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THE FLUORIDE CONTENT OF DRINKING WATER AND THE MENARCHEAL AGE

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Abstract

The mass prevention of caries by fluoridation method can only be done with adequate safety. For this it also has to be known whether in a given geographical or economic environment the regular and long-standing consumption of drinking water containing a fluoride-concentration optimal in regard of caries prevention influences destructively the normal physiological processes of the organism or not.

In this concern, authors studied the development and growth of school-aged children from two Hungarian settlements. The drinking water contains 1.09 mg/l of fluoride averagely in one of the settlements and 0.17 mg/l averagely in the other.

In the two, otherwise rather similar settlements (Kunszentmárton and Kiskunmajsa) no main variations were found in the puberty age (menarcheal age) of the schoolgirls. This supports the presumption of authors according to which the intake of fluoride optimal in the viewpoint of caries preveation does not show any effect on the puberty age.

Key words: fluoride-contain in water, caries, menarche, body development

Introduction

The caries development inhibitory effect of fluorine can by now be regarded as unanimously proved (ADLER, 1970; BACKER DIRKS, 1971; TÓTH, 1979; MARTHALER, 1979; JOHANSEN and OLSEN, 1979). There are also data on the fact that the daily optimal fluorine intake — which for example can be ensured with drinking water containing 1 mg/l fluoride — does not have any harmful effects on the human organism. These data, however, originate from the studies of such populations which live in geographical and economic environments different from that of Hungary (MCCLURE, 1944; MCCAULEY and MCCLURE, 1954; SCHLESINGER et al. 1956; Ministry of Health, 1962; SMITH, 1962; TRUSWELL, 1966; HODGE, 1968; BACKER DIRKS et al. 1969; BACKER DIRKS, 1971; ERICSSON, 1974; BINDER, 1974; MURRAY, 1976).

The number of human studies from Hungary related to the general effect of fluorine is relatively low (BARTHA, 1956; STRAUB and SZÜLE, 1956; ADLER, 1957; TÓTH et al. 1975).

If it is wished to apply fluoride in masses in the interest of preventing caries, this could only be done so with safety. To support the safety of prevention with fluoride it must be proved that the consequences drawn from studies carried out in different parts of the world also stand for the Hungarian conditions.

When evaluating the general effect of fluorine the daily total amount of fluoride reaching the circulation must be taken into account (COOK, 1973; NEWBRUN, 1975; MYERS, 1978). Although this amount decisively depends on the fluoride content of drinking water (TÓTH, 1975), every possible source, the living conditions, alimentary habits, individual variations of absorption, should also be considered which may dif-

fer in each case separately even besides the same fluoride concentration of drinking water.

In case the long-standing consumption of the daily fluoride content optimal in point of view of caries prevention would harmfully influence the normal physiological processes of the human organism, this should also be reflected in the state of health and development of the given population even between Hungarian circumstances.

To become familiar with this question more closely, a study was carried out on the somatic maturity of school-aged children from two Hungarian settlements where the fluoride concentration of the drinking water showed significant variations.

Our experiences on the bone development and body maturation of these two child populations have been published elsewhere (FAZEKAS et al., under publication, FAZEKAS et al., 1984). In this paper we should like to report on our results regarding the menarcheal age and reflecting the physiological maturation of the children.

Materials and Methods

In selecting the samples we were conducted by the basic viewpoint that the Hungarian popula-on to be studied should be such which regularly and long-standingly consumes drinking water containing fluoride of about 1 mg/1, held to be optimal between temperate climatic conditions. It was also our aim that the samples be suitable for statistic analysis.

In Hungary the fluoride concentration of drinking water is low in general. We only know of one settlement having higher population where the fluoride concentration of the drinking water is proved to be of optimal amount since years. This settlement is Kunszentmárton, a large village constituting an administrative division. Here the drinking water contains 1.09 mg of fluoride per litre.

