Minireview

Tipping the scales: Provider perspectives on a multi-disciplinary approach to obesity

Dellyse Bright, Katherine O'Hare, Rebecca Beesley and Hazel Tapp

Department of Family Medicine, Atrium Health, Charlotte, NC 28207, USA
Corresponding author: Hazel Tapp. Email: Hazel.tapp@atriumhealth.org

Impact statement

Obesity is a major multi-faceted, chronic disease that increases the risk of morbidity and mortality of children and adults particularly impacting high-risk populations and those of lower socioeconomic status. Given provider time constraints, models of care to effectively and efficiently address obesity in primary care are key. Although physician recommendations can exert a powerful influence on behavior, providers often feel powerless to adequately address obesity due to the complexity of physical and behavioral health problems. This mini-review focuses on describing the feasibility and evidence for tackling obesity through provider-led multidisciplinary weight management programs.

Abstract

Obesity is a costly and complex health issue that precipitates and/or complicates many medical conditions. Clinical recommendations include a comprehensive approach to weight loss with a combination of diet, physical activity, behavioral interventions, pharmacotherapy or surgery to achieve weight loss. Care in the primary care setting is integral in obesity management. Outside of their clinical role, primary care physicians serve as role models, educators, and promoters of healthy lifestyle practices and leaders in obesity treatment. Physician recommendations have consistently been shown to exert a powerful influence on patient behavior, but there is a substantial gap between patients who would benefit from obesity care and those receiving it. Providers, especially primary care, cite many obstacles to addressing obesity including lack of time, expertise, and resources. This review focuses on describing the feasibility and evidence for tackling obesity through provider-led multidisciplinary weight management programs. A literature search was conducted in Med Line and PubMed for published articles on multidisciplinary weight management programs that included lifestyle modification (diet and exercise), behavioral modification and a physician (MD/DO) with one or more of the following multidisciplinary team members: nutritionist/registered dietician (RD), behavioral health provider (BH), case manager (CM), pharmacist (Pharm), nursing (RN), and research staff. Relevant articles from bibliographies of systematic reviews/meta-analyses were included as well. Ten studies qualified, and we organized the articles to discuss the following three themes: diet and exercise, behavioral therapies and barriers, and facilitators for clinical weight management programs. The studies in this mini-review of multidisciplinary weight programs that included physicians reiterate the guidelines for successful treatment of obesity, with more research needed to fully understand how primary care providers can assist higher risk patient populations, particularly those of lower socioeconomic status who are disproportionally impacted by obesity.

Keywords: Obesity, nutritional, exercise, medicine, models, modifications

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Introduction

Obesity is an epidemic in the United States with more than one-third (36.5%) of the adult population classified as obese (BMI >30).[1] A costly and complex health issue, obesity complicates various other conditions including diabetes mellitus, hypertension, hypercholesterolemia, gallbladder disease, musculoskeletal and dermatologic conditions, infertility, menstrual problems, depression and anxiety.[2] Previous research reveals obesity disproportionality affects racial and ethnic minorities and those who are socioeconomically disadvantaged. Between 2014 and 2016, obesity rates were highest among non-Hispanic blacks (38.3%) and Hispanics (32.5%), followed by non-Hispanic whites (28.1%), and those with higher incomes were less likely to be obese (31.2%) compared to other groups (40.8%).[3–5]

Effects of various diets, including low-calorie and lower-fat, with exercise on weight management have been well studied. In 2013, the US Department of Health and Human

Services summarized national and international expert panel guidelines regarding obesity treatment strategies. Clinical recommendations include a comprehensive approach to weight loss, with diet, physical activity, behavioral interventions, pharmacotherapy, surgery, or a combination of these techniques for achievable and most efficacious weight management.[6] Unfortunately, weight-loss programs generally adopt a one-size-fits-all behavioral model without attention to cultural attitudes and preferences of minority members.[7–9] In many cases, patients perceive that a successful weight management program should include a support group,[10] enjoyable fun activities, meal preparation, and exercise in a comfortable environment. Healthcare providers feel that successful weight management programs must be comprehensive and available in various locations, incorporate the whole family, and foster sustainable lifestyle changes.[10] Emerging evidence suggests that the best weight loss outcomes derive from multidisciplinary approaches that utilize a broad range of expertise and varied interventions with proven synergy.[11,12]

