About the Relation between Vitamin C and Dental Caries.

By

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Many authors (BAUER, BUCHER, HANKE, HOWE, GAETHGENS, TOVERUD, KOCH, GUGGISBERG) are of the opinion, that vitamin C is an important factor for the prophylaxis of dental caries. HANKE writes for example: "Diets, rich in vitamin C, are conducive to an arrest of dental caries in man". Some others, however, deny this e. g. WESTIN, LINDSTRÖM, RIETSCHEL, GLANZMANN, KUGELMASS, KING and BOEDECKER, HESS and ABRAMSON. WESTIN says: "Meine Erfahrung aus allen von mir (1931) untersuchten Skorbutfällen weist demnach einheitlich dahin, dass, wenn überhaupt ein Zusammenhang zwischen Skorbut und Karies vorliegt, dieser derart ist, dass der Skorbut eine geringe Kariesfrequenz oder Immunität herbeiführt", and in 1938 he is of the same opinion, that *it is by no means right, when the literature of the present time will assert the opinion, that* HANKE *has shown, that the C-deficiency is important to the development of caries.* LINDSTRÖM writes: "caries arises independently of the content of vitamin C in the food" and "the results of the hospital and local medical examinations, which concern Norrland[1] only, even show that the caries picture is in direct contrast to the standard of vitamins".

The experimental study of the subject above mentioned (ZILVA and WELLS, HÖJER, WESTIN, HOWE, KEY and ELPHICK and several others) has demonstrated the destructive influence of the C-hypovitaminosis on the tooth of animal, and i. a. some writers consider they have produced caries or carieslike lesions in animals by a food deficient in vitamin C. If a vitamin C deficiency can give rise to or a C administration prevent the arise of dental caries in man is still very uncertain.

[1] The northern part of Sweden.

Table 1.

Mg % ascorbic acid of the blood (spring)	Caries frequency per year															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	N.	
0.00—0.07	2	3	2	2	1	4			3						17	M (caries) = 4.0 ± 0.2 M (asc. ac.) = 0.16 ± ± 0.006 Correlationcoefficient = r = — 0.05 ± ± 0.07 (ESSEN-MÖLLER).
0.08—0.15	3	9	9	8	11	9	8	5		1	3	3	1	2	72	
0.16—0.23	5	16	14	12	13	8	7	6	1		4				86	
0.24—0.31	1	1	2	4		1	2						1		12	
0.32—0.39				1					2		1				4	
0.40—0.47		1	1												2	
0.48—0.55		1					1								2	
0.56—0.63	1						1								2	
Summa	12	31	28	27	25	22	19	11	6	1	8	3	2	2	197	

In order to try to explain the supposed relation between caries and vitamin C we have investigated the ascorbic acid of the bloodserum and the carious lesions of about 190 persons from 7—20 years of age. The level of vitamin C in the bloodserum and the excretion of the vitamin in the urine varies namely, as well known, directly with the dietary intake. (FARMER and ABT and others). The material consists partly of healthy schoolchildren from Varberg, and partly of children and youth from Apelviken, Coastsanatorium of chirurgic (bone and joint) tuberculosis, Sweden. (Chief surgeon: ROBERT HANSON. M. D.)

The vitamin C-content of the blood is determined by titration with 2.6 dichlorphenol-indophenol according to the method of FARMER and ABT (see DAGULF), and *at least* two determinations are made on every person, one in the spring 1938 and one in the autumn the same year. In some cases, moreover, saturationstests ad modum JETZLER and NIEDERBERGER are carried out, whereby as criterium of saturation is choosen a qualitative increase of the titre in the urine.

Every person has also been submitted to a detailed dental inspection in Dec. 1937 and Dec. 1938, and for each person the total number of carious areas of the permanent teeth is noted. As caries are also meant all fillings and extracted teeth. Then we have determined the caries-frequency in relation to the age and the increase of the carious areas from the first to the second inspection.

Table 2.

