REVIEW ARTICLE

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Internet-based weight loss programs: a review

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Abstract

Introduction: The prevalence of obesity in the adult population is a public health concern. Pharmacological, surgical and behavioral therapies are consensual, but when they are not associated with changes in lifestyle are often ineffective in the long term. Web programs for weight loss are an alternative and complementary. *Objective*: To report web interventions for weight loss, analyze the model of intervention and results in weight reduction. *Methods*: Only randomized clinical trials of nutritional intervention applied via web published between the years 2002 and 2012 were selected. Databases were MEDLINE via PubMed and Web of Science. The articles were evaluated by categories, being Category 1: objectives, study group, sample size, time, and loss of follow up; and Category 2: intervention design, theoretical framework, personalization strategies and outcomes. *Results*: 15 randomized controlled trials were selected. The personalization strategies have been prepared from information collected through questionnaires filled by the users of programs. The interventions used models based on theories of behavior. Reduction in body weight achieved in the web groups ranged from 0.9 to 8.8 Kg. *Conclusion*: Web programs for weight loss provide interaction among users and in some cases promotes weight reduction. However, the resources used are not described in detail by the authors, and this hinders the creation of new science-based programs.

Keywords: Diet. Obesity. Weight Loss. Food and Nutrition Education. Internet. Food Behavior. Intervention Studies.

Introduction

The increasing prevalence of overweight and obesity in the adult population is a concern in public health.[1] Estimates from the World Health Organization showed that in 2008, 1.4 billion individuals aged 20 or older were overweight in the world and, approximately 500 million adults were obese (BMI ≥ 30 kg / m²).[2]

In Brazil, data from population surveys revealed that, in 2011, overweight was present in at least 39.8 % of the population of Sao Luis and in 55.4% in Porto Alegre.[3]

The progressive increase in body mass index is related to the emergence of non-transmissible chronic diseases such as heart-related, stroke, diabetes and cancer. These diseases are the death cause of 2.8 million people worldwide each year.[4]

Body weight is determined by the interaction of genetic, environmental, psychological and social factors, and overweight occurs when there is an imbalance of these factors.[5]

Many experts associate such imbalance with the contemporary lifestyle, which is influenced by factors such as economic growth, industrialization and mechanization of food production, urbanization, greater access to food in general and globalization The presence of these factors make treatment for obesity complex, thus requiring the involvement of a multidisciplinary team. For that reason, it is important to treat the causes related to the environment and changes in lifestyle.[6-8]

Consensus therapies prescribed for treatment include the pharmacological, surgical and behavioral ones. The first two, when not associated with changes in lifestyle, may be ineffective in the long run. Changes in lifestyle refer to the correction of habits related to improper eating, sedentary lifestyle and stress.[8]

Studies that focused on the changing in lifestyle have shown good results in decreased body weight to clinically significant levels (5-10% decrease of current weight).[9] For instance, the *Diabetes Prevention Program* is an intervention conducted by teams composed of nutritionists, physicians and psychologists, aiming to change eating behavior and which has reduced by about 60% the risk of developing diabetes. Half of the participants decreased by 7% their initial body weight in a treatment period of six months.[10] Despite the benefits, interventions such as this are expensive because they include direct spending on transportation, health professionals and service. Furthermore, they do not reach a large number of individuals.[11]

Over the past decade, the intervention programs for weight reduction via Internet showed to be more affordable options, due to lower cost and because they complement present nutritional actions.[12] Systematic literature reviews have shown scientific evidence on the effectiveness of educational programs via *web* in nutrition education and body weight reduction and maintenance.[13, 14]

Communication with individuals via *web* is established by means of systems that can treat them in real time, and in a customized and interactive manner. Thus, weight reduction and dietary re-education take into account individual preferences and needs.[15-18] Such customization is known as *tailoring*, in which educational strategies based on human behavior are used to establish individual goals, seeking to improve engagement.[15-18]

The provision of information and programs for weight reduction on the *web* is wide. The search on the *Google* engine for the words "losing weight *online*", yielded 9,130 pages with related topics.

