Evaluation of Early Weight Loss Thresholds for Identifying Nonresponders to an Intensive Lifestyle Intervention

Jessica L. Unick1, Patricia E. Hogan2, Rebecca H. Neiberg2, Lawrence J. Cheskin3, Gareth R. Dutton4, Gina Evans-Hudnall5, Robert Jeffery6, Abbas E. Kitabchi7, Julie A. Nelson8, F. Xavier Pi-Sunyer9, Delia Smith West10, Rena R. Wing1 and The Look AHEAD Research Group

Objective: Weight losses in lifestyle interventions are variable, yet prediction of long-term success is difficult. The utility of using various weight loss thresholds in the first 2 months of treatment for predicting 1-year outcomes was examined.

Methods: Participants included 2327 adults with type 2 diabetes (BMI: 35.8 ± 6.0) randomized to the intensive lifestyle intervention (ILI) of the Look AHEAD trial. ILI included weekly behavioral sessions designed to increase physical activity and reduce caloric intake. 1-month, 2-month, and 1-year weight changes were calculated.

Results: Participants failing to achieve a ≥2% weight loss at Month 1 were 5.6 (95% CI: 4.5, 7.0) times more likely to also not achieve a ≥10% weight loss at Year 1, compared to those losing ≥2% initially. These odds were increased to 11.6 (95% CI: 8.6, 15.6) when using a 3% weight loss threshold at Month 2. Only 15.2% and 8.2% of individuals failing to achieve the ≥2% and ≥3% thresholds at Months 1 and 2, respectively, go on to achieve a ≥10% weight loss at Year 1.

Conclusions: Given the association between initial and 1-year weight loss, the first few months of treatment may be an opportune time to identify those who are unsuccessful and utilize rescue efforts.

Trial Registration: clinicaltrials.gov Identifier: NCT00017953

Introduction

Given the high prevalence of obesity, strategies for improving weight loss are needed (1). Currently, intensive lifestyle interventions yield an average weight loss of up to 10% at 1 year (2,3). However, of concern is the large variability in response; with some individuals being highly successful while others lose very little weight or even gain weight from pre- to post-treatment (4-6).
Baseline variables have not consistently predicted treatment weight loss. However, weight loss in as early as the first few weeks of an intervention is predictive of longer-term weight loss success (7-10). In a sample of 262 obese women, individuals with the fastest rate of weight loss during the first month of treatment also had significantly larger weight losses at 6 and 18 months, compared to those with slower weight losses initially (10). Moreover, weight loss at the end of the intensive phase of lifestyle treatment predicts longer-term success (5,11,12). For example, in the Diabetes Prevention program, participants who achieved a \( \geq 7\% \) weight loss at 6 months were three times more likely to achieve this magnitude of weight loss at follow-up (mean 3.2 years) (5). Given the association between initial weight loss and subsequent outcomes, it may be important to try to identify early nonresponders and provide additional assistance for these individuals.

Previously, nonempirically supported weight loss thresholds have been used to determine whether and when to provide “rescue efforts” (i.e., a more intensive or different intervention approach) to nonresponders or to suggest that treatment be discontinued in individuals who are not meeting weight loss goals (4,13-16). For example, in Look AHEAD, pharmacotherapy was offered to individuals who lost <5\% at 6 months. This strategy had little effect on weight loss outcomes (4), suggesting that there was either poor compliance to the medication or the type or timing of this rescue intervention may not have been appropriate. The 6-month time point is also used in the new Medicare guidelines (14) where individuals not achieving a \( \geq 3 \) kg weight loss after 6 months of intensive therapy are required to have their readiness to change reassessed before further treatment is provided. Other investigators have found no benefits of providing more intensive behavioral treatment at week 12 to those who were experiencing difficulty (13,15). In contrast, a behavioral intervention offered at 6 weeks to those losing <2.5\% of their body weight was found to be effective (16). Although investigators are beginning to evaluate whether changing the type or intensity of the intervention can “rescue” nonresponders, empirically based weight loss thresholds have not been employed and it remains unclear how early these nonresponders can be identified.

The purpose of this manuscript is to examine the association between early treatment response and 1-year weight change among...
overweight/obese individuals with type 2 diabetes randomized to the intensive lifestyle intervention (ILI) arm of the Look AHEAD trial and to identify specific weight loss thresholds at 1 and 2 months that can be used by clinicians to classify early nonresponders to lifestyle treatment. In addition, this paper also examines the sensitivity and specificity of these initial weight loss thresholds for predicting 1-year weight loss outcomes. This information could be particularly valuable when choosing a weight loss threshold for initiating “rescue efforts”. For example, the threshold chosen may differ depending upon whether the treatment goal is to minimize the cost of supplemental “rescue” efforts or whether the goal to maximize the number of individuals receiving supplemental “rescue” treatment.

