Comparison of Verbal and Pictorial Measures of Hunger During Fasting in Normal Weight and Obese Subjects

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Abstract
LOWE, MICHAEL R., MARK I. FRIEDMAN, RICK MATTES, DIANA KOPYT, AND CHRISTINE GAYDA. Comparison of verbal and pictorial measures of hunger during fasting in normal weight and obese subjects. *Obes Res.* 2000;8:566–574.

Objective: Friedman, Ulrich, and Mattes described a new pictorial instrument for assessing hunger wherein respondents outline areas on a drawing of a human figure to depict the location of their hunger sensations. The present study compared normal weight and obese individuals on the pictorial measure and on more traditional verbal hunger measures during a 22-hour fast.

Research Methods and Procedures: The pictorial measure, along with 13 verbal items assessing hunger and hunger-related symptoms, was administered to 29 normal weight college students and 46 overweight clinic patients four times during a 22-hour fast. Factor analyses of verbal hunger items produced Hunger, Somatic Symptoms, and Stomach Symptoms factors. The pictorial measure was divided into peripheral (arms, legs, head) and central (trunk) body areas.

Results: The increases in hunger during the fast were greater when measured using the pictorial as opposed to the verbal instrument. Correlations between and within the three verbal hunger measures and two pictorial measures were generally few in number and modest in size. The overall pattern of correlations suggested that the verbally based hunger measures more adequately reflected the experience of hunger in normal weight than in obese individuals. A significant interaction between weight status and assessment period was found for the pictorial measure, indicating that normal weight subjects experienced more bodily hunger than overweight subjects initially but experienced less hunger than obese subjects after a prolonged period of food deprivation.

Discussion: Although more testing is needed, these results suggest that the pictorial hunger assessment provides information about the experience of hunger that could complement information provided by traditional verbally based hunger measures.

Key words: obesity, hunger, measurement, food deprivation

Introduction

Hunger is a complex psychobiological experience (1). To improve understanding and treatment of disorders characterized by either over- or undereating, the accurate assessment of hunger is fundamental (1–3). The experience of hunger has both cognitive and physical components. Dictionary definitions of hunger refer to it both as a state of mind and as a state of the body. For example, the first definition of hunger in the *American Heritage Dictionary* (4) is "a strong desire to eat," whereas the second definition is "weakness, debilitation, or pain caused by a prolonged lack of food; starvation."

It has been suggested that individuals frequently fail to distinguish between the physical need for food and the desire to eat due to factors other than biological need (1,5–7). Thus, responses to verbal measures of hunger may reflect either or both of these conditions. For clinical and research purposes, then, it would be desirable to have a means for distinguishing the subjective desire to eat from the physical manifestations of hunger.

Friedman et al. (2) recently proposed that the physical aspects of hunger may be distinguishable from more global hunger assessments by using a pictorial measure of hunger sensations. In an initial study, subjects were asked to fast for 22 hours and to identify on four occa-

Submitted for publication October 27, 1999.
Accepted for publication in final form June 6, 2000.
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sions during this fast the location and extent of their bodily hunger sensations by outlining body areas on a drawing of a human figure (2). Participants were also asked to respond to four items assessing hunger and nine items assessing hunger symptoms (e.g., stomach growling, dizziness) each time the pictorial measure was completed. Findings indicated that although increased hunger over the 22-hour deprivation period was observed on both verbal and pictorial measures, little or no correlation was found between these two measures. It was concluded that pictorial measures added unique information to that provided by traditional verbal measures of hunger.

The purpose of the current study was 2-fold. First, because the study of Friedman et al. (2) included only 14 participants, further research involving this new pictorially based measure is needed. Thus, a major aim of the present research is to reexamine the verbal and pictorial hunger measures, both individually and in relation to one another, during a 22-hour fast in a larger sample of participants.

Second, given the long history of interest in comparing the hunger responses of overweight and normal weight individuals (8–10), the current study investigated potential differences between weight groups, using the new hunger measure. In large part, interest in differences between the hunger experience of overweight and normal weight persons developed after research in the late 1960s and early 1970s that suggested that the eating behavior of overweight individuals may be heavily influenced by external cues such as the taste, smell, and sight of food (11–14).