In Brazil, 45% of the population have a computer at home and 38% of these are connected to the Internet.[19] However, in the Brazilian literature, there are only a few studies that explore this topic, and no reference was found to models of intervention for weight reduction used in programs via *web*.[20]

This study is a literature review that aims to explore nutritional intervention studies via the *web*, analyze the models of intervention used and the results obtained by individuals who access these programs.

Methods

To perform the search of scientific articles, the period 2002-2012 was determined. The databases used were PubMed via MEDLINE and Web of Science (ISI). The terms used in the search were: *internet*, *overweight*, *obesity*, *body weight changes*, *food habits*, *web-based*, *computer tailoring*, *nutrition education* and *adults*. The Boolean search followed the formulation: (*internet OR web-based OR computer tailoring*) *AND* (*overweight OR obesity*) *AND* (*body weight changes OR food habits OR nutrition education*) *AND* (*adults*).

Articles in Portuguese and English published in scientific journals on preventive medicine, medicine and internet, education and health behavior and obesity were selected. The word *tailoring* in this article has been translated "personalização".

Article inclusion criteria were: Randomized clinical and controlled trials on nutritional intervention applied via computer exclusively or mixed and with outcomes that addressed dietary behavior and body weight. Studies that did not use the *internet* in the intervention group as the main form of orientation of the participant were excluded - for example, those that used programs created on *CD-ROM*. As well as articles on the study design.

Selection of articles

The selected articles were assessed by category, according to the following research questions:

- **Category 1: Study design, objectives, studied group, sample size, follow-up time and loss**

1. What is the main objective of the study?
2. Which is the group studied on gender, mean age and body mass index?
3. What is the sample size?
4. What is the follow-up time of the study?
5. What is the follow-up loss?

- **Category 2: Control group and intervention design, theoretical grounds, strategies of customization and outcomes**

6. What is the study design for the intervention and control groups?
7. What is the behavioral theoretical referential used on the intervention group for weight reduction?
8. Which are the mechanisms or strategies of *tailoring*?
9. Which are the outcomes related to weight loss (in kg) and clinically significant weight loss (<5%)?

Results

The search yielded 201 articles, of which 15 randomized clinical trials met the inclusion criteria and were selected for analysis. Among the studies, 10 were developed in the USA, 3 in Australia, 1 in England and another in Holland.

Category 1: Study design, objectives, studied group, sample size, follow-up time and loss (Table 1).

Regarding gender, the works of Webber et al.[21] and Mouttapa et al.[22] have focused specifically in women, and the works of Morgan et al.[23] and Patrick et al.,[24] in men. On the other research works, there has been no subdivision with regard to gender.

Body mass index mean referred to class 1 obesity (from 30 to 34.9kg) in 78% of studies. Age ranged from 35.9 to 50. Minimum and maximum number of participants were 51 on the study of Pellegrini et al.[25] and 2.862 on Rothert et al.[26] Follow-up time ranged from 2 to 12 months, and in 33% of studies, patient follow-up lasted six months.

Most studies (60%) had follow-up loss higher than 20%.[23,24,26-31] Some studies identified follow-up loss was associated with low response in body weight loss, preference for presential treatment, and with the fact that intervention via *web* was not successfully customized. Only six studies (40%) had lower loss than 20%. [21, 22, 32-35]

Table 1. Gender, mean body mass index, mean age, sample size, follow-up time and loss. São Paulo-SP, 2012.