Care in the primary care setting is integral in obesity management, but there is a substantial gap between patients who would benefit from it, such as those at high risk or with lower socioeconomic status, and those receiving it.[13] Physician recommendations have consistently been shown to exert a powerful influence on patient behavior.[14,15] Physicians often have the first opportunity to encourage weight control and primary prevention with primary care practices a location for treatment of obesity-related conditions. However, time constraints, limited access to resources for lifestyle changes, and low reimbursement are barriers between patient and provider.[13,16,17] Additionally, there has been resistance on the part of many practitioners and the health care community to become actively involved with overweight and obese patients, despite the rapid increase in prevalence.[18,19] The reasons for this reluctance are varied, but include perceptions of the causes of obesity, lack of training, insufficient office time to deal with the difficulties patients face, limited staff support, difficulty with insurance coverage, and perceived poor long-term success rate.[20–22] One solution might be that primary care providers (PCPs) implement weight management programs (WMPs) with longer visit times dedicated to improving weight-loss outcomes in high-risk populations.[23]

Despite the extensive need for weight loss solutions for high-risk patients in primary care, there is paucity of data evaluating primary care weight loss interventions and long-term outcomes. This review focuses on describing the feasibility and evidence for tackling obesity in primary care through provider-led multidisciplinary approaches.

Methods

Mini-review

A literature search was conducted in Med Line and PubMed for published articles on multidisciplinary WMPs that included lifestyle modification (diet and exercise), behavioral modification, and a physician (MD/DO) with one or more of the following multidisciplinary team members: nutritionist/registered dietician (RD), behavioral health provider (BH), case manager (CM), pharmacist (Pharm), nursing (RN), and research staff. Relevant articles from bibliographies of systematic reviews/meta-analyses were included as well. There was no restriction on the type of study included. Relevant articles were searched by keywords: obesity, weight management, multidisciplinary, programs with limitations of English articles with adult ($\geq$ 19 years old) participants. The peer reviewed, and academically published articles are from 2008 to present, and papers published before that timeframe were excluded. Preserving the heterogeneity of evidence relating to multidisciplinary weight loss programs, results of this review are organized to discuss the following three themes: Diet and exercise; Behavioral therapies; and Barriers and facilitators for clinical WMPs.

Results

Ten studies of multidisciplinary weight loss programs published between 2008 to 2018 that included physicians and/or PCPs are summarized (Table 1). Of the 10 articles, 5 studies focused on various interventions for weight (wt.) loss,[24–28] while the other 5 focused on factors that impacted successful weight loss and retention in a WMP.[29–33] Two of the studies included primary care physicians,[25,28] but one study only included the PCP as a supportive/peripheral role in the multi-disciplinary team.[25] The average duration of the weight management interventions was 13.6 months (range 3–24 months). All studies involved a WMP intervention for weight loss with a combination of calorie-restrictive diets and exercise; study designs included RCTs, prospective, and retrospective studies. Only two studies added prescription medications as weight loss interventions.[27,28]

Diet and exercise

While nutrition is the root source of positive energy, obesity develops when there is an imbalance between energy intake exceeding energy expenditure to increase body mass.[34] Dietary therapy helps create a deficit in caloric intake, and very low-calorie diets (VLCDs) often use meal replacement products in the form of liquid shakes or snack bars to deliver up to 800 calories or less per day. Consuming less than 1000 calories per day has the same effect physiologically as starvation. As such, VLCDs promote rapid weight loss and should only be used for a short duration. Medically supervised VLCD programs found that patients who completed treatment experienced 15% to 25% weight loss at three to six months. However, attrition rates, cost, and regaining more than 50% of weight lost were found to be higher at one and two year follow-up evaluations.[36]

In a number of the studies, positive effect of VLCD on weight loss was reiterated.[24,26,37] Of note, the most vulnerable period when attrition rates demonstrated a marked increase was found to be after transitioning from VLCD to regular foods.[33] Successful weight loss was achieved in other forms of calorie-restrictive programs, which included

Table 1. Characteristics of studies of multi-disciplinary weight management programs (WMPs).