Schachter (9,10) proposed the internal-external hypothesis of obesity to explain these findings. This hypothesis stated that, in contrast to normal weight individuals, overweight individuals were relatively insensitive to internal hunger cues and oversensitive to external cues. Although weight-related differences predicted by the internal-external hypothesis were found in many studies, it is now clear that such differences were not simply a function of adiposity per se (15–17). Instead it seems that these differences may be more adequately explained by the theory of dietary restraint (15,18) that was developed from Nisbett's (8) work on obesity and body weight set point. Restraint theory suggests that, regardless of their weight, people who restrict their intake to stay below their natural body weight set point should show increased responsiveness to external cues and decreased responsiveness to internal cues of hunger when compared with individuals who are not restrained (7). Based on the assumption that the group of overweight individuals we studied would be more highly restrained than our normal weight participants (19), we predicted that the two weight groups would show differential hunger responses to the 22-hour fast. Specifically, overweight individuals were expected to be less responsive than normal weight individuals to the hunger manipulation (i.e., show smaller increases in hunger during the fast).

Research Methods and Procedures

Participants

A total of 46 (8 male, 38 female) obese and 29 (7 male, 22 female) normal weight university students participated in the study. All obese participants had a body mass index (BMI) of $\geq$27, and all normal weight participants had a BMI of $<$27 (20). The average BMI was 35.6 (SD = 5.7) in the obese group and 22.9 (SD = 2.2) in the normal weight group. Age ranged from 30 to 67 (mean = 47.9, SD = 9.9) in the obese group and from 19 to 46 (mean = 26.1, SD = 7.7) in the normal weight group. Obese participants were enrollees in a weight-loss program being conducted at MCP Hahnemann University. They took part in the current study before onset of the weight loss program. The group of normal weight participants consisted of the 14 subjects who took part in the original study by Friedman et al. (2) as well as an additional 15 student volunteers from MCP Hahnemann University. Procedures were approved by the Institutional Review Boards of the University of Pennsylvania and MCP Hahnemann University.

Measures

Hunger Questionnaire. The hunger questionnaire, described above and used by Friedman et al. (2) in their original study, consisted of the 13 verbal items measuring hunger and hunger symptoms as well as two (a male and a female) drawings of a human figure. The 13 verbal items consisted of 4 frequently used items assessing hunger level and 9 items describing symptoms of hunger and thirst previously identified by Friedman et al. (2) All items were rated on 9-point Likert-type scales. The four hunger items were 1) How hungry do you feel right now? (ranging from "not at all" to "as hungry as I have ever felt"); 2) How strong is your desire to eat right now? (ranging from "very weak" to "very strong"); 3) How much food do you think you could eat right now? (ranging from "nothing at all" to "a large amount"); and 4) How full does your stomach feel right now? (ranging from "not at all full" to "very full"). The nine symptoms were stomach growling, headache, thirst, nausea, weakness, dizziness, anxiety, stomach aches, and dry mouth.

Each participant received four questionnaires, enabling them to rate their hunger four times over the 22-hour food deprivation period. Scores for the pictorial measures were determined by the size and location of body areas outlined by participants at the four different assessment periods. Outlined areas were cut out by the experimenter and weighed to provide an estimate of hunger sensations. Areas from the center part of the figures (i.e. below the neck, excluding the arms and legs) were called Central Body. Areas removed from all remaining parts of the figures were termed Peripheral Body. The sum of these central and peripheral measures was called Total Body.

Restraint Scale. The Restraint Scale is a 10-item measure of chronic dieting that has been shown to predict differential eating patterns in restrained and unrestrained eaters (21). The Restraint Scale was not given to the 14 subjects from the previous study (2). The scale was given simply to confirm that the overweight subjects would be more restrained than the normal weight subjects.

Procedure

Similar to the procedures employed by Friedman et al. (2), participants were asked to fast for 22 hours beginning at 6:00 PM and ending at 4:00 PM the following day. (The exact length of the fast was arbitrary and was based on the design requirements of the original study by Friedman et al.) If participants' schedules did not allow them to eat dinner by 6:00 PM, they were instructed to begin their 22-hour fast and all subsequent measures 1 hour later. Participants were told to eat a normal dinner before beginning the fast. They were informed that they should not eat or drink anything but water throughout the fasting period. Participants were also asked to complete the hunger questionnaire at 10:00 PM, 8:00 AM, 12:00 PM, and 4:00 PM (or 1 hour later for those who began fasting at 7:00 PM). A manipulation check by the experimenters (involving having a subset of participants call into an answering machine when they made their ratings) revealed that participants' ratings were in fact conducted at or close to the designated assessment times.

