THE CHRONOGENETICS OF CARIES IN PRIMARY DENTITION

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A chronogenetic analysis of caries has been carried out in a sample of 100 twin pairs (27 MZ, 64 DZ, 9 UZ) aged 3-8 years, taking into account the number of decayed teeth and the intensity and severity of caries. Heritability estimates, calculated for each of the various parameters considered, support the hypothesis of a genetic control of the time of onset of caries.

The caries of primary dentition which has been studied on twins by Bachrach and Young (1927), Variot (1928), Korkhaus (1929), Ford and Mason (1943), Horowitz et al. (1958), Mansbridge (1959), Goodman et al. (1959), once again merits becoming an object of research because the short times of its manifestation enable the temporal parameter of its cycle to be probed and knowledge of the chronogenetic profile of a disease of hereditary component to be improved.

Research seems to be necessary and favored also from the epidemiological point of view when one thinks that at the Dental Hygiene Congress of Munich (1974) emphasis was placed on the fact that, on an average, 50% of three-year olds have 3 decayed teeth, and that in Western Europe, 9% of the children from 3 to 7 years of age have at least one decayed tooth. In our twin sample of 100 pairs distributed by age and zygosity as shown in Table 1, the estimated frequency of decay in the population was obtained through the frequency of pathology in the first observed twin of every pair and amounted to 51% (Table 2).

Evidence of the hereditary conditioning of caries in primary dentition is given by the heritability index based on concordance values in MZ vs. DZ pairs (Table 3) and giving a total value of 73.1%.

Table 1. *Distribution of the twin sample by age and zygosity*

Age	Zygosity			
	MZ	DZ	UZ	Total
3	6	5	5	16
4	5	8	1	14
5	2	19	1	22
6	4	13	1	18
7	6	13	—	19
8	4	6	1	11
Total	27	64	9	100

2

Table 2. *Distribution of the twin sample by presence or absence of caries in the cotwins*

| | MZ | | | DZ | | | | UZ | | | Grand total |
	MM	FF	Total	MM	FF	MF	Total	MM	FF	Total	
Both twins affected	7	10	17	10	4	7	21	—	1	1	39
One twin affected	1	1	2	5	4	11	20	1	1	2	24
Both twins healthy	4	4	8	4	4	15	23	3	3	6	37
Total	12	15	27	19	12	33	64	4	5	9	100

Table 3. *Twin concordance and the heritability of caries*

| Zygosity | Sex | Concordant pairs | | | Discordant pairs | | | Total |
		N	%		N	%		
MZ	MM	7	87.5		1	12.5		8
	FF	10	90.9		1	9.1		11
	Total	17	89.5		2	10.5		19
DZ	MM	10	66.7		5	33.3		15
	FF	4	50.0		4	50.0		8
	Total	14	60.9		9	39.1		23
$\hat{H}$	MM		62.5					
	FF		81.8					
	Total		73.1					

NOTE. In the estimate of $\hat{H}$ opposite-sex pairs were not considered in order not to introduce into the DZ sample alone an additional source of variability, i.e., the one between the sexes of the cotwins.

Our chronogenetic analysis now required examination in depth of the temporal distribution of caries, passing from a global evaluation of the hereditary incidence to the cariogenic cycle in the teeth of the individual subjects.

For this purpose, we quantified caries according to three parameters:

(1) Number of decayed teeth;

(2) Intensity of caries: 1, if the enamel is involved; 2, if the dentine is involved; 3, if the cement is involved; the individual intensity being calculated as the sum of the intensities divided by the number of the single teeth stricken;

(3) Severity of caries, i.e., the individual intensity of each decayed tooth. Table 4 shows the heritability indices (according to Holzinger, Jensen, Nichols) calculated for each of the above parameters, which testify to a different weight of the hereditary component according to the estimated phenotype: from 1/3 for the number of decayed teeth and severity to 1/6 for the intensity.

The existence of a noteworthy differential covariability in the two series of twins, notwithstanding the great variability introduced with the parametric evaluations, indicates how much the hereditary component weighs upon the symptoms of a caries both on the analytic and the synthetic level.

