

The Prevalence of Dental Caries among International Students at U.S. Universities

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Abstract

Last year 572,509 international students studied at U.S. universities. The dental health of these students is as diverse as the countries from which they come. This paper discusses the known prevalence and causative factors of dental disease among these students, reported global variations in oral health, and barriers to receiving care faced by international students while in the U.S. The author recommends greater appreciation of the dental needs of this population by scholastic administrators and suggests further research to better quantify the dental needs of this population.

Keywords: International student, dental, caries, oral health

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Introduction

Last year, 572,509 international students studied at U.S. universities.¹ The dental health of these students is as diverse as the countries from which they come. This paper discusses global variations in dental health, the known incidence and causative factors of dental disease among international students, and barriers to receiving dental care that international students face while in the U.S.

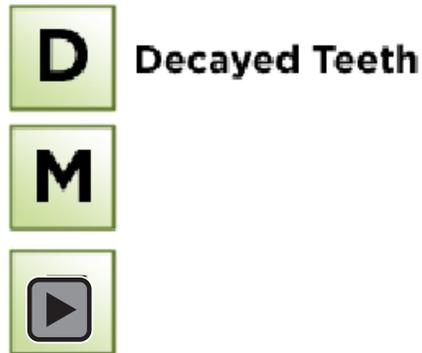


At U.S. institutions of higher education, international students comprise 4.6% of the total enrollment, 2.7% of undergraduate students, and 13.3% of graduate students.² The author's university currently hosts international students from 59 countries.³ The top ten countries of origin of international students in the United States are, in decreasing order: India, China, Republic of Korea, Japan, Taiwan, Canada, Mexico, Turkey, Indonesia, and Thailand.²

In the U.S. more than half of postsecondary international students are from developing and newly industrializing countries.⁴ Compared to the U.S. these countries are poorer and have less well-developed health care systems, including dentistry.⁵ Consequently, students from such nations are expected to exhibit poorer dental health than students from more developed nations.

Measuring Oral Health

Dental health surveys commonly utilize the DMF index to estimate the dental caries experience of individuals and populations. Measuring lifetime caries experience, the DMF index is a simple, rapid, and universally applicable instrument that has been used for decades.⁶ Data collection for this index involves performing dental screenings



Decayed Teeth

and recording the numbers of decayed, missing, and filled teeth.^{7,8,9} In the DMF index "D" indicates the number of decayed teeth, "M" the number of teeth missing due to caries, and "F" the number of satisfactorily filled teeth. For a tooth to be scored as "decayed," it must have "an unmistakable cavity."⁷ Incipient lesions are not scored.

The average number of decayed, missing, and filled teeth of a sample population is reported as that population's DMF index. A lower DMF index indicates better dental health. Because the DMF score of individuals cannot decrease over time, a direct relationship exists between the DMF index and age.

The World Health Organization (WHO) developed a DMF scale of severity to classify the oral health status of 12-year olds, a WHO indicator age group for dental caries. According to this scale a DMF of between 0.0 and 1.1 is considered very low, a DMF of between 2.78 and 4.4 is moderate, and a figure of 6.6 or more is very high.¹⁰

U.S. Dental Health

Improvements in the oral health of the U.S. population have been documented over the past 30 years. Among most age groups, the number of teeth per person affected by caries has decreased and the proportion of the population that has never experienced dental caries has increased.¹¹

A recent benchmark for oral health in the U.S. is the 1988-1991 National Health and Nutrition Examination Survey (NHANES III).¹² This large national study reported an average DMF score of 6.1 for Americans aged 18-24 and 12.7 for those aged 18-103. For 17-year old patients, 78% had experienced at least one carious lesion or dental filling.

Within the diverse U.S. population, caries rates vary by income and ethnicity. Individuals in families below the poverty level experience more dental caries than their more affluent peers.¹² Poor Mexican American adolescents aged 12-17 have the highest percentage of untreated decayed permanent teeth (47%), compared to poor non-Hispanic blacks (44%) and non-Hispanic whites (21%). Among non-poor adolescents, non-Hispanic blacks have the highest percentage of untreated decayed permanent teeth (42%), followed by non-poor Mexican Americans (23%), and non-Hispanic whites (12%).

