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Gut-Cued Eating for Weight Loss: A Preliminary Proof-of-Concept Study

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Abstract

Background: Despite numerous weight-loss programs (WLPs), obesity rates continue escalating. For many, WLPs are unsustainable due to their high time, dietary, and financial demands. Stomach sensation awareness is included in some WLPs but has not been evaluated in isolation.

Aim: To test the effect of a simple stomach/hunger-cued intervention, "Gut-Cued Eating" (GCE), on body weight.

Methods: N=31 adults with a BMI>26.9 watched a video explaining differences between mouth- and stomach-hunger and were asked to eat only when stomach-hungry and stop eating before overly full for eight weeks. Standardized and original questionnaires were administered.

Results: Weight decreased by 2.4 lb (range -4.0 to 11.6 lb; p=0.003). Greater median-split weight-loss participants lost a mean 5.5 lb; lower ones neither lost nor gained. Higher perceived stress and lower mindfulness predicted more weight loss. While no foods were banned, snack and sugary drink intake decreased.

Conclusion: Results provide proof-of-concept for GCE to reduce weight, meriting placebo-controlled investigations.

Keywords: Obesity Treatment; Hedonic Hunger; Mindful Eating; Intuitive Eating; Hunger-Satiety Awareness; Intervention; Non-Homeostatic Eating

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Introduction

Obesity continues to be a leading cause of morbidity despite the existence of numerous weight-loss programs [1]. For many, these programs are unsustainable because they are too time-demanding, require radical departures from one's customary diet, promote dependence *vs.* self-efficacy, and/or are too expensive [2-4]. Therefore, the aim of this study was to determine if a very simple intervention dubbed "Gut-Cued Eating" (GCE) produced weight loss. GCE allowed participants to eat whatever, whenever, and as much as they wished, so long as they followed two instructions, to eat only when hungry and stop eating before feeling completely full. GCE is like other hunger/satiety-guided approaches which have resulted in weight loss [5-12]. However, in these approaches, attention to stomach cues comprised only one part of a more complex program that included cognitive-behavioral or family-based strategies, exercise, diet modification, food logging, workbooks, group sessions, counseling, and other skills training. In contrast, GCE used hunger/satiety awareness alone as a weight-loss method. We hypothesized that:

- Participants would lose weight after GCE;
- Level of hunger before eating would be greater and level of fullness when eating stopped would be less; and
- Eating patterns would shift to more regular meals and fewer snacks, sweet drinks, and desserts.

Methods and Materials

Participants

Adults were recruited from Introduction to Psychology courses and flyers at The University of Alabama at Birmingham (UAB). Exclusion criteria included: BMI<26.9, pregnancy, breastfeeding, enrollment in a commercial weight-loss program, untreated diabetes and hypertension, history of bipolar, eating disorder, depression with suicidal ideation, illegal recreational drug use, and intent to start/stop medication that influenced appetite. The final sample of N=31 included 22 females/9 males: 51% White, 39% Black, and 10% "Other" (Hispanic, Middle Eastern, and Native American) with a mean age of 25, SD=11.05 and mean BMI of 34.9, SD=9.06. This study was approved by the UAB Institutional Review Board for Human Use.

Study Visits and Timeline

Participants made four lab visits (V1-V4) over eight weeks. On V1, they were measured for a BMI, completed demographic, psychological, and two original questionnaires, and underwent a GCE tutorial. V2 occurred two weeks later and V3 three weeks after V2. At these visits,

participants were weighed and underwent a progress interview. V4 occurred three weeks after V3. Participants were weighed, completed the original questionnaires again, had a last progress interview, and were debriefed.

Body Weight Measures

Height and weight were measured without shoes and outerwear on a calibrated stadiometer and scale. Assistants told participants their weight void of emotion and with no further comment. BMI was derived as kg/m^2.

