduction

1.1 Background

Oral diseases are among the most prevalent non-communicable diseases worldwide and are regarded as one of the major components in the global burden of diseases affecting mankind (Marcenes *et al.*, 2013). Among the commonest of dental conditions, dental caries is 10 times more prevalent than any other oral disease with a worldwide prevalence of between 60-90% amongst children (Kamran et al., 2017). In adults untreated tooth decay constitutes the most prevalent condition whereas in primary dentition it remains the 10th most untreated condition (Kassebaum *et al.*, 2015). This translates into 2.4 billion adults and 621 million children being affected by caries which has remained mostly untreated globally. The recognised high global prevalence of dental caries has qualified it to be classified as a pandemic disease responsible for untold pain, suffering and increased morbidity. This disease has shown a strong association with urbanisation and industrialisation amongst human populations across the world (Bedi, 2005). The disease has as a consequence impacted negatively on the general wellbeing of children in most developing nations and has had severe adverse effects on socio economic state within communities (Marcenes *et al.*, 2013). Thus dental caries remains one of the most common unmet health care needs in both adults and children with no exception in preschool children (Mahejabeen et al., 2006). The high levels of caries and the increased morbidity caused by dental caries has placed oral health as a priority on the agenda of public health authorities.

Dental caries is a disease of multi factorial origin and ensues as a result of the interplay between host factors, environmental factors and causative bacterial agents (Struzycka, 2014). The disease has primarily a direct destructive effect on teeth which can have secondary adverse systemic manifestations on the body such as on body weight, growth, poor quality of life in preschool children and permanent life lasting debilitating effects often requiring continuous maintenance and care (Ozdemir, 2013).

Most deleterious oral care habits associated with early childhood caries are developed during the pre-school period and pre-school children presents a convenient and easily accessible population where dental epidemiological surveys can be conducted to establish baseline prevalence data information aimed at early identification and continuous management of the disease within populations.

1.2 Caries Diagnostic Index

The DMFT index is a well-established and one of the simplest and most commonly used indices in epidemiologic surveys of dental caries and has been in use for almost 80 years. It quantifies dental health status based on the number of carious, missing and filled teeth (Anaise, 1984).

The DMF Index when applied to the permanent dentition is expressed as the total number of teeth or surfaces that are decayed (D), missing (M), or filled (F) in an individual. When written in lowercase letters, the dmf index is a variation that is applied to the primary dentition. When the index is applied to teeth specifically, it is called the DMFT index, and scores per individual can range from 0 to 28 or 32, depending on whether the third molars are included in the scoring. When the index is applied only to tooth surfaces (five per posterior tooth and four per anterior tooth), it is called the DMFS index, and scores per individual can range from 0 to 128 or 148, depending on whether the third molars are included in the scoring.

The caries experience for a child is expressed as the total number of teeth or surfaces that are decayed (d), missing (m), or filled (f). The dmft index expresses the number of affected teeth in the primary dentition, with scores ranging from 0 to 20 for children. Because of the difficulty in distinguishing between teeth extracted due to caries and those that have naturally exfoliated, missing teeth may be ignored according to some protocols. In such cases, it is then referred to as the df index. The teeth not counted are unerupted teeth, congenitally missing teeth or supernumerary teeth, teeth removed for reasons other than dental caries, and primary teeth retained in the permanent dentition.

Counting the third molars is optional. When a carious lesion(s) or both carious lesion(s) and a restoration are present, the tooth is recorded as a D. When a tooth has been extracted due to caries, it is recorded as an M. When a permanent or temporary filling is present, or when a filling is defective but not decayed, this is counted as an F. Teeth restored for reasons other than caries are not counted as an F.

1.3 PUFA/pufa diagnostic index

The PUFA/pufa index was developed as an adjunct to the DMFT/dmft index (Monse *et al.*, 2010a). The PUFA/pufa index records the presence of severely decayed teeth with visible pulpal involvement (P/p), ulceration caused by dislocated tooth fragments (U/u), fistula (F/f) and abscess (A/a). PUFA is an index used to assess the presence of oral conditions resulting from untreated caries. The index is recorded separately from the DMFT⁄dmft and scores the presence of either a visible pulp, ulceration of the oral mucosa due to root fragments, a fistula or an abscess. Lesions in the surrounding tissues that are not related to a tooth with visible pulpal involvement as a result of caries are not recorded.

The assessment is made visually without the use of an instrument. Only one score is assigned per tooth. In case of doubt concerning the extent of odontogenic infection, the basic score (P ⁄ p for pulp involvement) is given. If the primary tooth and its permanent successor tooth are present and both present stages of odontogenic infection, both teeth will be scored. Uppercase letters are used for the permanent dentition and lowercase letters used for the primary dentition.

The codes and criteria for PUFA index are as follows:
P⁄p: Pulpal involvement is recorded when the opening of the pulp chamber is visible or when the coronal tooth structures have been destroyed by the carious process and only roots or root fragments are left. No probing is performed to diagnose pulpal involvement.

U/u: Ulceration due to trauma from sharp pieces of tooth is recorded when sharp edges of a dislocated tooth with pulpal involvement or root fragments have caused traumatic ulceration of the surrounding soft tissues, e.g., tongue or buccal mucosa.

F/f: Fistula is scored when a pus releasing sinus tract related to a tooth with pulpal involvement is present.

A/a: Abscess is scored when a pus containing swelling related to a tooth with pulpal involvement is present.

The PUFA / pufa score per person is calculated in the same cumulative way as for the DMFT / dmft and represents the number of teeth that meet the PUFA / pufa diagnostic criteria. The PUFA for permanent teeth and pufa for primary teeth are reported separately. Thus, for an individual person the score can range from 0 to 20 pufa for the primary dentition and from 0 to 32 PUFA for the permanent dentition. The prevalence of PUFA/pufa is calculated as percentage of the population with a PUFA/pufa score of one or more.

The PUFA index is used in evaluating clinical consequences of untreated caries such as pulpal involvement and dental abscess, which may be more serious than the caries lesions themselves. Thus the index defines four different clinical stages of advanced caries that have different implications on general health status of individuals thus providing 'a face of the reality' to the prevailing and often ignored oral conditions. Use of DMFT/dmft index combined with the PUFA/pufa index for dental epidemiologic studies provides more accurate information on the magnitude of the disease prevalence (Monse *et al.*, 2010a).

Exposing decision makers to both DMFT/dmft and PUFA/pufa data, gives them a more comprehensive picture of the severity, magnitude and health impact that untreated caries may have on the quality of life of individuals and communities.

1.4 Research problem (Rationale)

This study aims to determine the factors that contribute to the increased incidence of early childhood caries amongst 2 – 6 year old children in Windhoek urban area, and to contribute towards an understanding of measures that could remedy the prevailing situation.

From the phletora of dental caries prevalence studies done worldwide very few have focused on the pre-school population as is the focus on in this study cohort.

The purpose of this study is to contribute to an understanding of the causes of the increased incidence of early childhood caries and its clinical consequences amongst 2-6 year old children within the urban Windhoek area. The findings of the study may be used by policy makers to make informed decisions on which intervention strategies to utilize in the elimination of early childhood caries.

1.5 Literature review

From review of current available epidemiological research data regarding the prevalence of dental caries, results have shown conclusively that there is a noted increase in the prevalence of dental caries worldwide. This observed worldwide increasing trend is seen in both children as well as adult populations thus affecting both primary as well as permanent dentition, posing a public health crisis in the absence of any intervention (Bagramian, Garcia-Godoy and Volpe, 2009). The very high prevalence of dental caries in children which has remained largely untreated especially has become a serious challenge to public healthcare delivery in developing countries where it has remained a cause of debilitating pain and suffering in both children and adult populations (Çolak *et al.*, 2013).

Dental pain is a common consequence of untreated dental caries and it invariably has a direct influence on an individual's quality of life. In a study of Head Start Dental programme, it was reported that among children with caries, 16.6% complained of toothache and 8.9% cried because of a toothache (Tinanoff and Reisine, 2009a).