The Oral Health of University Students in the U.S.

A thorough literature review found no recent published reports addressing the dental health of U.S. university students. Data from the author's university demonstrates reductions in the numbers of decayed, missing, and filled teeth of university students between 1960 and 2004.^{13, 14} In 1960 the reported DMF score for students was 12.7. This score decreased to 9.9 in 1993 and to 7.2 in 2004. This means that 2004 students averaged 5.5 (43%) fewer decayed, missing, and filled teeth than their 1960 counterparts.

An exhaustive review of the past 20 years' literature found no published data regarding the dental health of international students attending U.S. universities. One unpublished, preliminary study in 1995 reported differences in dental health between international and U.S.-Canadian students at three U.S. universities.¹⁵ In that study, at each institution and for each category (decayed, missing, and filled), U.S.-Canadian students had better dental health than international students. The average DMF score was 12.8 for the international students and 8.1 for the U.S. and Canadian students. In other words the average international student exhibited 4.7 (37%) more decayed, missing, and filled teeth than the average U.S. or Canadian student.

Relevant Global Dental Health Variations

Without good data about the dental health of international students in the U.S., studies of peripherally related populations can provide helpful estimates. One source is the WHO, which maintains a useful database of global dental health. Two recent studies specifically compared international and U.S. non-student populations.

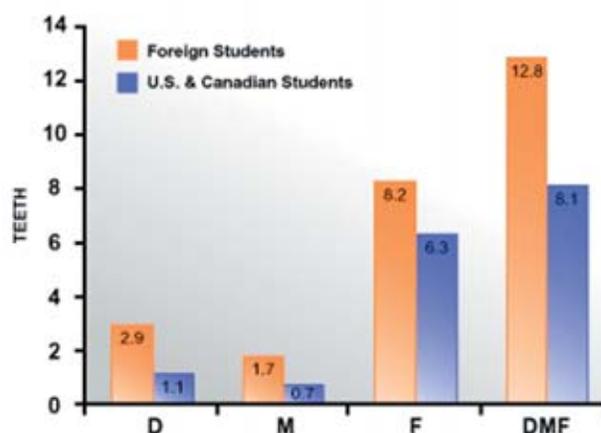


Figure 1. Average DMF Teeth of International vs. U.S.-Canadian University Students

a. Geller GI, Woodmansey KF, Finley TP. "International Student Dental Health Survey." Handout. Paper presented at the Research Symposium of the American College Health Association, Annual Meeting. Chicago, IL; May 1995.

A 1996 survey of 325 U.S. dentists and 198 international dentists reported notable differences between the dental health of their respective patient populations.¹⁶ Most significantly, the U.S. dentists reported 88% of their 18-year old patients had all of their natural teeth. International dentists reported only 66% of their 18-year old patients had all of their natural teeth. In other words the U.S. dental patients had 22% fewer missing teeth than their international cohorts.

A 2003 survey of athletes attending the International Special Olympics compared the oral health of U.S. and international athletes.¹⁷ The international athletes were more likely to have untreated caries (50%) than U.S. athletes (28%). The international athletes were also less likely to have dental restorations (20%) than U.S. athletes (63%). Because international athletes had more untreated caries and fewer dental restorations, it is assumed these individuals had received less dental care than their U.S. peers. This study concluded the international athletes' oral health closely mirrored the findings of the WHO Global Oral Data Bank for their respective countries.

The WHO Global Oral Data Bank is an organized record of oral health throughout the world, including findings from standard oral health surveys administered by WHO and from published results of others.¹⁸ In many cases

Table 1. DMF teeth, dentists per capita, sugar consumption, and fluoridation of selected countries.

