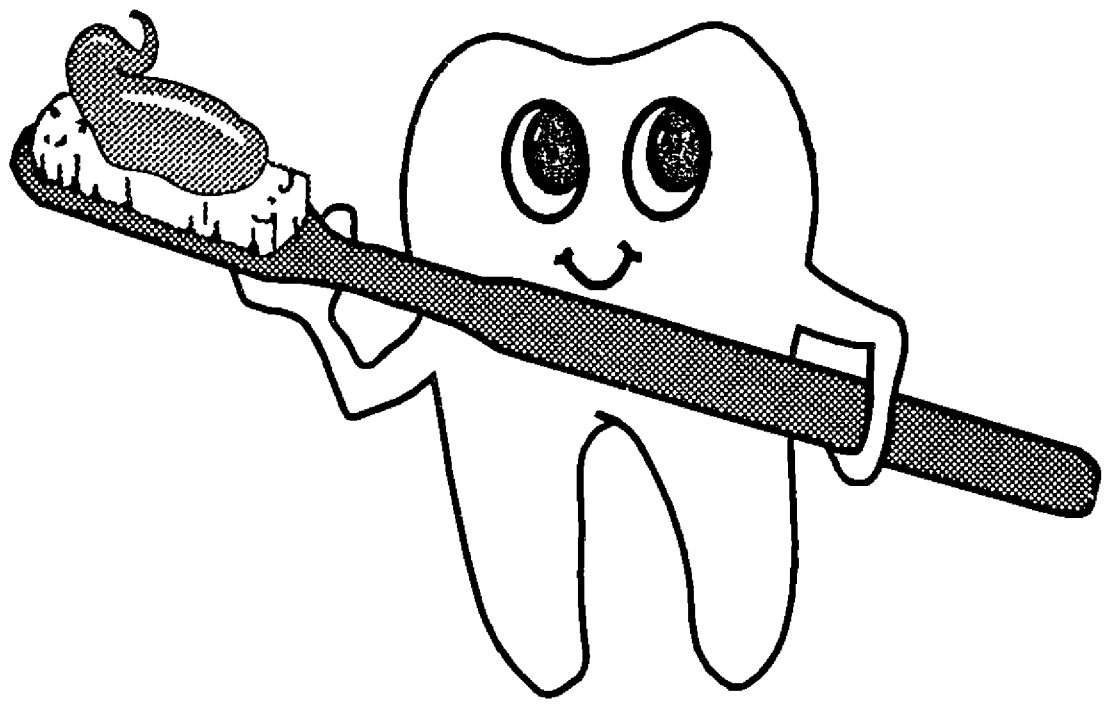
NATIONAL FLUORIDE SURVEY

BELIZE 1994-1995



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CONTENTS

SUMMARY

Prior to this study there was no information on the nutritional status of fluoride in Belize It was therefore difficult to assess the need for interventions aimed at improving the oral health profile of the population

A national survey on fluoride in urine was conducted to provide information on the availability of fluoride in school children This would assist in determining the measures necessary to control and prevent fluoride deficiency and hence to reduce dental deterioration The study was based on a representative sample of 1576 children attending schools The urban and rural strata included 898 and 678 children respectively The quality of the study provided good estimates for fluoride excretion in children, which is an index population for assessing the nutritional status of fluoride in the Belizean population

Results showed that school children from the Toledo and Orange Walk Districts had satisfactory levels of fluoride excretion, medians equal to or greater than 1 ppm Corozal, Belize, Cayo and Stann Creek Districts were classified as having mild fluoride deficiency This may be associated with an increased intake of fluoride probably from fluoridated salt at lower levels than required

Recommendations suggest the following

1 Implement a monitoring and surveillance system to ensure the appropriate fluoride level at 250 ppm of all imported salt and any that could be produced or packaged locally,
2 Implement yearly evaluation of the nutritional status of fluoride in school children of sentinel areas,
3 Develop and implement norms to ensure that all imported salt for human or animal consumption contains no less than the recommended levels of 250 ppm (mcg/g) of fluoride,
4 Coordinate actions among public and private sectors and the community to monitor imported fluoridated salt for adequate levels

I. INTRODUCTION

The metabolism of fluoride in the body involves three phases absorption, distribution and excretion Absorption takes place mainly in the intestine, although some absorption occurs in the mouth Around 50% of fluoride taken in is retained by the body and 50 per cent is excreted in urine

Fluoride increases the deposition of calcium and hence strengthens the bones It reduces acid formation in the mouth and decreases dental decay Small amount of fluoride is beneficial to the body, however, large excesses may be harmful

