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REVISTA MEXICANA DE ENDOCRINOLOGÍA, METABOLISMO & NUTRICIÓN ORIGINAL ARTICLE

Brief intervention as strategy treatment that improves nutritional adherence in obesity: a pilot study

Intervención breve como estrategia que mejora la adherencia nutricional en obesidad: estudio piloto

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ABSTRACT

Background: Obesity is a chronic disease with high prevalence worldwide. **Objective:** To evaluate the use of the Brief Intervention for Treatment Adherence (BITA) strategy for enhancing nutritional adherence to weight loss treatment in subjects with obesity. **Materials and methods:** A clinical trial of 4-month follow-up. The participants were assigned to a group with or without BITA. The nutritional intervention consisted of a 20% reduction in the total energy expenditure. **Results:** The use of BITA strategy significantly improved adherence to nutritional counseling in comparison with participants that did not receive BITA (71.8 ± 13.8 versus 42.0 ± 16.8%, $p < 0.05$). The group BITA showed significant improvements in weight loss (-4.9 ± 4.0 versus 1.3 ± 3.6 kg), body mass index (-1.7 ± 1.3 versus 0.7 ± 2.0 kg/m^2), body fat mass (-3.1 ± 4.0 versus 2.3 ± 3.5 kg), and abdominal fat, (-1.1 ± 2.8 versus 1.9 ± 2.2%), compared to group without BITA. **Conclusions:** The BITA strategy demonstrated to be useful for improving adherence to a nutritional intervention, achieving a greater weight loss.

Keywords: Nutritional adherence. Behavior change. Motivational interviewing. Weight loss. Obesity management.

RESUMEN

Introducción: La obesidad es una enfermedad crónica con alta prevalencia a nivel mundial. **Objetivo:** Evaluar el uso de la estrategia de Intervención Breve para la Adherencia al Tratamiento (BITA) para mejorar la adherencia nutricional al tratamiento de pérdida de peso en sujetos con obesidad. **Materiales y métodos:** Ensayo clínico durante 4 meses, los participantes asignados al grupo con BITA y grupo sin BITA. La intervención nutricional consistió en una reducción del 20% del gasto energético total. **Resultados:** El uso de la estrategia BITA en el grupo BITA mejoró significativamente la adherencia a las recomendaciones nutricionales vs. participantes que no recibieron BITA (71.8 ± 13.8 vs. 42.0 ± 16.8%, $p < 0.05$). El grupo con BITA mostró mejoras significativas en la pérdida de peso (-4.9 ± 4.0 vs. 1.3 ± 3.6 kg), índice de masa corporal (-1.7 ± 1.3 vs. 0.7 ± 2.0 kg/m^2), masa grasa corporal (-3.1 ± 4.0 vs. 2.3 ± 3.5 kg) y grasa abdominal (-1.1 ± 2.8 vs. 1.9 ± 2.2), comparado con el grupo sin BITA. **Conclusiones:** La estrategia BITA demostró ser útil para mejorar la adherencia a una intervención nutricional, logrando una mayor pérdida de peso.

Palabras clave: Adherencia nutricional. Cambio de comportamiento. Entrevista motivacional. Pérdida de peso. Obesidad.

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INTRODUCTION

Obesity is one of the most important health problems worldwide that is clearly associated with a high risk of mortality, cardiovascular disease, diabetes, and cancer[1]. Therefore, weight loss interventions highlight the importance of an adequate nutrition to promote and maintain good health throughout the life course[2]. Nonetheless, the lack of adherence and high desertion rates result in not achieving weight loss success[3].

Different types of interventions for weight control have been proposed, such as implementing behavior therapy (self-monitoring), reducing eating cues, responding to social pressures, and employing relapse prevention techniques to maintain short and long-term adherence in nutritional interventions[4,5]. In this context, the previous evidence indicates that energy restriction by adding behavior therapy becomes important as part of a multidisciplinary intervention may produce greater weight loss[4,6]. The focus of behavior therapy is on behavioral approaches and practical applications, such as motivational interviewing (MI)[7].

