

**Sensitivity to sweet and bitter taste in mother/child pairs
and its influence on their caries status**



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**A mini- thesis submitted in partial fulfillment of the requirements for the degree
of MSc (Dent) in Dental Public Health, University of the Western Cape**

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**Sensitivity to sweet and bitter taste in mother/child pairs and its
influence on their caries status**

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Keywords:

Taste Sensitivity

PROP

Bitter Taste

Super-tasters

Medium tasters

Non-tasters

High sugar preference

Low sugar preference

Dental caries.



Abstract

Introduction: Dental caries has one the highest incidences in children and the host's diet may be a major factor in determining susceptibility to the disease. A proposed tool to screen and identify high risk individuals uses a bitter compound 6-n-propylthiouracil (PROP). The goal of this screening tool is to identify mothers and children who are *Non-tasters* (those who cannot taste PROP) and to educate them about their possible affinity towards sugar substances and its harmful effects on oral and general health. It is suggested that *Non-taster* children could be prioritized when providing preventative dental treatment.

Aim: To validate the use of PROP as a screening tool for determining high caries risk individuals by identifying the taster status of mothers and children, their preference towards sugar, and its impact on their caries status.

Methodology: 75 mother/ child pairs were recruited to participate in this study. Caries experience, sugar preference and taster status were determined for all the subjects. Comparisons were made between mothers and their children to find a possible association.

Results: Caries experience was greater in individuals who were *Non-tasters* when compared to *Super-tasters*. A significant association between taster status and DMFT score was established ($p < 0.000$). A significant association between taster status and sugar preference was established ($p < 0.000$). A positive correlation with regard to taster status, sugar preference and caries experience was observed in mother/child pairs.

Conclusion: Similarities in the mother's and child's PROP taster status and its association with sugar preference allows such a screening test to identify individuals who are at high risk of developing dental caries. Early identification of mothers who are *Non-tasters* may allow the introduction of early intervention strategies and assist in the early detection of potentially high-risk children, especially in environments where resources are limited.

DECLARATION

I hereby declare that “**Sensitivity to sweet and bitter taste in mother/child pairs and its influence on their caries status**” is my own work, that it has not been submitted before for any degree or examination in any university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Vineeth Varghese

Nov 2018

Signed:



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ACKNOWLEDGEMENTS

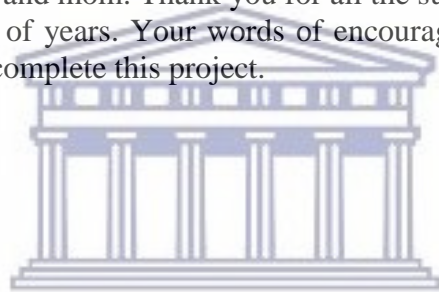
I wish to express my deepest gratitude to all those who have played a vital role in the completion of my work.

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Department of Health, Eastern Cape. Thank you for the permission granted to conduct this research

My wife Rose, my dad and mom. Thank you for all the support, prayers and sacrifices during the past couple of years. Your words of encouragement and support was my greatest motivation to complete this project.



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DEDICATION

I would like to dedicate this work to:

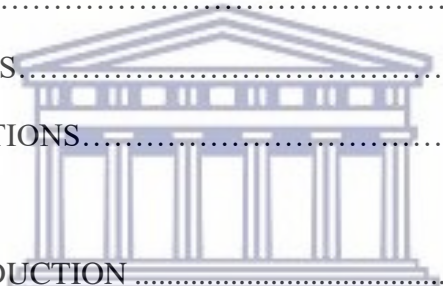
My beloved wife and parents for your constant support, prayers
and sacrifice.



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List of Abbreviations

PROP	6-n-propylthiouracil
ST	Super taster
MT	Medium taster
NT	Non- taster
DMFT	Decayed, Missing, Filled
DT	Decayed Teeth

CHAPTER 1

INTRODUCTION

Dental caries has a high prevalence among children with an estimate of 60-90% of school children being affected globally (Peterson, 2005). Diet, specifically sugars, has been identified as a major factor in determining susceptibility to the disease. Various strategies have been proposed to prevent dental caries such as fluorides and fissure sealants, however, in developing nations, due to the lack of resources, it is not feasible for every child to receive preventative treatment. Therefore, children who are at high risk must be identified and prioritized when providing preventative treatment. A proposed tool to screen and identify high risk individuals was suggested using a bitter compound 6-n-propylthiouracil (PROP). This method will be the focus of this study. The use of PROP can assist in categorizing individuals who are Tasters (those who can taste PROP), and non-tasters (those who cannot taste PROP). Non-tasters have a liking towards sugar substances predisposing them to dental caries. This categorization of individuals into the two groups can identify those who are at high risk depending on their taster status (Hegde and Sharma, 2008). Categorization of mothers as early as at pregnancy may assist in identifying their child's taster status as studies have shown that the ability to taste PROP is genetically inherited. Additionally, mothers who are identified as non-tasters have a greater affinity towards sugar substances which ultimately influences the child's sugar preference.

The goal of this screening tool was to identify mothers' and children who are non-tasters, to educate them about their affinity towards sugar substances and its harmful effects on oral health and general health. Additionally, non-taster children can be prioritized when providing preventative treatment. The aim of this study was to validate the use of PROP as a screening tool for determining high caries risk individuals by identifying the taster status of mothers and children, their preference towards sugar, and its impact on their caries status.

CHAPTER 2

LITERATURE REVIEW

2.1 Background

Dental caries has one the highest incidences in children and the host's diet may be seen as a major factor in determining susceptibility to the disease (Tomita and Bijella, 1996). Dental caries occurs as a result of bacterial acids that penetrate into the tooth structure demineralizing the organic components. These acids are produced by the oral bacteria following their metabolism of fermentable carbohydrates (Featherstone, 2008). Knowing the cariogenic power of fermentable carbohydrates, especially sugar, it makes it very important to analyze the dietary habits of the population (Chaves *et al*, 2003).

2.2 Familial Patterns in Dental Caries and Sugar Preference

Similar patterns in dental health has been found within families. Studies conducted by Klein in the 1940's had observed the relationship between the caries status of parents and children and concluded that children have a tendency to reflect the caries status of their parents in themselves (Klein, 1946; Klein 1947). Other studies conducted have exhibited similar findings and, in addition, found that similarities in mother/child caries pattern were greater than those of father/child (Ringelberg and Matonski, 1974; Garn *et al*, 1976; Pordeus, 1991).

Similarly, members of the same family exhibit similar patterns of sugar preference. Studies have shown that mothers are a strong influence on the pattern of sugar preference of their offspring (Rossow *et al*, 1990). Dietary habits linked to oral health are transmitted from mother to child (Rose, 1987; Pordeus, 1991). Dietary Patterns, specifically sugar, has been associated as one of the determinants for similarities in caries experiences between parents and children (Shaw and Murray, 1980).

In a study conducted by Maciel *et al* (2001), 255 children and mothers were recruited into the study. The mother's sugar preference had a weak but significant association with the preference of their children. A similar pattern in caries experience between mother and child pairs was observed within this population. The degree of similarity between mothers and their children in relation to their caries and sweet preference suggested that mothers play a crucial role in establishment of their children's dietary choices and dental health.

If mothers frequently provide their children with sugar items during their early years, a tendency to have an affinity towards sweet foods is seen among children, as their need for sweetness escalates with frequent exposure (Desor *et al*, 1979). The intensity of dental caries in children may be due to the frequent sugar consumption and high sugar preference. A preference for sweet substances may result in a high sugar intake amongst the majority of children (Lehl *et al*, 1999). Jamel *et al* (1996) conducted a study in Iraq (n=4157) across all ages and genders. Subjects were required to taste solutions with different concentrations of sugar to determine sweet preference. A positive association between DMFT levels and preference for sweetness in all population groups was observed. Of the total sample, 34.7% was caries-free and it was noted that no subjects from this caries free group preferred the solution with the highest concentration of sugar (0.59M). In the group with a DMFT score of 1-3, 34% of subjects chose the solution with the highest concentration. 63% of subjects in the group with the DMFT score of 4-6 chose the highest concentration followed by 86% in the group with scores 7-10 and 100% of subjects with a DMFT score of 10 or more. From these results one can conclude that the higher the preference for sugar, the more likely to have an increased caries index. The study recorded the number of cups of sweet tea taken daily to measure the frequency of sugar consumption. A strong association between caries prevalence and the number of cups of sweet tea taken daily was observed confirming that frequent sugar consumption has an association with caries experience (Jamel *et al*, 1997).

The more sugars people consumed, the higher their thresholds for sweetness. Therefore, they require more sugars in their foods to achieve the preference level of sweetness (Jamel *et al*, 1997).

