

# Obesity and the Denial of Hunger

ALBERT STUNKARD, M.D.

CURRENT CLINICAL conceptions of hunger are based on reports that the experience of hunger occurs primarily during periods of contractions of the empty stomach. We were therefore surprised during study of the gastric motility of 2 obese women to find that they consistently denied feelings of hunger, even at times when their stomachs showed the classical "gastric hunger contractions." Accordingly, we re-investigated the alleged association between gastric motility and the experience of hunger.

## Method

Seventeen obese and 18 nonobese women were studied. All were patients in the General Medical Clinic of the Hospital of the University of Pennsylvania who were in good health, with no condition believed to influence food intake (diabetes, hypoglycemia, etc.), gastric motility (peptic ulcer, gastritis, etc.), or ability to tolerate the experimental procedure (congestive heart

failure, anxiety reaction, etc.). The median per cent overweight of the obese subjects, as calculated from standard height-weight tables,<sup>5</sup> was 62 with a range from 26 to 182 per cent. Control subjects were not only of normal weight, but were without past history of overweight or underweight. There was no significant difference between the median age of the obese group (30 years) and the control group (34 years), or between their ethnic background, educational level or socioeconomic status. In an effort to obviate the effects of prior learning, no subjects were used who had previously undergone gastric intubation.

A standard experimental situation was devised. The patient arrived at the laboratory after an overnight fast and began the test at 9 A.M. At the beginning of the experiment a Levin tube with attached gastric balloon was inserted into the stomach. The balloon was inflated to a pressure of 15 cm. of water, and the tube was withdrawn until resistance was encountered at the cardia. The tube was then anchored at the nose with adhesive tape. Gastric contractions were recorded on a kymograph by means of a water manometer. Duration of the test was 4 hours.

The kymograph tracing was interpreted according to the original descriptions of Cannon and of Carlson as standardized by Code.<sup>1, 2, 3</sup> According to these authors, gastric motility can be divided into 4 basic

From the Departments of Psychiatry and Medicine, University of Pennsylvania, Philadelphia 4, Pa.

Presented before the Annual Meeting of the American Psychosomatic Society, May 3, 1959, Atlantic City, N. J.

This work was supported in part by the Research and Development Division, Office of the Surgeon General, Department of the Army, under Contract DA-49-007-MD-925.

Received for publication March 16, 1959.

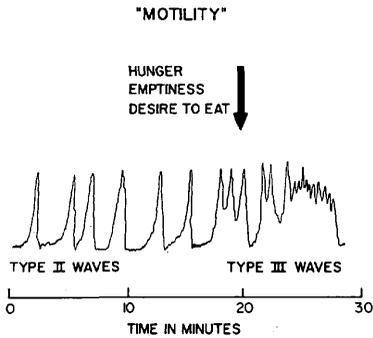


Fig. 1. Gastric pressure tracing during the presence of gastric motility. Type II and type III waves are shown and the subject's report of presence of "hunger," emptiness and desire to eat is entered directly on the motility tracing.

patterns,—type O and type I waves that were scored as "no motility," and type II and type III waves scored as "motility." As illustrated in Fig. 1, the shapes of the type II and III waves are distinctive and easily distinguished from type O and I waves shown in Fig. 2.

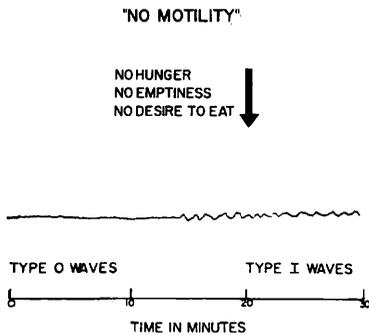


Fig. 2. Gastric pressure tracing during absence of gastric motility. No motility is called type O waves, and motility of low amplitude is called type I. Subject's report of the absence of "hunger," emptiness and desire to eat are recorded directly on the motility tracing.

In an effort to delineate the components of the hunger experience, 200 obese and nonobese persons were asked what they meant when they said they were hungry. The only replies regularly associated with a report of "hunger" focused on sensations of "emptiness" in the upper abdomen, or a "desire to eat," or both. Accordingly, we investigated these verbal responses and their association with the presence or absence of gastric motility. At 15-minute intervals, during the measurement of gastric motility, each of the 35 subjects was questioned concerning the presence of "hunger," abdominal "emptiness" and "desire to eat." The responses were then entered directly on the motility tracings, as illustrated in Figs. 1 and 2. Each experiment thus provided information during each of 17 periods in regard to each of 4 variables,—presence or absence of (1) gastric motility, (2) "hunger," (3) "emptiness" and (4) "desire to eat."