Based on the above, a brief intervention for treatment adherence (BITA) strategy was developed to enhance adherence to an energy restrictive diet for weight loss. Behavioral therapy strategies of this intervention were adapted from an intervention used in another study whose purpose was also to enhance adherence[8]. Furthermore, BITA included MI which has been shown to be useful in a weight loss program[7,9]. An important element of BITA was motivation, particularly optimism, which is a significant predictor of positive health outcomes[10]. The strategy called best possible self (BPS) with proven efficacy in increasing optimism was included in the BITA strategy[11,12].

Nevertheless, a limited number of methodological intervention reports do not clearly identify which techniques are the most effective in achieving adherence to treatment[13]. Therefore, the objective of this study was to evaluate the use of the BITA strategy for enhancing nutritional adherence to weight loss treatment in participants with obesity.

MATERIALS AND METHODS

A clinical trial was conducted from March 1, 2018, to March 31, 2019. Eligibility criteria were adult male and female aged between 25 and 50 years with obesity, according, to a body mass index (BMI) >30 kg/m^2, and sedentary subjects according to the World Health Organization (WHO) criteria. Ineligibility criteria included pregnant or breastfeeding women, a current diagnosis of diabetes, cardiovascular disease, cancer, or tobacco consumption, and exclusion criteria subjects that do not complete the intervention period (dropout). The participants were randomized (using simple method of random numbers table) assigned to two study groups. The flow chart of the eligibility process is shown in figure 1.

This study was approved by the Ethics and Biosafety Committee (CI-01219). All procedures performed were in accordance with Helsinki declaration and its later amendments. All participants signed an informed consent.

A nutritional intervention was provided during a 4-month follow-up period based on recommendations that reduction weight goals (around 10%) can be reached within 3–6 months[14]. The nutritional intervention was conducted by a professional nutritionist that designed an intervention based on NOM-008-SSA3-2010 for treatment of obesity recommendations that was a 20% reduction of the total energy expenditure with a distribution of nutrients that included 50% carbohydrates, 30% lipids, and 20% proteins. In each session, they were given a specific cyclic menu according to their requirements (it was adjusted in each session according to their actual weight). In addition, nutritionists-maintained contact with participants through email, calls, and use of social networks.

A three-day food record questionnaire was used to collect the dietary intake information, and subsequently, it was analyzed with the Nutritionist Pro™ software.

The complete intervention lasted 4 months and the BITA strategy consisted of two sessions (baseline and in the 2 months of the intervention period) of

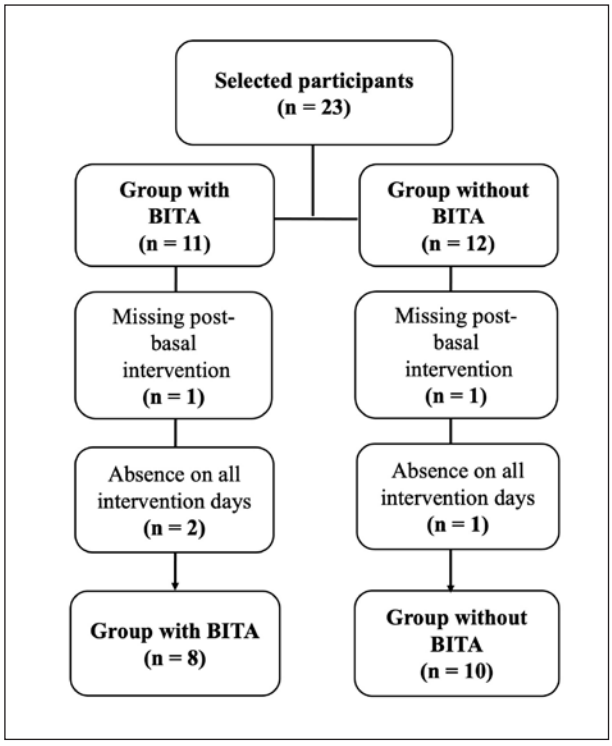

Figure 1. Flow chart of study participants. BITA: Brief Intervention for Treatment Adherence.

1 h each provided individually by a health psychologist. After the first session, participants were instructed to continue practicing the trained strategies and techniques.

