American Dietetic Association

RESEARCH

Research and Professional Briefs

Can Relaxation Training Reduce Emotional Eating in Women with Obesity? An Exploratory Study with 3 Months of Follow-Up

GIAN MAURO MANZONI, PsyD; FRANCESCO PAGNINI, MS; ALESSANDRA GORINI, MS; ALESSANDRA PREZIOSA, PhD; GIANLUCA CASTELNUOVO, PhD, PsyD; ENRICO MOLINARI, PhD, PsyD; GIUSEPPE RIVA, PhD

ABSTRACT

Stress and negative emotions have been shown to be critical factors in inducing overeating as a form of maladaptive coping in some patients with obesity. We evaluated the efficacy of a 3-week relaxation protocol enhanced by virtual reality and portable mp3 players in reducing emotional eating in a sample of 60 female inpatients with obesity who report emotional eating, using a three-arm exploratory randomized controlled trial with 3 months of follow-up. The intervention included 12 individual relaxation training sessions provided traditionally (imagination condition) or supported by virtual reality (virtual reality condition). Control participants received only standard hospital-based care. Weight, behavior and psychological data were collected and analyzed. Relaxation training was effective in reducing emotional eating episodes, depressive and anxiety symptoms, and in improving perceived self-efficacy for eating control at 3-month follow-up after discharge. The virtual reality condition proved better than the imagination condition in the reduction of emotional eating. Weight decreased in subjects in all three conditions without significant differences between them, probably due to the common treatment all inpatients received. We conclude that relaxation training supported by new technologies could be a useful tool for reducing emotional eating episodes and thereby reducing weight and obesity.

J Am Diet Assoc. 2009;109:1427-1432.

G. M. Manzoni is with Istituto Auxologico Italiano Istituto di Ricovero e Cura a Carattere Scientifico (IRCCS), Psychology Research Laboratory, San Giuseppe Hospital, Verbania, Italy, and is a doctoral degree candidate, PhD Program in Clinical Psychology, University of Bergamo, Bergamo, Italy. F. Pagnini is a doctoral degree candidate, PhD Program in Clinical Psychology, University of Bergamo, Bergamo, Italy. A. Gorini is with Istituto Auxologico Italiano IRCCS, Applied Technology for Neuro-Psychology Laboratory, Milan, Italy, and is a doctoral degree candidate, Research Institute Brain and Behaviour, Maastricht University, The Netherlands. A. Preziosa is with Istituto Auxologico Italiano IRCCS, Psychology Research Laboratory, San Giuseppe Hospital, Verbania, Italy. G. Castelnuovo and E. Molinari are with Istituto Auxologico Italiano IRCCS, Psychology Research Laboratory, San Giuseppe Hospital, Verbania, Italy, and with the Department of Psychology, Catholic University of Milan, Milan, Italy. G. Riva is with Istituto Auxologico Italiano IRCCS, Applied Technology for Neuro-Psychology Laboratory, Milan, Italy, and with the Department of Psychology, Catholic University of Milan, Milan, Italy.

Address correspondence to: Gian Mauro Manzoni, PsyD, Istituto Auxologico Italiano IRCCS, Psychology Research Laboratory, San Giuseppe Hospital, Verbania, Italy. E-mail: gm.manzoni@auxologico.it

Manuscript accepted: February 18, 2009.

0002-8223/09/10908-0013$36.00/0

doi: 10.1016/j.jada.2009.05.004

Obesity prevalence is dramatically growing worldwide (1). Given that overweight and obesity lead to serious health consequences that weigh heavily on health care costs, developing effective interventions for substantially reducing weight and maintaining weight loss is compelling.

Traditional interventions for obesity target almost exclusively reduction in energy intake and improvement in time spent engaging in physical activity. Indeed, an energy deficit is necessary for reducing weight, but maintaining weight loss is not so easy (2-4) and further exploration of alternative factors is needed. Echoing Ozier and colleagues (5,6), an important variable that must be taken into account is the relationship between food and stress (7,8). Eating in response to a negative mood or emotion (ie, emotional eating [9,10]), is quite common behavior and may be considered both an emotional relief and a form of dysfunctional coping (11-16). Individuals who frequently eat or overeat in response to negative emotions are more likely to be overweight or obese (6). Patients with obesity who decrease their emotional eating are more likely to succeed at weight reduction (17).

