Dental Caries in Twelve- and Fifteen-Year-Olds: Results from the Basic Oral Health Survey in Haiti

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Abstract

Objective: *Reports on oral health investigations in Haiti are sparse. There are only three peer-reviewed published articles on oral health in Haiti. In order to construct a national dataset useful for public health planning, a representative dental caries survey of Haitian school attending children was conducted in 1999.* ***Methods:*** *This survey was conducted using a modified version of the World Health Organization (WHO) Basic Oral Health Survey (BOHS) pathfinder method. Children ages 12 and 15 years old attending public or private schools in both rural and urban regions were targeted in seven of the nine geographic Departments of Haiti: each Department constituted a strata that was further stratified into the major urban center and one or more rural towns. Four trained examiners, calibrated to WHO caries criteria, conducted the survey.* ***Results:*** *Of the total 1,218 examined 12- and 15-year-olds, 31% of the 12-year-olds and 46% of the 15-year-olds had a DMFS of 1 or more, i.e., these percentages are the simple prevalence levels of dental caries for those age groups in Haiti. Mean DMFS scores were 1.01 (SE 0.09) and 2.52 (SE 0.02) for the 12- and 15-year-olds, respectively. No difference was observed between gender, while differences were found by geographical classification. Less than 1% of the children had any dental restorations.* ***Conclusions:*** *The findings from this investigation suggest that at the population level, permanent dentition caries in early adolescence is a minimal health problem, relative to dental caries in other neighboring Caribbean countries, as well as to other health conditions in Haiti. However, at the individual level, those children afflicted with decay are without dental services for all practical purposes.*

Key Words: Haiti, dental caries, national survey, oral health, children, Caribbean, prevalence

Introduction

Haiti has a population of approximately seven million people, and covers an area of 27,750 square kilometers. It is located in the western third of the island of Hispaniola, which it shares with the Dominican Republic (1). Haiti is divided into nine Departments that represent different geographical and political areas. There are two official languages: Creole, which is spoken by more than 97% of the population, and French (1). It is the poorest country in the Western Hemisphere, having an annual gross domestic product variously estimated at between $410-$1,200/person (2, 3). Though education is highly valued, it is financially unavailable to most individuals, resulting in illiteracy in 35% to 45% percent of the population (4). During the period from 1986 to 1990, only 44% of primary school-aged children were enrolled in school, with one-third of those attending public schools and two-thirds attending private schools (4).

Only 39% of the population has adequate access to safe drinking water (5). Malnutrition and infection are major causes of childhood mortality and morbidity in Haiti (6), with diarrhea and acute respiratory infections accounting for approximately half of the under-5 mortality rate (7). Other prevalent childhood diseases include tuberculosis, malaria, dengue fever and hepatitis (4,6). The Ministry of Health provides limited health care via clinics located throughout the country. In terms of oral health, Haiti has the lowest dentists to population ratio (0.12 dentists per 10,000) in the Western Hemisphere; comparatively, the dentist/population ratio is 2.54 per 10,000 in neighboring Dominican Republic (8). This low dentist/population ratio results in dental services consisting almost entirely of "reactive care," e.g., dental extractions, and even that with limited availability.

There are only three peer-reviewed published articles on oral health in Haiti. The first report (1972) described the knowledge of, and attitudes toward, oral health among thirty-four adults living in rural villages (9). The other two reports, published in 1983 and 1984, were oral health surveys of children and adolescents. The 1983 paper compared 879 rural 12- through 15-year-olds in Haiti to a similar number of 12- to 15-year-olds in Hamburg, Germany, finding a Haitian DMFS of 4.8 (10). The 1984 report was a descriptive study of oral disease in 61 adolescents (11). Additionally, a study of Haitian migrant adults in New York City reported a DMFS of 18.8 (12). While these data provide a limited, albeit piecemeal picture of oral health in Haiti and for Haitians, they lacked a national sampling frame

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needed to provide a representative descriptive epidemiologic picture of dental caries in Haiti, particularly for international comparisons following WHO guidelines.

In order to construct a national dataset useful for public health planning, a representative dental health survey of Haitian school- attending children ages 5, 6, 7, 12 and 15 years old was planned and conducted in 1999 by the faculty from the Haitian Dental School in collaboration with faculty from the New York University College of Dentistry. The project was supported by the Pan American Health Organization (PAHO), and the United States Center for Disease Control and Prevention (CDC) assisted in the examination calibration. The purpose of this report is to present the dental caries findings from the Haitian national survey for 12- and 15-year olds.