Cagnani *et al* (2014) conducted a study to observe the relationship between preference for sugar and prevalence of caries amongst 96 children. A modified version of the ‘Sweet Preference Inventory’ was used to measure sweet preference. The author concluded that the majority of the subjects preferred the sweetest solutions, however no association between higher sugar preference and higher levels of dental caries could be established.

In a systematic review conducted by Burt (2001), the author concluded that the association between sugar consumption and caries is much weaker in the recent years due to exposure to fluoride. Controlling sugar consumption is an important factor in caries prevention, however it is not the only relevant aspect.

2.3 Familial Patterns in Food Preference

Patterns of food preference can be seen in families and this suggests the existence of congenital predisposition toward similar tastes (Skinner *et al*, 2002). In particular, food preference is found to be related to the genetic sensitivity to taste (Anliker *et al*, 1991). Individual variations in food selection and taste preferences are a result of variations in a taste receptor gene that influence the taste sensitivity in humans. That means genetic variations in taste perception might contribute to differences in food preferences. Therefore, perceptions of bitterness and sweetness vary depending on one's genes (Anliker *et al*, 1991). Several studies of bitter taste receptors in mammals suggest that there are almost 30 receptor genes (Behrens and Meyerhof, 2009). The gene responsible for variation in PROP sensitivity is TAS2R38 which resides on human chromosome 7 (Kim *et al*, 2003).

2.4 Sensitivity to Bitter Taste

The genetic sensitivity to bitter taste can be measured using a bitter compound 6-n-propylthiouracil (PROP) (Bartoshuk *et al*, 1974). The human population across all ages can taste compounds that contain phenylthiocarbamide (PTC) and its derivative propylthiouracil (PROP) (Bartoshuk *et al*, 1974).

PROP is used to treat Graves's disease (hyperthyroidism) with a daily dose of 150-200mg of PROP for adults and daily dose of 50-150mg for children. However, PROP can be tasted at a low concentration. Paper strips containing 1.6mg of PROP are used for taste research (Lin, 2003). PROP is used as a tool by researchers to understand the genetics of taste and to gain knowledge of the endless variation in taste and food preferences that exist in the human population (Rupesh and Nayak, 2006).

Taster status has been defined as the degree to which an individual is able to perceive the bitter taste of PROP. Individuals are categorized as super-tasters (ST) (high sensitivity to bitter taste), medium tasters (MT) (moderate sensitivity), and non-tasters (NT) (low/no sensitivity) based on their intensity rating towards substance. Taste sensitivity to PROP is associated with a dislike for sweet flavours (Verma, 2006).

Other than genetics, variations in PROP sensitivity can also be due to anatomical differences amongst the population. The number of fungiform papilla present on the dorsal surface of the tongue influences an individual's taster status. Yeomans *et al* (2007) observed that PROP tasters had an increased number of fungiform papilla and functional taste buds were located on the apex of the tongue which explains their increased sensitivity to basic tastes such as sweet and bitter. Similar observations were made by de Wijk *et al* (2007) among PROP tasters which explained the increased sensitivity to basic tastes such as bitter and sweet. Females have more fungiform papillae and taste buds thus females were observed to be the majority of super-tasters (Bartoshuk *et al*, 1994 and Drewnowski *et al*, 1998).

In a study conducted amongst Filipino adults, no significant relationship between gender and PROP taster status was found. Within the female subjects who took part in this study, 11% were non-tasters and 89% were tasters. The results among the male subjects did not differ greatly; where 17% were non-tasters and 83% were tasters (Villarino *et al*, 2009).

Prescott *et al*. (2001) reported that super-tasters perceived higher intensities for the four taste qualities measured (i.e., sweet, bitter, sour, salty) than either medium or non-tasters. In this study, medium and non-tasters tended not to rate the intensities differently.

However, Drewnowski *et al* (1997) tested hedonic response and intensity perception over a range of sucrose mixtures in subjects and did not find any significant PROP sensitivity associated with enhanced perception of sweetness.

Looy and Weingarten (1992) linked adults with increased PROP sensitivity to be “sweet dislikers” and those with lower sensitivity to PROP to be “sweet likers”. Similar findings were observed by Hegde and Sharma (2008) where they concluded that super-tasters tended to dislike sweet food and non-tasters tended to like sweet food.

2.5 PROP as a screening tool

A study was conducted by Hegde and Sharma (2008) to determine genetic sensitivity to PROP as a potential tool to screen for dental caries. They concluded that children who were non-tasters exhibited a higher caries experience as compared to super-tasters and medium-tasters. This was in agreement to the findings by Rupesh and Nayak (2006) who conducted a similar study. They observed that as the sensitivity to PROP

increased, there was a significant decrease in caries status within the population. Both studies suggested that PROP test was a potential tool to identify subjects who are at a higher risk to develop dental caries after determining their sensitivity levels to bitter taste.

2.6 Comparisons between taster status, sugar preference and dental caries

Verma (2006) conducted a study on 500 children comparing their PROP taster status to caries experience. 33.4% were found to be non-tasters, whilst 66% were tasters. This is similar to the study by Lin (2003), where number of non-tasters were significantly lower (11%) than super tasters. Verma pointed out that the overall caries experience was significantly higher in the non-taster group as compared to the tasters. The increased caries experience can be explained by the increased sugar consumption by the non-taster children.

In a study conducted by Bartoshuk *et al* (1974), results showed 80.6% of supertaster children did not prefer sweets whereas 73.6% of non-tasters preferred sweets. But, only 25% of children who are medium tasters preferred sweets. Similar findings were also found by the same author in another study (Gent and Bartoshuk, 1983).

However, Keller and Tepper (2004) also concluded that taster children consumed sweeter snack foods like table sugar, soft drinks, candy and bakery sweets than non-tasters. Similar findings by Manella *et al* (2005) showed that 8yr old tasters preferred high concentrations of sucrose solutions and liked sweeter breakfast cereals. Children who were super tasters and medium tasters preferred liquids and foods that were significantly higher in sugar when compared with non -taster children, whereas the opposite had been observed with the studies in adults (Manella, 2005).

The preference for sweet tastes was associated with age and ethnicity, in agreement with studies that demonstrated that adults preferred lower levels of sweetness than children. Similarly, Europeans have lower sweet preference than those of African descent (Looy and Weingarten, 1992).

Adults and children who are non-tasters (NT) had significantly lower perceived sucrose intensity ratings as observed by Feeny *et al* (2010) and therefore would use more sugar as they have a lowered response to sweet taste. Verma *et al* (2006) pointed out that children who are insensitive to bitter taste, exhibited a higher prevalence of dental caries.

2.7 Non-tasters

Non-tasters to PROP are present in virtually all populations around the world, however, it depends on their race and ethnicity (Tepper, 1998). The approximate frequency of non-taster individuals among Caucasians is 30%. According to the various studies conducted around the world, approximate frequencies of non-tasters are lower (10-20%) in the Chinese, Japanese and in North Africa but can exceed 50% in studies amongst the Indian population (Guo and Reed, 2001). An explanation for this variation has not been understood. Some people can detect the bitter taste of PROP, however, others either cannot detect the bitter taste or need a high concentration to recognize its presence.

2.8 Conclusion

Non-tasters has a preference for sugar with an increased overall caries experience and supertasters tended to have a decreased preference with a decreased overall caries experience. Super tasters are more likely to avoid sweet food because their oral sensations are too intense to accept the strong sweet taste thus ultimately making super tasters less susceptible to dental caries (Pidamale *et al*, 2012). However, a study

conducted by Drewnowski (2001) had contradicting findings where super tasters had no significant dislikes towards sweetened solutions or sweet foods (Drewnowski, 2001).

Previous studies have made comparisons between PROP taster status and sugar preferences and PROP taster status and caries experience, but very few studies have looked into the PROP taster status of mothers and compared it to their children and observe its influence on their sweet preference and ultimately, their caries status.

The ability to identify high caries-risk children is of great importance in a developing nation such as South Africa. A screening tool using PROP may be a solution to identifying high caries-risk individuals.

Up to now, such taste sensitivity tests, and their association with dental caries, have only been conducted outside South Africa, so the purpose of this study was to gain insight into the variations of taste between mothers and their children, in a lower socio-economic status community of South Africa and explore its association with dental caries.



CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 AIM

The aim of this study was to investigate the association between dental caries, sweet taste preference and sensitivity to bitter taste in mother/child pairs.

3.2 OBJECTIVES:

- To compare the DMFT of mothers to the DMFT/dmft of children.
- To compare the sensitivity towards PROP amongst mothers and their children.
- To compare the sweet preferences of mothers and their children.
- To compare the relationship between non-tasters and tasters towards sweet preference.
- To compare the relationship between taster status and caries status.
- To compare preferences for sweet substances among different age groups.

3.3 METHODOLOGY

3.3.1 Study Design

The study design was a cross sectional analytical study

3.3.2 Sample Population

The target population for this study was 75 mothers and their children ranging between 6-16 years and of both sexes. Subjects were recruited at Empilweni Gompo Dental Clinic in East London.

