

LEVELS OF BLOOD SUGAR AND
BLOOD GLUCOSE IN RELATION
TO SYSTEMIC AND
ORAL HEALTH

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In trying to determine the range of normal values for two biochemical standards of health, the authors discover the greatest uniformity among dental students with the fewest signs and symptoms

The body maintains a constant internal environment through highly sensitive homeostatic mechanisms which regulate and keep in balance such things as temperature, blood pressure, and concentration of the constituents in body fluids (5). Each of these physiologic variables provides a potential test in the evaluation of a person's state of health. Such tests permit comparison with either the majority of a large random sample of subjects or the known range of values in normally functioning subjects.

In practically all cases, the accepted physiologic range for a particular biochemical test has been derived from the mean plus one or two standard deviations of a *presumably* healthy group of human subjects. The presumption is made that, if the patient's score falls within the spread of 68-95 per cent of the population measured, his results are within the physiologic range.

A second approach to physiologic spread

is to determine values for a particular test in a *symptomless* and *sign-free* group. This is reasonable since the presumption can be made that, all other factors being equal, a patient *without* symptoms and signs is probably healthier than one *with* clinical findings (2). This study represents an attempt to develop the range of values for non-fasting (postprandial) blood sugar and glucose in such a group.

Physiologic Variables

A healthy individual's blood sugar and blood glucose values are found to fluctuate only slightly from day to day despite great variations in diet, exercise, and nervous stress. The levels are held constant by the interaction of ingested food, liver and kidney function, adrenal and hypophyseal hormones, and insulin secreted by the pancreas. Blood sugar, carried in the plasma,

includes glucose and much smaller amounts of fructose and galactose. Blood glucose supplies the cells of the body with energy or is stored as glycogen, mainly in the liver and muscles.

Investigators disagree as to the ranges of blood sugar and glucose which may be regarded as within normal limits (4). It is generally agreed that the non-fasting (postprandial) blood sugar is physiologically under 140 mg. per cent (7), with the range in health from 70 to 120 mg. per cent (milligrams per 100 milliliters of plasma). Non-fasting blood glucose in health is less than 100 mg. per cent, ranging from 60 to 100, averaging 80 mg. per cent.

Method of Investigation

Forty male dental students were studied. They ranged from 20 to 34 years of age, with two-thirds of the group between 23 and 28 years of age. Each was questioned regarding general health and the presence of oral symptoms. The oral cavity was examined carefully in each subject. Periapical roentgenograms were also made.

A two-hour postprandial blood sugar determination was made of each subject (3), and the blood glucose was measured (6, 8, 9). Distribution of blood sugar and blood glucose values for the forty subjects, with means and standard deviations are shown in the accompanying table.

Analysis of the Measures in Terms of Health

Negative Systemic History

Of the forty subjects, twenty-two reported a negative systemic history, that is, no history of cancer, arthritis, diabetes mellitus, hypertension, or allergy. Thus 68 per cent of the group had blood sugar values ranging from 80.9 to 110.1 mg. per cent, with a mean of 95.5 (S.D. \pm 14.6). The mean glucose value, as shown on the second of the accompanying charts, was 77.5 mg. per cent (S.D. \pm 14.3).

Negative Oral Symptoms

Thirty-one of the dental students reported a negative history of oral symptoms, that is, none of these described dry or burning mouth or gingival tenderness. It should be pointed out, however, that some of these subjects may have had a positive history of systemic disease. Two-thirds of this group ranged from 85.3 to 108.9 mg. per cent blood sugar, with a mean of 97.1 (S.D. \pm 11.8); mean glucose value was 78.7 (S.D. \pm 12.6).

Full Dental Complement No Tooth Mobility

Seventeen subjects were found to have 28 or more teeth with no clinical tooth mo-

Blood Sugar (Mg. Per Cent)	Number of Subjects	Percentage of Subjects	Blood Glucose (Mg. Per Cent)	Number of Subjects	Percentage of Subjects
125-34	2	5.0	110-19	1	2.5
115-24	3	7.5	100-109	3	7.5
105-14	6	15.0	90-99	4	10.0
95-104	11	27.5	80-89	9	22.5
85-94	13	32.5	70-79	15	37.5
75-84	2	5.0	60-69	6	15.0
65-74	3	7.5	50-59	2	5.0
Total	40	100.0	Total	40	100.0
Mean	96.6		Mean	78.6	
S.D.	13.4		S.D.	13.5	

