

Intensive Lifestyle Interventions for Overweight and Obesity:

Scientific Basis and History

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Executive Summary

In 2015, more than 2/3 (68.8%) of American adults were considered to be overweight or obese according to the National Institutes of Health. Over the last three decades, medical research has established obesity to be associated with many medical problems, including type 2 diabetes and cardiovascular disease (CVD). In 2011, the direct costs of medical care associated with obesity were estimated to be over \$110 billion and the overall direct and indirect costs are now estimated to be over \$190 billion. In 2003, Surgeon General Richard Carmona called obesity the fastest growing cause of illness and death in the US. In 2006, he regarded the obesity epidemic to be a bigger threat than terrorism. Very little has changed in the interim.

The rapidly increasing prevalence of obesity in the US and most of the world has been amply documented. For years, most people and even most health care providers viewed obesity to be an intractable and essentially untreatable disorder. Slowly this perception has changed. For many years, there was a general consensus that for weight loss to be considered “successful”, an overweight or obese person needed to achieve a “normal” weight level. Over the past 20 years, the consensus has changed to recognize that relatively small but sustained reduction in body weight could have wide ranging positive effects on health ranging from prevention of type 2 diabetes to reduction of depression and improvement of quality of life. Today’s consensus is that sustained reduction of at least 5% of initial body weight is considered to define clinically meaningful weight loss.

Over the past 40 years, health care researchers have developed one safe and effective method for achieving at least 5% weight loss for adults from all walks of life. This approach has come to be called intensive lifestyle interventions (ILIs). There have been many variations of ILIs that have been tested over the years. Starting in the 1990s, the National Institutes of Health (NIH) funded a series of controlled clinical trials which established that ILIs could successfully induce clinically meaningful weight loss and could be used to maintain clinically meaningful weight losses for over eight years. During the last two decades, the common components of successful ILIs have been established. According to several expert panels, successful ILIs need to be intensive (at least 14 sessions over the first 6 months) and include counseling to change lifestyle habits related to diet and physical activity. Furthermore, successful ILIs should include programs to develop the skills that are necessary to maintain long-term adherence to changed habits pertaining to diet and physical activity. As the internet has developed, a number of innovators tested the efficacy of providing ILIs via online counseling. After one year of ILI, these studies of face-to-face and online ILIs reported that about 50% to 90% of participants had lost at least 5% of initial weight and more recent studies have shown that such weight loss can be sustained for 2 to 8 years with continued, but attenuated ILI. The health benefits of achieving a clinically meaningful (5%) weight loss have been documented repeatedly in these studies.

Two features of ILI have been identified as key aspects of successful weight loss and improved health: adherence and retention. As noted earlier, ILIs are designed to promote adherence to strategies that result in changes in habits related to diet and physical activity. They are also designed to prevent premature drop-outs from the program. By combining strategies to enhance adherence and retention, the overall benefits of ILI can be magnified. Other studies have tested whether ILIs can be cost-effective strategies for preventing and treating obesity-related medical conditions. Current evidence suggests a positive answer to this issue, which has resulted in a recommendation (as a part of the Affordable Care Act) for mandated treatment of obesity (with at least one co-morbid CVD risk factor) using ILIs. Two very good features of ILIs are that almost everyone can benefit and very few harmful effects of ILIs have been observed in over 40 years of research.

In conclusion, medical research over many years has established some very important facts about adult obesity. One unhappy fact is that the prevalence of obesity has been increasing systematically for over 25 years. Also, obesity is a serious medical problem that is costing the American economy between 5% and 10% of annual dollars spent on health care. Several positive facts have also been discovered. First, relatively modest reductions in body weight can result in very positive health benefits. In other words, a person does not need to lose weight to a “normal” size in order to yield good health outcomes. Second, a relatively inexpensive and cost-effective method for addressing adult obesity has been established. This method is called intensive lifestyle intervention. The procedures and strategies necessary to successfully treat obesity and co-morbid medical conditions have been clearly established. Finally, with the aid of modern technology, the means for bringing this successful intervention to everyone, regardless of where they live, is now possible. With the advent of accessible, convenient, and affordable obesity treatment, it may be possible to effectively reverse the trend of the obesity epidemic.

How Obesity Became Recognized as a Medical Problem

For most of the history of mankind, humans struggled to find adequate food supplies and consequently, most people were very thin. By the 18th century, being overweight or “corpulent” was associated with wealth and high social standing. During the late 1800s to mid-1900s, the abundance of food was such that most people in developed countries could finally achieve a “normal” weight. After World War II, stigma was attached to being overweight or obese (Eknoyan, 2006) and obesity was often viewed as a cosmetic problem associated with gluttony, laziness, and low self-discipline (Kopelman, 2000). During this period of time, medical researchers, beginning with Himsworth (1939), began to note the relationships between obesity, type 2 diabetes, and a variety of cardiovascular risk factors, including hypertension and unhealthy blood lipids. In 1988 Reaven formally hypothesized a Syndrome X that linked insulin resistance (a primary feature of type 2 diabetes) with a range of medical conditions. In later years, this Syndrome X became known as the Metabolic Syndrome (Oda, 2012) and it was strongly associated with the presence of overweight and obesity (Reaven, 2005). By 2000, it was clear that obesity was best regarded as a medical problem, as opposed to a cosmetic problem (Kopelman, 2000) and that excess adiposity was associated with a wide variety of medical conditions. At the time of this recognition, the human race reached a landmark: over half of the population was overweight or obese (Caballero, 2007). Since about 1990, the population of the United States and most other countries has been steadily becoming more and more overweight. This phenomenon has been called the global

epidemic of obesity and it is generally considered to be significant burden to the world economy and to world health. It is this situation that motivated new, population-based approaches to combat this epidemic. This paper summarizes the evolution of one approach for the treatment of obesity and related problems. This approach has come to be known as Intensive Lifestyle Intervention (ILI).

Evolution of Intensive Lifestyle Intervention for Obesity-Related Medical Problems

In 1980, Albert Stunkard published one of the first modern texts on the etiology and treatment of obesity. In this book, a variety of treatment regimens were described: diets, exercise, drugs, psychoanalysis, self-help, gastric bypass, and behavior modification. This last type of treatment became known as intensive lifestyle intervention for obesity. In 1980, Stunkard described this approach as a “treatment modality that has aroused much initial enthusiasm” (p 20) and from these humble beginnings, hundreds of studies and programs were developed over the next 40 years.

The seminal paper of Richard Stuart in 1967 is generally viewed as the first paper describing the effectiveness of an intensive lifestyle intervention for obesity. In 1972, Stuart and Davis published the first treatment guide for intensive lifestyle modification for weight management. It was titled: *Slim Chance in a Fat World*. Over the next 20 years, over 70 randomized controlled trials (RCTs) were published that validated this approach as a mainstay for weight management (Williamson & Perrin, 1996). By the mid-1990s, the health benefits of weight loss had been established and the National Institutes of Health initiated a series of large-scale multi-site randomized controlled trials (RCTs) that investigated the efficacy of lifestyle interventions for weight loss and prevention of obesity-related problems, e.g., diabetes and cardiovascular disease. The process of refining and maximizing the effectiveness of lifestyle interventions began with the design and implementation of the Diabetes Prevention Program (DPP) in the 1994. This section summarizes the evolution and effectiveness of intensive lifestyle interventions over the past two decades using the methodology and results of four exemplary studies: DPP, Look AHEAD, POUNDS Lost, and CALERIE. The total cost for these studies was over \$800 million and the key investigators include some of the most distinguished medical researchers in the world. The methodology of the ILIs has progressed over the past two decades. These methods and the primary results of the studies are summarized below.

Diabetes Prevention Program

The methods of the DPP were first reported in 1999 and the primary results were published in 2002. The RCT found that modest (~7%) reductions of body weight that were sustained for 3.2 years could significantly delay the onset of type 2 diabetes in adults who were pre-disposed to developing diabetes (often called pre-diabetes). After completion of the initial DPP trial, the DPP Observation Study (DPPOS) was initiated and participants were followed for a total of ten years. At the beginning of DPPOS, participants in the medication group (metformin) and the placebo group received the ILI of DPP delivered via group counseling. Over the course of the 10 years, the participants in the original ILI gradually regained weight that had been lost. Their final average weight was 2% below baseline. An important finding was that in the initial ILI group the onset of type 2 diabetes was significantly delayed in comparison to the original placebo group. Thus, prevention (delay) of diabetes with ILI can persist for 10 years. The ILI was also associated with improved metabolic markers and CVD risk factors when averaged

across the 10 years. Also, ILI was found to be cost-effective in comparison to placebo medication after 10 years of follow-up.

Look AHEAD

The planning for the Action for Health in Diabetes (Look AHEAD) study began in the early 2000s. The description of the Look AHEAD intensive lifestyle intervention was published in 2006 and a series of papers were published over the next 8 years, with the 8 year weight loss outcomes reported in 2014. The study recruited overweight and obese adults who had been diagnosed with type 2 diabetes. The primary findings of Look AHEAD were: 1. In comparison to a control group, an ILI resulted in significantly greater weight loss after one year (~9%) and after 8 years (~5%) of ILI treatment, 2. Weight changes were associated with a wide variety of improved health indicators ranging from improved CVD risk factors to improved quality of life, 3. Improvement of health indicators was sustained for 8 years, and 4. In comparison to the control arm, the overall medical costs of ILI were significantly lower. Finally, the weight loss results were robust, with equal success over a variety of ethnic and gender sub-groups.

POUNDS Lost

The planning for the Preventing Obesity Using Novel Dietary Strategies (POUNDS Lost) study began in the mid-2000s and the primary outcome paper was published in 2009 (Sacks, Bray, Carey, et al, 2009). This RCT compared four macro-nutrient diet prescriptions for weight loss. The four diets differed in terms of the percentages of carbohydrates, proteins, and fats that were recommended. The study included mostly healthy overweight and obese adults. The study duration was two years and no differences in weight changes were observed across the four diets. All four macro-nutrient diets required caloric restriction and were associated with approximately 8% weight loss after one year and 6% weight loss after two years. Improvement of CVD risk factors was observed after 2 years.

CALERIE

The Comprehensive Assessment of Long term Effects of Reducing Intake of Energy (CALERIE) study included two phases. This description will focus only on phase 2, which was a multi-site RCT that compared caloric restriction to an ad lib (normal eating) control group over a period of two years that began in 2007. The study included healthy adults who were either normal weight or overweight. A description of the intensive lifestyle intervention of CALERIE was provided by Rickman, Williamson, Martin, et al (2011). The primary outcomes (Ravussin, Redmon, Rochon et al, in press) were: 1. In comparison to a control group, ILI resulted in significantly greater weight loss after one year (~11%), which was sustained (~10%) after two years of ILI treatment, 2. Improvement of health indicators (CVD risk factors, quality of life, metabolic measures) were observed for ILI during the two-year study, and 3. Biomarkers for aging were improved relative to the control group.