Children's dental pain affected regular activities, such as eating, sleeping, school attendance and playing. Amongst the most extreme of consequences, Cassamassimo and colleagues recently summarized the human and economic costs of ECC, finding reports of several deaths associated with sepsis., (Tinanoff and Reisine, 2009a).

Great efforts to achieve improvements in oral health have been implemented in recent decades by both governmental and nongovernmental agencies worldwide. Subsequent World Health Organization (WHO) findings suggest that prevalence of caries experience has declined in many locations in the world. The largest decline namely a 90% reduction in the number of decayed, missing, and filled (DMFT) teeth for 12-year old children occurred in the early 1970's to mid-1990's in the United States and Western and Nordic European high-income countries. The decline was less obvious in low-income countries (Lagerweij and van Loveren, 2015). In Africa, higher caries prevalence is to be found amongst the higher socio-economic groups in the urban areas reflecting, perhaps, the increasing "westernization" of the diet of these high-income groups and the increasing availability of refined carbohydrates.

Dental caries prevalence levels in developed countries has been low mainly due to the presence of children's preventative oral health programmes, availability of dental clinics and affordable health insurance (Sheiham, 1984), whereas in most developing countries such programmes and facilities are non-existent (Bagramian R. A., Garcia-Godoy, F. and Volpe, A. R., 2009). In the U. S. A. it is estimated that children 5 to 7 years of age lose more than 7 million school hours annually because of dental problems and/or visits, many of which are consequences of caries that began when they were preschoolers (Tinanoff and Reisine, 2009a).

Marked improvements have been achieved in so far as betterment of oral health of children is concerned. Significant strides have been made in recent years in developing and applying oral health related quality of life measures for young children. Most studies have relied on caregiver reports of the impact of severe caries on their children or on the family, although some studies included self-reports from children.

In a study of 4-year olds with severe caries and those with no caries conducted in Brazil, caregivers were interviewed and asked to assess the impact of caries on their children. The children also had rated how they felt about their teeth using a happy face and sad face. Caregivers of children with severe caries stated that their children were more likely to be absent from school (26%), were ashamed to smile (31%), and had problems eating (49%). Children with severe caries were also more likely to select the sad face (34%) compared with caries-free children (22%), (Bönecker *et al.*, 2012).

A pilot study of children ages 35 to 66 months referred for treatment under general anaesthesia was conducted in Montreal, Canada. Caregivers interviewed before and after treatment reported that before treatment, 48% of the children complained of pain, 43% had problems eating, 35% had problems sleeping, and 5% had negative reports from school. After treatment, most of the problems resolved, and the authors concluded that severe caries had a serious impact on the children's quality of life and that treatment eliminated many of these problems (Tinanoff and Reisine, 2009a). Another study in the United Kingdom found that 22% of parents of children aged 5 under reported at least one impact of oral conditions among their children, the most common being pain (16%) and limitations in oral function (6%), (Tinanoff and Reisine, 2009a).

In the United States, Filstrup *et al.* (2003) included self-reports from children on the impact of caries on quality of life. Forty-three percent of children aged 36 to 47 months were able to respond to questions such as, “Do your teeth hurt you now?” and “Does a hurting tooth wake you up at night?”

In most of the developing countries in South East Asia, children had a high prevalence of dental caries in the primary dentition, often in contrast to the situation in the permanent dentition. The reasons for this difference were not obvious but may have been linked to differences in diet. In a study done by Monse *et al.* (2010a) the prevalence of fistulae and abscesses of 18% among 6-year-old Filipino children was consistent with the findings for 5-year-old Scottish children, where the prevalence of

sepsis was reported to be 11% for children living in the most deprived areas in Scotland (Pine *et al.*, 2006).

In the Middle East (Abu Dhabi), studies have shown that the prevalence of ECC ranged from 71 to 86% among 4 year olds and 82 to 94% among 5 year old children (AlKhayat, 2018), while in Indian studies, the reported prevalence was 37.7, 47.3 and 47.4% amongst 3,-4 and 5 year olds respectively (Gupta *et al.*, 2015).

A large variation has been seen in the trends of dental caries among the index age groups as suggested by WHO worldwide. It was observed that the American Region (AMRO) and the Europe Region (EURO) presented a risk of 1.14 and 1.10 times higher than the average in the world. The African Region (AFRO) was with 19% lower risk compared to the average of all countries surveyed, followed by Southern Eastern Asian Region SEARO region. In most highly developed countries like USA, UK, and Japan, there was a precipitous increase in prevalence and incidence of the disease during 1920's to 1950. Recently there was a dramatic reduction in caries in countries of the western world, primarily due to the increased use of fluorides from a variety of sources, especially toothpastes. A decrease in dental caries among children in highly developed countries started to emerge around 1970, and the percentage of caries free children in different age categories have increased since then (Silveira Moreira, 2012).

A changing trend has been observed in developing countries like India and Thailand, where there has been a reported increase in dental caries. This could be ascribed to the increased availability and use of processed sugars and underutilization of preventive services in these developing countries (Kundu *et al.*, 2015). In 1940, the prevalence of dental caries in 5 and 12-year-old schoolchildren in India was 55.5% and it jumped to 68% in the 1960 and climbed to 89% in subsequent years. Prevalence of dental caries was about 50% in 5 year old children and close to 84.1% in older age population as reported by National oral health survey and fluoride mapping 2002-2003 (Kundu *et al.*, 2015). Notwithstanding the observation of increased prevalence of dental caries worldwide, such conclusive results have not been established for sub Saharan Africa, due to a lack of research studies on this

topic and in particular amongst the age group cohort of 2-6 year old children (Cleaton-Jones and Fatti, 1999).

In Africa, dental caries prevalence in the preschool child seems to be increasing somewhat in countries or parts of countries where there is an increase in sugar intake, while it stays low in countries where a poor economy restricts sugar intake. However the prevalence in Africa does not seem to be as high as in South East Asia (Holm, 1990).

In most industrialized countries in northern Europe, in North America, in Australia and New Zealand, dental caries is decreasing, often linked to an increasing use of fluoride coupled with various types of dental health education programmes. In many European countries, the prevalence in preschool children is, however, still high and caries in primary teeth is often left untreated. In Scandinavia, where all preschool children are included in an organized dental care programme, dental caries has been decreasing markedly during the 1970s and at the beginning of the 1980s (Holm, 1990).

From a systematic review study of published information regarding prevalence of dental caries for the period 1967–1997 which was done online from 35 countries in sub-Saharan mainland Africa, the study showed a predominantly downward trend in dental caries which was statistically significant for dmft at age 5 to 6 years and for DMFT at 35 to 44 years over a period of two decades between 1967 to 1987 (Cleaton-Jones, Fatti and Bönecker, 2006).

Studies done in the past on caries prevalence for 5-year-old children in Namibia have found a mean dmft of 1.4 nationally and 1.23 for Khomas region in which Windhoek is located (Schier and Cleaton-Jones, 1995). In another closely related study by Hofstedt and Stillerman (1990) on 6-7 year old children of both rural and urban Windhoek, only 20% of the urban children and 35% of the rural children were caries free and the mean dmft in the urban area was 3.36 (SD 2.93) and in the rural area 2.43 (SD 3.18). The goal set by WHO was to have more than 80% of the 6-year-olds caries free by the year of 2015 (Hofstedt and Stillerman, 1990).

This review of the literature serves to highlight an alarming situation for Namibian children where dental caries has been found to be severe (Thopil, 2013) and the fact that many children will be confronted by caries even in their permanent dentition.
This assumption has been proven by previous studies that have shown a high correlation between high caries frequency in deciduous dentition followed by high caries frequency in the permanent dentition (Çolak and Dülgergil, 2012).

Given the scarcity of information on the oral health status of 2-6 years old preschool children in Namibia and the fact that oral health surveys done before have focused mainly on primary or secondary school children and as such there is not enough data available for the pre-school population for Windhoek and the rest of Namibia; it was with this background that the present study sought to determine the magnitude of early childhood caries among children aged between 2-6 years in the urban setting of Windhoek in Namibia.