Methods

Participants

Look AHEAD enrolled 5145 participants from 16 centers across the United States and inclusion/exclusion criteria have been previously reported (17). In short, participants who had type 2 diabetes, were aged 45-76 years, had a BMI ≥25 kg/m² (or ≥27 kg/m² if taking insulin), HbA1c ≤11%, triglycerides <600 mg/dL, and systolic and diastolic blood pressure ≤160 and ≤100 mmHg, respectively. All participants provided written informed consent, and study procedures were approved by each center’s institutional review board.

Intervention

Look AHEAD participants were randomly assigned to an intensive lifestyle intervention (ILI; n = 2570) or Diabetes Support and Education (n = 2575), which served as the comparison group. During Months 1-6, ILI participants attended three weekly group sessions and one individual counseling session per month, which was reduced to two-group and one-individual session per month in Months 7-12.

Participants in ILI were prescribed a calorie goal of 1200-1800 kcal/day depending upon initial body weight and were instructed to consume <30% of total calories from dietary fat. Meal replacements were provided, and participants were instructed to replace two meals and one snack per day with a meal replacement product for months 1-6 and one meal and one snack per day during months 7-12. Participants were given a home-based physical activity regimen designed to gradually increase structured activity to ≥175 min/week within the first 6 months.

Behavioral strategies such as regular self-weighing, daily self-monitoring, and stimulus control were discussed. To help unsuccessful participants meet the study goals, a “toolbox” strategy was implemented at 6 months. This “toolbox” has previously been described in greater detail (4). In short, it consisted of advanced behavioral strategies such as motivational interviewing, problem solving techniques, instrumental support (e.g., gym memberships, cookbooks, etc.), and the option to use orlistat. A total of 291 of the 722 participants losing <5% at month 6 were started on orlistat, which as previously reported did not improve their one-year weight losses (4).

Measurement of body weight and calculation of weight change

Weights were measured at each intervention visit by unmasked intervention staff using a digital scale to the nearest 0.2 lb (model BWB-800; Tanita, Willowbrook, IL). Baseline weight was considered the weight at the first intervention meeting. Annual assessment weights were obtained by a staff member masked to intervention assignment.

Percent weight change at Month 1 was calculated as follows: \[\frac{(Session 5 weight - Session 1 weight)}{Session 1 weight} \times 100\]. If a participant did not attend the intervention meeting at Session 5 or complete a “make-up”, but was present at both Sessions 4 and 6, the average of these two weights was used as their 1-month weight. If a participant was missing a Session 5 weight and had a weight at either Session 4 or 6, they were included in the analyses and their Session 4 or 6 weight was used as their 1-month weight. If a participant was absent at Sessions 4-6, they were excluded from the analyses. Similar procedures were employed to calculate 2-month weight change using weight measurements at Sessions 1 and 9.

Data analyses

About 2570 participants were randomized to ILI, 2327 of whom were included in the subsequent analyses: 2318 individuals (90%)
had weights at Month 1 and Year 1, and 2303 (90%) had weights at Month 2 and Year 1.

Weight loss quartiles at Months 1 and 2 were calculated and rounded to the nearest whole integer. These values were used to group participants into categories based upon achievement of these various magnitudes of weight loss at Months 1 or 2. For example, the upper weight loss quartile at Month 1 was 3.97%, which rounded up to 4%. Participants were then stratified into one of the two categories: (1) <4% weight loss or (2) ≥4% weight loss at Month 1. The proportion of individuals within each of these two groups achieving a ≥5% or ≥10% weight loss at Year 1 was calculated. A similar approach was taken for each quartile of weight loss at 1 and 2 months.

Logistic regression modeling assessed the relationship between early weight loss and 1-year weight loss, defining 1-year success as achievement of a ≥5% (18) or ≥10% (19) weight loss. These 1-year thresholds were chosen because they are often used to define clinically significant weight loss and have been shown to be associated with significant improvements in long-term health outcomes (18-20). Unadjusted models and models adjusting for clinic site, gender, age, race/ethnicity, and initial BMI were performed. As we were interested in identifying participants at risk of being unsuccessful treated over the year period, we chose to model the probability of failing to reach these weight loss goals. The cut-points representing the quartiles of weight loss at Months 1 and 2 were entered as dichotomous predictors in separate models. For Month 1 the cut-points were 2%, 3%, and 4% weight loss; for Month 2, 3%, 5%, and 7% were used.

To examine the ability of the initial weight loss thresholds to correctly classify individuals based upon whether they were successful or unsuccessful at Year 1, four groups were created: (1) true positives: failed to achieve the weight loss threshold at Month 1 and Year 1, (2) false positives: failed to achieve the weight loss threshold at Month 1 but achieved the weight loss threshold at Year 1, (3) false negatives: achieved the weight loss threshold at Month 1 but failed to achieve the weight loss threshold at Year 1, and (4) true negatives: achieved the weight loss threshold at Month 1 and Year 1. Similar groupings were formed combining Month 2 and Year 1 weight loss thresholds. Sensitivity and specificity were calculated for each model:
sensitivity = [true positives/(true positives + false negatives)] and specificity = [true negatives/(true negatives + false positives)].