REF#	Title	Study design	Multi-disc team	Primary study goal	Intervention	WT loss outcomes	Participant info[a]	BMI (mean, kg/m^2)	Gender ethnicity
[24]	A novel multi-disciplinary intervention for long-term weight loss and glycemic control in obese patients with diabetes	Retrospective cohort ———— MRP vs. DC	MD/DO (endo) +RD + EP+ BH	Wt. loss, BMI %HgbA1C in participants with DM @ 12 and 30 mos	Meal replacement + Exercise	@ 12 mos, MRP more wt. loss, decreased HgbA1C and BMI; @ 30 mos wt. loss from baseline <5%, improved HDL only in MRP group	#80, #40 MRP (63.3 yrs, 8.2% HgbA1C) #40 DC (68 yrs,7.9% HgbA1C)	MRP–37.5 DC–37.7	MRP–55% female DC–51% female 100% Australian
[26]	The impact of a managed care obesity intervention on clinical outcomes and costs: a prospective observational study	Prospective observational study ———— WMP vs. commercial Wt. loss prog [weight watchers, (WW)] vs. commercial pedometer prog	MD/DO (endo) + RD, EPx1	Evaluate impact of benefit and financial incentives on 1.WMP participation 2.BMI, 3. Direct medical costs	WMP- VLCD +Exercise CWMP- Moderate Diet Pedometer- Exercise	Retention: 70% of WMP, 71% Weight watchers, 90% walking spree. ALL 3 – improvements in SBP, DBP, HDL, TC and fasting glucose most pronounced in WMP WMP – BMI decreased by 4, HgbA1C decreased by 0.6%; ALL 3 – Decrease in per member per month (PMPM) cost of lab testing; reduced rate of increased PMPM costs over 1 yr	#1138 with BMI >35 or >32 with >1 comorbidities; 49 yrs of age	38.3	53% female ethnicity not mentioned
[25]	Comparative effectiveness of weight-loss interventions in clinical practice	RCT ———— Coaches (in person) vs. web-based support vs. control	Trained WM coaches; PCP indirect, supportive	Effectiveness of behavioral wt. loss Interventions: With and without in-person contact	DASH diet + Exercise	Wt loss 1.1% in self-directed group, 5% remote support and 5.2% in-person support @ 24 mos	#415 with >1 CV risk factor; 54 yrs,	36.6	64% Female 41% Black, 2.2% Hispanic, 1.9% Other, 56.1% White
[28]	Evaluation of a multidisciplinary tier 3 weight management service for adults with morbid obesity, or obesity and comorbidities, based in primary care	Cohort; 1 yr WMP (6 mo IFR)	MD/DO (1^o care)- + RN + BH + EP	>5% wt. loss @ 12 mos; Changes in quality of life and diet, physical activity, BP, A1C (for pts with DM); %wt loss @ 18 and 24 mos	Diet + Exercise + LELD + Orlistat	72.6% of #117 > 5% wt. loss @ 12 mos, mean 6.4% wt. loss @ 1 yr. All secondary outcomes improved	#230 enrolled, 134 completed (#117 12 mo and #17 6 mo programs); 52.7 yrs, most common comorbidities- HTN, MDD, DM;	44.1	70% female ethnicity not mentioned
[27]	Intensive multidisciplinary weight management in patients with type 1 diabetes and obesity: a one-year retrospective matched cohort study	Retrospective matched cohort	MD/DO (endo) +RD +EP +BH	% wt. loss after 12 week program @ 12 months; glycemic control @ 12 mos	Diet + exercise +anti-obesogenic diabetic medications	6.4% wt. loss, decrease BMI by 2 @ 12 mos vs. no wt. loss in STD group. Decreased total daily insulin and antihypertensive requirement after WMP. No	#68, 42 yrs, Duration of DM-I 23 yrs; Hgb A1C 8.3%;	36.2	62% Female 1.5% Black, 1.5% Asian, 95.6% White

(continued)