3.3.3 Inclusion Criteria

- Children and their biological mothers
- Children 6-16 years of age

3.3.4 Exclusion Criteria

- Subjects who were on antibiotic therapy
- Subjects with fixed orthodontic appliances
- Subjects who are diabetics
- Individuals who reported a restriction on sugar consumption

3.3.5 Ethical Consideration

Participants were first approached in the waiting area and were invited to participate in the study. The general features of the study were explained to the volunteers and a patient information sheet was given (**APPENDIX 1**), after which they were expected to sign a written consent form (**APPENDIX 2**) if they wished to participate. An additional patient information sheet (**APPENDIX 3**) and consent form (**APPENDIX 4**) was designed in Xhosa for their convenience. Approval from the Department of Health, Eastern Cape was obtained to conduct the research at the clinic (**APPENDIX 7**). Approval from the Biomedical Research Ethics Committee of the University of Western Cape was obtained (**APPENDIX 8**).

3.3.6 Data collection and procedures

A questionnaire was used to collect data such as medical history, age, sex and dietary sugar preferences. Other data such as caries status and preference to bitter

and sweet taste tests was also collected and recorded on a data collection form (APPENDIX 5). Once the data was collected, it was transferred and recorded on a summary sheet (APPENDIX 6). All oral examinations, sugar preference and PROP testing were carried out at the same time of the day between 7am and 8am throughout the study.

3.3.6.1 Assessing oral health

Caries experience was assessed using the dmft index (number of decayed, those with extraction indication and filled deciduous teeth) and DMFT index (number of decayed, missing and filled permanent teeth), according to the diagnostic criteria defined by the World Health Organization (WHO, 1997). A single examiner, with the aid of a recorder carried out all the examinations. Clinical examinations were conducted according to WHO recommendations, under natural light, ambient conditions, with the aid of a clinical mirror after cleaning the teeth with gauze to remove food debris when necessary. Biosecurity standards were met by the field team.

3.3.6.2 Sweet Preference Test

The test of preference for sugar was prepared in accordance with a modified version of the “Sweet Preference Inventory”. For this test, concentrated juice products always of the same commercial brand was used. Five concentrations were prepared. The recommended dilution by the manufacturer was 1:7. The following five concentrations were prepared: A- diluted at 1:11; B- diluted at 1:9; C- diluted at 1:7; D- diluted at 1:5 and E-diluted at 1:3.

Each subject received the juice in small disposable cups (containing 10 ml), at ambient temperature, in random order. The cups were marked underneath as A, B, C, D, E with Cup A being the solution with the least concentration, and Cup E with the highest concentration. Between one tasting test and the other, the child was asked which solution he/she preferred, and at the end of the test, the child

pointed out the solution of his/her choice, which was noted on the subject's chart. The test was repeated for the mother in the same manner. The subjects had water between each solution to neutralize the palate. An interval of two minutes was allowed between each tasting. This protocol was followed throughout the entire series of tastings enabling subjects to rank their preference for the five solutions. The tests were repeated if the need arose.

The juice sample was divided as low preference for sugar (Solutions A, B, C) and high preference (Solution D, E). The participants who required urgent treatment were treated at the clinic.

3.3.6.3 PROP taste test

Sensitivity to bitter taste was tested using a small piece of filter paper containing 1.6 mg of 6-n-propylthiouracil (PROP). The PROP taste test was carried out on all the participating subjects. The subjects were instructed to place the filter paper on the dorsal surface of the anterior two-third region of the subject's tongue for 30 seconds and let it get well moistened with saliva. To quantify the intensity of the bitter taste, a scale called the Visual Analogue Scale (VAS) was used. The participants were required to mark their intensity on the scale. The scale covered the whole range of sensory intensity and participants rated their taste sensations from (0 to 100). The value categorized the subjects as super-tasters when the value was >60 , medium tasters when it was between 12-59, or non-tasters when it was <12 . The tests were repeated if the child was in doubt.

3.4 Data Analysis

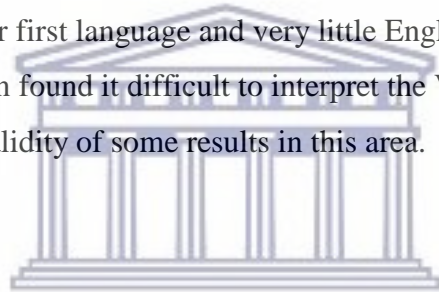
Data captured was captured on the forms and tabulated on Microsoft Excel. The data was entered onto Excel for each variable: The actual age of the subjects; For gender, males were assigned as 1 and females as 2; The actual DMFT/dmft

scores were captured. For the sweet preference inventory, low preference for sugar category was assigned as 1, and high preference for sugar was assigned as 2. For the PROP taster status, Super-taster was assigned as 1, medium-taster as 2 and a Non-taster as 3. The significance of the variables was analyzed by Chi-square and Fischer exact test when applicable using a commercially available statistical software package (SPSS 13.0, SPSS Inc.). For the few continuous variables descriptive statistics, such as means, standard deviation and medians were calculated. Statistical significance was set at p-value <0.05.

3.5 Limitations:

Language was sometimes a barrier, because the majority of subjects spoke Xhosa as their first language and very little English.

Some children found it difficult to interpret the VAS scale, so this may have limited the validity of some results in this area.



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CHAPTER 4

RESULTS

4.1 Study population

The study population consisted of 75 mother-child pairs. Of the 75 children, 52% were males and 48% were females. The average age of the children was 8.89 and the age ranged between 6 and 14. The average age of the mothers was 34 years with an age range between 26 and 49 (Table 1).

The age distribution of the children and mothers are shown below in Figure 1 and Figure 2 respectively.

	Child	Mother
Age		
Mean (SD)	8.89 (2.185)	34 (5.191)
Range	6 - 14 years	26 – 49 years
Sex		
Males	52 %	-
Females	48 %	100 %

Table 1: Age and Gender characteristics

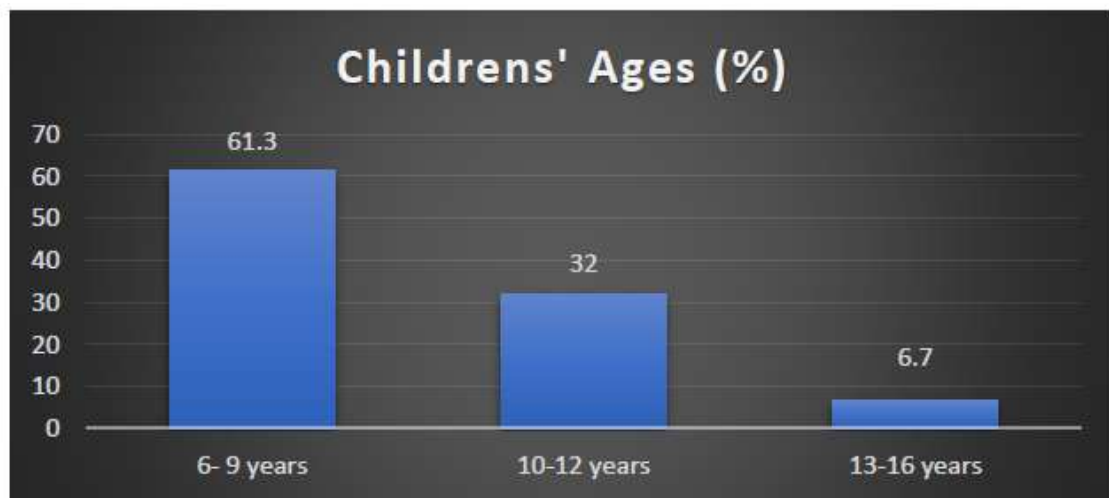


Figure 1: Age distribution of children

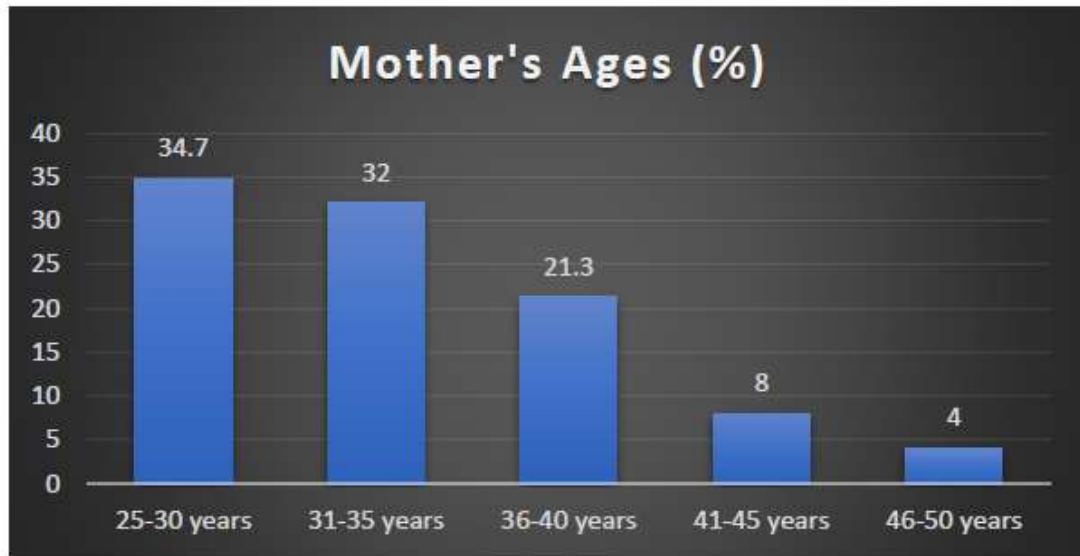


Figure 2: Age distribution of mothers

4.2 Oral Health status

4.2.1 Mean dmft/DMFT of children

The mean dmft of the primary dentition was 2.45 (SD= 2.559) and the DMFT score of the permanent dentition was 0.28 (SD= 0.781). Only 25.3% (n=19) of the children were caries free and 22.6% (n=17) of the children had a dmft/DMFT score of zero.