To complete the pictorial measure, participants were instructed to indicate the location and extent of their bodily hunger sensations by outlining corresponding areas on the figure drawing appropriate to their gender (2). They were informed that the area they outlined should indicate the site(s) within which they experienced hunger sensations. In addition, they were told that the size of the area outlined should reflect the intensity of their hunger sensations.

Results

Data Reduction

SPSS software (version 6.1.4; SPSS, Inc., Chicago, IL) was employed for all statistical analyses and an α level of 0.05 was used for all statistical tests. Before the main analyses, a principal components analysis with varimax rotation was performed to consolidate verbal questionnaire items into a reduced number of dimensions. Because the first four questionnaire items addressed global hunger and have been used together repeatedly in previous research (1,2), they were analyzed separately from the other nine questionnaire items that addressed specific hunger symptoms and were relatively novel. Using Kaiser's (22) criterion of eigenvalues $\geq$1 as well as the requirement that factors include only items with loadings of $\geq$0.50, all four global hunger items were found to load on one factor. The eigenvalue of this factor was 2.5, and the smallest factor loading was 0.57. This factor was termed Verbal Hunger. The verbal hunger factor accounted for 62.4% of the variance in these items.

The second principle components analysis, which was based on the remaining questionnaire items, employed the same criteria to identify factors. In addition, it was required that at least two items load on each factor. Analysis yielded a three-factor solution. The factor accounting for the greatest amount of variance (38.2%) in these items was labeled Somatic Symptoms and was composed of items assessing dizziness, headache, and weakness. A second factor termed Thirst accounted for 15.7% of the variance and included items assessing thirst and dry mouth. (This factor was not included in subsequent analyses because 1) the current focus is on hunger rather than thirst, and 2) subjects were allowed to drink water during the deprivation period, which rendered the thirst ratings less meaningful.) The final factor, labeled Stomach Symptoms, accounted for an additional 13.5% of the variance. This Stomach Symptoms factor included measures of stomach growling, nausea, and stomach aches. The Somatic, Thirst, and Stomach factors together accounted for 67.4% of the variance in hunger symptom items. Factor scores for each factor were calculated by summing the items loading on that factor. Hereafter, all references to "verbal measures" refer to these factor scores.

Factor analyses were based on participants' first set of hunger ratings, because these took place at a level of deprivation (4 hours after the last meal) closest to that experienced by most people on a daily basis. (Factor analyses performed on the other three time periods also produced three factors similar to those reported above, with the only major difference being the amount of variance each factor accounted for.)

Main Analyses

Because the normal weight subjects were drawn from two different university populations, analyses were conducted to see whether the two normal weight groups differed. No significant differences were found with regard to age, BMI, Somatic Symptoms, Stomach Symptoms, or on the Central Body or Total Body measures. Subjects from the original study by Friedman et al. (2) reported less hunger on the Hunger factor ($F(1,27) = 5.59$, $p < 0.05$) and identified a larger Peripheral Body area associated with hunger sensations ($F(1,27) = 4.25$, $p < 0.05$) than did MCP Hahnemann subjects. Because these findings reflected less hunger in the Friedman et al. participants and greater hunger in the MCP Hahnemann participants, they do not seem to represent a systematic difference in hunger between the two samples. Nonetheless, the results reported below involving normal weight/obese comparisons on these two measures must be interpreted cautiously because the two normal weight groups themselves differed on them.

Also, we analyzed subjects' Restraint scores to confirm that the overweight subjects not only had higher relative weights but were also more restrained than the normal weight subjects. The overweight subjects scored higher on restraint than normal weight subjects, with means of 19.9 and 9.9, respectively, $t(60) = 7.22$, $p < 0.001$). The two weight groups differed significantly on both the dietary concern and weight fluctuation subscales that have been identified in past factor analytic studies of the Restraint Scale (17).

Correlational analyses were performed to examine the relationships both within and across the three verbally based factors and the three pictorial measures. These correlations, which are shown in Tables 1 through 4, were examined at each of the four levels of deprivation in normal weight and overweight subjects separately. Because of the large number of correlations generated, patterns of correlations rather than single correlations will be reviewed here. Relationships among the verbal and pictorial measures will be considered first, followed by relationships between these two types of measures.

As can be seen in the tables, only about half of the correlations among the three verbal hunger measures were significant, and even these were generally modest in size. The magnitude of the correlations between the three verbal measures was generally greater for the normal weight than for the overweight subjects (across the 12 correlations for each weight group, the average correlation (calculated by first converting correlations to z-scores) was 0.42 for normal weight subjects and 0.26 for overweight subjects). Thus it seems that hunger (as measured by the verbal hunger factor) and hunger-related symptoms (as measured by the Verbal Somatic and Verbal Stomach factors) are relatively more independent in overweight than in normal weight subjects.