Table 1. Continued

REF#	Title	Study design	Multi-disc team	Primary study goal	Intervention	WT loss outcomes	Participant info[a]	BMI (mean, kg/m^2)	Gender ethnicity
						difference in glycemic control @ 12 mos			
[33]	Factors associated with participant retention in a clinical, intensive, behavioral weight management program	Prospective cohort	MD/DO (endo) + RD; EP X1	Describe factors associated with 2 yr WMP retention; 15% wt. loss by 6 months	VLCD + Exercise + Financial Incentives	15 kg wt. loss; BMI decreased by 5; SBP and BP medication decreased, Attrition greatest 6–12 mos Completers@ 6 mos and 2 yrs were older with lower baseline BMI	#270, 51% completed, 49 yrs; 53% with HTN, 50% HLD, 34% OSA, 29% DM	41	52% Female 85% White 15% Other
[32]	Fit and motivated: outcome predictors in patients starting a program for lifestyle change	Prospective cohort	MD/DO (endo + psy) + RD	>5% wt. loss @ 6 mos; confirm predictive value of TREMORE[b] for wt. loss	Diet + exercise	35.3% (#117) completed 6 mos; #57 of #117 achieved >5% wt. loss; higher total TRE-MORE score associated with wt. loss; lower TRE-MORE 3 associated with drop-out	#331, 43.2 yrs;	38.8	72.9% Female 100% Italian
[31]	Early dropout predictive factors in obesity treatment	RCT ————— Prescriptive diet with (TXT) and without (STD) group CBT	MD/DO (endo) + BH + RD	Effectiveness of group CBT and evaluate physical and psychologic factors associated with dropout	Group CBT + diet; exercise education given	69.9% attending @6 mos.; Completers decreased BMI by 2; no significant difference regarding age, sex, BMI, education, work and marriage; High level of stress associated with dropout	#146, 73 in both groups; 45 yrs,	32.3	74.7% Female 100% Italian
[30]	Predictors of dropout by female obese patients treated with a group cognitive behavioral therapy to promote weight loss	Prospective cohort RCT; 2 phase trial ——— Completers vs. non-completers	MD/DO + RD	Investigate predictors of attrition of overweight/obese Japanese women in Group CBT	Diet + exercise	75.6% completed. Non-completers factors: body shape concern, unemployed, perceived their mothers to be less caring and had disorganized temperament. No mention of % of 90 participants who achieved > 5% of baseline wt. for RCT 3 mos wt. management phase	#119, 47.7 yrs	31	100% Female 100% Asian (Japanese)
[29]	Predictors of success to weight loss intervention program in individuals at high risk for type 2 diabetes	Prospective cohort	MD/DO (endo) + RD +RN as BH support	Evaluate predictive value of weight-loss readiness tool (WRLT) for responders to lifestyle intervention (>5% wt. loss @ 12 mos)	Diet + Exercise	#18/35.6% wt. lost > 5% @ 1 yr; Lower result to question "I am capable of doing more physical activity" associated with lack of success	#51, 50.8 yrs 86.3% Pre-DM, 68.6% metabolic syndrome	40.5	65% Female 100% French-Canadian;

[a]Mean values for study data listed.
[b]Treatment motivation and readiness test.
BH: behavioral health professional (therapist or psychologist); BMI: body mass index (kg/m^2); CBT: cognitive behavioral therapy; DASH: dietary approaches to stop hypertension ; DBP: diastolic blood pressure; DC: diabetes clinic; DM: diabetes mellitus; Endo: endocrinologist; EP: exercise physiologist; F/u: follow up; GrpV: group visit; HDL: high density lipoproteins; HTN: hypertension; Indiv: Individual; IFR: individual funding request; LELDs: low energy liquid diets; mos: months; MD/DO: physician; MDD: major depressive disorder; MRP: metabolic rehabilitation program; PCP: primary care provider; Pts: patients; Psy: psychiatrist; RCT: randomized controlled trial; RN: nurse; RD: registered dietician; SBP: systolic blood pressure; STD: standard care; TC: total cholesterol; TXT: treatment group; VLCDs: very low calorie diets; WM: weight management; Wt: weight; Yrs: years.

commercial diet plans or supplements,[24,26] the DASH diet[25] and generalized (e.g. decreasing caloric intake by 500–600 kcal/day).[28,30–32] Three studies by Lih *et al*.,[24] Jennings *et al*.,[28] and Mottalib *et al*.[27] provided individualized diet instructions. In all the WMP studies, dietary education was given to study participants by an RD, diabetes educator or nutritionist (see Table 1), except one where a trained health coach delivered dietary education.[25]

Although weight loss requires decreasing caloric intake, increasing physical activity is a critical component of weight loss therapy.[6] In addition, exercising regularly has also been shown to be a key factor for weight loss maintenance.[38] Moderate to vigorous exercise regimens are consistent with the American Medical Society of Sport Medicine (AMSSM) guidelines for weight loss.[39]