Authors	Gender	Mean BMI (kg/m2)	Mean age	Sample size	Follow-up time (months)	Follow-up loss (%)
Mc Connon *et al.*[27]	Men and women	*	*	221	12	41
Morgan *et al.*[23]	Men	30.6 (2.8)	35.9 (11.1)	65	12	29
Harvey-Berino, *et al.*[32]	Men and women	35.7 (5.6)	46.6 (9.9)	481	6	4
Webber, *et al.*[21]	Women	31.1 (3.7)	50 (9.9)	66	4	2
Polzien, *et al.* [33]	Men and women	33.1 (2.8)	41.3 (8.7)	57	3	0

Authors	Gender	Mean BMI (kg/m2)	Mean age	Sample size	Follow-up time (months)	Follow-up loss (%)
Gold, *et al.* [28]	Men and women	32.3 (3.9)	46.5 (10.7)	126	12	35
Rothert, *et al.*[26]	Men and women	33 (3.8)	45.6 (12.1)	2862	6	80
Pellegrini, *et al.* [25]	Men and women	33.7 (3.6)	44.2 (8.7)	51	6	27
Patrick,*et al.*[24]	Men	*	43.9 (8)	441	12	30
Collins, *et al.* [34]	Men and women	*	*	209	3	16
Van Genugten, et al. [29]	Men and women	28 (1.94)	47.8 (9.4)	539	6	35
Chambliss, *et al.* [30]	Men and women	*	*	120	3	21
Booth, *et al.* [31]	Men and women	30.6 (*)	47.5 (*)	73	3	27
Tate, *et al.* [35]	Men and women	*	*	192	6	19
Mouttapa, *et al.* [22]	Women	*	*	307	2	15

*Author does not mention mean BMI and age, nor total standard deviation of sample.

Category 2: Control group and intervention design, theoretical referential, strategies of customization and outcomes (Table 2)

Study designs of McConnon et al.[27], Patrick et al.[24], Collins et al.[34], Chambliss et al.[30] and Tate et al.[35] have compared a group that participated in weight loss programs *online* with a control group that did not receive any guidance. Gold et al.[28], Rothert et al.,[26] Van Genugten et al.[29] and Booth et al.[31] have compared two *online* programs, aiming to create improvements for the original programs.

The studies of Morgan et al.[23] and Webber et al.[21] compared in-person appointments conducted by therapists, nutritionists or doctors with *online* programs. Harvey-Berino et al.,[32] Polzien et al.[33] and Pellegrini et al.[25] compared the results found in three groups: in-person treatment, *online* programs, and the two combined.

Models used in education and intervention were mostly based in behavioral theories. The most cited theories were: cognitive-behavioral,[23,35] cognitive-social [22,24,33,34], and motivational theories.[24, 31]

Most customization strategies of intervention were developed from information gathered through questionnaires or records on body weight, food consumption and frequency of physical activity, filled by users on the *website*. Based on this information, counseling was developed by researchers who used data at in-person appointments, via email replies, or through specific systems capable of processing all data and preparing a computerized recommendation.

Counseling generated by the computerized nutritional intervention system was presented in the form of goals, tips, texts and graphics. The topics covered were related to the degree of user motivation, behavior change, diet, gastronomy and exercise.

The studies of Harvey-Berino et al.[32], Webber et al.[21] and Gold et al.[28] used a computerized nutritional intervention that allowed the user to communicate with the researcher and with the other participants. This communication was established in chat rooms regularly available on the website of the program or in *blogs*.

The achieved reduction in body weight ranged from 0.9 to 8.8 Kg The works of Polzien et al.,[33] Gold et al.,[28] Rothert et al.,[26] Pellegrini et al.,[25] Patrick et al.,[24] Collins et al.,[34] Tate et al.[35] and Mouttapa et al.[22] significantly differed ($p < 0.05$) in weight loss, compared to control. Two works with longer follow-ups showed significant difference for weight maintenance after reduction, in 12 months.[24, 28]

Some articles demonstrate clinically significant weight reduction (> 5 %) among participants. In studies McConnon et al.,[27] Morgan et al.,[23] Collins et al.[34] and Tate et al.,[35] The percent reduction above or equal to 5% of body weight among participants was higher than in the control group.

Table 2. Control group and intervention design, theoretical referential, strategies of customization and outcomes. São Paulo-SP, 2012.