Methods

This survey was conducted using a modified version of the World Health Organization (WHO) Basic Oral Health Survey (BOHS) pathfinder method (13). Children ages 12 and 15 years who attended public or private schools in rural and urban regions were targeted for examination.

Consent procedures. Due to the high rate of illiteracy in the country, written consent for the dental examinations was obtained via school principals. The school principal was identified as the most knowledgeable community member with immediate responsibility for children, and as having the children's welfare paramount. As such, they provided the informed consent. A consent form in French describing the purpose of the study was submitted to each school principal. A presentation in either French or Creole consisting of a verbal description of the study and an offer to answer any questions regarding the study was made to the principal at the time of an examining team's school contact. Additionally, the study procedure and purpose was explained in Creole in an age-appropriate manner to each classroom having children of the ages of interest. Students were invited to participate and each child's assent was required. This study was approved by the Institutional Review Board (IRB) of the University of Connecticut Health Center and reviewed and approved by the Haitian Ministries of Education and Health.

Sample. The sampling frame consisted of seven of the nine geographic Departments of Haiti (West, Northwest, North, Northeast, South, Grand-Anse and Artibonite) each constituting a stratum that was further stratified into the major urban center, the *Chef-lieu* (Department capital, generally with 50,000 or more inhabitants) and one or more rural towns (less than 50,000 inhabitants with no infrastructure such as electricity and tap water). There were two exceptions. The Department of Artibonite had two urban centers sampled, but no rural samples, while the West Department included the capital Port-au-Prince, which was over- sampled. Two departments, the Central and Southeast, were not sampled.

Sampling within each Department's urban or rural stratum was carried out using a modified version of the WHO Pathfinder method. In rural areas, the targeted sample size was 25 children for each of the two age groups (12-year-olds and 15-year-olds), while in urban areas the age-specific sample sizes were doubled to 50. The only exception occurred in the inner-city area of the capital, Port-au-Prince, where each age group (12-year-olds and 15-year-olds), had 100 children, and the surrounding suburban area of Port-au-Prince where each age group had 50 children targeted for examinations. Overall, approximately two-thirds of the sample was to be selected from the major urban centers (i.e., the Capital city or the *Chef-lieu's*) and the other third from the rural areas. As is standard for a national survey, the targeted sample size and distribution provided stability for overall national DMFS and caries prevalence estimates by gender and urban-rural residence rather than for specific geographic sub-area statistical comparisons.

The initial plan for the survey included only four of the nine geographic Departments of Haiti (North, Northwest, West, and South), as the WHO BOHS guidelines suggest sampling the capital city, two major towns and four rural areas. However, as the survey's field operations approached, circumstances allowed for an expansion of the sampling frame to include two additional urban-rural-Department strata, (i.e., Northeast and Grand-Anse) and two urban towns in the Artibonite Department. Thus, seven of the nine Haitian Departments were included in the final sampling frame, and the final sample consisted of 1,218 12- and 15-year olds.

A total of 108 schools were randomly selected from a master list of all Haitian schools provided by the Ministry of Education for the seven Departments A letter was sent to the principals of these schools explaining the objectives of the study. Schools from this list were invited to participate until the sample size for each age group was achieved in that stratum. All invited schools participated. A strike of the public school teachers that occurred at the beginning of the field examinations precluded conducting examinations in some of the schools selected in two of these Departments. In each case, an alternative school was selected, usually the non-striking school nearest to the school originally selected.

Oral examination. Three dentists were trained and calibrated to WHO standards by a WHO- trained calibrator. These four personnel performed all oral examinations. Six recorders/field supervisors, who were newly graduated dentists from the University of Haiti Dental School, assisted them. The examiners were calibrated to 90% agreement to the referent examiner for decay, missing, and filled tooth surfaces (DMFS/dmfs) according to WHO criteria during the two weeks preceding the beginning of the field examinations.

Examinations were conducted under normal daylight conditions supplemented by portable headlamps and using mirrors and #23 explorers. Dental caries were scored by surface

on all erupted teeth. The data collected relied solely on the visual-tactile examination performed by the trained examiners without the use of dental radiographs.

