Original Research Article

Oral Health Determinants among Adult Mauritians

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ABSTRACT

Objectives and Study Design: Knowledge of oral health determinants allows development of strategies for overcoming inequity and oral health problems. Healthy adults (n=250) were interviewed from 2012 to 2013 and assessed for their oral health status using the World Health Organisation DMFT (Decayed, Missing, Filled Teeth) index.
Methods: A new indicator, teeth-brushing index (TBI), was used as a measure of oral hygiene practice. Cost assessment of local dental oral care tools was done to compute an oral self-care package.
Results: Univariate analysis showed that income and oral health status was significantly associated with poor oral health. The variation of 66% in DMFT was explained by economic status, TBI and smoking as per multivariate analysis. Cost of a basic oral self-care package ranged between only 0.2% of the monthly income for the higher economic status group but to as high as six-fold (1.2%) for the lower economic status group which represents nearly half of the expenses allocated for all health costs in this group (p<0.05). Income, TBI, smoking and dental attendance were the main determinants of oral health (p<0.05).
Conclusion: This study highlights that encouraging health literacy and increasing affordability of dental oral care products are the urgent actions needed for prevention of oral diseases and its adverse consequences such as chronic diseases.

Keywords: oral health, oral hygiene, cost, health literacy.

INTRODUCTION

Oral diseases affect a significant proportion of the world's population and their impact on individuals and societies are considerable. [1] Early diagnosis, intervention and prevention can halt the progress of most oral diseases which can have painful, disfiguring and lasting negative and serious consequences if left untreated. [2] Yet, a large number of people suffer from conditions which are for the most part preventable on account of the fact that a substantial number of barriers exist at different levels in societies. Barriers, be they financial, structural or cultural, prevent people from enjoying oral health and accessing the care they need, leaving them underserved. Oral health inequalities have emerged as a major public health challenge because economically disadvantaged groups have been seen to experience disproportionately higher levels of oral

disease and lower levels of care than those who are better off. [1] These differences in oral health status have markedly increased during the last decades, [3] compounded by a concurrent increase in non-communicable chronic diseases which could be a result of the chronicity of prevailing oral problems worldwide.

Poverty imposes constraints on the material conditions of everyday life, by limiting access to the fundamental building blocks of health such as adequate housing, good nutrition and the opportunity to maintain optimal personal hygiene. [4] Social and economic factors are found to significantly determine oral health [5-6] and have been associated with risk factors for dental caries. [7-8] Socially disadvantaged people also experience disadvantages with regards to health in general. Thus, low income level impacts on the health of populations and this also applies to oral conditions. [9-10] Moreover, since at first glance, few oral health problems appear life-threatening, most people delay treatment for long periods of time, which only increases the severity of the condition when they finally do seek care. [11] By then, poor oral health would already have silently progressed to further chronic complications that have a direct impact on general health in later life.

Mauritius is middle-income country with a population of about 1.3 million of diverse ethnic groups. Oral health services around the island are provided by both public and private institutions, the former being free of charge. Dental health statistics are very scant in the island and there is a lack of published studies in regards to oral health. However, according to the Health Statistics Report 2011, the number of dental attendances in public services has increased by 10% from 2007 to 2011. [12] Population projections predict that in 2050, Mauritius is estimated to have an elderly population of

26.1 % and 20.3 % of the total population for the aged groups 60 and over and 65 and over respectively. With an increasing old age population and the increasing prevalence of non communicable diseases, there will be increased oral problems and demand for oral services that shall constitute additional burden on health economics. Despite great achievements in oral health of populations globally, problems still remain in many communities all over the world and Mauritius is not an exception. This study has the following objectives: 1) to determine the impact of economic and educational level on oral health and 2) to identify the major barriers to oral hygiene practices and oral health care access.