### Results
Baseline characteristics of the entire Look AHEAD cohort have been previously reported (17). The 2327 ILI participants who were included in the current analyses (Figure 1) had a mean BMI of 35.8±6.0kg/m², 59.7% were female, 63.6% were Caucasian, and the mean age was 58.6±6.8 years.

The mean weight change at each time point was as follows: Month 1 (−2.7±2.7%), Month 2 (−4.6±3.3%), and Year 1 (−8.8±6.7%). Month 1 and 2 weight change were significantly correlated with weight change at Year 1 (r = 0.43 and 0.61, respectively, P < 0.001). This association is graphically depicted in Figure 2. Participants were categorized based upon their initial weight loss at Month 1 (Figure 2a) or Month 2 (Figure 2b) into one of the six weight loss categories. These groupings were selected in 1% weight loss increments for visual purposes and the monthly weight change trajectory throughout the first year of the intervention was plotted for each group.

Table 1 presents the proportion of participants falling above or below several 1-month or 2-month weight loss thresholds, while also examining what percentage of participants achieve a ≥5% and ≥10% weight loss at Year 1, based upon these initial weight loss thresholds. Sensitivity and specificity were calculated for each model: sensitivity = [true positives/(true positives + false negatives)] and specificity = [true negatives/(true negatives + false positives)].
met the criteria for a clinically significant weight loss at Year 1, compared to those who did not meet the criteria initially. In addition, the higher the initial weight loss threshold (e.g., ≥4% vs. ≥2%) the greater the proportion of participants who were “successful” at Year 1. The monthly weight loss trajectory for those falling above and below each of the weight loss thresholds at Month 1 and Month 2 is shown in the online Supporting Information Figure 1.

Table 2 displays the odds of not achieving a ≥5% or ≥10% weight loss at Year 1 based upon change in body weight at Months 1 and 2. Table 2 Odds (95% confidence interval) of failing to achieve a ≥5% and ≥10% weight loss at Year 1 based upon change in body weight at Months 1 and 2

| Month | Failure to achieve a 5% weight loss at Year 1 | Failure to achieve a 10% weight loss at Year 1 |
|-------|---------------------------------------------|-----------------------------------------------|
| 1 Month |                                             |                                               |
| ≥2% WL at 1 month | 1.0 (ref) | 1.0 (ref) |
| <2% WL at 1 month | Unadjusted 4.84 (4.00, 5.85) | 5.61 (4.50, 7.00) |
|                  | Adjusted 4.77 (3.90, 5.84) | 5.53 (4.39, 6.98) |
| ≥ 3% WL at 1 month | 1.0 (ref) | 1.0 (ref) |
| < 3% WL at 1 month | Unadjusted 5.22 (4.22, 6.46) | 4.90 (4.09, 5.87) |
|                  | Adjusted 4.98 (4.00, 6.20) | 4.71 (3.90, 5.68) |
| ≥ 4% WL at 1 month | 1.0 (ref) | 1.0 (ref) |
| < 4% WL at 1 month | Unadjusted 5.85 (4.33, 7.91) | 4.69 (3.83, 5.73) |
|                  | Adjusted 5.58 (4.10, 7.59) | 4.55 (3.68, 5.61) |
| 2 Months |                                             |                                               |
| ≥ 3% WL at 2 months | 1.0 (ref) | 1.0 (ref) |
| < 3% WL at 2 months | Unadjusted 8.36 (6.81, 10.26) | 11.58 (8.60, 15.58) |
|                  | Adjusted 8.30 (6.68, 10.31) | 11.07 (8.17, 14.99) |
| ≥ 5% WL at 2 months | 1.0 (ref) | 1.0 (ref) |
| < 5% WL at 2 months | Unadjusted 8.83 (6.94, 11.22) | 7.76 (6.42, 9.39) |
|                  | Adjusted 8.76 (6.83, 11.23) | 7.90 (6.46, 9.67) |
| ≥ 7% WL at 2 months | 1.0 (ref) | 1.0 (ref) |
| < 7% WL at 2 months | Unadjusted 16.82 (10.13, 27.93) | 10.21 (7.99, 13.06) |
|                  | Adjusted 16.27 (9.75, 27.17) | 10.75 (8.29, 13.94) |

Adjusted models include age, race/ethnicity, gender, clinic site, and baseline BMI.