Reliability. To assess intra-examiner reliability, each examiner performed duplicate examinations on 10% of the sample of subjects examined. The field supervisor arranged the reexamination in such a way that the examiners were blinded as to which children would be reexamined. As the examiners covered different geographical areas, the only inter-examiner reliability assessment was during the training and calibration sessions, where 90% DMFS agreement was achieved. This was accomplished by examining groups of ten children and requiring *exact* DMFS scores for nine of these ten examinations. The calibration method has been used previously by the authors and represents stricter criteria for surveys of this nature than kappa scores. Further, a DMFS percent agreement score allows for more meaningful comprehension of the process for field examiners, who often lack rigorous scientific theoretic training.

Field operations. All field examinations occurred over the six-week period from October 6th through November 12th, 1999. Basic demographic information was recorded regarding age, gender, geographic department, and urban/rural status. Visual-tactile examinations were conducted indoors or outdoors as necessary, using school benches to place the children in a supine position. Children who where found to have an oral condition that required immediate attention (e.g., cases of acute pulpitis) were directed to the nearest health center, and a note was given to the school principal describing the problem. The children's parents were notified of the dental emergency status of the child via their teacher. The teachers received a treatment needs assessment for all the examined children, in the event that treatment could be obtained. Standard infection control procedures were rigorously practiced during all field operations.

Data management. The data were recorded on carbonless multi-copy record forms in the field. The data were subsequently double-entered and verified manually by one individual, using the data entry program SPSSDE. The data were then cleaned prior to initiating the data analysis.

Statistical analyses. As the sampling methodology included stratification by Department-urban and Department-rural status for the towns selected, analyses accounted for the stratified sampling design (Stata V.7).

DMFS means and caries prevalence were determined for gender, urban/rural status and Department. Assuming Poisson and logistic distributions for DMFS and prevalence respectively, the caries outcomes (DMFS and caries prevalence as caries yes/no) were regressed on gender and urban-rural status as "dummy" variables (Port-au-Prince, suburban Port-au-Prince, other urban, and other rural) using multivariable Poisson and unconditional logistic models. National DMFT means were determined for 12- and 15-year-olds. All models accounted for the effect of the planned Departmental stratification. Intra-examiner reliability consistency was assessed for the stability of the DMFS scoring by correlation analyses using 193 duplicate exams.

Results

Examinations were conducted on a total of 1,218 children, with half being 12-year-olds (n=611, 53% female) and half being 15-year-olds (n= 607, 59% females). The Port-au-Prince cohort was composed of 224 children (18%); while the sample for the other urban areas of Haiti was composed of 610 children (50%). The suburban Port-au-Prince sample was composed of 132 (11%) children; 252 (21%) of the examined children were from rural towns

The age, gender, geographic type and Department sample distributions are presented in Table 1.

Generally, the urban, rural and suburban areas met or exceeded their targeted sample size with five exceptions. In the Northeast Department only 50 urban children (vs. a planned 100) were examined due to time constraints and environmental condi-

TABLE 1
Descriptive statistics of the Basic Oral Health Survey (BOHS) in Haiti, 1999

	12 yr. olds N (%)*	15 yr. olds N (%)*	Total N (%)*
Gender			
male	287 (47)	247 (41)	534 (44)
female	324 (53)	360 (59)	684 (56)
Total	611	607	1,218
Urban-Rural			
Port-au-Prince (P-a-P†)	118 (19)	106 (17)	224 (18)
Suburban (P-a-P†)	68 (11)	64 (11)	132 (11)
Urban‡	298 (49)	312 (51)	610 (50)
Rural	127 (21)	125 (21)	252 (21)
Total	611	607	1,218
Department			
West (P-a-P†)	118 (19)	106 (17)	224 (18)
West (suburban P-a-P†)	68 (11)	64 (11)	132 (11)
North	79 (13)	79 (13)	158 (13)
North West	91 (15)	69 (11)	160 (13)
South	79 (13)	106 (17)	185 (15)
North East	59 (10)	51 (8)	110 (9)
Artibonite	45 (7)	43 (7)	88 (7)
Grand Anse	72 (12)	89 (15)	161 (13)
Total	611	607	1,218