For obese patients, physical activity should be tailored to accommodate ability, start slowly and increase gradually.[6] Two studies followed the recommendation of structured but flexible individual activity for weight loss.[27,28] Protocols of moderate to vigorous exercise regimens were used in several studies: one study included this regimen three months after the initial gradual increase in exercise,[26] while three prescribed the increased intensity from the start of the program.[24,30,33] Although participants were instructed/educated about need for exercise, two studies did not specify instructions or education for participants.[25,32] Michelini *et al*.[31] provided less emphasis on exercise and more focus on cognitive behavior treatment in the form of group visits in addition to using a hypocaloric diet.[31] Most of the WMPs gave exercise instructions, regarding number of minutes per week and intensity consistent with AMSSM recommendations for weight loss.[24,26–28,30,33]

In addition to diet and exercise, two studies used medications to assist with weight loss[27,28] Orlistat is a standard weight loss medication with a good safety profile that was used in the study by Jennings *et al*.[28] The investigators in a study of patients with type 1 DM and obesity adjusted medications that were obesogenic (e.g. switching long-term insulin to detemir, degludec, or glargine that induce less weight gain), as well as added metformin and pramlintide which demonstrate the side effect profiles favorable for weight loss.[27]

Behavioral therapies

WMPs typically include guidance on behavioral strategies as part of comprehensive lifestyle interventions to accomplish the prescribed dietary and exercise goals.

Racial and ethnic group differences in goal setting indicate the need to gain a greater understanding of individual, social, and environmental factors that may uniquely impact the ability to set goals, and the importance of tailoring obesity intervention strategies for optimal, sustainable behavior change.[40]

Motivational interviewing (MI) and shared decision-making with goal setting are the crux of the treatment plans.[41–44] MI is integral in the treatment of overweight and obese children as noted in a review that investigated the effects of MI techniques and showed statistically significant positive effect on changing body mass index (BMI) and secondary obesity-related behavior outcomes in overweight or obese children from ages 2 to 11.[44] One of the WMP listed in Table 1 utilized a goal setting component that positively influenced the behavior change for the low-income, rural women participants who were contemplating lifestyle changes.[30] In another study, the use of MI is associated with reduction in energy intake, consistent with better adherence to dietitian visits.[45] Additionally, a study noted daily text messaging with MI can improve outcomes.[42]

Behavioral medicine fits alongside the traditional medical treatment for obesity. Behavioral therapy can minimize the need for more intensive medical treatments, improve outcomes, and improve adherence to treatment plans.[46,47] A behavioral medicine framework for obesity counseling is the "5 As" behavioral change model – Assess, Advise, Arrange, Agree and Assist – that health care providers can use to help patients formulate a personal action plan for behavior change.[48]

Structured WMPs often include guidance on behavioral strategies and approaches to accomplish the prescribed dietary intake and physical activity goals. Increased self-monitoring, such as weekly online support groups or food diaries, coupled with behavioral sessions have been associated with weight loss success.[49] Mindfulness may also be relevant in tackling obesity and eating disorders by decreasing binge eating episodes – partly responsible for weight regain for many people – and increasing awareness of emotional and other triggers for overeating.[50] Health coaching as an obesity intervention has proven to be effective in corporate wellness and behavioral weight loss programs.[51]

All studies employed MI, food diaries, and self-monitoring of weight as behavioral therapies (Table 1). In addition, all studies included accountability for whether participants attended individual or group visits as means to increase weight loss success. Many of the studies utilized group visits as intervention or vehicle for care delivery,[24,25,27,28,30,31,52] as group visits have been shown to enhance outcomes in patients with chronic diseases like diabetes, congestive heart failure (CHF), and obesity.[53–55]

Assessment of participants' behavioral health status via standardized screenings/assessment tools or behavioral health providers, is common in studies with[24,28,30–33] or without[25,26] formal assessment or treatment of behavioral health factors. The primary goal of two studies was to evaluate the properties of psychometric tools in addressing several behavioral factors – assessing weight loss readiness[29,32] and predicative capacity in weight management.[32]

Behavioral health interventions were conducted in various ways in the reviewed studies.

Appel *et al*.[25] employed trained personnel as weight management coaches and Kong *et al*.[29] employed nurses to focus on attainable goals with progressive but sustained small changes in nutrition and physical activity to provide individualized behavioral support to participants. A psychologist, dietician, or physician conducted group visits to deliver behavioral support/education in the Italian studies.[24,30] One study used nurses to provide behavioral

support during the monthly group visits in addition to various means of psychological therapies (e.g. CBT, hypnosis) by trained behavioral health providers (i.e. therapist, psychologist or psychiatrist).[28] Accordingly, trained behavioral health providers were utilized in individual or group visits to deliver behavioral health to participants as a one-time consultation[24,32] or throughout the WMP.[27,31] In the studies, there was no significant difference between the effectiveness of behavioral therapies delivered by a traditional behavioral health provider and those by a non-behavioral health provider. No behavioral therapy or assessment was included in the study by Rothberg *et al*.[26,33] possibly related to the managed care basis of these studies. There could have been a conflict of interest, especially given that the presence of mood disorders and other psychiatric conditions could lead to concerns of insurability or higher rates of insurance premiums in some states.

Barriers and facilitators for clinical WMPs

Meal replacements, commercial diets, fresh foods, and supplements for weight loss can be costly.[56–58] Re-imbursement for behavioral health and dietician can also be problematic.[59] Two studies offloaded direct or indirect costs to participants by offering insurance incentives[26,33] and by providing food/meal replacements to participants free of charge.[33] If the WMP does not have grant-funding support or financial incentives, diet costs and copays can be cost prohibitive for some participants. Jennings *et al*.[28] was awarded grant funding to develop a multidisciplinary team and incorporate a six-month treatment arm for underfunded participants. This opportunity was made possible by funds from policy makers in a rural area with elderly population and poor public transport.

Recidivism is rampant in weight management. Possible assumptions of those who sign up for WMP are in the "action" stage of change paradigm; however, participants may be in the contemplative stage or revert from action to contemplative or pre-contemplative.[60] Treatment "failures" are often viewed as those who "drop out" of programs or those who do not achieve or maintain expected weight loss. Multiple studies aimed to evaluate various factors of success and or retention in weight loss programs (Table 1).[30,32,33] Those who had lower self-confidence score of increasing physical activity predicted a poor response to weight loss intervention.[29]

Results from the review suggest there are demographic differences and ways to improve recidivism rates. Older age of participants, less extreme obesity [those with slightly lower BMI] and higher muscle mass[32] were characteristics of participants who completed at least six months of the WMP program.[33] Financial incentives were associated with positive outcomes for WMP participation and weight loss. Attrition factors included high levels of stress,[31] stronger body shape concerns, unemployment, disorganized temperament and perception of having mothers who were less caring.[30] Additional reasons were pregnancy, changes in insurance, moving and death.[33] Perhaps the most practical importance for clinicians is the concurrence of factors leading to attrition in many studies.

In order to identify factors that inhibit successful weight management, three of the five studies that focused on retention factors used standardized behavioral psychometric inventories such as the General Health Questionnaire (GHQ-28),[31] Impact of Weight on Quality of Life-Lite (IWQOL-lite) and Inventory of Depressive Symptomology (IDS-SR),[33] state-Traiti Anxiety Inventory (STAI), Rosenberg Self-Esteem Scale (RSES), TORONTO Alexithymia Scale (TAS-20), Parental Bonding Inventory (PBI), Multi-dimensional Perfectionism Scale (MPS) and Eating Disorder Examination Questionnaire (EDE-Q 6.0).[30] While not specifically focused on retention in WMP, Cresci *et al*.[32] attempted to confirm the predicative value for successful weight loss using the validated TRE-MORE, Treatment Motivation and Readiness Test. The TRE-MORE has three subsets exploring obstacles and how to overcome them: taking care of themselves, sharing problems, and current lifestyle. Interestingly, results showed that scores assessing current lifestyle were associated with drop-out.[32] Kong *et al*.[29] formulated a weight loss readiness tool (WLRT) to assess readiness to change and conviction to accomplish various goals within WMP – a lower score on the WLRT question regarding conviction of exercising more correlated with a lower response to intervention.

Psychosocial factors obviously affect success and retention in weight management. Obesity is closely associated with multiple medical and psychological conditions.[2] Given the close association, it would be beneficial for participants with comorbidities of obesity to be included in studies. Exclusion criteria align with the objectives of the study and carry important implications of scientific rigor and ethical principles, such as pregnancy which has obvious ethical bases to ensure no harm to fetus.[61] The majority of studies did not specifically exclude participants with mood disorders.[24,26,28,29,33] Most studies included comorbid conditions such as obstructive sleep apnea (OSA), DM[25,26,29,33] (Table 1).[25,29] Studies by Rothberg *et al*. and Jennings *et al*. included participants with multiple comorbidities including depression.[28,33] Participants with medical conditions frequently associated with obesity were included in most of Table 1 studies.[24–26,28,29,33,52] The North Norfolk study by Jennings employed the least restrictive exclusion criteria of all 10 studies with only pregnancy, severe eating disorder, poor motivation as identified by standardized questionnaire and failure to respond to the invitation to attend the WMP as the sum of exclusions.[28] However, one study excluded participants with mood disorders, on anti-psychotics (obesogenic medications) and those with DM, while another study excluded those with DM, endocrine disease, and severe psychiatric illness.[30,31]

Psychologic comorbidities can potentially be a barrier to successful weight management and may be a reason why many studies evaluating weight loss success exclude participants with various psychological conditions. Studies by Sawamoto *et al*. and Rothberg *et al*. showed increased association with lack of weight loss success and retention in WMP among participants who had more psychologic symptoms.[30,33] High levels of stress were associated with dropout in the study by Michelini *et al*.[31] However, this

population is among the most vulnerable to adverse health conditions to which obesity can worsen and contribute to weight gain.[62]

Treatment modalities for obesity (balanced, low fat diet and exercise as the foundation) are beneficial for those with psychiatric conditions[63] and certain rheumatologic/musculoskeletal conditions for which some are on obesogenic medications e.g. chronic steroids.[64] Behavioral interventions are key components of treatment for many psychiatric disorders,[65,66] and have been shown to improve outlook, quality of life, and treatment success for patients with many rheumatologic conditions that negatively affect the quality of life.[67]

In light of recommendations to adopt a multifaceted approach to treating the chronic disease of obesity, the Cabarrus Family Medicine Weight Management Program (CFMWMP) was created within Atrium Health in 2009. The aim was to empower patients to make changes for a healthier lifestyle and promote weight loss in a supportive environment where they received focused medical treatment, education, and encouragement. The CFMWMP employed various calorie restrictive diets, including the DASH diet and commercial plans/supplements. Physician-directed (MD), the program garnered interdisciplinary support from a registered dietician (RD), psychologist (PhD) and sports medicine fellow (SMF). Shared-decision making (SDM) and MI techniques were used by all members of the team during the office visits. To begin the program, referred patients completed an office visit with the lead physician. At the initial visit, program participants paid a $100 fee and received a loose-leaf binder with nutrition and exercise reference materials, along with a gym bag, water bottle, pedometer, journal, and exercise bands to facilitate the lifestyle changes. As a behavioral therapy intervention, the CFMWMP administered the Beck's Depression Inventory (BDI) at the time of enrollment.

CFMWMP-structured group visits with the lead physician, and either a psychologist or registered dietician, which helped offset cost to participants beyond the primary care copay. While there was no funding support to increase access to nutritious food, healthy meals and snacks were provided during some group visits to reinforce various aspects of healthy diet (low calorie cooking demonstration and healthy snacks). Physical exams and lab work further assessed for co-morbid conditions and causes of obesity. RD visit followed in two to three weeks to go in depth for dietary changes needed. Physician and nutritionist follow up was determined by the type of diet and/or medications prescribed. Within the first two to three months of program, patients were scheduled with the psychologist to assess for psychological conditions or habits that may counteract weight loss efforts, and the SMF for exercise prescription with assessment and treatment of obesity-associated musculoskeletal conditions. Weight and blood pressure were tracked and shared with patients at every visit. These values were coupled with neck and waist circumference at 0 and 2-month intervals, along with photographs of the patient at 0 and 6-month intervals. Bariatric scale, chairs, and exam table were available for patients' use to provide a comfortable environment. Voluntary group sessions with MD and either the RD (nutrition focused), PhD (behavioral training) or SMF (exercise participation/education) were held monthly. The CFMWMP included all patients without deference to medical or mental conditions/illness (except pregnancy) or medication.

Monthly inter-disciplinary team meetings were held to discuss patients' progress and treatment plans. All assessments, treatment plans, and laboratory data were shared with patients and their PCP. Patients were encouraged to have family members accompany them for group and/or individual sessions to provide additional support with treatment plans. No time limit for program participation was mandated. Patients who attended $\geq$ 2 visits within the WMP were included in data analyses.

Between April 2009 and June 2013, 174 participants were seen in the CFMWMP. Two participants were excluded due to age <18 years; 69 were excluded either due to dropping out after one visit ($n = 42$) or missing medical records with electronic medical record conversion ($n = 27$). A total of 103 participants completed two or more visits within the WMP; those who completed five or more visits ($n = 46$) are included in the data analyses for weight loss. Average time of program participation for participants who completed five visits was 132 days. Nine participants attended group visits (GrpV); there was no significant difference in weight loss in those who participated in group vs. individual (Indiv) visits. Participants were 90% women (93 women, 10 men) with a mean age of 49.32 (18– 65 years old), 76.7% Caucasian, 23.3%, African-American, and 0.97% Latino. All participants had private insurance or Medicare with a private supplement. Baseline mean BMI was 41.86, mean BMI at five visits was 40.26.

Major factors that attributed to weight loss success were attendance to WMP visits and adherence to individualized diet, exercise, and behavioral goals. Participants in the CFMWMP who achieved weight loss were female, with lower than average baseline BMI, findings concurrent with the studies included in this review. In addition, those who adhered to the goals made through SDM were successful in losing weight.

Discussion

The importance of treating obesity has been well established as it is associated with the development of multiple chronic diseases that are significantly improved with modest weight loss (5% reduction in weight). The studies in this mini-review of multidisciplinary weight programs included physicians that reiterated the guidelines for successful treatment of obesity outlined by the Dept of Health and Human Services, and recommendations by the Institute of Medicine, the American Academy of Pediatrics, and other health organizations, where weight status assessment and monitoring, healthy lifestyle promotion, treatment, clinician skill development, clinic infrastructure development, community program referrals, community health education, multisector community initiatives, and policy advocacy are considered critical.[68]

Frequent contact with participants during weight management intervention and addressing multiple aspects of

weight management, over $\geq$ 3-month time frame contributed to successful weight loss in the 10 studies. Behavioral change requires accountability and frequent reiteration, while obesity is a multi-faceted chronic disease that requires multi-disciplinary treatment. Moreover, providing participants with healthy, low calorie food items, financial incentives (direct or indirect) and, in some cases, anti-obesogenic medication helped participants achieve weight loss goals. For some studies, excluding participants with conditions that confound obesity and/or increase risk of negative weight management outcomes may have contributed to achievement of weight loss goals.

As patient strive to achieve weight loss goals, physicians can serve as role models, educators, promoters of healthy lifestyle practices, and leaders in obesity treatment. The collected studies also prove that despite time limitations in patient care, physicians can provide strategic treatment for obesity and be integral to reducing obesity, improving health and preventing chronic illnesses. The studies have various templates that can be replicated in primary and specialty care offices. Group visits are effective for delivering patient education and interventions associated with obesity treatment, as well as a vehicle to deliver care to a larger number of patients at one time compared with individual patient visits. The physician can play a directive role in the WMP instead of a supportive or peripheral role. The physician had a supportive role to the WM team of dietician, psychologist, and exercise physiologist in the successful Look Ahead trial that demonstrated the reduction in weight and cardiovascular disease risk factors in persons with type 2 diabetes and obesity.[68] However, one study included a primary care physician who directed the WMP and demonstrated the success in achieving weight loss and mitigating attrition.[33] Expectedly, most of the physician-directed programs involved an endocrinologist. Overall, neither physician specialty nor physician degree of involvement led to differences in length of program, weight loss outcomes nor retention in those programs.

While this mini-review reveals factors that serve as facilitators and barriers for weight management, multiple social determinants of health serve as obstacles for successful weight management such as access to nutritional foods, safety of outdoor spaces for exercise, lack of access to gyms, lack of insurance due to financial restraints and the stress of poverty. One review of evidence identifies how PCPs can successfully prevent and treat childhood obesity by coordinating efforts within the primary care setting and through linkages to obesity prevention and treatment resources within the community.[68] More research is needed to understand how PCPs can assist higher risk patient populations, particularly those of lower socioeconomic status that are plagued with obesity.[69,70]

Given the predominance of obesity in primary care combined with the missed opportunities to address obesity in primary care, these studies serve as models of obesity treatment in the current arena of integrated primary care. Identifying successful models that integrate primary care, public health, and community-based efforts are important to advancing progress in preventing childhood obesity and treating adult obesity.

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