MATERIALS AND METHODS
Study Design and Sample Selection: A cross sectional survey was carried out to assess the extent to local barriers impacted oral culture in adult Mauritians. The study was approved by the Mauritius Ministry of Health and Quality of Life and University Research Ethics Committee. Healthy adults (n=250), were recruited at random from the nine districts of Mauritius after obtaining their informed consent. Inclusion criteria were subjects above 25 years old (mean age: 46.0 ± 19.5 years) with no medical history of chronic diseases (such as diabetes, cardiovascular diseases, cancer and oral diseases). A self-designed questionnaire was pilot tested and further used to elicit information from participants based on a number of variables. These comprised income level, self oral care, frequency of dental attendance during the last five years as well as reasons for non-observance of hygiene practices and smoking habits. This was followed by a standardized oral health examination using Decayed, Missing, and Filled Teeth (DMFT) indexing method performed by a trained dental surgeon. The DMFT index is recommended by the World

Health Organisation for measuring and comparing dental caries experience in populations. [13] Dental examination was conducted after teeth were air-dried, under artificial light and with the aid of a dental mirror and explorer. An assessment of the minimum price of locally available dental oral care tools was computed based on regular usage of dental oral care tools according to recommendations by the American Dental Association. The cost of observing proper oral self-care was compared to the Mauritian monthly health expenditure budget.

Statistical Analysis: Prior to analysis, data was ordered and codified accordingly. Age was broken down into 2 groups; 25-45 years and >45 years. Monthly income was recorded to the nearest thousand Mauritian rupees (MUR) and classified as follows: < MUR 10,000 (LES-Low Economic Status, 330 USD), MUR 11,000-30,000 (Average Economic Status, 360-1000 USD) and MUR> 30,000 (High Economic Status, >300USD). Education was categorized as Primary, Secondary and Tertiary level. A new variable, teeth-brushing index, (TBI), was defined based on the sum of teeth-brushing frequency values and time taken for brushing. Points allotted in respect of the derived index (TBI) ranged from 2 to 6 and were further classed as; 2-3: Poor, 4: Average, 5-6: Good. DMFT scores were categorized into four levels 0-3, 4-7, 8-13 and >13 representing for this study; good oral health, average oral health, poor oral health and very poor oral health. [14] Data was analysed using SPSS 16.0. Chi Square tests, Pearson and Spearman correlations, as well as multiple regression analyses were used to explain the underlying associations. Unless specified otherwise, differences at the 0.05 level were considered to be statistically significant.

RESULTS

Age Group, Economic Status and Oral Health: The sample population comprised equal number of participants from both age groups (n=125 for the 25 − 45 years age group and n=125 for the >45 years age group). Age group and oral health was significantly associated ($p<0.001$). A large difference in DMFT scores was observed for the two groups. The >45 years age group showed poorer oral health with mean DMFT score of 8.0±4.8 compared to 4.9±2.5 for the 25 to 45 years old.

Of the 250 respondents, 19.2 % were of low economic status (LES), 57.6% of average economic status (AES) and 23.2% of high economic status (HES). Cross tabulations demonstrated direct associations between income status and DMFT levels of the respondents ($r= -0.51$, $p=<0.001$). 37.9% of participants from HES group were found to have very good DMFT scores (0 − 3) as compared to 11.8% for AES and 4.2% for LES. The highest percentage of participants from both HES and AES had average oral health and for LES, highest percentage (43.8 %) of subjects had very poor oral health with DMFT scores >13 (Table 1).

Educational Level and Oral Health: Table 2 shows the DMFT scores of the three educational levels; Primary (8.1 ± 4.5), Secondary (5.8 ± 3.6) and Tertiary (5.7 ± 3.8). Regression analysis revealed that DMFT Levels decreased with enhanced formal education from primary to tertiary level. A weak association was observed with only 20% of the variation in oral health being explained by educational levels ($r= 0.22$, $p<0.05$).

Oral Hygiene Practices, Oral Health and Economic Status: Significant association was also found between teeth-brushing index (TBI) and oral health ($r_s=0.50$, $p=<0.001$). As TBI increased, DMFT scores decreased significantly for the sample population (Table 3). Mean DMFT Score of

the Poor TBI group was approximately three fold that of subjects with good TBI. No single participant with either average or good TBI had very poor DMFT Scores. Use of hygiene tools (dental floss) other than toothbrush and fluoride paste was reported only by 0.8% of participants.

Table 1: DMFT levels and mean DMFT by economic classes.

