

## Statistical Association of Dietary Components with *Simonsiella* Species Residing in Normal Human Mouths

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**Members of the genus *Simonsiella*, aerobic, multicellular filamentous gliding bacteria, were detected in swabbings from the palates of 32% of 212 human subjects free of gross oral pathologies. Nutritional evaluations for 142 of the subjects showed a significantly greater daily intake among 53 *Simonsiella* carriers for 13 dietary variables, including four fat components, but there was no significantly greater daily intake for any of the carbohydrate components. Overall, there was a general excess dietary intake by *Simonsiella* carriers. The mean dietary intake of the carriers was numerically greater than that of the noncarriers for 70 of 74 dietary variables.**

Members of the genus *Simonsiella*, aerobic gliding bacteria composed of flat multicellular filaments with dorsal (convex)-ventral (concave) differentiation, have been known to inhabit the human mouth; they have not been implicated as etiological agents of oral disease (8). In this study, we addressed the ecological questions of the *Simonsiella* incidence in humans free of gross oral pathologies and of the environmental factors affecting its presence in the mouth. We sampled a population of human subjects and evaluated dietary components for their association with the observation of simonsiellas in oral specimens. There is emerging evidence that diet can affect the microorganisms inhabiting the mouth and other parts of the digestive tract in humans and other warm-blooded vertebrates (1, 3, 9, 13-15).

The population survey was conducted by collecting a specimen from the hard palate of each human subject with a swab in midmorning or midafternoon and then by placing the specimen on agar where it was screened for simonsiellas with the microscope as described by Nyby et al. (11) and Kuhn (8). The survey detected simonsiellas in 32% of a total population of 212 human subjects ranging in age from 4 to 80 years. Among young adults between the ages of 19 and 29 years, the organism was found in 34% of 172 individuals. The approximately 7.5% greater frequency in males than in females in both the total population (35.2% of 128 males; 27.4% of 84 females) and the group of young adults (36.9% of 111 males; 29.5% of 61 females) was not statistically significant ( $\chi^2$ , 1.07 and 0.66, respectively;  $P > 0.05$ ).

The daily dietary intake of 142 subjects was determined by a computerized nutritional frequency questionnaire method (Dietronics program 1-75 0; Dietronics Division of Health Evaluation Systems, Inc., Richardson, Tex.) listing 46 nutrient classifications and ratios (7, 12). For 28 of these 46 components, a recommended dietary allowance (RDA) has also been defined, making a total of 74 variables analyzed. In addition to the 10 components listed in Table 1, the program estimated the RDA for polyunsaturates, calories, tryptophan, vitamin B<sub>1</sub>, magnesium, and phosphorus; the actual daily amounts and RDA for protein, seven essential amino acids (phenylalanine, leucine, isoleucine, lysine, valine, methionine, and threonine), nine vitamins (A, B<sub>2</sub>, B<sub>6</sub>, B<sub>12</sub>, C, E, niacin, pantothenic acid, and folacin), and five minerals (Ca, Fe, Zn, I, and K); the actual amounts of cholesterol, sodium (contained in food components), fiber,

and carbohydrate; the number of dairy, cereal, vegetable-fruit servings, teaspoons of sugar, and dental plaque-forming and firm non-plaque-forming food exposures; the polyunsaturates/saturates, fat/calories, and calcium/phosphorus ratios; and the percentage of calories in the total diet obtained from refined carbohydrates.

Comparisons between the means of the 74 variables in the positive *Simonsiella* carriers and in the negative group were based on Student's *t* test. Statistically significant differences were found between the two groups for the means of the actual amounts of the dietary components listed in Table 1. Of these, tryptophan and phosphorus also differed in RDA. Overall, the mean of the carriers was numerically greater than the mean of the noncarriers for 70 of the 74 nutritional variables analyzed. If one compares the 46 actual dietary components, the mean dietary intake of the carriers exceeded that of the noncarriers in 43 of 46 instances. Assuming no difference in dietary intake between the two groups, this outcome would be expected because of chance alone, with a probability of less than one in 1,000,000,000,  $P (X \geq 43; n, 46; P, 0.5)$ . Although a number of these components are undoubtedly correlated, the preponderance of instances in which the dietary intake of carriers exceeded that of noncarriers nevertheless indicates that the excess intake of *Simonsiella* carriers is more general than reflected by the group of 10 variables for which statistically significant differences were demonstrated.

