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Sexual Differences in Fasting Blood Sugar.

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Investigators have disagreed as to the changes in blood sugar during fasting; those who have reported a decrease have failed to note a sexual difference. Allen believed that the blood sugar is maintained at 100 mg.% through prolonged starvation, almost up to death. Joslin[2] found the blood sugar decreased from 120 to 90 mg.% during 4 days, in which a healthy woman fasted, save for small quantities of weak bouillon.

Weeks and his co-workers[3] observed 64 epileptics, who fasted 3 weeks. Sugar determinations were made only once a week; the sugar was reported as being maintained at an approximately even level. Acidosis was present, but not severe. Shaw and Moriarty[4] observed epileptic children during 10 to 14 day fasts. They found a steady diminution in blood sugar, with the minimum (46 mg.%) between 3 and 8 days, after which the sugar increased. They considered the diminution in blood sugar peculiar to childhood, since it was supposed that the blood sugar is not much diminished in adults during fasting.

Lennox and his co-workers[5] observed 16 men and 8 women during 3 to 21 day fasts. They noted that the blood sugar fell during the first week of fasting. Their minimum was 65 mg.%. Shope[6] studied one woman who fasted 6 days. He found that the blood sugar decreased to a minimum of 37 mg.%. As the fast continued, a secondary rise in blood sugar occurred. Deuel and Gulick[7] observed 5 men and 5 women during 7 day fasts. The women subjects showed ketosis before the men. It developed more rapidly and became more severe, as shown by both the urine analyses and the carbon dioxide combining power of the plasma. No blood sugar studies were made.

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2 Joslin, E. P., *Carnegie Inst. of Wash. Pub.*, No. 323, 1923, 137.

3 Weeks, D. F., Renner, D. S., Allen, F. M., and Wishart, M. B., *J. Metab. Res.*, 1923, **3**, 317.

4 Shaw, E. B., and Moriarty, M., *Am. J. Dis. Child.*, 1924, **28**, 553.

5 Lennox, W. G., O'Connor, M., and Bellinger, M., *Arch. Int. Med.*, 1926, **38**, 553.

6 Shope, R. E., *J. Biol. Chem.*, 1927, **75**, 101.

7 Deuel, H. J., Jr., and Gulick, M., *J. Biol. Chem.*, 1932, **96**, 25.

In spite of contradictory findings, several text-books hold to the view that there is no marked decrease in blood sugar during fasting. Macleod[8a] states that early in starvation the blood sugar becomes much lower than normal, after which it remains steady, but in the same text[8b], he contradicts this, and states that in complete starvation the blood sugar does not fall very much below the normal level. Starling[9] states that even during prolonged starvation the blood sugar does not fall notably below the amount present after a fast of only a few hours. Howell[10] states that even in prolonged starvation the sugar contents of the blood are kept at a normal level.

In view of the differences of opinion, it seemed desirable to make additional studies. The decrease in blood sugar during fasts of 60 hours has been determined in a group of 54 adults (28 women and 26 men), who were either students or instructors. Water, black coffee, and clear tea were allowed. Each subject did his usual work during the fast.

The blood was drawn by venepuncture after 12, 36, and 60 hours of fasting. The sugar was determined (in duplicate) by the Shaffer-Somogyi method. The following values were found; they are expressed as milligrams percent:

hr.		28 women	26 men
12	Min.	71	73
	Max.	95	95
	Aver.	83±0.70	85±0.45
36	Min.	56	64
	Max.	79	89
	Aver.	69±0.84	78±0.79
60	Min.	48	59
	Max.	80	92
	Aver.	62±1.05	67±0.82

The following differences between the sexes were found; the men had the higher values in every case.

12 hours	36 hours	60 hours
1.5±0.83	8.9±1.15	5.3±1.33

The total fall for women was 25.6%; of this, 67% occurred between 12 and 36 hours. The total fall for men was 20.6%; of this, 39.1% occurred between 12 and 36 hours. It is evident that the fall is more rapid in women during the early stages of the fast. It may be that women have less glycogen stored in the liver than men.

[8] Macleod, J. J. R., Physiology and Biochemistry in Modern Medicine, 1926, 5th ed., (a) 792; (b) 875.

[9] Starling, E. H., Human Physiology, 1933, 6th ed., 666.

[10] Howell, W., Text-book of Physiology, 1933, 12th ed., 983.

It has been found that female rats have lower fasting liver glycogen values than male rats[11].

Qualitative tests for acetonuria were done at 36 and 60 hours. Twelve of the women showed acetonuria at the end of 36 hours, and 27 at the end of 60 hours. Six men showed acetonuria at the end of 36 hours, and all showed it at the end of 60 hours. These results agree with those of Deuel[7].

The average weight loss for women was 5.1 pounds; for men, 6.4 pounds. The range of weight loss for women was 3 to 10 pounds; for men it was 3⅞ to 12½ pounds. The women lost 1.8% of the body weight between 12 and 36 hours; the total loss was 3.8% of the body weight. The men lost 1.9% between 12 and 36 hours; the total loss was 3.6%.

In view of Haggard's findings[12], the subjects were asked not to smoke during the half hour preceding the taking of the blood each morning. Among the women fasters, there were 14 smokers and 14 non-smokers. Among the men there were 20 smokers and 6 non-smokers. The differences between the smokers and non-smokers were not consistent. The women smokers have lower values than the non-smokers; the differences were 7. mg. % at the end of 12 hours, 4. at 36 hours, and 9. at 60 hours. The men smokers had 3. mg.% more sugar than the non-smokers at 12 hours; at 36 hours the non-smokers were 3 mg.% above the smokers; at 60 hours the non-smokers were less than 1 mg. higher than the smokers. Smoking during the days of fasting, except during the half-hour preceding the venepuncture each day, has no consistent effect on blood sugar.

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11 Greisheimer, E. M., *J. Nutrition*, 1931, **4**, 411.

12 Haggard, H. W., and Greenberg, L. A., *Science*, 1934, **79**, 165.