For the pictorial measures, none of the eight correlations between the Central and Peripheral measures was significant, indicating that the two measures change independently at all levels of deprivation for both groups of subjects. That is, whereas both pictorial measures increased in size as deprivation increased, the extent of pictorially based hunger experienced in central and peripheral regions was unrelated in both normal weight and overweight subjects at each of the four assessment periods.

An examination of the correlations between both the Central Body and Peripheral Body measures with Total Body revealed an interesting pattern. (Correlating these two scores with Total Body scores is of course a confounded comparison because the two subscores comprise the total score. However our purpose in doing this was only to compare these relationships in normal weight and overweight subjects, thereby eliminating concern about the confound.) Not surprisingly, because the Central Body measure comprised most of the Total Body measure, the two were highly correlated in both groups at all time points. However, the Peripheral Body measure was strongly related to the Total Body measure among obese subjects at all four time periods, but was related to Total Body measure among normal weight subjects only during the last two measurement periods. The difference in correlations during the first two assessment periods was striking: For obese subjects, the Peripheral/Total correlations were 0.74 and 0.81, whereas for the normal weight subjects, the same correlations were 0.28 and 0.04.

To understand why this occurred, we examined the means and SDs for these measures during the first two measurement periods. The mean Central Body area scores for normal subjects were much higher than their mean Peripheral Body scores (the ratio of the Central Body means to the Peripheral Body means was 2.88 for period 1 and 19.0 for period 2). The mean Central Body scores of the obese subjects were also higher than their mean Peripheral Body scores, but by a much smaller margin (with the comparable ratios being 1.19 and 1.78 for periods 1 and 2, respectively). Thus the peripheral areas comprised a much greater proportion of the total body area associated with hunger sensations in obese subjects compared with normal weight subjects during these two periods. At the same time, the level of variability in the central relative to the peripheral measures was much greater in normal weight subjects compared with obese subjects: For normal subjects, the ratio of the SD of the central to the peripheral measure was 2.41 (for period 1) and 6.62 (for period 2); the comparable figures for obese subjects were 0.97 and 0.70. Thus variability in the peripheral measure contributed proportionately more to variability in the Total Body area in obese subjects than it did in normal weight subjects. Taken together, these findings for the first two assessment periods indicate that, for obese subjects relative to normal weight subjects, the Peripheral Body area represented a larger proportion of the Total Body area associated with hunger and also contributed much more to the variability in Total Body area. This pattern explains why correlations between Peripheral and Total Body areas during the 10-PM and 8-AM assessments were so much higher for the obese subjects.

Also of interest were the correlations between the three verbal hunger measures and the two components of the pictorial measure (i.e., Central Body and Peripheral Body). Three patterns were evident. First, of 48 correlations (3 verbal $\times$ 2 silhouette $\times$ 4 time periods for both normal and obese subjects), only 12 were significant, and most of these were modest in size (0.3 to 0.6). Thus there is a considerable degree of nonredundant information being conveyed by the verbal and pictorial measures. Second, focusing on the verbal and pictorial measures that seem to best assess hunger as conventionally defined (i.e., the verbal hunger factor and the Central Body measure, which focuses on the abdominal area), three of the four correlations between verbal hunger and Central Body were significant for both normal weight and overweight subjects. However, even here the correlations were quite modest in size, which supports the widely held view that verbal hunger ratings reflect more

Table 1. Intercorrelations of verbal and pictorial measures for normal weight subjects (above the diagonal) and obese subjects (below the diagonal) for the first (10 PM) measurement

	1	2	3	4	5	6
Verbal Hunger	—	0.15	0.38*	0.18	0.31	0.30
Verbal Somatic	0.22	—	0.56**	−0.04	−0.06	−0.06
Verbal Stomach	0.22	0.16	—	0.00	0.15	0.06
Central Body	0.59**	−0.02	0.03	—	−0.13	0.92**
Peripheral Body	0.35*	0.01	−0.08	0.06	—	0.28
Total Body	0.64**	−0.01	−0.04	0.72**	0.74**	—

* $p \leq 0.05$; ** $p \leq 0.01$.

than physical sensations of deprivation. Third, excluding the verbal hunger measure, there were six other significant correlations between verbal and pictorial measures for obese subjects, but none for normal weight subjects.