In this article we describe the follow-up part of an exploratory randomized controlled study. Our aim was to evaluate the midterm effects of a 3-week relaxation training program enhanced by virtual reality and supported by portable mp3 players on emotional eating behaviors, anxiety, depression, and perceived self-efficacy for eating control in a sample of women with obesity enrolled in an inpatient program. Post-treatment results have already been reported and widely discussed (18). Here, postintervention findings are

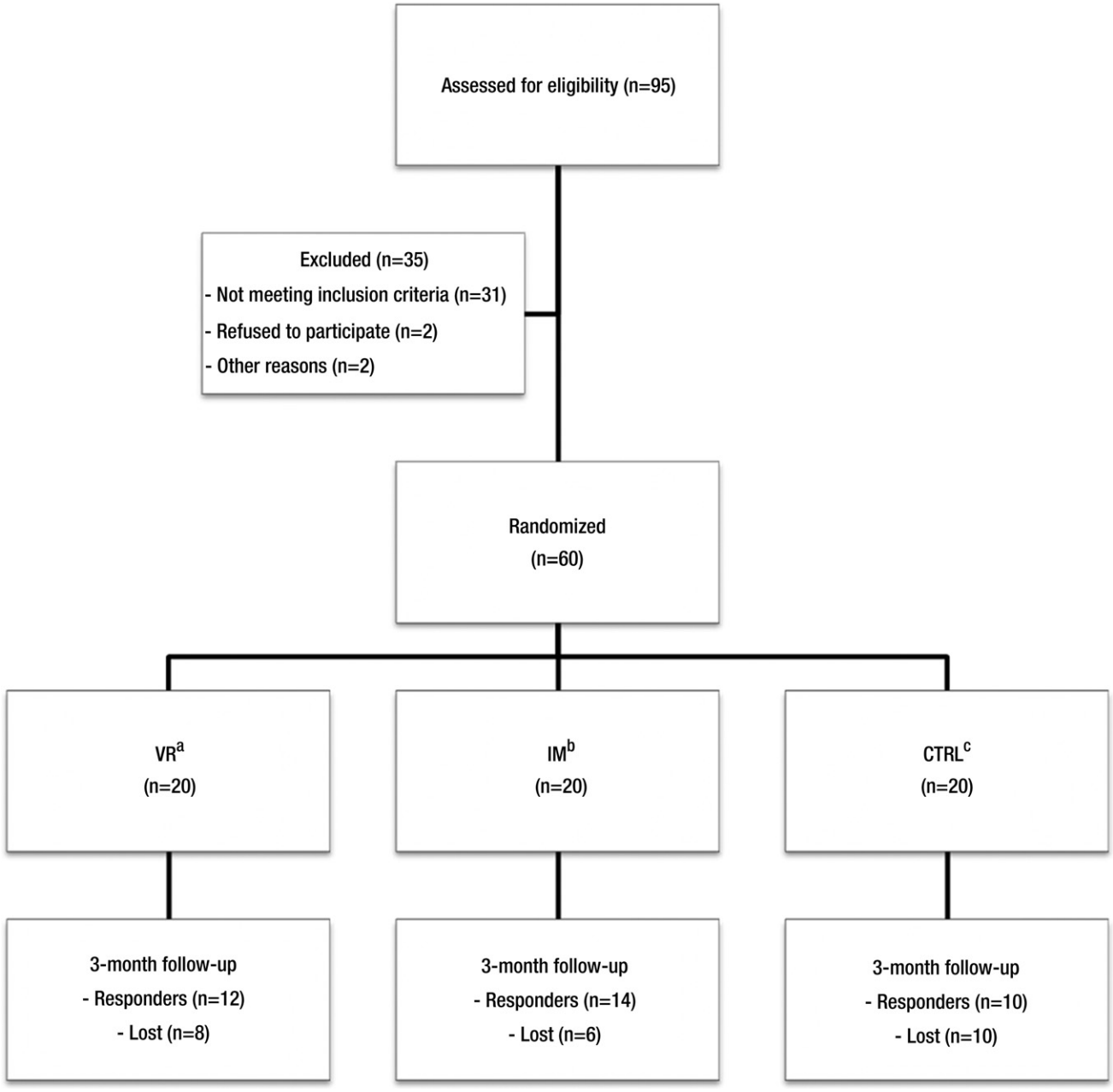

Figure. Flowchart describing procedures of a study designed to evaluate the efficacy of a 3-week relaxation protocol enhanced by virtual reality and portable mp3 players in reducing emotional eating in a sample of 60 female inpatients with obesity who reported emotional eating. [a]VR=virtual reality condition. [b]IM=imaginative condition. [c]CTRL=control condition.