The techniques and strategies were conducted under the following guidelines:

(A) First session: the focus was on the importance of adherence to treatment in an energy restrictive diet. This session included the following techniques: (1) *Psychoeducation*. This technique is used to provide information on how psychological aspects operate in relation to the condition, in this case, on weight loss (2) *Behavioral contract*. A procedure that seeks behavioral change and consists of a written agreement between the health psychologist and the person who wants to make the behavior change. The procedure involves records in writing of the contingencies (either reinforcement or punishment as the case may be)[11,12]. (3) *Decision balance*. A clinical procedure that comes from MI to help participants resolve ambivalence by simultaneously considering their own arguments for and against a change[15]. (4) *Response cards*. In this technique, the participant writes on a small piece of paper the benefits of following or stopping a particular behavior, depending on the situation[16]. (B) Second session: the focus was on motivation, particularly optimism, to attend more sessions and be consistent with the entire treatment[17]. This session included The best possible selves (BPS), activity in which participants write about themselves in the future by imagining that everything has worked out in the best possible way, and thus, this strategy helps patients achieve health goals[18]. The complete instrument (BITA) is provided in supporting information (Annex 1).

Anthropometric data

Each subject was interviewed with a medical history questionnaire to obtain sociodemographic data and a dietary assessment. Height and weight were measured after a 12-h fast and while wearing light clothes by the same nutritionist in each session and tetrapolar body electrical bioimpedance was used to assess body composition (InBody 370, Biospace Co. Seoul, Korea), the bioelectrical impedance analysis (BIA) is a valid method for the assessment of body composition and predicts body fat percentage. BIA is a validated alternative compared to other invasive and expensive methods like dual-energy X-ray absorptiometry, computerized tomography, and magnetic resonance imaging, and controlling factors as the instrument itself, including electrodes, operator (same in each session), subject, and environment[19].

We analyzed adherence with a self-report provided by each participant and adequation percentage to the kcal and macronutrients according to the menu provide by nutritionist (Data of 3 days record analyzed in nutritionist Pro). An adherence goal was 70-80% to see great results in weight lose approximately a 10% of reduction in a period of 4 months[14].

The sample size for pilot studies was realized in according to proposed by Hertzog that around ten subjects per group for a pilot study are adequacy in providing estimates precise enough to meet a variety of possible aims[20]. Quantitative parameters were analyzed with the Student´s t-test and non-parametric values with Mann-Whitney U test. The Student's paired t-test or Wilcoxon test were used to show

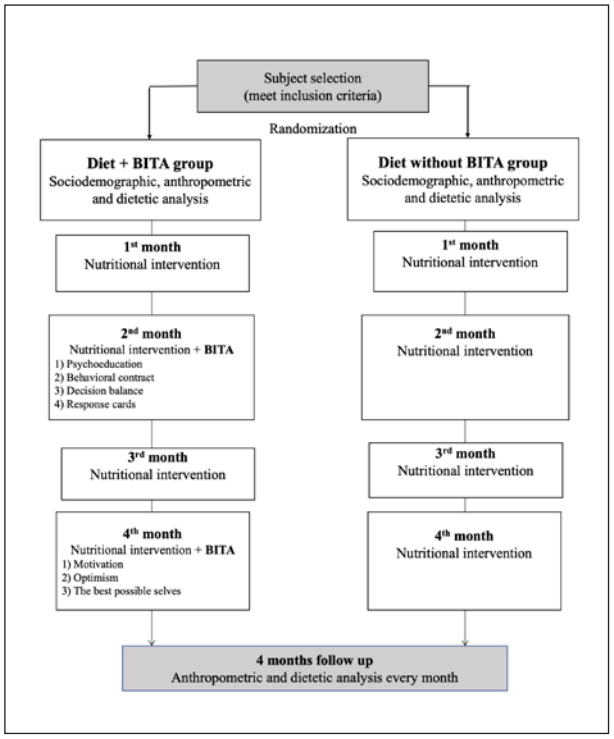

Figure 2. Procedure flow chart.

differences before and after the intervention. Furthermore, the effect size was estimated with Cohen's d test to show the magnitude of the change. A Cohen's d value ≥ 0.8 was considered as a large effect size.

RESULTS

A total of 23 participants of both sex (78% women, 22% men) were included in the study, the mean age was 37.8 ± 6.1 years. The study groups included 11 participants in the BITA group and 12 participants in the group without BITA. No differences were found in sex and age between the study groups. After exclusion of participants with missing post-baseline-intervention (n = 2), or absence on all intervention days (n = 3), data of 18 participants were analyzed (Fig. 2).