We also examined the extent to which each of the hunger and hunger symptom measures changed from the start to the end of the 22-hour deprivation period. This was done by dividing the difference between the score for the first and last observations by the first observation value (to adjust for the differences in the units of measurement for the various measures). The increases in the three verbal measures were similar, with the increase in the final scores being two to

Table 2. Intercorrelations of verbal and pictorial measures for normal weight subjects (above the diagonal) and obese subjects (below the diagonal) for the second (8 AM) measurement

	1	2	3	4	5	6
Verbal Hunger	—	0.29	0.48**	0.63**	−0.19	0.61**
Verbal Somatic	0.16	—	0.78**	−0.01	−0.09	−0.02
Verbal Stomach	0.39*	0.01	—	0.01	−0.12	0.00
Central Body	0.44**	0.15	0.51**	—	−0.11	0.99**
Peripheral Body	0.19	−0.02	−0.05	−0.07	—	0.04
Total Body	0.43**	0.08	0.26	0.54**	0.81**	—

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

Table 3. Intercorrelations of verbal and pictorial measures for normal weight subjects (above the diagonal) and obese subjects (below the diagonal) for the third (12 PM) measurement

	1	2	3	4	5	6
Verbal Hunger	—	0.31	0.36	0.48**	0.03	0.40
Verbal Somatic	0.41**	—	0.32	0.09	−0.05	0.05
Verbal Stomach	0.25	0.40**	—	−0.01	−0.25	−0.11
Central Body	0.47**	0.48*	0.55*	—	0.24	0.91**
Peripheral Body	0.04	0.33*	0.04	0.08	—	0.63**
Total Body	0.38**	0.56**	0.46**	0.82**	0.63**	—

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

Table 4. Intercorrelations of verbal and pictorial measures for normal weight subjects (above the diagonal) and obese subjects (below the diagonal) for the third (4 PM) measurement

	1	2	3	4	5	6
Verbal Hunger	—	0.47*	0.46*	0.39*	0.04	0.33
Verbal Somatic	0.31*	—	0.57**	0.28	0.21	0.34
Verbal Stomach	0.23	0.32*	—	0.12	−0.17	0.04
Central Body	0.27	0.21	0.39**	—	0.09	0.85**
Peripheral Body	0.29	0.16	0.06	−0.06	—	0.61**
Total Body	0.40**	0.27	0.36*	0.77**	0.59**	—

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

three times the initial scores. The size of the increase (or dynamic range) of the pictorial measures was greater. The Peripheral Body measure increased 3-fold, and both the Central Body and Total Body measures increased >10-fold. The smaller increases shown with the verbal measures do not represent a ceiling effect, because the highest scores were still well below the maximum possible scores.

Comparison of Weight Groups Over Time

We conducted three mixed-model (2×4) ANOVAs comparing the two weight groups (obese and normal weight) on various hunger indices at the four different assessment periods. The dependent variables in these analyses were Verbal Hunger, Somatic Symptoms, and Stomach Symptoms. In addition, a mixed-model ANOVA (involving the between-group factor of weight status and the within-group measures of the four time periods and the two body area measures) was performed on the pictorial measure. Because no significant main or interactional effects were found for gender on any of the verbal or pictorial measures, data from the two sexes were combined in all analyses.

A significant main effect was found for time on all dependent measures ($p < 0.001$), which reflected steadily increasing scores across the four time periods. In contrast, no significant main effects were found for the weight groups on any of the dependent measures (Figures 1-6). A significant group by time interaction (i.e., collapsing across type of pictorial measure) was found for the 2×2×4 analysis assessing responses to the pictorial measure, $F(3,219) = 2.58$, $p = 0.05$. This interaction is illustrated in Figure 6, which depicts the results for Total Body (i.e., the sum of Central and Peripheral areas). (Standardized scores were calculated for the Total, Central, and Peripheral areas so the ordinate on each figure would be in comparable units.) As illustrated in Figure 6, normal weight participants initially indicated greater pictorially depicted hunger than obese participants, a trend that subsequently reversed. However, follow-up tests of simple effects revealed no significant differences between obese and normal weight participants at any of the four rating times (p values > 0.05). Results for Central Body and Peripheral Body (Figures 4 and 5) are also shown for illustrative purposes. These findings suggest that response patterns on both measures contributed to the interaction found on the Total Body measure.