High intakes of fluoride may destroy certain vital enzymatic processes Toxic levels may occur naturally in water sources Seafood may also be a limited source of fluoride Additionally fluoride may occur in some plant foods in soil fertilized or sprayed with fluoride compounds Fluoridated water supplies are by far the most common intervention to increase fluoride availability However, in countries where the majority of people drink water from home cisterns instead of from central water supplies, fluoridated water would not be cost effective Several countries in Latin America have successfully introduced fluoridated salt for human consumption as a safe and effective systematic mechanism for improving fluoride intake

Fluoride increases the deposition of calcium and hence strengthens the bones. It reduces acid formation in the mouth and decreases dental decay. Fluoride is needed for healthy teeth and good oral health.

II. BACKGROUND

No information related to the nutritional status of fluoride of the Belizean population was available This information was needed to complement the oral health profile in order to evaluate the nutritional situation of fluoride by means of fluoride excretion in urine of school children

No information on the nutritional status of fluoride in the population was available.

III. OBJECTIVES

A. General Objective

To provide information on the nutritional status of fluoride in school children

B. Specific Objectives

1 To estimate the prevalence of fluoride deficiency using urinary excretion in children ages 7 to14 years old

2 To identify population groups which are vulnerable to fluoride deficiency

3 To document the oral health condition associated with the nutritional status of fluoride

IV. METHODOLOGY

A. Sample Design

The study was based on a two stage cluster sampling design stratified by residence area, urban and rural This study used the sampling scheme of the National Iodine Survey 1994-95 The first stage was a random sample of clusters selected in direct proportion to the size of the schools Larger schools may have contained more than one cluster Cluster elements were selected by a systematic sampling scheme, using a fixed range among elements in each school Each cluster consisted of 35 school children The design effect proposed was of 2 0 with an intra-cluster correlation of 0 0294 in the prevalence of low levels of fluoride excretion

The urban and rural strata included 1015 and 735 children respectively, adjusting for the design effect The sample size estimate for each stratum was based on a "guessed" estimate of 30% prevalence of low levels of fluoride in urine (<0 5 ppm) an absolute error of 5% and 95% of confidence coefficient of the estimate

B. Data Collection

Urine samples were collected from children of urban and rural areas of the six districts of the country, listed approximately from north to south Corozal, Orange Walk, Cayo, Belize, Stann Creek and Toledo The sample size for each district was proportional to its school population

Urine sample collection and handling was performed using standard procedures (INCAP) Spot urine samples were kept in ice-boxes at +4/+8°C for the remainder of each data collection day The collected samples were then stored refrigerated at +2/+4°C until they were transported to INCAP in Guatemala City for analysis

The determination of fluoride was performed by means of a potentiometer adjusted to standard solutions of well known levels of fluoride and a reference electrode

C. Field and Laboratory Sampling Yields

A total of 1664 urine samples were collected (94 5% of planned size), 960 in the urban area and 704 in the rural areas From these, 1576 collected urine samples were evaluated for their fluoride content This represented 90 1% of the planned sample size, 898 and 678 in urban and rural areas, respectively Some samples were lost due to transport and handling or too little urine for testing

A total of 1576 school children were included in the study throughout the country, 898 and 678 in urban and rural areas, respectively.

D. Data Analysis

The data analysis was performed by means of the program CSample of the computational package Epi-Info version 6 0 The estimates were obtained by residence areas and by post-stratification of districts