The dietary variables were analyzed at baseline and we found an inadequate intake pattern characterized by a high content in total fats, mainly saturated fats, cholesterol and very high in sugar. Furthermore, no differences were detected between the groups at baseline demonstrating the correct randomization of study participants. According to the anthropometric data, no significant differences were found between the study groups at baseline (Table 1).

After the nutritional intervention a significant decrease energy consumption, a greater contribution of polyunsaturated fatty acids (PUFAs) reaching almost 10%, which is the recommended intake, and a decrease in the intake of dietary cholesterol was found.

An analysis was carried out to evaluate the impact of the BITA strategy on nutritional adherence to weight loss treatment in participants with obesity. Table 2 shows the differences in percentage of adherence during the 4 months of the intervention. The BITA group maintained an adherence rate between 71.8% and 80%, while the group without BITA had a significant decrease of adherence throughout the intervention time.

Furthermore, in the 3rd and 4th month of intervention, patients who received BITA had greater adherence (80.0 ± 11.0% and 51.5 ± 15.5%, respectively) *versus* participants who did not receive BITA (51.5 ± 15.6% and 42.0 ± 16.8%, respectively). Data are shown in table 3.

Finally, we analyzed if the changes in weight loss (deltas) and we found that the participants who received BITA showed statistically significant changes in weight (−4.9 ± 4.0 kg weight lost), BMI (−1.7 ± 1.3 kg/m^2), BFM (−3.1 ± 4.0 kg), percentage of fat (−1.1 ± 2.8) (Table 4), whereas in group without BITA, no significant changes in weight were detected (1.3 ± 3.5 kg weight gain).

DISCUSSION

In this study, the BITA strategy was favoring the adherence to an energy restrictive diet for weight loss success in patients with obesity.

In this study, we found an inadequate nutritional pattern in accordance with the previous report and indistinctly in normal weight and participants with obesity[21]. This diet is characterized as high in

Table 1. Baseline comparison of nutritional and anthropometric data between the study groups

Nutrients	With BITA (n = 8)	Without BITA (n = 10)	p-value
Age (years)	40.3 ± 5.5	36.5 ± 7.1	0.196
Sex (M/F %)	25/75	19/81	0.722
Energy (kcal/d)	1903.9 ± 1037	2135.5 ± 583.4	0.557
Ps (%)	17.0 ± 3.3	18.2 ± 4.4	0.546
Carbohydrates (%)	41.7 ± 9.5	46.1 ± 12.1	0.408
Total fatty acids (%)	42.7 ± 8.4	36.8 ± 9.1	0.117
SFA (%)	14.5 ± 4.4	11.4 ± 4.0	0.135
MUFA (%)	15.3 ± 4.0	13.3 ± 3.1	0.249
PUFA (%)	3.4 ± 1.9	3.4 ± 2.4	0.952
Total sugar (g/d)	63.2 ± 46.1	68.4 ± 49.9	0.823
Cholesterol (mg/d)	447.8 ± 255.6	374.7 ± 212.7	0.517
Fiber (g)	19.4 ± 8.4	26.2 ± 9.7	0.140
Weight (kg)	94.4 ± 18.2	88.5 ± 8.9	0.382
BMI (kg/m^2)	34.9 ± 3.4	33.0 ± 2.7	0.227
WC (cm)	103.6 ± 13.9	100.9 ± 7.2	0.591
BFM (kg)	41.9 ± 9.1	37.0 ± 4.9	0.167
SMM (kg)	29.1 ± 7.7	27.5 ± 4.9	0.641
Fat (%)	44.6 ± 6.4	42.2 ± 6.1	0.421
Lean mass (kg)	49.3 ± 12.2	49.7 ± 7.7	0.622
Abd fat (kg)	20.9 ± 3.5	20.0 ± 3.5	0.538
Water (kg)	38.8 ± 9.2	37.3 ± 6.7	0.694

M: male; F: female; Ps: Proteins; SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; BMI: body mass index; WC: waist circumference; BFM: body fat mass; SMM: skeletal muscle mass; Abd fat: abdominal fat. Student t-test.

