

# We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index  
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?  
Contact [book.department@intechopen.com](mailto:book.department@intechopen.com)

Numbers displayed above are based on latest data collected.  
For more information visit [www.intechopen.com](http://www.intechopen.com)



---

# Multimodal Lifestyle Intervention: Outlines and Outcomes

---

Mahmoud M. A. Abulmeaty

Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/66371>

---

## Abstract

Multimodal lifestyle intervention is an essential step in obesity management. This chapter will discuss the structure and components of a proper multimodal lifestyle intervention. The setting for supplying this intervention is preferred to be served by a multidisciplinary team in a secondary care setting, but primary healthcare or even online setting is effective. The results of this type of holistic intervention are much more promising than single-discipline outcome. Success rates of intensive multimodal lifestyle intervention are growing to make it as a potential alternative to bariatric surgery in selected morbidly obese cases. However, this intervention has some limitations such as unpredicted outcomes and high dropout rates. Future studies should augment its curing effects and address the underlying mechanisms.

**Keywords:** multimodal lifestyle intervention, obesity management, obesity multidisciplinary teams

---

## 1. Introduction

Study and management of obesity are hot points in medical research and healthcare services worldwide. This increasing importance of studying and combating obesity came as a result of rapid pandemic prevalence of obesity and being one of the most preventable risk factors of many comorbidities. The traditional management of obesity included many disciplines of healthcare providers through many remedies including dietary manipulations, physical activity (PA) plans, behavioral modification, pharmacotherapy, bariatric surgery, and other complementary therapies [1]. Shift toward trial of complementary methods, such as acupuncture, homeopathy, chiropractic spinal manipulation, and herbal remedies, reflects the limited success rates of the nonsurgical methods for management of obesity. However, single

use of a complementary remedy showed small effects with unconvincing evidence in addition to some adverse effects [2]. Low success rates of nonsurgical treatments of obesity and inadequate results may not only result in a management failure but may increase severity of obesity [3]. Even in surgical solutions of obesity, one can find a promising rate of weight loss in short-term basis, but after few years, weight regained especially if not combined with lifestyle modifications such as compliance to dietary and physical activity prescriptions [4]. Accordingly, it can be concluded that single treatment modality is not sufficient for obesity management even with bariatric surgery. The multifactorial nature of obesity as a chronic disease emphasizes this theory. Combined different remedies for weight loss such as diet plus physical activity achieved a synergistic result rather than using combined protocols in the same remedy such as low-fat diet and low-carbohydrate diet [5].

Teamwork management including different disciplines is increasingly emphasized in management of many chronic diseases. Depth of collaboration among allied disciplines created many levels of multimodal intervention. A multidisciplinary-team approach refers to the cooperation among members from different specialties, but each one stays within his boundaries and works independently or sequentially, each from his or her own disciplinary-specific perspective (i.e., no overlap), in order to improve patient care. The second level is interdisciplinary approach, which harmonizes links between the different disciplines, in a coordinated and integrated fashion toward a common goal for the patient. The third level is transdisciplinary team in which specialists work jointly using a shared conceptual framework that draws together discipline-specific approaches, to address a common problem. Here, the traditional boundaries among different specialties were transcended [6]. Obesity is a good candidate for applying any of these levels for teamwork management because of its multifactorial nature, diversity in response to separate treatment approaches, and predisposition to multiple comorbidities belong to different medical specialties.

## 2. Multimodal lifestyle intervention for obesity management

From practical point of view, the nonsurgical obesity-related disciplines are much easier to collaborate in a teamwork at any level of multidisciplinary structure. Diet, physical activity, and behavioral modification represent the cornerstone of nonsurgical management of obesity. Combination of these three modalities, which collectively seek to achieve a healthier and less obesogenic lifestyle, is the multimodal lifestyle intervention.