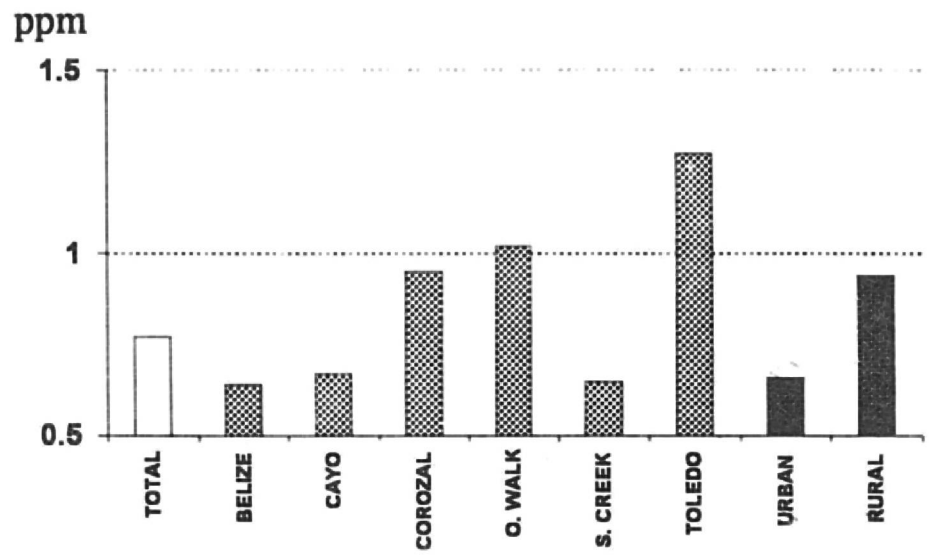
V. RESULTS AND DISCUSSION

The median urine fluoride excretion in school children varied among districts. High excretion values were observed in the Toledo and Orange Walk Districts. The Corozal District showed fluoride excretion close to 1 ppm; however, it did not meet the international criterion to be classified as not deficient in fluoride. Lower levels were found in the Belize, Cayo and Stann Creek Districts. Fluoride excretion was higher in children from the rural area than from children in the urban area.

Generally the median of fluoride excretion in the urine of populations with no fluoride intervention is within the range of 0.3 and 0.4 ppm. The median fluoride excretion of children in the six districts was above this level. This may be due to sources of fluoride in water, salt or toothpaste or a combination of all three.

School children from Toledo and Orange Walk Districts showed satisfactory medians of fluoride excretion.

Medians of Urine Fluoride by District and Area



Source: National Fluoride Survey, 1995.

Assuming a salt consumption of 10 grams and 250 ppm of added fluoride, each person would have available, 2.5 milligrams of fluoride per day. It is expected that 60 per cent of fluoride is retained from production to consumption, i.e., 1.5 milligrams of fluoride per person per day. Fifty per cent of fluoride taken in is retained in the body of young children and the rest is excreted. This means that 0.75 milligrams per day of fluoride provided by salt is excreted, added to the usual fluoride excretion of 0.3-0.4 milligrams per day. In total the fluoride excretion should be 1.05-1.15 milligrams per day.

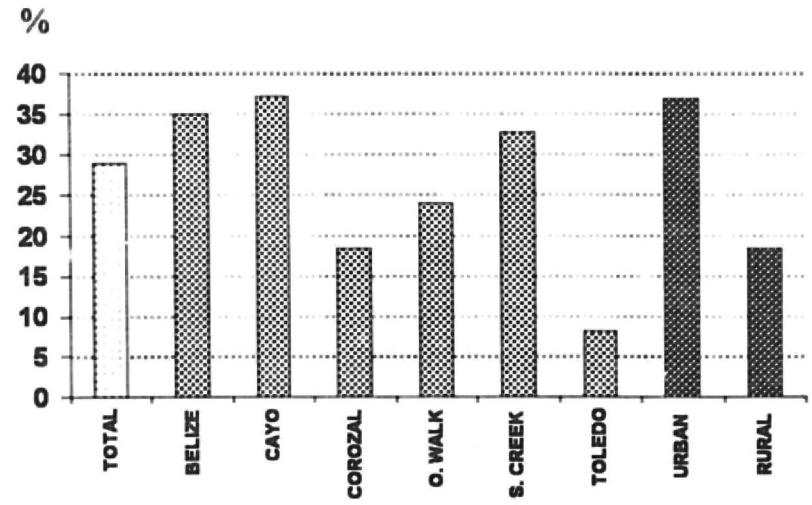
School children from rural areas had higher urine fluoride excretion than those from rural areas, probably due to higher salt intake.

School children included in this study had 0.77 ppm excretion. This suggests that the fluoridated salt consumed contributed less fluoride than expected. This may be due to the fluoridated salt having a lower concentration than stated or to a high loss rate of fluoride in salt from production to consumption or to low salt consumption or any combination of these three conditions. Children from urban areas excreted less fluoride than those from rural areas. They had higher prevalence as compared to their peers in the rural areas. The main reason may be due to an increased intake of salt.

The prevalence of low levels of urine fluoride excretion (less than 0.5 ppm) ranged from 8.1 to 37.2 per cent. The highest prevalence was observed in the Cayo District and the lowest in the Toledo District.

The highest prevalence of fluoride deficiency (moderate or severe) was observed in the Cayo District and the lowest in the Toledo District.