Results from the 2×2×4 analysis also yielded a significant interaction between silhouette type and time ($F(3,219) = 13.09$, $p < 0.001$). Examination of Figures 4 and 5 suggests that, collapsing across weight groups, this interaction was primarily due to an overall increase in the Central Body measure from time 1 to time 2 along with a decrease in the Peripheral Body measure during the same period.

The only findings that changed when age was used as a covariate were the emergence of significant main effects for groups in analyses involving Central Body and Somatic Symptoms measures. These age-adjusted analyses indicated

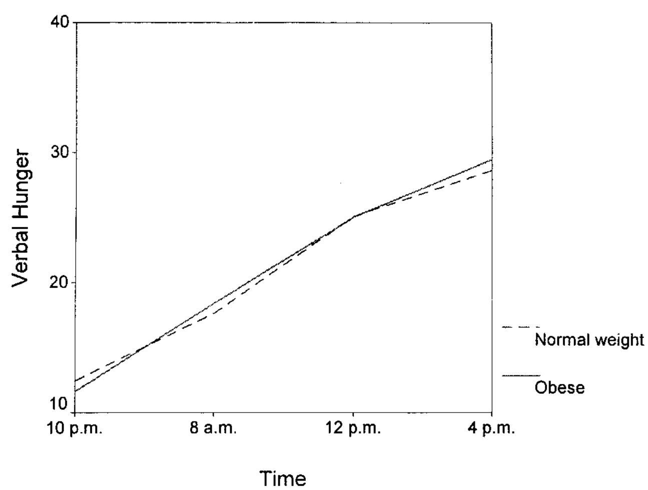

Figure 1. Comparison of normal weight and obese subjects at the four measurement periods: Verbal measurement of Hunger. The ordinate reflects factor scores.

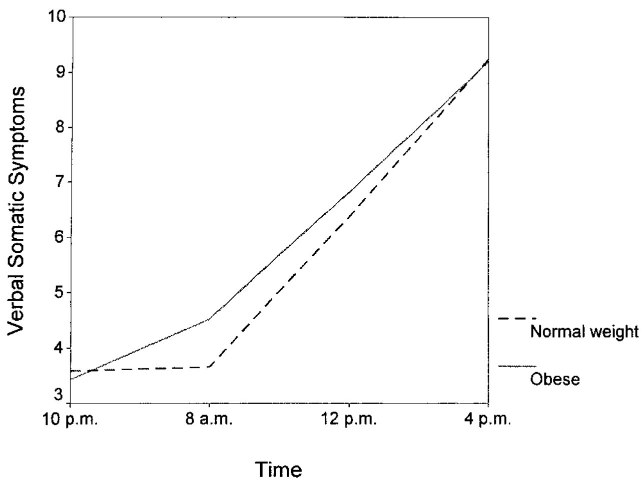

Figure 2. Comparison of normal weight and obese subjects at the four measurement periods: Verbal measurement of Somatic Symptoms. The ordinate reflects factor scores.

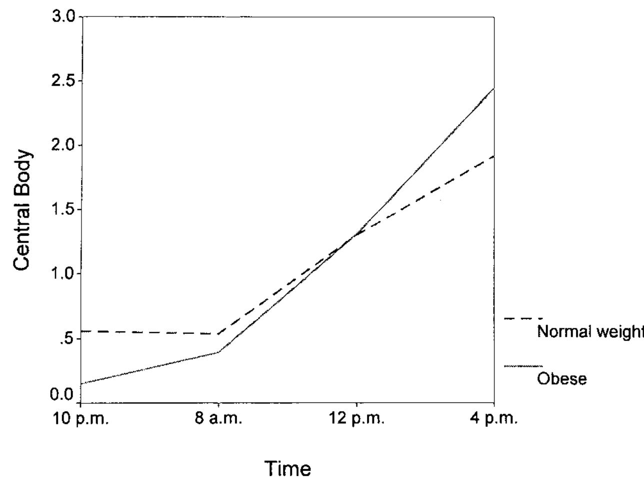

Figure 4. Comparison of normal weight and obese subjects at the four measurement periods: Pictorial measurement of Central Body. The ordinate reflects standardized scores based on the weights of the circled body areas.

that obese participants exhibited greater hunger on the silhouette-based measure as well as more intense somatic symptoms.

Discussion

The first objective of this study was to supplement the initial data provided by Friedman et al. (2) for their recently described pictorial measure of hunger. In this regard, the present study added more data on normal weight subjects and also included a large group of obese subjects for comparison. The current study compared the pictorial measure not only with the hunger-related items (as Friedman et al. (2) had done), but also with two factorially derived measures of hunger-related symptoms (Somatic and Stomach Symptoms) identified previously by Friedman et al. (2).