Evolution of ILI Components: DPP, Look AHEAD, POUNDS Lost, and CALERIE

Table 1 summarizes the most important components of the ILI tested in these four studies.

Table 1. Key ILI components used in four studies: DPP, Look AHEAD, POUNDS Lost, and CALERIE

Component	DPP	Look AHEAD	POUNDS Lost	CALERIE
# of ILI Sessions	16	42	76	68
Group counseling	No	Yes	Yes	Yes
Indiv counseling	Yes	Yes	Yes	Yes
Enhance Adhere	Yes	Yes	Yes	Yes
Diet Prescription	CR + Reduced FI	CR	CR	CR
Exercise Goal	150 min/wk	175 min/wk	90 min/wk	N/A
Weight Loss Goal	7%	10%	N/A	Individualized
ILI Duration	24 weeks	1 year	2 years	2 years
Follow-up Dur	10 years	8 years	2 years	2 years
Use of MR	No	Yes	No	Yes
Use Toolbox	Yes	Yes	Yes	Yes
Use CTS	Yes	Yes	Yes	Yes
Use Math Models	No	No	No	Yes

Abbreviations: DPP = Diabetes Prevention Program, Look AHEAD = Action for Health in Diabetes, POUNDS Lost = Preventing Obesity Using Novel Dietary Strategies, CALERIE = Comprehensive Assessment of Long term Effects of Reducing Intake of Energy, # = number, ILI = Intensive Lifestyle Intervention, Indiv + Individual, Adhere = Adherence, Dur = Duration, MR = Meal Replacement, CTS= computer tracking system, CR = caloric restriction, FI = food intake, min = minutes, wk = week, N/A = not applicable.

One striking difference across the studies (ordered in terms of beginning dates) is that the number of sessions and the overall duration of ILI systematically increased over time. Also, the ILI of DPP only used individual counseling and the other three studies used a combination of individual and group counseling. The ILIs of all four studies utilized components to enhance adherence to diet and exercise prescriptions. These components included training a variety of skills ranging from problem-solving and relapse prevention to self-regulation of body weight. All of the ILIs prescribed some form of caloric restriction (CR) and 2 of the 4 used meal replacement programs to assist participants maintain consistent CR. All of the ILIs made use of toolbox strategies to assist motivation of participants who were struggling. The four ILIs used computer tracking systems (CTS) to monitor various performance indicators and as computer technology improved, the sophistication of the CTS improved. Finally, only the CALERIE study used a weight loss tracking system using mathematical modeling of weight loss (Pieper, et al, 2011; Thomas, et al, in press) to individualize weight loss goals based on the age, sex, and initial height and weight of the individual.

Summary

Over the past two decades, the methodology for delivering highly effective ILI for overweight and obesity in adults has significantly advanced. These advances are exemplified by the four multi-site, NIH-sponsored clinical trials that were highlighted in this section. Several important conclusions are warranted from the findings of these four studies: 1. Modest, but clinically meaningful weight loss and improved health can be achieved by ILI, 2. Types of adults who are responsive to ILI are very diverse; the four populations of the studies were quite different, ranging from type 2 diabetes (Look AHEAD) to pre-diabetes (DPP) to healthy overweight/obese (POUNDS Lost) to healthy non-obese (CALERIE), 3. Weight losses and health improvements were sustained for 2 to 8 years after initial ILI, and 4. ILI can be

delivered in a variety of sub-populations, with equal degrees of effectiveness; these sub-populations range from all ethnic and cultural groups to both men and women and to rural and urban citizens.

Recent Recommendations about the Structure of Effective Intensive Lifestyle Interventions

Since the original Stuart paper in 1967, hundreds of RCTs and smaller clinical studies have investigated the efficacy of ILI. An important question that has been raised is: What are the key components of effective ILI? This question has been addressed in four recent reviews and evaluations of the research literature (Christian et al, 2010; Jensen et al, 2014; Wadden et al, 2012; LeFevre for USPSTF, 2014). Table 2 summarizes the conclusions from three of these reports for initial weight loss. All three reports concluded that effective ILI for initial weight loss must be at least 20 weeks in duration with ideal content at least 14 contacts during this period of time. There was general agreement about the content and structure of ILI. The intervention program should include: calorically restricted diet prescription, regular and intense exercise programs, educational presentations, self-monitoring (food intake, physical activity, and body weight), feedback from counselors, individual and/or group counseling, and a variety of components to promote adherence to the ILI (e.g., problem-solving, cognitive restructuring, meal planning, etc). Two of the reports emphasized the potential importance of using meal replacement or structured meal programs. All three reports concluded that ILI could be delivered via face-to-face counseling sessions, telephone contact, or using the internet.

Table 2. Summary of Key Characteristics of Effective ILI for Weight Loss

Report	Length of Treatment	Frequency of Contact	Key Components	Types of Delivery
U.S. Preventive Services Task Force (USPSTF) 2014	9-12 months	5-16	<ul style="list-style-type: none"> a. CR Diet b. Intense Exercise c. Educational Presentations d. Self-monitoring e. Individual and/or Group Counseling f. Structured program to enhance adherence 	<ul style="list-style-type: none"> a. Face-to Face b. Telephone c. Internet
2013 Guidelines for Weight Management	6 months or more	14 or more	<ul style="list-style-type: none"> a. CR Diet b. Intense 	<ul style="list-style-type: none"> a. Face-to Face b. Telephone

Jensen et al (2014)			<ul style="list-style-type: none"> Exercise c. Educational Presentations d. Self-monitoring e. Individual and/or Group Counseling f. Structured program to enhance adherence 	<ul style="list-style-type: none"> c. Internet d. Mobile devices
Wadden et al 2012	20-26 weeks	Weekly	<ul style="list-style-type: none"> a. CR Diet b. Intense Exercise c. Educational Presentations d. Self-monitoring e. Individual and/or Group Counseling f. Structured program to enhance adherence 	<ul style="list-style-type: none"> a. Face-to Face b. Telephone c. Internet

Similar conclusions were derived for weight loss maintenance, as summarized in Table 2. The USPSTF did not provide specific recommendations for weight loss maintenance so this source of information is not included in Table 3. Both the 2013 Weight Management Guidelines Committee and Wadden et al (2012) concluded that weight loss maintenance ILI should last at least one year and that contact should be at least monthly to every other week. Also, both reports recommended frequent weighing and the development of weight self-regulation skills. They also recommended continued calorically restricted diets and even more intense and regular exercise (>200 min/wk). Individual and/or group counseling was recommended along with a structured program to prevent relapse. The 2013 Guidelines Committee recommended delivery of ILI for weight maintenance via face-to-face counseling or via telephone, but did not recommend dissemination via the internet or mobile devices.

Table 3. Summary of Key Characteristics of Effective ILI for Weight Loss Maintenance

Report	Length of Treatment	Frequency of Contact	Key Components	Types of Delivery
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2013 Guidelines for Weight Management Jensen et al (2014)	> 1 year	Monthly	a. Continued CR Diet b. Intense Exercise (> 200 min/wk) c. Educational Presentations d. Occasional Self-monitoring e. Individual and/or Group Counseling f. Structured program to prevent relapse	a. Face-to-face b. Telephone
Wadden et al 2012	At least 1/year	Bi-weekly	a. Continued CR Diet b. Intense Exercise (> 200 min/wk) c. Educational Presentations d. Occasional Self-monitoring e. Individual and/or Group Counseling f. Structured program to prevent relapse	Unspecified

One question of critical importance is what is the minimal intensity of ILI counseling of ILI that is necessary to achieve effective weight loss with significant health benefits? Three of the reports addressed this important question (Christian et al 2010; Jensen et al, 2014, and USPSTF 2014). All three reports concluded that high intensity (usually at least 14 sessions in the initial 6 months) was associated with clinically meaningful results. Low-intensity programs were generally ineffective for either weight

loss or improved health.

How Do You Determine Whether a Treatment Yields Clinically Meaningful Weight Loss?

In a 1995 review article, George Blackburn suggested that 5% weight loss might be sufficient to be regarded as clinically meaningful. Prior to the 1990s, weight loss was primarily viewed as a cosmetic outcome with little regard for the association between weight loss and health benefits. When health benefits were considered, most medical professionals advocated much larger weight losses, usually >10% or achieving a “normal” weight level. Furthermore, most cosmetically motivated weight loss programs asked participants to specify an ideal “weight goal” and for most people, this ideal goal required losing considerably more than 5% of initial body weight. In this context, Blackburn’s suggestion that weight loss as minimal as 5% might be clinically relevant was considered to be quite bold.

By the early 2000s, there was considerable support for the idea that relatively small weight losses could result in clinically significant health outcomes (Klein, et al, 2004). In 2002, the results of the Diabetes Prevention Program were published and reported that weight loss as low as 7% (average) could prevent the onset of type 2 diabetes. In 2007, the Food and Drug Administration (FDA, 2007) adopted the following criteria for evaluating obesity drug effectiveness: a product was considered effective for weight management “if after 1 year of treatment either of the following occurs: a) the difference in mean weight loss between the active-product and the placebo-treated groups is at least 5 percent and the difference is statistically significant or b) the proportion of subjects who lose greater to or equal to 5 percent of baseline body weight in the active-product group is at least 35%, is approximately double the proportion in the placebo-treated group, and the difference between the two groups is statistically significant. (p7)” Therefore, by 2007, the 5% weight loss criterion (with some qualifications) was accepted by the FDA for evaluating obesity drug effects.

During this time period, the precise rationale for selecting 5% (as opposed to 4% or 6%) as the criterion for clinical significance had not been documented more specifically than a general conclusion that relatively small weight losses could have significant health benefits. In 2011, Wing and colleagues published a paper based on the Year 1 results of the Look AHEAD study. In this paper, the investigators examined the relationship between per cent weight loss and a variety of health outcomes. By treating per cent weight loss as a continuous variable, correlations between weight loss and health indicators were consistently significant (except for LDL cholesterol) with magnitudes ranging from 0.08 to 0.34. When weight losses were categorized (from Gained > 2% to lost > 15%) improvement of the following health indicators were noted only after participants lost at least 5% body weight: HbA1c, fasting glucose, systolic blood pressure, HDL cholesterol, and cholesterol lowering medications. The findings of this study established the validity of the 5% weight loss criterion as a marker of clinical significance. In 2013, an expert panel formed by the NIH (Jensen, et al, 2014) conducted an evidence-based review around 5 critical questions. Question 1 addressed health benefits of weight loss and specifically: What amount (shown as percent lost, pounds lost, etc.) of weight loss is necessary to achieve benefit with respect to CVD risk factors, morbidity, and mortality? The graded evidence statements that resulted from this effort provide the strongest support for weight loss beginning at 3% to 5% to be considered clinically meaningful. The committee went on to conclude that “increased weight loss amounts provide greater benefits” and that “while most interventions target 5% to 10% weight loss, there is no need to target an

ideal weight” (p S2). Thus, by 2015 the consensus and evidence for 5% weight loss as a marker for clinical significance was strong.

