

Development of salt fluoridation in the Americas

Summary

Fluoridation of water supplies has proven to be an effective preventive measure for dental caries. Many developing countries in the Americas have multiple water systems and economies that do not permit the viable application of this approach. Some of the highest dental caries prevalence in the world was evident in the Americas. Fluoridated salt was considered as a potential solution on account of the urgent need for dental caries prevention to millions of people with limited access to routine dental services. A fluoridated salt trial was initiated in Colombia (1963) and upon successful completion with preventive results comparable to water fluoridation, the approach was introduced to other countries and was supported by resolutions of WHO, PAHO, regional health groups and the FDI. The procedures for addition of fluoride were comparable to those for iodization and the two elements were compatible. In the period 1972–2004, ten countries introduced national or localized programmes and five more initiated programmes. Results, based on addition of F ion at 200–250 mg/kg salt, indicated caries prevalence reductions in 12 year olds ranging from 84% in Jamaica, 73% in Costa Rica to 40% in Uruguay at an average cost of US \$ 0.06 /capita/year. This paper provides a background to the situation in the Americas, illustrates the approaches and feasibility of implementing viable fluoridated salt programmes in countries, and demonstrates the results obtainable at minimum cost.

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Introduction

Fluoridation of domestic salt (FS) for human consumption was initiated in Switzerland in 1955. Following the iodization of salt in Switzerland since 1922, fluoridation of salt for the prevention of dental disease was considered a valid approach based on experiences of fluoride in the prevention of dental caries (WESPI 1950).

The results illustrated the feasibility of such approach and community acceptability (MARTHALER & SCHENARDI 1962). Based on this evidence, the Pan American Health Organization (PAHO)

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Committee on Medical Research recommended that a project be initiated in Colombia and specified the site, details for the study and aspects for evaluation (PAHO/WHO 1963).

Development plan

The successful experience in Switzerland indicated that a similar approach could be utilized in the Americas. Latin America and the Caribbean had multiple small water systems and extensive poor populations dispersed in rural localities without treated water (PAHO/WHO 1956). With low income, high levels of disease (some of the highest in the world in Central America) and dentist population ratios in the order of 1:40,000 in many sites, fluoridation of water supplies was not economically feasible and access to services was limited (RESTREPO 1967). The potential applicability of using FS was based on: (1) the success of the programme implementation in Switzerland, (2) the universality of salt use throughout society, (3) access to all communities (both urban and rural) at all socio-economic levels, (4) the experience of salt iodization and knowledge of operators in addition of compounds to salt and compatibility with iodization, (5) potential low cost, reduced needs for equipment, installations, compounds and training, (6) lack of requirement for referendum and additional legal procedures frequently used in approving water fluoridation, (7) salt was a government product in several countries and a private sector initiative in others, (8) little requirement for additional human resources, and (9) the consistency of salt intake.

PAHO with the collaboration of the National Institutes of Health, USA, Colombian Authorities and the University of Antioquia, Medellin, Colombia, finalized the study approach involving four small communities (10,000 pop. each) in the state of Antioquia where salt production was controlled by the Colombian Government. A National Institute of Dental Research, USPHS grant (DE-01848) provided funding and an arrangement was made to add fluoride to domestic salt at the Faculty of Dentistry at the University of Antioquia.

The project was established in 1963 to consider primarily the following factors: (1) whether fluoride could effectively be added to salt in Colombia, (2) what compounds could effectively be used in the fluoridation of salt, (3) the impact of fluoridated salt on the community and dental disease, (4) toxicity and interference with other health status.

In the same geographic region, one community received fluoridated water, one community received salt with added calcium

fluoride, a further community salt with added sodium fluoride, and one community was maintained as control (RESTREPO et al. 1972). All communities had comparable characteristics, diets and populations. In order to ensure an effective mixture of fluoride with refined salt, discussions with Monsanto Chemicals St. Louis, USA, provided a mixture of fluoride with pyrophosphate and monophosphate for addition to the salt (MONSANTO 1962). Initial problems related to humidity of salt and grain size resulting in a concentration of fluoride in the bottom of the salt packages. Both these factors were overcome by ensuring the grain size of the sodium and calcium compounds was compatible with the grain size of the salt produced, and humidity was controlled through the use of anti-humectants and anti-caking agents preventing accumulation of fluoride. With only one salt processor involved (mined salt), consistency of production and distribution was ensured.

