Urinary Fluoride Levels in Children in a Single School in Trinidad and Tobago
A Preliminary Investigation

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ABSTRACT

Objective: *To determine urinary fluoride levels in school children in a non-fluoridated area in Trinidad and Tobago.*
Method: *Morning urine samples were requested from 750 children aged 5 to 14 years, attending a primary school in the area of St Joseph, north west Trinidad. Urine was collected at home and brought to school in labelled plastic bottles. Urinary fluoride concentration (ppm) was measured using an ion-specific electrode.*
Results: *Urine samples were available for 500 children (67%). Mean age was 8.5 years. Overall mean fluoride concentration was 0.5 ppm ± standard deviation (SD) 0.27; males (n = 263) were 0.58 ppm ± 0.28 and females (n = 237) 0.55 ppm ± 0.27. Children in the 5 to 7-year age group had the highest levels (0.64 ppm ± 0.33).*
Conclusion: *Mean urinary fluoride levels in this sample of school children were low indicating a fluoride intake below the optimum level for caries prevention. Fluoridation programmes may need to be implemented to increase fluoride intake among school children in the study area.*

Niveles de Fluoruro Urinario en los Niños en una Escuela de Trinidad y Tobago
Una Investigación Preliminar

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RESUMEN

Objetivo: *Determinar los niveles de fluoruro urinario en escolares de un área no fluorada en Trinidad y Tobago.*
Método: *Se solicitaron muestras matutinas de orina a 750 niños y niñas de 5 a 14 años de edad, que asistían a la escuela primaria en el área de St. Joseph, en el noroeste de Trinidad. La orina fue recogida en las casas y llevada a la escuela en frascos plásticos rotulados. La concentración de fluoruro urinario (ppm) fue medida usando un electrodo de ión específico.*
Resultado: *Hubo muestras de orina disponibles de 500 niños (67%). La edad media fue 8.5 años. La concentración media de fluoruro en general fue 0.5ppm ± desviación estándar (SD) 0.27. Varones (n = 263) 0.58 ppm ± 0.28, hembras (n = 237) 0.55 ppm ± 0.27. Los niños y niñas en el grupo etario de cinco a siete años tuvieron los niveles más altos 0.64 ppm ± 0.33.*
Conclusión: *Los niveles de fluoruro urinario en esta muestra de escolares fueron bajos, indicando que la ingestión de fluoruro se hallaba por debajo del nivel óptimo para la prevención de las caries. Puede que se requiera la implementación de programas de fluoración a fin de aumentar el consumo de fluoruro entres los escolares del área estudiada.*

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INTRODUCTION

Fluoride is a strongly electronegative ion commonly found in combination with calcium or sodium, forming compounds that occur naturally in soil and water. When ingested, fluoride is readily incorporated into the hard tissues of the human body (*ie* bones and teeth) where it forms the stable compound fluorapatite ($Ca_{10}[PO_4]_6F_2$) (1).

Dental caries (tooth decay) is the destruction of tooth tissue due to the action of oral bacteria. The caries preventive effects of fluoride have been proven unequivocally in studies throughout the world and its safety as regards general health, at the levels required to prevent dental caries (tooth decay), has been endorsed by international scientific bodies (1–3). Fluoride strengthens the crystalline structure of dental enamel making it less susceptible to breakdown by acids from oral bacteria (dental plaque).

Since the 1970s, fluoride toothpastes have become widely available and presently several other vehicles for fluoride delivery are also in use *eg* tablets, drops, mouthwashes and varnishes. Many countries have also implemented fluoridation programmes involving artificially increasing the fluoride content of public water sources to approximately one part per million (ppm) or introducing fluoridated salt (250 mg/kg) in order to improve the oral health of whole communities. Despite these benefits, when there is ingestion of fluoride much above 1ppm during the period of tooth formation there is an increase in the risk of fluorosis (mottling of teeth) which may compromise aesthetic appearance (1).

Dental caries experience in any given population is expressed as the mean DMFT (*ie* mean number of decayed [D], missing [M] and filled [F] teeth). The last reported national oral health survey in Trinidad and Tobago was undertaken in 1989 and showed a large increase in the DMFT in 12-year olds since the previous survey in 1961 (4). Similarly in the 1980s, Jamaica had one of the worst levels of caries experience in the English-speaking Caribbean, yet the DMFT of 12-year olds improved significantly between 1984 and 1994 (4). This improvement in the oral health of Jamaican school children has been attributed to the implementation of salt fluoridation as a public health measure in 1987 (5). Before a similar programme could be considered for Trinidad and Tobago, baseline information on systemic fluoride levels in children requires investigation.

Systemic fluoride concentration can be determined from the concentration of fluoride in urine, as urinary fluoride levels are considered an accurate marker of ambient fluoride exposure (6–8). Studies have shown that the higher the levels of fluoride exposure, the higher the urinary excretion (9). Little is known about the fluoride intake of school children in Trinidad and Tobago but as there has been no formal fluoridation programme implemented, it is likely that their level of fluoride exposure is low.

OBJECTIVE

Information on a population's average fluoride exposure is required to enable the planning of appropriate preventive strategies and to avoid the risk of over ingestion of fluoride. The objective of this study was therefore to acquire preliminary data on urinary fluoride levels in school children at a single school in Trinidad and Tobago.