Table 2. Changes in percentage of adherence during the nutritional intervention in each study group

Group	1st month	2nd month	3rd month	4th month	p-value
	% Adherence				
With BITA	79.0 ± 6.4	78.1 ± 7.4	80.0 ± 3.9	71.8 ± 4.9	0.830
Without BITA	67.0 ± 5.3	62 ± 4.0	51.5 ± 4.9	42.0 ± 5.3	0.018 *

Data are expressed as percentage ± standard error. BITA: Brief Intervention for Treatment Adherence; Repeated measurements ANOVA test.
*p value 1st month versus 4th month.

processed foods and the main nutrients include saturated fats and sugars. However, after our nutritional intervention, we observed an increase in PUFA intake and a reduced cholesterol intake, these changes are associated with health improvements.

The waist circumference (WC) has a decrease after intervention, so these could have a positive metabolic effect on the metabolism of study participants.

In addition to the WC, indicators of body composition, such as weight and BMI, continue to be of

Table 3. Changes and differences in percentage of adherence during the nutritional intervention intragroup and intergroup

Adherence	With BITA (%)	Without BITA (%)	p-value	Cohen's t-test
1st month	79.0 ± 18.3	67.0 ± 17.0	0.168	0.6
2nd month	78.1 ± 21.0	62.0 ± 12.9	0.062	0.9
3rd month	80.0 ± 11.0	51.5 ± 15.6	< 0.001	2.2
4th month	71.8 ± 13.8	42.0 ± 16.8	0.001	1.8

Data are expressed as percentage ± standard deviation. BITA: Brief intervention for Treatment Adherence. $p < 0.05$ 1st month versus 4th month by repeated measurements ANOVA test (Intragroup comparison). Student t-test (Intergroup comparison). A Cohen's d test ≥ 0.80 demonstrating a large size effect.

Table 4. Changes in anthropometric variables by the BITA strategy

Variable	With BITA Δ (n = 8)	Without BITA Δ (n = 10)	p-value	Cohen's t-test
Weight (kg)	−4.9 ± 4.0	1.3 ± 3.6	0.003	1.6
BMI (kg/m^2)	−1.7 ± 1.3	0.7 ± 2.0	0.009	1.4
WC (cm)	−6.3 ± 4.5	−3.8 ± 3.8	0.231	0.6
BFM (kg)	−3.1 ± 4.0	2.3 ± 3.5	0.007	1.4
SMM (kg)	−1.0 ± 1.0	−0.8 ± 0.6	0.623	0.2
Fat (%)	−1.1 ± 2.8	1.9 ± 2.2	0.023	1.2
Lean mass (kg)	−1.7 ± 1.4	−0.3 ± 2.5	0.209	0.6
Abd fat (kg)	−0.9 ± 1.1	0.02 ± 1.2	0.110	0.7
Water (kg)	−1.6 ± 1.5	−0.3 ± 1.7	0.123	0.8

BMI: body mass index; WC: waist circumference; BFM: body fat mass; SMM: skeletal muscle mass; Abd fat: abdominal fat, Δ= final data-baseline data. Student's t-test. A Cohen's d test ≥ 0.80 demonstrating a large size effect.

great relevance in weight loss treatments and they have been associated with improving metabolic and inflammatory profiles[22].

According to the WHO recommendations, rates less than the 70% are considered to be no adherence to treatment and consequently, significant results were not achieved in these weight loss cases[23] and just BITA group maintain around these adherence percentage during intervention.

In a meta-analysis that quantified adherence rates in weight loss intervention studies showed that the overall adherence rate was very low (60.5%); these results could explain the poor impact of weight loss treatments[24]. However, they found that interventions offering social support (included motivational strategies to remain engaged in the weight loss intervention) improved adherence rates around 30% compared to those interventions that did not include them[24].

In this regard, results from a clinical trial aimed at assessing the effect of adherence and the effectiveness of four popular diets, showed that the level of adherence to dietary advice, rather than the type of diet, was the key determinant of greater weight loss reductions[25]. This finding is consistent with results in this study, where the BITA strategy was a useful tool for an improved weight loss program.

In particular, this study showed that behavioral therapy, one of the components of BITA, in conjunction with nutritional treatment, can achieve improvements in body weight, which coincides with other analyzed studies where behavioral therapy combined with diet recommendations have been reported to improve weight loss[26].