Routine epidemiological investigations were carried out prior to the initiation of the salt fluoridation and at subsequent intervals during the period of the study. Examples of fluoride consumption were assessed through the use of urinary evaluations of school children – pooled urine – and analyzed for fluoride concentration. Salt consumption was assessed by providing families with known quantities of salt and recording the salt usage over a period of time such as one week (MEJIA et al. 1974). Diet in all villages was similar and consistent. The clinical results illustrating changes in dental caries prevalence and the efficacy of FS comparable to water fluoridation are shown in Table I.

Corollary studies on other health conditions, in particular nutrition, bone density, and goitre, illustrated no adverse nutritional effects, no incompatibility between fluoride and iodide added to salt, and no adverse impact in the beneficial effects in prevention of goitre (VELEZ 1968).

The successful trial in Colombia indicated that results should be further reviewed and discussed by other scientists, in nutrition and oral health, who had been involved with utilization of fluorides, water fluoridation and addition of fluoride to salt. In 1977 an international meeting was convened in Medellin, Colombia involving 12 countries (Brazil, Colombia, Finland, Guatemala - INCAP, Mexico, Panama, Sweden, Switzerland, Spain, Hungary, United States, Venezuela), six of which had experience in the addition of fluoride to domestic salt. Following detailed discussion, a visit was made to the sites where fluoride had been added to salt. A visible and clinical evaluation of impact confirmed the results. Representatives of the National Institutes of Health (USA)

Tab.1 Comparison of the Average DMFT and Percentage Differences between the Initial Survey (1964) and the Final Survey (1972) of Children of Both Sexes, 6 to 14 Years of Age, in the Four Communities Studied by the Research Project

Age in Years	Armenia Calcium Fluoride			Montebello Sodium Fluoride			Don Matias Control			San Pedro Water Fluoridation		
	DMF 1964	DMF 1972	Difference %	DMF 1964	DMF 1972	Difference %	DMF 1964	DMF 1972	Difference %	DMF 1964	DMF 1972	Difference %
6	0.7	0.4	42.9	0.8	0.0	100	1.0	0.9	10.0	1.1	0.2	81.8
7	2.3	0.4	82.6	2.9	0.6	79.3	2.3	2.6	-13.0	2.4	0.4	83.3
8	3.7	1.4	62.2	3.8	1.1	71.0	4.3	3.8	8.8	3.8	0.8	78.9
9	5.3	2.0	62.3	3.9	1.9	51.3	5.3	5.2	1.9	4.7	1.6	66.0
10	5.7	2.5	56.1	5.3	2.2	58.5	7.0	6.9	1.4	6.2	2.9	53.2
11	9.7	3.4	64.9	7.1	3.6	49.3	9.9	10.1	-2.0	7.8	3.7	52.6
12	9.4	5.0	46.8	8.6	4.5	47.7	10.7	11.0	-2.8	9.5	4.1	56.8
13	12.3	7.3	40.7	10.5	5.4	48.6	13.1	14.3	-9.2	11.1	6.5	41.4
14	9.7	8.2	15.5	9.6	7.4	22.9	15.6	16.4	-5.1	12.9	7.2	44.2
Total	6.7	3.5	47.8	6.3	3.2	49.2	8.6	8.2	4.7	6.7	2.7	59.7

Adapted from Mejia R, Espina F, Velez H VIII. Results of Fluoridation of Salt in four Colombian Communities 1964–1972. Bol. of Sanit. Panam. 1976; 80: 205–219

noted the absence of fluorosis in the fluoridated salt community. It was agreed that further development of fluoridated domestic salt should proceed for possible wider application in Latin America (GILLESPIE & ROVIRALTA 1986).

Lessons learned from the Colombia Trial

(1) Fluoridated salt is compatible with iodized salt and comparable to water fluoridation in dental caries prevention. (2) Addition of 200 mg/kg fluoride ion produces effective reduction in caries prevalence. (3) Equipment and the mixture used in the trial would not be efficient and commercially viable if used on a large or national scale. (4) Collaboration between health authorities, salt processors and distributors, and the community are necessary for successful implementation. (5) Fluoridated salt is well accepted by the community. (6) The packaged fluoridated salt should have compatible grain size and low humidity. (7) Need to monitor and evaluate at the processor, in the market and in the individual. (8) Young children do not take in excessive fluoride. (9) Cost, shipping and regulations together with currency and devaluation are important factors in choice and source of compounds. (10) Packaging should be clearly labelled and vigilance is needed to prevent imitation products without adequate fluoride being marketed. (11) Minimal quantities of fluoride compound are required compared to water fluoridation.