Mg % asc. as. of the blood (autumn)	Cariesfrequency per year															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	N.	
0.22—0.33	1			1	1										3	$M_c = 4.0 \pm$
0,34—0.45	1	1	2	2	4	6	2	1	1						20	± 0.2
0.46—0.57		3	3									1		1	8	$M_a = 0.96 \pm$
0.58—0.69	2	1			1			1	2						7	± 0.02
0.70—0.81	1	3	1	4	3	1		2	1		1	1	2		20	$r = -0.038$
0.82—0.93	2	6	2	4	5	4	4	2			2				31	± 0.07
0.94—1.05	1	4	8	2	4	3	4	2		1	1	1			31	
1.06—1.17		1	2	2	3	2	4	1			1				16	
1.18—1.29	4	4	5	2	2	1	3							1	22	
1.30—1.41		3	1	3	1	1		1							10	
1.42—1.53		3	1	1		3	3				1				12	
1.54—1.65		1	2	2											5	
1.66—1.77									1		1				2	
Summa	12	30	27	23	24	21	20	10	5	1	7	3	2	2	187	

In order to study the correlation between the caries-frequency and the ascorbic acid in the blood we have made the following tables, which show the values of all these cases in the spring (1) and in the autumn (2).

The correlation coefficient (r) in both tables signifies, that it is improbable, that any correlation is existing between the two investigated statements, while the value 0 is within and near the chance of variation of the found values of the correlation coefficients.

It is of interest to see, if the cases with chirurgic tuberculosis (36 cases) in any degree differ from the healthy children. (Tables 3 and 4).

We can here notice, that the tbc-patients in spite of their low titre of ascorbic acid (0.07 and 0.46 compared with the school-childrens 0.18 and 1.07 mg%) have no higher caries-frequency. And this is the more remarkable, because 50 % of the cases with tuberculosis never have had any dental treatment, but all the healthy cases having systematic school dental service yearly.

We have also investigated, if any correlation exists between the increase of carious areas (from the first to the second inspec-

Table 3.

Mg % asc. acid (spring)	Cariesfreq.		
	0—3.9	4—13	
0.00—0.07	10	6	
0.08—0.24	8	12	$M_c = 4.0$. $M_a = 0.074$.

Table 4.

Mg % ascorb. ac. (autumn)	Cariesfrequency		
	0—3.9	4—13	
0.25—0.45	10	13	
0.46—0.92	8	5	$M_c = 4.0$. $M_a = 0.46$.

Table 5.

Mg% ascorbic acid of the blood (spring)	Increase of carious areas from the 1st to the 2nd inspect.													
	0	1	2	3	4	5	6	7	8	9	10	11	12	N.
0.00—0.07	4	4	1		1	1	1					2		14
0.08—0.15	14	10	13	3	8	2	3	7	3	3				66
0.16—0.23	17	18	9	11	13	5	5	2	3	3			1	87
0.24—0.31	1	3	2	4		1				1				12
0.32—0.39	1			1					2					4
0.40—0.47	1		1											2
0.48—0.55	1							1						2
0.56—0.63	1						1							2
Summa	40	35	26	19	22	9	10	10	8	7		2	1	189

M(caries) = 3.6 ± 0.2

M (asc. ac.) = $0.16 \pm \pm 0.006$.

Correlationcoefficient = $= -0.027 \pm \pm 0.07$.

tion) and the individual vitamin C standard. (Tables 5—6 all cases and tab. 7—8 the sick cases).

It appears from these tables the same, as mentioned before, that hardly any correlation at all is to be found between the two factors. Neither have the tbc-patients any greater increase of caries than the schoolchildren. (Cp. JUNDELL, HANSON and SANDBERG.)

Saturation tests are made on 14 of the above-mentioned 36

Table 6.

Mg% ascorbic. acid of the blood (autumn)	Increase of caries from the 1st—2nd inspection													
	0	1	2	3	4	5	6	7	8	9	10	11	12	N.
0.22—0.33	1	1						1						3
0.34—0.45	4	1	4		2	1	1	1	1			1		16
0.46—0.57	2	3			1	1		1						8
0.58—0.69	2				1				2					5
0.70—0.81	1	5	6	2	3			1				1	1	20
0.82—0.93	9	5	1	3	5		3	1	1	2				30
0.94—1.05	5	3	6	4	5	1	2	3	1	1				31
1.06—1.17	3	1	2	2	2	4	1			2				17
1.18—1.29	6	5	2	3		2	2		1	1				22
1.30—1.41	3	5		1						1				10
1.42—1.53	3	2	1		2	1		2	1					12
1.54—1.65			2	1	1									4
1.66—1.77	1								1					2
Summa	40	31	24	16	22	10	9	10	8	7		2	1	180

$M_c = 3.1 \pm \pm 0.2$
$M_a = 0.97 \pm \pm 0.02.$
$r = -0.044 \pm 0.08$

Table 7.