Discussion

Findings from this study show that weight losses in the first two months of treatment are strongly correlated with weight loss following the first year of an intensive lifestyle intervention. Moreover, few individuals who lose <2% or <3% at months 1 and 2,
TABLE 3 Sensitivity and specificity using a $\geq 5\%$ and $\geq 10\%$ weight loss threshold at Year 1 based upon several weight loss thresholds at Months 1 and 2

| Month | Weight loss threshold | Sensitivity or true positive rate (N) | Specificity or true negative rate (N) | False negative rate (N) | False positive rate (N) |
|-------|----------------------|--------------------------------------|--------------------------------------|------------------------|------------------------|
| 1     | 2%                   | 57.9% (405)                          | 77.8% (1260)                         | 42.1% (294)            | 22.2% (359)            |
| 1     | 3%                   | 81.0% (666)                          | 55.1% (892)                          | 19.0% (133)            | 44.9% (727)            |
| 1     | 4%                   | 92.6% (647)                          | 32.0% (518)                          | 7.4% (52)              | 68.0% (1101)           |
| 2     | 3%                   | 59.4% (409)                          | 85.1% (1374)                         | 40.6% (280)            | 14.9% (240)            |
| 2     | 5%                   | 86.5% (596)                          | 57.9% (935)                          | 13.5% (93)             | 42.1% (679)            |
| 2     | 7%                   | 97.7% (673)                          | 28.6% (461)                          | 2.3% (16)              | 71.4% (1153)           |

Using a $\geq 5\%$ weight loss threshold at Year 1

| Month | False negative rate (N) | False positive rate (N) |
|-------|-------------------------|-------------------------|
| 1     | 42.1% (679)             | 68.0% (1101)            |
| 2     | 42.1% (679)             | 68.0% (1101)            |

Using a $\geq 10\%$ weight loss threshold at Year 1

Sensitivity rate is defined as the percentage of participants failing to achieve $\geq 5\%$ or $\geq 10\%$ weight loss at Year 1 who are correctly identified using the initial weight loss threshold [true positives (true positives + false negatives)], while false negative rate is the percentage of those incorrectly identified [false negatives (true positives + false positives)]. Specificity rate is defined as the percentage of participants achieving a $\geq 5\%$ or $\geq 10\%$ weight loss at Year 1 who are correctly identified using the initial weight loss threshold [true negatives (true negatives + false positives)], while false positive rate is the percentage of those incorrectly identified [false positives (true negatives + false positives)].

respectively, go on to achieve clinically significant weight loss at Year 1. Thus, as illustrated in Figure 2, many individuals remain on the same weight change trajectory as established very early within treatment. This suggests that the first 2 months of treatment may be an ideal time to identify, and possibly intervene upon, those at greatest risk of not achieving clinically significant weight losses.

Although both 1- and 2-month weight losses significantly predicted 1-year outcomes, Month 2 weight loss was a stronger predictor than Month 1. Thus, if an intervention is designed to target and provide additional treatment to those at greatest risk of being unsuccessful in a standard behavioral program, waiting until Month 2 may improve the accuracy in predicting weight loss success. However, many of these individuals can actually be identified as early as Month 1: waiting until Month 2 or beyond may be too late to “rescue” these early nonresponders, given that they may already be disengaged. For example, Carels et al. found that delivering a more intensive intervention to those failing to meet specific weight loss goals at week 12 was not effective (13), whereas one delivered at week 6 was successful (16). Moreover, Jakicic et al. (15) used a “stepped care” intervention model (13,15,16,21,22) and offered participants who lost $<5\%$ at Month 3 (46% of sample) an additional 10-minute telephone contact monthly. This intervention only “rescued” 8% of these participants. Thus, these findings suggest that both the timing and type of “rescue” intervention are important to consider, and warrant further investigation.

When using these empirically derived weight loss thresholds and choosing the threshold to identify early nonresponders, it is important to weigh the cost of providing supplemental “rescue” treatment against the number of individuals that would be reached. For example, if the cost of the “rescue” strategy is high, limiting the number of individuals receiving additional intervention unnecessarily may be of greatest interest (i.e., false positives). In this case, a 2% weight loss threshold at Month 1 would be ideal, given that only 116 participants (5% of total sample) would receive supplemental intervention when it was not needed; however, a large number of individuals who may actually need supplemental intervention would not receive it (false negatives; $n = 775$; 33% of the total sample). If on the other hand, the cost of the supplemental intervention is low, the goal may be to maximize the number of individuals receiving supplemental treatment who really need it (true positives) and minimize the number of individuals not receiving supplemental treatment, but who might have benefited from it (false negatives). In this case, a 4% weight loss threshold at Month 1 would maximize the true positives ($n = 1231$; 53% of the total sample) and minimize the false negatives ($n = 192$; 8% of the total sample). However, the number of individuals receiving supplemental treatment unnecessarily (i.e., false positives) also substantially increases ($n = 517$; 22% of total sample). Thus, clinicians, investigators, and policy makers should consider this potential trade-off when making treatment decisions.

Although this study is the first to examine the predictive accuracy of several initial weight loss thresholds on achievement of clinically significant weight losses at 1 year, the current findings are in agreement with Nackers et al. (10), who reported that obese women losing weight at a rate of $\geq 0.68$ kg/week ($\geq 2.7\%$ weight loss at 1 month) are 5.1 times more likely to achieve a $\geq 10\%$ weight loss at 18 months compared to those losing weight more slowly, defined as $<0.23$ kg/week (approximately $<1\%$ weight loss at 1 month). These findings suggest that individuals losing $<2-2.5\%$ weight loss at
Month 1 may be unlikely to go on to achieve a ≥10% weight loss at Year 1 and may require additional support or treatment. Alternatively, interventions could consider discontinuing treatment in these early nonresponders given their low likelihood of success.