Table 4. *Heritability of various parameters of caries*

		N	r	Holzinger's H	Jensen's h^2	Nichols' HR
Number of teeth	MZ	19	0.6300	31.29	33.76	53.49
stricken	DZ	23	0.4615			
Intensity	MZ	19	0.7168	8.83	17.66	17.83
	DZ	23	0.0097			
Severity	MZ	19	0.7168	36.36	32.00	22.22
	DZ	23	0.5569			

It being evident that parametric analysis introduces considerable sources of variability, we think that the presence of a covariability on the level of the parameters studied shows chronogenetic covariability of the number of teeth stricken and the severity of the damage. The reduction to 1/6 of the heritability index for intensity is due to the reduction of the variability determined by the construction of the index itself which is in practice an average. Our chronogenetic analysis proceeds with the analysis of the different covariability of caries in the MZ and DZ series of twins, comparing the distributions expected in the hypothesis of independence from the cotwin situation (obtained on the basis of the estimate of the individual frequency and that of caries) against the experimental distribution noted in the MZ and DZ series (Table 5).

Table 5. *Observed and expected distribution of the twin sample according to presence or absence of caries in the cotwins*

	MZ		DZ		Total	
	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.
Both twins affected	7.0	17	16.6	21	23.6	38
One twin affected	13.5	2	32.0	20	45.5	22
Both twins healthy	6.5	8	15.4	23	21.9	31
Total	27.0	27	64.0	64	91.0	91

The expected distribution was calculated on the basis of the estimated individual frequency in the hypothesis of independent occurrence of caries in the cotwins.

The difference between the expected and the experimental frequency in the class of caries formed by one afflicted and one healthy cotwin, weighed on the expected frequency for the same class, represents a good estimate of the different behavior of caries in different types of pairs. The resulting values are 81% and 37%, for the MZ and DZ, respectively. Discordance is reduced in the DZ because of the same environment, but the frequency of concordance of the specific genotypes is only of 37%, while in the MZ, who share the same environment and the same genes, it is of over 81%.

Keeping in mind that the environmental coefficient, such as food, family and social background of the cotwins in the 3-8 age group can be considered concordant, the remarkable difference in the within-pair covariability of caries in the MZ and DZ pairs (cf. Table 5) must be attributed to the different within-pair genetic correlation.

On the basis of our observations, we can conclude:

(1) The caries of primary dentition is a morbid process due 50% to hereditary causes;

(2) The phenogenesis of the caries of primary dentition is controlled by the specific genotype not only in terms of severity of damage but also of the time of onset;

(3) The chronogenetic study of caries in the family can help prevention by singling out the dangerous ages for the onset and development of the morbid process.

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RIASSUNTO

La Cronogenetica della Carie nella Prima Dentizione

È stata condotta un'analisi cronogenetica della carie in un campione di 100 coppie gemellari (27 MZ, 64 DZ e 9 non classificate) dai 3 agli 8 anni di età, prendendo in considerazione il numero di denti cariati, l'intensità e la gravità della carie. Le stime di ereditarietà, calcolate per ciascuno dei parametri considerati, favoriscono l'ipotesi di un controllo genetico del tempo d'insorgenza della carie.

RÉSUMÉ

La Chronogénétique de la Carie dans la Première Dentition

Une analyse chronogénétique de la carie a été conduite sur un échantillon de 100 couples de jumeaux (27 MZ, 64 DZ et 9 non classifiées) de 3 à 8 ans. Le nombre de dents cariées, l'intensité et la gravité de la carie ont été considérés. Les estimes d'hérédité effectuées pour chacun des différents paramètres considérés soutiennent l'hypothèse d'un contrôle génétique de l'âge de début de la carie.

ZUSAMMENFASSUNG

Die Chronogenetik der Karies bei den Milchzähnen

Bei einer Musterreihe von 100 Zwillingspaaren (27 EZ, 64 ZZ und 9 nicht klassifiziert) im Alter zwischen 3 und 8 Jahren wurde die Chronogenetik der Karies untersucht. In Betracht gezogen wurden folgende Punkte: Zahl der von Karies befallenen Zähne, Intensität und Schwere der Karies selbst. Die für jeden dieser Parameter errechnete Erblichkeitsschätzung würde dafür sprechen, daß die Auftretenszeit der Karies erbbeding ist.

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