Country	DMF of 12-year olds ¹⁸	Dentists per 100,000 population ¹⁸	Sugar consumption (Kg/person/year) ^{18, 27}	Fluoridation program ¹⁸
Africa & Middle East:				
Ethiopia	1.0	0.08	3.9	No
Nigeria	0.7	3	6.8	NA
Kuwait	2.6	44.7	33.1	NA
Pakistan	1.4	3.39	24.2	NA
Saudi Arabia	1.7	15	28.5	NA
India	0.9	2.74	16.5	No
The Americas:				
Brazil	3.1	94.9	57.5	Yes
Canada	3.7	54.5	40.2	Yes
El Salvador	1.4	21	37.6	No
USA	1.3	55.2	32.6	Yes
Europe:				
Denmark	0.9	91.7	37	No
France	1.9	71.9	41.2	Yes (salt)
Germany	1.2	75.9	37	Yes (salt)
Greece	2.2	114	NA	No
Italy	2.1	78	26	NA
Poland	3.8	51.8	44.8	Yes
United Kingdom	0.9	47.6	35	Yes (10+%)
The Pacific:				
Thailand	1.6	10.2	29.1	Yes
Australia	0.8	43.3	63.5	Yes
China	1.0	0.025	6.7	NA
Japan	2.4	67.9	19.0	Yes
S. Korea	3.1	34.7	21.4	Yes

the data applies to large groups from the most populous parts of countries and provides working estimates rather than being fully representative. The data illustrates differences between countries and global regions. Table 1 includes a compilation of DMF data from the Global Oral Data Bank.¹⁸ These selected DMF indices for 12-year olds range widely, from a low of 0.7 for Nigerians to a high of 3.8 for Polish natives. The 2004 global average for 12-year olds is calculated as 1.6 decayed, missing, and filled teeth.

Immigrant Studies

Recent studies have documented the influence of immigrant populations on a host country's dental health and, conversely, the influence of a host country on the dental health of immigrant populations. A population of international students may similarly influence U.S. university

populations, and, conversely, that campus environment may influence the dental health of international students.

A Swiss study demonstrated statistical increases in caries prevalence were at least partially due to an influx of immigrants with poorer dental health.¹⁹ In 1994 7-year old children were examined in Zurich, where 42% of school children are immigrants. Native Swiss children had a DMF index of 1.7, while immigrants from Yugoslavia averaged 7.2 and immigrants from all other countries averaged 3.8. The average DMF score for all of these children was 2.9, which is 71% greater than the native Swiss average.

An interesting study between 1996 and 2002 compared the DMF indices of Dutch 12-year olds of high and low socio-economic status to

those of Turkish and Moroccan immigrants.¹⁹ As expected, the high SES group had a lower DMF score than the low SES group. Both Dutch groups had lower DMF averages than the immigrant groups. Most notable was the rapid improvement of DMF scores among the immigrant groups over the four-year trial. This seems to demonstrate the normative influence of the adoptive country's lifestyle and dental care practices.

Factors Related to Dental Caries

Dental caries is the most common disease in the world. It is an infectious disease generally believed to be caused by acid-producing *mutans streptococci* and *lactobacillus bacteria*.²⁰ Even in the presence of these bacteria, however, dental caries can largely be prevented with modulation of environmental factors. Harris, et al. identified 106 factors that were significantly related to the incidence or prevalence of caries.²¹ Of those dietary carbohydrates, personal oral hygiene, and exposure to fluoride were the environmental factors most closely correlated with dental caries experience.

Marthaler has postulated that in many highly industrialized nations there is a recent "lack of correlation between the decline of caries and average sugar consumption."¹⁹ Most researchers, however, believe a highly significant relationship exists between dietary sugar and tooth decay.^{22, 23, 24} They have calculated sugar alone accounts for 28-50% of the variation in human caries experience.^{23, 25, 26}

In general societies with lower carbohydrate diets have a lower risk for dental caries. The average American diet, however, is high in carbohydrates which infers some caries risk.²⁷ Consequently, international students from countries with low per capita carbohydrate consumption who adopt an American diet while studying in the U.S. may accept an increased risk of caries. Similarly, in developing nations, the incidence of dental caries is expected to rise due to growing consumption of sugars and inadequate exposure to preventive dental care including fluorides.²⁷

In China sugar consumption has rapidly increased from 0.25 kg per capita before the "great cultural revolution" to 6.7 kg per capita today.²⁸ Table 1

includes the annual per capita sugar consumption of various countries. According to this data, annual per capita sugar consumption varies from a low of 3.9 Kg in Ethiopia to a high of 63.5 Kg in Australia.^{25, 27}