The higher levels of fat, protein, vitamin B<sub>1</sub>, and phosphorus probably reflected a greater consumption of animal proteins by the group of *Simonsiella* carriers. Because the essential amino acid tryptophan is derived mainly from animal, not vegetable, proteins, it is correlated with the daily number of protein servings rather than with the total amount of protein consumed. There were no significant differences between the means of any of the carbohydrate-related variables. Within both groups, a wide range existed for these variables. For example, the positive subjects consumed 2.3 to 32.0 teaspoons of sugar per day; the negative subjects consumed 1.7 to 37.0 teaspoons of sugar per day.

In general, the 142 subjects consumed adequate diets; only 3 registered a deficient intake of protein at 89% of their RDA or less. Among the components of significance (Table 1), the most commonly recorded deficiencies were in the intake of vitamin B<sub>1</sub> and magnesium and in the case of women, in the intake of iron. The relatively low intake of vitamin B<sub>1</sub> and

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TABLE 1. Dietary components of statistical significance associated with the presence of *Simonsiella* species

Dietary component	Actual amt consumed/day (mean $\pm$ SE)		Statistical analysis	
	Positive <sup>a</sup>	Negative <sup>b</sup>	t test <sup>c</sup>	Probability
Fat (g)	122 $\pm$ 7.3	103 $\pm$ 3.4	2.67	<0.01
Monounsaturates (g)	50 $\pm$ 3.0	42 $\pm$ 1.4	2.74	<0.01
Polyunsaturates (g)	18 $\pm$ 1.2	15 $\pm$ 0.6	2.29	<0.05
Saturates (g)	54 $\pm$ 3.7	46 $\pm$ 1.7	2.24	<0.05
Calories	2,420 $\pm$ 131	2,120 $\pm$ 65	2.26	<0.05
Protein servings	2.8 $\pm$ 0.2	2.3 $\pm$ 0.1	2.28	<0.05
Tryptophan (mg)	1,200 $\pm$ 73	1,050 $\pm$ 38	2.03	<0.05
Vitamin B <sub>1</sub> (mg)	1.5 $\pm$ 0.1	1.3 $\pm$ 0.1	2.04	<0.05
Magnesium (mg)	380 $\pm$ 23	330 $\pm$ 13	2.04	<0.05
Phosphorus (mg)	1,700 $\pm$ 97	1,480 $\pm$ 54	2.14	<0.05

<sup>a</sup> Group in which simonsiellas were detected (n, 53).

<sup>b</sup> Group in which simonsiellas were undetected (n, 89).

<sup>c</sup> From BMD01V (4).

iron agreed with nutritional profiles of dental students (6) and of dentists and their wives (2).

All persons included in the dietary survey considered themselves to be in normal oral health and none reported using drugs at the time of the investigation. Of these, 11 *Simonsiella* carriers volunteered for a free-of-charge dental examination. Their oral conditions, which were assessed by one examiner in a complete dental examination of the hard and soft tissues, including X radiography by the Panorex method, ranged from an excellent state of health to various degrees of dental decay, periodontitis, and deposits of calculus. None had pathological symptoms on the palate or on other parts of the mouth.

The finding that almost all dietary variables had a higher mean in the group of *Simonsiella* carriers than in the group in which simonsiellas were not detected and that a number of these dietary components showed statistically significant differences with respect to the actual amounts of foods consumed suggested that the occurrence of human-adapted *Simonsiella* sp. (8) is at least to some extent influenced by the dietary components and habits of an individual. Of particular interest is the significantly higher dietary intake of fat and protein, but not sugar, by *Simonsiella* carriers. Previously, dietary fats were known to be cariostatic (10). The potential antiadhesive mechanisms of lipids have been reviewed by Freter (5). Moreover, the chemical structures, quantities, and relative amounts of fatty acids were shown to affect the microbial flora associated with tissues of higher

organisms (1). The selective advantage of diet on simonsiellas rests on the nutrition of *Simonsiella* sp., on the *Simonsiella*-epithelium cell-cell interactions, or on the physiological condition and health of the host.

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