

# THE IMPACT OF DIETARY CARBOHYDRATE PATTERNS ON ORAL HEALTH IN MAURITIUS

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## ABSTRACT:

**Background:** The gradual westernisation of diets over the last two decades compounded by the deteriorating oral health of Mauritians is cause for concern as the prevalence of chronic diseases in the island remains at an all high.

**Subjects and Methods:** The subjects were 150 Mauritian adults aged 25 to 65 years. The sample included equal numbers of healthy controls (n=50), diabetics (n=50) and cardiac patients (n=50). After assessing for dietary carbohydrate patterns and oral hygiene practices, participants underwent oro-dental examination via Decayed Missing Filled Teeth (DMFT) and Oral Rating Index (ORI).

**Results:** White bread (83.3%) and white rice (40%) were found to be heavily consumed by the sample population. DMFT and ORI scores for the control group were significantly lower than diabetics and cardiac patients ( $p < 0.05$ ). DMFT scores of healthy controls were found to be strongly associated with consumption of both highly refined snacks and soft drinks ( $r^2 = 0.56$ ,  $p < 0.05$ ).

**Conclusion:** New dietary trends were associated with high consumption frequencies of carbonated soft drinks and refined snacks in the sample population. This modern diet pattern may underlie the deteriorating oral health in Mauritians which is linked to the high prevalence of chronic diseases in the country.

**Keywords:** Carbohydrate foods, oral health, chronic disease

## INTRODUCTION:

Nutrition and oral health have a synergistic bidirectional relationship. Diet and nutrition may affect the development and integrity of the oral cavity. Besides its influence on craniofacial development in early life, nutrition also affects the development of oral mucosal as well as the progression of oro-dental diseases. In a similar way, oral infectious diseases, as well as chronic systemic diseases with oral manifestations impact the functional ability to eat as well as nutrition status [1]. Amongst oral diseases, dental caries

and periodontal disease provide with the most significant impact on the development and progression of chronic systemic diseases such as diabetes and cardiovascular diseases amongst others. Dental caries, which is an infectious bacterial biofilm disease, is expressed in a predominantly pathologic oral environment [2]. Although acid generating bacteria are the etiologic agents, dental caries has been thought of as multifactorial since it is influenced by dietary as well as host factors [3].

Diet and nutrition have a direct influence on the progression of dental caries which occurs as a result of demineralisation of enamel and dentine by organic acids produced through the anaerobic metabolism of dietary sugars by oral bacteria in dental plaque [4]. With the adoption of a more “westernized” diet packed with refined carbohydrates and sugars, populations worldwide have experienced a marked increase in dental caries [5]. In the same line, dietary patterns in Mauritius have gradually changed over the last two decades to favour western foods compounded by the adoption of poor snacking habits in children and adolescents in Mauritius [6,7]. More so, a review of local statistics regarding curative dental services depicts a gradual soar in the number of tooth extractions and restorations since 2006 [8].

In this view, it is becoming imperative to investigate whether this transition towards more processed and refined foods underlies the deteriorating oral health of Mauritians. This study will serve to delineate any causal associations that can eventually serve to build on the prevailing public health recommendations geared towards reversing the progression of oral diseases and its adverse impact on chronic diseases in the country. The objectives of this study are (i) to survey the carbohydrate-rich eating patterns in a sample of healthy and diseased Mauritians (ii) to gauge the oro-dental health of these subjects (iii) to assess and appreciate the effects of such diets

on oral health and their implications in chronic disease.

## **MATERIALS AND METHODS:**

### ***Study Design and Sampling***

The subjects were 150 Mauritian adults aged 25 to 65 years. The sample included equal numbers of healthy controls (n=50), diabetics (n=50) and diabetics with cardiovascular disease (n=50). Smokers, subjects wearing dentures, individuals who were undergoing antibiotic or other antimicrobial therapy within 3 months prior to the examination and those suffering from any other ailment besides diabetes and cardiovascular disease were excluded from the study. Non-insulin dependent diabetics were chosen under this study. All participants received verbal and written information about the study, and signed consent forms prior to participation. Patients were assured of confidentiality and informed of their right to refuse to participate or withdraw from the study. The study protocol was approved by the Ethics Committees of the Ministry of Health and Quality of Life, Mauritius and the University of Mauritius Ethics Committee. All subjects underwent an oral examination by a trained dental practitioner. A short questionnaire was used to elicit information from participants. The questionnaire surveyed the frequency of consumption of locally available carbohydrate foods, dairy products, refined snacks and soft drinks and was followed by questions on oral hygiene practices, which allowed the

subjects to be categorised as having (i) Poor Oral Hygiene (ii) Average Oral Hygiene and (iii) Good Oral Hygiene.