briefly summarized for clarity reasons and reported data pertain to the most informative follow-up part of the trial.

It was hypothesized that relaxation training is effective in improving all the considered variables compared to a control condition, that it is effective in maintaining gains at follow-up, and that the experimental protocol enhanced by virtual reality is more effective than an imagination-based traditional one.

METHODS

Participants

Participants were recruited during a 7-month period during 2007 from an obese population admitted for weight reduction treatment at San Giuseppe Hospital, Istituto Auxologico Italiano, Verbania, Italy. Sixty women with obesity participated in the trial during the inpatient therapy (a flowchart of the procedures is shown in the Figure).

To be included in the study, patients had to be women;

between ages 18 and 60 years; have received a primary diagnosis of obesity based on World Health Organization criteria (1); report the presence of recurrent episodes of emotional eating, as assessed through the Emotional Overeating Questionnaire (EOQ) (19); and have a body mass index ≥30 (1). Diagnostic interviews were conducted during the first week of the inpatient program by an independent clinical psychologist as part of his clinical work. Patients affected by other psychiatric, psychological, or neurological disorders were excluded from the study.

Patients who met the inclusion criteria were provided with detailed information about the study and the experimental treatments by the same clinical psychologists who administered the intervention. After giving written informed consent to participate, the participants were consecutively randomly assigned to one of three conditions: virtual reality condition, imaginative condition, or control condition.

Detailed epidemiologic, clinical, and demographic characteristics of the sample are reported elsewhere (18). No significant baseline differences were found in all variables among the three groups of patients. The study received ethical approval from the Ethical Committee of the Istituto Auxologico Italiano.

Inpatient Program for Weight Reduction and Rehabilitation

All women recruited for participation in the trial underwent a 5-week hospital-based program for weight reduction and rehabilitation. Experimental treatments were administered during the inpatient program, with sessions scheduled among the other activities. During the residential period, admitted patients lived in a medical hospital–like environment located on a mountain highland far away from towns and cities. Visits from parents were allowed only in the afternoon. All patients receiving the standard treatment program were placed on a low-energy balanced diet (80% of basal energy consumption estimated according to the Harris-Benedict equation) that consisted of 16% protein, 25% fat, and 59% carbohydrates, and participated in nutrition programs provided by a food and nutrition professional, psychological counseling provided by a clinical psychologist, and physical activity training provided by a physiotherapist. Nutrition training took place in group sessions (90 minutes each) twice a week and included information on obesity and its causes, evaluation of nutritional status, modalities for proper eating, regulation of body weight, biological and social stimuli affecting food intake, and strategies for engaging in regular physical exercise and for long-term weight management.

Control participants did not receive any relaxation training protocol and received only the previously described in-hospital treatment.

Relaxation Training

The additional relaxation training interventions were administered by two licensed clinical psychologists and one licensed psychotherapist under the supervision of a senior psychotherapist. The three therapists were randomized between two conditions: virtual reality–enhanced and imaginative condition.

Common relaxation training protocol consisted of four sessions per week (12 sessions in total) and lasted 3 weeks. It included a combination of different relaxation techniques mainly based on Progressive Muscular Relaxation (20) and the Applied Relaxation technique (21). In both intervention conditions (imaginative condition and virtual reality), relaxation training was provided through recorded audio-narratives. In the virtual reality condition, narratives were presented together with a very relaxing virtual environment (named Green Valley) showing a mountain landscape around a calm lake. After being immersed in the Green Valley, participants were asked to walk around the lake, to observe the nature and, after few minutes, to virtually sit on a comfortable deck chair and relax. In the imaginative condition, narratives suggest imagining a similar environment. For hardware, software, and protocol details, see previously published work (18).