DMFT Score [I]	% LES [II]	% AES [III]	% HES [IV]	
0 – 3 (Good)	4.2	11.8	37.9	r= -0.51 p<0.001
4 – 7 (Average)	25	70.1	51.7	
8 – 13 (Poor)	27.1	15.3	6.9	
>13 (Very Poor)	43.8	2.8	3.4	
DMFT Score*	11.1±4.7	5.8±2.8	4.2±3.3	

[I] *DMFT Score: Decayed Missing Filled Teeth Score;* [II] *LES: Low Economic Status;* [III] *AES: Average Economic Status;* [IV] *HES: High Economic Status;*DMFT scores are presented as mean ± SD*

Table 2: DMFT levels and mean DMFT by educational levels.

DMFT Score [I]	%Primary	%Secondary	%Tertiary	
0 – 3 (Good)	9.6	20.0	18.3	r= 0.22 p<0.001
4 – 7 (Average)	54.8	58.9	57.3	
8 – 13 (Poor)	15.1	13.7	18.3	
>13 (Very Poor)	20.5	7.4	6.1	
DMFT Score*	8.1 ± 4.5	5.8 ± 3.6	5.7 ± 3.8	

[I] *DMFT Score: Decayed Missing Filled Teeth Score; * DMFT scores are presented as mean ± SD*

Table 3: DMFT levels by Teeth-brushing Index

Teeth-brushing Index	% Poor	% Average	% Good	
0 – 3 (Good)	1.5	21.4	21.8	r_s= 0.50 p<0.001
4 – 7 (Average)	22.7	69.0	69.7	
8 – 13 (Poor)	34.8	9.5	8.5	
>13 (Very Poor)	40.9	0.0	0.0	
DMFT Score*	11.4±4.1	5.0±2.8	4.6±2.1	

[I] *DMFT Score: Decayed Missing Filled Teeth Score; *DMFT scores are presented as mean ± SD*

Table 4: Teeth-brushing Index (TBI) and Economic Status.

Economic Status	% Poor TBI	% Average TBI	% Good TBI
LES [I]	66.7	12.5	20.8
AES [II]	18.8	15.3	66.0
HES [III]	12.1	24.1	63.8
(χ^2 = 53.3, df = 4, p <0.001)			

[I] *LES: Low Economic Status;* [II] *AES: Average Economic Status;* [III] HES: High Economic Status

Our results also showed that teeth-brushing index was strongly associated with economic status (χ^2 = 53.3, df = 4, p <0.001). 66% of participants from average economic status (AES) had good TBI compared to 63.8% from high economic status (HES) and 20.8% from low economic status (LES). The LES group had a majority of subjects with Poor TBI (Table 4).

The mean DMFT score of smokers (11.0 ± 4.8) was much higher than non-smokers (5.6 ± 3.3). It was worth noting that 47.5% of smokers were of low economic status as compared to 37.5% in the average economic status group and 15.0% in the higher economic status.

Dental Attendance, Oral Health and Associated Barriers: Among the sample population, 28% of the respondents had not attended a dental clinic for check up in the last 5 years. Dental attendance was significantly associated with oral health (r=0.46, p<0.001). 70% of participants who never attended any dental checkup during the last five years had DMFT scores >13 (Table 5).

Table 5: DMFT Scores and Frequency of Dental Attendance.

DMFT Score [I]	Each 3 months	Each 6 months	Once yearly	Never
0 – 3 (Good)	24.4	36.6	22.0	17.1
4 – 7 (Average)	14.0	55.9	9.1	21.0
8 – 13 (Poor)	0	2.6	61.5	35.9
>13 (Very Poor)	0	0	29.6	70.4
(r= -0.46, p<0.001)				

[I] DMFT Score: Decayed Missing Filled Teeth Score

Frequency of dental visits and income status were strongly associated (χ^2=36.2, df=6, p<0.001). 56.2% from low economic status (LES) never attended dental checkups compared to 22.2% from average economic status (AES) and 19.0% from high

economic status (HES). A higher percentage of those attending regular dental checkups were observed among HES. Out of the 250 participants, 35.6% who never attended any dental checkups were educated to primary level only. Of the 28% never attended dental checkups, 14.1% respondents could not afford the treatment, 66.2% were of the opinion that oral health was not important, 15.6% did not have enough time, and 4.2% stated that professional oral care did not form part of their lifestyle.