Face-to Face versus Online Delivery of ILI?

Since the publication of the primary findings of DPP in 2002, a primary thrust for research on the efficacy of ILI has been to test different delivery systems for ILI. The two most frequently tested strategies are face-to-face (FTF) counseling in clinical settings and the use of the internet to provide online counseling.

Face-to-Face Counseling. Controlled studies of ILI delivered via face-to-face counseling have proliferated over the past 25 years. For example, in a recent review of this literature, Jensen et al (2013) identified almost 400 studies that addressed this issue and selected 51 trials (74 publications) to make specific recommendations about the strength of the evidence in support of ILI for treatment of obesity in adults. Numerous reviews of the literature have conducted similar analyses (e.g., Wadden et al, 2012). These reviews have concluded that the evidence supporting the efficacy of ILI is strong and that intense (at least 14 sessions) delivery of ILI in clinical settings other than primary care offices generally yield average weight losses of 7% to 10% within the first six months of intervention. Maintenance of weight loss over several years after initial treatment has proven to be more challenging. Jensen et al (2013) concluded that the evidence was strongly supportive of the conclusion that on average participants regain 1 to 2 kg/year, but the amount of weight loss was still greater than control groups such as usual care. For example, the Look AHEAD study reported average weight loss about 5% after 8 years of follow-up and this amount of weight loss was superior to the control group (The Look AHEAD Research Group, 2014).

Online Counseling. Delivery of ILI via the internet has been investigated over the past 15 years and this research literature is not well developed in comparison to the published literature on FTF delivery of ILI. For example, many of the studies of online weight management counseling have durations of six months or less. Also, the methods used in online counseling studies are quite diverse. Nevertheless, the promise of disseminating ILI in non-clinical (face-to-face) settings is very enticing given the public health perspective of providing effective weight management treatment to the entire population without regard to their location or economic circumstances.

Two studies conducted by Tate (2001; 2006) involved six months of online ILI. In both studies, online programs that included human-administered e-counseling (O-Hec) were more efficacious in comparison to online programs that did not include e-counseling (O). In the Tate (2006) study, at 6 months, O-Hec was more efficacious in comparison an automated e-counseling (O-Aec) program which did not differ from the control arm.

One of the primary reasons for studying online weight management programs is that traditional FTF counseling is expensive, inconvenient, and often unavailable to a large portion of the population. One of the great appeals of online weight management programs is that they might yield comparable results to FTF counseling without the expense, inconvenience, and unavailability. An important question is whether online weight management programs yield results that are equivalent to FTF counseling. Two

studies conducted by Harvey-Berino (2002; 2010) directly addressed this question by comparing an online e-counseling program with FTF counseling. In the 2002 study, she reported that after the end of treatment (6 months) there was no difference between the O-Hec program and two FTF arms that differed in terms of frequency of FTF contact. At 12-month follow-up, however, both FTF arms were more effective for weight loss maintenance in comparison to O-Hec. In the 2010 study, she reported similar results after only six months. The addition of one FTF meeting/month to the O-Hec program was not as effective as weekly FTF group counseling sessions. One noteworthy finding from the Harvey-Berino studies and the Tate (2001; 2006) studies is that the online programs with human e-counseling yielded average weight losses at six months ranging from ~5% to ~9%, which are comparable to the average 6-month weight losses of large-scale RCTs such as DPP, Look AHEAD, and POUNDS LOST.

Research concerning long-term maintenance of weight loss that occurred during the first 12 months of treatment has repeatedly found that when participants do not have follow-up counseling sessions, they tend to regain most of their weight loss within a few years. Research by Perri and colleagues (1998) has found that periodic “booster sessions” after Month 12 (e.g., monthly follow-up counseling or telephone consultation) can significantly slow weight regain. One of the great promises of online weight management has been the prospect that it could be used as a more convenient alternative to scheduled booster sessions. Four studies tested online strategies for at least one-year following a weight loss induction period. Three of the four studies (Harvey-Berino, 2004; Cussler, 2008; Wing, 2006) used online strategies that included human e-counseling. The fourth study (Svetkey, 2008; Weight Loss Maintenance Trial) tested an automated e-counseling program that was designed to simulate human e-counseling. In all four studies, online programs with e-counseling were not found to be more effective for preventing weight regain in comparison to a control arm. Despite these negative findings, it is important to compare the weight status at 12 to 18 month follow-up with weight status following initial weight loss induction in the three studies that included human e-counseling. Harvey-Berino (2004) reported no regain at 12-month follow-up. Cussler (2008) reported ~ 10% weight regain at 12-month follow-up, and Wing (2006) reported ~ 30% regain at 18-month follow-up. In summary, online weight management has not proved to be as successful for long-term weight loss maintenance as was hoped 10 years ago, especially in comparison to FTF counseling. However, the overall long-term effectiveness of these online programs is still impressive.

The primary findings of studies of online ILI counseling are summarized below:

1. Employment of human counselors yielded better weight loss and weight maintenance in comparison to automated systems.
2. Online weight management programs (including both human and automated e-counseling) did not yield significantly better long-term weight management in comparison to face-to-face counseling.
3. Online approaches are less efficacious for long-term weight loss maintenance when compared to face-to-face counseling.

Efficacy of ILI: Clinically Meaningful Weight Loss for FTF and Online Counseling (H-ec).

As noted earlier, weight loss of at least 5% has been established as a criterion for clinically meaningful weight loss. Table 4 summarizes the findings of four studies that tested the efficacy of FTF delivery of ILI and seven studies that tested the efficacy of online delivery of ILI using human counselors. As noted in the previous section, the use of human counselors in online counseling has been found to yield significantly greater weight loss in comparison to purely automated online delivery of ILI. The metric of percentage of participants who lost at least 5% body weight was selected to compare the findings across studies.

Table 4. Summary of the clinical effectiveness of FTF and Online Delivery of ILI

ILI Delivery Strategy	Study/Investigator	Duration of ILI	% lost at least 5%
Face-to-Face	DPP	Year 1	60%*
Face-to-Face	POUNDS Lost	Year 2	37%
Face-to-Face	Look AHEAD**	Year 1	68%
Face-to-Face	Look AHEAD	Year 4	47%
Face-to-Face	Look AHEAD	Year 8	50%
Face-to-Face	CALERIE	Mo 6	91%
Face-to-Face	CALERIE	Mo 12	94%
Face-to-Face	CALERIE	Mo 18	94%
Face-to-Face	CALERIE	Mo 24	91%
Online H-ec	Harvey-Berino 2002	18 months	44%
Online H-ec	Harvey-Berino 2010	6 months	52%
Online H-ec	Gabrielle 2011	3 months	37%
Online H-ec	Tate et al 2001	6 months	52%
Online H-ec	Tate et al 2006	6 months	52%
Online H-ec	Webber 2013	12 weeks	52%

*Estimated from the report of Hamman et al (2006) **Included a meal replacement program during Year 1 and used meal replacements throughout the 8 year program in order to facilitate weight loss maintenance.

Abbreviations: DPP = Diabetes Prevention Program, MR = meal replacement program, H-ec = human e-counseling

Can ILI Treat or Prevent Disease?

Preventive Effects of ILI

The DPP study provides the most frequently cited evidence in support of ILI as a lifestyle preventive strategy. This study reported that ILI over the course of about 3 years resulted in significant delays of the onset of type 2 diabetes in comparison to medication placebo and metformin, a medication that helps control type 2 diabetes. The primary findings of DPP were published in 2002: ILI reduced the incidence rate of type 2 diabetes by 58% in comparison to placebo. Later studies reported

that this preventive effect was very robust in that it was observed in participants who were highly at risk for type 2 diabetes and also effective for those at medium and low risk (Sussman et al, 2015). Another study (Hamman, et al, 2006) found that weight loss was the primary driver for prevention of type 2 diabetes and that each kg of weight loss reduced the incidence of diabetes by 16%. A recent meta-analysis of the effects of ILI on mortality (Kritchevsky, et al, 2015) reported that 18 months of ILI had reduced the risk of mortality (death) by 15%. The most famous study of the question whether ILI can reduce the risk of death and/or CVD events such as heart attacks and stroke was the Look AHEAD study. This eight year RCT evaluated whether ILI could reduce CVD events in overweight adults who had been diagnosed with type 2 diabetes. The study was halted after eight years because the incidence of CVD events and death were equivalent between ILI and the control group, primarily because the incidence rates for CVD events were very low (The Look AHEAD Research Group, 2013). Based on the existing evidence, it appears that long-term ILIs may have relatively small effects on overall mortality, but as discussed earlier, has robust effects on CVD and metabolic risk factors. One additional preventive effect of ILI has been investigated in recent years: the effects on biomarkers for longevity. Two studies have reported that on the anti-aging effect of ILI after about 6 months of ILI caloric restriction. These studies reported that ILI and caloric restriction have beneficial effects on several biomarkers of the aging process (Heilbronn, et al, 2006; Ruvussin, et al, in press) in overweight and normal weight adults. It is unclear whether these preventive effects on aging can be sustained after two years, however.

Effects of ILI on Medical Diseases and Problems

As noted earlier, ILI has been found to be effective for reducing CVD risk factors. ILI is also effective for improving a number of other medical conditions. The findings from RCTs testing the efficacy of ILI as a treatment for a variety of medical diseases and problems are summarized below. Evidence for ILI as an effective treatment has been reported for the following medical conditions:

1. Cardiovascular risk factors— The Look AHEAD Research Group (2010, 2013); Wing et al (2011).
2. Liver functioning and disease—Lazo, et al (2010).
3. Partial remission of type 2 diabetes—Gregg, et al (2012).
4. Knee pain—Foy, et al (2011).
5. Mobility—Rejeski, et al, 2012.
6. Sleep apnea—Araghi, et al (2013); Foster et al (2009).
7. Depression—The Look AHEAD Research Group (in press).
8. Quality of Life—Williamson, et al (2009); Williamson & Rejeski (2014).