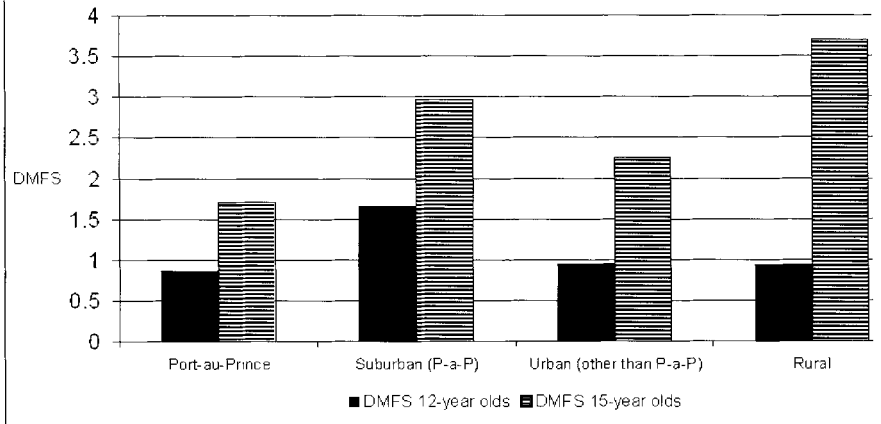
*Percentages may not add to 100% due to rounding
† P-a-P = Port-au-Prince
‡ Urban = urban areas other than Port-au-Prince

tions; in the Department of Artibonite only the urban areas were sampled due to time constraints. In only three other Department-urban-rural-age strata were samples less than the targeted 25 per age group obtained (15-year -olds in the rural Northwest, 12-year-olds in the rural South and Grand Anse).

Overall DMFS for Haitian 12-year-olds was 1.01 (SE 0.09), with a caries prevalence of 31% (CI 27%, 35%) (Table 2). For the 15-year-olds, the DMFS was 2.53 (SE 0.02) and the caries prevalence was 46% (CI 42%, 50%). These indexes are higher by 250% for DMFS and 150% higher for caries prevalence for the 15-year-olds relative to the 12-year-olds. Nine of the examined children had any restorations, i.e., 9 of 1,218.

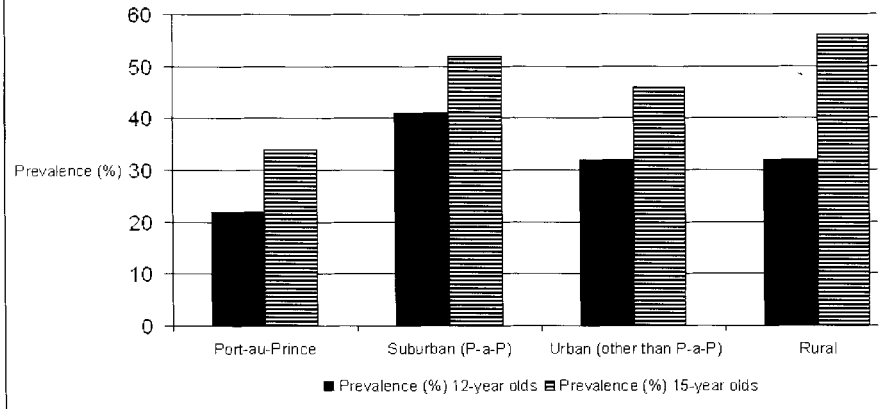
Caries prevalence for males and females were virtually identical for both age groups (Table 2). Females had a 25% higher DMFS than males in the 12-year-old cohort (1.12 vs. 0.89), while males demonstrated a 31% higher DMFS among 15-year-olds (2.9 vs. 2. 28). However, these differences between genders failed to achieve statistical significance at the 0.05 level in the multivariate models (Poisson and logistic) that controlled for urban-rural status (p= 0.20 and 0.33, respectively for 12- and 15-year-olds).

FIGURE 1
DMFS* in 12- and 15- year-old males and females by geographic classification†, Haiti, 1999



* DMFS: Decayed, Missing (due to caries), and filled surfaces
† Geographical classification: Urban Port-au-Prince, Suburban Port-au-Prince, other Urban areas, other rural areas

FIGURE 2
Caries prevalence (%) in 12- and 15-year-old male and females by geographic classification*, Haiti, 1999



*Geographical classification: Urban Port-au-Prince, Suburban Port-au-Prince, other Urban areas, other rural areas

For 12-year-olds, the Port-au-Prince suburban sample had a statistically significant higher DMFS relative to urban Port-au-Prince (1.66 vs. 0.86 DMFS, p=0.04) in the multivariate model, while for 15-year-olds, only the national rural sample demonstrated a statistically significant higher DMFS relative to the urban Port-au-Prince cohort (3.70 vs. 1.71 DMFS) (Table 2 and Figure 1).