In addition, 75.9% of the 25 – 45 years age group and 59.5% of the >45 years age group considered oral health to be unimportant. Multiple regression analysis showed that 66% of the variation in oral health was found to be explained by economic status, teeth-brushing index (TBI) and cigarette smoking ($r^2=0.658$, $p<0.05$).

Local Cost Assessment of Dental care products: The minimum price of locally available dental oral care tools was computed to generate the oral care package cost. The cost was then expressed as a percentage based on the mean monthly salaries. The total monthly cost for an oral self-care package was at 59 MUR (2 USD). Monthly expenditure in this respect for the 3 groups ranged from 0.2% for the high economic status group to 1.2% for the lower economic status group (Table 6).

Table 6: Oral self-care package price expressed as a percentage of minimal income.

Economic Status	Minimum Monthly Salary (MUR)	Monthly cost of oral self-care package (%)
LES [I]	5,000 (166 USD)	1.2
AES [II]	11,000 (366 USD)	0.5
HES [III]	31,000 (1033 USD)	0.2

[I] *LES: Low Economic Status;* [II] *AES: Average Economic Status;* [III] *HES: High Economic Status*

DISCUSSION

Given the increase in usage of dental health services and the scant data available in Mauritius, this study yields important information on several determinants of oral health in our local context. Our results show a significant association between ageing and oral health ($p<0.001$). With increasing age, subjects showed higher DMFT scores, inferring poorer oral health status. The <45 years age group was found to have a DMFT score which was almost two-fold that of those between 25 to 45 years old. Our findings herein corroborate with several studies conducted in Chile, China and Australia where similar patterns have been documented. [15-17] A longitudinal study in Slovenia observed an ageing population over a ten year period and a marked decline in oral health was observed as DMFT scores increased from 15.9 to 19.1. [18] Similar results were found in Iran where an upward trend in dental caries was found with increasing age. [19] The process of ageing is accompanied by a changing profile of disease and may directly or indirectly increase the risk of oral disease. [1] In addition, oral health of older people is strongly affected by economic and social determinants, high prevalence of co-morbidities compounded by inadequate hygiene practices. [20] In Mauritius, as in most countries of the world, population is ageing and life expectancy has risen from 69.6 years in 1990 to 73.4 years in 2011. [13] This trend will no doubt challenge health services to improve and maintain oral health in adult and senior populations.

Our results are also informative on the role of socioeconomic factors in oral health. Findings of this study strongly advocate an association between economic status and oral health ($p<0.001$). Lower levels of income were associated with higher DMFT scores and consequently poor oral health. The mean DMFT scores of the lower economic status (LES) group were approximately two-fold that of the other two groups. The initial data highlight the key role that income plays since profound disparities in adults' oral health status were

found on an economic echelon. Our findings were reflected in several studies conducted in higher income countries like Australia and Brazil which demonstrated that lower socioeconomic status groups are associated with a higher prevalence of dental caries. [21,22] This can be explained by the fact that lower income status is associated with poor oral hygiene and low levels of dental care [23] as early as adolescent years. [24] In addition, as people grow old, socioeconomic status worsens and inadequate hygiene practices due to morbidities, further deteriorates oral health. [21]

This study demonstrates a link between education level and oral health. Although a similar percentage (about 50%) of subjects within primary, secondary and tertiary education were observed to have DMFT scores between 4 to 7, very poor oral health in participants educated to primary level was three-fold that of those who had attained secondary and tertiary education. Similar findings in developing countries reported that dental caries experience was highest in countries with low percentage of primary level completion. [25] However, in the present study only 20% of the variance in DMFT scores was found to due to educational level. Conversely, in other published data in Brazil and the United States, educational levels were found to be a major determinant of oral health. [22-26] The weak association observed in this study can be explained by the lack of health education in local schools since health literacy has been documented to be a strong determinant of oral health. [27,28] However, measures for the introduction of health education in the curriculum have only been recently implemented in the local schooling institutions [29] and will take time to effect.