The barriers to a healthful lifestyle are numerous and complex but can be sorted in four levels: intrapersonal, interpersonal, community, and public policy levels. For adolescents, as an example, the main intra/interpersonal barriers were improper perception of the condition, lack of willingness, priority of studying, unsatisfactory weight loss results, and low self-esteem, while lack of family and cultural support, inadequate nutritional education, and scarcity of resources were the common community/public barriers [7]. Perspective of clinical nutrition, as a main medical specialty interested in obesity management, cannot combat these entire barriers resulting in high dropout and failure rates of obesity management. Clinical nutritionist with obesity interest should add some skills about physical activity prescription

and behavioral modification to achieve better results. Therefore, integrated efforts of clinical nutritionist, physical activity trainer, and behavioral therapist could overcome much more of these barriers with better commitment and higher success rates of obesity management.

## **2.1. Which specialties should share the responsibility?**

### *2.1.1. Main medical specialties*

The first two components of multimodal lifestyle intervention were clinical nutrition and physical activity. Addition of physical activity augments diet-induced weight loss through many mechanisms. One study examined the total energy expenditure by doubly labeled water and resting metabolic rate by indirect calorimetry in 116 severely obese patients undergoing intervention with diet alone or diet plus physical activity (PA). The results were lower reduction in the daily total energy expenditure ( $-122 \pm 319$  vs.  $-376 \pm 305$  kcal day<sup>-1</sup>), elimination of the usual decrease of the activity-induced energy expenditure ( $83 \pm 279$  vs.  $-211 \pm 284$  kcal day<sup>-1</sup>), and greater weight loss ( $13.0 \pm 7.0$  vs.  $8.1 \pm 6.3$  kg) in diet plus PA group vs. diet alone. Increased PA was associated with greater adherence to low-calorie prescriptions and maintenance of greater weight loss after 6 months [8]. Furthermore, combination of PA modalities such as aerobic training and resistance training adds more to the healthy eating lifestyle than one PA modality. A randomized, parallel-group clinical trial at community-based exercise facilities in two Canadian cities examined 304 adolescents with obesity and revealed that resistance, aerobic, and combined training decreased total percent body fat and waist circumference in adolescents with obesity. Additionally, adherent cases with combined training might cause greater results than aerobic or resistance training alone [9]

Adding a new player to the obesity managing team such as behavioral modification/therapy raises the success rates and gives promising results not only in weight loss but also in body composition. Therefore, it is now accepted that behavioral therapy is an essential component of any adequate obesity managing team. Behavioral management includes many techniques such as goal setting, stimulus control, stress management, problem-solving procedures, self-monitoring, reinforcement techniques, cognitive restructuring, rewarding changes in behavior, social and family support, and relapse anticipation/prevention training [10]. Detailed description of these techniques is out of scope of this chapter. Another alternative psychological approach for obesity management was reported [11]. It is based on food dependency model of obesity. This model considers obesity as a form of addiction, similar to psychoactive substance abuse, that is, obesity is a combination of the inability to control eating and exercise behaviors to control body fat as a result of an addictive process produced by a vicious circle of distorted thinking and physiological disturbances. According to this model, recommendation for weight loss included reasonable caloric restriction, gradual decrease of fat quantity in food, physical exercise, strategies for improving self-regulation of eating and exercise, and social/family support [12]. A large number of clinical trials examined the effects of behavioral treatment on weight loss. Most of these trials structured group meetings weekly for the initial 3–6 months of treatment period, biweekly meetings later on up to 12 months, and then become monthly or bimonthly for the later phases of the study (up to 2 years). Group therapy may be more effective than individual treatment as it is less costly and provides a combination of empathy, social support, and healthy competition [13].

Another member of the team could enhance weight loss outcomes, which is adding a pharmacotherapy to previous approaches. Medications try either to modify the internal environment centrally or peripherally or to minimize the obesity-related physiological disturbances as a trial to predispose to a healthier internal environment. Orlistat, phentermine/topiramate, glucagon-like peptide-1 receptor agonists, lorcaserin, dipeptidyl peptidase-4 inhibitors, pramlintide, and dapagliflozin are available medications of variable adjuvant effects, when integrated with the multimodal lifestyle intervention yield more success [14]. In the future, novel therapeutic targets should extend beyond appetite control to include new strategies, such as taste preferences (e.g., Umami), energy expenditure, gut microbiota, bile acid signaling, preservation of  $\beta$ -cell function and hepatic glucose output, and so on.