Importance of Adherence and Retention for Long-Term Effectiveness of ILI

Adherence

Recent evidence from some of the large-scale RCTs, e.g., Look AHEAD and POUNDS Lost, has indicated that the overall engagement of participants and their success at weight loss in the first six to twelve months of ILI may be critical for long-term weight management. In practical terms, the conclusions argue that recommendations to follow a specific diet or a specific exercise program are less important than finding a diet or exercise program that can be consistently followed by each ILI

participant (Jensen, et al, 2014; Pagoto & Appelhans, 2013). As an example, the POUNDS Lost study found no differences in weight loss or CVD risk factor outcomes after two years consuming four macro-nutrient diets that differed in terms of the percentages of fat, protein, and carbohydrates. All four diets were used in the context of calorically reduced meal plans and delivered as an ILI. A recent meta-analysis of studies of the effects of different “diet types” came to a similar conclusion: ILI should use any type of diet that a patient will adhere to lose weight (Johnston et al, 2014). For exercise recommendations, the total amount of time that is spent each week is more important than the actual type of activity that is prescribed, i.e., adherence by the participant to an exercise plan is more important than the specific exercise prescription (Jensen, et al, 2014). An important conclusion derived from many studies is that caloric reduction is more efficacious than increased physical activity for weight loss, but increased activity and physical fitness are very important for long-term weight management (Williamson, Martin, & Stewart, 2006). Taking all of the evidence into consideration, the general consensus is that ILI should incorporate both dietary caloric restriction and increased physical activity in the context of a lifestyle modification program that enhances adherence (Jensen, et al, 2014; Johns, et al, 2014). The importance of adherence, broadly defined, is illustrated by the findings of two recent studies. From the Pounds LOST study, Williamson and colleagues (2010) reported that while four different macro-nutrient diets did not result in differential weight loss, adherence to the components of ILI (including self-monitoring and attendance) were significant predictors of weight loss and health improvement after 6 and 24 months of treatment. Similarly, in the Look AHEAD study, Wadden et al (2011) reported that after four years of ILI, participants who lost at least 10% of initial body weight after one year were very likely (70%) to have maintained at least 5% weight loss after four years. Conversely, participants who failed to lose significant weight (< 5%) after one year were very unlikely (22%) to have lost 5% of body weight after four years of ILI. The most powerful factors that differentiated the two groups were higher attendance, lower caloric intake, and higher energy expenditure by those who lost 10% body weight in comparison to those who lost less than 5% body weight during the first year of ILI.

Retention

Attrition (drop-out rate) in most commercial programs delivered in community settings is very high, i.e., 35% to 70% in the first year of treatment (Grave, et al, 2006). Most research studies diligently work to reduce drop-outs and to increase retention. They also use a statistical method called intention-to-treat (ITT) analysis to control the effects of attrition on outcomes (Detry & Lewis, 2014). Failure to use ITT analyses can lead to flawed results. The attrition from research studies is typically lower than that of commercial programs, delivered in the “real world.” One often unstated feature of modern clinical studies is that they screen out potential drop-outs by a complex process that includes requiring potential enrollees to attend a series of pre-randomization clinic visits, self-monitor diet and exercise for two weeks, and to undergo a series of interviews that are designed to identify potential barriers for success. Potential enrollees who fail to successfully complete any one of these pre-randomization requirements are never considered a participant and are never randomly assigned to a treatment arm. This process creates a siphon that reduces the number of people who respond to initial advertisements to a small portion of the original cohort. The lengthy process of entering the study had the effect that a large portion (~40%) of the potential volunteers drop-out before they enroll in a study. This observation is important for two reasons: 1. Evaluation of attrition rates in

research settings and 2. Voluntary attrition before initiating ILI partially determines attrition during treatment.

What happens to Participants who Drop Out and Why Did They Drop Out?

Very little is known about the weight loss outcomes of people who drop out of ILI. Grave, et al (2006) reported on a retrospective study of 1000 people who had dropped out of ILI three years earlier. They reported that at three year follow-up, people who completed treatment had lost more weight than those who dropped out (5.2% vs 3.0% weight loss) and that the most common reasons for dropping out were logistical problems such as long travel time to clinics, scheduling conflicts, and financial problems, and unsatisfactory weight loss results. Interestingly, 8% of dropouts were confident that they did not need professional weight management treatment and these participants lost 6.5% body weight after three years. Thus, not all people who drop out of ILI are failures, but staying in treatment appears to be beneficial for most people.

Scientific evidence pertaining to adherence to ILI indicates that it may be one of the key drivers of successful weight loss and that it is important to strive for high levels of retention. The structure of ILI has evolved to enhance adherence to changes in dietary and exercise habits. Therefore, ILI is specifically designed to promote adherence, which is the most likely explanation for why ILI has been found to be more efficacious for long-term weight management in comparison to interventions that rely exclusively on dietary or exercise prescriptions.

Retention is a more complex topic. Two findings are important for a proper understanding of the significance of retention: 1. People who drop out generally do not lose appreciable weight (though there are exceptions) and 2. People who do not lose clinically meaningful weight in the first year of ILI are unlikely to lose significant weight over the next three years. The first finding suggests that in order to maximize weight loss at the population level, it is important to attempt to minimize attrition. The second finding suggests that in order to conserve resources and to ultimately reduce health care costs associated with ILI, it is important to focus primarily on people who lose significant weight during the first year of ILI. One study of the association of adherence and weight loss reported that early adherence during the first six months of ILI were most important for long-term success (Williamson, et al, 2010). Putting all of these findings together suggests a need for balance between enhancing adherence and retaining individuals who are less responsive to ILI during the initial phases of treatment. If the proper balance can be achieved, maximal weight loss and health benefits can be achieved while simultaneously conserving resources and reducing the cost of delivering ILI.

Can ILI save Health Care Dollars?

The results of the hundreds of studies of ILI have established that intensive clinic-based lifestyle treatment and online counseling using human coaches can have remarkably strong preventive and treatment effects on obesity, type 2 diabetes, and an array of other medical conditions. An important question is: Does ILI save health care costs? Consider type 2 diabetes. The direct costs of traditional diabetes management are only 23% of the total annual health care costs of the disease. In other words, the costs associated with the medical consequences of type 2 diabetes account for 77% of the total

costs. Therefore, consideration of the costs and benefits of ILI must take into consideration the direct costs of delivering ILI and the indirect benefits associated with reducing the costs of living with or developing type 2 diabetes. In 2010, Li and colleagues reviewed studies of the cost-effectiveness of preventing and controlling type 2 diabetes. They included 56 studies from 20 countries. One of their conclusions was that ILI was found to be **very** cost-effective for preventing type 2 diabetes among people diagnosed as pre-diabetic. The study that investigated this question most intensely was DPP and the 10 year follow-up study DPPOS. As noted by Brink (2009), the initial three-year results of DPP “blew the lid off some long-standing assumptions” (p57) associated with the prevention of type 2 diabetes. The results suggested that many of the 57 million Americans with this disease could be spared much of the suffering (and cost) associated with diabetes. A series of studies has investigated the cost-effectiveness of DPP. Herman et al (2005) reported on the initial DPP costs and benefits and concluded that ILI, in comparison to placebo, resulted in substantial health care benefits relative to costs (~\$8800 per quality-adjusted life year saved). Based on the DPPOS findings (DPP Research Group, 2009), two subsequent cost-effectiveness analyses came to similar conclusions: in comparison to placebo, ILI is highly cost-effective (Herman et al, 2013; The DPP Research Group, 2012).

A second study that has undergone extensive cost-effectiveness analyses is Look AHEAD. This clinical trial tested the efficacy of ILI in comparison to a control group for treatment of overweight type 2 diabetics and prevention of CVD. After the first year of ILI, medication cost was reduced \$480 per year in comparison to the control group (Redmon, et al, 2010). After 10 years of ILI, Espeland and colleagues (2014) reported that in comparison to the control group, ILI reduced annual hospitalizations by 11%, hospital days by 15%, and number of medications by 6%. These reductions in costs represented 10% cost savings for hospitalizations and 7% cost savings for medications. They estimated the mean relative cost savings of ILI to be \$5280 per person.

These cost-effectiveness studies clearly indicate that relatively labor intensive face-to-face ILI can save health care costs. As Brink (2009) queried: “Can these carefully planned and orchestrated interventions really be replicated outside of trial settings and prove useful in the real, messier, less organized world?” (p58). There is reason for optimism. Numerous studies and reviews (Hamman, et al, 2006; Jensen, et al, 2014; Wing, et al, 2011) have concluded that the health benefits of ILI are primarily driven by the amount of weight loss and the relationship between health benefits and weight loss is continuous, i.e., the more weight that you lose, the greater the health benefits. As noted in Table 4, many studies have delivered ILI via online counseling that uses human coaches and these studies (that are less labor intensive and more convenient) have yielded average weight losses that are almost as strong as ILI delivered via FTF counseling. The great challenge from a public health perspective is whether these less labor intensive (and less costly) strategies can yield health benefits that rival those of DPP and Look AHEAD. If this challenge is met, then the answer to the question of cost savings by using ILI will be answered “yes.”

Who Can Benefit from ILI?

Face-to-Face Counseling

One of the positive features of ILI delivered in traditional clinical settings is that it seems to be equally

effective for many sub-populations. For example, DPP exclusively treated pre-diabetics; Look AHEAD exclusively treated adults who had been diagnosed with type 2 diabetes; Pounds LOST treated healthy overweight and obese adults; CALERIE treated healthy overweight and normal weight adults. As noted earlier, all four RCTs resulted in clinically meaningful weight losses and weight loss maintenance and the results across the four studies are remarkably similar. Furthermore, comparisons of sub-groups within these cohorts of these studies have reported that comparable weight loss results were found for men and women and all ethnic groups ranging from blacks and whites to native Americans (Wadden, et al, 2011). Similar findings were reported for prevention of type 2 diabetes in DPP (The DPP Research Group, 2002). In Look AHEAD, participants with severe obesity (BMI > 40) versus less severe obesity or overweight had equivalent weight loss and CVD risk factor outcomes and they were equally adherent to the ILI program (Unick, et al, 2011). Also, in DPP, type 2 diabetes was prevented by ILI for all participants, ranging in risk status from low to high (Sussman, et al, 2015)

Online Counseling

Online weight management programs have been reported to be efficacious for a variety of sub-groups, Ranging from Healthy Overweight/Obese to Pre-diabetes (Tate, 2003). Special populations treated using online ILI include Air Force active duty Soldiers (Hunter, 2008) and hypertensive obese patients (Bennett, 2010). In summary, online weight management programs using human e-counseling have reported efficacy for weight loss in a wide variety of populations, and is not contraindicated for people with significant medical problems.

Alternative Methods for Weight Loss and Maintenance

There are many strategies for losing weight that differ significantly from ILI. Three approaches have been studied intensively: 1. Commercial Weight Loss programs, 2. Weight Loss Medications, and 3. Weight Loss Surgery. The evidence supporting the use of these strategies is reviewed next.