Both verbal and pictorial measures of hunger increased during the 22-hour fast in both normal weight and obese subjects. With one exception, all hunger measures increased across the four time periods. The exception was for Peripheral Body area, which declined between 10 PM and 8 AM. Thus nearly all indices of hunger changed in the appropriate direction in response to fasting, thereby supporting the validity of these instruments as measures of one aspect of the hunger experience.

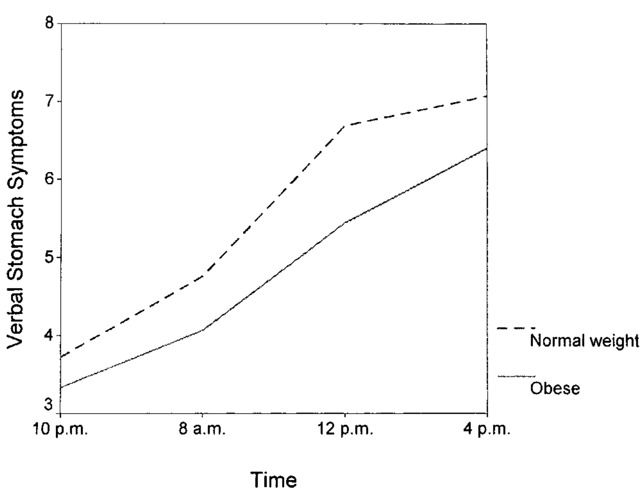

Figure 3. Comparison of normal weight and obese subjects at the four measurement periods: Verbal measurement of Stomach Symptoms. The ordinate reflects factor scores.

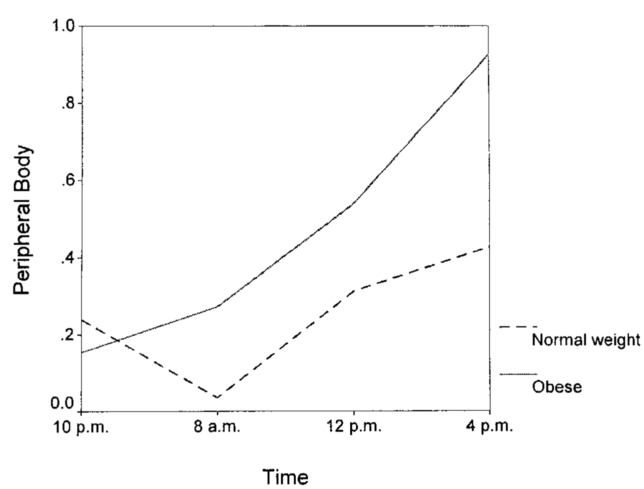

Figure 5. Comparison of normal weight and obese subjects at the four measurement periods: Pictorial measurement of Peripheral Body. The ordinate reflects standardized scores based on the weights of the circled body areas.

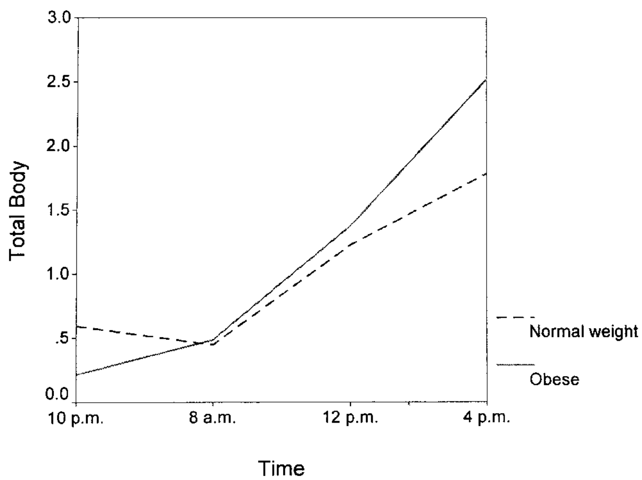

Figure 6. Comparison of normal weight and obese subjects at the four measurement periods: Pictorial measurement of Total Body. The ordinate reflects standardized scores based on the weights of the circled body areas.

There were two notable findings regarding the novel pictorial measure. First, there were no correlations between the Peripheral and Central Body area measures in either normal weight or obese subjects at any time point. Although both measures increased with increasing deprivation, the two measures were consistently unrelated. A priority for research on this new instrument is to determine whether one or both of these measures are associated with other hunger-related responses. Given the independence of the two measures, we recommend that the central and peripheral measures be assessed and examined separately in future studies using the pictorial instrument.