### 2.1.2. Other disciplines

Complementary and alternative medicine (CAM) is defined as a group of varied medical and healthcare systems, practices, and products that are not considered to be part of any current Western healthcare system [15]. CAM included a wide range of remedies that were used in obesity management such as herbal supplements, acupuncture, and noninvasive body-contouring devices in addition to homeopathy, yoga therapy, relaxation techniques, massage, and chiropractic medicine. Despite the lack of a strong evidence about efficacy and safety, CAM is widely used especially at private centers and as a folk medicine. The positive results may appear more with mild degrees of obesity [2]. For acupuncture as an example, a meta-analysis published in 2009 [16] investigated the randomized controlled trials (RCTs) for acupuncture compared either with placebo-controlled or with dietary intervention for obesity management and revealed that acupuncture is an effective modality for obesity treatment. However, the amount of evidence is not highly convincing because of the poor methodological quality of trials reviewed. Addition of one or more remedies of CAM to the multimodal lifestyle intervention might produce more success in obesity cure. This evident in a study performed a retrospective analysis of patients attending a 13-week weight loss program consisting of chiropractic/spinal manipulative therapy in addition to nutritional intervention, physical activity, and one-on-one counseling. The results were statistically and clinically significant as regarding changes in weight and BMI. This might provide supporting evidence on the effectiveness of a multimodal approach to weight loss supplemented with chiropractic therapy [17].

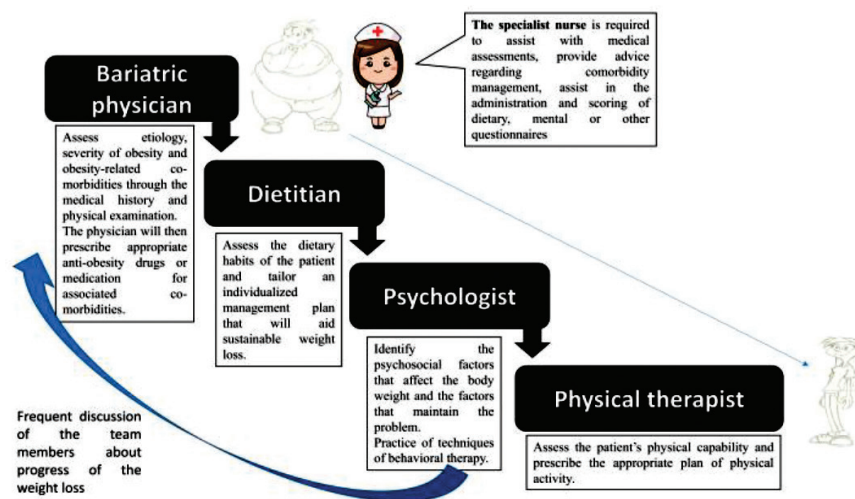
## 2.2. Where? or In which setting?

### 2.2.1. Obesity multidisciplinary teams (OMDTs)

Construction of multidisciplinary, interdisciplinary, or transdisciplinary centers for obesity management is necessary for augmentation of success rates of lifestyle intervention. The National Institute of Health and Care Excellence (NICE) has recommended that multidisciplinary teams (MDTs) should be used in the treatment of complex obesity. In each hospital, OMDT should consist of a bariatric physician with a specialist interest in obesity as a leader, a registered dietitian, a clinical/counseling psychologist, a specialist nurse, and an access to a physical therapist/exercise physiologist. MDT weight management services should be delivered in the secondary care setting where bariatric physician (such as an endocrinologist or a



physician nutrition specialist) can assess etiology, severity of obesity, and its related comorbidities through the medical history and physical examination. The physician will then prescribe appropriate antiobesity drugs or medication for associated comorbidities. Patient should be referred or shifted to other members of OMDT. A dietitian is required to assess the dietary habits of the patient and to tailor an individualized management plan that will aid sustainable weight loss. The role of a psychologist is to identify the psychosocial factors that contributed to the body weight and the factors that maintain the problem and prevent making meaningful lifestyle changes. Then he recommends a plan for how these factors can be managed either by a psychological support within the MDT service or by referring them to an appropriate psychiatric subspecialty. A physical therapist is essential to assess the patient's physical capability and prescribe the appropriate plan of physical activity. The specialist nurse is required to assist with medical assessments, provide advice regarding comorbidity management, assist in the administration and scoring of dietary, mental or other questionnaires [18], see **Figure 1**.



**Figure 1.** Construction and job specification of the obesity multidisciplinary team.

### 2.2.2. Primary healthcare setting

Primary healthcare (PHC) practitioners are encouraged to screen all adults for obesity and to offer nutritional education and behavioral counseling to cases with obesity. Training of PHC practitioners on implementation of the basic components of multimodal lifestyle intervention especially dietary, physical activity, and behavioral counseling is mandatory. In the year 2006, the National Heart, Lung, and Blood Institute (NHLBI) funded practice-based opportunities for weight reduction (POWER) trials for this purpose [19]. Three clinical trials [20–22] proved that PHC practitioners produced mean weight losses ranged from 3.6 to 9.7 at 6 to 12 months when they provided a brief behavioral counseling to obese patients in their daily practices. A fourth study randomly enrolled overweight 113 women into a dietitian-led intervention, a dietitian-led intervention plus meal replacements, or a PHC intervention with meal replacements. Participants were instructed to attend brief every-other-week visits with their primary care physician or nurse. After 1 year, adherent cases (65%) in PHC group lost weight slightly

more than dietitian-led group (4.3% vs. 4.1% of initial weight). However, participants in the dietitian-led plus meal replacements group lost 9.1%, that is, PHC intervention using meal replacements was as effective as the traditional dietitian-led group intervention not using meal replacements [23].

### *2.2.3. Via telephone or the internet*

Multimodal lifestyle intervention is now being delivered by the telephone or Internet (rather than in face-to-face setting). Web-based programs such as Weight Watchers and Nutrisystem allow individual to record their weight, dietary intake, and physical activity online and to receive colorful dietary regimens, tips for physical activity, and behavioral modification, together with graphic displays of weight changes. Even in some programs, a personalized intervention by a lifestyle specialist can be offered. Internet intervention generally produces mean weight losses about one-third of the traditional face-to-face programs and about three times of the self-help controls. These commercial interventions proved their effects via RCTs against self-help controls [13, 19].

## **3. Outcomes of multimodal lifestyle intervention**

Outcomes of the multimodal lifestyle intervention are still inferior to surgical results. However, it is increasingly promising especially if implemented via OMDT. Clinical studies comparing intensive multimodal lifestyle intervention with bariatric surgery provide a convincing evidence about the growing effect of nonsurgical solutions of obesity. A randomized controlled, clinical trial with a 2-year intervention aimed to compare the efficacy of the three levels of obesity intervention, that is, conventional obesity therapy (COT), intensive multimodal obesity management including behavioral therapy (IMOM), and bariatric surgery (BS) as regarding changes in body weight and metabolic parameters in morbidly obese patients. IMOM group resulted in a greater percentage of weight loss than COT patients (−11.3% vs. −1.6%;  $P < 0.0044$ ). Furthermore, 31.4% of patients in the IMOM group became non-morbidly obese within six months of intervention, and at the end of the study, they increased to 44.4%. By comparison with BS group, percentage weight loss grew from 5% for COT group to 38% for IMOM from surgical achievement, that is, percentage of weight loss in IMOM achieved more than one-third of the results of bariatric surgery without complication of surgery. Accordingly, IMOM could be an alternative therapy to patients with obesity, who cannot tolerate bariatric surgery [24].