The population of the settlement is 12 599 according to the data of the census taken in 1980. The caries preventive effect of the regular fluorine consumption is well reflected in the population's state of teeth (ADLER et al., 1950; ADLER and POLCZER, 1963; TÓTH, 1970; TÓTH et al., 1978).

Kiskunmajsa (population in 1980: 13 419) was chosen as control, a settlement where the drinkink water has low fluoride concentration (0,17 mg/1), but which is similar in other viewpoints to Kunszentmárton.

669 boys and 711 girls were studied in Kiskunmajsa and 617 boys and 589 girls in Kunszentmárton. The twins and gypsy children belonging to another ethnic group were left out of the evaluation.

During the course of the studies carried out at the schools, the personal data were recorded and dressed to underwear, the measurements of the body weight, body height, normal breast circumference and in case of the girls, the crystae width were taken according to the technique of Martin (MARTIN and SALLER, 1956). The information regarding first menstruation was also recorded in case of the girls on the data-collecting sheet used for the studies on the menarcheal age of girls in Csongrád county (FARKAS et al. 1983). During the processing of the data we calculated the parameters of the characteristics of the children divided into half-year age groups according to the decimal chronological table.

Results

Here we should only like to refer the fact that we did not find any essential changes in the studied characteristics of the morphological age and on it's base the body development of the two samples (FAZEKAS et al. under publication). The x-rays taken of the hands and the evaluations with TW2 method (TANNER et al. 1975) also did not manifest any differences in the time of bone development of the two studied populations.

We made inquiries concerning the time of the first menstruation in the case of 337 girls in Kunszentmárton, and 467 girls in Kiskunmajsa. Information is given in Tables 1 and 2 regarding the frequency the first menstruation, according to age groups.

The numerical method was used to determine the median (FARKAS, 1975) which gives the same result as the values obtainable by probit analysis.

Table 1. Distribution according to age gropus of the time of first menstruation of the girls of Kunszentmárton

Age group x	Total no. of cases n	Those menstruating from this		Probit of p. c. of those mentstruating P
		r	%	
10.0	15	1	6.67	3.50
10.5	30	—	—	—
11.0	26	2	7.69	3.58
11.5	41	6	14.63	3.95
12.0	27	8	29.63	4.46
12.5	48	16	33.33	4.57
13.0	34	23	67.65	5.46
13.5	35	26	74.29	5.65
14.0	17	13	76.47	5.72
14.5	14	14	100.00	—
15.0	6	6	100.00	—
15.5	9	9	100.00	—
16.0	12	12	100.00	—
16.5	11	11	100.00	—
17.0	4	4	100.00	—
17.5	4	4	100.00	—
18.0	2	2	100.00	—
18.5	1	1	100.00	—
19.0	—	—	—	—
19.5	1	1	100.00	—
	337	159	47.18	

Table 2. Distribution according to age groups of the time of first menstruation of the girls of Kiskunmajsa

Age group x	Total no. of cases n	Those menstruating from this		Probit of p. c. of those menstruating P
		r	%	
10.0	1	—	—	—
10.5	29	—	—	—
11.0	36	—	—	—
11.5	41	5	12.20	3.84
12.0	33	10	30.30	4.48
12.5	40	17	42.50	4.81
13.0	51	22	43.14	4.83
13.5	41	28	68.29	5.48
14.0	50	44	88.00	6.18
14.5	22	21	95.45	6.70
15.0	31	31	100.00	—
15.5	22	22	100.00	—
16.0	19	19	100.00	—
16.5	17	17	100.00	—
17.0	9	9	100.00	—
17.5	14	14	100.00	—
18.0	9	9	100.00	—
18.5	2	2	100.00	—
	467	270	57.82	

Tables 3 and 4 show the coincidence of the birth and menarche months in the two populations of girls.

In Kunszentmárton the median value of the menarche was found to be 12.779 years, and 12.79 years in the case of the Kiskunmajsa sample. The difference between the two medians is so slight (0.011 year) that it is not considered as substantial, since it should be taken into account that in case of the girls from the Hungarian and lowland settlements the difference found between the menarche median of the girls born as the first and third child, respectively was 0.37 year.