Commercial Weight Loss Programs

Most ILI research has been conducted in academic medical research centers. Over the past 30 years, a large commercial weight loss industry has developed in an effort to deliver effective weight management to the general public. As noted in a review written by Tsai and Wadden (2005), there have been few controlled studies, e.g., RCTs, of commercial weight loss programs, but a few of the biggest providers of commercial weight loss programs, e.g., Weight Watchers and Jenny Craig, have sponsored RCTs to evaluate the efficacy of specific programs (Gudzune et al, 2015). A major shortcoming of studies of commercial programs in the real world is that they generally fail to adequately manage the problems associated with attrition (Tsai & Wadden, 2005). Problems associated with attrition greatly influence the conclusions that can be derived from these studies. Attrition in these studies is often quite high, e.g., > 50% of the cohort. Early studies of commercial programs typically reported weight loss only for those who completed various lengths of treatment, though this problem has been rectified in more recent RCTs (Gudzune et al, 2015). Reporting only data from “completers” is widely regarded to yield biased results and is highly discouraged in more rigorous RCTs such as those testing ILIs in the last decade. A second shortcoming of research on the efficacy of commercial weight loss programs is that they seldom

report long-term results. For example, Tsai and Wadden (2005) found only one study that reported long-term (2 year follow-up) weight loss. A more recent review of this literature (Jensen et al, 2014) noted similar problems. They concluded that the strength of the evidence in support of the efficacy of commercial programs was “low.” There have been a few notable exceptions, however.

One of the stronger studies of a commercial program was recently reported by Donnelly et al (2013). This study tested the efficacy of Health Management Resources (HMR) products and programs for weight loss over 6 months and weight maintenance over 12 months. Treatment was delivered via FTF counseling and via telephone. The primary intervention was replacement of **all** meals using HMR products during the first 6 months and replacement of 14 meals per week during the 12 month follow-up period. Average weight losses at Month 6 were impressive: 12.3% for telephone and 13.4% for FTF. At Month 18, average weight losses were 7.4% for telephone and 8.5% for FTF. Also, a series of RCTs conducted by Rock and colleagues (2007, 2010, 2014) have tested the efficacy of the Jenny Craig program for periods as long as two years. These studies reported average weight losses between 5% and 10% and they found that over half of the cohort lost at least 5% of initial body weight. Jenny Craig also requires participants to replace all three meals. One problem with most commercial weight loss programs is a focus is on selling products, e.g., foods, not on changing lifestyle behaviors. One final statement about commercial weight loss programs is warranted: Most commercial programs utilize some type of lifestyle counseling as a part of the program. There is a clear need for high quality delivery of ILI for the general public and recent technological developments may make turn this need into reality.

Weight Loss Medications

The search for highly effective and safe medications for weight loss and long-term weight maintenance has spanned at least 25 years. Unfortunately, this history has been filled with hope and despair as effective medications are discovered, used, and then found to have significant adverse side-effects (Bray, 2002). Partly because of this tenuous history, the FDA went 13 years before approving a new weight loss medication (lorcaserin) in 2012. Yanovski and Yanovski (2014) reviewed the most recent evidence pertaining to the safety and efficacy of weight loss medications. They reported four drugs had been approved for long-term (> a few weeks) usage: Orlistat (Xenical), Lorcaserin (Belviq), Phentermine combined with Topiramate ((Qysmia), and Bupropion combined with Naltrexone (Contrave). Since that review, a fifth medication, Liraglutide (Saxenda), has obtained FDA approval for long-term use (Kumar & Aronne, 2015; Ryan, 2015). All of these medications are recommended for use in conjunction with ILI (Fujioka, 2015). Thus, the primary aim of weight loss medications is to enhance the efficacy of ILI, especially for patients who are struggling to lose weight. One study (Wadden et al, 2009) reported failure of the use of Orlistat as a “rescue” strategy for participants who were not losing weight. Most RCTs pertaining to the safety and efficacy of weight loss medications initiate drug therapy immediately, i.e., at the beginning of treatment. Therefore, there is limited research on the efficacy of combining ILI and weight loss medications after unusually low weight loss during the initial phase of ILI. When used as an initial treatment strategy, Orlistat and Lorcaserin yield about 3% greater weight loss than placebo and the combination of Phentermine and Topiramate results in about 9% greater weight loss than placebo (Yanovski & Yanovski, 2014). Liraglutide and Bupropion/Naltrexone yield about 4% to 6% additional weight loss (Kumar & Arrone, 2015). Given the limited efficacy of these medications and the costs associated with long-term use, the search for an effective, safe weight loss medication

continues. In the meantime, the 2013 Guidelines for weight management (Jensen et al, 2014) recommend the use of weight loss medications as an adjunct to ILI in adults with BMI of at least 30 or BMI of at least 27 with one or more co-morbid medical conditions.

Weight Loss Surgery

Over the past 30 years, five types of weight loss (bariatric) surgery have been tested (Jensen et al, 2014). The 2013 Guidelines recommend the use of bariatric surgery as an adjunct to ILI in adults with BMI at least 40 or 35 with one or more co-morbid medical conditions. Jensen et al (2014) concluded that the strength of the evidence for the efficacy of weight loss surgery was “high.” Average weight losses after 2 to 3 years after surgery were found to be between 20% and 30% of initial weight. They also concluded that obesity-related conditions, such as type 2 diabetes, are significantly improved after surgery. The strongest evidence for weight loss efficacy was found for laparoscopic adjustable gastric banding and the Roux-en-Y Gastric Bypass surgery. Short and long-term medical complications stemming from weight loss surgery vary by procedure and patient characteristics such as extreme obesity and the presence of CVD. The incidence of complications ranges from about 1% to 8%. Thus, bariatric surgery can be very effective, but it is reserved for adults with extreme obesity and/or obesity with one or more co-morbid medical conditions. These adults have generally been unable to lose clinically meaningful weight via ILI and are very much at risk for severe medical consequences.

Myths about Weight Management, Diet, and Exercise

Over the past 20 years, misunderstanding about safe effective weight loss strategies has become very widespread. These so-called “myths” have resulted in considerable confusion among the public and has led to the development of numerous ineffective and in some cases, dangerous, solutions to the obesity epidemic (Casazza, Fontaine, Astrup et al, 2013; Cohen, 2013). This section provides scientific evidence concerning a few of the more egregious examples of popular myths pertaining to diet, exercise, and weight loss.

De-tox Methods are Safe Effective Weight Loss Strategies

Common detoxification methods include juice diets, fasts, and various trendy “cleanses.” The scientific basis for this practice comes from medical detoxification related to ending alcohol and drug dependence in addicts. This practice in healthy overweight adults is considered by some to be essential for ridding the body of toxins that are accumulated over time. These advocates believe that these strategies are both healthy and safe. Skeptics, however, believe that these treatments are unnecessary, ineffective, and often unsafe. So, what is known about de-toxing? The answer, from a scientific perspective, is: Not Much. No RCTs pertaining to the efficacy and safety of de-toxing have been conducted. Furthermore, given the ethics of conducting such trials, it is unlikely that such trial will be conducted in the future. A few things are known, however: 1. The body is **not** systematically collecting toxins, 2. Illness is **not** caused by toxins, 3. De-tox methods do **not** remove “toxins” from the body, and 4. Many of the suggested methods, e.g., coffee enemas, are unsafe.

Natural or Herbal Weight Loss Supplements are Safe and Effective

These products are not tested for efficacy or safety. They are not regulated by the FDA. Very few have been studied in RCTs. Many of these products have contained substances that have been banned by the U.S. government because they have been found to be unsafe. Even the quality of these supplements is unknown since they are not inspected by the FDA. Therefore, whether they include the “specified” active ingredients is unknown. Use of these products must be questioned by people who value the necessity of careful testing to establish the safety and efficacy of products ranging from electronics to foods.

Skipping Meals is a Good Way to Lose Weight

Skipping meals is often associated with increased (ravenous) hunger and increased drive to eat large amounts of food. The most common recommendations of ILL are to eat at least 3 regular meals per day in a consistent pattern, e.g., same times of the day and ideally in the same settings. Research concerning appetite and eating have consistently shown that a consistent pattern of eating is associated with periodic increases and decreases in glucose, insulin, and subjective feelings of hunger and satiety that set the occasion for the next meal or snack. Therefore, for most people, skipping meals simply leads to compensatory eating that does not lead to an energy deficit resulting in weight loss.

Starvation is the Best Way to Lose Weight

Similar to the previous myth, there are significant problems with the idea that the best way to lose weight is through starvation. This idea is probably caused by the fact that it tends to “work” over a very short time period, e.g., a few days. These so-called “crash diets” generally result in rapid weight loss, including considerable fluid loss. It is difficult to maintain starvation regimens for more than a few days to a week, however. Then, the person is ravenously hungry and once they begin eating, they cannot stop eating. These crash diets are not only ineffective for long-term weight management, but are also potentially dangerous, with side-effects ranging from fainting to extremely low blood sugar.

A Radical Exercise Regimen is the Best Way to Lose Weight

Successful weight loss and especially long-term weight maintenance typically involves making small changes in your exercise routine and in activities of daily living. These changes can start small, e.g., as few as 90 minutes per week, and gradually be expanded to more than 200 minutes per week. For the purposes of weight loss, the intensity of the work out or other activity does not need to be extreme. Recent research has demonstrated that frequent short-duration exercise can be as effective as lengthy intense exercise if the short-duration exercise becomes a feature of the person’s normal lifestyle.

You can Spot Reduce for Tight Abs and Toned Arms

From the perspective of weight management, it is best to exercise the entire body rather than focusing on one body area for toning. People who are overweight or obese, first need to lose body fat. During the process of losing weight, some muscle mass will also be lost, in most cases. Therefore, inclusion of whole-body exercise, e.g., walking, jogging, aerobic exercise, etc, is advisable. Inclusion of resistance training, especially after improvement of fitness, is also advised.

No Pain, No Gain

This mantra of the gym is so well known that virtually everyone knows it and almost everyone believes it. Yet, from the perspective of weight management, it is not only a myth, but also potentially damaging. People who are overweight or obese are frequently not physically fit. Therefore, it may be unsafe to engage in extreme exercise (that produces pain). Also, people tend to avoid activity that produces “pain.” If a lifestyle goal is to establish a consistent plan for increased physical activity, this mantra could cause harm by motivating avoidance of exercise and the continuation of a sedentary lifestyle.

Carbohydrates Cause Weight Gain

Over the past two decades, many dietary villains have been proposed ranging from dietary fat to sugar. One common villain has been carbohydrates, focusing on starches like pasta and bread. Research on the weight loss effects of different macro-nutrient diets has led to a general conclusion that exclusive focus on the consumption of specific foods or the avoidance of other specific foods is a misplaced focus. Eaten in the proper quantities, carbohydrates do not cause weight gain. Furthermore, numerous studies have concluded that the number of calories consumed is the primary determinant of weight loss. Therefore, eating carbohydrates in moderation is quite healthy and can be a part of a healthy lifestyle over the course of many years.

Healthy Foods Are More Expensive

This myth seems to stem from the “foodie” emphasis of using fresh fruits and vegetables and the notion that these ingredients must be more expensive than other foods. Close examination of the costs of healthy and easily accessed foods shows that it is entirely possible to select healthy food options that are very affordable. The general recommendations of ILI are to consume more home prepared meals and fewer fast-food and restaurant prepared meals. These home cooked meals can be low in calories, and prepared with relatively inexpensive but nutritious ingredients.

Exercise Turns Fat into Muscle

The cells of fat and muscle are completely different types. When you lose weight, you should lose body fat by shrinking fat cells. They do, however, remain fat cells. When you exercise you should gain muscle mass, but you do not convert fat cells to muscle cells.

Reasons for Optimism: Innovations in the Past Five Years

Over the past five years a variety of innovations have been tested which have created a realistic scenario for developing an effective and less costly system for delivering ILI to the population at large. These innovations are primarily derived from advances in information technology and from the use of “big data” strategies. These innovations are described in the following sections.

Online Live Digital Videoconferencing

As noted in the review of ILI delivered via online counseling, this approach can yield impressive weight losses when human e-coaches are utilized. One disadvantage of earlier internet-based approaches was

that they were constrained by the technology at those earlier times; it was not possible to simulate FTF counseling via the internet. With the advance of live online videoconferencing, it is now possible to meet in “virtual” groups and converse directly with counselors and fellow group members. This conversation can be accomplished orally or through written text. This innovation makes it possible to bring the FTF counseling experience to participants in a variety of settings (e.g., work or home) and this experience is not limited to a clinic setting which is time consuming, expensive, and inconvenient.

Mobile Applications

Over the past few years, smart phones have gone from being a novelty to being ubiquitous. As noted in a review by Mosa et al (2012) health care applications for mobile devices have exploded. Now it is commonplace to use smart phones for monitoring food intake and activity, searching for health information, and communicating with others with similar interests, e.g., health behavior change. In combination with live videoconferencing, mobile applications have enormous potential for delivering ILI any place with internet access.

Computer tracking systems

In recent studies, sophisticated computer tracking systems (CTS) have been developed to monitor various aspects of adherence including tracking changes in body weight, self-monitoring of food intake and physical activity, attendance to appointments, and changes in hunger and satiety. When CTS data reflect poor adherence, problem-solving strategies can be used by the participant to modify their lifestyle, e.g., eating and activity, so that adherence can be improved.

Mathematical models of Weight Loss

Another recent innovation is the development of mathematical models for expected rate of weight loss for ILI (Brady & Hall, 2014; Thomas et al, 2015). These mathematical models can be individualized for each participant. Weight loss trajectories can be adjusted by sex, age, height, and starting body weight (Rickman et al, 2011). Also, this information can be instantaneously displayed as feedback to the participant and to online counselors. This innovation provides an electronic guide for individualized weight loss on a prescribed schedule that is both safe and effective. A recent study reported by Marin et al (in press) combined the use of mathematical modeling of weight loss with a mobile application that employed human e-counselors. This pilot study reported average weight loss of 8% after only three months of ILI. This study illustrates the power of integrating modern technology with the basic strategies of ILI that have been developed and tested over the past 40 years.

Wearable technology

With the increase of smart phone utilization, has come an explosion of software applications that can be used to monitor food intake, physical activity, and changes in body weight. Experts in the field of mobile health innovation expect these developments to lead to wearable technology that will automatically track behaviors related to food intake, physical activity, and body weight and provide instant feedback to the wearer. When combined with an electronic record that incorporates CTS data from mobile technology, the HCP will be able to remotely monitor adherence and progress toward weight goals.

Training Weight Loss Counselors

The traditional counselors for both FTF and online ILI programs have been professionals with

backgrounds and training in nutrition, exercise physiology, psychology, and other health care fields. In fact, recent guidelines about the use of ILI for obesity treatment have explicitly recommended the use of professionally trained counselors in order to achieve clinically meaningful outcomes (Jenson et al, 2014; USPSTF, 2014). However, as noted by Brink (2009) and as recommended by the 2013 Guidelines (Jensen et al, 2014), there is great need to investigate the “personal characteristics, skills, and training required of a lifestyle interventionist” (pS28). In recent years there have been at least two studies that have trained paraprofessionals to function as lifestyle counselors in order to test strategies for translating ILI into a cost-effective intervention that can be utilized in community settings. In the first study, Perri et al (2008) trained employees of Cooperative Extension Service offices in rural Florida to deliver ILI. The average wage of these employees was \$10.50 per hour. Over a one year study period, these paraprofessionals utilized ILI to produce average weight losses of 10% after 6 months and 9% after 12 months; these weight losses were significantly better than those in the control group. The second study was reported by Ackerman et al (2008). In this 12 month study, YMCA employees were trained to deliver ILI. These paraprofessionals produced average weight losses of 6% at months 6 and 12. The results of these two studies of paraprofessionals trained to deliver ILI reported very encouraging results; average weight loss was comparable to those reported for FTF and online ILI that employed highly specialized professionals as counselors. Thus, preliminary evidence supports the continuation of efforts to train paraprofessionals to deliver ILI for entire communities that live in the disorganized, messy real world.

ILI for Weight-related Problems and the Affordable Care Act

Prevention of disease is one of the key features of the Affordable Care Act (Brink, 2009). Recently, The US Preventive Services Task Force (LeFevre for the USPSTF, 2014) recommended offering or referring adults who are overweight or obese with one additional CVD risk factor to ILI to promote healthy diet and physical activity to prevent CVD. Recommendations of the USPSTF mandate coverage under the Affordable Care Act (ACA). This development can be interpreted to mean that health care insurers are now required to cover ILI for overweight or obese adults with at least one co-morbid CVD risk factor. Thus, ILI for obesity has moved from a novel weight loss strategy in 1967 to a mandated intervention for obesity in 2015.

How Does Wellness Differ from ILI?

Wellness is generally viewed as another term for alternative medicine that focuses on a range of human features ranging from physical health to spirituality. Wellness can, in principle, be applied to everyone, but it is generally viewed as a life enhancement strategy that is especially relevant to adults who are relatively healthy and are motivated to stay healthy. In contrast, ILI for obesity has been primarily offered to overweight or obese people with the explicit rationale to prevent or treat a variety of obesity-related medical problems. Given the recent recommendations of the USPSFT, it is best to regard ILI as a type of preventive medicine for people who are at risk for cardio-metabolic disorders. The term wellness might be reserved for using similar procedures for relatively healthy people.

Preventive Lifestyle Medicine: Looking to the Future

Lifestyle medicine is a new buzzword in the health care field. The success of ILI for obesity, as documented in hundreds of clinical trials over the past 40 years, is one of the major success stories of lifestyle medicine. As documented in this paper, ILI has evolved from very humble origins and now

incorporates innovative technology that was not available even five years ago. Undoubtedly, this innovation will continue as new technology is developed and adapted to assist people change their lifestyles to promote healthy eating, more physical activity, and less body weight. Given all that has been learned over the past few decades, these changes, if achieved at a population level, will stimulate longer and healthier lives with a higher quality of life. Most of these changes will involve prevention of disease at a population level and at an individual level. This vision needs a new name: **Preventive Lifestyle Medicine.**

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Supplemental Material

Understanding the Science: Research Design and Interpretation of Findings

The transition between conceptualizing obesity as a cosmetic problem to a medical problem determined many other changes in the scientific study of weight management strategies. With the recognition of the developing obesity epidemic (Flegal, et al, 1998), an urgent need for intense scientific investigation of obesity treatment was designated by government and industry leaders (Field, et al, 2002). Before the mid-1990s, most studies of obesity treatment were relatively low-cost and small in scale (Williamson & Perrin, 1996). After the mid-1990s, the National Institutes of Health began funding large-scale weight management trials that targeted weight loss as well as disease prevention. The Diabetes Prevention Program was the first of many such studies. These new multi-site large scale clinical trials were quite costly and required the use of the very best scientific methods that were available. This section describes some of the most important considerations in the design, conduct, and interpretation of results of modern clinical trials. Understanding these concepts is very important for evaluating the science behind the development and validation of the many weight management strategies over the past two decades.

Importance of Randomized Controlled Trials (RCTs)

In modern medicine and obesity treatment, RCTs are considered the gold standard for evaluating the efficacy of an intervention (Jensen et al, 2014). The first randomized experiments were in the field of psychology (Pierce & Jastrow, 1885) and were popularized by Fisher's writing in the field of agriculture in the 1920s and 30s. The first medical RCT was published in 1948 by Hill and colleagues. The advantages of RCTs for evaluating the efficacy of medical or behavioral interventions are many, including the reduction of bias and enhancement of inferring causal relationships between treatment and outcomes. The use of RCTs is presumed to yield more scientifically valid conclusions in comparison to purely observational cross-sectional or longitudinal studies. Cross-sectional studies simply compare two or more groups at the same point in time. For example, a study might report that obese people consume more artificial sweeteners in comparison to non-obese people. One could conclude that consuming more artificial sweeteners causes obesity. Or one could conclude that people who are obese consume more artificial sweeteners because they are trying to either lose weight or at least not gain more weight. The point is that from cross-sectional studies, you cannot determine what causes what, i.e. artificial sweeteners could cause obesity or obesity could cause people to consume artificial sweeteners at a higher frequency in order to avoid weight gain. Longitudinal studies observe the same individuals over time and also examine associations between variables that are measured. For example, a study might report that people who gain weight consume more artificial sweeteners in comparison to those who do not gain weight. You can see the same cause and effect confusion. Does increased artificial sweetener consumption cause weight gain? Or do people who are gaining weight consume more artificial

sweeteners in an attempt to stem weight gain. As with cross-sectional studies, there is no way to validly answer such cause and effect questions. Only through the design of well-constructed RCTs can questions of cause and effect (and therefore effectiveness) be validly addressed. There are many subtle features that influence the quality of RCTs. Some of the nuances of well-conducted RCTs are discussed in the next sections.

Random Assignment of Participants. One key feature of RCTs is that participants must be randomly assigned to treatment groups. In the most simple research design for a RCT, there are two groups: 1) active treatment and 2) control. In this simple design, a cohort of participants is assembled and they are randomly (like flipping a coin) assigned to either the treatment group or the control group. By the use of random assignment, pre-existing characteristics of participants, e.g., age, sex, weight, etc, cannot be used to select the most highly qualified participants for participation in one of the groups, e.g., active treatment. This “selection bias” is controlled by randomization. One implication of the use of random assignment is that it is not permissible to compare people who are already receiving active treatment to a control group of convenience. Earlier studies that compared treatment often used this flawed approach.

Experimental Hypotheses and Type 1 and Type 2 Errors. Another central feature of RCTs is that prior to beginning the study, the investigator makes certain predictions about the effects of treatment on outcomes in comparison to the control group. For example, in weight management studies, a common hypothesis would be: The active treatment group will lose more weight in comparison to the control group. This simple design requires two groups (treatment and control) and pre-and post testing (of body weight). The statistical design of RCTs is based on the probability of finding no difference between the treatment group and the control group, which is called the null hypothesis, and is the exact opposite of the experimental hypothesis. Properly designed RCTs attempt to minimize the likelihood of concluding support for the experimental hypothesis when it is in fact false (called type 1 error). They also try to minimize the likelihood of failing to find a positive effect of treatment when it is in fact effective (called type 2 error). Many features of modern RCTs are designed specifically to avoid these types of errors. Inclusion of these design features is very important for deriving valid findings from an investigation.

Sample Size and Statistical Power. Decisions about whether the experimental hypothesis is supported or not supported by the evidence from a study are based on inferential statistics. If the number of participants in a study is very small, then the experimental evidence is unlikely to support the experimental hypothesis by not finding a significant effect (type 2 error). This problem is caused by “low statistical power”. If the sample size of a study is very large, significant (but not clinically meaningful) effects of treatment can be found, but the results are trivial. One key feature of modern RCTs is that the statistical power of the study is based on the expectation of a clinically meaningful effect of treatment *and* an adequate sample size. Decisions about statistical power and sample size should be made prior to initiating a RCT.

Recruitment of Participants. In most RCTs, the people who are recruited can be defined using what are called inclusion (e.g., obese, male or female) and exclusion (e.g., absence of serious medical problems such as cancer) criteria. The reason for carefully defining the study cohort is to be able to

generalize the findings to a particular group of people, and not to all people. Thus, the findings of studies that only recruit healthy obese adults should not be generalized to overweight type 2 diabetic patients and the converse is also true.

External/Ecological Validity. All RCTs are designed with the intent to generalize the findings from an experimental or clinical setting to a real-world community setting. Unfortunately, many of the features to strengthen the internal validity of the study, e.g., stringent inclusion /exclusion criteria and tight control over drop-outs, have the impact of making the conclusions of the study less easily generalized to the real world. A common problem related to recruitment is that the RCT is usually designed to sample participants from a defined population, e.g., overweight type 2 diabetic patients, but can only select those participants that are available for study. Thus, by definition, the participants are not a random selection of people from a distinct population; they are the people who volunteered for the study. In summary, the design of RCTs is often a balance between good internal and external validity.

Threats from Attrition. As noted earlier, the sample size of a study cohort must be carefully considered before beginning the RCT. Inevitably some participants will drop-out of the study before it ends (called attrition) and others will not sufficiently adhere to the treatment procedures. The effects of attrition and poor adherence generally “water down” the effectiveness of the treatment. Therefore, if the investigators only report the results for those who completed the study (called completers) the results can only be viewed as a “best case scenario”. In the period before modern RCTs (~ pre-2005) pertaining to obesity, RCTs often only reported the results of completers. Thus, the results of many of these studies can be questioned. The solution to this problem was the use of intent-to-treat (ITT) statistical analyses (Detry & Lewis, 2014). Now most RCTs report both ITT and completer analyses. When using ITT analyses, adherence is treated as random (uncontrolled) error but the missing outcome values for all drop-outs are replaced with reasonable (and conservative) approximations. This procedure is called imputation. Studies with large attrition rates, e.g., > 50% in the first year, cannot be salvaged even using ITT analyses. Therefore, careful scrutiny of attrition rates and the use of ITT analyses are very important when deriving conclusions from otherwise very well controlled RCTs.

Choice of Control Group(s). RCTs generally (but not always) include at least one relatively inactive “intervention” that is used as a comparator to the active treatment group. Types of control groups range from medication placebos to usual care to no-treatment. Generally, a very inert (inactive) control group e.g., no treatment, will yield outcomes, e.g., changes in body weight or blood pressure, which do not change from baseline (the pre-treatment period). Also, a modestly active control group, e.g., medication placebo, health education, and usual care, will often have a modest treatment effect. Therefore, since the control group is contrasted with the active treatment group to test an experimental hypothesis, careful scrutiny of the control group in each RCT is essential for understanding the relative efficacy of treatment.

What is the Proper Length of an RCT for Obesity and Metabolic Problems?

Earlier treatment outcome studies for obesity were often quite brief, with treatment duration of only a few weeks to a few months. Over the 1970s, 80s, and 90s, typical treatment lengths

systematically increased to about 4 to 6 months (Williamson & Perrin, 1996). The ideal length of weight loss treatment should consider the type of intervention, e.g., pharmacotherapy versus lifestyle versus surgery, and the expected time to achieve maximal weight loss. Generally, this time frame is between 6 and 12 months. After RCTs such as the Diabetes Prevention Program demonstrated the preventive effects of obesity treatment, the demand for longer and sustained weight loss became much stronger. Studies of lifestyle and drug treatments for obesity prior to 2000 had demonstrated that abrupt cessation of treatment resulted in fairly rapid weight regain (Wing, 2002; Ryan, 1996). However, a series of RCTs conducted by Perri and colleagues (summarized in Perri et al, 2002) found that a variety of relatively inexpensive booster and supportive interventions could preserve much of the weight loss of the initial 6 to 12 months. Thus, by 2015, it was common for RCTs to last for 18 to 24 months of intervention. Short-term studies, e.g., no more than 12 weeks, are now generally viewed as too short to evaluate the sustainability of weight loss over clinically meaningful periods of time.

Potential Bias of Industry-sponsored Studies

Questions about potential biases associated with industry-funded studies have been raised over the past two decades (Chopra, 2003). These concerns are very important for evaluating new medical strategies, including commercial weight loss programs, drugs, and other medical technologies pertaining to obesity treatment. The sources of potential bias include: 1. Early termination of trials due to ineffectiveness, 2. Research design flaws that bias the study in the direction of positive findings, 3. Inadequate length of the study, 4. Use of “weak” control groups, 5. Inappropriate or misleading statistical analyses, and 6. Suppression of the publication of negative findings. Furthermore, questions about financial interests in the outcomes of clinical trials have been raised; leading to the demand for disclosure of conflicts of interest in scholarly lectures and publications. Numerous studies of a bias for finding more favorable results in RCTs sponsored by industry versus those sponsored by non-profit organizations have routinely reported that industry-sponsored studies tend to yield more favorable findings for new drugs, strategies, and devices (Lexchin, 2012; Ridker & Torres, 2006). For example, Ridker and Torres (2006) reviewed findings pertaining to cardiovascular health from 2000 to 2005 in some of the most prestigious medical journals. They reported that of 104 trials funded solely by non-profit organizations, 49% reported favorable results for new treatments; of 137 industry-sponsored trials, 67% reported favorable results.

These findings, in the context for a need to establish real-world solutions to obesity and related disorders present a conundrum: Society needs new research that is often very expensive; one source of funding comes from industry; but can we trust the findings from industry? This controversy has led to more frequent disclosure of conflicts of interest and higher scrutiny by editors and those who serve as peer reviewers for journals. In a 2012 editorial in *NEJM*, Jeffery Drazen, the editor, noted that his journal had taken strong steps to ensure full transparency, but that in the end a “trial’s validity should ride on the study design, the quality of data-accrual and analytic process, and the fairness of results reporting” (p. 1153). Thus, in the final analysis, fair evaluation of research should use the design features described earlier plus the reporting of results for evaluating the validity of medical research. Entirely relying upon the source of funding for a study to evaluate its validity is also a form of bias that must be resisted when it is imperative that we develop medical strategies that are efficacious, safe, and cost-effective.

Efficacy of Commercial Weight Loss Programs

Early and Recent Conclusions

As noted by Tsai and Wadden, by 2005 there had been few controlled studies, e.g., RCTs, of commercial weight loss programs. A major shortcoming of these studies was that they generally failed to adequately manage the problems associated with attrition. For example, early studies of commercial weight loss programs failed to use ITT analyses and therefore represented a “best case scenario” (Womble, Wang, & Wadden, 2002). Attrition in these early studies was often quite high, e.g., > 50% of the cohort. These studies typically reported weight loss only for those who completed various lengths of treatment and as noted earlier, reporting only data from “completers” is widely regarded to yield biased results. A second shortcoming of research on the efficacy of commercial weight loss programs was that they seldom report long-term results. For example, Tsai and Wadden (2005) found only one study that reported long-term (2 year follow-up) weight loss. In a more recent review of this literature (Jensen et al, 2014) noted similar problems. They concluded that the strength of the evidence in support of the efficacy of commercial programs was “low.” A recent meta-analysis of this literature (Gudzone et al, 2015) derived different conclusions. This group of experts examined 4,212 published studies to find 62 papers (representing 45 studies) that met their inclusion and exclusion criteria. They had identified 32 commercial weight loss programs that were eligible for study and of these only 11 programs had undergone credible evaluations of efficacy. Of the 11 programs that had been studied, only two programs were studied for periods of 12 months or more: Weight Watchers and Jenny Craig. After 12 months of treatment, participants in Weight Watchers averaged weight losses 2.6% greater than control groups and participants in Jenny Craig averaged weight losses 4.9% greater than controls. Gudzone et al (2015) concluded that clinicians should consider referral of overweight and obese patients to Weight Watchers or Jenny Craig. Since these two programs are the most effective of the many options for commercial weight loss programs, the following sections will focus exclusively upon the research pertaining to Weight Watchers and Jenny Craig. Modern dissemination of both programs has options for face-to-face counseling, use of telephone consults, and delivery via online programs including computer and smart phone applications.

Brief Description of the Treatment Programs

Weight Watchers. Weight Watchers was established in 1961. The initial guiding philosophy of Weight Watchers was that groups of overweight and obese people (initially all women) could discuss their feelings about weight and food to provide social support for weight loss and weight loss maintenance. Today, Weight Watchers is the largest support group for weight loss in the world. The focus of Weight Watchers is on four central aspects of weight management: food plan, exercise/activity plan, lifestyle behavior change, and group support. Participants in Weight Watchers are only required to pay a stipend (subscription) for group sessions, though Weight Watcher foods are available for purchase. Participants who achieve and maintain weight goals become life-time members at no charge. A central feature of the Weight Watchers program is the food point system. Foods are assigned point values depending on calories and fat grams, which increase with higher calories and fat content, and fiber grams, which decrease point values. Each person is allocated a range of allowable points based on height, weight, age, sex, and the time point in a weight loss program. Participants can also earn points

through exercise and these points can be used against food points. The net result is that the program encourages decreased caloric intake and increased caloric expenditure that results in negative energy balance and thus weight loss. Weight loss goals are 1 to 2 lb per week. The person can remain in the program as long as desired. There are no entry requirements. Group leaders are generally lifetime members who have lost weight to achieve their goal weight and undergo leadership training.

Jenny Craig. Jenny Craig was established in 1983. The program began in Australia. Jenny Craig also emphasizes behavior change and social support provided by individual counseling sessions each week. It also prescribes pre-packaged meals and snacks that are required costs of the program. Thus, the cost of Jenny Craig is higher than that of Weight Watchers since it covers both counseling and food costs. The pre-packaged foods include entrees, fruits, vegetables, and starches. Initially, participants are expected to consume all meals purchased from Jenny Craig. When participants achieve half of their weight loss goal, they begin to eat foods from a menu (not pre-packaged foods) one to two days per week. When participants reach their desired weight goal, they are no longer expected to consume pre-packaged foods. Jenny Craig also includes an exercise program that prescribes at least 150 minutes of physical activity per week. Counselors are paraprofessionals that are trained by Jenny Craig by a 48 hour training program and monthly follow-up educational classes.

The use of pre-packaged meals has been studied intensively. Pre-packaged meals can be viewed as a type of structured meal plan (The Look AHEAD Research Group, 2006) that reduces decision making related to portion sizes and food selections. A similar approach is called a “meal replacement” strategy. Meal replacements are readily available in most grocery stores and pharmacies and can be viewed as a form of self-help for weight management. An early study of meal replacements was provided by Ditshuneit et al (1999). In this study two meal replacements per day were provided during Months 1 -3 using Slimfast products. During Months 4 – 28, meal replacements were recommended for one meal per day. Average weight loss at Month 28 was ~ 11%. More recently, Franz et al (2007) provided a meta-analysis of meal replacement studies and reported average weight losses of ~ 4 kg (4% - 5% weight loss) at Month 12. Thus, there is substantial evidence that the replacement of 1 to 2 meals per day can yield significant weight loss. Also, in a study that replaced all three meals per day for six months, Donnelly et al (2013) reported ~8% average weight loss after 12 months of follow-up. Therefore, the effectiveness of the Jenny Craig program must be considered in the context of other programs that provide pre-packaged foods.

RCTs for Weight Watchers and Jenny Craig

Since the 2005 review of Tsai and Wadden, several large scale RCTs have investigated the efficacy of Weight Watchers and Jenny Craig (Gudzune et al, 2015). The results of these studies are summarized in Table 1. To be included in this summary, studies were required to be RCTs of at least 6 month duration. Five studies of Weight Watchers were found. Three of the five were funded by Weight Watchers International. All five studies recruited healthy overweight or obese adults and all five studies controlled for attrition using ITT analyses. Weight losses for Weight Watcher participants across studies ranged from approximately 3% to 6% and in all studies but Pinto et al (2013), Weight Watchers was associated with greater weight loss in comparison to the control group. In the Pinto study, the weight loss associated with Weight Watchers was comparable to the weight loss of ILI conducted by trained

professionals. The percentage of participants who lost at least 5% body weight (at end of the study) ranged from 31% to 51% which is slightly less than observed for most RCTs of ILI delivered face-to-face or online. Most participants (>70%) were women.

Table 1. Summary of Findings for the Most Important RCTs of Weight Watchers and Jenny Craig

Study	Commercial Program	Arms	Duration	Industry Sponsored	Population	ITT used	% wgt loss	% losing 5% WL
Heshka et al 2003	WW	Self-Help vs WW	24 months	Yes	Overweight or Obese	Yes	WW =3% C=0%	34%
Jolly et al 2011	WW	Self-Help vs WW	12 months	No	Overweight or Obese	Yes	WW=4.6% C=1.4%	31%
Johnston et al 2013	WW	Self-Help vs WW	6 months	Yes	Overweight or Obese	Yes	WW=5.1% C=.6%	NS
Jebb et al 2011	WW	UC vs WW	12 months	Yes	Overweight or Obese	Yes	WW=5.8% C=2.6%	46%
Pinto et al 2013	WW	BWL vs WW	12 months	No	Overweight or Obese	Yes	WW=6.1% C=5.8%	51%
Rock et al 2007	JC	JC vs UC	12 months	Yes	Overweight or Obese	Yes	JC=7.8% C=.7%	NS
Rock et al 2010	JC FTF and Telephone (T)	JC FTF vs JC T vs UC	24 months	Yes	Overweight or Obese	Yes	JC FTF=7.9% JC T=6.8% C=2.1%	JC FTF=62% JC T=56%
Rock et al 2014	JC FTF Low Fat (LF) & Low Carb (LC)	JC LF vs JC LC vs UC	12 months	Yes	Type 2 Diabetes	Yes	LF=7.4% LC=9.0% C=2.5%	LF and LC=58%

Abbreviations: WW = Weight Watchers, JC = Jenny Craig, UC = Usual Care, BWL = Behavioral Weight Loss therapy, C = Control, ITT = intention-to-treat statistical analyses, wgt = weight, WL = weight loss.

Three RCTs of the Jenny Craig program were identified. Two of the studies recruited healthy overweight or obese adults and the other study recruited adults diagnosed with type 2 diabetes. All three studies were funded by Jenny Craig. All three studies controlled for attrition using ITT analyses. All three studies reported significantly greater weight loss for Jenny Craig in comparison to the control group. One of the studies (Rock et al, 2010) investigated two delivery systems (FTF vs telephone) and found no differences in effectiveness. Another study (Rock et al, 2014) compared two types of structured meals (low fat versus low carbohydrate) and found no differences in effectiveness. Two of the studies (Rock et al 2007; 2010) studied only women. The sample of Rock et al (2014) included 52%

women. The average weight loss associated with Jenny Craig was found to consistently be greater than the weight loss associated with Weight Watchers, but is consistent with the results of studies using partial or full meal replacement programs (see above). Also, the percentage of participants losing at least 5% body weight was higher than Weight Watchers and is consistent with the statistics from most trials of ILI.

Cost-effectiveness of Weight Watchers versus Jenny Craig

Finkelstein and Kruger (2014) recently reported a cost-effectiveness analysis of commercial weight loss studies that included Weight Watchers and Jenny Craig. They reported that Weight Watchers was less costly (\$515 per year) in comparison to Jenny Craig (> \$ 2,600 per year). Though Jenny Craig produced greater weight loss than Weight Watchers, the cost per kg lost was significantly lower for Weight Watchers (~\$155) in comparison to Jenny Craig (~\$400). The authors concluded that Jenny Craig was more expensive in comparison to Weight Watchers primarily due to the costs of food costs that are required by the program. It is noteworthy that the annual subscription costs for Jenny Craig (\$340/year) are actually lower than the subscription price for Weight Watchers (\$515), but the costs of food for Jenny Craig (> \$2,000/year) drive the annual cost to make Jenny Craig a less desirable program from a cost-effectiveness perspective.

Attrition

In the RCTs summarized in Table 1, attrition ranged from 5% (Rock et al, 2010) to 39% (Jebb et al, 2011). This level of attrition is roughly comparable for most ILI RCTs that were conducted in academic settings. In the “real world” it appears that attrition may be much higher. Early reviews (Tsai & Wadden, 2005; Womble et al, 2002) concluded that high attrition made difficult the interpretation of weight loss results reported for Weight Watchers and Jenny Craig. More recent reports from the field have indicated that the problem of high attrition continues for both programs. For example, in a retrospective study of 1,605 participants in the Tennessee Medicaid (Tenn-Care) study of Weight Watchers, Mitchell et al (2012) reported considerable problems of attendance. They reported that only 23% of participants attended at least 13 sessions in the first year of treatment. Recent study groups (Jensen et al, 2014; Lefevre for USPSTF, 2014) have concluded that at least 14 sessions were needed in the first six months of ILI in order to achieve successful weight loss. Using this standard, the annual attrition rate for Weight Watchers in the Tenn-Care study was approximately 77%. Real world studies have reported problems of attrition associated with the delivery of Jenny Craig. For example, Finley et al (2007) reported overall attrition at the end of Year 1 to be 93%. In conclusion, though the results of recent RCTs have indicated very reasonable attrition, it appears that attrition in non-academic setting may be unreasonably high for both Weight Watchers and Jenny Craig.

Do Weight Watchers and Jenny Craig Appeal to Men and Women?

Weight Watchers began in 1961 as a weight loss program for women. Jenny Craig is named for a woman. One question that has plagued both programs is that it appeals primarily to women. RCTs such as those summarized in Table 1 attempt to recruit diverse populations including equal numbers of men and women. The proportion of women in RCTs for weight management generally exceeds the

proportion of men by about 2 to 1. This trend was evident in the RCTs for commercial weight loss programs. With the exception of Rock et al (2014) that recruited type 2 diabetics, the other seven RCTs recruited samples with women ranging from 72% to 100%. Field studies of Weight Watchers have consistently reported that women are the predominant customers. For example, in a UK sample, Ahern et al (2011) reported 90% women; in the US, Mitchell et al (2012) reported 72% women, and Lowe et al (2008) reported that of the long-term successful weight losers in Weight Watchers, 95% were women. In response to these concerns, Weight Watchers and Jenny Craig have created weight loss programs specifically for men. Furthermore, Weight Watchers has validated its program for men in two RCTs (Barraj et al, 2014).

Should Primary Care Physicians (PCPs) refer Obese Patients to Weight Watchers and Jenny Craig?

A review of the literature by Jensen et al (2014) concluded that “low- to moderate-intensity lifestyle interventions for weight loss provided to overweight or obese adults by primary care practices alone have not been shown to be effective” (pS23). A good question is whether referral of these cases by PCPs to commercial weight loss programs is a more effective option. A recent RCT (Jebb et al, 2011) directly addressed this question. They randomly assigned referrals of obese adults from PCPs to Weight Watchers or usual care (administered by the PCP) for 12 months of treatment. As shown in Table 1, participants referred to Weight Watchers lost an average 5.8% of initial weight and the control group lost 2.6% body weight and this difference was statistically significant. In an uncontrolled study, Ahern et al (2011) reported on the results of 29,326 cases referred to Weight Watchers from the UK National Health Service. They reported that the median weight loss was 3.1% body weight and that 33% of cases lost at least 5% of initial body weight, the criterion for clinically meaningful weight loss. In summary, preliminary evidence suggests that referral of obese patients by PCPs to Weight Watchers is likely to be more effective in comparison to treating the person in the PCP office practice.

Summary of Effectiveness of Commercial Weight Loss Programs

There are many commercial weight loss programs that are available to overweight and obese adults. For example Gudzone et al (2015) identified 32 programs that were eligible for study. Of these many commercial programs, only two, Weight Watchers and Jenny Craig, have sufficient support for efficacy to be recommended. Reviews of the literature pertaining to these two programs indicate that over the past decade, they have made significant progress in building scientifically credible evidence in support of the effectiveness of the programs over periods of one to two years. Concerns about high attrition remain for conducting these programs for the general public, however. Weight Watchers in particular, has invested heavily in building an evidence-based case for its services. They now have good evidence to support their program for men and for referrals by PCPs to Weight Watchers. Also, in comparison to Jenny Craig Weight Watchers has been found to be more cost-effective (Finkelstein & Kruger, 2014).

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