There are many strengths of this study including the large sample size and the determination of clinical weight loss cut-points at 1 and 2 months for identifying individuals least likely to achieve clinically significant weight losses at Year 1. However, it is unclear whether these findings would hold true in healthier or younger cohorts or within treatment programs utilizing a less intensive intervention.

In conclusion, the current findings suggest that for overweight or obese adults with type 2 diabetes, weight loss in the first 2 months of a lifestyle intervention is predictive of 1-year weight loss. Moreover, of those individuals failing to meet specific weight loss criteria in the first 2 months, few go on to attain a ≥10% weight loss at Year 1. Therefore, the first few months of treatment may be an opportune time to identify individuals at greatest risk for being unsuccessful at the conclusion of treatment and to provide additional intervention “rescue efforts” before it is too late. Future studies should examine the efficacy and cost-effectiveness of using these empirically based weight loss thresholds for early identification and “rescue efforts” for these initially nonresponsive individuals.

Acknowledgments

The following organizations have committed to make major contributions to Look AHEAD: Federal Express; Health Management Resources; Johnson & Johnson, LifeScan Inc.; Optifast-Novartis Nutrition; Roche Pharmaceuticals; Ross Product Division of Abbott Laboratories; Slim-Fast Foods Company; and Unilever.

Role of sponsors

The National Institute of Diabetes and Digestive and Kidney Diseases participated in the design and conduct of the study but did not participate in the collection, management, analysis, and interpretation of the data; or preparation, review, or approval of the manuscript. The decision to publish was made by the Look AHEAD Steering Committee, with no restrictions imposed by the sponsor.

Trial personnel

Look AHEAD research group at 1-year

Clinical Sites

The Johns Hopkins Medical Institutions Frederick L. Brancati, MD; Michael S. Kosinski, MD, MPH; Jeff Horas, MS; Lawrence Cheskin, MD; Jeanne M. Clark, MD, MPH; Barry Stewart, EdD; Richard Rubin, PhD; Jeanne Charleston, RN; Kathy Horak, RD; Pennington Biomedical Research Center George A. Bray, MD; Kristi Rao; Allison Strate, RN; Brandi Armand, LPN; Frank L. Greenway, MD; Donna H. Ryan, MD; Donald Williamson, PhD; Amy Bachand; Michelle Begnaud; Betsy Berhard; Elizabeth Caderette; Barbara Cerniauskas; David Cree; Diane Crow; Helen Guay; Nancy Kora; Kelly LaFleur; Kim Landry; Missy Lingle; Jennifer Perauld; Mandy Shipp, RD; Marisa Smith; Elizabeth Tucker; The University of Alabama at Birmingham Cora E. Lewis, MD, MSPH; Sheikily Thomas MPH; Monika Safford, MD; Vicki DiLillo, PhD; Charlotte Bragg, MS, RD, LD; Amy Dobelstein; Stacey Gilbert, MPH; Stephen Glasser, MD; Sara Hannum, MA; Anne Hubbell, MS; Jennifer Jones, MA; DeLavallade Lee; Ruth Luketic, MA, MBA, MPH; Karen Marshall; L. Christie Oden; Janet Raines, RN, BSN; Janet Truman; Nita Webb, MA; Audrey Wrenn, MA; Harvard Center Massachusetts General Hospital: David M. Nathan, MD; Heather Turgeon, RN, BS, CDE; Kristina Schumman, BA; Enrico Cagliero, MD; Linda Delahanty, MS, RD; Kathryn Hayward, MD; Ellen Anderson, MS, RD; Laurie Bissett, MS, RD; Richard Ginsburg, PhD; Valerie Goldman, MS, RD; Virginia Harlan, MSW; Charles McKitterick, RN, BSN, CDE; Alan McNamara, BS; Theresa Michel, DPT, DSc CCS; Alexi Poulos, BA; Barbara Steiner, EdM; Joclyn Tosch, BA