Accordingly, it could be said that even in the case of a more than six-fold difference in the fluoride content of drinking water, there are no essential changes observable in the time of puberty age of the girls.

In the followings such results of analysis regarding the time of first menstruation of the studied girl populations will be reported, which are not in direct connection with the basic question drafted in the objective, but may provide useful data to the special literature on the menarcheal age, according to our judgement.

The distribution of the monthly appearance of menarche is also usually studied, apart from the median. If it is presumed that the first menstruation of girls appears in an even distribution every month of the calendar year, then in each calendar month the first menstruation should appear in 8.33% of the girls.

Experimental data do not prove this assumption. Thus for example, in the case of the girls of Southern Hungary, in the Winter months and in August it's relative frequency is prominently high (FARKAS, 1962). In the case of these girls the first menstruation usually appears in the Winter months.

In the Kunszentmárton sample the highest frequency was found to be in January, while in Kiskunmajsa this was in August. According to this, the two girl communities do not differ from the cases experienced earlier. However, there was a difference observed, namely, that in both groups of girls the majority had their first menstruation in Summer (and not Winter).

Nevertheless, according to our opinion these observations do not mean substantial variations between the two samples, therefore it cannot be stated that the seasonal distribution of the menarche would differ from the ordinary on the probable effect of higher fluorine content in drinking water.

Examples can also be frequently found for studies carried out on the coincidence of birth and menarche moths. VALŠÍK, pointed out that there is no mathematical correlation betwen the two events (VALŠÍK, 1953). Despite this, author also found that generally the frequency that the adolescent menstruates for the first time in the same month as her birth is between 8—15%. VALŠÍK also referred to the fact that the size of the studied settlement may influence the frequency of coincidence, too (VALŠÍK, 1953). This is probably in accordance with the fact that in large cities the births are distributed more uniformly in the various months of the year than in villages where the habits of marriage are regulated better. Due to this, the seasonal distribution of births also varies.

This assumption is also supported by our previous data, since in the case of the girls of Szeged city having 200.000 inhabitants, the coincidence of the birth and menarche months was found to be 13.49% and 8.65% in the villages being in the neighbourhood of Szeged (FARKAS, 1962).

In the case of the girls of Kunszentmárton the monthly coincidence of the two events was observed to be 7.55%, and 12.64% in the case of the girls of Kiskunmajsa. The difference, however, can by no means be explained by the variations in size of the settlements, but rather by sociological causes not studied by us.

Table 3. Coincidence of the month of menarche and month of birth in the case of girls of Kunszentmárton

Month of birth			Month of menarche												Together		
			Spring			Summer			Autumn			Winter					
			III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	I.	II.			
	Spring	III.	—	5	1	—	2	5	3	—	1	2	3	—	22	13.8%	46
		IV.	1	1	1	—	1	3	1	—	—	1	1	3	13	8.2%	29%
		V.	—	1	1	1	—	2	1	—	1	2	2	—	11	6.9%	
	Sommer	VI.	—	2	1	1	—	2	—	1	—	1	4	—	12	7.5%	
		VII.	1	1	1	—	1	2	2	—	1	—	2	1	12	7.5%	36
		VIII.	2	—	1	1	1	3	1	1	1	—	—	—	11	6.9%	22%
	Autumn	IX.	1	1	1	1	3	1	—	1	—	1	6	—	16	10.1%	35
		X.	—	—	—	—	3	—	1	—	2	—	2	1	9	5.7%	22%
		XI.	—	1	—	1	2	1	2	1	—	—	2	—	10	6.3%	
	Winter	XII.	1	2	—	—	—	—	2	1	1	2	1	1	11	6.9%	43
		I.	—	—	—	3	4	2	1	2	1	1	1	1	16	10.1%	27%
		II.	—	—	—	3	1	1	2	1	—	3	3	2	16	10.1%	
			6	14	7	11	18	22	16	8	8	13	27	9			
Total			3.8%	8.8%	4.4%	6.9%	11.3%	13.8%	10.1%	5.0%	5.0%	8.2%	17.0%	5.7%	159		
			27 17%			51 32%			32 20%			49 31%					