Questionnaires

Demographic and psychological questionnaires: Age, gender, and ethnicity were collected electronically as were responses to four psychological questionnaires:

- Perceived Stress Scale: The PSS measures how often one has experienced events as stressful over the past month;
- Mindful Awareness Attention Scale: The MAAS assesses how often one's mind stays focused on the present *vs.* perseverates on past and future events and frequency of awareness regarding one's state and surroundings;
- Dutch-Eating Behavior Questionnaire–Restraint: The DEBQ-R measures preoccupation with dieting and actual dieting behavior to lose weight;
- Barratt Impulsiveness Scale 11: The BIS-11 yields a measure of attentional, motor, and non-planning impulsiveness. On these measures, higher scores indicate greater levels of behavior.

Original Questionnaires

Two questionnaires were developed for this study:

- Stomach Sensation Scale: The SSS measured change in levels of hunger and fullness in nine settings. See Figure 1. Participants used this 1-8 scale to rate sensations in their stomach on most days to nine occasions:
  - When I woke up;
  - Just before I started to eat a meal;
  - When I finished eating a meal;
  - Just before I started to eat a snack;
  - When I finished eating a snack;
  - Just before I started to eat a dessert;
  - When I finished eating a dessert;
  - When I went to bed; and
  - When I was alone and could eat as much as I wanted.

N/A was an available choice if they did not normally eat a meal, snack, or dessert. Each item was scored 1-8 and the mean rating on each of the nine items was used in analyses.

- Daily Eating Patterns Survey: The DEPS measured number of meals, snacks, desserts, meal-replacement drinks, and sugary drinks consumed "on most days." Responses were 0 - "5 or more." The mean rating on each of the five food types was used in analyses.

Gut-Cued Eating (GCE) Intervention

On V1, participants were shown a four-minute video that used photos and text to explain the difference between eating for "stomach hunger" (eating triggered by physical hunger sensations in the stomach) *vs.* "mouth hunger" (eating triggered by anything other than stomach hunger such as feelings, family or friends, mere presence of food, or a craving). It then pointed out that healthy-weight individuals do not diet or give up favorite foods but are able to maintain their weight in part because stomach sensations play a larger role in determining when they start and stop eating [13-15]. The video then presented the two essential GCE instructions: "Start to eat only when you are stomach hungry" and "Stop eating when you are satisfied, but before you feel completely full." The instructions were followed by an illustration of the Hunger Meter [5]. A cursor pointed to both the healthy level of hunger and satiety and to the brief description of stomach sensations corresponding to each. The meter was used solely to help participants identify sensations associated with when they should start and stop eating as per the two instructions and to dissuade participants from becoming too hungry before eating. An assistant then verbally quizzed participants on the two GCE instructions and asked them to follow the Instructions every time they ate anything for the remainder of the study. The only additional verbal information provided was related to the known lack of satiety compensation on subsequent meals when liquid *vs.* solid food calories are consumed [16]. This was relayed to the participants by explaining to them that caloric drinks such as sweet tea, soda, alcohol, and fruit juice can "trick the stomach" by making it feel less full at the next meal compared to if they *ate* the same number of calories that were in the drinks. So, drinking *vs.* eating calories could make them end up eating more before they felt satisfied. Still, no drinks were banned. After the video and fielding any questions, the assistant gave participants a hardcopy of the two GCE instructions and Hunger Meter. On V2-V4, a semi-structured progress interview assessed any problems identifying when to start and stop eating and asked participants to describe times when it was difficult to follow the two GCE instructions. A list of potential triggering sources was included to encourage detailed recollection and candidness. The assistant reflected the information back, asked how they would handle the same or similar situation going forward, and ensured that the strategies adhered to letting stomach sensations dictate when to start and stop eating, e.g., a response of "I won't eat that anymore" was countered with "You can, just wait until you are stomach hungry to eat it".

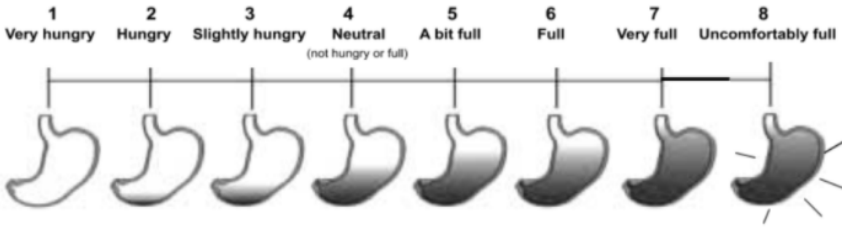

Figure 1: Stomach Sensation Scale (SSS) Ratings.