Strategic planning and targets

A definitive and detailed plan of action was required in order to assess the applicability of the findings of the Colombia study to countries in the Americas. A plan was necessary to identify stages for development of a programme to cover both geographic and technical aspects related to salt fluoridation. The 25 year plan of PAHO envisaged the following activities and stages:

1972–1977 Monitor the situation, promotion of the information relative to the efficacy of fluoridation of salt, public relations and contacts with the technical consultants involved in the addition of compounds to salt for human consumption. The approval of international and regional health organizations was needed to proceed with the implementation of this approach further to the acceptance by FDI and WHO of this approach and the passage of a resolution by the Directing Council PAHO (PAHO 1976) and Caricom Ministers Responsible for Health in 1977 (CARICOM 1977).

1978–1983 Obtain a further PAHO resolution for guidance to the countries of the region (PAHO 1979). Consider issues to be resolved prior to implementation of FS as a widespread or even national community measure. This required analysis of technical aspects, training of personnel in salt fluoride addition, laboratory analysis and monitoring, review of legislation and health requirements, and identification of countries where the implementation of fluoridated salt would be readily applicable. Development of and contact through international meetings and participation in national events relative to the benefits of fluoride salt prevention. Finalize approaches relative to humidity, mixing techniques, grain size, monitoring, marketing, distribution, packaging, cost and administrative structure taking into consideration the range of possibilities from government-owned salt production to private-public entities and purely private entities. Criteria for zones of exclusion (such as those with high levels of fluoride in the water supply or fluorosis) also needed to be identified.

1984–1989 Develop awareness and initial interest on the part of countries in the Americas, particularly Mexico, Peru, Venezuela,

Colombia, the Caricom Community (Anguilla, Antigua, Barbados, Belize, British Virgin Islands, Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Kitts Nevis, St. Lucia, St. Vincent, Surinam, Trinidad and Tobago), Costa Rica, Ecuador, Dominican Republic and Cuba. Implement salt fluoridation in several countries.

1990–1997 Consolidate the fluoridation of salt programmes in existence and assist others that wished to implement this measure. Conduct epidemiological evaluations in those sites with fluoridated salt. Assess the efficacy of evaluation and monitoring activities and the cost benefit of this preventive approach. Identify additional improvements in technology to facilitate the process.

A plan was developed which involved and included the following aspects: (1) The need to inform health and political personnel of the region of the potential and capability of salt fluoridation. (2) To establish a basis for the implementation of FS, through WHO, PAHO and regional institutions such as CARICOM Resolutions. (3) A study of mixing technology for the mixing of fluoride with salt in situations where compounds, such as iodine, were being added either through a wet or a dry mix. The assessment of production methods and equipment available in the various salt production plants for the fluoride addition, and evaluation and monitoring of fluoride content and fluoride excretion. (4) Applicability of technologies for varying locations and situations. (5) A review of country salt production to identify quality, capacity and readiness. (6) Salt distribution and packaging. (7) The training of personnel in the particular technologies for the addition of fluoride. This primarily involved engineers working in salt production facilities and laboratory personnel for evaluation and control. (8) The identification of particular compounds appropriate for addition to refined domestic salt. (9) Collaboration required from Health Authorities and salt producing authorities for implementation of FS in communities. A review of legislation and current health practices within the various sites. (10) Evaluation in terms of health issues, FS implementation, the salt industry, impact on oral health, and community acceptance. (11) Identification of sites likely to benefit from salt fluoridation and relative costs and coverage compared to water fluoridation.