Table 4. Coincidence of the month of menarche and month of birth in the case of girls of Kiskunmajsa

birth of Month			Month of menarche												Together		
			Spring			Summer			Autumn			Winter					
			III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	I.	II.			
	Spring	III.	2	3	1	5	—	3	1	2	4	—	4	2	27	10.0%	71
		IV.	1	2	1	—	2	4	—	—	2	2	4	—	18	6.7%	26%
		V.	1	2	1	3	6	3	2	1	3	2	2	—	26	9.7%	
	Summer	VI.	2	—	3	1	2	2	2	2	—	—	1	—	15	5.6%	55
		VII.	—	—	1	1	3	3	1	2	1	4	4	3	23	8.6%	21%
		VIII.	—	2	—	1	3	3	—	1	2	3	2	—	17	6.3%	
	Autumn	IX.	1	—	1	6	1	5	6	2	3	2	1	2	30	11.1%	73
		X.	1	2	—	5	3	2	5	1	—	—	1	—	20	7.4%	27%
		XI.	1	3	1	3	3	4	1	4	1	1	1	—	23	8.6%	
	Winter	XII.	2	1	—	8	1	6	1	—	1	6	—	1	27	10.0%	70
		I.	1	—	3	2	2	2	1	—	2	1	4	2	20	7.4%	26%
		II.	2	—	2	2	3	2	—	2	3	—	3	4	23	8.6%	
Total			14	15	14	37	29	39	20	17	22	21	27	14			
			5.2%	5.6%	5.2%	13.8%	10.8%	14.5%	7.4%	6.3%	8.2%	7.8%	10.0%	5.2%			269
			43 16%			105 39%			59 22%			62 23%					

Table 5. Empiric relative frequencies in the case of Hungarian girls

4—6	4—5	4—4	4—3	4—2	4—1	4	4+1	4+2	4+3	4+4	4+5	4+6	Sample size
Kunszentmárton													
101.8	88.3	132.4	94.6	66.2	110.3	110.3	88.3	147.2	165.6	66.2	120.4	101.8	159
Kiskunmajsa													
93.4	140.0	80.0	97.4	172.5	72.3	65.9	118.0	131.8	97.4	112.1	106.7	93.4	269
Western Hungary													
90.6	89.0	95.1	99.9	94.8	104.5	137.5	106.1	92.2	98.0	94.6	97.8	90.6	8255
Southern Hungary													
102.0	84.6	90.9	97.2	100.9	99.0	134.9	105.3	86.8	97.9	99.8	100.5	102.0	3247

A more realistic view could be gained if the empiric occurrence is compared with the monthly, expectable average occurrence obtained after dividing by 12 the total element numbers of the samples. In such a way the changes observable in the case of the different samples could be determined, compared to the average frequency.

The average frequency (rounded of) in the case of the Kunszentmárton sample was 159/12 = 13, and 269/12 = 22 in case of Kiskunmajsa.

The appropriate empiric relative frequency can be obtained if the absolute frequency is expressed in the percentage of the average frequency.

Table 5 shows comparisons between the samples of Kiskunmajsa, Kunszentmárton, Western Hungary and Southern Hungary. The column marked „n" indicates the empiric relative frequency of the coincidence of the birth and calendar months. In the columns n + 1, n+2..., n+6 these relative frequencies are related to such cases in which the first menstruation appeared 1, 2,..., 6 months later compared to the month of birth.

It can be seen from the Table that the coincidence of the months of birth and menarche and the percental occurrence of the further variations, resp. show changes according to samples. The higher variability observable in our samples may also evidently be influenced by the relatively low element numbers therefore it would not be correct to draw far-reaching conclusions from it.