### **Oral Health Examination**

Standardised oral health examination was conducted for each participant by qualified dental practitioners after teeth were air-dried, under artificial light and with the aid of a dental mirror and explorer. Cotton rolls were used to control salivary flow. Oral health status was assessed by measuring the Decayed, Missing, and Filled teeth (DMFT) which is well established as a leading measure of dental caries experience in epidemiology [9]. In addition to the DMFT index which quantifies oral health in terms of dental caries, periodontal condition was assessed by the Oral Rating Index (ORI) which varies from 2 to -2. The ORI which presents the advantages of being a quick and reliable method for recording of periodontal status, informs on gingival condition, calculus and plaque accumulation [10].

### **Intake of Carbohydrate Food Frequency Assessment**

Information on carbohydrate intake was gathered using food frequency questionnaires. The food-frequency questionnaire included 10 commonly consumed carbohydrate dense food items, followed by snacking and dairy products and carbonated soft drinks. Participants were asked to concentrate on the past 3 months and indicate how many times they usually ate the particular food [7]. The consumption

frequencies of the 10 commonly consumed carbohydrate foods (white bread, white rice, brown rice, brown bread, pharata, dhal puri, pizza, noodles, macaroni and spaghetti) representing commonly eaten indigenous or Western foods in Mauritius and are used as indicator foods (Table 1). Highly Refined Snacks referred mainly to Biscuits, Potato Chips, Corn Snacks, amongst other similar locally produced and imported snacks. Carbonated soft drinks were locally available soft drinks. Dairy products comprised yoghurt, dahi, curd and other similar products on the local market.

### **Statistical analysis**

All analyses were carried out using SPSS 16.0. Identification of the major carbohydrate intake patterns was done by frequency analysis food consumption frequencies which were correlated to the oral health of the sample population. Underlying associations were observed using Chi Square test and Pearson's correlation. Multiple linear regressions were further employed to explain the impact of several of food items on the oral health status. Unless specified otherwise, differences at the 0.05 level were considered to be statistically significant.

## **RESULTS:**

We noted that the percentages were performed on only 74 teeth because three of them were perforated during handling and three are calcified, have not been taken into account. Without

visual aids or ultrasonic inserts, the MB2 canal was located in seven teeth (9.46%). With the use of the ultrasonic inserts, the MB2 was located in five additional teeth shifting to a percentage of (16.21%). With the use of binocular loupes MB2 was found in ten other teeth, the percentage become (29.72%). Finally with the use of the operating microscope, the MB2 canal was located in seven additional teeth (39.18%) (table 1).

Sectioning of the mesiobuccal root disclosed the presence of a MB2 canal in twenty seven more teeth 75.67% (table 2).

According to Weine's classification, the distribution of canal configuration of mesiobuccal canals was as follows: 18 (24.32%) were type I, 35 (47.29%) type II, 10 (13.51%) type III, and 2 (2.70%) were type IV canal configuration. Nine no defined type 12.16% correspond to mesiobuccal roots whose configuration cannot be classified in four types of Weine (Table 3).

## DISCUSSION:

### ***Trends in Carbohydrate Consumption***

The food frequency chart (Figure 1) specifies dietary patterns in respect of carbohydrate foods favoured by Mauritians. White bread (83.3%) and white rice (40%) were found to be heavily consumed by the sample population on a daily basis and dhal puri which showed the highest frequency (54.7%) on a 2-4 times weekly basis. For improved comparison, the 2-4 times

weekly consumption pattern was merged with the daily consumption trend and regarded as 'regular' consumption. This revealed that on a regular basis, consumption of white rice (86%) slightly surpassed that of white bread (85.3%). Dhal Puri was also found to be heavily consumed on a regular basis (82%). The consumption trend decreased to 50.7% for highly refined snacks, 48.7% for traditional Indian Breads (Pharata and Naan). In regards to carbonated soft drinks, 26% of subjects consumed the item on a regular basis.