The information obtained from each subject was entered in a series of 2 by 2 boxes that related the presence or absence of gastric motility to the simultaneously recorded reports of the hunger experience. Figure 3 shows a series of 2 by 2 boxes for a subject whose reports of "hunger" occur predominantly during periods of gastric motility. Such organization demonstrated the pattern of association of gastric motility and "hunger," "emptiness" and "desire to eat" for each subject. Ordering of these data was guided by a critical consideration; the total number of responses for a group is less significant than the pattern of responses of individual persons. We are more interested in how individual persons organize their experience than in summations of reports of experience per se. To achieve this end, 2 main statistical techniques were used. The first was a rough ordering of the data from each subject according to her predominant response; the second was a finer ordering of the data from each person according to per cent of any particular response.<sup>6</sup>

Ordering according to predominant re-

	"HUNGER"	NO "HUNGER"	"EMPTINESS"	NO "EMPTINESS"	"DESIRE"	NO "DESIRE"
MOTILITY	6	1	6	1	6	1
NO MOTILITY	1	9	1	9	1	9

Fig. 3. Organization of information from a nonobese subject whose reports of "hunger" occur predominantly during periods of gastric motility.

sponse is illustrated in Fig. 4. The predominant verbal response during both motility and no-motility was entered in the appropriate box. In the case shown in Fig. 3, for example, the predominant responses were in the motility—"hunger" and in the no-motility—no—"hunger" boxes, and this subject would contribute one unit to each of these boxes. The (rare) cases in which

there was an equal number of responses were omitted. These data were analyzed by means of the chi-square test.

Ordering according to per cent of response is illustrated in Fig. 5. The basic unit is the per cent of the time during which each subject reported "hunger" in the presence of gastric motility. In the case cited in Fig. 3, for example, "hunger" was

NON-OBESE WOMEN

	"HUNGER"	NO "HUNGER"
MOTILITY	14	3
NO MOTILITY	2	12

$$X^2 = 14.110$$

$$P < .001$$

OBESE WOMEN

	"HUNGER"	NO "HUNGER"
MOTILITY	5	11
NO MOTILITY	2	14

$$X^2 = 1.645$$

$$P \text{ NOT SIGNIFICANT}$$

Fig. 4. The subjects' predominant response as regards "hunger" during both motility and no-motility is recorded. The nonobese women show a striking association of "hunger" and motility as well no-"hunger" and no-motility. Obese women fail to show this association.

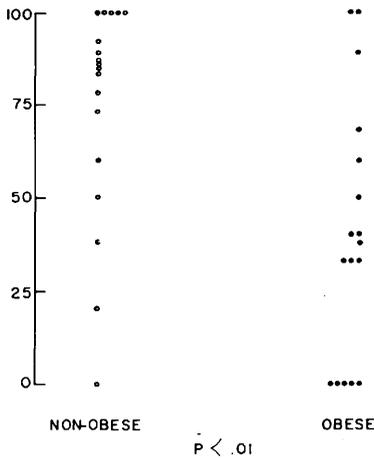


Fig. 5. The per cent of the time during which the subject reported "hunger" in the presence of gastric motility is recorded on the vertical axis. Each point represents the percentage for one subject. Most control subjects report "hunger" most of the time. The obese subjects very frequently deny "hunger" under the same circumstances.

reported 6 times out of 7, or 86 per cent of the time. Such values for each subject were entered on the chart along the vertical axis. The data were analyzed by means of rank order tests.

### Results

#### Patterns of Nonobese Women

The nonobese women usually reported "hunger" during periods of gastric motility and no "hunger" during periods of no motility. This finding is illustrated in the upper half of Fig. 4 where the responses in the motility—"hunger" and no-motility—no-"hunger" boxes greatly outnumber those in the other two boxes. Figure 5 shows that the majority of nonobese women usually report "hunger" in the presence of gastric motility.

Reports of "emptiness" and "desire to

eat" were investigated in the same manner. These responses occurred predominantly in association with those of "hunger." Any reference to "hunger," thus applies also to "emptiness" and "desire to eat," as far as the non-obese women are concerned.

#### Reports of "Hunger" by Obese Women

In contrast to the frequent reports of "hunger" by the nonobese women, the obese women rarely reported "hunger." The difference in total number of reports of "hunger" between the 2 groups was significant at the one per cent level of probability. The remainder of this study constitutes an effort to determine the reasons for this discrepancy.