References

ADLER, P. (1957): Die Trinkenwasser Fluoridierung als Karies-prophylaktische Massnahme. — Dtsch. Stomat. *7*, 268—283.

ADLER, P. (1970): Fluorides and Dental Health. — In: Fluorides and Human Health, World Health Organisation, Geneva. 351.

ADLER, P. and POLCZER, Gy. (1963): A caries-intenzitás fokozódása az utolsó évtizedben (Increase in cariesintensity in the last decade). — Népegészségügy. *44*, 40—45.

ADLER, P., STRAUB, J. and SÁRKÁNY, I. (1950): Kunszentmárton, Öcsöd és Békésszentandrás iskolás lakosságának fogazati viszonyai (Conditions of the teeth of the school-aged population of Kunszentmárton, Öcsöd and Békésszentandrás). — Népegészségügy. *31*, 505—509.

BACKER DIRKS, O. (1971): Water Fluoridation. — Roy. Soc. Hlth. J. *91*, 92—96.

BACKER DIRKS, O., COX, F. H., HELLEMEN, P. W. and REINOUTS VAN HAGA, P. (1969): Haematologic values of children in a nonfluoride and fluoride community. — J. Dent. Res. 48. Suppl. *6*, 1—20.

BARTHA, E. (1956): Odontogene Herderkrankungen im Spiegel der Mortalitätsstatistik. — Zahnarztl. Rdsch. *65*, 311—315.

BINDER, K. (1974): Prophylaxe der Zahnkaries mit Fluoriden. — Hippokrates. *45*, 366—376.

COOK, H. A. (1973): Fluoride toxicity (letter). — Lancet, II, 1026.

ERICSSON, Y. (1974): Report on Safety of Drinking Water Fluoridation. — Caries Res. Suppl. *8*, 16—27.

FARKAS, Gy. (1962): Az első havi vérzés (menarche) ideje Csongrád megyei leányoknál (The time of the first menstruation with the girls in county Csongrád). — Anthrop. Közl. *6*, 83—105.

FARKAS, Gy. (1975): A gyomai gyermekek testi fejlettsége és nemi érése (Die körperliche Entwicklung und sexuelle Reifung der Kinder in Gyoma, Ungarn). — Anthrop. Közl. *19*, 97—104.

FARKAS, Gy., HUNYA, P., HERENDI, I. and SZEKERES, E. (1983): Studies on the menarcheal age of the girls of county Csongrád (Southern Hungary). — Acta Biol. Szeged. *29*, 169—178.

FAZEKAS, A., FARKAS, Gy., SZEKERES, E. and KOCSIS, S. G. (in press): Különböző mennyiségű fluoridot tartalmazó ivóvizű települések 6.5—16.5 éves fiataljainak szomatikus fejlettsége (Somatic development of the 6.5—16.5 years old children from settlements having drinking water containing various amounts of fluoride). — Anthrop. Közl.

FAZEKAS, A., FARKAS, Gy. and KOCSIS, S. G. (1984): Die Knochenreife von Kindern in Gemeinden mit unterschiedlichem Fluoridgehalt im Trinkwasser. — Anthrop. Anz. 42, 57—65.

HODGE, H. C. (1968): Highlights of Fluoride Toxicology. — J. Occup. Med. *10*, 273—277.

JOHANSEN, E. and OLSEN, T. O. (1979): Topical Fluorides in the Prevention and Arrest of Dental Caries. — In: JOHANSEN, E., TAVES, D. R. and OLSEN, T. O. (Ed.): Continuing Evaluation of the Use of Fluorides. AAAS Selected Symposium 11. Westview Press, Colorado, 61—110.

MARTHALER, T. M. (1979): Fluoride Supplements for Systemic Effects in Caries Prevention. — In: JOHANSEN, E., TAVES, D. R. and OLSEN, T. O. (Ed.): Continuing Evaluation of the Use of Fluorides AAAS Selected Symposium 11. Westview Press, Colorado, 33—59.