Authors		
Mc Connon *et al.* [27]	Group control and intervention design	Control group: usual treatment Intervention group: Internet with free access to the *website*
	Behavioral theoretical referential	None
	Customization strategies	The *website* offered suport tools for the change of habits. Motivational messages were created based on participant report.
	Outcome	**Mean weight loss**: Internet Group: 1.3 kg, Control Group 1.9 kg (p = 0.56). **Weight loss > 5%:** Internet group 22% ; Control Group 18%
Morgan *et a* [23]	Group control and intervention design	In-person appointment group + weight loss guide. In-person appointment intervention group (guidance on the use of the *website*) + weekly weight record, daily exercise and diet on the website
	Behavioral theoretical referential	In the intervention group: Cognitive-behavioral theory
	Customization strategies	*Feedbacks* based on diet, weight and exercise records were sent seven times. Users could post messages on the program's page
	Outcome	**Mean weight loss**: Internet group 5.3 kg, Control 3.1 kg (p=0.408) **Weight loss > 5%:** Internet Group: 57.7%; Control group and: 30% (p=0.062)

Harvey-Berino, *et al.* [32]	Group control and intervention design	Group: in-person*:* weekly meeting in groups + calorie control *Internet group*: web + group online weekly meetings (*chat*) + calorie control Mixed group: characteristics of the Internet group + in-person meetings once a month + calorie control
	Behavioral theoretical referential	In all three groups: Use of behavioral strategies and self-management of competences
	Customization strategies	Behavioral strategies included self-monitoring, stimuli control, troubleshooting, establishment of goals, downfall prevention, and assertional training
	Outcome	**Mean weight loss**: In-person group 8.0 kg, Internet group 5.5 kg; mixed group 6.0Kg (p=0.01) **Weight loss > 7%:** in-person group 56.3%; internet 37.3%; mixed 44.4% (p 0.01)
Webber, *et al.* [21]	Group control and intervention design	Control groups: Minimum web intervention: Intervention group advanced *web*: the same strategy as the previous group + chat room.
	Behavioral theoretical referential	Motivational interview
	Customization strategies	The website was updated with: weight loss tips, weekly exercises, self-monitoring guidance, links to other *websites* and there was a platform for messages. Chats had motivational techniques
	Outcome	**Mean weight loss**: Minimum web intervention group 2.22 kg, advanced *web* intervention group: 3.71 kg (p=0.19) **Weight loss > 5%: 6**7% Minimum web intervention group and 46% Advanced *web* intervention group (p=0.07)

Polzien, *et al.* [33]	Group control and intervention design	In-person control group: seven appointments on the first month, two on the second, and one on the third Mixed group: (in-person + *technology*). in-person + a monitor to measure energy expenditure supposed to be used 3 times . Technology group: in-person + a monitor to control energu expenditure for daily use
	Behavioral theoretical referential	Cognitive-social theory
	Customization strategies	The system capable to monitor energy expenditure provided *feedback* on energy balance. At the end of the day, each user should *upload* the system on the *website* of the program. Analysts checked their energy balance to provide feedback at in-person meetings
	Outcome	**Mean weight loss**: In-person control group 4.1kg, Mixed group: 3.4 kg , Technology group: 6.2 Kg (p=0.04) **Weight loss > 5%:** none
Gold, *et al.* [28]	Group control and intervention design	Intervention group behavioral *web* (six months for weight loss and six months for maintenance). Intervention group commercial web
	Behavioral theoretical referential	Dietary behavior strategies
	Customization strategies	Weight loss time: Users should access the website and register their weight and diet besides answering some questions related to dietary behavior and weight. There was *feedback* on users responses through emails. There was chat and *blogs*
	Outcome	**Mean weight loss in 12 months**: Intervention group behavioral *web*: 7.8 Kg, Intervention group commercial web: 3.4kg (p= 0.002) **Weight loss > 5%:** Intervention group behavioral *web*: 65%, Intervention group commercial web: 37.5%; *(p* = 0.01) in 12 months