Look AHEAD study is an interesting 8-year randomized clinical trial. They investigated the effects of intentional weight loss via intensive multimodal lifestyle intervention that included behavioral therapy vs. usual care (education and medication of diabetes), on cardiovascular morbidity and mortality in 5145 overweight/obese adults with type 2 diabetes. Dropout rate was only 12%, and in adherent cases, a clinically significant weight loss ( $\geq 5\%$ ) at year 8 occurs in 50% of patients with type 2 diabetes [25]. Furthermore, they proved that severely obese participants had similar adherence, percentage of weight loss, and improvement in CVD risk compared with less obese participants, indicating that multimodal lifestyle intervention including behavioral therapy should be considered an effective option for this high-risk category [26].

A recent meta-analysis assessed the impact of lifestyle interventions including a physical activity plan on health outcomes of patients with class II and class III obesity. After the analysis of 56 articles, they concluded that lifestyle interventions including a PA plan can improve weight and various cardiometabolic risk factors in class II and class III obese individuals [27]. By shifting to prospective studies, Karlsen et al. [28] reported that the predictors of weight loss after intensive multimodal lifestyle intervention for one year in morbidly obese patients were excess weight loss at 12 weeks, baseline mental health-related quality of life, occupational status, and age.

Data from pediatric studies are also promising. Morano et al. [29] designed a 6-month multimodal lifestyle intervention for children (ages 10–12 years) with obesity, incorporating school- and family-based components, nutritional education, fun-type physical activities, and exercise training. The results were significant reduction in body mass index z-score, body fat percentage, arm and waist circumferences, and skinfold thickness (for all  $P < 0.05$ ), in addition to improvement of actual and perceived physical abilities, physical activity enjoyment, psychosocial health-related quality of life, and dietary pattern. This indicates the importance of combined dietary-physical activity-behavioral interventions in children with overweight and obesity. Meta-analysis of 64 pediatric and adolescent RCTs (5230 participant) including lifestyle interventions focused on physical activity and sedentary behavior (12 studies), diet only (6 studies), and multimodal interventions concentrated on behavioral modification/therapy (36 studies), and antiobesity drug interventions (metformin, orlistat, and sibutramine) were found in 10 studies. The studies varied greatly in design, outcome measurements, and methodological quality. The authors concluded that combined behavioral lifestyle interventions compared to standard care or self-help can produce a significant and clinically meaningful weight reduction in children and adolescents. However, the limited quality data cannot recommend one treatment program to be superior over another [30].

Efforts should be directed toward explanation and extraction of the underlying mechanisms of proper lifestyle intervention of obesity. As a trial, many studies examined body compositional changes during and after intervention. I have one published article about this issue, where a cohort of adult men with overweightness and obesity underwent to a multicomponent lifestyle intervention including dietary restriction, gradual physical plan, and techniques of behavioral modification for 12 months. In regards to the short-term changes in the body composition, there were a significant loss of fat-free mass (FFM), fat-free mass index (FFMI), and total body water (TBW) in obesity group rather than overweight group. This indicates that patients with obesity lose water and fat-free tissues together with fat loss in the early weeks of multimodal lifestyle intervention for obesity management. On the other hand, long-term body compositional changes after 6 to 12 months showed progressive significant reduction of weight, BMI, waist circumference, percent body fat, fat mass, and fat mass index throughout the study, in addition to preservation of FFM, FFMI, and TBW [31]. Unpublished data revealed also a significant reduction of estimated visceral fat area and improvement of lipid panel. A new meta-analysis of RCTs, which assessed the effect of caloric restriction and exercise training on bone mineral density (BMD), was published [32]. It proved that diet-induced weight reduction led to reduction of BMD at the hip and lumbar spine, while exercise-induced weight loss did not. Furthermore, a running RCT investigating body composition and bone mass changes among children undergoing multimodal lifestyle intervention was started by



Cohen et al. [33]. They designed a RCT for 6- to 8-year-old children with overweightness or obesity, where participants were randomized to a family-centered intervention including nutritional education, physical activity, and behavioral control vs. standard treatment.