MARTIN, R. and SALLER, K. (1956): Lehrbuch der Anthropologie. Bd. I. Gustav Fischer Verlag, Stuttgart, 323—343.

MCCAULEY, H. B. and MCCLURE, F. J. (1954); Effect of fluoride drinking water on the osseus development of the hand and wirts in children. — Publ.Hlth. Rep. (Wash.). *69*, 671—683.

MCCLURE, F. J. (1944): Fluoride domestic waters and systemic effect. I. Relation to bone fracture experience, height and weight of high-school boys and young selectees of the Armed Forces of the United States. — Publ. Hlth. Rep. (Wash.). *59*, 1534—1558.

MINISTRY OF HEALTH (1962): The Conduct of the Fluoridation Studies in the United Kingdom and the Results Achieved after Five Years. — Reports on Public Health and Medical Subjects N° *105*. Her Majesty's Stationery Office, London. 41—49.

MURRAY, J. J. (1976): Teeth, fluorine and human nutrition. — J. Hum. Nutr. *30*, 101—112.

MYERS, H. M. (1978): Fluorides and dental fluorosis. — Monogr. in Oral Sci. *7*. Krager, Basel. 63—66.

NEWBRUN, E. (1975): Water fluoridation and dietary fluoride ingestion (Editorial Comment). — West J. Med. *122*, 437—442.

SCHLESINGER, E. R., OVERTON, D. E., CHASE, C. H. and CANTWELL, K. T. (1956): Newburgh-Kingston caries-fluorine study. XIII. Pediatric findings after ten years. — J. Am. Dent. Ass. *52*, 296—306.

SMITH, F. A. (1962): Safety of Water fluoridation. — J. Am. Dent. Ass. *65*, 598—602.

STRAUB, J. and SZÜLE, L. (1956): A magasabb fluorid tartalmú ivóvíz hatása (The effect of drinking water containing higher amount of fluoride). — Fogorv. Szle. *49*, 74—79.

TANNER, J. M., WHITEHOUSE, R. H., MARSHALL, W. A., HEALY, M. J. R. and GOLDSTEIN, H. (1975): Assessment of skeletal maturity and prediction of adult height (TW2 Method). — Academic Press. London.

TÓTH, K. (1970): The Epidemiology of Dental Caries in Hungary. — Akadémiai Kiadó. Budapest. 174—206.

TÓTH, K. (1975): Optimum and tolorated intake of fluorine. — Acta Med. Acad. Sci. Hung. *32*, 1—14.

TÓTH, K. (1979): A háztartási só fluordúsítása, mint hazánkban alkalmazható kollektív caries megelőző módszer (The fluorine enrichment of table salt as a collective caries preventive method appliable in Hungary). — Fogorv. Szle. *72*, 110—114.

TÓTH, K., MARI, A., KOVÁCS, Á. and KESZTHELYI, G. (1975): A fogszuvasodás megelőzése Deszken az asztalisó fluordúsítása útján. XI. Testfejlődési adatok 5 év kísérleti idő után (The prevention of caries in the village Deszk, by the fluorine enrichment of table salt. XI. Data on body development following a 5 years' experimental period). — Fogorv. Szle. *68*, 184—186.

TÓTH, K., OLASZ, T. and TÓTH, É. (1978): Kunszentmárton 4—14 éves korú lakosságának fogazata 1977. évben (The state of teeth of the inhabitants of Kunszentmárton between the age 4—14 years in 1977). — Fogorv. Szle. *71*, 257—262.

TRUSSWELL, A. S. (1966): Is Fluoridation Harmful? — Roy. Soc. Hlth. J. *86*, 121—125.

VALŠÍK, J. A. (1953): K otázce pohlavního dospivani brněnských dorostenek. — Anthrop. Společn. *6*, 29—34.

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