Although long-term studies have shown strong correlations between good oral self-care and low caries rates, dietary sugar has been more strongly correlated with dental caries than poor oral hygiene.^{17, 29, 30} While oral hygiene procedures are known to reduce quantities of oral bacteria and available substrate sugars, the use of fluoride-containing dentifrices is believed to be most responsible for caries prevention.³¹ The caries-preventive effects of toothbrushing alone have been difficult to quantify because most dentifrices now contain fluoride.³² In controlled randomized studies comparing dentifrices with and without fluoride, the reductions ascribed to fluoride are generally between 20% and 40%.³³

As early as 1874, dentists recognized fluoride can prevent the development of dental caries.³⁴ More than 73 studies on permanent teeth have demonstrated a modal reduction in tooth decay of between 18% and 60% for individuals exposed to fluoridated water.^{35, 36} Other topical and systemic fluoride applications are known to produce similar reductions in dental caries.^{37, 38}

More than 800 million people throughout the world now benefit from fluoride as a means of controlling caries. This is mostly achieved through dentifrice fluoridation (450 million people), water fluoridation (210 million people), and salt fluoridation (50 million people).³ Table 1 indicates which countries have fluoridation programs.

Although fluoride is widely available, access to professional dental care varies greatly throughout the world. For the countries listed in Table 1, the ratio of dentists per 100,000 citizens varies from 0.025 in China to 114 in Greece. Although influenced by economic and population factors, this huge disproportion somewhat reflects the societal demand for dental care.^{39, 40}

In developing nations where access to oral health services is limited painful teeth are often left untreated or extracted. In such areas little value may be placed on maintaining oral health. The

loss of a tooth (or teeth) may be viewed as a culturally acceptable insignificant loss or as a natural consequence of aging.⁵

In the U.S. millions of dollars are spent annually to advertise and market oral health products, while preventive dental care remains scarce in developing nations. In 1980 it was estimated 70% of the Chinese population did not have regular toothbrushing habits.²⁸ Even today in many countries members of a family often share a toothbrush. In such populations where an individual toothbrush is a luxury, professional dental care is likely to be an unaffordable extravagance.

Oral disease is the fourth most costly disease to treat in industrialized countries, accounting for between 5% and 10% of total health care expenditures and exceeding the cost of treating cardiovascular disease, cancer, and osteoporosis.⁴¹ In low-income countries, if it were treated, the cost of treating dental caries alone in children would exceed the entire budget for children's healthcare.

Barriers to Dental Care for International Students in the U.S.

Cost and fear are the reasons most often reported for avoidance of professional dental care.^{42, 43, 44, 45} International students in the U.S. may be affected similarly by these same factors. Depending on their country of origin, language and cultural differences may also be barriers to receiving dental care.



As a requirement of their visas, international students are required to purchase medical insurance policies prior to entering the U.S.⁴⁶

Such policies provide limited dental benefits, restricted to emergency treatments for pain relief. Because preventive and restorative dental care are not covered by these insurance policies, some international students may defer treatment until they return to their native country.

The cost of dental care varies widely throughout the world. Some international students' home countries offer socialized or government-subsidized dental care that is less expensive than similar treatment in the U.S. Government-subsidized dental care is available in the U.S., but treatment choices may be limited and based on cost.

American dentistry is of exceptional quality, but its costs are significant for students on limited budgets. Among privately practicing dentists in 2004, the U.S. national median fee for an extraction was \$100 and the cost of a molar root canal was \$700.⁴⁷ Because personal and family savings are the primary source of funds for 67% of all international students, these costs may be unaffordable for some.⁴⁸

Conclusion

Dental needs and dental care vary greatly throughout the world. Studies are needed to accurately assess the dental needs of international students at U.S. educational institutions. In these populations studies should explore the relationships between dental caries incidence and patient age, sex, diet, and country of origin. Surveys should attempt to define the barriers to receiving dental care – including language, cultural differences, fear, and cost. Beyond dental caries, future studies should assess other measures of oral health including periodontal health. For comparative purposes, the oral health of American students studying abroad might also deserve examination.

Educational institutions must recognize the dental needs of their international students, appreciate the expense of dental treatment, and endeavor to assist in procuring dental services. Effective preventive oral health measures such as fluoride use, low carbohydrate diets, and good oral self-care should be promoted. The improved dental health of individuals and university campuses is a worthwhile and achievable goal.

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