Prevalence of Low Levels of Urine Fluoride (less than 0.5 ppm) by District and Area

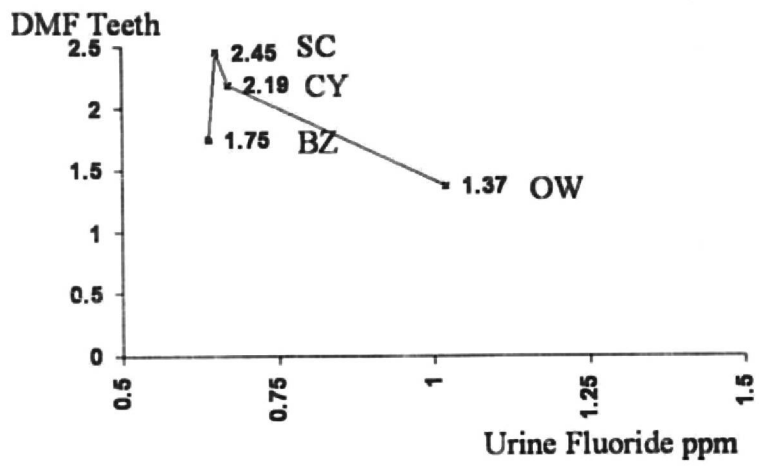


Source: National Fluoride Survey, 1995.

Data available at district level, except for Corozal and Toledo, showed a relationship between decayed-missing-filled (DMF) teeth from 6 to 12 years of age and fluoride excretion in urine of children from 7 to 14 years of age. Children from districts with low levels of fluoride excretion had high DMF teeth means.

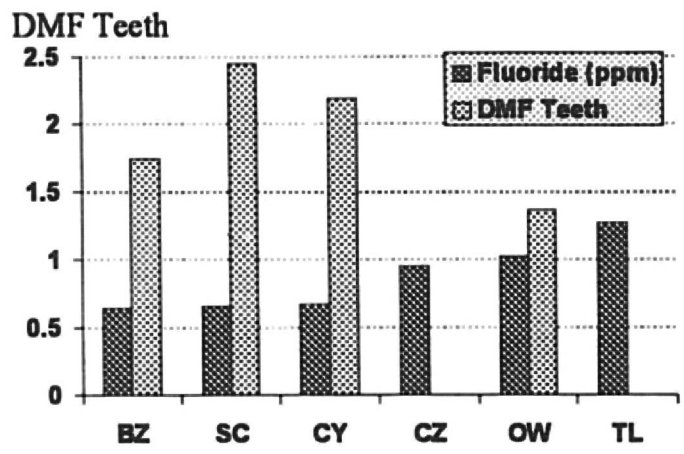
There is still room for improvement in oral health, particularly in Stann Creek and Cayo. Although, there is no DMF teeth means for Toledo and Corozal, it is expected that the DMF teeth means is lower than for the other districts, based on fluoride excretion and may be comparable to that of the Orange Walk District.

DMF Teeth and Fluoride Levels by District



Source: National Fluoride Survey, 1995.
National Oral Health Survey, 1989.

Urine Fluoride Medians (ppm) and
Decayed-Missing-Filled (DMF) Teeth by District



Source: National Fluoride Survey, 1995.
National Oral Health Survey, 1989.

The overall goal of measuring the nutritional status of fluoride is to monitor and correct fluoride deficiency. An optimal nutritional status of fluoride is essential for good oral health, especially in regards to DMF teeth. Other factors which may affect DMF teeth are related to oral hygiene and consumption of foods and drinks containing sugar.

The nutritional status of fluoride is highly associated with the oral health conditions. In this sense, urinary fluoride is an excellent indicator of the oral health situation.

Corozal, Belize, Cayo and Stann Creek Districts were classified as having a mild degree of fluoride deficiency.

Moreover, for a smaller cost, urinary fluoride gives metabolic information that allow oral health personnel to get a clear description of high risk population groups for oral health interventions. Consideration needs to be given to underlying periodontal conditions.