Unpredicted outcomes are a common feature of lifestyle intervention for chronic diseases especially for obesity. Karlsen et al.'s study [28] tried to report some predictors of weight loss after intensive multimodal lifestyle intervention in morbidly obese patients (see above). In Abulmeaty [31] study comparison of the basal characteristics adherent with non-responding and dropped out cases revealed that cases with high percent body fat were more prone to dropping out. Furthermore, Suchánek et al. [34] reported that body composition changes in adult females after lifestyle intervention were influenced by the NYD-SP18 gene polymorphism, where overweight/obese female carriers of the NYD-SP18 rs6971091 GG genotype exhibited a more beneficial response to the intensive lifestyle intervention than others.

Another significant limitation of multimodal lifestyle intervention is high rates of dropout. One systemic review searched the literature to find an answer of that question "what are the dropout rates in lifestyle intervention programs for overweight and obese infertile women?" Ten out of studied fifteen articles reported dropout rates. The median dropout rate was 24% (ranged from 0% to 31%). They also concluded that women who drop out lose less weight and have lower spontaneous pregnancy chances than adherents [35]. About 64% is another published rate of dropout from Kuwaiti adult males and females with chronic diseases including diabetes [36]. They also reported the main causes of dropout from dietary intervention, which included unwillingness (48.6%), difficulty adhering to a diet different from that of the family (30.2%), and social meetings (13.7%). The main reasons of exercise dropout were lack of time (39.0%), co-morbid conditions (35.6%), and bad weather conditions (27.8%). The factors interfering with adherence to lifestyle measures were use of cars more than walking (83.8%), traditional fatty food, (79.9%), daily stress (70.7%), high frequency of social meetings (59.6%), high consumption of fast food (54.5%), and the presence of house cleaners (54.1%).

## Author details

Mahmoud M. A. Abulmeaty

Address all correspondence to: dr.abulmeaty@gmail.com

1 Clinical Nutrition Program, Department of Community Health Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, KSA

2 Obesity Research and Management Unit, Department of Medical Physiology, Faculty of Medicine, Zagazig University, Zagazig, Egypt

## References

- [1] Hainer V, Toplak H, Mitrakou A. Treatment modalities of obesity: what fits whom?. *Diabetes Care*. 2008; 31 Suppl 2: S269–S277. Doi: 10.2337/dc08-s265.

- [2] Pittler MH, Ernst E. Complementary therapies for reducing body weight: a systematic review. *International Journal of Obesity*. 2005; 29: 1030–1038. Doi:10.1038/sj.ijo.0803008
- [3] Quilliot D, Roché G, Mohebbi H, Sirvaux MA, Böhme P, Ziegler O. Nonsurgical management of obesity in adults. *Presse Médicale*. 2010; 39 (9): 930–944. Doi: 10.1016/j.lpm.2010.05.017.
- [4] Bradley LE, Forman EM, Kerrigan SG, Goldstein SP, Butryn ML, Thomas JG, Herbert JD, Sarwer DB. Project HELP: a remotely delivered behavioral intervention for weight regain after bariatric surgery. *Obesity Surgery*. 2016. [Epub ahead of print]. Doi:10.1007/s11695-016-2337-3.
- [5] Alexandraki I, Palacio C, Mooradian AD. Relative merits of low-carbohydrate versus low-fat diet in managing obesity. *Southern Medical Journal*. 2015; 108 (7): 401–416.
- [6] Choi BCK, Pak AWP. Multidisciplinarity, interdisciplinarity, and transdisciplinarity in health research, services, education and policy: 3. Discipline, inter-discipline distance, and selection of discipline. *Clinical and Investigative Medicine*. 2008; 31 (1): E41–E48.
- [7] Amiri P, Ghofranipour F, Ahmadi F, Hosseinpanah F, Montazeri A, Jalali-Farahani S, Rastegarpour A. Barriers to a healthy lifestyle among obese adolescents: a qualitative study from Iran. *International Journal of Public Health*. 2011; 56 (2): 181–189. Doi: 10.1007/s00038-010-0119-6.
- [8] DeLany JP, Kelley DE, Hames KC, Jakicic JM, Goodpaster BH. Effect of physical activity on weight loss, energy expenditure, and energy intake during diet induced weight loss. *Obesity (Silver Spring)*. 2014; 22 (2): 363–370. Doi: 10.1002/oby.20525.
- [9] Sigal RJ, Alberga AS, Goldfield GS, Prud'homme D, Hadjiyannakis S, Gougeon R, Phillips P, Tulloch H, Malcolm J, Doucette S, Wells GA, Ma J, Kenny GP. Effects of aerobic training, resistance training, or both on percentage body fat and cardiometabolic risk markers in obese adolescents: the healthy eating aerobic and resistance training in youth randomized clinical trial. *JAMA Pediatrics*. 2014; 168 (11): 1006–1014. Doi: 10.1001/jamapediatrics.2014.1392.
- [10] Haintier V, Toplak H, Mitrakou A. Treatment modalities of obesity: what fits whom? *Diabetes Care*. 31 (Suppl. 2): S269–S277, 2008
- [11] Goodrick GK, Foreyt JP. Why treatments for obesity don't last. *Journal of American Dietetic Association*. 1991; 91: 1243–1247.
- [12] Foreyt JP, Goodrick GK. Factors common to successful therapy for the obese patient. *Medicine and Science in Sports and Exercise*. 1919; 23: 292–297.
- [13] Butryn ML, Webb V, Wadden TA. Behavioral treatment of obesity. *The Psychiatric Clinics of North America*. 2011; 34 (4): 841–859. Doi:10.1016/j.psc.2011.08.006.
- [14] Miras AD, le Roux CW. Can medical therapy mimic the clinical efficacy or physiological effects of bariatric surgery? *International Journal of Obesity*. 2014; 38: 325–333; Doi: 10.1038/ijo.2013.205.