Rothert, *et al.* [26]	Group control and intervention design	Group 1 usual information via *web* for weight loss Group 2 usual information via *web* customized for loss of weight
	Behavioral theoretical referential	None
	Customization strategies	A questionnaire was applied to both groups on *baseline*. No diets were prescribed, patients received automated *feedback* based on the questionnaire. Social support was provided by means of a *blog*
	Outcome	**Mean weight loss**: Group 1: 2.8kg; Group 2: 1.1 Kg (p=0.0007) **Weight loss > 5%:** none
Pellegrini, *et al.* [25]	Group control and intervention design	Intervention In -person group :
	Behavioral theoretical referential	Mixed group : (in -person + technology) . Group technology : energy expenditure monitor emails + researchers + phone calls once a month .
	Customization strategies	behavioral strategies
	Outcome	Monthly meetings with a face and three weeks in group
Patrick,*et al.* [24]	Group control and intervention design	Users of monitor used during the day and discharged the information recorded in the program where the food intake and weight site . Investigators evaluated a weekly feedback.
	Behavioral theoretical referential	Mean weight loss : classroom intervention group: 7.1 kg ; Mixed group : 8.8 kg ; Technology Group : 7.6 kg
	Customization strategies	(p = 0.001)
	Outcome	Weight loss > 5 % : not described

Collins, *et al.* [34]	Group control and intervention design	Intervention group : online weight reduction program
	Behavioral theoretical referential	Control group : usual habit
	Customization strategies	Social Cognitive Theory and decisive behavior model
	Outcome	A focus group was accomplished with some men before the start of the program. The information collected in this group were used to adapt the site the reality of the male perspective in reducing the weight .
Van Genugten, et al. [29]	Group control and intervention design	Mean weight loss: Intervention group: 0.9kg Control group: 0.2 kg (P = 0.01)
	Behavioral theoretical referential	Weight loss > 5 % : not applicable
	Customization strategies	Control group : lisa waiting ; Intervention group online web standard; Intervention group advanced online web
	Outcome	Social cognitive theory and key mediators of behavioral change
Chambliss, *et al.* [30]	Group control and intervention design	Recommendation use four times a week and record food intake and physical activity. The weight record was daily.
	Behavioral theoretical referential	None
	Customization strategies	Basic group: customized dietary plan daily self-monitoring of diet and exercise through the *software*. Educators sent weekly *feedback* based on diet and exercise. Monthly in-person appointment. The advanced group received the same information as the other group, but it included strategies for the management of dietary behavior, once a month through newsletters and a phone call every month

	Outcome	**Mean weight loss**: Basic group 2.7 Kg Advanced group 2.5 kg Control +0.3, (p= 0.61) **Weight loss > 5%:** Basic group 52%; Advanced group 35%; Control group
Booth, *et al.* [31]	Group control and intervention design	ED group: dietary and physical intervention via the web Ex group: intervention only for exercise guidance via web
	Behavioral theoretical referential	Motivational Theory: "*goal setting theory*"
	Customization strategies	Description of the group with dietary treatment: the subjects answered questions about the consumption of certain foods. From this should set goals to improve the consumption of certain foods. At least one and maximum of 12 targets should be completed per week. The same occurred with caloric intake. A positive return was sent to the user, as well as strategies to identify barriers to change. Still receiving newsletters on nutrition in general
	Outcome	**Mean weight loss**: ED group: 0.7 Kg Ex group: 1.9kg (p=0.09) **Weight loss > 5%:** NA
Rothert, *et al.*[35]	Group control and intervention design	Intervention group via web with automatic *feedback*; intervention group via web created by an expert Control group: usual habit
	Behavioral theoretical referential	Cognitive-behavioral theory
	Customization strategies	Diet (1,200 to 1,500 kcal) + exercise in *baseline*. On the website, encouragement to record weekly weight, with automated responses in graphs and tips to reduce calorie consumption and changes of habit.
	Outcome	**Mean weight loss**: Intervention group via web with automatic *feedback*; 4.9 Kg; Intervention group via web created by an expert: 7.3kg; Control: 2.6 kg (p=0.001) **Weight loss > 5%:** Intervention group via web with automatic *feedback*; 34%. Intervention group via web created by an expert: 52%; Control: 27% (p=0.01)