Assessment

Weight, behavior, and psychological data were collected in three time points. Baseline and final assessments were completed during the inpatient program; follow-up data were gathered via mailed questionnaires after participants were discharged and living at home.

Self-report questionnaires included the Beck Depression Inventory (BDI) (22), the Weight Efficacy Life-Style Questionnaire (WELSQ) (23), the State-Trait Anxiety Inventory (STAI) (24), and the EOQ (19). The last two questionnaires were administered only at the start and 3 months after discharge. Weight at follow-up was self-reported.

STATISTICAL ANALYSIS

Power analysis with α=.05 showed a statistical power of 0.80 and a total sample size of 51 to detect a large difference (f=0.45) between the three groups (virtual reality, imaginative condition, and control condition).

Normality of distributions was tested with Kolmogorov-Smirnov test, which showed the violation of the assumption for many variables in all three groups. Expecting to find large differences between each experimental group (virtual reality and imaginative condition) and the control condition, we decided to use the less powerful nonparametrical tests both for between- and within-groups comparisons. The Kruskall-Wallis test with post hoc analysis (25) was used for between-groups comparisons of independent measures and the Wilcoxon rank-sum test was used for repeated measures. The χ^2 test was used for categorical data, with α=.05, two-tailed. Data were analyzed using Statistical Package for the Social Sciences (version 12.0, 2003, SPSS, Inc, Cary, NC).

RESULTS AND DISCUSSION

Postintervention results show that perceived self-efficacy for eating control (WELSQ) and depression (BDI) significantly improved in the virtual reality and imaginative condition experimental groups without significant difference between them. No significant change was found within the control group (18). Given the in-hospital final assessments, emotional eating episodes were obviously

set to zero and weight significantly decreased within all three groups without significant difference among them. For details on postintervention data, see our previously published work (18).

Thirty-six out of 60 patients (12 virtual reality, 14 imaginative condition, and 10 control condition) completed follow-up measures. No baseline differences among groups were found in this subsample.

Comparing baseline with follow-up scores, the Wilcoxon test shows statistically significant improvements within both virtual reality and imaginative condition experimental groups in all variables and no statistically significant changes for the control group (see the Table).

Across-groups comparisons in follow-up scores show statistically significant differences in WELSQ, STAI, and EOQ (Table). Post hoc tests reveal that virtual reality and imaginative condition groups had a lower median score on STAI ($P<0.01$ and $P<0.01$, respectively), EOQ ($P<0.001$ and $P<0.01$, respectively), BDI ($P<0.05$ and $P<0.01$, respectively), and a higher median score on WELSQ ($P<0.001$ and $P<0.001$, respectively) in comparison with the control group. In addition, EOQ median score was significantly lower in the virtual reality group compared with the imaginative condition group ($P<0.05$).

By treatment completion, no statistically significant differences in weight reduction emerged among the three groups. Median weight reported at the end of the inpatient program was maintained or improved at follow-up (Table).

These results suggest that relaxation training enhanced by virtual reality and mobile mp3 players may be a useful technique to employ while treating obese women with emotional eating. The virtual reality protocol proved to be superior to the control condition and to traditional relaxation training in reducing emotional eating episodes at 3 months of follow-up. By the end of the treatment, both relaxation programs were effective in reducing depression. Improvement was maintained at follow-up, where a reduction in trait-anxiety was also observed. This result is in accordance with previous studies showing emotional benefits from relaxation training in a variety of clinical and community samples (26,27) and with recent small trials on the use of the new technologies for relaxation purposes (28-30).

Both relaxation protocols were also effective in improving perceived self-efficacy for eating control, both at the end of the treatment and at follow-up. This probably means that patients improved beliefs about being able to cope functionally with critical situations and supports the hypothesis that obese patients with emotional eating tend to use eating to cope with stressful situations and related negative emotions (6,8,9). Indeed, after 3 months, treated subjects reported significantly lower emotional eating episodes in comparison with controls.