In addition, these results are consistent with Jian-Zhen and colleagues who demonstrate that after a MI technique combined with peer participation, the compliance and programs for losing weight can improve[27].

Furthermore, optimism has been associated with higher self-reported adherence, independent of negative emotional states[28]. For this reason, BITA included the promotion of optimism because it is a factor that helps maintain motivation, and it is concordant with other studies that indicate that pessimism influences people to not eat a healthy diet[28].

In that context, a study conducted in Germany population, Bischoff et al. propose that multidisciplinary lifestyle intervention including besides nutritional counseling and behavior therapy, they demonstrate that integral intervention considering behavior therapy be useful for weigh lose and improve parameter associated with metabolic syndrome[29].

The limitations of the present study are the small sample size and the dropout rate. However, considering this is a small pilot study, and the first study where the proposed BITA strategy, satisfactory results on achieving greater adherence in nutritional treatments were demonstrated, and therefore, better weight loss results. Furthermore, we suggest including nutritional intervention for weight loss in the future studies with a greater number of participants and evaluated the impact on other biochemical and metabolic parameters.

CONCLUSION

According to the results presented in this study, the BITA strategy demonstrated to be useful in improving adherence to nutritional intervention, and thus achieving a greater weight loss in the long-term; however, these results must be confirmed in a clinical trial involving a larger number of subjects. Therefore, it is recommended to complement the nutritional intervention with psychological support based on cognitive-behavioral and motivational techniques to achieve better long-term results.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

ETHICAL DISCLOSURES

Protection of people and animals. The authors declare that the procedures followed complied with the ethical standards of the responsible human experimentation committee and in accordance with the World Medical Association and the Declaration of Helsinki.

Data confidentiality. The authors declare that they have followed the protocols of their work center regarding the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

SUPPLEMENTARY DATA

Supplementary data are available at DOI: 10.24875/RME.22000052. These data are provided by the

corresponding author and published online for the benefit of the reader. The contents of supplementary data are the sole responsibility of the authors.