#### Gastric Motility of Obese and Nonobese Women

The patterns of gastric motility of the obese women were indistinguishable from those of the nonobese women, and were thus apparently not responsible for the difference in total reports of "hunger."<sup>4</sup> The median per cent of time during which gastric motility was present was 49 per cent for the obese women and 46.4 per cent for the control subjects.

#### Reports of "Hunger" During Gastric Motility

The discrepancy in total reports of hunger between obese and nonobese women is due entirely to differences in reports of "hunger" in the presence of gastric motility. Nonobese women, as has been noted, usually reported "hunger" during the presence of gastric motility. Obese women, on the other hand, usually reported no "hunger" under the same conditions.

This finding is illustrated in Fig. 4. In the presence of gastric motility 14 of 17 nonobese women reported "hunger" as their predominant response. Under like circumstances, only 5 of 16 obese women reported "hunger" as their predominant response. This difference between obese and nonobese women is further illustrated in Fig. 5. In the presence of gastric motility 5 nonobese women reported "hunger" 100

per cent of the time, and 11 of 18 reported "hunger" more than 80 per cent of the time. Five of the obese women, on the other hand, never reported "hunger" in the presence of gastric motility, and 11 of 17 reported "hunger" less than 40 per cent of the time under these conditions. These differences are significant at the one per cent level.

#### Reports of "Emptiness" and "Desire to Eat" During Gastric Motility.

The failure of obese women to report "hunger" in the presence of gastric motility was investigated by a study of their reports of abdominal "emptiness" and "desire to eat." The results were unequivocal; during gastric motility the obese women usually reported no "emptiness" and no "desire to eat."

Such reports of "emptiness" and "desire to eat" as did occur were usually in association with reports of "hunger," a pattern similar to that found among the nonobese women. In other words, if they were able to report "emptiness" and "desire to eat," the obese subjects were just as likely to report "hunger" as were the nonobese ones.

#### Reports of "Hunger" in the Absence of Gastric Motility

Is the failure to report "hunger" a non-specific difficulty in appreciating gastrointestinal sensations, or is it specifically related to gastric motility? In an attempt to answer this question the responses of the obese women were studied during the absence of gastric motility. Nonobese women, as has been noted, usually report no "hunger" during such periods.

The responses of the obese subjects were the same as those of the control subjects. Both groups usually report no "hunger" in the absence of gastric motility. These findings are illustrated in Fig. 4. Fourteen of 16 obese women reported no "hunger" in the absence of gastric motility, as compared with 12 of 14 nonobese women. Figure 6 further illustrates this finding. There is no difference in the patterns of the obese and

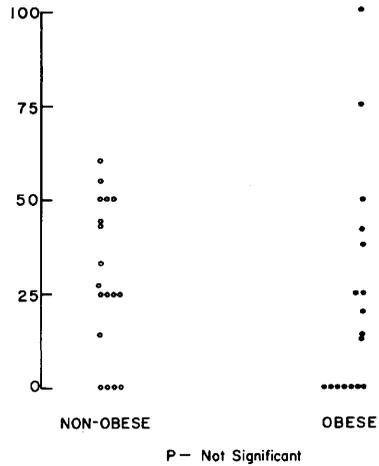


Fig. 6. The per cent of the time during which the subject reported "hunger" in the absence of gastric motility is recorded on the vertical axis. Each point represents the percentage for one subject. Obese and control subjects seldom report "hunger" under these circumstances.

nonobese groups when the data is ordered according to per cent of reports of "hunger" during the absence of gastric motility.

#### The Night-Eating Syndrome

One final question deserves consideration. Is the failure to report "hunger" by obese women a function only of their obesity, or is there perhaps some more limited, and more revealing, association? Our casual acquaintance with the subjects permitted only a limited exploration of this possibility. We did, however, uncover a surprising association.

A distinctive pattern of food intake,—the "night-eating syndrome," has previously been shown to occur in some obese persons during periods of emotional stress.<sup>7</sup> Each subject in the present study was questioned as to the presence of this pattern that consists of morning anorexia, evening hyperphagia, and insomnia. Eight of the 17

obese women suffered from the night-eating syndrome. Failure by these 8 night-eaters to report "hunger," revealed a striking difference, when compared with the other 9 obese women.

The night-eating women were far less likely to report "hunger" in the presence of gastric motility than were the other obese women. This finding is illustrated in Fig. 7 where the obese women are ranked according to the per cent of "hunger" responses to total responses in the presence of gastric motility. The mean per cent of "hunger" responses among the night-eating women was 22 as compared with 57 per cent for the other obese women; comparison by means of a rank order test reveals a difference which is significant at the 5 per cent level.