Mouttapa, *et al.* [22]	Group control and intervention design	Intervention group – Intervention nutritional program via web; Control – no intervention
	Behavioral theoretical referential	Cognitive-social theory
	Customization strategies	Individual nutritional intervention Participants chose a goal to lose weight or prevent diseases and were encouraged to identify which would be their next seven goals in reality.
	Outcome	**Mean weight loss**: Intervention group: 0.885 kg; Control: 0.227 kg (p=0.05) **Weight loss > 5%:** none

Discussion

Studies Polzien et al.,[33] Gold et al.,[28] Rothert et al.26th Pellegrini et al. 25th Patrick et al. 24th Collins et al. Tate et al.35 and 34 Moutappa et al.[22] reported a statistically significant difference ($p < 0.05$) in reducing the weight in the intervention group. However, the results of this review, as well as Arem et al.,[36] suggest that interventions do not promote web via a uniform effect on weight reduction because they depend on study design, follow-up time of the intervention and treatment adherence. Regarding the range of weight reduction, it was not possible to perform a statistical analysis to see if there were differences between the studies because the methodology (sample size, follow-up and treatment regimen) were different.

A metanálise[37] of 18 studies published in 2009 suggested that interventions web promote weight reduction similar in the groups with minimal intervention. Apparently, you can only reach significant effect on body weight when the program allows interactions between individual, community, health professionals and the website. In this review, studies showed satisfactory reduction in weight allowed such interactions and, in addition, in studies Polzien et al.[33] and Pellegrini et al.,[25] a device that monitored energy expenditure for 24 hours and was attached to the arm was used the individual. At the end of the day, the participant should access the online home of the program and update it with the monitor information.

Contento[38] argued that nutrition education focused on weight reduction is more likely to be effective when it is conducted in person, if appropriate to the individual and behavioral needs and establish goals, strategies, provide feedback during treatment and enable the active participation of the individual in learning process. In this review, as well as in the Enwald & Huotari,[39] it was observed that the components of the intervention via the web that are potentially associated with efficacy are those who favor the personalization of treatment and have the following characteristics:

- Best related to the higher number of accesses (logins) to the site by the user result;
- Availability of self-monitoring tools in the program, such as for daily food records and physical activity;
- Social support such as communication among users;
- Service online (chat or chat rooms) to exchange messages with nutritionists or professional psychologists.

The literature argues that better adherence to guidelines is related to motivational state of the individual. Programs via the web can assist in awakening to the intention of change : for example, to show the participant how is your current eating habits , as they enable the calculation of dietary intake and its instant comparison with the recommendations dietéticas.[18]

Apart from the degree of motivation of the individual, sex is another feature that can influence the success of the intervention. Among the articles selected in this review, the work of Morgan et al.,[23] Webber et al.,[21] Patrick et al.[24] and Moutappa et al.[22] were developed specifically for women or men. In the study by Patrick et al.,[24] for example, a focus group was conducted with some men before the start of the program and the information gathered was used to adapt the program from a male perspective in the context of weight reduction.

Moreover , women and men may have different preferences for the type of intervention . In the study by Terry et al.,[40] in which participants could choose between interventions via the web or telephone, the males preferred the first option.

Conclusion

Current systems provide web interaction and practicality and can be accessed as often as needed, anytime and anywhere. Furthermore, there is active participation of the individual, represented by the interactivity between program / program and individual / group (social networks), which stimulates the engagement of participants in weight loss process. Thus, one can induce awakening to the process of change of lifestyle.

Controlled studies with interventions via the web are very recent and resources used in the intervention, in most cases, are not described in detail by the authors , which hinders the creation of new programs with scientific evidence.

In addition , the programs made for weight reduction of promoting web often not clinically satisfactory weight reduction varied . Those programs that contributed to weight reduction greater than 5% of initial weight have no similarity in the intervention model.

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