### ***Consumption Pattern of Selected Common Items***

The three groups were split according to health status for analysis of difference in mean consumption of selected food items. The severity of post hoc analyses were maintained at  $\alpha=5\%$ . Analysis of Variance revealed that only specific foods showed significant difference (LSD,  $p<0.05$ ) in consumption frequency between healthy, diabetic and cardiac patients. These include white rice, pizzas, noodles and macaroni, highly refined snacks and soft drinks. Other food items including those presenting with high consumption in all groups (white bread, Indian breads, dhal puri showed) no significant difference between groups.

### ***Oral Status of Participants***

No significant difference was seen in Oral Hygiene Practice between the diabetic, cardiac and control groups ( $p>0.05$ ). Approximately two thirds of

the subjects observed average oral hygiene practices and one third observed poor oral hygiene practices independent of the three groups. The control population (healthy) showed a mean of  $7.6 \pm 3.81$  as compared to  $11.6 \pm 3.49$  for diabetics and more than a double increase ( $16.1 \pm 6.23$ ) for cardiac subjects (Table 2). One way ANOVA showed that DMFT scores were significantly different for the three groups ( $F=35.295$ ,  $p<0.05$ ).

Similar observations were recorded for the Oral Rating Index (Figure 2). Oral examination showed that the ORI score dropped from 2 to -2 from healthy to diabetic subjects and further to the cardiac participants ( $p<0.05$ ). Approximately one-third of them had positive scores, while the rest observed negative scoring with the majority of subjects falling in the (-1) category.

### ***Carbohydrate Food Consumption and Oral Health***

The food frequencies recorded in the questionnaires were correlated with the oral health status of the subjects. However, since the state of being diseased significantly impacted oral health, the groups were split and linear regression was done to evaluate the coefficients of determination between the oral status of healthy subjects and food consumption. Split data showed no associations between oral health status of diseased groups and their consumption frequencies ( $p>0.05$ ). However, the DMFT scores of healthy controls were found to be strongly

associated with consumption of highly refined snacks and soft drinks ( $p<0.05$ ), with 55.6% of the variation in the oral health status being predicted by the independent variables.

Linear regression analysis also showed that with increased consumption of refined snacks and soft drinks, the oral status of healthy subjects tended towards increased DMFT scores. The impact of consuming refined snacks and soft drinks remained significant even after controlling for oral hygiene of the subjects ( $p<0.05$ ), together accounting for a variation of 48.7% in DMFT scores. However, despite high consumption of other carbohydrate foods such as dhal puri, white rice and white bread, no statistically significant associations with DMFT scores could be derived.

In respect of the Oral Rating Index, the association was found to be explained only by consumption of refined snacks ( $r^2= 0.22$ ,  $p<0.05$ ). As the consumption of refined snacks increased, the oral status showed shifts towards poor oral hygiene and severe gingivitis. However, despite controlling for oral hygiene practices, the relationship remained significant ( $p<0.05$ ). The other food items including carbonated soft drinks showed no associations with the oral rating index.

### **CONCLUSION:**

The present study outlines the diffusion of western dietary patterns in our population which has brought about drastic changes in eating patterns as far as consumption of carbohydrate and its

derivatives are concerned. This study also highlights the impact of current nutrition trends on oral health of Mauritians. Highly refined foods and soft drinks were shown to be impact heavily on oral health and are found to underlie the deteriorating oral status of Mauritians. Based on our findings, targeted health and nutrition education appear to be primordial in sensitising the healthy population with a view to preventing oral disease and decreasing its adverse consequences, such as chronic diseases. Despite the fact that only few items showed a significant association with oral health, the dietary carbohydrate patterns observed in our study can also prove to be detrimental

to general health through their potential to elicit high glycaemic responses in the body. It is therefore becoming urgent to understand the implication of this nutritional transition on the development of chronic diseases in Mauritius.