Mg% asc. acid (spring)	Increase of carious areas		
	0—3	4—11	
0.00—0.07	9	5	$M_c = 3.3.$
0.08—0.24	9	7	$M_a = 0.075.$

Table 8.

Mg% asc. acid. (autumn)	Increase of carious areas		
	0—3	4—11	
0.24—0.45	11	8	$M_c = 3.3.$
0.46—0.76	7	4	$M_a = 0.45.$

cases with chirurgic tuberculosis and moreover on 8 patients. Also these show the very low vitamin C-standard of the sick cases and confirm the low titre of the bloodserum (Table 9).

Table 9.

Nr.	Bloodascorb. acid mg%		Deficit/kg bodyweight
	spring	autumn	
57/37	0.08	0.56	50 mg.
213/36	0.06	0.24	41 »
15/36	0.12	0.52	32 »
140/37	0.12	0.40	26 »
184/36	0.04	0.48	35 »
295/37	0.08	0.40	33 »
158/37	0.04	0.52	69 »
292/37	0.24	0.40	18 »
68/35	0.04	0.32	60 »
265/37	0.04	0.76	24 »
345/37	0.12	0.40	25 »
30/37	0.04	0.36	42 »
38/37	0.08	0.24	26 »
18/35	0.00	0.44	73 »
233/37	0.04	0.40	37 »
29/37			51 »
141/37			35 »
35/36			53 »
243/36			50 »
343/36			41 »
121/35			60 »
109/36			26 »

The normal deficit per kg. bodyweight is considered to be 10—15 mg.

The mean value of the caries-frequency of these cases with vitamin C-"deficit" is 3.3, and compared with the caries-frequency of the healthy cases with a higher vitamin C standard, there is no higher resistance to caries among the latters.

Our investigations do not give proof of vitamin C being an etiologic factor for the genesis of caries. This is already 20 years ago intimated among others by the scorbutinvestigator TOBLER, who has called the attention to the good dental conditions in respect just now mentioned not being unusual by manifest scurvy. Even a very low standard of vitamin C does not appar-

ently cause an arise of caries in persons with tuberculosis of the bones and joints.

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Summary.

The amount of ascorbic acid in the blood, and the frequency of caries have been determined in circa 190 both healthy and tuberculous people, between the ages of 7—20 years. *At least* two investigations have been made of the amount of ascorbic acid during the spring and during the fall of 1938, and of the frequency of caries in December 1937 and December 1938. No basis for correlation between vitamin C and caries could be found.

The material includes 36 cases of extra-pulmonary (chir.) tuberculosis, and about 150 healthy persons.

The experiments have not shown vitamin C to be an etiologic factor in the cause of caries. Even the very low vitamin C-standard in tuberculous patients does not seem to provoke increased occurrence of caries.

Zusammenfassung.

Die Blutascorbinsäure und die Kariesfrequenz sind bei ca. 190 Individuen im Alter von 7—20 Jahren bestimmt. *Am mindesten* zwei Untersuchungen sind vorgenommen: Die Ascorbinsäure im Frühling und Herbst 1938, die Kariesfrequenz im Dez. 1937 und Dez. 1938. Das Material umfasst 36 Fälle von extrapulmonaler (chir.) Tuberkulose and ca. 150 gesunde Personen. Korrelationsberechnungen gaben keinen Anhalt für einen bestehenden Zusammenhang Vitamin C-Karies.

Durch die Untersuchungen ist nicht gefunden, dass Vitamin C ein etiologischer Faktor für die Entstehung der Karies ist. Auch der sehr niedrige Vitamin C-Standard der Tuberkulosekranken scheint keiner erhöhten Karieshäufigkeit mit sich bringen.

Résumé.

L'acide ascorbique du sang ainsi que la fréquence de la carie ont été déterminés chez environ 190 sujets âgés de 7 à 20 ans. *Au moins* deux examens ont été pratiqués. L'acide ascorbique au printemps et à l'automne 1938, la fréquence de la carie en déc. 1937 et en déc. 1938. Le matériel comporte 36 cas de tuberculose extra-pulmonaire (chir.) et environ 150 sujets bien portants. Les calculs n'ont donné aucun appui à la théorie de l'existance d'une relation définie entre la vitamine C et la carie.

Par ces recherches on n'a pas pu trouver que la vitamine C soit un facteur étiologique dans le développement de la carie. Même le titre infime de vitamine C chez les tuberculeux ne semble pas entraîner un accroissement de la fréquence de la carie.

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