Implementation

Various actions were taken to acquire the relative knowledge and information necessary for the effective implementation of a hemispheric wide programme. First an assessment was made of those countries with the greatest evidence of oral disease, the relative urban population distribution, economic situation, existence of current preventive programmes such as water fluoridation, availability of dental resources, and the salt industry. The results of the Colombia study and the experience of Switzerland were presented in informational meetings with various countries and professional societies in the region with particular emphasis on the Latin American countries. Consultation with experts and salt engineers in United States, Canada, United Kingdom, Switzerland (RUTISHAUSER 1986) and The Netherlands were conducted in order to assess methodologies and effective mixing procedures and equipment. This was followed by a travelling seminar for salt engineers from Latin America and the Caribbean to those same countries to review equipment, compounds and procedures utilized in the addition of iodide and fluoride in the salt refining process. Information manuals were produced to illustrate procedures that could be utilized to effectively fluoridate salt in a salt refining facility, both through wet mix or dry mix.

In order to produce a homogeneous and refined mix of salt with fluoride, specific attention was paid to aspects of a dry mix in batches of a few metric tons where the equipment designed by Nautamix of Holland proved to be the most appropriate and effective in ensuring a homogeneous and consistent mix. The principal compounds to be considered would be sodium fluoride or potassium fluoride. The possibility of magnesium fluoride was mentioned by Canadian engineers, but never pursued further. An evaluation of equipment in Latin American countries illustrated that most of the dry mix products such as iodine were added through a screw conveyor system, and in those sites where liquid mix was used, it was mainly through a system of rather elementary pumps. The larger countries tended to contain one major salt processor with frequently some smaller local production. In Central America in particular, most of the salt production was in the hands of small companies and much of it involved the use of salt ponds. It was difficult in that region to envisage a consistent quality of refined domestic salt or the possibility of a controlled distribution system.

Effective implementation of such programmes in the countries necessitated avoiding those political and community problems associated with the inability and delays in water fluoridation. Health regulations needed to be reviewed on a country-by-country basis to assess the ability of the Ministry of Health to implement such a beneficial health measure without the need for additional legislation or regulatory permission. Many countries identified that fluoride could be added to salt under existing health regulations and if legislation was required it could be prepared subsequently. Whereas in Colombia salt was a national commodity produced by the government, in most other Latin American countries, the salt industry was private or a combined government/private organization. This necessitated the effective establishment of collaboration between the salt industry and health authorities to achieve desired implementation.

Obstacles

Obstacles that could be foreseen included debates regarding fluoride, the increased sodium intake from sodium compounds, salt consumption and heart disease, areas with high fluoride content in water supplies and unsightly fluorosis, legality, cost, technological problems, salt quality, lack of motivation by the authorities involved, workforce compliance, and community acceptance.

These were overcome by direct contact with salt processors and health authorities to avoid referendum approaches and identify enabling regulations; collaboration with health professions advising on the negligible additional sodium intake and comparability to iodization for goitre prevention; identifying areas with fluorosis and high water fluoride content and assuring no delivery of FS occurred in those sites. Salt quality and technological problems in achieving a homogeneous mix did delay implementation at some sites but did not affect decisions on having an FS programme. Community acceptance was achieved through production of materials identifying benefits and lack of toxicity, informational meetings, and the quality of the salt. The programme developed in Jamaica by Dr. Warpeha for community leaders was outstanding in this aspect (WARPEHA 1994). Salt industry collaboration was readily achieved due to the comparability to iodization technology and an improved salt product.

An unexpected obstacle was the attitude of some public health dentists who, despite past experience of the unsuccessful implementation in many countries, suggested further delays of FS to

permit the possible fluoridation of water supplies. In most of those countries over the course of the period 1970–1992, with the exception of Brazil and Chile, no country in Latin America substantially increased its water fluoridation, and several moved from water fluoridation as the prime focus to consideration of the fluoridation of refined domestic salt.

An important issue concerned the relative costs for prevention of dental caries. Eliminating the use of the phosphate aggregates used in the study in Colombia reduced the cost of fluoride addition to an incredibly low level. In most instances mixing equipment was available in salt processing plants, or if not could be acquired for relatively low cost, and the cost of the compounds could be assessed at approximately less than US \$ 0.01 cent per capita per year (MARTHALER & GILLESPIE 2005).

Status of implementation by countries in the Americas

1972–1986 In the United States and Canada water fluoridation is dominant; both countries participated in the early trials of water fluoridation in 1945 and witnessed the benefits (ARNOLD 1957). The fluoridation of water supplies in most community systems prompted little interest in FS. In the case of certain sites where water fluoridation was not in effect and where there was interest in the possibility of FS, circumscribed distribution could not be implemented. In Canada, the major salt producer was interested but, with the larger cities fluoridated and no directive from the Ministry of Health in Canada to produce such a product, this was not commercially viable for the company, despite supplying domestic salt to certain of the Caribbean countries.