Joslin Diabetes Center: Edward S. Horton, MD; Sharon D. Jackson, MS, RD, CDE; Osamu Hamdy, MD, PhD; A. Enrique Caballero, MD; Sarah Bain, BS; Elizabeth Bovaird, BSN, RN; Ann Goebel-Fabbri, PhD; Lori Lambert, MS, RD; Sarah Ledbury, MEd, RD; Maureen Malloy, BS; Kerry Ovalle, MS, RCEP, CDE; Beth Israel Deaconess Medical Center: George Blackburn, MD, PhD; Christos Mantzoros, MD, DSc; Kristinia Day, RD; Ann McNamara, RN; University of Colorado Health Sciences Center James O. Hill, PhD; Marsha Miller, MS, RD; JoAnn Philipp, MS, RD; Robert Schwartz, MD; Brent Van Dorsten, PhD; Judith Regensteiner, PhD; Salma Bencheekroun MS; Ligia Coelho, BS; Paulette Cohrs, RN, BSN; Elizabeth Daeninck, MS, RD; Amy Fields, MPH; Susan Green; April Hamilton, BS, CCRC; Jere Hamilton, BA; Eugene Leshchinsky; Michael McDermott, MD; Lindsey Munkwitz, BS; Loretta Rome, TRS; Kristin Wallace, MPH; Terra Worley, BA; Baylor College of Medicine John P. Foreyt, PhD; Rebecca S. Reeves, DrPH, RD; Henry Pownall, PhD; Ashok Balasubramanyam, MBB; Peter Jones, MD; Michele Burrington, RD; Chu-Huang Chen, MD, PhD; Allyson Clark, RD; Molly Gee, MEd, RD; Sharon Griggs; Michelle Hamilton; Veronica Holley; Jayne Joseph, MD; Patricia Pace, RD; Julieta Palencia, RN; Olga Satterwhite, RD; Jennifer Schmidt; Devin Volding, LMSW; Carolyn White; University of California at Los Angeles School of Medicine Mohammed F. Saad, MD; Siran Ghazarian, MD; Ken C. Chiu, MD; Medhat Botrous; Michelle Chan, BS; Kati Konersman, MA, RD, CDE; Magpuri Perpetua, RD; The University of Tennessee Health Science Center University of Tennessee East: Karen C. Johnson, MD, MPH; Carolyn Gresham, RN; Stephanie Connelly, MD, MPH; Amy Brewer, RD, MS; Mace Coday, PhD; Lisa Jones, RN; Lynne Lichterman, RN, BSN; Shirley Vosburg, RD, MPH; J. Lee Taylor, MEd, MBA