Chapter 2. Aims and Objectives

2.1 Aim of the Study

The aim of this study was to determine the caries prevalence of pre-school children aged 2-6 years in Windhoek, Namibia.

2.2 Objectives

(i) To determine the prevalence of caries amongst 2-6-year-old children attending selected crèches in Windhoek, Namibia.

(ii) To assess the clinical consequences of untreated tooth decay amongst 2-6-year-old children attending selected crèches in Windhoek using the pufa index.

(iii) To investigate the strength of correlation between the dmft and pufa indices amongst 2-6 years-old children attending selected creches in Windhoek, Namibia.

(iv) To evaluate the correlation between oral hygiene practices and early childhood caries amongst 2-6-year-old children attending selected crèches in Windhoek, Namibia.

Chapter 3: Materials/Methods

3.1 Study Design

A descriptive, cross sectional survey was chosen for this study as it best suited the study aims and objectives.

The examination was done under natural light and caries was diagnosed according to WHO criteria as cited by (Assaf *et al.*, 2004).

3.2 Study Site and Study Population

The sample was selected by random sampling method and the sample size was subdivided proportionally according to the total population of early childhood development and pre-primary learners in each of the 9 constituencies of Windhoek. A total of 27 randomly selected crèches were identified to participate in the survey and 586 children between the ages of 2-6 years were to be examined. However, due to formalities that had to be met before in terms of obtaining permission from the respective school boards and parental consent from would be participants, only 24 creches and 250 parents gave permission and consent.

The study site was comprised of 24 randomly selected creches within Windhoek's 9 urban constituencies (*Namibia Statistics Agency. Namibia Inter-censal Demographic Survey 2016 Report. Namibia Statistics Agency, Windhoek. (2017) [accessed 21 August 2018] - Google Search*,2017). With the permission from the school management participating creches were identified. With the assistance of the respective school principals and the individual class teachers of the respective learners per age group, prospective learners were identified, and their parents were sent the necessary consent forms as well as an oral health questionnaire that they had to complete on behalf of their children.

The prospective learners' parents were informed of their rights to either allow or withhold their children from participating in the study.

From the total of 586 a total of 250 parents gave consent and completed the issued consent and oral health questionnaire forms. From the 27 earmarked creches that were selected to be participants in the research, only 24 accepted and as such these comprised the total number of creches that participated in the research study.

The study population comprised of 2-6 year old learners attending various creches in Windhoek's 9 urban constituencies (*Namibia Statistics Agency. Namibia Inter-censal Demographic Survey 2016 Report. Namibia Statistics Agency, Windhoek. (2017) [accessed 21 August 2018] - Google Search*,2017).

3.3 Sampling and sample size

Using the sample size calculator from The Survey System (https://www.surveysystem.com/sscalc.htm) at 95% confidence level and a margin of error (confidence interval) of 4%, a random sampling method was used to select the children from the chosen participating creches. The sample size was subdivided proportionally according to total population of early childhood development and pre-primary learners in each of the 9 constituencies of Windhoek, Namibia.

The sample comprised of a total of 250 participants of which 48% (119) were females and 52% (131) were males. Age distribution amongst the participants was as follows: 2-year old 6.2% (16), 3-year old 11.6% (30), 4-year old 20.5% (53), 5-year old 32.5% (84) and 6-year old 29.1% (75).

3.4 Methodology

The study instrument consisted of two components:

- Clinical examination of children was performed using the WHO dmft and pufa index for the assessment of dental caries and untreated decay in primary dentition.

  The clinical assessment was made by visual inspection without the use of any instruments except for gauze pads that were used only to remove loose food debris from the surface of the teeth. Infection control barrier measures like nonsterile, single use disposable gloves and face masks were worn during the dental examination. The gloves and used gauze were disposed of in a red colour coded medical waste disposal bag. Hand disinfection sanitizer was used by the examiner after each child's clinical examination.
- A complementary oral health questionnaire was completed prior to the clinical dental examination and the forms contained 19 questions that consisted of demographic details such as age, gender, place of birth, occupation, level of education, living conditions and the parent's or care giver's oral health and dietary habits as well as questions related to the child regarding his/her oral health and dietary habits. This questionnaire was similar to that used in a study by Thopil (Thopil, 2013) and was modified for use in this study (see appendix 3)

Training and calibration of the single examiner Dr. Aluteni was done by the team from the Department of Community Dentistry at the Wits Oral Health Sciences School. A short lecture covering dental caries and clinical diagnosis using WHO criteria as described in the WHO Basic Methods Manual, was presented to the researcher (World Health Organization, 2013). Extracted primary teeth were mounted in plaster (approximately 30) and placed on a display table. After going through the criteria that the WHO uses for caries diagnosis, the researcher examined the mounted extracted teeth in the plaster mould for the presence or absence of caries using visual inspection under good light. His diagnosis and findings were assessed and checked for any discrepancies from the "model answer". Correct diagnoses were discussed with the researcher and consensus/agreement was reached with the researcher on the correct diagnosis. The mounted teeth were then re-arranged in a different order from the 1st round of the exercise and the whole process of examining the mounted teeth for the presence or absence of caries was

repeated. After this, a Kappa score was calculated to determine the intra-examiner variability. The target was to obtain a Cohen Kappa score of 0.8 or more in order to ensure good reliability and standardization for caries diagnosis. An intra-rater reliability score of 0.91 was attained.

The dental clinical examinations were done by a single examiner. The clinical findings during the clinical examination were recorded in a modified WHO form for dmft and pufa recording. Each participant's clinical examination form was attached to the corresponding completed oral health questionnaire.

The examiner was assisted by a dental assistant whose task was that of recording the clinical findings onto the relevant form for each participant and filing the completed forms in designated registry.

The dental examination were performed with both the child and examiner seated on ordinary classroom school chairs and under normal day light conditions in a designated enclosure as was provided or indicated by the school coordinator of each respective creche. The examiner adopted a systematic approach to the examination for dental caries, proceeding in an orderly manner from one tooth or tooth space to the adjacent tooth or tooth space.

To ensure consistent clinical judgment, 10% of each examination sample was randomly selected and re-examined in order to ensure intra examiner reliability. A Cohen's Kappa score of 0.8 or more was achieved each time thus ensuring intra-examiner reliability and consistency.

3.5 Ethics consideration and clearance

Ethics clearance and approval to conduct the research study was applied for prior to commencement of the research study and was duly obtained from both the Ministry of Health and Social services in Namibia and from the Human Research Ethics Committee from the University of the Witwatersrand. A letter was sent to parents of children attending selected participating creches explaining the aims of the study and

asking them for their consent. Signed informed consent was obtained from each participant's parent or care giver prior to conducting the clinical dental examinations. Participation in this study was entirely voluntary and the participants were allowed to withdraw from the study at any time should they wish to do so without any untoward consequences.

Parents and care givers were assured that strict confidentiality would be maintained at all times and that none of their names or personal details would be mentioned in the write up of the study.

Anonymity was achieved by not using the participant's names on the questionnaire and the questionnaires were recorded with coded numbers.

3.6 Data analysis

Data was analysed using STATA version 12. Quantitative variables were summarized as proportions, frequencies and percentages. Because both the dmft and pufa indices were not normally distributed, Spearson's test for correlation was used to determine the strength of the association between both indices (dmft & pufa). Multi-variable adjusted logistic regression was carried out using a backward deletion approach starting with a full model of factors significantly associated with early childhood caries. The level of significance was set at $P<0.05$.

Chapter 4. Results

4.1 Socio-demographic characteristics of the study participants (n=250)

From the total number of 586 questionnaires distributed 250 signed forms were returned equating to a response rate of 43% for the earmarked target population sample. Gender distribution by the participants was 48% (119) females and 52% (131) males.