Statistical Analyses

Change in body weight, BMI, and scores on the SSS and DEPS were tested for normality and analyzed with repeated-measures ANOVAs using Bonferroni pairwise comparisons. One-tailed Pearson's r tested associations between difference scores for body weight, SSS, and DEPS scores. Linear regressions tested demographics, baseline body weight, and questionnaires scores as predictors of amount of weight loss. For descriptive purposes only, subgroups were created based on the median split total amount of body weight lost. Data are reported as means and SD=standard deviations with alpha = 0.05 for significance.

Results

Change in body weight after GCE

Mean weight decreased from 212.30, SD=58.25 at V1 to 209.93, SD=56.45 lb at V4 (p=0.003). As shown in the Figure 2 solid line, participants lost a mean 2.37 lb between V1 and V4 (range -4.0 to 11.6 lb). Weight did not change from V1 to V2 but did from V1 to V3 (p=0.010) and V1 to V4 (p=0.019). Hatched lines in Figure 2 revealed that the Greater group lost a mean 5.49, SD=3.06 lb (p<0.001) while there was no weight loss or gain in the Lesser group (p=0.054). In the entire sample, there was also a small but significant decrease in BMI from 34.92, SD=9.06 to 34.71, to 34.55, SD=8.78 at V3 (p=0.009) and 34.57, SD=8.88 at V4 (p=0.024).

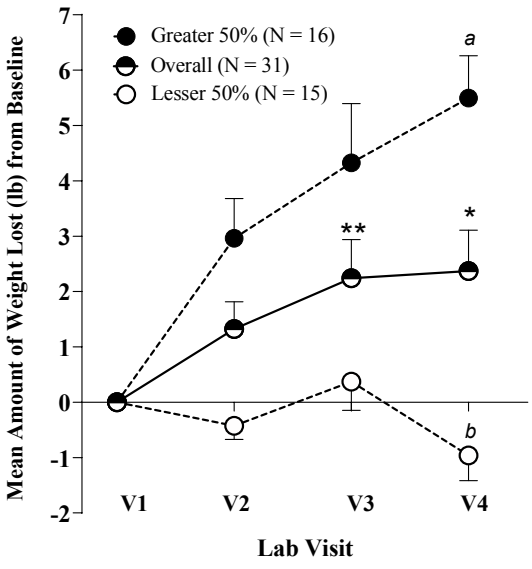

Figure 2: Change in body weight from Visit 1 (V1) to Visit 4 (V4). Positive numbers connote weight loss. V2, V3, and V4 data reflect cumulative weight change from baseline (V1). The overall sample changes are shown on the solid line; **= p<0.01, *= p<0.05. For exploratory purposes only, the hatched lines represent weight change of subgroups based on the Greater and Lesser than median amount of weight lost (1.9 lb). a V1 vs. V4 change, p=0.000; b V1 vs. V4 change, p=0.54, ns. Error bars represent standard error of the mean.

Change in stomach sensations and eating patterns after GCE

Scores on the SSS revealed that stomach hunger was greater before eating snacks (p=0.012) and desserts (p=0.036), and fullness was lower after meals, desserts, and when eating alone and able to eat as much as wanted (p=0.0.011, 0.023, 0.044, respectively). While consistent with GCE instructions, the changes did not correlate with amount of weight lost. Exploratory analysis found a correlation between greater weight loss and decreased fullness after meals only in the Greater 50% weight loss group (r = 0.64; p=0.01). The DEPS scores revealed no change in the number of meals or desserts consumed. However, the number of snacks was halved (from 2.17, SD=1.37 to 1.07, SD=0.88; p=0.001), and the number of sugary drinks was nearly halved (from 1.90, SD=1.65 to 0.97, SD=0.85; p=0.002). Meal replacement drink consumption also decreased (p=0.016). These reductions were not correlated with change in body weight.