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**TABLES:**

**Table 1: Description of Selected Indigenous Food Items**

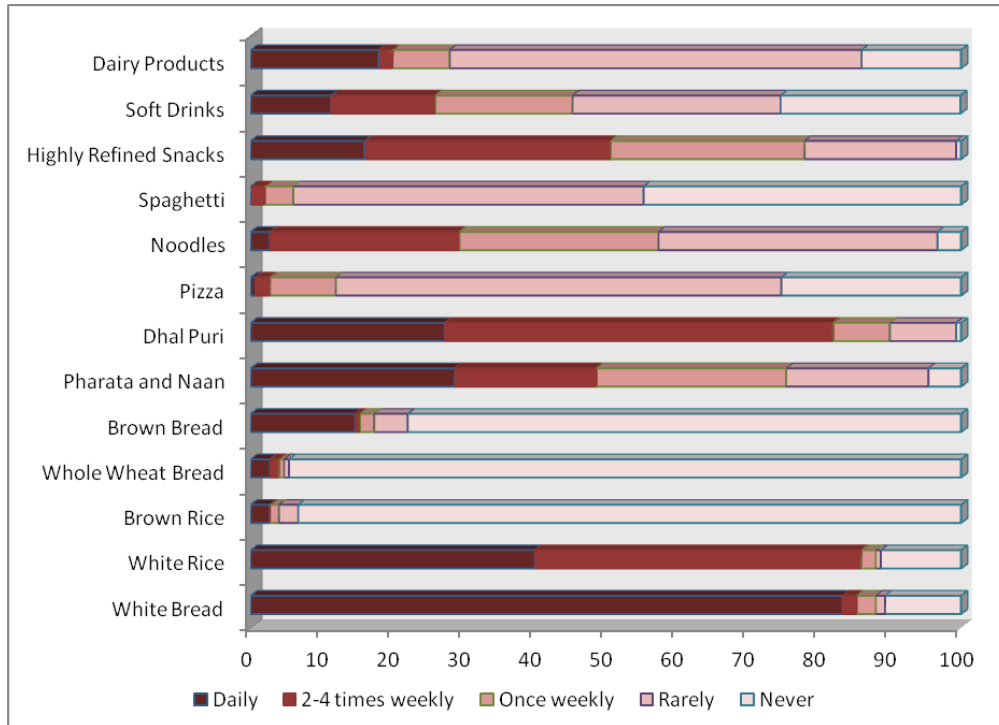
<b>Indigenous Foods</b>	<b>Description</b>
White Bread	Commercial bread baked of refined white flour
Whole Wheat Bread	Commercial Bread baked of whole wheat flour
Brown Bread	Commercial bread baked of less refined wheat flour
White Rice	Imported basmati rice prepared as per local cuisine
Brown Rice	Imported rice with bran
Pharata and Naan	Traditional Indian pan-baked bread made with white wheat flour
Dhal puri	Traditional flat bread stuffed with dhal
Pizza	Fast-food restaurant pizzas
Noodles	Wet and dry noodles made from unleavened dough
Spaghetti	Dry pasta made from semolina and durum wheat flour
Refined Snacks	Fried local snacks (Flour/Chickpea Flour), Biscuits, Imported snacks
Dairy Products	Yoghurt, Dahi, Curd, Local Dairy Products
Soft Drinks	Locally available carbonated drinks and imported fizzy drinks

**Table 2: Mean DMFT Scores of Subjects**

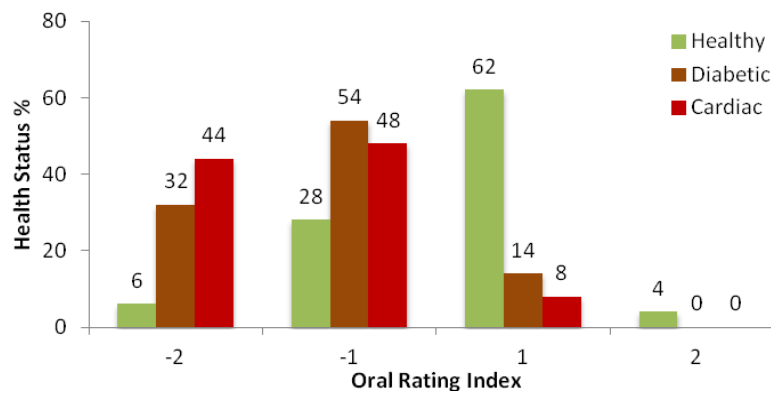
Subjects	Decayed Missing Filled Teeth (DMFT) Score
Healthy	7.6 ± 3.81
Diabetic	11.6 ± 3.49
Cardiac	16.1 ± 6.23

(F=35.295, p<0.05), Post Hoc LSD (p<0.05)

**FIGURES:**



**Figure 1: Consumption Trend of Selected Locally Consumed Foods**



**Figure 2: Percentage Subjects based on Oral Rating Index (ORI) Scores**