A corollary of this greater failure to report "hunger" by the night-eating women emphasizes its importance. If these subjects are excluded from the comparison of obese and nonobese women, there is no significant difference between the 2 groups. The dif-

ference in failure to report "hunger" between obese and nonobese groups is entirely due to the contribution of those women suffering from the night-eating syndrome.

### Discussion

#### Responses of the Nonobese Women

The responses of the nonobese women confirm in a decisive way the observation of Cannon and of Carlson that the experience of hunger occurs primarily during contractions of the empty stomach.<sup>1,2</sup> The nature of the experimental situation, furthermore, obviates some criticisms of the earlier work. This earlier work primarily investigated the ability of subjects to recognize the "pangs" associated with individual gastric contractions. In the classical situation the subject signalled his awareness of such pangs by pressing a key, and excellent correlation was established between key presses and individual gastric contractions. Such virtuosity in the recognition of visceral sensations may, however, be quite different from reporting "hunger" during a prolonged period of gastric motility, particularly when reporting during the gastric quiescence between 2 contractions. The current study, then, with its questions at 15-minute intervals, measured a different response from the earlier ones, and a response which may be more relevant to the problem of hunger. It further clarifies the nature of the association of gastric motility and the experience of hunger. A casual reading of Cannon and of Carlson may leave the impression that gastric motility is a constant correlate of the hunger experience. Carlson, indeed, maintained that gastric contractions determined not only the experience of hunger, but even the regulation of food intake. The current study makes it clear that among the control subjects gastric motility and reports of "hunger" were associated in a statistical and not in an absolute sense. No subject's responses were wholly within the motility—"hunger" and no-motility—no—"hunger" boxes.

Many of the early studies utilized trained

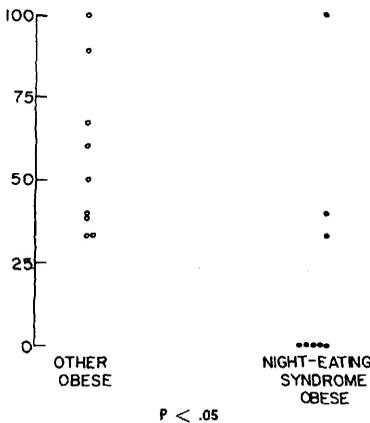


Fig. 7. Only obese subjects are included in this illustration of reports of "hunger." Obese persons manifesting the night-eating syndrome show denial of hunger to a far higher degree than other obese subjects.

volunteers which raised the problem that the effects of learning may have influenced their association of gastric motility and reports of hunger pangs. The subjects of the current study, however, had never previously been intubated and were largely unaware of the purpose of the study. Their ready association of "hunger" with gastric motility thus increases our confidence that this phenomenon is independent of laboratory conditioning.

#### The Denial of Hunger

The statistically highly significant correlation of gastric motility and reports of "hunger" by the control subjects renders more striking the failure to report "hunger" by the obese women. What is the nature of this phenomenon?

For convenience, the failure to report "hunger" in the presence of gastric motility will be designated as "denial of hunger." This term evades the question of whether the failure to report hunger is due to a lack of awareness of the hunger experience, or whether it simply results from a disinclination to report it.

If the denial of hunger is due to a lack of awareness of the experience, at least 2 mechanisms might achieve this. The women might correctly perceive sensations of abdominal emptiness, and might recognize their desire to eat, but still be unable to code these experiences as hunger. On the other hand their denial might be so profound as to extend to these raw materials of the hunger experience. This latter appears to be the case. The denial of hunger was evidently not a result of a failure to interpret correctly perceived sensations and impulses. It arose rather from a denial of those very sensations and impulses.

#### Origins of the Denial of Hunger

What are the origins of the denial of hunger? Is it simply a cause of obesity, or a consequence? The evidence argues against any such simple causal relationship. Such denial may not be present in obese persons and may be found in others with no his-

tory of obesity. The association between obesity and the denial of hunger is, however, frequent enough to suggest some meaningful relationship. For example, if denial of hunger were responsible for the obesity of only some persons, or were one factor among others in the obesity of many persons, the demands of the evidence would be satisfied. This hypothesis cannot be validated with the data at hand, and such validation might well require predictive studies before the onset of obesity. It remains, however, an intriguing possibility and will be considered at greater length below.

The possibility that denial of hunger may result from obesity, and particularly from the concomitant social pressures, is also intriguing and perhaps easier to study. The sequence seems a reasonable one. The act of eating must become increasingly conflict-ridden for the obese woman as she continues in her efforts to control her food intake. And as the social pressures mount for weight reduction, what would be more reasonable than a denial of the signals that herald the approach of the repetitive conflict over eating?