SUBJECTS AND METHODS

A large primary school (TML Muslim School) in the town of St Joseph in county St George was selected as the sample frame for this pilot study. Consent forms and covering letters were distributed to all parents, explaining the purpose of the study and requesting that they and their children take part. Consenting parents were provided with a small, labelled plastic bottle and requested to collect the first morning urine passed from their children enrolled at the school. The urine samples were brought to school the same day. Data collection took place from March to April 2001. Approval for the study was gained from the Ministry of Education, Trinidad and Tobago. Fluoride samples were analyzed by the Department of Chemistry at the University of the West Indies, St Augustine, Trinidad and Tobago. In order to ensure quality and consistency with other analytical laboratories, the measurement of the urinary fluoride samples involved the use of a fluoride ion specific electrode (ISE) which was calibrated using fluoride standard solutions.

Calibration of the fluoride ion specific electrode *(ISE)*

Fluoride standards were prepared at 0.01 ppm, 0.10 ppm, 0.50 ppm, 1.00 ppm and 5.00ppm by adding aliquots of a 100 ppm stock solution and diluting using de-ionized water to produce 10ml of solution in volumetric flasks. To each of these solutions 1ml of Total Ionic Strength Adjustment Buffer TISAB (III) was added to obtain a final volume of 11ml. Each standard was transferred to a 20 ml beaker and stirred with a magnetic stir bar. These standards were used to calibrate the Ion Meter to obtain a graph gradient of approximately –56mV/dec.

Analysis of the urine samples

Urine samples were stored in a laboratory fridge which was checked daily for maintenance of correct temperature. Samples for analysis were prepared by adding 1ml TISAB (III) (using individual automatic pipettes to avoid contamination) to 10 ml of each urine sample in a 20 ml beaker and stirred with a magnetic stir bar. Readings for each sample were taken using the fluoride ISE in ppm. To further ensure reliability of the measurements, the ISE was recalibrated using standard solutions after every 20 sample readings.

RESULTS

From the entire school of 750 pupils, measurable urine samples were available for 500 children (67%). Mean age was 8.5 years (range 6–14 years). The mean fluoride concentration was 0.57 ppm (± sd 0.27). The Figure shows the distribution for the whole sample. For males (n = 263), the mean fluoride concentration was 0.58 ppm ± 0.28 and for females (n = 237) 0.55 ppm ± 0.27. The mean fluoride concentration by age group is shown in the Table.

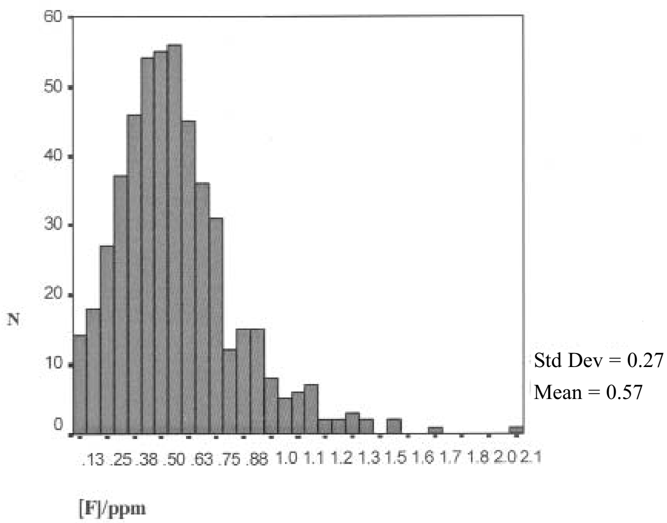

Figure: Urine fluoride concentration (n = 500)

Table: Fluoride concentration by age group

Age group (yrs)	n	[F] ppm ± SD	
5–7	160	0.64	0.33
8–10	250	0.53	0.24
11–14	90	0.52	0.23

DISCUSSION

The use of fluoride has been one of the most successful measures in public health dentistry. It has been effectively used in preventive strategies to control dental caries, a disease that has major health, economic and social effects on communities worldwide (7). Furthermore, the effects of dental caries during childhood are potentially very serious due the resultant pain, infection and need for treatment that often involves extraction of teeth.

Caries experience in school children in Trinidad and Tobago has been reported as high (4) and recent data from a paediatric dental emergency clinic in county St George, Trinidad and Tobago, reported that most emergency cases were due to toothache and abscess (10). Ten per cent of these children presented with 'rampant caries' a form of decay that affects the teeth of infants and pre-schoolers and caused by prolonged feeding from sweetened baby bottles. Most of these children required all their deciduous (baby) teeth extracted under general anaesthetic.

It is critical to establish fluoride intake in children at risk of dental caries in order to determine and plan for appropriate fluoride regimes. Although Trinidad and Tobago does not have an artificially fluoridated public water supply, fluoride toothpaste is commonly available and it is also used as a mouthwash, professionally applied gels or as dietary supplements (drop or tablets). Apart from these sources, trace amounts may also be ingested *via* water if present naturally. An investigation of fluoride sources in Trinidad and Tobago revealed that the mean natural level in water in Trinidad was 0.2 ppm and in Tobago 0.25 ppm (11), well below the recommend 1ppm required for caries prevention. Although fluoridated salt has become available in Trinidad and Tobago, this has not been part of any systematic fluoridation programme. A small scale preliminary study suggests that table salt is an inadequate source of dietary flouride for this population (12).

In view of the low level of fluoride in these children as determined by urinary excretion, it would appear that increasing fluoride intake levels through a fluoridation programme involving water or salt may be required to effectively protect them from dental caries. Further well-designed studies involving other regions of the country are necessary to confirm these findings.

CONCLUSION

Mean urinary fluoride levels in this sample of school children were low indicating a fluoride intake below the optimum level for caries prevention. Further national studies are required. A national fluoridation policy may be needed to increase fluoride intake among school children in Trinidad and Tobago.

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