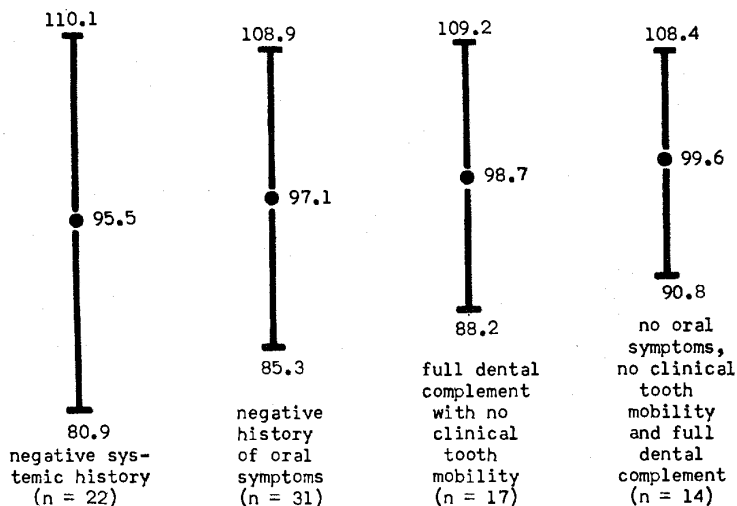


FIG. 1.—After postprandial blood sugar was measured in 40 relatively symptomless and sign-free dental students, the values were compared: those of subjects with negative systemic histories versus those of subjects without oral symptoms versus two further groups with even fewer oral signs and symptoms. As the mean sugar approached 100 mg/100 ml plasma, the range of values decreased in successively more healthy subjects.

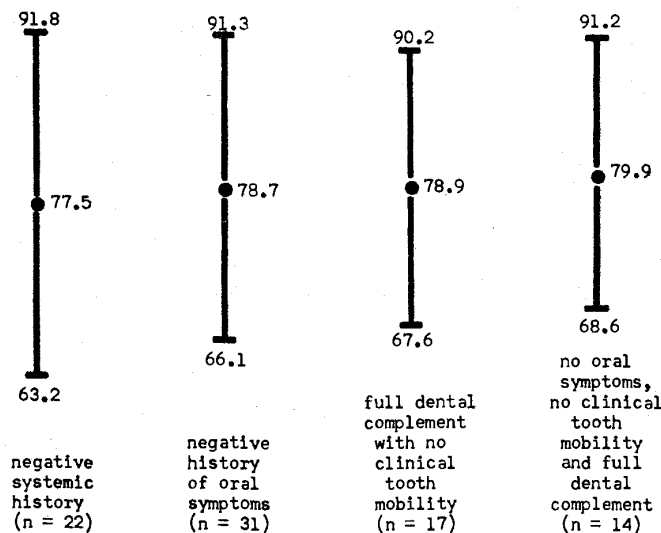


FIG. 2.—In the same subjects and categories shown in Fig. 1, the mean blood glucose value rose toward 80 mg. per cent, while the range of values again diminished.

bility. Accompanying this greater degree of oral health was a higher mean blood sugar level of 98.7 and a decreased standard-deviation range of 88.2-109.2. Mean blood glucose was 78.9; as with blood sugar, the range of values had shrunk, reflecting a standard deviation of ± 11.3 .

Full Dental Complement. No Tooth Mobility. No Oral Symptoms

Finally, subjects satisfying all the criteria used as expressing dental health were studied. These fourteen dental students showed a mean blood sugar determination of 99.6 (S.D. ± 8.8) and a mean glucose value of 79.9 (S.D. ± 11.3). Once again the ranges of the values had decreased.

Implications

By applying a succession of criteria for health (e.g., negative systemic history, absence of oral symptoms) to non-fasting blood sugar values of a group of relatively symptomless and sign-free subjects, we have seen the mean blood sugar slowly rise toward 100 mg. per cent and mean glucose slowly rise toward 80 mg. per cent. By stiffening the specifications for health—selecting subjects with increasingly fewer symptoms and signs—the ranges of values for the two measures shriveled markedly, from ± 14.3 to ± 11.3 mg. per cent for glucose; from ± 14.6 to ± 8.8 for blood sugar. It is noteworthy in this regard that an earlier study (7) showed *fasting* blood glucose approaching 75 mg. per cent.

It is interesting to speculate what the physiologic spread of these standard meas-

ures would be if a large enough sample permitted even more rigid health criteria to be imposed. Presumably non-fasting blood sugar might even be a point. Actually, this cannot be if for no other reason than the intrinsic experimental error involved in the test. This has been established at both inter- and intra-technician levels by having two technicians perform the same test at the same time and at different times on the same blood sample. The mean error is approximately 3 mg. per cent.

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FOR THE BUSY READER

Summaries and Biographies

Levels of Blood Sugar and Blood Glucose in Relation to Systemic and Oral Health • *Ringsdorf, Cheraskin, and Hollis*

Non-fasting blood sugar and blood glucose were determined for forty dental students who were also questioned and examined as to general health and oral symptoms and signs. Differential analysis of the sugar measures in terms of subjects with relatively greater health—fewer symptoms and signs—showed increasingly narrow ranges of values, suggesting that these biochemical standards of health may be more explicit than is presently held when more rigid criteria of health are imposed.

Warren M. Ringsdorf, Jr., earned both a D.M.D. and an M.S. degree at the University of Alabama in 1956. After service as captain in the United States Air Force Dental Corps, he entered private practice. In 1959 he became a member of the University of Alabama faculty, where he is now assistant professor of clinical dentistry, Department of Oral Medicine. **Emanuel Cheraskin** is professor and chairman, Department of Oral Medicine at the University of Alabama Medical Center. He holds an M.A. degree (1941) and a D.M.D. degree (1952) from Alabama and an M.D. degree (1943) from the University of Cincinnati. After a short time in private medical practice, he joined the faculty at Alabama. **Carolyn F. Hollis** has contributed to this and other studies as statistical assistant.

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