A means of determining whether social pressures influence denial of hunger would be the study of persons in a culture that placed a positive valuation on obesity and in which obese persons might be free of the pressures so prominent in our society. While we were considering this possibility we began a psychological study of a group of obese men. Their obesity, it appears, places them under less social pressure than is the case with women. We therefore decided to test their hunger responses during periods of gastric motility. The first results of this study are in accord with the hypothesis—none of the obese men to date have indicated denial of hunger.

There is evidence, then, that denial of hunger is related to the social pressures upon obese persons. The close association between the night-eating syndrome and denial of hunger suggests that it is also related to neurosis and emotional stress.

Neither factor, however, is a sufficient cause of the denial. For many obese women, subject to social pressures, fail to show denial of hunger. And men for whom independent psychological ratings showed severe conflicts over eating likewise failed to show denial of hunger.

How may these findings be reconciled? The most parsimonious hypothesis may well require 2 factors. *Denial of hunger may occur only in persons who are (1) subject to a conflict over eating and who are (2) experiencing intense social pressures about their eating.*

Evidence supporting this hypothesis has come from an unexpected quarter. Two women, subject to intense conflicts as well as great social pressures in regard to their eating have, in accord with the hypothesis, shown denial of hunger in the presence of gastric motility. These women, however, are not obese. Instead, they are suffering from anorexia nervosa, and the social pressures are towards increase of food intake!

#### Denial of Hunger and the Regulation of Food Intake

The regulation of food intake is accomplished by adjustments of current food intake to prior food intake, as well as to changing levels of energy expenditure. These adjustments seem to occur largely outside awareness, and in response to subtle cues, to which most people respond with remarkable sensitivity. If, however, a person is unable to appreciate these cues, as appears to be the case with many obese women, then regulation of food intake may no longer be possible on an automatic, unconscious, basis. Instead of being a casual satisfying of biological desires, eating becomes a matter of conscious and often desperate choice at meal after meal. Such is the testimony of many obese persons,—it has been years since they were able to trust their senses as to how much to eat. Every meal requires careful and often conflict-ridden decisions regarding previous caloric intake, previous caloric output, and current caloric alternatives. Such book-learning compares

unfavorably in precision of regulation with the wisdom of the body. And when conscious control of food intake supersedes automatic regulation, it appears extraordinarily difficult to return to automatic regulation.

#### Summary

The relationship of gastric motility to the experience of hunger has been investigated. In accord with traditional views a group of nonobese women usually reported hunger during contractions of the empty stomach, and no hunger in the absence of such contractions. A group of obese women, on the other hand, usually failed to report hunger during the presence of stomach contractions. This denial of hunger extended to a denial of sensations of epigastric emptiness and of the desire to eat,—fundamental characteristics of the hunger experience among nonobese women. That the denial of hunger was due to a specific difficulty in discrimination in the presence of gastric motility is suggested by the observation that there was no difference between obese and nonobese women in the distribution of hunger reports in the absence of gastric motility.

Obese subjects manifesting the "night-eating syndrome" showed a significantly higher incidence of denials of hunger than did obese persons not manifesting this syndrome.

The suggestion is made that denial of hunger occurs in persons with a conflict over eating who are simultaneously subjected to strong social pressures in this regard. Its function, according to this hypothesis, would be to exclude from awareness any stimuli that signal an approaching caloric deficit with its concomitant conflict over eating.

#### References

1. CANNON, W. B. and WASHBURN, A. L. An explanation of hunger. *Am. J. Physiol.* 29:441, 1912.
2. CARLSON, A. J. *The Control of Hunger in Health and Disease.* Chicago, Univ. Chicago Press, 1916.
3. CODE, C. F., HIGHTOWER, W. C., JR. and MORLOCK,

- C. G. Motility of the alimentary canal in man; review of recent studies. *Am. J. Med.* 13:328, 1952.
4. KOCH, C. R. and STUNKARD, A. J. Obesity, age and the gastric "hunger" contractions. (In preparation.)
  5. *Metropolitan Life Insurance Company Statistical Bulletin.* 24:6, 1943.
  6. SIEGAL, S. *Nonparametric Statistics for the Behavioral Sciences.* New York, McGraw-Hill, 1956.
  7. STUNKARD, A. J., GRACE, W. J., and WOLFF, H. G. The night-eating syndrome: a pattern of food intake among certain obese patients. *Am. J. Med.* 19:78, 1955.