It has been recommended that the assessment of the severity of fluoride deficiency, be evaluated based on the urinary fluoride excretion, as follows:

DEGREE OF FLUORIDE DEFICIENCY	MEDIAN URINARY FLUORIDE EXCRETION (ppm=mcg/dl)	NEED FOR CORRECTION OF FLUORIDE DEFICIENCY
0 (No deficiency)	1 0 or more	
1 (Mild)	0 50 - 0 99	Important
2 (Moderate)	0 20 - 0 49	Urgent
3 (Severe)	less than 0 20	Critical

The findings of the nutritional status of fluoride of school children by districts, based on the median excretion of fluoride, showed that only the Toledo and Orange Walk Districts can be classified as not deficient The other districts, Corozal, Belize, Cayo and Stann Creek can be classified as having a mild degree of fluoride deficiency This situation is consistent with the prevalence of fluoride deficiency (see Annex) and the oral health situation evaluated using DMF teeth indicator This is also an indication that an important part of the salt consumed in Belize may be fluoridated

It is safe to assume that current dietary habits may provide an adequate intake of fluoride, if salt consumed is fortified at the legally regulated level of 250 ppm of fluoride

The increased fluoride excretion observed in rural children may be related to a probable higher salt consumption as compared to their peers in the urban areas

The increased fluoride intake through salt fortified with fluoride has a very important long term effect There is a continuous provision of this nutrient to the fetus before birth The benefits continue throughout life

More than 90% of fluoride is excreted by the kidneys More importantly, natural fluoride sources are very limited, so that the increased fluoride excretion beyond 0 3-0 4 ppm observed in the school children population of Belize can be associated with an additional source of fluoride in the diet, such as

fortified salt This extra source of fluoride can be estimated as the difference between 0 3-0 4 ppm usual excretion and the observed 0 77 ppm excretion in this study, i e , 0 37-0 47 ppm

The usual diet provides low quantities of fluoride so that the expected fluoride excretion ranges within 0 3 and 0 4 ppm If the fluoride provided by fortified salt is low, as is the case of 0 77 ppm in Belize, the situation calls for an appropriate level of salt fortification, probably to 250 ppm This is recommended so as to allow for adequate urine excretion of fluoride after adjusting for 40% loss from production to consumption

Fortified salt with 250 ppm fluoride may be required to guarantee proper nutritional status of fluoride.

It seems that the question to answer, based on these findings is whether the target level of salt fortified with fluoride is adequate It seems that levels of 250 ppm of fluoride may be adequate for the population needs

For a country like Belize, where climate is warm and moist, it has been recommended that salt should contain proper amounts of fluoride of at least 90 per cent of all the sampled household salt

This would guarantee a daily absorption of 1 00 ppm fluoride This recommendation assumes (1) a mean salt intake of 10 g/day, and (2) a 40 per cent loss from salt production to fluoride intake and a 50 per cent loss of available fluoride at absorption level

Closer and permanent monitoring of the nutritional status of fluoride is required for decision making with regards to fluoride interventions.

A functional monitoring system is required on a permanent basis

VI. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

1 There was a mild degree of fluoride deficiency at national level Fluoride excretion in urine of school children showed inadequate fluoride intake in Belize, Cayo, Stann Creek and Corozal Districts

2 Toledo and Orange Walk Districts were the only districts which showed no fluoride deficiency

3 There was an increased fluoride intake among rural children over urban children, probably due to higher salt intake

4 There was an increased intake of fluoride probably through fortified salt, however, the fortification with fluoride does not appear to be at adequate levels

B. RECOMMENDATIONS

1 To implement a monitoring and surveillance system to ensure the appropriate 250 ppm fluoride levels in all imported salt and any that could be produced or packaged locally

2 To implement a yearly evaluation of the nutritional status of fluoride in school children of sentinel areas

3 To develop and implement norms to ensure that all imported salt for human or animal consumption contains no less than the recommended levels of 250 ppm (mcg/g) of fluoride

4 To coordinate actions among public and private sectors and the community to monitor imported fluoridated salt for adequate levels

VII. REFERENCES

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Annex

MEDIAN OF FLUORIDE (ppm) AND PREVALENCE OF DEFICIENT LEVELS OF FLUORIDE IN URINE BY DISTRICT AND RESIDENCE AREA
BELIZE 1994-95

District	Sample size (n)	Median	Prevalence	Confidence Limits (95%)		Sampling Design Effect
				Lower	Upper	DEFF
1 Belize	474	0 64	35 0	23 2	46 9	7 6
2 Cayo	349	0 67	37 2	24 4	50 1	6 5
3 Corozal	196	0 95	18 4	8 4	28 3	3 4
4 Orange Walk	287	1 02	24 0	6 8	41 2	12 1
5 Stann Creek	134	0 65	32 8	18 7	46 9	3 1
6 Toledo	136	1 27	8 1	4 8	11 4	0 5
Country	1576	0 77	28 9	22 7	35 2	7 8
Urban	898	0 66	36 9	25 8	48 0	12 4
Rural	678	0 94	18 4	11 6	25 3	35 2

Source National Fluoride Survey Belize 1994-95

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