University of Tennessee Downtown: Abbas E. Kitabchi, PhD, MD; Helen Lambeth, RN, BSN; Debra Clark, LPN; Andrea Crisler, MT; Gracie Cunningham; Donna Green, RN; Debra Force, MS, RD, LDN; Robert Kores, PhD; Renate Rosenthal PhD; Elizabeth Smith, MS, RD, LDN; and Maria Sun, MS, RD, LDN; and Judith Soberman, MD; University of Minnesota Robert W. Jeffery, PhD; Carolyn Thorson, CCRP; John P. Bantle, MD; J. Bruce Redmon, MD; Richard S. Crow, MD; Scott Crow, MD; Susan R Kautz, PhD, RD; Kerrin Breij, MPH, RD; Carolyne Campbell; Jeanne Carls, MEd; Tara Caremean-Mihm, BA; Emily Finch, MA; Anna Fox, MA; Elizabeth Hoelscher, MHP, RD, CHES; La Donna James; Vicki A. Maddy, BS, RD; Therese Eckenden, RN; Birgitta I. Rice, MS, RPh CHES; Tricia Skarphol, BS; Ann D. Tucker, BA; Mary Susan Voeller, BA; Cara Walcheck, BS, RD; St. Luke’s Roosevelt Hospital Center Xavier Pi-Sunyer, MD; Jennifer Patricio, MS; Stanley Heshka, PhD; Carmen Pal, MD; Lynn Allen, MD; Diane Hirsch,
RNC, MS, CDE; Mary Anne Holowaty, MS, CN; University of Pennsylvania Thomas A. Wadden, PhD1; Barbara J. Maschak-Casey, MSN, CDE2; Stanley Schwartz, MD3; Gary D. Foster, PhD; Robert I. Berkowitz, MD1; Henry Glick, PhD4; Shiriki K. Kumanyika, PhD, RD, MPH5; Johanna Brock; Helen Chomontowski; Vicki Clark; Canice Cerrand, PhD; Renee Davenport; Andrea Diamond, MS, RD; Anthony Fabricatore, PhD; Louise Hesson, MSN; Stephanie Krauthamer-Ewing, MPH; Robert Kuehnel, PhD; Patricia Lipschutz, MSN; Monica Mullen, MS, RD; Leslie Womble, PhD, MS; Nayyar Iqbal, MD; University of Pittsburgh David E. Kelley, MD1; Jacqueline Wese-Wthobaben, RN, BSN, CDE; Lewis Kuller, MD, DrPH2; Andrea Kriska, PhD2; Janet Bonk, RN, MPH; Rebecca Danchenko, BS; Daniel Edmundowicz, MD1; Mary L. Klem, PhD, MLIS3; Monica E. Yamamoto, DrPH, RD, FADA 3; Barb Ellynzcyk, MA; George A. Grove, MS; Pat Harper, MS, RD, LDN; Janet Kruia, RN, BSN, CDE; Juliet Mancino, MS, RD, CDE; Anne Mathews, MS, RD, LDN; Tracey J. Murray, BS; Joan R. Ritchea; Jennifer Rush, MPH; Karen Vujевич, RN-BN, MSN, CRNP; Donna Wolf, MS; The Miriam Hospital/Brown Medical School Rena R. Wing, PhD1; Renee Bright, MS2; Vincent Pera, MD; John Jakicic, PhD3; Deborah Tate, PhD4; Amy Gorin, PhD5; Kara Gallagher, PhD3; Amy Bach, PhD; Barbara Bancroft, RN, MS; Anna Bertorelli, MBA, RD; Richard Carey, BS; Tatum Charron, BS; Heather Che not, MS; Kimberly Chula-Maguire, MS; Pamela Coward, MS, RD; Lisa Cronkite, BS; Julie Currin, MD; Maureen Daly, RN; Caithin Egan, MS; Erica Ferguson, BS, RD; Linda Foss, MPH; Jennifer Guvin, MS; Don Kieffer, PhD; Lauren Jessard, BS; Deborah Maier, MS; JP Massaro, BS; Tammy Monk, MS; Rob Nicholson, PhD; Erin Patterson, BS; Suzanne Phelan, PhD; Hollie Raynor, PhD, RD; Douglas Raynor, PhD; Natalie Robinson, MS, RD; Deborah Robles; Jane Tavares, BS; The University of Texas Health Science Center at San Antonio Steven M. Haffner, MD1; Maria G. Montez, RN, MSHP, CDE2; Carlos Lorenzo, MD1; University of Washington / VA Puget Sound Health Care System Steven E. Kahn, MB, ChB2; Brenda Montgomery, RN, NS, CDE2; Robert Knopp, MD1; Edward Lipkin, MD1; Matthew L. Maciejewski, PhD2; Dace Trence, MD1; Terry Barrett, BS; Jolit Barrat, BA; Diane Greenberg, PhD; Anne Murillo, BS; Betty Ann Richmond, MD,Ed; April Thomas, MPH, RD; Southwestern American Indian Center, Phoenix, Arizona and Shipo rock, New Mexico William C. Knowler, MD, DrPH1; Paula Bolin, RN, MC2; Tina Killeen, BS2; Cathy Manus, LPN3; Jonathan Krakoff, MD3; Jeffrey M. Curtis, MD, MPH3; Justin Glass, MD3; Sara Michaels, MD3; Peter H. Bennett, MB, FRCP3; Tina Morgan3; Shandlin Begay, MPH; Bernadita Falls RN, RHIT, CCS; Jeanette Hermes, MS, RD; Diane F. Hollowbreast; Ruby Johnson; Maria Meacham, BSN, RN, CDE; Julie Nelson, RD; Carol Percy, RN; Patricia Poorthunder; Sandra Sangster; Nancy Scurloc, MSN, ANP-C, CDE; Leigh A. Shovestull, RD, CDE; Janelle Smiley; Katie Toledo, MS, LPC; Christina Tomcheck, BA; Darryl Tonemah PhD; University of Southern California Anne Peters, MD2; Valerie Ruelas, MSW, LCSW1; Siran Ghaazarian Sengardi, MD2; Kathryn Graves, MPH, RD, CDE; Kati Konersman, MA, RD, CDE; Sara Serafin-Dokhan; Coordinating Center; Wake Forest University Mark A. Espeland, PhD1; Judy L. Bahnson, BA2; Lynne Wagenknecht, DrPH1; David Reboussin, PhD1; W. Jack Rejeski, PhD2; Alain Ber toni, MD, MPH3; Wei Lang, PhD; Gary Miller, PhD; David Lef kowitz, MD; Patrick S. Reynolds, MD3; Paul Ribisl, PhD3; Mara Vitolins, DrPH1; Michael Booth, MBA2; Kathy M. Dotson, BA2; Amelia Hodges, BS2; Carrie C. Williams, MA2; Jerry M. Barnes, MA; Patricia A. Feeney, MS; Jason Griffin, BS; Lea Harvin, BS; William Herman, MD, MPH; Patricia Hogan, MS; Sarah Jaramillo, MS; Mark King, BS; Kathy Lane, BS; Rebecca Neiberg, MS; Andrea Ruggiero, MS; Christian Speas, BS; Michael P. Walkup, MS; Karen Wall; Michelle Ward; Delia S. West, PhD; Terri Windham: Central Resources Centers; DXA Reading Center, University of California at San Francisco Michael Neveit, PhD1; Susan Ewing, MS; Cynthia Hayashi; Jason Maeda, MPH; Lisa Palermo, MS, MA; Michaela Rahorst; Ann Schwartz, PhD; John Shepherd, PhD; Central Laboratory, Northwest Lipid Research Laboratories Sautica M. Marcovina, PhD, ScD2; Greg Stylerewicz, MS; ECG Reading Center, EPICARE, Wake Forest University School of Medicine; RonaldJ. Prineas, MD, PhD1; Teresa Alexander; Lisa Billings; Charles Campbell, AAS, BS; Sharon Hall; Susan Hensley; Yabing Li, MD; Zhu Ming Zhang, MD; Diet Assessment Center, University of South Carolina, Arnold School of Public Health, Center for Research in Nutri tion and Health Disparities Elizabeth J Mayer-Davis, PhD2; Robert Moran, PhD; Hall-Foushee Communications, Inc.; Richard Foushee, PhD; Nancy J. Hall, MA