In terms of caries prevalence, rural 12-year-olds had a 45% higher prevalence compared to urban Port-au-Prince 12-year-olds, which approached significance, p=0.06, while the suburban and urban cohorts demonstrated statistically significant higher prevalences, again related to urban Port-au-Prince. (Table 2 and Figure 2).

The suburban Port-au-Prince urban and rural 15-year-old cohorts all had a statistically significant higher prevalence as compared to the urban Port-au-Prince cohort.

For international comparisons the mean DMFT (decayed, missing due to caries and filled teeth) was also computed. DMFT's for 12-year-olds were 0.65 (se. 0.05) and 15-year-olds, 1.4 (se. 0.09).

Additionally, fluoride levels in 75 water samples of potable water taken separately from all areas of this survey and tested using standard, manufacture's specifications for testing procedures revealed a national mean and median fluoride level of .18 and 0.16 ppm, respectively. The highest fluoride level detected was 0.39 ppm, suggesting a uniformly low, non-therapeutic fluoride level in the potable water supplies throughout Haiti.

The intra-examiner DMFS reliability for the Spearman Rank correlation exceeded 0.98 for all examiners.

Discussion

This report presents caries findings of the first national oral health survey in Haiti and provides definitive baseline data for caries in 12- and 15-year-old Haitian school-attending children. The school system was used as the best sampling frame to obtain a representative sample of Haitian 12-

TABLE 2
N (%), DMFS* mean and caries prevalence by gender and urban or rural residence in Haitian 12- and 15-year-olds in 1997

Age (years)	Factor (gender geographic)	N (%)	Mean DMFS (SE)	Statistical Significance†	Prevalence (95% CI)	Statistical Significance‡
12	Gender					
	Male	287 (47%)	0.89 (0.11)	Ref ¶	30% (25%, 35%)	Ref ¶
	Female	324 (53%)	1.12 (0.14)	0.197	32% (27%, 37%)	0.452
	Total	611 (100%)	1.01 (0.09)		31% (27%, 35%)	
15	Male	247 (41%)	2.90 (0.39)	Ref ¶	46% (40%, 52%)	Ref ¶
	Female	360 (59%)	2.28 (0.21)	0.330	46% (41%, 52%)	0.411
	Total	607 (100%)	2.53 (0.20)		46% (42%, 50%)	
12	Urban-Rural					
	Port-au-Prince (urban)	118 (19%)	0.86 (0.21)	Ref ¶	22% (15%, 30%)	Ref ¶
	Suburban (Port-au-Prince)	68 (11%)	1.66 (0.37)	*0.040*	41% (29%, 53%)	*0.006*
	Urban §	298 (49%)	0.95 (0.12)	0.615.	32% (27%, 37%)	*0.040*
	Rural	127 (21%)	0.94 (0.17)	0.660	32% (24%, 40%)	*0.063*
	Total	611 (100%)	1.01 (0.09)		31% (27%, 35%)	
15	Port-au-Prince (urban)	106 (17%)	1.71 (0.34)	Ref ¶	34% (25%, 43%)	Ref ¶
	Suburban (rural)	64 (11%)	2.97 (0.63)	0.098	52% (39%, 64%)	*0.019*
	Urban §	312 (51%)	2.25 (0.26)	0.298	46% (40%, 51%)	*0.030*
	Rural	125 (21%)	3.70 (0.58)	*0.004*	56% (48%, 64%)	*0.001*
	Total	607 (100%)	2.53 (0.20)		46% (42%, 50%)	

* DMFS = Decayed, Missing (due to caries), and Filled permanent teeth
† Regression assuming a Poisson distribution (gender or Urban-Rural adjusted)
‡ Regression assuming a logistic distribution (gender or Urban-Rural adjusted)
¶ Referent category
§ Other than Port-au-Prince

and 15-year-olds. Despite the facts that only 6% of Haitian children complete an 8th grade education and that only 44% of school- aged children are 'in school' in any given year, virtually all Haitian school children attend school for a few years of education. This system of rotational—if short—length of attendance in school by Haitian children results in the school system providing the best sampling frame for a representational sample that determine 'which years for which child' are random across the population. There are no pre-existing data at the Haitian national level that could be used for historical comparisons, although Franz and Gotze report a DMFS of 4.8 for a sample of rural 879 12- through 15-year-old Haitian children. (10). Their DMFS of 4.8 is higher than the rural DMFS observed in this investigation, i.e., 0.94 and 3.70 for rural 12- and 15-year-olds, respectively. This may be explained by differing examination methods or a secular trend in caries.