The analysis of countries in Latin America and the Caribbean at that time indicated:

Caribbean: English-speaking countries, even though some were salt producers, only had salt processors in Jamaica and Trinidad and Tobago. Water collection systems and costs precluded water fluoridation in many of these countries. Guyana had adequate fluoride levels in the capital water supply. Cuba was interested but needed to modify processing plants and salt packaging and Dominican Republic was assessing the capacity of processors to produce and distribute such salt.

Mexico: was fluoridating water in certain cities, has zones of fluorosis and capability to fluoridate salt by big processors. Fluoridation of salt was authorized and trials initiated in 1973 (MARTINEZ 1986).

Central America: Guatemala, Honduras, there was no major processor and salt was of variable quality and grain size. El Salvador had possible fluorosis and limited salt processing. In Nicaragua, the capital water supply had adequate natural fluoride. Belize imported salt. Costa Rica had discarded water fluoridation on account of cost and limited distribution, but illustrated the potential capacity and interest to fluoridate salt. Panama was not interested as it had been committed to water fluoridation over many years.

Andean Region: Colombia was already committed to fluoridate salt. Venezuela expressed interest but the salt industry needed to consolidate processing prior to initiating such a process. Ecuador was interested and had the potential through the major salt processor. Bolivia was interested but needed to review technology applicable to the processing of salt in that country. Peru was interested in the private sector, but the major salt processor, the government, was not in condition to apply fluoride.

Southern Cone: Brazil, Chile and Argentina were interested in expanding water fluoridation. Paraguay had not expressed any

position and Uruguay – a country previously opposed to water fluoridation – was interested to fluoridate salt.

1986–1992 The first countries to fluoridate refined domestic salt in the Americas were Jamaica and Costa Rica (1986–1987). Both small countries had contemplated the fluoridation of water supplies but realized that in view of multiple water systems (for example 62 in Jamaica) (PAHO 1956), economically and technically this was an expensive and difficult process to implement. In Jamaica the salt factory implemented a spray wet mix system and decreed that all salt for human consumption within the country would be fluoridated. Jamaican salt was also distributed to other countries in the English-speaking Caribbean. In Costa Rica implementation took place with four operating plants through the collaboration of the largest salt co-operative that had a 50% share of the salt market at the time of implementation. Uruguay implemented FS in 1991 providing it only to the domestic market and not to the food industry or bakeries. The private salt industry assessed the feasibility of addition of fluoride to salt, obtained the relative equipment, and implemented the programme. A decree of the Ministry of Health permitted national distribution. Mexico also commenced a national programme during this period with legislation by the Mexican Congress. The large salt producer prepared two grades of salt with one distribution going to those areas with low fluoride, and the remainder distributed to the rest of the country.

Other countries considering FS early on were Ecuador, Bolivia, Brazil, Peru and Venezuela. No real consideration of the Central American countries, apart from Costa Rica, was made at the time owing to the nature of the salt industry, the relative inability to control distribution, salt hygiene, salt quality, and the existence of many minor salt producers. The salt produced in such countries tended to have variable grain size and in certain cases considerable humidity was noted in packages requiring holes to be pierced in the polythene packs to permit moisture to evaporate. In Nicaragua and El Salvador, the existence of fluoride in the water supplies needed to be further evaluated prior to consideration of additional fluoride. The occupational health of salt workers involved in adding fluoride to salt required an adequate healthy environment and attention to prevent inhalation of fluoride dust.

1992–2004 A further programme was developed in PAHO that involved support to the original countries and additional countries (such as Honduras, Guatemala, Paraguay, Nicaragua), for which foundation and international bank support was received (ESTUPINAN-DAY 2005). Great emphasis was placed on improving technological procedures in salt processing, mixing (MILNER & ESTUPINAN-DAY 2000), monitoring and epidemiological evaluations, legislation and dissemination of information. Argentina commenced production of FS.

Concerns

These included the ability of the processors to maintain accurate addition of fluoride, good laboratory evaluation and control, and environmental and health concerns associated with the inappropriate ingestion of fluorides, the distribution of FS products, and the consistency of required application of fluoride compounds. Although it is virtually impossible to provide excess fluoride through the amounts required for FS, it is necessary to be vigilant. The relative lack of fluorosis in salt fluoridated communities is notable, particularly compared with the occurrences currently in certain water-fluoridated communities.

Another factor is the potential appearance of improper products not containing the required amount of fluoride but identified as “fluoridated salt” in the market. This has occurred with the product even including license numbers and permits allegedly authorized by the Ministry of Health. Therefore a review of FS sold in the markets or shops needs to be constant. The packaged FS (usually sold in 500 gm, or 1 kilo bags) should be clearly labelled and the benefit of salt with fluoride and iodide identified on the appropriate packages. The need for good industrial relations and worker collaboration is essential for an effective and consistent programme.

In the Americas the initial emphasis of the programme was on the fluoridation of refined domestic salt for household consumption, as opposed to Switzerland where, in the original cantons of Vaud and Glarus, all salt, including salt for bakeries and restaurants, had been fluoridated. The initial rationale considered it more effective for quality control in the existing environment if only salt for human consumption was considered and monitored at production and marketing points. Subsequently, FS has additionally been made available to the food industry, bakeries, restaurants and hospitals in certain countries (MARTHALER 2005).

Results

In the period 1986–1992, Jamaica, Costa Rica, Mexico and Uruguay introduced nationwide salt fluoridation. In Jamaica all salt for human consumption was fluoridated (200 mg/kg F ion), whereas in Uruguay (250 mg/kg F ion) it was solely for household use. Results obtained from the countries illustrate reductions in caries prevalence in the DMF-T of 12-year age groups. In Jamaica, prevalence reduction of 84%, caries free children increased from 2.8% to 61.7%, with 96% fluorosis free (ESTUPINAN-DAY et al. 2001); 73% in Costa Rica, with costs/capita/year (3,900,000 pop.) calculated at US \$ 0.06 (SOLORZANO et al. 1999); and 44% in Mexico (IRIGOYEN & CAMACHO 1997). Uruguay decreased prevalence 40%, and increased caries free children 75%, with FS market share rise to 95%. Legislation has been developed in many countries and in Uruguay now requires 60% of domestic salt for household use in that country to be iodized and fluoridated (MINISTERIO DE SALUD PÚBLICA DE URUGUAY 1999). The reductions can largely be attributed to introduction of FS in 1987 in Jamaica and Costa Rica, since fluoridated toothpaste had been available for some 20 years prior to the baseline study, and diets, health promotional, and other preventive activities had not changed significantly (WARPEHA et al. 2001).

By 1992, the Americas had two countries with national programmes where all domestic salt was fluoridated (Jamaica, Costa Rica); four countries with partial FS (Colombia, Mexico, Peru, Uruguay); CARICOM countries with access to FS from Jamaica: French-speaking dependencies with access to FS from France; Venezuela developing a programme with PAHO, UNIDO and eventually World Bank support; Bolivia, Cuba, Dominican Republic and Ecuador initiating programmes. By 2004, nearly all countries in Latin America with the exceptions of Brazil, Chile, and Panama had initiated FS activities (ESTUPINAN-DAY 2005).

Discussion

The rapid implementation of salt fluoridation in the developing countries of the Americas (1986–2004) and the impact upon oral disease are notable. This approach has illustrated that implementation of this measure is extremely economical and effective. In some instances, processors have indicated that it is more expen-

sive to raise the price of salt than to add fluoride to the salt. The addition of fluoride to salt does not necessarily imply the need to increase the market price. Extensive population coverage with FS in Latin America (over 100 million) has been achieved in a relatively short period of time for the mass implementation of a public health measure. Latin America and the Caribbean now have many more countries and communities with fluoridated salt than water fluoridation and the figures are higher than those of Europe.

The upgrading and improvement of the salt production facilities over the last decade, particularly in Central America, have enabled such countries to move more effectively and with greater confidence towards the fluoridation of salt.

Such situations have occurred in Venezuela, Peru, Panama and the Dominican Republic. In the course of three decades, numerous and diverse problems of salt fluoridation were met and were solved. A recent paper, taking into account also experiences and observations in other parts of the world, summarizes approaches and solutions for many difficult aspects frequently associated with the introduction of fluoridated salt (MARTHALER & PETERSEN 2005).

Conclusions

It is feasible to introduce successful dental caries prevention in the developing countries of the Americas and Caribbean through fluoridation of domestic salt at levels of 200–250 mg F ion/kg salt. Programmes have the flexibility to be either national or limited geographically, provide choice or be obligatory, be combined with iodized salt or not, and still be effective and viable. Significant reductions in caries prevalence in children can be obtained independent of whether the salt is only for domestic household use or with additional use in the food industry. Costs are minimal compared to treatment costs or water fluoridation and coverage can be universal. Effective programme implementation depends upon collaboration between health authorities, salt processors, distributors, and the community.

In reality it is the most effective and economical public health measure for mass prevention of dental caries in children that currently exists.

Acknowledgements

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Zusammenfassung

Die Fluoridierung des Trinkwassers hat sich als eine wirksame vorbeugende Massnahme gegen Zahnkaries erwiesen. Viele Entwicklungsländer des amerikanischen Kontinentes haben zahlreiche Wasserversorgungen und Volkswirtschaften, welche dieser Vorbeugungsmassnahme entgegenstehen. In einigen Ländern des Kontinentes findet sich ein Kariesbefall, der sich weltweit unter die höchsten Befallsraten einreicht. Fluoridiertes Salz wurde als eine mögliche Lösung betrachtet im Hinblick auf

dringlich nötige Kariesvorbeugung bei Millionen von Menschen, die nur beschränkt Zugang zu zahnärztlicher Versorgung haben. Eine Studie über fluoridiertes Salz wurde 1963 in Kolumbien begonnen und führte nach deren erfolgreichem Abschluss zu Ergebnissen ähnlich denjenigen der Trinkwasserfluoridierung. Die Salzfluoridierung wurde darauf in anderen Ländern eingeführt und durch Resolutionen der WHO, dem WHO-Regionalbüro für Amerika und weiterer Gruppierungen inkl. FDI unterstützt. Die Verfahren zur Zugabe von Fluorid waren ähnlich wie bei der Jodierung, und die beiden Spurenelemente waren kompatibel. Von 1972 bis 2004 führten zehn amerikanische Länder nationale oder lokale Salzfluoridierungsprogramme ein, und fünf weitere begannen solche Programme. Ergebnisse, erreicht mit Konzentrationen von 200 bis 250 ppmF, ergaben bei 12-jährigen Kindern einen Rückgang der Kariesprävalenz von 84% in Jamaika, 73% in Costa Rica und 40% in Uruguay bei durchschnittlichen Kosten von 0.06 US-Cents pro Person und Jahr. Diese Arbeit zeigt Hintergründe der Lage in Amerika, illustriert Vorgehen und Machbarkeit von Programmen der Salzfluoridierung und zeigt die Resultate, die bei geringem finanziellen Aufwand erreicht wurden.

Résumé

La fluoruration de l'eau s'est avérée mesure préventive efficace dans la lutte contre la carie dentaire. Toutefois de nombreux pays en voie de développement de l'Amérique ont des systèmes économiques très variés; de même pour l'approvisionnement en eau, ce qui empêche la fluoruration généralisée. Mais comme c'est dans ces pays que la carie est particulièrement répandue, touchant des millions de gens démunis de services dentaires réguliers, l'emploi de SF y a paru une solution préventive qui s'imposait d'urgence. Un essai fut fait en Colombie (1963) dont les effets furent aussi favorables que ceux obtenus par la fluoruration de l'eau. Ce procédé fut alors introduit dans d'autres pays, grâce au soutien de résolutions prises par OMS, PAHO, FDI et quelques organisations régionales. L'addition de fluorure se servait de procédés comparables à ceux de l'iodisation, et les deux éléments étaient compatibles. Entre 1972 et 2004, dix pays ont introduit des programmes à l'échelle nationale ou régionale. Les résultats sont encourageants. Après l'addition de fluorure (200–250 mg/kg de sel) la prévalence de carie parmi les enfants de 12 ans a été réduite de 84% (Jamaïque), 73% (Costa Rica) et 40% (Uruguay), ceci ne coûtant annuellement que US \$ 0,06 par habitant. Cette présentation offre un aperçu de la situation dans les deux Amériques, considère les conditions et la praticabilité de programmes de FS dans ces pays et en démontre les résultats possibles tout en maintenant les frais à un minimum.

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