- [15] Esteghamati A, Mazaheri T, Rad MV, Noshad S. Complementary and alternative medicine for the treatment of obesity: a critical review. *International Journal of Endocrinology and Metabolism*. 2015; 13 (2): e19678. Doi: 10.5812/ijem.19678.
- [16] Cho SH, Lee JS, Thabane L, Lee J. Acupuncture for obesity: a systematic review and meta-analysis. *International Journal of Obesity*. 2009; 33: 183–196. Doi: 10.1038/ijo.2008.269.
- [17] DeMaria A, DeMaria C, DeMaria R, Alcantara J. A weight loss program in a chiropractic practice: a retrospective analysis. *Complementary Therapies in Clinical Practice*. 2014; 20: 125–129.
- [18] Kmietowicz Z. Multidisciplinary teams are needed throughout UK to manage obesity. *BMJ* 2013; 346: e8679. Doi: 10.1136/bmj.e8679.
- [19] Wadden TA, Volger S, Tsai AG, Sarwer DB, Berkowitz RI, Diewald L, Carvajal R, Moran CH, Vetter M. Managing obesity in primary care practice: an overview and perspective from the POWER-UP study. *International Journal of Obesity (London)*. 2013; 37 (0 1): S3–S11. Doi: 10.1038/ijo.2013.90.
- [20] Cohen MD, D'Amico FJ, Merenstein JH. Weight reduction in obese hypertensive patients. *Family Medicine*. 1991; 23: 25–28.
- [21] Ockene IS, Hebert JR, Ockene JK, Saperia GM, Stanek E, Nicolosi R, Merriam PA, Hurley TG. Effect of physician-delivered nutrition counseling training and an office-support program on saturated fat intake, weight, and serum lipid measurements in a hyperlipidemic population: Worcester Area Trial for Counseling in Hyperlipidemia (WATCH). *Archives of Internal Medicine*. 1999; 159: 725–731.
- [22] Martin PD, Rhode PC, Dutton GR, Redmann SM, Ryan DH, Brantley PJ. A primary care weight management intervention for low-income African-American women. *Obesity*. 2006; 14: 1412–1420. Doi:10.1038/oby.2006.160.
- [23] Ashley JM, St Jeor ST, Schrage JP, Perumean-Chaney SE, Gilbertson MC, McCall NL, Bovee V. Weight control in the physician's office. *Archives of Internal Medicine*. 2001; 161: 1599–1604.
- [24] Burguera B, Tur JJ, Escudero AJ, Alos M, Pagán A, Cortés B, González XF, Soriano JB. An intensive lifestyle intervention is an effective treatment of morbid obesity: the TRAMOMTANA study—a two-year randomized controlled clinical trial. *International Journal of Endocrinology*. 2015; 2015: 194696. Doi: 10.1155/2015/194696.
- [25] Wadden TA, Bantle JP, Blackburn GL, and the Look AHEAD Research Group. Eight-year weight losses with an intensive lifestyle intervention: the look AHEAD study. *Obesity (Silver Spring)*. 2014; 22 (1): 5–13. Doi: 10.1002/oby.20662
- [26] Unick JL, Beavers D, Jakicic JM, Kitabchi AE, Knowler WC, Wadden TA, Wing RR; Look AHEAD Research Group. Effectiveness of lifestyle interventions for individuals with severe obesity and type 2 diabetes: results from the look AHEAD trial. *Diabetes Care*. 2011; 34 (10): 2152–2157. Doi: 10.2337/dc11-0874.