REFERENCES

1. Hruby A, Hu FB. The epidemiology of obesity: a big picture. Pharmacoeconomics. 2015;33:673-89.
2. Carrara A, Schulz PJ. The role of health literacy in predicting adherence to nutritional recommendations: a systematic review. Patient Educ Couns. 2018;101:16-24.
3. Barrett S, Begg S, O'Halloran P, Kingsley M. Integrated motivational interviewing and cognitive behaviour therapy for lifestyle mediators of overweight and obesity in community-dwelling adults: a systematic review and meta-analyses. BMC Public Health. 2018;18:1160.
4. Jeffery RW, Drewnowski A, Epstein LH, Stunkard AJ, Wilson GT, Wing RR, et al. Long-term maintenance of weight loss: current status. Health Psychol. 2000;19:5-16.
5. Gillison F, Stathi A, Reddy P, Perry R, Taylor G, Bennett P, et al. Processes of behavior change and weight loss in a theory-based weight loss intervention program: a test of the process model for lifestyle behavior change. Int J Behav Nutr Phys Act. 2015;12:2.
6. Kheniser K, Saxon DR, Kashyap SR. Long-term weight loss strategies for obesity. J Clin Endocrinol Metab. 2021;106:1854-66.
7. Dogru A, Ovayolu N, Ovayolu O. The effect of motivational interview persons with diabetes on self-management and metabolic variables. J Pak Med Assoc. 2019;69:294-300.
8. González-Cantero JO, Tena RO, Rodríguez JA. Intervención cognitivo-conductual para el control metabólico de la diabetes mellitus tipo 2: un estudio piloto. Terapia Psicológica. 2019;37:287-94.
9. Li Z, Chen Q, Yan J, Liang W, Wong WC. Effectiveness of motivational interviewing on improving care for patients with Type 2 diabetes in China: a randomized controlled trial. BMC Health Serv Res. 2020;20:57.
10. Scheier MF, Swanson JD, Barlow MA, Greenhouse JB, Wrosch C, Tindle HA. Optimism versus pessimism as predictors of physical health: a comprehensive reanalysis of dispositional optimism research. Am Psychol. 2021;76:529-48.
11. Peters ML, Meevissen YM, Hanssen MM. Specificity of the best possible self intervention for increasing optimism: comparison with a gratitude intervention. Ter Psicol. 2013;31:93-100.
12. Aggarwal R, Deutsch JK, Medina J, Kothari N. Resident wellness: an intervention to decrease burnout and increase resiliency and happiness. MedEdPORTAL. 2017;13:10651.
13. García-Flores R, Sanchez-Sosa JJ. Efectos de la entrevista motivacional en el tratamiento de la diabetes mellitus tipo 2. Psicología Y Salud. 2013;23:183-93.
14. Report of the national cholesterol education program expert panel on detection, evaluation, and treatment of high blood cholesterol in adults. The expert panel. Arch Intern Med 1988;148:36-69.
15. Young C, Campolonghi S, Ponsonby S, Dawson SL, O'Neil A, Kay-Lambkin F, et al. Supporting engagement, adherence, and behavior change in online dietary interventions. J Nutr Educ Behav. 2019;51:719-39.
16. Miller WR, Rose GS. Motivational interviewing and decisional balance: contrasting responses to client ambivalence. Behav Cogn Psychother. 2015;43:129-41.
17. Poulimeneas D, Anastasiou CA, Kokkinos A, Panagiotakos DB, Yannakoulia M. Motives for weight loss and weight loss maintenance: results from the medweight study. J Hum Nutr Diet. 2021;34:504-10.
18. Talbot F, Fournier JS, Hendriks M. Life goal reconstruction for people with chronic health conditions: feasibility of a brief internet-based writing intervention using a minimally monitored delivery. Internet Interv. 2021;25:100431.
19. Sergi G, De Rui M, Stubbs B, Veronese N, Manzato E. Measurement of lean body mass using bioelectrical impedance analysis: a consideration of the pros and cons. Aging Clin Exp Res. 2017;29:591-7.
20. Hertzog MA. Considerations in determining sample size for pilot studies. Res Nurs Health. 2008;31:180-91.
21. Campos-Pérez W, González-Becerra K, Ramos-López O, Silva-Gómez JA, Barrón-Cabrera E, Roman S, et al. Same dietary but different physical activity pattern in normal-weight and overweight Mexican subjects. J Food Nutr Res. 2016;4:729-35.
22. Armborst D, Metzner C, Bitterlich N, Lemperle M, Siener R. Effect of a weight-loss stabilization following a weight reduction with or without meal replacement on cardiometabolic risk in overweight women. A randomized controlled trial. Int J Food Sci Nutr. 2019;70:453-66.
23. WHO. Adherence to Long-Term Therapies: Evidence for Action. Geneva: WHO. Available from: https://www.who.int/chp/knowledge/publications/adherence_report/en [Last accessed on 2020 Dec 16].
24. Lemstra M, Bird Y, Nwankwo C, Rogers M, Moraros J. Weight loss intervention adherence and factors promoting adherence: a meta-analysis. Patient Prefer Adherence. 2016;10:1547-59.
25. Dansinger ML, Gleason JA, Griffith JL, Selker HP, Schaefer EJ. Comparison of the Atkins, Ornish, Weight Watchers, and Zone diets for weight loss and heart disease risk reduction: a randomized trial. JAMA. 2005; 293:43-53.
26. Mastellos N, Gunn LH, Felix LM, Car J, Majeed A. Transtheoretical model stages of change for dietary and physical exercise modification in weight loss management for overweight and obese adults. Cochrane Database Syst Rev. 2014;2:CD008066.
27. Jz W, Mh D, JX, Hx L. Effect of motivational interviewing combined with peer participation on obesity management in adolescents. Zhongguo Dang Dai Er Ke Za Zhi. 2016;18:645-9.
28. Millstein RA, Celano CM, Beale EE, Beach SR, Suarez L, Belcher AM, et al. The effects of optimism and gratitude on adherence, functioning and mental health following an acute coronary syndrome. Gen Hosp Psychiatry. 2016;43:17-22.
29. Bischoff M, Zimny S, Feiner S, Sauter J, Sydor S, Denk G, et al. Multidisciplinary lifestyle intervention is associated with improvements in liver damage and in surrogate scores of NAFLD and liver fibrosis in morbidly obese patients. Eur J Nutr. 2022;61:2725-35.