Our study also reported a teeth-brushing index (TBI) comprising a scoring method based on oral self-care. Good TBI scores showed a tendency to improvement

of oral wellbeing (p<0.001). A similar pattern was observed in a Nigerian study wherein lower oral hygiene score in children was positively correlated with an increase in the occurrence of dental caries. [30] Another study involving medically compromised patients who were not able to observe adequate oral hygiene, reported that less frequent teeth-brushing was highly associated with oral health deterioration. [31] This association can be explained by the fact that increased brushing frequency and longer brushing time is related to more frequent fluoride contact. [32] Use of oral hygiene tools other than toothbrush and fluoride paste was reported only by 0.8% of participants who flossed inter-dental spaces as a hygiene measure. This very low usage of dental floss may be due to the lack of adequate sensitization and information regarding its use. [33] In addition, further evidence from this study showed that adequate practice of oral self-care, including the use of dental floss, represented only 0.2% of the monthly income for HES and 0.5% for AES, to as high as 1.2% for LES group. This is considerable for the LES people since overall health expenditure represents 3.1% of the monthly income of a Mauritian household. [34] Thus, besides lack of health literacy, the high cost involved in observing proper oral hygiene practices, may also be contributive towards poor oral health especially in disadvantaged groups. Such evidence is documented in other studies wherein with higher economic status, people tended to be vigilant towards oral self-care. [35-36] Moreover, it is important to note that lower income groups may well be affected by malocclusions that in turn affect caries experience. [37] Hence, a low income as well as health illiteracy deprives people from practicing adequate oral self-care which is recommended as a measure to prevent dental caries and associated diseases. [38]

In this study, smokers were found to have higher mean DMFT scores than non-smokers (11.0 v/s 5.6, p<0.001). Similar findings have been documented in other studies on the relationship between smoking and dental caries experience. [39,40] Cigarette smoking has been reported to be a direct risk factor for oral diseases [41] and strong dose dependent associations have been found between cigarette smoking and tooth loss. [42] Another interesting observation from our data is that the majority of smokers were of low economic status. Several studies have outlined the relationship between low economic status and smoking which is thought to be associated with perceived dimensions of socioeconomic weakness. [43,44]

When the adherence to professional oral care was evaluated, 28% of participants were observed not to have attended any dental check-up in the last five years. This percentage comprised more than half of the subjects from the LES group. A higher regularity in dental visits (each three and six months) was observed among HES group. These results concur with the fact that access to dental care is closely associated with income and people of higher economic status are more likely to visit a dentist. [45] A significant association was obtained for dental visits and oral health status. As the frequency of dental visits increased in regularity, oral health considerably improved. This association is supported by a recent risk indicator study in Hong Kong where binomial regression analyses revealed higher DMFT scores with less frequent dental visits. [46]

A deeper analysis on the barriers to dental visits showed that out of the 28% participants who never attended any dental checkups in the last five years, 66% considered that oral health was not important. They were equally distributed across all educational levels attained.

Besides education, affordability and time constraints as well as culture were the lesser barriers to observing professional dental care. A recent study conducted in India also demonstrated that individuals perceived dental care only as an emergency measure and were not sufficiently aware of the importance of maintaining good oral health implying low health literacy levels. [47] Lack of time was another less important barrier observed in this investigation. Similar findings have also been reported in other studies. [48,49]

CONCLUSION

The main implications of this study are that several determinants affected oral health in Adult Mauritians. However, the impracticality of controlling for nutritional barriers remains a major limitation of this study.

This study shows that with increasing age, participants were at higher risk of developing oral diseases. Likewise, smoking, lower economic status and inadequate oral hygiene practices significantly translated into poor oral health. Despite the fact that dental public health services are free of charge in Mauritius, its irregular usage can be attributed to the lack of health literacy, which was found to also heavily influence oral hygiene behaviors. Moreover, the cost of observing adequate self oral care was found to be considerably high for the low economic status group. Based on our findings, recommended measures to tackle the prevailing situation are (a) to impart appropriate health education for reducing cigarette consumption, (b) sensitization of the public to modify their oral hygiene behaviors and to attend regular dental checkups (c) to better monitor quality of oral care products and regulation of their retail prices.

This study highlights the need to develop preventive programs that would aid

the dissemination of knowledge to the population in general with a view to enhancing oral health and decreasing long term complications such non-communicable chronic diseases in Mauritius. The existing barriers will continue to block any significant progress towards improving the oral health of the local populace, unless a sense of value and a desire for oral health become the norm.

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