Second, the pictorial measures, and the Central Body measure in particular, increased from the beginning to the end of the 22-hour deprivation period more than the verbal hunger measures. Furthermore, across all subjects, the verbal measures showed some increase from the first to the second observation period (i.e., overnight), whereas the pictorial measure remained essentially unchanged. This means that most of the differential changes in the pictorial measures occurred during the third and fourth time periods, when deprivation was particularly intense. One interpretation of these results is that the pictorial measure is more sensitive to extreme than to mild hunger, whereas the reverse is true for verbal measures. It is possible that the timing of the data collection (late in the evening and early in the morning) influenced this pattern of results; additional research that begins the deprivation period at different times of the day would resolve this question.

Three findings suggested that the experience of hunger may have been somewhat different for normal weight and obese subjects. First, the number and magnitude of correlations between the three verbally based hunger measures was greater in normal weight than in overweight subjects. Second, during the first two assessment periods, the Peripheral Body area measure contributed more to the level of, and variability in, Total Body area in obese than in normal weight subjects. This finding indicates that, when moderately hungry, obese individuals are much more likely than those of normal weight to experience a significant proportion of their bodily hunger in peripheral areas. It also suggests that there is much more variability among obese individuals in their experience of peripheral hunger than there is in normal individuals. Third, although similar correlational patterns were found between the Hunger factor and Central Body measure for both weight groups, hunger symptom measures correlated more often with the verbal and pictorial measures in obese compared with normal weight subjects.

In addition to suggesting a difference in the experience of hunger between lean and obese individuals, these findings are characterized by a common theme: namely, that the experience of hunger is tied more closely to physical sensations in obese individuals than in normal weight individuals. In contrast, verbally based hunger measures seem to more adequately reflect the experience of hunger in normal weight individuals compared with obese individuals. This pattern of findings seems to be inconsistent with Schachter's (9,10) "internal-external" theory of obesity and with restraint theory (7), because these theories predict that obese/restrained individuals should be less rather than more sensitive to internal hunger sensations than normal weight/unrestrained individuals. However, the findings are consistent with clinical reports of obese individuals who often claim they are "always" hungry or thinking about food.

No weight group or interactional effect was found on the three verbal hunger factors. Indeed, Figures 1 through 3 indicate that the hunger responses and symptoms of the two weight groups were similar, both initially and in response to increasing deprivation. These results also do not support previous suggestions that overweight individuals are underresponsive to internal hunger signals. The fact that the present study repeatedly measured hunger responses during 22 hours of food deprivation should have increased the probability that normal/obese differences in hunger responsiveness or symptoms, if they exist, would be observed.

According to the Total Body measure of hunger, obese individuals were somewhat less hungry than were normal weight subjects early in the fast, but more hungry toward the end of the food-deprivation period. This result was reflected in the significant interaction between weight status and time for the Total Body measure of hunger. The fact that the verbal measures of hunger did not show such a difference with time speaks to the discriminant validity of the pictorial instrument. However, both the statistical interaction and this conclusion should be interpreted with caution because it is the only significant effect to emerge from the several ANOVAs performed. If a Bonferroni correction were applied based on the expected experimentwise error rate, the interaction would no longer be significant. Clearly, it will be necessary to replicate this result before firm conclusions can be drawn.

Several limitations of the present study suggest directions for future research. First, it is possible that the timing and/or size of the subjects' meals before the fast may have influenced the results; that is, obese and normal weight subjects may have eaten different amounts of food in anticipation of the 22-hour fast. Standardization of food intake before fasting and collection of hunger ratings after the standard meal are recommended for future research using the instrument described here. Second, as in the earlier study by Friedman et al. (2), it is not clear whether the responses on the pictorial instrument reflected *where* hunger was experienced, the *intensity* of hunger sensations, or both. Future research should assess these two dimensions separately. Third, the figure drawing used in this study represents a normal weight body; this may not have been the most appropriate way of assessing bodily hunger sensations in obese individuals. Studies using figure drawings that reflect actual or perceived body dimensions might produce different results. Fourth, the normal weight sample was drawn from two different universities and the two normal weight subgroups differed on two of the variables studied. It would be desirable in future studies to draw all subjects in a particular group from a single source. Finally, a critical goal for future research is determining whether the pictorial hunger measure is able to account for variance in appetitive responses (e.g., salivary output, food cravings) above and beyond that captured by traditional verbal measures of hunger.

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