Baseline predictors of weight loss

As shown in Table 1, a higher baseline weight, higher perceived stress scores, and lower mindfulness scores predicted greater weight loss after GCE.

Table 1: Separate linear regressions with amount of body weight lost (lb) as the dependent variable and baseline Perceived Stress Scale (PSS) and Mindfulness Attention Awareness Scale (MAAS) scores as independent variables.

Independent Variables	B	Std. Error	β	t	p =
Baseline weight	0.03	0.01	0.48	3.17	0.004
PSS scores	0.14	0.05	0.39	2.58	0.016
Adj. R^2 = 0.37					
Baseline weight	0.04	0.01	0.52	3.35	0.002
MAAS scores	-1.41	0.60	-0.36	-2.36	0.026
Adj. R^2 = 0.35					

Sex, ethnicity (dummy-coded), and age were not significant independent variables; including them in the regressions did not change the significant associations between PSS scores or MAAS scores and weight loss. The DV is V4 minus V1 (baseline) mean weight in pounds.

Discussion

The study obtained proof-of-concept data for GCE, a greatly simplified stomach-sensation-guided-intervention, to reduce body weight. Participants lost a mean 2.37 lb, a small but statistically significant weight change. However, exploratory analyses found that half of the participants achieved a mean loss of 5.49 lb, ranging from 1.9 to 11.6 lb. Results also revealed that those most likely to lose weight with GCE are those with higher perceived stress and those with lower mindfulness. Those who started GCE with greater perceived stress may have been more concerned about losing weight so adhered more strictly to the two study instructions. Another possibility is suggested by the link between eating and stress [17], and eating as way of coping with stress in those with higher BMI [18]. Since GCE instructed to eat only for stomach-hunger, weight of those with higher perceived stress would be most affected. Similarly, those lower in mindfulness may have been helped to a greater degree by GCE than those already mindful because the instructions asked them to be cognizant of their stomach sensations. This also suggests that habitual overeating by the already more mindful participants may have little to do with unawareness of stomach sensations.

Results also found that number of meals consumed remained unchanged while number of snack and sweet drink consumption decreased. Snacks and sugary drinks are known contributors of obesity [19], so a decrease in their intake would aid weight loss and health. Although desserts are also in this category, participants lost weight without a decrease in desserts. GCE did not ban any foods and this finding attests to the ability to lose weight without having to give up tasty foods. This effect should make weight loss with GCE more sustainable.

The study obtained proof-of-concept for GCE to yield weight loss and so warrants subsequent investigations without the limitations of this first test, namely the lack of a no-intervention group and self-report

of the original measures. A no-intervention condition and ecological measures of hunger and satiety and of consumption are needed to validate GCE as the cause of weight loss. However, the change in stomach sensations, number of certain food types consumed and association with lower baseline mindfulness give confidence that GCE will be prove to be the cause of weight loss. Finally, acknowledging that a healthy diet is required to meliorate the morbidities of obesity [20], GCE may have a more important role as a method of preventing obesity. With obesity rates continuing to escalate, prevention holds the most promise of bringing down these rates.

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Availability of Data and Materials

Available from the corresponding author (MMB) on request.

Ethics Approval and Consent to Participate

All procedures were approved by the UAB Institutional Review Board for Human Use in accordance with the 1964 Helsinki declaration and later amendments. Informed consent was obtained from all participants.

Consent for Publication

Not applicable.

Conflict of Interest

All authors declare no conflict of interest.

Author's Contributions

Ebeling provided conceptual improvement of the methods, created electronic surveys, trained assistants, conducted analyses, and wrote initial drafts. Braswell created the study video and narration; Wood streamlined flow of procedures; White conceived of pre-post survey administrations; and all four performed background literature searches, consented participants, and carried out procedures. Lausen and Isaac screened, contacted and scheduled participants and assisted in carrying out procedures. Boggiano conceived of the study, developed original materials, and supervised manuscript writing and analyses. All authors provided critical feedback of drafts and approved the final version.

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