Federal Sponsors
National Institute of Diabetes and Digestive and Kidney Diseases; Barbara Harrison, MS; Van S. Hubbard, MD PhD; Susan Z.Yanovski, MD; National Heart, Lung, and Blood Institute; Lawton S. Cooper, MD, MPH; Jeffrey Cutler, MD, MPH; Eva Obarzanek, PhD, MPH, RD; Centers for Disease Control and Prevention; Edward W. Gregg, PhD; David F. Williamson, PhD; Ping Zhang, PhD

1 Principal Investigator
2 Program Coordinator
3 Co-Investigator

All other Look AHEAD staffs are listed alphabetically by site.

© 2014 The Obesity Society

References
1. Flegal KM, Carroll MD, Kit BK, Ogden CL. Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999-2010. JAMA 2012;307: 491-497.
2. Wadden TA, Stunkard AJ. Handbook of Obesity Treatment. New York: The Guildford Press; 2002.
3. Barte JC, ter Bogt NC, Rogers RP, et al. Maintenance of weight loss after lifestyle interventions for overweight and obesity, a systematic review. Obes Rev 2010;11: 899-906.
4. Wadden TA, West DS, Neiberg RH, et al. One-year weight losses in the Look AHEAD study: Factors associated with success. Obesity (Silver Spring) 2009;17: 713-722.
5. Wing RR, Hamman RF, Bray GA, et al. Achieving weight and activity goals among diabetes prevention program lifestyle participants. Obes Res 2004;12:1426-1434.
6. Jakicic JM, Marcus BH, Lang W, Janney C. Effect of exercise on 24-month weight loss maintenance in overweight women. Arch Intern Med 2008;168:1550-1559; discussion 1559-1560.
7. Carrols RA, Cacciapaglia HM, Douglass OM, Rydin S, O'Brien WH. The early identification of poor treatment outcome in a women's weight loss program. Eat Behav 2003;4:265-282.
8. Dutton CA, Jakicic JM, Goodpaster BH, Otto AD. Is initial weight loss associated with longer-term weight loss in obese adults? Med. Sci. Sports Exerc 2008;40: S111.
9. Elfhag K, Rossner S. Initial weight loss is the best predictor for success in obesity treatment and sociodemographic liabilities increase risk for drop-out. Patient Educ Couns 2010;79:361-366.
10. Nackers LM, Ross KM, Perri MG. The association between rate of initial weight loss and long-term success in obesity treatment: Does slow and steady win the race? *Int J Behav Med* 2010;17:161-167.

11. Wadden TA, Neiberg RH, Wing RR, et al. Four-Year Weight Losses in the Look AHEAD Study: Factors associated with long-term success. *Obesity (Silver Spring)* 2011.

12. Elfhag K, Rossner S. Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obes Rev* 2005;6:67-85.

13. Carels RA, Young KM, Coit CB, et al. The failure of therapist assistance and stepped-care to improve weight loss outcomes. *Obesity (Silver Spring)* 2008;16:1460-1462.

14. Centers for Medicare and Medicaid Services. Final Coverage Decision Memorandum for Intensive Behavioral Therapy for Obesity 2011 [August 8, 2013]. Available from: http://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?&NcaName=Intensive%20Behavioral%20Therapy%20for%20Obesity&bc=ACAAAAAAAIAAAA&NCAId=253.

15. Jakicic JM, Tate DF, Lang W, et al. Effect of a stepped-care intervention approach on weight loss in adults: A randomized clinical trial. *JAMA* 2012;307:2617-2626.

16. Carels RA, Wott CB, Young KM, et al. Successful weight loss with self-help: A stepped-care approach. *J Behav Med* 2009;32:503-509.

17. Pi-Sunyer X, Blackburn G, Brancati FL, et al. Reduction in weight and cardiovascular disease risk factors in individuals with type 2 diabetes: One-year results of the look AHEAD trial. *Diabetes Care* 2007;30:1374-1383.

18. Blackburn G. Effect of degree of weight loss on health benefits. *Obes Res* 1995;3(Suppl 2):211s-216s.

19. National Heart L, and Blood Institute (NHLBI). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: The evidence report. *Obes Res* 1998;6(Suppl 2):S1S-S10S.

20. Wing RR, Lang W, Wadden TA, et al. Benefits of modest weight loss in improving cardiovascular risk factors in overweight and obese individuals with type 2 diabetes. *Diabetes Care* 2011;34:1481-1486.

21. Brownell KD. Public health approaches to obesity and its management. *Annu Rev Public Health* 1986;7:521-533.

22. Carels RA, Darby L, Cacciapaglia HM, et al. Applying a stepped-care approach to the treatment of obesity. *J Psychosom Res* 2005;59:375-383.