To make comparisons, the total dmft/DMFT scores and its different components were added together (Figure 3). The combined mean DMFT+dmft score was 2.73 (SD= 2.412) The average score for the combined decayed component (d+D) for children was 2.19 (SD= 2.246). There were no children present with restorations (Table 2).

	Children
Mean dmft	2.45 (SD= 2.559)
Mean DMFT	0.28 (SD= 0.781)
Mean (dmft + DMFT)	2.73 (SD= 2.412)
Mean Decayed component (d+D)	2.19 (SD=2.246)
Mean Missing Component (m+M)	0.55 (SD= 0.827)
Mean Filled Component (f+F)	0 (SD=0)

Table 2: Mean DMFT/ dmft scores of children

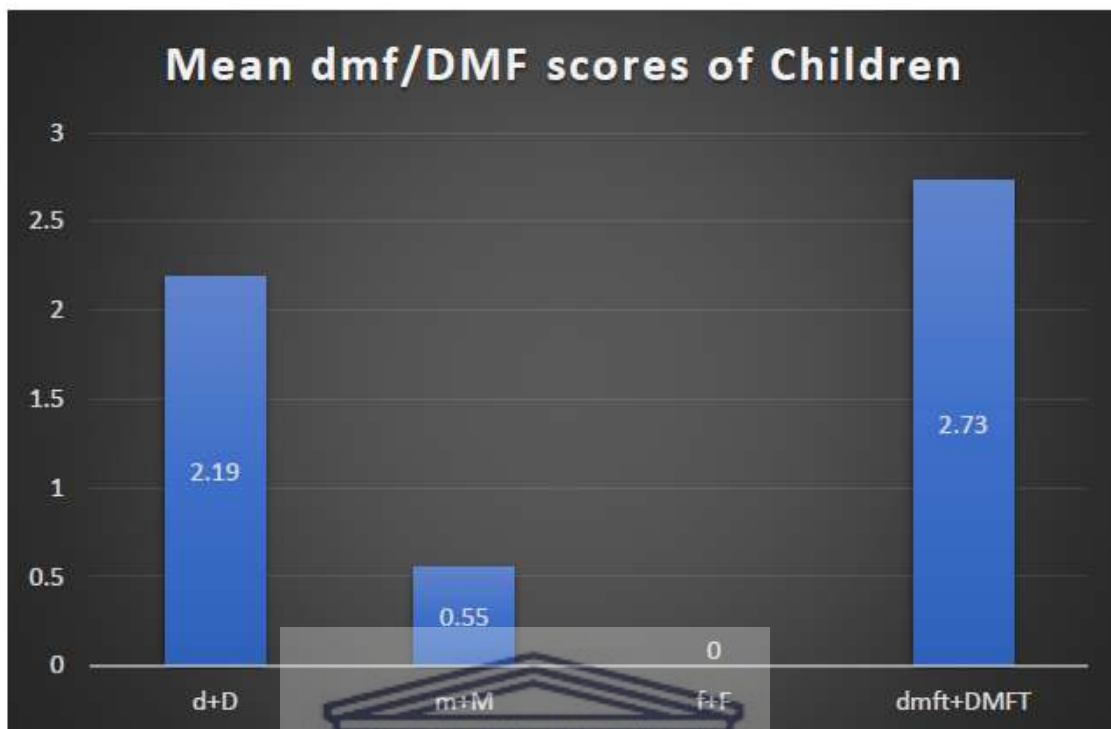


Figure 3: Mean dmf/DMF scores of children

4.2.2 Mean DMFT of the mothers

The mean DMFT of the mothers' 2.85 (SD= 2.448). There were no mothers present with restorations. Only 50.7% (n=38) of the mothers were caries free and 22.7% (n=17) had a DMFT score of zero. A majority of the mothers had 1-4 teeth missing (48%) (Table 3).

	Mothers
Mean DMFT	2.85 (SD= 2.448)
Mean Decayed component (D)	1.03 (SD= 1.365)
Mean Missing Component (M)	1.84 (SD=2.000)
Mean Filled Component (F)	0 (SD=0)

Table 3: Mean DMFT scores of mothers

4.2.3 Caries Risk Category

All the subjects were further categorized into high and low risk groups according to their DMFT and decayed component (DT) scores. If the scores were less than the average, then they were categorized as low risk and if above, as high risk.

The number of mother/child pairs classified as low risk and high risk (according to their DMFT scores) were equal in both groups (n=26) (Figure 4). To make comparisons between the caries risk categories (according to DMFT scores) in mother/child pairs, a Chi-Square test was used. A statistical significance was observed (p=0.0022). The Relative risk ratio was also calculated (R=2.22) (Table 4)

	Child in High Risk Category	Child in Low Risk Category	Significance (p<0.05)
Mothers in High Risk Category	n=26 (34.6%)	n=11 (14.6%)	Significant (p= 0.0022) RR= 2.22
Mothers in Low Risk Category	n=12 (16%)	n=26 (34.6%)	

Table 4: Caries risk categories in mother/child according to their DMFT scores

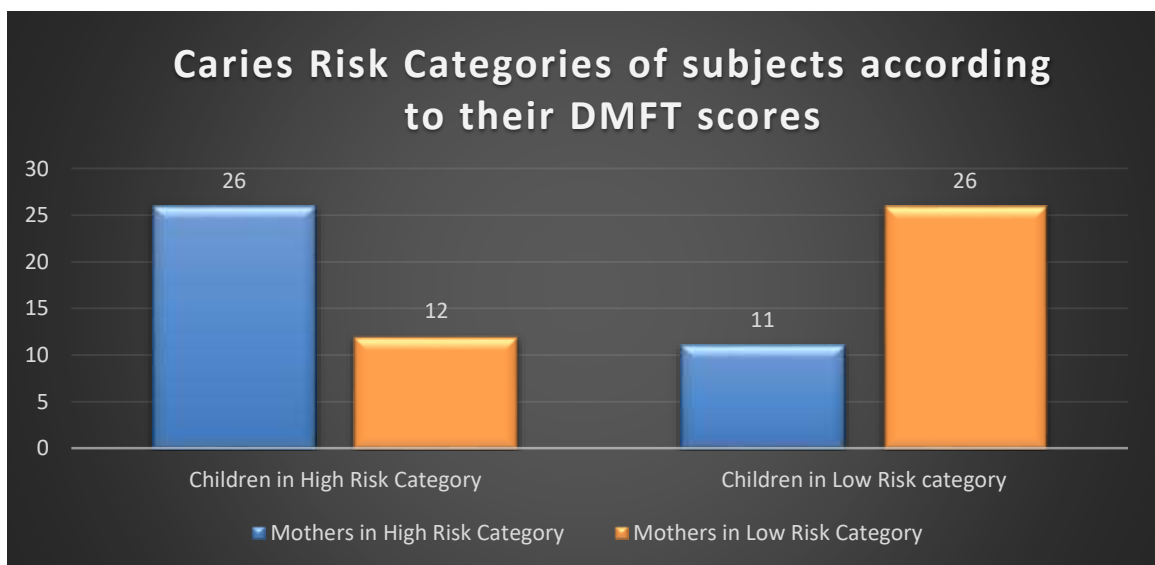


Figure 4: Caries risk categories in mother/child pairs according to DMFT

Mother/child pairs classified as high risk was 17.3% (n=13) and 54.6% (n=41) as low risk subjects according to their DT component. The number of high risk mothers with low risk children was 13.3% (n=10) and the number of low risk mothers with high risk children was 14.6 % (n=11) were classified as high risk according to the decayed component (Table 5) (Figure 5). A Chi- Square test was used. A statistical significance was observed when comparing the Caries Risk Category (according to DT) in mother/ child pairs ($p=0.002$). The relative risk ratio was also calculated ($R=2.67$).

	Children In High Risk Category	Children in Low Risk Category	Significance ($p<0.05$)
Mothers in High Risk Category	n=13 (17.3%)	n=10 (13.3%)	Significant ($p= 0.0024$) ($R= 2.67$)
Mothers in Low Risk Category	n=11 (14.6%)	n=41 (54.6%)	

Table 5: Caries risk categories in mother/child pairs according to DT component

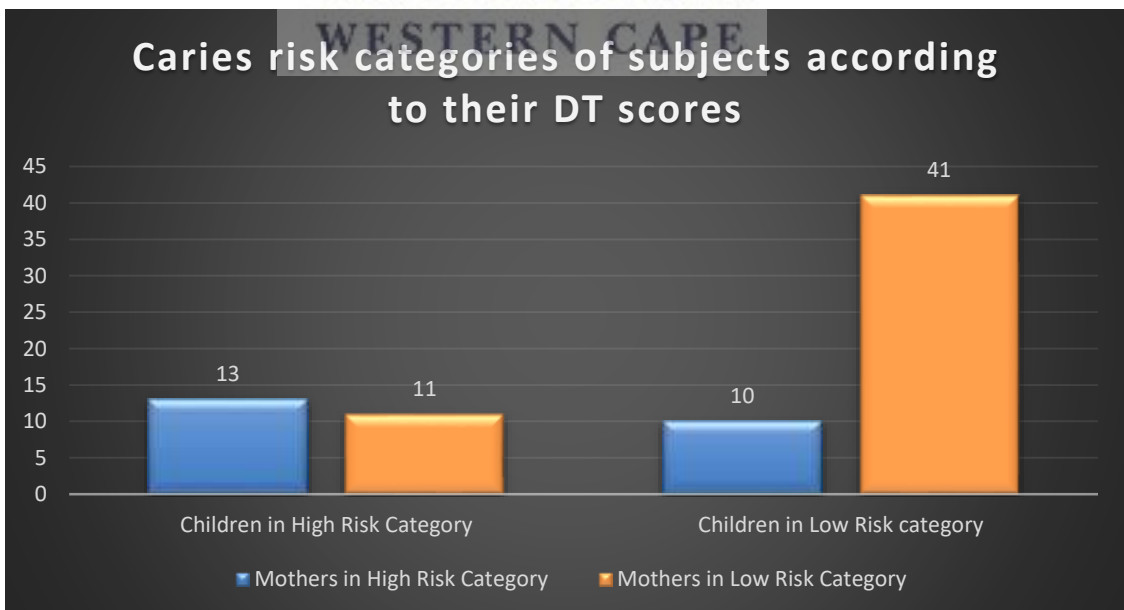


Figure 5: Caries risk categories in mother/child pairs according to DT component

4.3 Taster Status

Most of the children were super-tasters (60%), while 14.7% were medium tasters and 25.3% were non-tasters. Most of the mothers were also super tasters (52%), 29.3% were medium tasters and 18.7% were non-tasters (Table 6).

	Child	Mother	TOTAL
Super Taster	n= 45 (60 %)	n= 39 (52 %)	n=84 (56%)
Medium Taster	n= 11 (14.7 %)	n= 22 (29.3 %)	n=33 (22%)
Non- Taster	n= 19 (25.3%)	n= 14 (18.7%)	n=33 (22%)

Table 6: Distribution of ST, MT and NT in mothers and children

4.3.1 Taster status in mother/child pairs

There were 33 ST mothers with children who shared the same taster status. None of the NT mothers had a child who was a ST. Four ST mothers had children who were NT. All the NT mothers had children who shared the same taster status (n= 14) (Figure 6). In order to make comparisons strictly between the ST and NT group, the Fischer Exact test was used to analyze the relationship between the taster status in mother/child pairs. A significant relationship was observed ($p=0.000$).

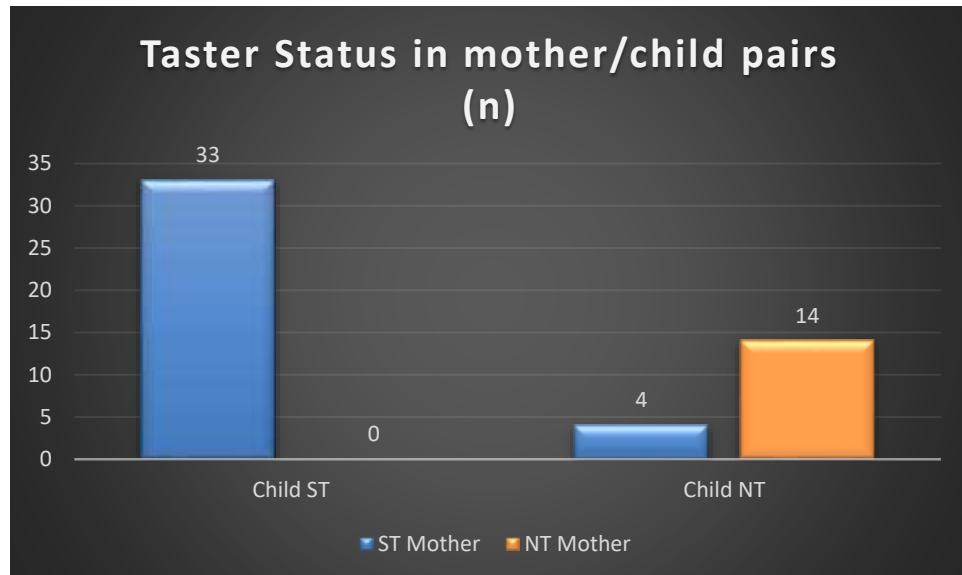


Figure 6: Taster status in mother/child pairs

4.4 Sugar Preference

Of all the children 39 children (52%) preferred low sugar while 36 (48%) preferred high sugar. Among the mothers, 43 (57%) preferred low sugar while 32 (43%) preferred high sugar (Table 7) (Figure 7).

	Child	Mother
Low sugar preference	n= 39 (52%)	n= 43 (57.3%)
High sugar preference	n= 36 (48%)	n= 32 (42.7%)

Table 7: Sugar Preferences in mothers and children

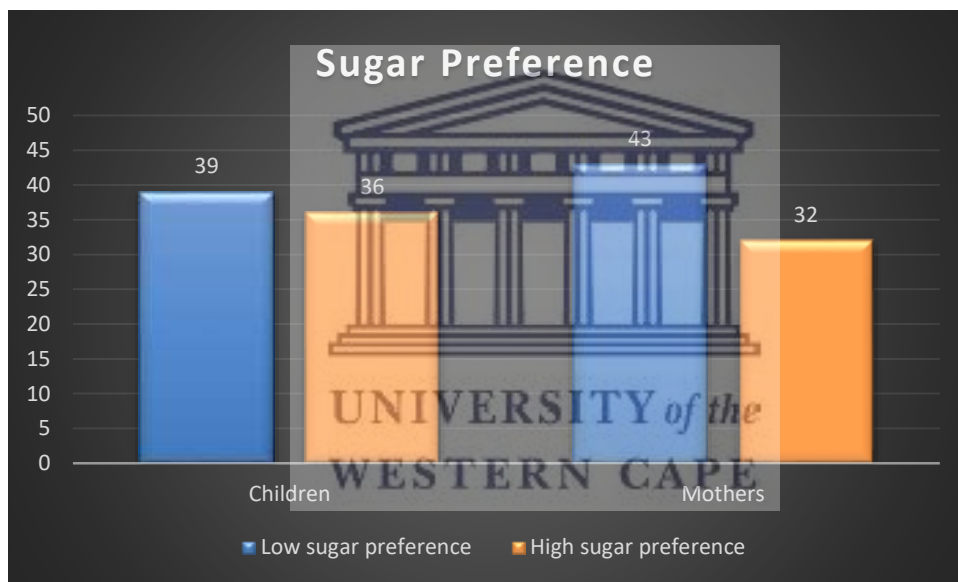


Figure 7: Sugar Preference in mothers and children

4.4.1 Sugar Preferences in mother/child pairs

There were 35 mother/child pairs who had a low sugar preference. There were 28 mother/child pairs who had a high sugar preference. Only 8 mothers with a low sugar preference had children with the high sugar preference. Only 4 mothers with a high sugar preference had children with a low sugar preference (Table 8) (Figure 8). A Chi- Square test was used to analyze the sugar preferences in mother/child pairs. A significant relationship was observed ($p=0.000$).