- [27] Baillot A, Romain AJ, Boisvert-Vigneault K, Audet M, Baillargeon JP, Dionne IJ, Valiquette L, Abou Chakra CN, Avignon A, Langlois M. Effects of lifestyle interventions that include a physical activity component in class II and III obese individuals: a systematic review and meta-analysis. *PLoS One*. 2015; 10 (4): e0119017. Doi: 10.1371/journal.pone.0119017.
- [28] Karlsen T, Søyhagen M, Hjeltnesæth J. Predictors of weight loss after an intensive lifestyle intervention program in obese patients: a 1-year prospective cohort study. *Health and Quality of Life Outcomes*. 2013; 11: 165. Doi: 10.1186/1477-7525-11-165.
- [29] Morano M, Rutigliano I, Rago A, Pettoello-Mantovani M, Campanozzi A. A multicomponent, school-initiated obesity intervention to promote healthy lifestyles in children. *Nutrition*. 2016; 32: 1075–1080.
- [30] Oude Luttikhuis H, Baur L, Jansen H, Shrewsbury VA, O'Malley C, Stolk RP, Summerbell CD. Interventions for treating obesity in children. *Cochrane Database of Systematic Reviews*. 2009, Issue 1: Art. No.: CD001872. Doi: 10.1002/14651858.CD001872.pub2.
- [31] Abulmeaty MMA. Multimodal-lifestyle intervention produces reduction of the fat mass rather than body weight loss in men with obesity: a prospective cohort study. *Nutrition Clinique et Metabolisme*. 2016; 30 (2): 163–171.
- [32] Soltani S, Hunter GR, Kazemi A, Shab-Bidar S. The effects of weight loss approaches on bone mineral density in adults: a systemic review and meta-analysis of randomized controlled trials. *Osteoporosis International*. 2016; 27 (9): 2655–2671. Doi: 10.1007/s00198-016-3617-4.
- [33] Cohen TR, Hazell TJ, Vanstone CA, Plourde H, Rodd CJ, Weile HA. A family-centered lifestyle intervention to improve body composition and bone mass in overweight and obese children 6 through 8 years: a randomized controlled trial study protocol. *BMC Public Health*. 2013; 13: 383.
- [34] Suchánek P, Lánská V, Hubáček JA. Body composition changes in adult females after lifestyle intervention are influenced by the NYD-SP18 variant. *Central European Journal of Public Health*. 2015; 23 (Supplement):S19–S22. Doi: 10.21101/cejph.a4105.
- [35] Mutsaerts MAQ, Kuchenbecker WKH, Mol BW, Land JA, Hoek A. Dropout is a problem in lifestyle intervention programs for overweight and obese infertile women: a systematic review. *Human Reproduction*. 2013; 28 (4): 979–986.
- [36] Serour M, Alqhenaei H, Al-Saqabi S, Mustafa A, Ben-Nakhi A. Cultural factors and patients' adherence to lifestyle measures. *British Journal of General Practice*. 2007; 57: 291–295.