Our data are in accordance with the Transactional Model of Stress and Coping (5,6). We argue that relaxation training improved behavioral and psychological resources; that is, relaxation abilities and perceived self-efficacy. These improvements positively affected the secondary appraisal process (what can be done about a stressful situation) and functional coping (cognitive and

Table. Psychological, behavior, and weight median values of women with obesity and emotional eating (n=60) who participated in a three-arm randomized controlled trial on the efficacy of a 3-week relaxation training protocol enhanced by virtual reality and portable mp3 players

Measurement tool	**Virtual Reality Group**			**Imagination Group**			**Control Group**			**Kruskal-Wallis**	
	Baseline (n=20)	**Post-treatment (n=20)**	**Follow-up (n=12)**	**Baseline (n=20)**	**Post-treatment (n=20)**	**Follow-up (n=14)**	**Baseline (n=20)**	**Post-treatment (n=20)**	**Follow-up (n=10)**	**Test**	***P* value[a]**
Emotional Overeating Questionnaire	4,5		1**	5		3,5*	6		8	6,21	<0.05
Spielberger's State-Trait Anxiety inventory-Y Form	50,5		34,5**	48,5		44	51,5		53	14,58	<0.01
Beck Depression Inventory	14,5	6,5***	6,5*	11,5	6**	7*	13	11**	12	4,83	NS[b]
Weight Efficacy Life-Style Questionnaire	6,1	7,3**	8,8**	5,9	7,8**	7,8**	5,7	6,5**	6	14,79	<0.01
Weight (kg)	110,6	109,5	101,5**	104,9	98,5	99**	107,7	96	102**	1,19	NS

[a]Omnibus comparisons on follow-up median scores across the three groups.
[b]NS=not significant.
*$P<0.05$, **$P<0.01$, ***$P<0.001$ indicate Wilcoxon Rank-Sum tests comparing baseline scores with post-treatment and follow-up scores in each group.

behavioral efforts to manage stress), decreasing the need for food as a way of dealing with stress and negative emotions.

Furthermore, given the high ratings of food cravings reported by individuals with obesity in response to negative emotions (31), we think that relaxation techniques could act like a concurrent task that diverts the attention from food images, thus reducing food cravings. This has been shown in other studies (32,33). Indeed, according to a recent interesting theoretical model (34,35), individuals create mental images in response to emotional triggers and elaborate on them by the recruitment of additional information from memory. One example of this is the relief or reward sensations associated with consumption of the desired food. This confers enhanced motivational power that may lead to overeating and/or to binging (33,35).

With respect to weight, we found an unexpected result. Emotional eating episodes significantly decreased within the virtual reality and imaginative condition groups while no improvement was observed within the control group. However, no statistically significant difference in weight reduction emerged across the groups at follow-up. This is probably due to the short term follow-up and, even more, to the great effect produced by the inpatient treatment all participants received.

Study limitations include the small sample and the high attrition rate at follow-up (24 out of 60 participants responded to the follow-up call). Given that an intention-to-treat analysis was not used, statistical power was even lower than the one we had for pre-post analysis but, by looking at the data this way, we preserved type I error from inflation. On the contrary, our study is exposed to the threat of type II error. For these reasons, further studies are necessary to elucidate the effect of relaxation training enhanced by the new technologies in large samples of obese subjects with emotional eating. Additional studies should include males and should look at designs that include a longer period of follow-up.

CONCLUSIONS

Brief relaxation training enhanced by virtual reality and portable mp3 players appears to be an effective aid for treating obese female inpatients with emotional eating. Given this preliminary evidence, we believe that food and nutrition professionals should take into account stress management and coping improvement techniques for the treatment of individuals with obesity who report symptoms of emotional eating or binge eating disorder.

STATEMENT OF POTENTIAL CONFLICT OF INTEREST: No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT: This research was supported by the Italian Ministry of Education, University, and Research Basic Research Investment Fund (MIUR FIRB) program (Project "Immersive Virtual Telepresence [IVT] for Experiential Assessment and Rehabilitation–IVT 2010", RBIN04BC5C).

References

1. Obesity and overweight. World Health Organization Fact Sheet No. 311. http://www.who.int/mediacentre/factsheets/fs311/en/index.html. Accessed February 1, 2008.
2. Wing RR, Tate DF, Gorin AA, Raynor HA, Fava JL. A self-regulation program for maintenance of weight loss. *N Engl J Med.* 2006;355:1563-1571.
3. Ikeda JP, Hayes D, Satter E, Parham ES, Kratina K, