

Charu Mohan Marya¹, BR Ashokkumar², Vandana Dahiya³, Anil Gupta⁴

Prevalencija i težina dentalne fluoroze u endemskim područjima fluora; Haryana u Indiji: epidemiološka studija

Prevalence and Severity of Dental Fluorosis in Endemic Fluoride Areas of Haryana, India: An Epidemiologic Study

¹ Zavod za preventivnu i javnu stomatologiju, Sudha Rustagi College of Dental Sciences & Research, Faridabad, Haryana, India
Department of Preventive & Community Dentistry, Sudha Rustagi College of Dental Sciences & Research, Faridabad, Haryana, India

² Zavod za preventivnu i javnu stomatologiju, KLEVK Institute of Dental Sciences, Belgaum, Karnataka, INDIA
Department of Preventive & Community Dentistry, KLEVK Institute of Dental Sciences, Belgaum, Karnataka, India

³ Zavod za konzervativnu stomatologiju i endodontiju, Sudha Rustagi College of Dental Sciences & Research, Faridabad, Haryana, India
Department of Conservative and Endodontics, Sudha Rustagi College of Dental Sciences & Research, Faridabad, Haryana, India

⁴ Zavod za dječju stomatologiju, Eklavya Dental College, Kotputli, Jaipur, Rajasthan, India
Department of Pedodontics, Eklavya Dental College Kotputli, Jaipur, Rajasthan, India

Sažetak

Fluor se često naziva "dvostranim mačem" zbog pozitivnog učinka u idealnim dozama i štetnoga u slučaju prevelikih količina. Njegov unos sprječava nastanak zubnog karijesa, no ako se pretera u razdoblju kada se formira caklina može se pojaviti caklinska fluoroza. **Ispitanici i postupci:** Trideset sela iz dvaju područja Haryane klasificiralo se prema različitim razinama fluora u vodi za piće. Ukupno je bilo pregledano 3007 učenika iz ruralne populacije u dobi između 12 i 16 godina. Endemska koncentracija fluora u tim je područjima varirala u vrijednostima od 0,50 (ispod optimuma), 0,7 i 1,13 (blizu optimuma) te 1,51, 2,45, 5,27 i 8,50 ppm (više od optimuma). **Rezultati:** Ukupna prevalencija fluoroze iznosila je 54,4 posto i bila je gotovo ista kod muškaraca i žena - kod muškarca 51,9 posto, a kod žena 48,1 posto. Postotak je rastao s porastom sadržaja fluora u vodi i to od 9,35 posto uz sadržaj fluora 0,5 ppm do 100 posto uz 8,5. **Zaključak:** Čini se da je razina fluora od 1 do 1,2 ppm najprikladnija i da u tom slučaju izaziva minimalnu količinu estetski nepoželjne fluoroze.

Zaprimljen: 8. veljače 2010.

Prihvaćen: 20. srpnja 2010.

Adresa za dopisivanje

Dr. Charu Mohan Marya BDS, MDS
Professor and Head
H.No: 986, Sector- 15
Faridabad, 121007 Haryana; India
Phone: 0091 9811144408
maryacm@yahoo.co.uk

Ključne riječi

fluoroza, dentalna; zubni karijes; fluoridi, trovanje; Indija

Uvod

Danas postoje načini za prevenciju glavnih oralnih bolesti. Bolja su i sredstva, a i znanje je veće. Kad kažemo da treba „zaštiti populaciju“, to znači mnogo više negoli nekada. „Zaštiti“ znači da su stomatolozi obvezni prevenirati inicijalni razvoj bolesti te da konzervativno i ekonomično provjeravaju početna stanja koristeći se pritom svim kliničkim i društveno dostupnim sredstvima (1).

Ako se u razdoblju razvoja zuba u organizam unosi previše fluora, može nastati caklinska fluoroza (2,3). Povezanost prevelike koncentracije fluora u vodi i dentalne fluoroze dokumentirana je u mnogobrojnim istraživanjima diljem svijeta (2, 4-12).

Odnos između koncentracije fluora i dentalne fluoroze ustanovljen je u mnogim epidemiološkim istraživanjima iz sredine 1930-tih, a osobito u studiji Deana i njegovih suradnika (13,14).

U siječnju 1945. Grand Rapids u Michiganu postao je prvi grad na svijetu koji je prilagodio koncentraciju fluora u

Introduction

Today, there are means for preventing major oral diseases. Our tools are better and our horizons broader. Today “caring for the population” means much more than it did not very many years ago. “Caring” now means that the dental professional has a fundamental obligation to prevent the initial development of diseases, and to conservatively and economically check incipient conditions, using all clinical and community means available (1).

When there is excessive systemic intake of fluoride during the period of enamel formation, enamel fluorosis may occur (2,3). Relationship between excessive concentration of fluoride in water and dental fluorosis has been documented by various studies in the different parts of the world (2, 4-12).

The relation between concentration of fluoride and dental fluorosis was established from numerous epidemiological studies beginning in the mid 1930s, and especially from the classic 21-study reported by Dean (13, 14). On January, 1945 Grand Rapids, Michigan became the first city in the

vodi razini za koju se očekivalo da će poboljšati zdravlje zubi (15). Tada su Galagan i Vermillion preporučili raspon optimalne koncentracije fluora u vodi od 0,7 ppm u krajevima s najvišim temperaturama u Sjedinjenim Državama do 1,2 u njezinim najhladnijim područjima (16). Mnogo se istraživalo kako bi se povezale prevalencija i težina dentalne fluoroze s optimalnom endemskom razinom koncentracije fluora (17-19). No, dostupno je samo nekoliko studija iz kojih se može doznati sigurna i očekivana razina fluora u vodi za piće u našoj zemlji, premda je stanovništvo u deset do četrnaest indijskih pokrajina pogođeno fluorozom (20-25).

Zato bi bilo vrijedno truda provesti istraživanje kako bi se odredila povezanost dentalne fluoroze s različitim razinama fluora u vodi za piće, a novi podaci mogli bi pomoći da doznamo sigurne i prihvatljive razine za našu zemlju.

Ispitanici i postupci

Za istraživanje je bilo izabrano 30 sela iz dvaju područja Haryane (pokrajine Gurgaon i Hissar) s različitim razinama fluora u rasponu od 0,30 do 8,50 ppm u vodi za piće prema odredbi Zavoda za javno zdravstvo. Za studiju je bilo važno da sela imaju samo jedan izvor za opskrbu vodom, kako bi se isključila razlika u konzumaciji fluora zbog korištenja vode iz različitih izvora. Bilo je odabrano i jedno selo s dvama izvorima (Hayatpur) jer je razlika u sadržaju fluora bila jako velika (2,20 i 8,5 ppm). Raspodjela količine fluora u pitkoj vodi u tim selima bilježila se po skupinama. Složene su bile prema razini fluora od 0,50 (ispod optimuma), 0,87 i 1,13 (blizu optimuma) te 1,51, 2,45, 5,27 i 8,50 ppm (više od optimuma). Čimbenici poput prehrambenih navika, nutritivnog statusa, konzumacije vode i uvjeta života, bili su gotovo jednaki u svih sedam istraživanih skupina.

Ukupno je bilo pregledano 3007 učenika (1558 dječaka i 1449 djevojčica) u dobi između 12 i 16 godina (prema posljednjem rođendanu). Odabrani su samo đaci trajno nastanjeni na istraživanim područjima, a smatralo se da je dijete trajno nastanjeno na području gdje je rođeno i gdje živi, osim tijekom kratkotrajnih prekidova za praznike. Uvjet je također bio da su ispitanicima niknuli svi trajni zubi (osim trećih kutnjaka).

Preglede je obavljao jedan stručnjak uz pomoć osobe koja je bilježila podatke, a bila je educirana za postupak. Bio je odabran pregled tipa III (pregled s uporabom zrcala i sonde te adekvatnim osvjetljenjem). Pribavljeno je i dovoljno instrumenata kako se pregledi ne bi prekidali radi sterilizacije. Liječnik se koristio zrcalom, oštrom sondom, potiskivačem jezika, pincetom i bubrežastom posudom. Od materijala rabili su se vata, gaza, ručnik za ruke, sapun, rukavice, antiseptici Dettol i Cidex te džepna svjetiljka. Intraistraživačka pouzdanost u određivanju dentalne fluoroze mjerena je Kappa testom te je vrijednost od 0,91 pokazala odlično slaganje.

Pregledi ispitanika obavljani su u učionicama uz maksimalno osvjetljenje i ventilaciju. Svaki pojedinac zamoljen je da prije pregleda usta temeljito ispere vodom. Za preglede se upotrebljavao uspravan stolac s visokim naslonom na koji se

world to adjust its water fluoride concentration to a level expected to promote dental health. (15)

Galagan and Vermillion recommended a range of optimum concentration of fluoride from 0.7 ppm in water of the warmest temperature zones of the United States to 1.2 ppm in the coldest zones (16). There are various studies undertaken to relate the prevalence and severity of dental fluorosis with optimum level of endemic fluoride concentration. (17-19). There are only few studies available to know the safe and expectable level of fluoride and drinking water for our country, although people of around 10-14 states of India are affected by fluorosis (20-25).

It would be therefore worthwhile to undertake a study to assess the interrelationship between dental fluorosis at varying levels of fluoride in drinking water, and the current information can contribute to know the safe and acceptable levels of fluoride in drinking water for our country.

Materials and methods

30 villages from 2 districts of Haryana (District Gurgaon and Hissar) having varying fluoride levels ranging from 0.30 to 8.50 ppm in drinking water as established by public health department, were selected for the study. Villages having single source of water supply only were selected for the study, to eliminate the discrepancy in consumption of fluoride in drinking water from different sources. One village (Hayatpur) with two sources of water supply was also selected because the difference in fluoride content in two sources was quite marked (2.20 and 8.5 ppm). The group wise distribution of fluoride content in drinking water of these villages was recorded. The groups made were 0.50 (sub optimum), 0.87, 1.13 (near optimum), 1.51, 2.45, 5.27 & 8.50 (more than optimum) ppm fluoride level. Environmental factors like eating habits, nutritional status, consumption of water, living conditions were almost uniform in all seven groups studied.

A total of 3007 students (1558 males and 1449 females) in the age group 12 - 16 years (as age at last birthday) were examined. Only subjects who were continuous residents of their respective areas were selected. A child was considered to be a continuous resident in any area if he/ she had been born and lived in that area except for short intervals, such as during holidays. It was also ensured that the selected individuals had all their permanent teeth (except third molars) erupted.

The examination was done by the investigator only and was assisted by an alert and cooperative recorder well trained with the procedure. Type III examination was done (inspection using a mouth mirror and explorer in adequate illumination). Sufficient number of instruments was made available to avoid the need to interrupt examination while used ones were sterilized. Instruments used were mouth mirror, sharp explorer, tongue depressor, tweezers and kidney tray. Materials used were cotton, gauze, hand towel, soap, gloves, dettol, cidex and torch.

Intra-examiner reproducibility for the dental fluorosis was assessed by the Kappa statistic and the value was found to be 0.91, showing perfect agreement.

The examination of the subjects under survey was carried out in their respective school classroom in maximum light

mogla nasloniti glava. Korišteno je samo prirodno svjetlo, a ispitanik je sjedio tako da se postiglo maksimalno osvjetljenje (26).

Određivanje dentalne fluoroze bilo je obavljeno prema indeksu Dean's Fluorosis. (1942).

Informirani pristanak i službeno dopuštenje za istraživanje dobiveni su od roditelja i mjerodavnih institucija. Prikupljeni podaci unosili su se u računalno te kvalitativno i kvantitativno analizirali Z-testom.

Rezultati

Rezultati istraživanja prevalencije i težine dentalne fluoroze predstavljeni su tablično u skladu sa skupinama iz područja s različitim razinom fluora. Različite skupine bile su suboptimalna (0,5 ppm), blizu optimuma (0,87 i 1,13 ppm) i više od optimuma (1,51, 2,45, 5,27 i 8,5 ppm).

and ventilation to carry out the examination. Each individual was asked to rinse the mouth thoroughly with plain water before being subjected to examination. A straight chair with a tall back on which individuals head could rest was used for examination. Natural light alone was used, the subject sitting so as to receive maximum illumination (26).

The dental fluorosis was assessed using the Dean's Fluorosis index. (1942).

Informed consent and official permission to carry out the survey was obtained from the parents of children and all the concerned authorities.

The collected data was fed into a computer and analysed qualitatively and quantitatively using Z- test.

Results

The results of the study as regards to the prevalence and severity of dental fluorosis were tabulated in accordance with different fluoride level group areas. The different groups were the suboptimum (0.5 ppm), near optimum (0.87 and 1.13 ppm) and more than optimum (1.51, 2.45, 5.27 and 8.5 ppm).

Tablica 1. Raspodjela uzorka prema razini fluora u vodi za piće
Table 1 Distribution of the sample according to fluoride level in drinking water

Skupina, broj • Group No.	Selo • Village	Područje • District	Koncentracija fluora • Fluoride Content (ppm)	Prosječna konc. fluora u skupini • Average Fluoride Content Of The Group	Broj pregledane djece prema dobi • No. Of Children Examined by age groups					
					12	13	14	15	16	Ukupno • Total
1	KIRMARA BADSHAHPUR SINGHWAKHAS KHOR	HISSAR GURGAON HISSAR GURGAON	0.34	0.50	119	132	119	81	30	481
			0.38							
			0.62							
			0.65							
2	SARBASIRPUR RAINWALA GAWAR KURTHALA MOHAMMADPUR	GURGAON HISSAR HISSAR GURGAON GURGAON	0.70	0.87	45	102	123	83	40	393
			0.74							
			0.91							
			1.00							
			1.00							
3	RAIPUR PILCHIYAN TIGHRA BAPAS RAHANWA	GURGAON HISSAR GURGAON GURGAON GURGAON	1.00	1.13	48	87	126	117	46	424
			1.11							
			1.14							
			1.20							
			1.20							
4	BANDHAULI AGROHA TARAKPUR CHULIKHURD	GURGAON HISSAR GURGAON HISSAR	1.26	1.51	29	95	130	107	78	439
			1.59							
			1.60							
			1.60							
5	KAIMRI HAYATPUR(1) CHAHALKA DAULTAWAS SALEMGARH MOHAMMADPUR LALUWAL LADHUWAS	HISSAR GURGAON GURGAON GURGAON HISSAR HISSAR HISSAR HISSAR	2.10	2.45	139	181	194	190	67	771
			2.20							
			2.25							
			2.25							
			2.50							
			2.50							
			2.58							
3.25										
6	SAWKA GHIRAI GURANA	GURGAON HISSAR HISSAR	4.05	5.27	70	98	99	111	49	427
			5.15							
			6.60							
7	HAYATPUR(2)	GURGAON	8.50	8.50	18	22	18	8	6	72
TOTAL					468	717	809	697	316	3007

HAYATPUR(1) - voda se dobiva iz izvora • source of water is well

HAYATPUR(2) - voda se dobiva ručnom crpkom • source of water is hand pump

ppm - parts per million

Tablica 1. prikazuje raspodjelu uzorka prema razini fluora u vodi za piće u 30 sela. Tablica 2. (Slika 1.) predstavlja prevalenciju dentalne fluoroze prema različitim razinama fluora. Ukupna prevalencija fluoroze bila je 54,4 posto i bila je podjednaka - kod dječaka je iznosila 51,9 posto, a kod djevojčica 48,1 posto.

Postotak fluoroze povećavao se s porastom količine fluora u vodi (Slika 2.).

Prevalencija dentalne fluoroze, uz istu razinu fluora, bila je manja kod djevojčica do razine od 2,45 ppm. Kod razine od 5,27 i 8,25 ppm fluora prevalencija dentalne fluoroze bila je jednaka u ispitanika obaju spolova.

Na Tablici 3. je „Z“ vrijednost u usporedbi srednje vrijednosti dentalne fluoroze za različite koncentracije razine fluora. Zabilježene su vrlo velike i znatne razlike između bilo kojih dviju skupina, osim između razina fluora od 0,87 i 1,13 ppm. Tu razlika nije bila značajna.

Table 1 shows the distribution of sample according to fluoride level in drinking water in 30 villages.

Table 2 (Figure 1) shows the prevalence of dental fluorosis at varying fluoride levels. The overall fluorosis prevalence was 54.4%. The fluorosis for males and females were almost the same, males having 51.9% and females having 48.1% prevalence.

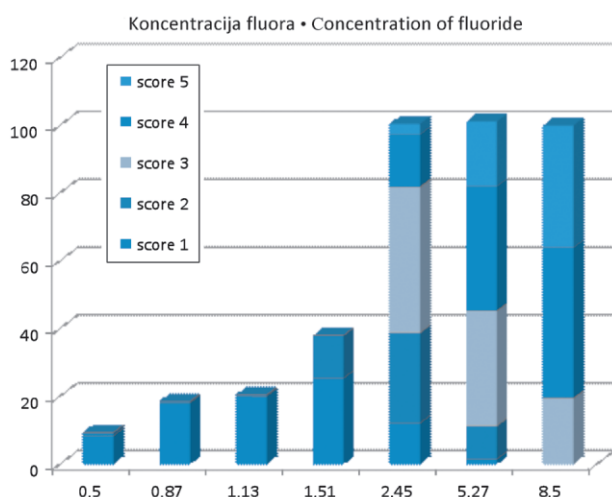
The percentage of fluorosis increased with the increase in fluoride content of water. (Figure 2)

The prevalence of dental fluorosis at the same level of fluoride was comparatively lesser in females upto 2.45 ppm fluoride level. At 5.27 and 8.25 ppm fluoride level, the prevalence of dental fluorosis was the same for females as that in males.

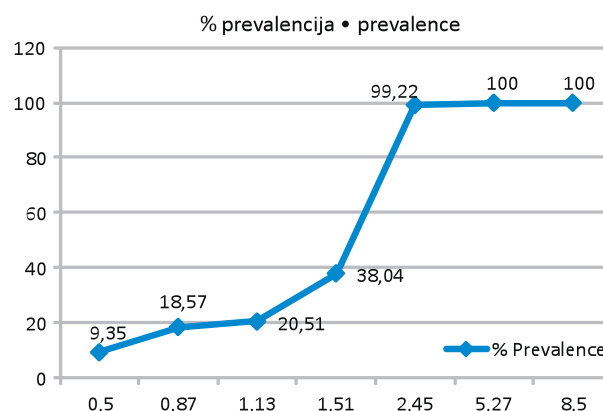
Table 3 gives the value of 'Z' in comparing the value of mean value of dental fluorosis for different concentration levels of fluoride. Very significant and highly significant difference was observed for any two groups except between 0.87 & 1.13 ppm fluoride level where it was not significant.

Tablica 2. Prevalencija i težina dentalne fluoroze kod različitih razina fluora
Table 2 Prevalence and severity of dental fluorosis at various fluoride levels

RAZINA FLUORA • FLUORIDE LEVEL (ppm)	0,50	0,87	1,13	1,51	2,45	5,27	8,50
DJEČACI • MALE							
Broj pregledane djece • No. of children examined	253	208	221	226	409	207	34
Broj djece s fluorozom • No. of children with fluorosis							
Zbroj bodova • Score 1	24	38	47	58	45	00	00
Zbroj bodova • Score 2	02	02	02	29	107	18	00
Zbroj bodova • Score 3	00	00	00	00	172	71	06
Zbroj bodova • Score 4	0	00	00	00	67	77	14
Zbroj bodova • Score 5	00	00	00	00	15	41	14
Ukupno • Total	26 (10.27%)	40 (19.23%)	49 (22.17%)	87 (38.49%)	406 (99.26%)	207 (100%)	34 (100%)
DJEVOJČICE • FEMALE							
Broj pregledane djece • No. of children examined	228	185	203	213	362	220	38
Broj djece s fluorozom • No. of children with fluorosis							
Zbroj bodova • Score 1	16	33	38	53	48	01	00
Zbroj bodova • Score 2	03	00	00	27	99	24	00
Zbroj bodova • Score 3	00	00	00	00	150	74	08
Zbroj bodova • Score 4	00	00	00	00	52	80	18
Zbroj bodova • Score 5	00	00	00	00	10	41	12
Ukupno • Total	19 (8,33%)	33 (17,83%)	38 (18,71%)	80 (37,55%)	359 (99,17%)	220 (100%)	38 (100%)
UKUPNO • TOTAL							
Broj pregledane djece • No. of children examined	481	393	424	439	771	427	72
Broj djece s fluorozom • No. of children with fluorosis							
Zbroj bodova • Score 1	40	71	85	111	93	01	00
Zbroj bodova • Score 2	05	02	02	56	206	42	00
Zbroj bodova • Score 3	00	00	00	00	322	145	14
Zbroj bodova • Score 4	00	00	00	00	119	157	32
Zbroj bodova • Score 5	00	00	00	00	25	82	26
Ukupno • Total	45 (9,35%)	73 (18,57%)	87 (20,51%)	167 (38,04%)	765 (99,22%)	427 (100%)	72 (100%)
Mean Fluorosis Score	0.1	0.19	0.21	0.51	2.69	3.69	4.17
S.D.	0,5831	0,6403	0,6481	0,8426	1,0000	0,9539	0,8544