	Child Low Sugar Preference	Child High Sugar Preference	Significance (p<0.05)
Mother Low Sugar Preference	n= 35 (81.4%)	n= 8 (18.6%)	Significant p=0.000
Mother High Sugar Preference	n= 4 (12.5%)	n= 28 (87.5%)	

Table 8: Sugar Preferences in mother/child pairs

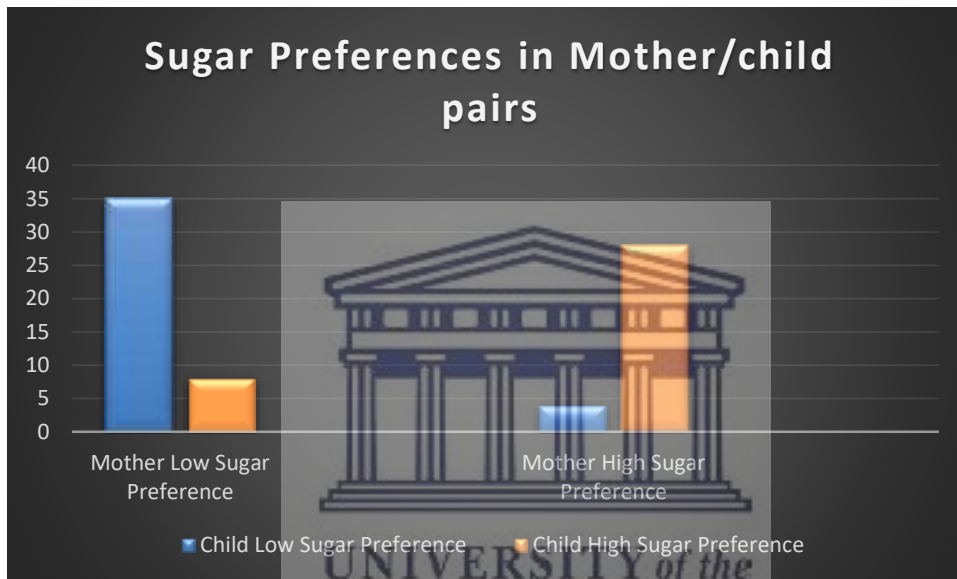


Figure 8: Sugar Preferences in mother/child pairs

4.5 Taster Status versus DMFT

Comparisons between Taster status and DMFT scores were made across all the subjects. From all the ST subjects, 23.8% had a DMFT score of zero (n=20), 39 % of the MT group had a DMFT score of zero (n=13) while none of the Non-tasters had a DMFT score of zero. The majority (87.8%) of the Non-tasters had a DMFT score greater than the average (Figure 9).

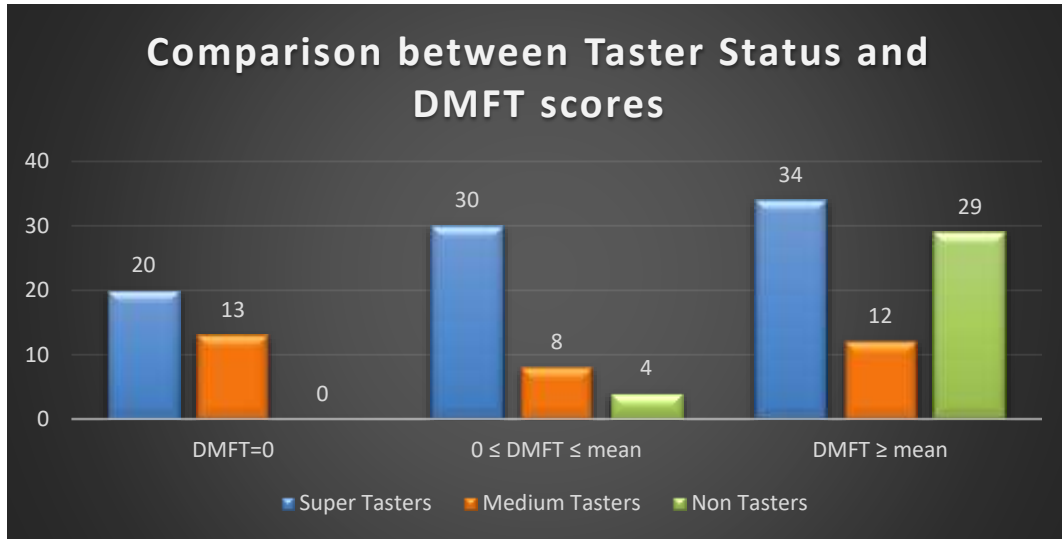


Figure 9: Comparison between Taster status and DMFT scores

4.5.1 Taster Status versus DMFT risk categories

The taster status of each group was compared to the caries risk categories. The majority of the ST and MT subjects were classified as low risk for dental caries, 59.5% of ST subjects (n=50) and 63% of the MT subjects (n=21) respectively, while only 12.1% of NT subjects (n=4) were classified as low risk for dental caries. The number of ST and MT subjects classified as high risk was 34 (40.4%) and 12 (36.3%) respectively. The majority of NT subjects (85%) were classified as high risk for dental caries (n=29) (Table 9). A chi-square test was used and a statistical significance was observed when comparing the Taster status and Caries risk categories (p=0.000).

	Low Risk Category	High Risk Category	Significance (p<0.05)
Super Tasters	50	34	Significant p= 0.000
Medium Tasters	21	12	
Non- tasters	4	29	

Table 9: Comparisons between Taster Status and Caries Risk Categories

4.6 Mother Taster status versus child DMFT scores

Of all the ST mothers, 20.5% had children with a DMFT score of zero (n= 8) while none of the NT mothers had a child with a DMFT score of zero (n=0) (Figure 10)

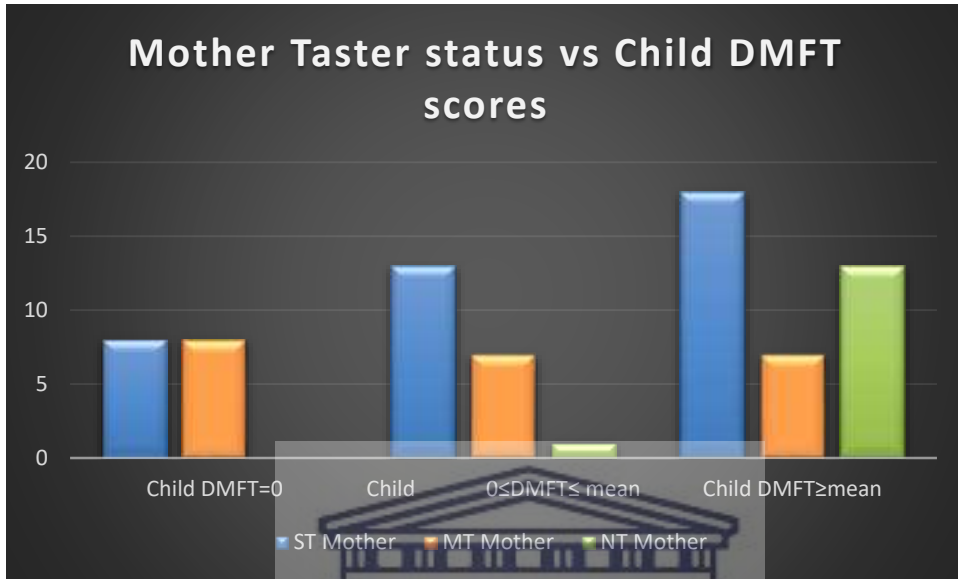


Figure 10: Mother Taster status versus Child DMFT score

4.6.1 Mother Taster status vs Child Caries Risk

Of all the ST mothers, 53.8% had children who were classified as low risk for dental caries (n= 21) while only 7.1% of NT mothers had children who were classified as low risk for dental caries (n=1).

Of all the ST mothers, 46.2% had children who were classified as high risk for dental caries (n=18) while 92.9% of NT mothers had children who were classified as high risk for dental caries (Table 10). A chi-square test was used and a significant association was observed (p= 0.001)

	Child Low Risk	Child High Risk	Significance (p<0.05)
Mother ST	21	18	Significant p=0.001
Mother NT	15	7	
Mother NT	1	13	

Table 10: Comparison between mothers' taster status and child caries risk

4.7 Taster Status versus Sugar Preference

The majority of ST subjects (60.7%) had a low sugar preference (n=51). For the NT subjects, only 6% had a low sugar preference (n=2). NT subjects with a high sugar preference was 94% (n=31) while 39% of super tasters had a high sugar preference (Figure 8). The majority of MT subjects (87.8%) had a low sugar preference (n=29) and only 12.1% of the MT subjects had a high sugar preference (n=4) (Table 11) (Figure 11). A statistical significance was observed when comparing the Taster status and sugar preference (p=0.000).

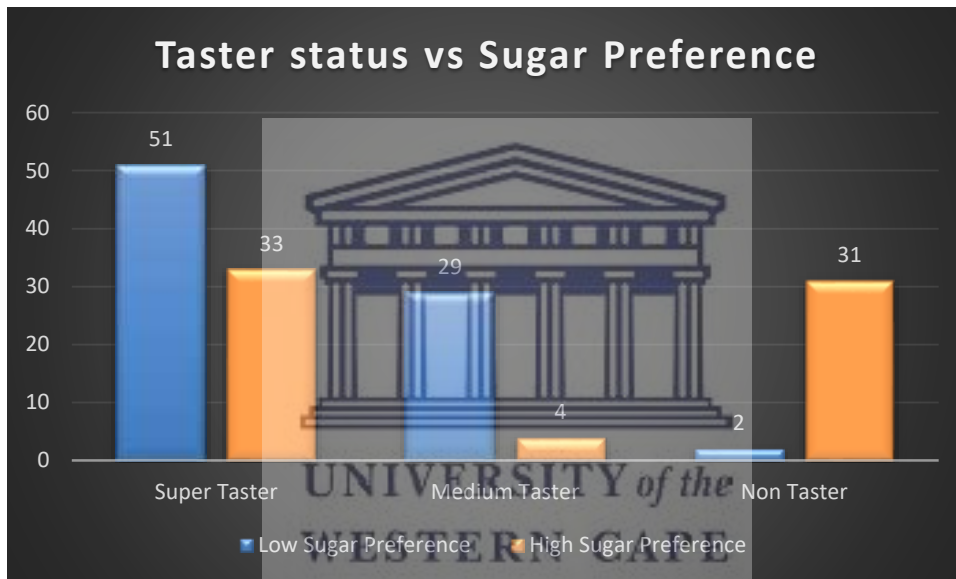


Figure 11: Comparison between taster status and sugar preference

	Super Taster Child	Non-taster Taster Child	Significance (p<0.05)
Super Taster Mother	n=33	n=4	Significant p= 0.000
Non-Taster Mother	n=0	n=14	

Table 11: Distribution of mother/child pairs according to Taster Status

4.8 Mother taster status versus child sugar preference

Of all the Super taster mothers 35.8% had children who had a high sugar preference (n=14), while 64.1% of ST mothers had children who had a low sugar preference (n=25). All the NT mothers had children who had a high sugar preference and none of the children of the NT mothers had a low sugar preference (Figure 12) (Table 12). The Fischer Exact test was used to analyze the relationship between Mothers' taster status and child's sugar preference. A statistical significance was observed (p=0.000)

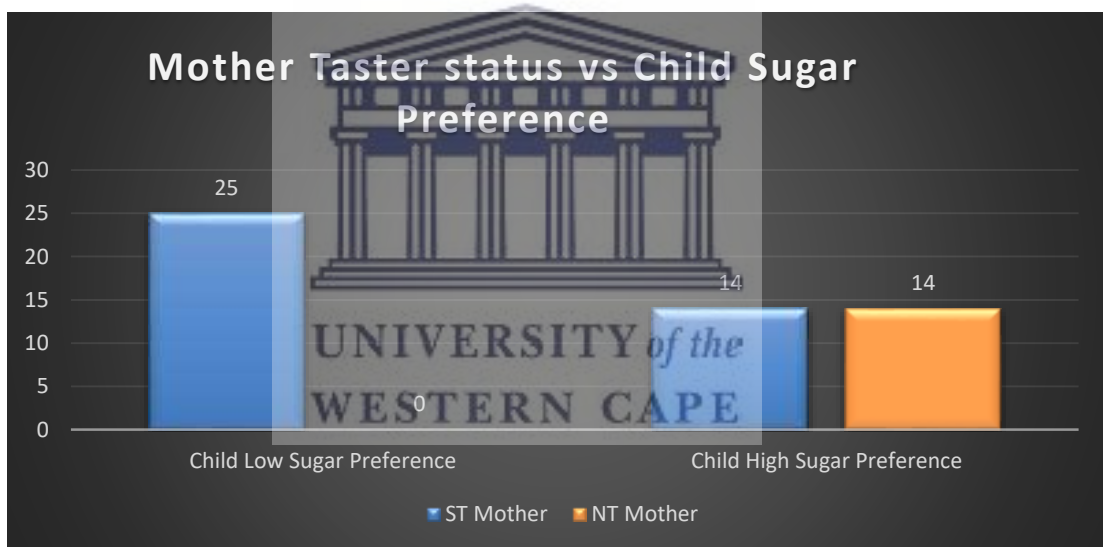


Figure 12: Comparison between Mother taster status and child sugar preference

	Child Low Sugar Preference	Child High Sugar Preference	Significance (p<0.05)
Super Taster Mother	n=25	n=14	Significant p= 0.000
Non-Taster Mother	n=0	n=14	

Table 12: Comparison between mothers taster status and child sugar preference

CHAPTER 5

DISCUSSION

Dental caries continues to be a major public health concern and its impact seems to be more aggressive in nations where access to oral health care and resources are limited. South Africa is such a country where its resources to provide preventative measures are limited. A proposed tool to screen and identify high risk individuals was suggested using a bitter compound 6-n-propylthiouracil (PROP). Gaining insight into understanding the familial patterns in dental caries and its relationship to bitter and sweet taste sensitivity was the primary objective of this study which validated the use of PROP as a method to screen for high caries risk mothers and children.

Familial patterns in dental caries, particularly between mothers and children has been observed in the past. Studies dating back to the 1940's observed the relationship between the caries status of parents and children and concluded that children are more likely reflect the caries status of their parents in themselves (Klein, 1946; Klein 1947). Additionally, similarities in the caries pattern of each mother and child pair, were greater than those of father/child pair (Ringelberg and Matonski, 1974; Garn *et al*, 1976; Pordeus, 1991). In this present study, to make comparisons between the mother and child's caries experience, the total child dmft/DMFT scores and its different components were added together. The average combined DMFT score for children was 2.73. The average DMFT score for mothers was 2.85. Furthermore, caries risk according to DT scores of children and their mothers were also compared and a positive association with regard to caries risk in mother/child pairs was observed ($p=0.002$). Similar results were observed by Lee *et al* (2018) who used DMFT scores and DT scores to make comparisons between mothers and children and concluded that the mothers' oral health status and child's oral health status had a positive correlation. However, this study was in disagreement with the findings of the study by Noce *et al* (2008) who observed that the caries status in children had no association with the caries

status of their mothers.

Diet, and sugar consumption in particular, is well-established as one of the major determinants for similarities in caries experiences between parents and children (Shaw and Murray, 1980). Studies conducted by (Rossow *et al*, 1990) have shown that mothers are a strong influence on the sugar preference of their offspring.

In this study, the percentage of subjects with preference for high and low sugar was 54% and 46% percent respectively. It is of interest to note that 87.5% of mothers who were categorized as high sugar preference, had children who also greatly preferred sugar. A positive association with regard to the sugar preference between mothers and children was established ($p= 0.000$). Maciel *et al* (2001) observed that the mother's sugar preference had a weak but significant association with the preference of their children.

The degree of similarity between mothers and their children in relation to their caries and sweet preference suggested that mothers play a crucial role in the establishment of their children's dietary choices and dental health. If mothers frequently provide their children with sugar items during their early years, a tendency to have an affinity towards sweet foods is seen among children, as their need for sweetness increases with frequent exposure (Desor *et al*, 1979).

Similarities in food preferences between mothers and their children can be attributed to their sensitivities to bitter tastes. Studies have shown that the ability to taste bitter compounds such as PROP is inherited (Drewnowski, 2001). In this present study, almost half of subjects were ST (56%) while only 22% were NT. Although the number of NT mothers in this study was a minority, all the NT mothers had children with the same taster status. When comparing taster status in mother/child pairs, the majority of ST mothers had children with the same taster status (84%). Although the number of NT mothers was a minority ($n=14$), all of their children were also non-tasters. A positive association between mother's taster status and their child's taster status was established ($p=0.000$). A similar result was observed by Keller and Tepper, 2004. They

established that there is a positive correlation between maternal and child taster status however the effect was statistically insignificant and concluded that it may be due to the paternal contribution of the child's taster status.

Sensitivity to the bitter taste of PROP has long been associated with an increased sensitivity to other taste sensations including sweetness. Individuals who are Super-tasters have an increased sensitivity to bitter taste and sugar in foods, and often show lesser affinity towards foods that are sweet, while non-tasters of PROP show an increased acceptance towards sweetened foods (Rupesh and Nayak, 2006).

In the present study, a total of 33 subjects were Non-tasters, and 31 subjects from the NT group, had a high sugar preference. Additionally, no NT subjects had a DMFT score of zero and the majority of NT subjects (87.8%) were classified as high risk for dental caries. The affinity towards sweet substances and its impact on the development of dental caries has been observed in several studies.

In short, super-tasters are “sweet dislikers” and non-tasters are “sweet likers” and are more likely to be a higher risk for dental caries.

The results of the present study indicated that children of NT mothers exhibited a higher caries experience than children of ST mothers. The DMFT score of children of non-taster mothers (DMFT=3.57), was significantly greater than the average mean DMFT dental caries in the children of supertaster mothers (DMFT=2.87). A similar finding was observed by Alanzi *et al*, 2013. This study also discovered that out of the fourteen NT mothers' none of their children had a DMFT score of zero.