A search of the literature for reports on dental caries in the Caribbean region identified oral health surveys that have been conducted in several Caribbean and Central American countries. Moreover, while there were some differences in methodology in older surveys in the Caribbean. The more recent surveys used standard methods developed by WHO/PAHO and thus lend themselves to comparison with the Haitian surveyed population. The high caries-free prevalence of 69% in Haitian 12-year-olds is similar to Belize (70.6%, 1999), which has the highest 12-year-old caries-free proportion for the Caribbean in reports since the mid-1980's (14). The caries-free prevalence from other Caribbean regional countries based on contemporary reports were: Anguilla, 32% (1991), Bahamas, 40% percent (1993), Barbados, 52% (1996), Costa Rica, 28% (1999), Dominican Republic 13.5% percent (1997), and Jamaica, 61% (1995) as caries-free (14,15).

The Haitian 12-year-old DMFT level of 0.65 compares favorably with DMFT scores from countries of the Caribbean basin and North America. For example, the low DMFT scores for countries such as Jamaica (1.1), the United States of America (1.4), Guyana (1.3) Cayman Island (1.7) and Canada (1.8) demonstrate the low age-specific Haitian population caries experience. The caries level for Haitian 12-year-olds can be categorized as being very low and fits the profile of undeveloped and developing countries in the early 1980's (14, 16).

There are few reports on caries in 15-year-olds in the Caribbean (17,18). However, a 1995 survey in Jamaica with a comparable case definition as the Haiti national survey, reported DMFT scores of 1.1 and 3.0 for 12- and 15-year-olds, respectively (18). Given that the DMFT score for Jamaican 15-year-olds (3.0) is one hundred percent higher than the Haitian 15-year-old DMFT score (1.4), the very low population caries levels in Haiti are remarkable, and more so because Jamaica has had salt fluoridation since 1987. Overall, Haiti's dental caries is a relatively insignificant public health problem for Haitian 12- and 15-year-olds.

The observed low caries experience in Haitian school children may simply represent a caries shift to older ages, as is suggested by the findings

of this study in which a 250% and 150% increase in DMFS and caries prevalence was observed between the ages of 12 and 15. Dental caries risk factor exposures data was not the goal of, and was not collected in, this first national descriptive epidemiologic study on dental caries in Haiti, other than the determination of water fluoride levels from nationally representative potable water sources. Therefore, scientifically-based explanatory mechanisms for the low observed caries rate of school- attending children would be totally speculative at this time. However, future studies that test analytical hypotheses regarding the low age-specific caries rates in Haiti, as well as in Haitian migrant populations, should be undertaken and will undoubtedly further the understanding of risk and protective factors associated with dental caries in developing countries. For example, Haiti is the poorest country in the Western Hemisphere with high levels of malnutrition (7), which has been associated with delayed eruption of the primary teeth (19, 20). A delayed tooth eruption would shorten the cariogenic exposure time for a specific age, resulting in lower age-specific caries measures. This may partially explain the findings reported here. In addition to shortening cariogenic exposure time, this extreme level and extent of poverty might also minimize the amount of age-specific cariogenic diet exposures. Of note in this context of both risk and protective factors is the statistically significant higher caries prevalence levels observed in all urban-suburban-rural strata relative to Port-au-Prince, and the higher DMFS observed in suburban 12-year-olds and rural 15-year-olds. Given the country's internal transportation/communication difficulties and local food availability differences, particularly processed food availability, future age-specific studies on hypothesized risk and protective exposures between these geographical entities may be particularly fruitful.

Notably, the "filled" component of the DMFS index was essentially nonexistent with only nine children in total (1% of the 1,218 examined) having any restorations. Pre-adolescents and adolescents in Haiti essentially do not receive restorative dental care, and in point of fact, receive very limited dental extraction services.

The findings from this investigation suggest that at the population level, permanent dentition caries in early adolescence is a minimal health problem, relative to dental caries in other neighboring Caribbean countries, as well as to other health conditions, in Haiti. However, at the individual level, those children afflicted with decay are without dental services for all practical purposes and eventually, virtually every decayed tooth progresses, tooth destruction and/or infection.

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