Table 1: Socio-demographic characteristics of the study participants (n=250)

Characteristics	**%(n)**
Gender of child	
Female	47.60 (119)
Male	52.40 (131)
Level of education of mother	
No schooling	3.49 (8)
Secondary school	24.02 (55)
High school	21.83 (50)
College/university	50.66 (116)
Level of education of father	
No schooling	3.40 (5)
Secondary school	21.77 (32)
High school	28.57 (42)
College/university	46.26 (68)
Self-rated oral hygiene by parents	
Good	67.19 (170)
Fair	28.85 (73)
Poor	3.95 (10)
Parent brushing child's teeth	
No	6.10 (15)

Yes	93.90 (231)
Flossing by child	
Once/day	18.85 (46)
2 or 3 times a day	11.89 (29)
Never	69.26 (169)
Quantity of toothpaste applied	
Full length of bristles	26.14 (63)
About size of a grain of rice	4.56 (11)
About the size of a pea	26.56 (64)
Half-length of bristles	42.74 (103)
Duration of brushing	
About 30seconds	19.68 (49)
About 1 minute	32.53 (81)
About 2 minutes	32.53 (81)
Don't know	15.26 (38)
Use of pacifier	
No	93.36 (211)
Yes	6.64 (15)
Thumb sucking	
No	86.00 (215)
Yes	14.00 (35)
Mouth pain	
No	80.32 (200)
Yes	19.68 (49)
Child going to bed with a baby bottle	
No	85.83 (212)
Yes	14.17 (35)
Parent's rating of oral hygiene status of child	
Good	47.58 (118)
Fair	38.31 (95)
Poor	14.11 (35)

4.2 Age distribution of the participants

Table 2 below depicts the age distribution of the child participants. Two hundred and fifty- (250) children were examined and the majority of the participants were five-year olds at 32.5% followed by six-year olds and the least were 2-year olds at 6.2%. The mean age of the study population was 4.70 years (SD 1.16).

Table 2 age distribution of the participants. (n=250)

2-year-old	16	6.2%
3-year-old	29	11.6%
4 years old	51	20.5%
5 years old	81	32.5%
6 years old	73	29.1%

4.3 Early childhood caries in children

Early childhood caries was calculated by adding decayed, missing and filled teeth to generate dmft. Most of the children had a dmft of 3 and the mean dmft from the study population was 2.38. Prevalence for the study was 55.77%. The pufa score was a minimum of 0 and a maximum of 3 with a mean of 0.11(SD=0.45) thus resulting in a mean pufa score of 0.11. and a prevalence of 6.54% for the study population. This implies that on average there was about a 1 in 10 chance of the child who had tooth decay presenting with symptoms such as p u f or a.

4.4 Correlation between dmft and pufa

Spearman's correlation was used instead of Pearson's test because both dmft and pufa were not normally distributed. Also, the variables were ordinal not continuous which is one of the indicators for the use of Pearson's test. The dmft and pufa variables have shown a direct proportional relation thus therefore a positive

correlation of 0.2838 i.e. 28.3% ($p<0.001$) between pufa and dmft was established, meaning that the higher the dmft, the higher is pufa.

4.5 Caries (cavities) observed by parents

From figure 1 below it is observed that prevalence of parent-reported caries/cavities was established at 33.88%.

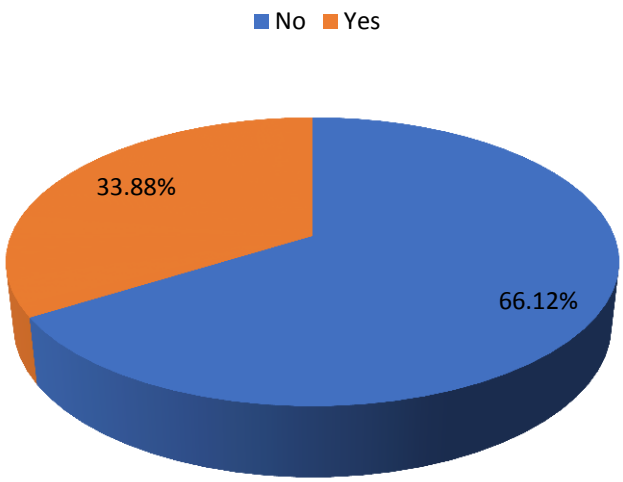

Figure 1: Caries (cavities) observed by parents

4.6 Prevalence of early childhood caries by oral hygiene practices

Table 3 below shows reported oral hygiene practices for the study cohort.

As observed in table 3 below, a higher proportion of children whose parents reported having cavities had early childhood caries (65.85% vs. 50.63%; p=0.029). The lower the duration of tooth-brushing, the more the proportion of early childhood caries was (p=0.024). There was no significant difference in the proportion of caries with other oral hygiene practices such as the frequency of child's tooth brushing,

frequency of flossing in a day, quantity of toothpaste used, use of pacifiers and thumb sucking.

Table 3: Reported oral hygiene practices for the study cohort n=250

Characteristics	**Prevalence %(n)**	**P-value**
Oral health of parent		0.731
Good	53.53 (91)	
Fair	58.90 (43)	
Poor	60.00 (6)	
Cleaning of child's teeth by parent		0.693
No	51.72 (15)	
Yes	56.50 (126)	
Use of toothbrush to clean child's teeth		0.815
No	60.00 (12)	
Yes	55.07 (125)	
Use of toothpaste to clean child's teeth		0.637
No	57.89 (11)	
Yes	50.88 (116)	
Parent helps child to clean teeth		0.856
No	52.94 (18)	
Yes	51.17 (109)	
Overall parent cleaning for child		0.794
No	60.00 (9)	
Yes	55.41 (128)	
Materials used to clean child's teeth		0.673
Toothbrush + toothpaste + dental floss	50.00 (10)	

Toothbrush + Toothpaste only	56.56 (125)	
Don't know	66.67 (6)	
Frequency of child's tooth brushing		0.460
Less than once a day	40.00 (6)	
Once a day	56.38 (84)	
Twice a day	57.50 (46)	
More than twice a day	80.00 (4)	
Time tooth brushing was normally done		0.682
In the morning	56.38 (84)	
In the evening	42.86 (6)	
Both morning and evening	59.76 (49)	
Don't know	60.00 (3)	
Frequency of flossing/day		0.120
Once a day	41.30 (19)	
2 or 3 times/day	58.62 (17)	
Never	57.99 (98)	
Quantity of toothpaste		0.401
Full length of bristles	63.49 (40)	
About size of a grain of rice/size of a pea	53.33 (40)	
Half-length of bristles	53.40 (55)	
Duration of brushing		0.024*
About 30seconds	59.18 (29)	
About 1 minute	55.56 (45)	
About 2 minutes	46.91 (38)	
Don't know	76.32 (29)	
Use of pacifier		0.791
No	54.03 (114)	

Yes	60.00 (9)	
Thumb sucking		0.464
No	56.74 (122)	
Yes	48.57 (17)	
Cavities/caries observed by parents		0.029*
No	50.63 (81)	
Yes	65.85 (54)	
Mouth pain		0.079
No	53.00 (106)	
Yes	67.35 (33)	
Bottle to bed		0.857
No	55.19 (117)	
Yes	57.14 (20)	
Parent's rating of oral hygiene status of child		<0.001*
Good	43.22 (51)	
Fair	63.16 (60)	
Poor	82.86 (29)	

*p<0.05

4.7 Risk Factors for early childhood caries ECC

Table 4 provides information on the possible risk factors associated with ECC in the study cohort.

It was found that children whose parents rated their oral hygiene either as fair Odds Ratio - OR: 2.71; 95% Confidence Interval - CI: [1.49-4.92] or poor Odds Ratio - OR: 9.65; 95% Confidence Interval - CI: [3.10-30.06] were significantly more likely to have early childhood caries when compared to children whose parents rated their oral hygiene as good . Also, female children were more likely to have early childhood

caries compared to male children Odds Ratio - OR: 1.94; 95% Confidence Interval - CI: [1.09-3.43].

Children who were either 5 years Odds Ratio - OR: 4.36; 95% Confidence Interval - CI: [1.02-18.57] or 6 years Odds Ratio - OR: 5.05; 95% Confidence Interval - CI: [1.18-21.61] were more likely to have early childhood caries than 2-year olds. However, there was no difference in the odds ratio of between the 3- and 4-year olds and the 2-year olds.