The children of NT mothers are at a higher risk of caries as compared to children of ST mothers and fewer ST children had dental caries than NT children.

A similar observation was made by Lin, 2003. In this study, the mean DMFT for ST children was 2.71 and mean DMFT for NT children was 3.94. None of the NT children had a DMFT score of zero.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

Very few studies have looked into taster status, sugar preference and dental caries in mother/child pairs. The need to identify high risk caries children is important in a developing nation such as South Africa where resources are limited.

Similarities observed in this study between the mother and child's taster status and its association with sugar preference and dental caries encourages such a test to identify individuals who are at high risk of developing dental caries. The results observed in this study agree that non-taster mothers are more likely to have children who are also non-tasters. These non-tasters in general have a high sugar preference and are more susceptible to dental caries.

Early identification of mothers and children who are non-tasters may allow early intervention strategies such as dietary advice and preventative treatment in order to reduce their risk of developing dental caries.

The screening tool proposed in this study is potentially an aid in determining high risk individuals and this early identification may assist in identifying patients for preventative treatment in situations where resources are limited.

CHAPTER 7

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Patient Information sheet and consent form

Good day. I am Dr. Vineeth Varghese, a dentist at Empilweni Gompo Community Health Centre. I am conducting a research study project titled “Sensitivity to sweet and bitter taste in mother/child pairs and its influence on their caries status”.

What is the purpose of this study?

The main aim of the study is to find the associations between dental caries, sweet preference and bitter taste sensitivity between yourself and your child. The research will be conducted in 2017. You are required to participate just for one visit.

What the study entails?

An oral examination will be given using a dental mirror, probe and a light. Additionally, you are required to taste different grape juices with varying sugar concentrations. Finally, you are required to taste a filter paper containing a substance called PROP. There are no risks involved while tasting any of the substances mentioned above.

Confidentiality

If you consent to your participation, we would like to assure you that all information collected will remain confidential. The information will be kept in a secure location.

Participation is voluntary

Participation is voluntary and you are free to refuse participation or to withdraw at any time. Refusal to participate or discontinue will not disadvantage you in any way.

Contact details:

If you have any queries or would like more information about this study, please contact myself, Dr. Vineeth Varghese: 0847848179 or via email on varghese.vee@gmail.com

Your cooperation in this regard will be highly appreciated.

APPENDIX 2

Patient Consent Form:

I understand that I am free to refuse my participation or withdraw my consent and discontinue participation in this project at any time. I have been informed as to the procedures to be followed in this project. In signing this consent form, I allow permission for my mouth to be examined and to participate in the study.

Name of Participant (child): _____

Name of Participant (mother): _____

Personal Contact details of participant: _____

Signature: _____

Date: _____



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APPENDIX 3

Ingcukacha zesigulana (Patient information sheet)

Molweni. Igama lam ndingu Dr.Vineeth Varghese. Ndisebenza Empilweni Gompo Community Health Centre ndingugqirha wamazinyo. Ndiqhuba upando ngeprojekthi ebizwa “Ingaba ukufuza komntwana umama kuyachapazela / kuye kufane nendlela umama ava ngayo incasa engaphumisa iziqhamo umthelale kwindlela avangayo incasa.

Yintoni injongo vesisifundo? (What is the main purpose of this study?)

Ezona njongo zoluphando kukufumanisa ubudlelane pakathi (dental caries) ingaba ziyawenza umahluko xa umama ebesiva msinya ubukrakra okanye ubuswiti.Uphando lwakuqala ngonyaka ka 2017. Uyagunyaziswa ukuba uthathe inxaxheba .

Luqulethe ntoni oluphando? (What does the study entail?)

Uxilongo lwakuqhutywa kusetyenziswa ispili. Ukongeza , uyacelwa ukuba ungcamle isiselo sediliya (grape juice)ezifakwe iswekile ngokushiyana kwazo.Okokugqibela uzacelwa ungcamle ipetshana elincinci elikrakrayo linento ekuthiwa yiProp . Zonke ozabe uzingcamlile azinabungozi.

Imfihlo (Confidentiality)

Ukubangaba uyavuma ukuthatha inxaxheba sifuna ukuqinisekisa ukuba zonke incukacha othe wazinikezela kuleprojekthi izakugcinwa iyimfihlo.Zonke incukacha ezifumanekileyo zakugcinwa kwindawo ebucala .

Ukuththa-Inxaxheba kuyintando yakho (Participation is voluntary)

Inxaxheba oyithathayo kuleprojekthi uyenza ngentando yakho kwaye sifuna ukuqinisekisa kulilungelo lakho ukukhetha ungathathi nxaxheba okanye ungarhoxa naninina.Ukwala ukuthatha inxaxheba aluzokubeka emngciphekweni walo nalupi uhlobo olungamkelekanga.

Unxibelelwano /Uqhagamishelwano (Contact Details).

Xa unemibuzo okanye ufuna ulwazi oluthe vetshe ngaleprojekthi nceda ungxulumano nam ngokukhululekileyo. uGqirha Vineeth kulenombolo kanomyayi:0847848179 okanye varghese@gmail.com .

Uncedo lwakho nentsebenziswano yakho kuleprojekthi iyakwamkeleka kakhulu.

APPENDIX 4

Iphepha lesivumelwano sesigulane (Patient consent form)

Ndiyavuma ngokukhululekileyo ndingarhoxa ekuthatheni inxaxheba kuleprojekiti nangalo naluphina ixesha ndifuna ukuyeka kuyo. Ndazisiwe nangemiqathango ezakulandelwa kuleprojekithi. Ngokusayina sisivumelwano ndiyavuma ndithatha inxaxheba, ndivuma ngomlomo wam ukuba ndixilongwe,ndithathe nenxaxheba kuleprojekithi.

Igama Lomntwana: _____

Igama LukaMama: _____

Imfo-nomfono yomthathi Nxaxheba: _____

Sayina: _____

Usuku: _____

Sayina: Vineeth Varghese (Inqununu YeProjekithi) Suku



UNIVERSITY of the
WESTERN CAPE

APPENDIX 5

QUESTIONNAIRE AND DATA COLLECTION SHEET

FAMILY RECORD #:

NAME: _____ AGE: _____

MALE | FEMALE

MOTHER | CHILD

How many teaspoons of sugar do you add to your coffee/ tea/ cereal per day?	
How many glasses of sugary drinks such as OROS, COCA-COLA etc. do you drink per day?	
Do you think you consume a lot of sugar/ sweet substances such as sweets, chocolates etc.	

Bitter Taste Test Scaling Chart



DMFT scores

D	M	F	TOTAL

dmft scores

D	M	F	TOTAL

Sweet Preference Test

CUP A	CUP B	CUP C	CUP D	CUP E



Eastern Cape Department of Health

Enquiries: Madoda Xokwe

Tel No: 040 608 0856

Date: 28 June 2017
e-mail address: madoda.xokwe@echealth.gov.za

Fax No: 043 642 1409

Dear Dr. V. Varghese

Re: Sensitivity to Sweet and Bitter Taste in Mother/Child Pairs and Its Influence on Their Caries Status (EC_2017RP26_337)

The Department of Health would like to inform you that your application for conducting a research on the abovementioned topic has been approved based on the following conditions:

1. During your study, you will follow the submitted protocol with ethical approval and can only deviate from it after having a written approval from the Department of Health in writing.
2. You are advised to ensure, observe and respect the rights and culture of your research participants and maintain confidentiality of their identities and shall remove or not collect any information which can be used to link the participants.
3. The Department of Health expects you to provide a progress on your study every 3 months (from date you received this letter) in writing.
4. At the end of your study, you will be expected to send a full written report with your findings and implementable recommendations to the Epidemiological Research & Surveillance Management. You may be invited to the department to come and present your research findings with your implementable recommendations.
5. Your results on the Eastern Cape will not be presented anywhere unless you have shared them with the Department of Health as indicated above.

Your compliance in this regard will be highly appreciated.

SECRETARIAT: EASTERN CAPE HEALTH RESEARCH COMMITTEE



APPENDIX 8



OFFICE OF THE DIRECTOR: RESEARCH RESEARCH AND INNOVATION DIVISION

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14 June 2017

Dr V Varghese and Prof N Myburgh
Community Dentistry
Faculty of Dentistry

Ethics Reference Number: BM17/4/11

Project Title: Sensitivity to sweet and bitter taste in mother/child pairs and its influence on their caries status.

Approval Period: 05 June 2017 – 05 June 2018

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report in good time for annual renewal.

The Committee must be informed of any serious adverse event and/or termination of the study.

A handwritten signature in black ink, appearing to read 'Josias'.

*Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape*

PROVISIONAL REC NUMBER -130416-050