Slika 1. Težina fluoroze prema različitim razinama fluora
Figure 1 Severity of fluorosis at varying levels of fluoride



Slika 2. Prevalencija fluoroze prema različitim razinama fluora
Figure 2 Prevalence of fluorosis at varying fluoride levels

Tablica 3. Tablica "Z" vrijednosti za prevalenciju dentalne fluoroze za različite koncentracije razine fluora
Table 3 Table of z values for prevalence of dental fluorosis between various fluoride levels

	Razina fluora • Fluoride level (ppm)						
	0.50	0.87	1.13	1.1	2.45	5.27	8.50
0.50	--	2.1513**	2.6699**	8.5045***	57.8681***	67.3888***	39.0809***
0.87		--	0.4435 NS	6.2039***	51.6781***	62.1208***	37.6375***
1.13			--	5.8746***	51.8517***	62.2849***	37.5369***
1.51				--	40.3819***	51.9399***	33.7557***
2.45					--	15.0601***	13.8397***
5.27						--	4.3333***
8.50							--

NS - nije značajna • not significant

* značajna • significant (p<0.05)

** dosta značajna • very significant (p<0.01)

*** izrazito značajna • highly significant (p<0.0027)

Rasprava

U posljednjih 50 godina mnogi su stručnjaci često istraživali prevalenciju dentalne fluoroze u slučaju različitih razina fluora, kako bi se doznala njegova sigurna i prihvatljiva razina u vodi za piće i postigla maksimalna zaštita od karijesa uz estetski prihvatljivu dentalnu fluorozu. U Indiji je objavljeno vrlo malo istraživanja o povezanosti dentalne fluoroze s različitim razinama fluora u vodi za piće (27,28).

U ovom istraživanju dokazana je izravna veza koncentracije fluora u vodi za piće i prevalencije te težine dentalne fluoroze. Kao i u ostalim studijama, također je potvrđen znatan porast i u prevalenciji i u težini fluoroze na razinama fluora većima od optimalne, s najjačom izraženošću kod najviših testiranih razina (27,29-32). Prevalencija fluoroze bila je niska u slučaju optimalnih razina fluora (0,87 do 1,13 ppm). Samo 18,57 do 20,51 posto djece imalo je znakove fluoroze, no većina je bila upitna, tj. bodovana je kao tip I. Taj nalaz slaže se s drugim istraživanjima objavljenima u literaturi (33). Kako je razina fluora rasla do 2,45 ppm, 99,22 posto ispitanika imalo je fluorozu, ali je kod većine bila ocijenjena kao vrlo blaga ili blaga. No, s daljnjim porastom razine fluora po-

Discussion

The prevalence of dental fluorosis at varying fluoride levels had been extensively studied during the last 50 years by different investigators to know the safe and acceptable levels of fluoride in drinking water for maximum caries protection and esthetically acceptable dental fluorosis. In India, very few studies to establish the interrelationship of dental fluorosis at varying fluoride levels in drinking water have been reported. (27,28)