Table 4: Risk factors for ECC n=240

Characteristic	**Odds ratio (OR)**	**95% Conf. Interval**	**P-value**
Parent's rating of oral hygiene status of child			
Good	1.0		
Fair	2.71	1.49-4.92	0.001
Poor	9.65	3.10-30.06	<0.001
Gender of child			
Male	1.0		
Female	1.94	1.09-3.43	0.024
Age of child (year)			
2	1.0		
3	2.53	0.53-12.09	0.246
4	3.16	0.72-13.95	0.129
5	4.36	1.02-18.57	0.046
6	5.05	1.18-21.61	0.029

4.8 Mean dmft by age of child

Results in table 5 clearly shows that children within the 2-year age group had the lowest dmft score. The 3-4-year-old age group had almost similar dmft scores and the 5-year-old children had the highest dmft score followed by the 6-year olds that

was marginally lower. The mean dmft scores show an increasing trend with age except for an inverse relation trend between the 5 and 6-year-old age group. The overall mean dmft from the study population was established at 2.38.

Table 5:Percentage and mean dmft by age of child

Age (Year)	Dmft =0 (%)	Dmft>0 (%)	Mean dmft (Standard deviation)
2	69.2	30.8	0.77 (1.48)
3	53.3	46.7	1.53 (1.91)
4	54.7	45.3	1.81 (3.02)
5	38.1	61.9	3.02 (3.56)
6	33.3	66.7	2.84 (3.09)

4.9 Prevalence of caries by demographic and socio-economic factors

Table 6 shows that there was no significant difference in the prevalence of caries between male and female children. Also, the level of education of either the mother or father did not affect the prevalence of caries. However, the older a child was the higher the prevalence of early childhood caries (p=0.030).

Table 6: Prevalence of caries by demographic and socio-economic factors n=250

Characteristic	Prevalence % (n)	p-value
Gender of child		0.094
Male	52.10 (62)	
Female	62.60 (82)	
Age of child (year)		0.030
2	30.77 (4)	
3	46.67 (14)	
4	47.17 (25)	
5	61.90 (52)	
6	66.67 (50)	
Level of education of mother		0.220

No schooling	87.50 (7)	
Secondary school	63.64 (35)	
High school	62.00 (31)	
College/University	54.31 (63)	
Level of education of father		0.992
No schooling	60.00 (3)	
Secondary school	56.25 (18)	
High school	54.76 (23)	
College/University	57.35 (39)	

4.10 Summary

The mean age of the children was 4.7 years, the mean dmft index score was 2.38 and the mean pufa score was 0.11. There was an increase in caries prevalence from 30.77% amongst the 2-year-old children to 66.67% amongst the 6-year-old children thus indicating an increase in caries prevalence with increasing age in both girls and boys.

The caries and pufa prevalence amongst the study cohort was established at 55.77% and 6.54% respectively. There was a positive correlation of 0.2838 i.e. 28.3% ($p<0.001$) between pufa and dmft, meaning as dmft score increased so did the pufa score, thus conferring a direct proportional relation between the two variables.

Chapter 5. Discussion

5.1 Introduction

Dental caries is a major health problem in Namibian school children, especially in low income populations, however, very few studies have been done on the prevalence of the disease, treatment needs as well as the associated risk factors in this age group. The recognized high global prevalence of dental caries from various studies done by researchers such as (Bagramian and colleagues 2009,; Kassebaum *et al.*, 2015) and from the few studies done in Namibia by (Thopil, 2013,; *Priwe and Herunga, 1997*,; Hofstedt and Stillerman, 1990) a trend can be deduced corroborating and suggestive of an increased incidence of early childhood caries for Windhoek and Namibia. Although the few studies done have focused on older age groups and generally have not included children younger than 6 years of age. This study is amongst the first to provide detailed epidemiological data on caries prevalence on children younger than 6 years of age in Windhoek, Namibia.

From the results of this study, it was established that caries prevalence in pre-school children of urban Windhoek was 55.77% with a mean dmft of 2.38 and there was a positive correlation of 0.2838 i.e. 28.3% ($p<0.001$) between pufa and dmft. The findings of this study can be used as baseline knowledge on the oral health status of preschool children from against which future studies on this topic for other towns and cities in Namibia can be referenced against. The risk factors for ECC included age of children and parental rating of children's oral hygiene status. Children whose parents rated their oral hygiene as poor were more likely to have early childhood caries when compared to children whose parents rated their oral hygiene as good. A higher proportion of children whose parents reported having cavities had early childhood caries.

The relationship between early childhood caries and associated risk factors especially, in relation to oral hygiene habits, feeding habits and socio-economic conditions has been well documented (Prakash *et al.*, 2012a).

The common indicators used for assessing risk factors in most studies have been the child‘s feeding habits and patterns, oral hygiene habits and practices followed by the education and employment status of the parents or care givers. In the present study, feeding and oral hygiene habits and practices along with the education and socio-economic conditions of parents and care givers were assessed.

Although dental caries has been declining globally in general, especially among older children, the contrary has been observed in developing nations. (Mahejabeen *et al.*, 2006). Most oral health surveys have targeted school going children because of their easy accessibility which is not the case in preschool children. The oral health of pre-school children has remained an overlooked and neglected aspect which has rendered them a vulnerable sector of the population.

5.2. Demographic composition

In this study there was a response rate of 43% for the earmarked target population sample amounting to two hundred and fifty (250) children that were examined with a gender distribution of 48% (120) females and 52% (130) males; showing that the gender representation in the study population was comparable with the representation of the total preschool learners population of Windhoek (*Namibia Statistics Agency. Namibia Population and Housing Census 2011.N [accessed 21 August 2018] - Google Search*, no date).

Female children were observed to have an increased likelihood of early childhood caries compared to male children Odds Ratio - OR: 1.94; 95% Confidence Interval - CI: [1.09-3.43]. The majority of participants were 4 years and older with a mean age of 4.70 years and there was not a significant difference in the number of participants amongst the 5- and 6-year olds.

Low maternal education was related to higher caries prevalence in their children. In the study sample of 250 children, 87.5% of children whose mothers had no schooling were affected with caries.

This was statistically significant when compared to those children whose mothers had received higher education. The results of this study are similar to other studies, which showed a strong association between mother's education and presence of caries in their children as was the findings in a study done in central Trinidad (Naidu, Nunn and Kelly, 2013). This may be attributed to the lack of information and awareness about oral health care for children in uneducated mothers. Mothers are the primary care givers of children and thus any tangible efforts aimed at curbing the disease should involve mothers forthwith. There are a number of studies that have found separate but overlapping findings in different settings on the effects of dietary feeding practices as well as parental factors and their influence on early childhood caries development (Rai and Tiwari, 2018; Evans *et al.*, 2013; Feldens *et al.*, 2010; Qin *et al.*, 2008; Ersin *et al.*, 2006; Schroth and Moffatt, 2005)

5.3 Prevalence of caries and pufa

The prevalence of parent-reported caries/cavities was 33.88% and the prevalence of clinically diagnosed caries was 51.54%. Most of the children had a dmft of 3 (n=27; 18.6%) and the mean dmft from the study was 2.38. The mean pufa score for this study was 0.11 and the prevalence pufa score was 6.54% (n=17). These findings were substantially lower than was found in a related study in north east Poland by Bagińska *et al* (2013) were the mean dmft was 5.56 and the pufa experience/prevalence was 2.20/43.4%.

Results from the Namibian National Oral Health Survey of 2010/11 found a caries prevalence of 41.67% for Khomas region and a weighted national average of 42.95% for the age group 5-6 year olds. Although the results from the National Oral Health Survey of 2010/11 provide baseline information especially for the 5-6 year old age group the two studies are not exactly comparable as the one was a national study with specific age groups of which the only relevance was the 5-6 year old age group; (Ministry of Health and Social Services Republic of Namibia, 2013).

Similarly in a study done by Hofstedt and colleagues (1990) which included 6-7 year old children it was found that the caries prevalence among the urban children was higher than the rural children of Windhoek (Hofstedt and Stillerman, 1990).

Another study done in the past on caries prevalence for 5-year-old children in Namibia found a mean dmft of 1.4 nationally and 1.23 for Khomas region in which Windhoek is located (Schier and Cleaton-Jones, 1995). From past studies done a strong association between urbanization/industrialization and increased prevalence of caries has been posited by Bedi (2005) and therefore Windhoek being a major urban city in Namibia with a heterogeneous population, the findings from this study could be used to provide useful baseline knowledge that can be used by healthcare planners.

The increased caries prevalence findings from this study are indicative that increased morbidity as a consequence is to be expected in the near future and as such oral health should become a high priority on the agenda of Namibian public health authorities as is advocated for globally (Kassebaum *et al.*, 2015). Therefore the increased morbidity will have a concomitant effect on the quality of life of children and an increased financial burden on families as was the findings in a study by (Çolak *et al.*, 2013; Tinanoff and Reisine, 2009). Findings from this study indicate a high caries prevalence and a low pufa prevalence. Thus, with the appropriate intervention strategies the disease progression process can be successfully thwarted and optimum oral health can be attained among the preschool population of Windhoek.

5.4 Age distribution versus caries prevalence

Children within the 2-year age group had the lowest dmft score. The 3-4 year-old age group had almost similar dmft scores and the 5-year-old children had the highest dmft score followed by the 6-year olds that was marginally lower than of the 5 year old. The mean dmft scores showed an increasing trend with age except for an inverse relation trend between the 5 and 6-year-old age group. The difference in the

caries prevalence was significant (<0.05) between the age groups of 3-4 years and 4 and 5 years, and highly significant (<0.001) between the age groups of 2 and 5 years.

This increase in caries prevalence with increasing age was consistent with findings in similar studies done in Bangalore, India (Prakash *et al.*, 2012b) and Riyadh, Saudi Arabia (Al-Meedani and Al-Dlaigan, 2016). Therefore the older a child was the higher the prevalence of early childhood caries was (p=0.030). This could be due to increased exposure of the dentition to cariogenic assault in older teeth than in younger teeth.

Goals set by the WHO to have a 20% caries prevalence in 6 year old children by the year 2015 as cited by Hofstedt and Stillerman (1990) it is evident that from this study the caries prevalence for Windhoek's pre-school population is high. An extrapolation can then be deduced that the disease prevalence would even be higher in the permanent dentition given the postulation that caries onslaught in the primary dentition is a precursor for disease affliction in the permanent dentition (Çolak and Dülgergil, 2012).

Results from this study and previous studies done in Namibia are suggestive of increasing caries levels for Namibia as a country contrary to the trend seen in developed nations such as the USA, UK, Japan where there has been a noted decrease in caries levels for the past few decades (Lagerweij and van Loveren, 2015; Silveira Moreira, 2012). Despite this good strides made in the developed countries a paradoxical situation is found in sub Saharan Africa where caries prevalence is on the increase due to increased consumption of refined carbohydrates as a consequence of improved socioeconomic status (Holm, 1990).

5.5 Clinical consequences of untreated tooth decay

Using the pufa index as developed by Monse *et al* (2010) to assess the clinical consequences of untreated decay among the 2-6 year old children attending selected crèches the pufa score was a minimum of 0 and a maximum of 3 with a

mean of 0.11(SD=0.45). The mean pufa was determined to be 0.11. with a total prevalence of 6.54% for the study population which was comparable with a related study done in suburban school children in Nigeria where the mean pufa score was 0.16 (Oziegbe and Esan, 2013).

Though the dmft prevalence was high the clinical consequences as a result were moderate and of relatively low severity which is consistent with a study done in Brazil by Figueiredo *et al.* (2011) where the mean pufa score was 0.4. Thus the mean pufa score from this study was comparable to both studies done in children in suburban Nigeria and Brazil where the mean pufa scores were 0.16. and 0.4 respectively.

In another study by Mehta and Bhalla (2014) on the clinical consequences of untreated tooth decay even though their study was on 5-6 year old children in an urban population in India their findings were comparable to this study for the particular age group where their findings were 0.9 for pufa index and 2.54 for dmft compared to 0.11 pufa and an average of 2.93 dmft respectively from this study. .

5.6 Correlation between dmft and pufa

Spearman's correlation was used instead of Pearson's test because both dmft and pufa were not normally distributed. Also, the variables were ordinal not continuous which is one of the indicators for the use of Pearson's test (Bishara and Hittner, 2012).

There was a positive correlation of 0.2838 i.e. 28.3% ($p<0.001$) between pufa and dmft as the two variables being studied were showing a direct proportional increase. Statistical analysis revealed a strong relation between dmft and pufa in especially the 4,5 and 6 year age groups. The presence of non-treated tooth decay (dmft) in this study population had a direct proportion on the presence of clinical consequences (pufa).

Even though the pufa prevalence of 6.54% and a mean pufa score of 0.11 were fairly low in comparison to the dmft prevalence of 55.77% and mean dmft score of

2.38 respectively for this study. When compared to other similar or related studies from north east of Poland (Bagińska *et al.*, 2013).; where prevalence and mean scores for dmft and pufa were 43.4% and 5.56 for 5year olds and 72.4% and 6.69 for 7 year olds with pufa scores of 2.2 for 5year olds and 2.44 for 7 year olds respectively, still a positive correlation was found between caries prevalence and clinical consequences.

The work of Mehta and Bhalla (2014) showed positive and significant correlation of dental caries and clinical manifestations as a consequence. Though the findings from their study were higher than this study it should be noted that their study was only on 5-6 year old children, whereas this study's findings are on 2-6 year old children.

Findings from this study should be cautiously weighed as the study population differed from their study population, however there were commonalities worth noting. From the results it can be deduced that given enough time, more than half of the children from the study group would at least develop pain as a consequence of untreated tooth decay and as a consequence healthcare planners need to design appropriate curative programmes soon.

5.7 Correlation of oral hygiene practises and early childhood caries - ECC

Despite the fact that parents/care takers indicated that they actively assisted their children in the execution of their daily oral hygiene duties prevalence of early childhood caries by oral hygiene practices ranged between 50-66%.

From the research findings a higher proportion of children whose parents reported having cavities had early childhood caries (65.85% vs. 50.63%; p=0.029). The lower the duration of tooth-brushing, the more the proportion of early childhood caries was. There was no significant difference in the proportion of caries with other oral hygiene practices such as the frequency of child's tooth brushing, frequency of flossing in a day, quantity of toothpaste used, use of pacifiers and thumb sucking.

Results from this study have shown a strong association between parent's rating of oral hygiene status of child and an increased presence of early childhood caries. Children whose parents rated their oral hygiene as poor were more likely to have early childhood caries when compared to children whose parents rated their oral hygiene as good.
This was consistent with similar results from a Brazilian study done by Corrêa-Faria *et al* (2016) were the prevalence of early childhood caries was 53.6% due to poor oral hygiene practises.

Children who were either 5 years Odds Ratio - OR: 4.36; 95% Confidence Interval - CI: [1.02-18.57] or 6 years Odds Ratio - OR: 5.05; 95% Confidence Interval - CI: [1.18-21.61] were more likely to have early childhood caries than 2-year olds.

From this study a strong congruence can be inferred with studies done in India and Brazil, where similarities in socio-economic conditions are a prevailing common denominator (Kundu *et al.*, 2015; Holm, 1990). It has thus emerged from this study that poor oral hygiene practices due to a lack of appropriate dental health knowledge had a major contributory effect on the increased prevalence of early childhood caries.

5.8 Limitations of the study

This study was a cross-sectional study and cross-sectional studies are inherently flawed in the sense that their findings are period specific and cannot be used to analyze behavior over an extended period. They fail to prove the temporal relationship between exposure and outcome and they are beset with a high propensity for potential bias.

The lack of use of diagnostic intra oral radiographs, the challenging settings in which the clinical examinations were conducted and difficulties in obtaining optimum cooperation from the patients being examined, has made it difficult to conduct this

dental research examinations under ‘ideal’ clinical settings. Therefore, the results of this study may have an inherent under estimation of dental caries. Dental caries prevalence would probably have been higher had probes/explorers and intra oral radiographs been used.

Populations of young children at risk for dental caries were difficult to recruit because they were not enrolled in large numbers in institutional settings where they would be easily accessible for research related studies.
Lack of understanding regarding the importance and relevance of dental research from parents/caregivers and owners of creches which influenced their decision making resulting in refusal to participate in the study.

In this study, a small randomly selected urban population sample was selected and as such the research results found should be cautiously interpreted as representative of populations other than the one being studied if comparisons are made against incongruent national and discordant sized population studies.

The lack of other studies with which to compare the results from this research study for preschool learners of Windhoek may be a limitation but certainly the findings from this study can be used as baseline knowledge for future similar or related studies.

Chapter 6. Conclusions and recommendations

6.1 Conclusion

This study sought to determine the caries prevalence of pre-school children aged 2-6 years in Windhoek, Namibia.

From the results of this study, it was established that caries prevalence in pre-school children of urban Windhoek was 55.77% with a mean dmft of 2.38 which is considered high when compared with other countries. An increase in age was positively correlated with an increase in dmft. The pufa prevalence was determined at 6.54% with a mean of 0.11 and the study showed that there was a positive correlation of 0.2838 i.e. 28.3% ($p<0.001$) between pufa and dmft meaning that a direct proportional relation was exhibited between the two variables which means as the dmft variable increased so also did the pufa variable increase.

Correlation of oral hygiene practises associated with early childhood caries was established and a 50-66% caries presence in children was found despite parents indicating that they were actively involved with daily oral hygiene practises of their children. Children whose parents rated their oral hygiene as poor had increased prevalence of early childhood caries than children whose parents rated their children's oral hygiene as good.

This study has conclusively proven that there is a high caries prevalence among the preschool population of Windhoek which could have deleterious effects on the general health in this population

6.2 Recommendations

The following recommendations are made on the basis of the findings:

6.2.1 Preventive oral health promotion programmes

Oral health promotion programmes aimed at prevention of early childhood caries must be developed and actively promoted via all available platforms such as for example radio, television, newspapers, magazines, and social media.

6.2.2 Studies on caries prevalence of pre-school children in rest of Namibia

From the findings of this study dental researches, policy makers and dental healthcare practitioners should focus on future studies that will shed more knowledge on the caries prevalence of preschool children population of Namibia in order to devise an encompassing national oral health policy programme.

6.2.3 Identification of communities and individuals with high caries risk

Dental professionals should establish systematic continuous periodic dental screenings within the various communities and pay special attention to families with mothers with low education levels, whereby early detection of groups of children at increased risk of early childhood caries development can be done.

6.2.4 Toothbrushing with fluoridated toothpaste

Brush in programmes at all creches must be established where all preschool children can be taught the correct tooth brushing methods using fluoridated toothpaste.

6.2.5 Counselling to Reduce Harmful Behaviours

Counselling aimed at parents to change their behaviours and adopt preventive dental behavioural practices that will result in reducing the risk of early childhood caries development .

6.2.6 Dental Referral

Children identified with early childhood caries should be immediately referred to dental professionals for prompt treatment.

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Appendices

Appendix 1. Information leaflet for research on preschool children.

Appendix 2. Parent's/guardian's/care giver's consent form for dental research involving a minor child.

Appendix 3. Oral health questionnaire for parent's/guardian's/care givers, seeking information on behalf of and of relevance to minor child.

Appendix 4. Oral health clinical assessment form.

Appendix 5. Human Research Ethics Clearance Certificate (Wits).

Appendix 6. Human Research Ethics Clearance Certificate (MoHSS).

Appendix 1: Information cover letter for research on preschool children.

Caries prevalence amongst pre-school children in Windhoek, Namibia

Your child is being invited to participate in a research study. Participation in this research study is voluntary and confidentiality is assured. No individual data will be reported.

Thank you for taking the time to read this information leaflet.

RESEARCH TEAM: Dr. Moses Aluteni, currently a registered student for the MSc Dentistry degree at the University of the Witwatersrand, School of Oral Health Science; is leading this research project. Our contact details are included at the end of this document.

WHAT ARE THE OBJECTIVES OF THIS STUDY? The purpose of the study is to determine the prevalence of early childhood caries amongst 2 – 6-year-old children in Windhoek urban area.

WHY HAVE I BEEN INVITED TO TAKE PART? You have been approached to participate in this research, as you are a parent/guardian of a pre-school/ crèche-going learner.

WHAT WILL HAPPEN IF YOU VOLUNTEER? Your participation is entirely voluntary. If you agree to participate, your child will be invited to take part in a dental/oral clinical examination. This would involve a basic examination of the mouth. The instruments we would be using would be a disposable wooden spatula, light disposable gloves and a mask. We would want to count the number of decayed (rotten) teeth and the number of healthy teeth. We would also assess the state of the gums and other soft tissues. You will be asked to complete an oral health questionnaire on behalf of your child and this information may have direct relevance to your child's prevailing oral health status.
There is neither cost nor payment to the participants involved in this study.

CONFIDENTIALITY:
Your child's name will not be used when data from this study is published. Every effort will be made to keep clinical records, research records and other personal information confidential.

WHAT ARE THE BENEFITS OR RISKS ASSOCIATED WITH THE STUDY? While there will be no direct benefit to you from the study, the findings have the potential to make a contribution to our understanding of the oral disease prevalence (the extent of the number of children who have rotten teeth) and associated risk factors for early childhood caries amongst the pre-school age population in Windhoek urban area (we will determine this from the response you provide in the questionnaire that you as the parent/caregiver will be asked to fill in). As such, the findings from this study will be presented at university level and at national and international conferences. The findings will also be submitted for publication in peer-reviewed journals.

However, no individual participant will be identified in any publication or presentation and only anonymised quotes will be used in these reports and publications. There are no known risks associated with participation.

RIGHT TO WITHDRAW: You can decide to withdraw from the study at any point without any consequence. You can contact the researchers to request this.

HOW WILL YOUR INFORMATION BE USED? Your responses that we receive from the filled-out questionnaires, together with the results we obtain from the clinical oral examination, of your child, will be combined and reported as part of the finding of this study. They may be compared to findings of studies done in other parts of the country, or to other international studies. However, it is important to indicate that individuals will remain anonymous.

NEXT STEPS: If you are willing to take part in the study, we would ask you to please return the attached 'Parent's/guardian's permission (consent) form for dental research involving a minor child' Appendix 2 to the principal's office at your child's crèche.

FURTHER INFORMATION & CONTACT DETAILS: If you have any further questions about the research or would like information on the findings, you can contact:

Principal researcher: Dr. Moses Aluteni
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This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg ("Committee"). A principal function of this Committee is to safeguard the rights and dignity of all human subjects who agree to participate in a research project and the integrity of the research.
If you have any concern over the way the study is being conducted, please contact the Chairperson of this Committee who is Dr. Clement Penny, who may be contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za

Thank you for reading this Study Information Sheet.

Appendix 2: Parent's/guardian's/care giver's consent form for dental research involving a minor child.

Title of project:
Caries prevalence amongst preschool children in Windhoek, Namibia

1. I have been given a Participant Information Sheet which explains the nature and processes involved in this study;
2. I was given time to read it, or had it read to me, in the language I best understand;
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;
4. I believe I fully understand why the study is being conducted and what the intended outcomes will be;
5. I understand that there will be no immediate benefit to me or my child, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw my child from the study at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained
7. I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study, I am free to speak to any of these contacts.

Contact details:

Dr. M Aluteni, Principal Investigator, telephone no. 26461304180/8, or by e-mail at mosesaluteni@gmail.com

Professor V Yengopal, Supervisor, on telephone no. +27 11 717 2593, or by e-mail at Veerasamy.Yenugopal@wits.ac.za

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. +27 11 717 2301, or by e-mail at Clement.Penny@wits.ac.za

Name of Parent/Guardian/Caregiver of Participant (please print):

_____

Name of Child Participant (please print):

_____

Date: _____
Place: _____
Signature or mark _____

Witnessed by:
Name of Witness: _____
Signature: _____
Date: _____

Appendix 3: Oral health questionnaire for parent's/guardian's (care givers), seeking information on behalf of and of relevance to minor child.