In this study, a direct relation between the fluoride concentration of drinking water and prevalence and severity of dental fluorosis was demonstrated. There was also a substantial increase in both the prevalence and the severity of fluorosis at higher than optimal water fluoride level with the condition being most pronounced at the highest levels tested like the other studies (27, 29-32). The prevalence of fluorosis was low at the optimal fluoride levels (0.87 to 1.13 ppm). Only 18.57-20.51% of children showed some signs of the condition, majority being of questionable or score 1 type. This finding is in accordance with other studies reported in literature (33). As fluoride level increased further to 2.45 ppm,

većala se i izraženost dentalne fluoroze te je kod većine djece bila umjerena do teška. Ovo istraživanje pokazalo je da je optimalna razina fluora u vodi za piće u našim uvjetima približno 1,13 ppm (od 1 do 1,2) i u tom je slučaju bilo nađeno najmanje estetski neprihvatljive fluoroze.

U ovom istraživanju razlika fluoroze prema spolu bila je neznatna. Taj je rezultat isti kao i u ostalim studijama (34-36).

Zaključak

Potvrđena je izravna povezanost između razine fluora i prevalencije te težine dentalne fluoroze – kako je u vodi za piće rasla razina fluora, povećavale su se i prevalencija i težina dentalne fluoroze. Ističe se da je optimalna razina fluora u vodi za piće 1,13 ppm i tada je bilo najmanje estetski neprihvatljive fluoroze. Razina fluora oko jednog ppm, tj. od 1,0 do 1,2, čini se da je optimum kod kojega se može postići minimalna izraženost dentalne fluoroze.

99.22% of the individual had fluorosis but the majority being of 'very mild' and 'mild' types. But as the fluoride levels increased further, there was an increase in the severity of dental fluorosis, majority of the children showing moderate and severe type of fluorosis. The present investigation showed that the optimal fluoride levels for drinking water for our conditions were near 1.13 ppm (1-1.2 ppm) as there was the least amount of esthetically objectionable fluorosis at that level.

The difference of fluorosis in both genders was insignificant in the present study. This result too was the same as compared to other studies (34-36).

Conclusion

A direct relationship between fluoride levels and prevalence and severity of dental fluorosis was observed, that is there was an increase in both prevalence and severity of dental fluorosis with every increase in fluoride level in drinking water. The optimum level of fluoride in drinking water was found to be 1.13 ppm at which there was minimum amount of esthetically objectionable fluorosis. A fluoride level of near 1 ppm i.e. 1.0-1.2 ppm appears to be the optimum where minimum of dental fluorosis can be achieved.

Abstract

Introduction: Fluorine is often called as a two-edged sword because of its beneficial effects in optimal doses and harmful effects due to overdoses. Intake of fluorine does prevent dental caries but when there is excessive systemic intake of fluoride during the period of enamel formation enamel fluorosis may occur. **Material and Methods:** 30 villages from 2 districts of Haryana were classified according to differing levels of fluoride in the drinking water. A total of 3007 students in the age group 12 – 16 years were examined in the rural population. Endemic fluoride concentration in these areas varied from 0.50 (sub optimum), 0.87, 1.13 (near optimum), 1.51, 2.45, 5.27 & 8.50 (more than optimum) ppm fluoride level. **Results:** The overall fluorosis prevalence was 54.4%. The fluorosis for males and females were almost the same, males having 51.9% and females having 48.1% prevalence. The percentage of fluorosis increased with increase in fluoride content in the water. The percentage of fluorosis increased from 9.35 % in 0.5 ppm to 100% in 8.5 ppm. **Conclusion:** It appears that 1- 1.2 ppm is the most compatible fluoride level to produce minimal amount of esthetically objectionable fluorosis.

Received: February 8, 2010

Accepted: July 20, 2010

Address for correspondence

Dr. Charu Mohan Marya BDS, MDS
Professor and Head
H.No: 986, Sector- 15
Faridabad, 121007 Haryana; India
Phone: 0091 9811144408
maryacm@yahoo.co.uk

Key words

Fluorosis, Dental; Dental Caries, Fluoride Poisoning; India

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