Name of child: (enter code only) .....

Name of crèche: (enter code only).....Constituency: …….

1. Gender of child: Male Female

2. What is your highest qualification?

	Father	Mother
•	No schooling	•
•	Secondary school	•
•	High school	•
•	College/university	•

3. How many people are currently living in your household, including yourself? ___. Of these people, how many are children? ___

4. How would you rate your own oral health?
(i) Good (ii) Fair (iii) Poor

5. How often do you visit your dentist?
(i) Only when I have a problem (ii) Once a year
(iii) Every 6 months (iv) I don't visit the dentist at all

6. How often during the past 12 months did you have a toothache or felt discomfort due to your teeth?
(i) Often (ii) Occasionally (iii) Rarely (iv) Never

7. Do you have any cavities? Yes/No Do your gums bleed? Yes/No

8. What happens if you eat a lot of sweets? (please tick)
(i) It's good for your teeth (ii) It's bad for your teeth
(iii) It has no effect on your teeth (iv) Don't know

9. What happens if you drink a lot of cold drink/juice drinks? (please tick)
(i) It's good for your teeth (ii) It's bad for your teeth
(iii) It has no effect on your teeth (iv) Don't know

10. Not cleaning your teeth everyday can cause. (please tick)
(i) Tooth decay (ii) Gum disease (iii) Bad breath
(iv) All of the above (v) Cause nothing (vi) Don't know

11. Do you clean your child's teeth? Yes/No
Do you use a toothbrush to clean your child's teeth? Yes/No
Do you use toothpaste to clean your child's teeth? Yes/No
Do you help your child with tooth brushing? Yes/No

12. What do you use for cleaning your child's teeth? (please tick)
(i) Brush + toothpaste + dental floss (ii) Dental floss only
(iii) Brush + toothpaste only (iv) Don't know

13. How often do you brush your child's teeth each day? (please tick)
(i) Less than once a day (ii) Once a day
(iii) Twice a day (iv) More than twice a day

14. When do you normally brush your child's teeth? (please tick)
(i) In the morning (ii) In the evening
(iii) Both morning and evening (iv) Don't know

15. How often do you floss your child's teeth each day? (please tick)
(i) Three times a day (ii) Once a day
(iii) Twice a day (iv) Never

16. How much toothpaste do you normally put on your child's toothbrush? (please tick)
(i) Full length of bristles (ii) About the size of a grain of rice
(iii) About the size of a pea (iv) Half-length of bristles

17. How long do you normally take to brush your child's teeth? (please tick)
(i) About 30 seconds (ii) About 2 minutes
(iii) About 1 minute (iv) Don't know

18. Does your child use a pacifier? Yes/No
Does your child suck a thumb or fingers? Yes/No
Have any of your children ever had cavities? Yes/No
Does your child complain of mouth pain? Yes/No
Does your child take a baby bottle to bed? Yes/No
Does your child walk around drinking from a bottle or cup? Yes/No

19. How is your child's dental health? (Please tick)
(i) Good (ii) Fair (iii) Poor

Date: .....

Appendix 4: Oral health clinical assessment form.

ORAL HEALTH CLINICAL ASSESSMENT FORM

Pre-school Name (enter code only)	
Parental Consent: Yes No	
Constituency:	

Enter patient no	

Date of Examination							
	Y	Y	M	M	D	D	

Age		
Gender (1- female, 2- Male)		

Intra-oral assessment	**YES**	**NO**
Any abnormal condition		
Ulceration (Apthous, Herpetic, Traumatic)		
Candidiasis		
Abscess		
Other (specify)		

DENTITION STATUS AND TREATMENT NEEDED

*for each **d/D**, please check for **pufa/PUFA***

Dentition

	16	**55**	**54**	**53**	**52**	**51**	**61**	**62**	**63**	**64**	**65**	**26**
dmf/ pufa Status												
Treatment												
	46	**85**	**84**	**83**	**82**	**81**	**71**	**72**	**73**	**74**	**75**	**36**
dmf/ pufa Status												
Treatment												

STATUS		
Permanent tooth		**Primary tooth**
0	Sound	A
1	Decayed	B
2	Filled and decayed	C
3	Filled, no decay	D
4	Missing due to carries	E
5	Missing any other reason	
6	Sealant, varnish	F
7	Bridge abutment or special crown	
8	Un-erupted tooth	
9	Excluded tooth	

TREATMENT	
0	None
1	Caries arrest. Or sealant care
2	1 Surface filling
3	2 or more surface filling
4	Crown on bridge abutment
5	Bridge element
6	Pulp care
7	Extraction
8	Need for other care
9	Specify

Summary of Dental Status

D/d		P/p	
M/m		U/u	
F/f		F/f	
DMFT/dmft		A/a	

D/d: decayed

M/m: Missing

F/f: filled

P/p: pulpitis

F/f fistula

U/u ulceration

A/a Abscess

Appendix 5: Human Research Ethics Clearance Certificate (Wits).

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

Office of the Deputy Vice-Chancellor (Research & Post Graduate Affairs)

TO: Dr M Aluteni
School of Oral Health Sciences
Department of Community Dentistry
Dental School
University

E-mail: mosesaluteni@gmail.com

CC: Supervisor: Professors V Yengopal & SM Nemutandani
<Veerasamy.Yengopal@wits.ac.za>
and <HREC-Medical.ResearchOffice@wits.ac.za>

FROM: Iain Burns
Human Research Ethics Committee (Medical)
Tel: 011 717 1252

E-mail: Iain.Burns@wits.ac.za

DATE: 2019/06/24

REF: *R14/49*

PROTOCOL NO: **M190243** *(This is your ethics application study reference number. Please quote this reference number in all correspondence relating to this study)*

PROJECT TITLE: *Caries prevalence amongst pre-school children in Windhoek, Namibia*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to the Government funding of the University.

MSWorks2000/Iain0007/Clearscan.wps

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr M Aluteni

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M190243

NAME: (Principal Investigator)	Dr M Aluteni
DEPARTMENT:	School of Oral Health Sciences Department of Community Dentistry Dental School University
PROJECT TITLE:	Caries prevalence amongst pre-school children in Windhoek, Namibia
DATE CONSIDERED:	2019/02/22
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Professors V Yengopal & SM Nemutandani
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2019/06/24

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the 3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **February** and will therefore reports and re-certification will be due early in the month of **February** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE CLEARANCE CERTIFICATE NUMBER IN ALL ENQUIRIES

Appendix 6: Human Research Ethics Clearance Certificate (MoHSS).

REPUBLIC OF NAMIBIA

Ministry of Health and Social Services

Private Bag 13198
Windhoek
Namibia

Ministerial Building
Harvey Street
Windhoek

Tel: 061 – 203 2562
Fax: 061 – 222558
E-mail: hnangombe@gmail.com

OFFICE OF THE EXECUTIVE DIRECTOR

Ref: 17/3/3 **MA**
Enquiries: Dr. H. Nangombe

Date: 28 March 2019

Dr. Moses Aluteni
PO Box 23769
Windhoek

Dear Dr. Aluteni

Re: Caries prevalence amongst pre-school children in Windhoek, Namibia

1. Reference is made to your application to conduct the above-mentioned study.

2. The proposal has been evaluated and found to have merit.

3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**

3.1 The data to be collected must only be used for academic purpose;

3.2 No other data should be collected other than the data stated in the proposal;

3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;

3.4 A quarterly report to be submitted to the Ministry's Research Unit;

3.5 Preliminary findings to be submitted upon completion of the study;

3.6 Final report to be submitted upon completion of the study;

3.7 Separate permission should be sought from the Ministry for the publication of the findings.

4. All the cost implications that will result from this study will be the responsibility of the applicant and **not** of the MoHSS.

Yours sincerely,

PERMANENT SECRETARY
MINISTRY OF HEALTH & SOCIAL SERVICES

MR. BEN NANGOMBE
EXECUTIVE DIRECTOR

"Health for All"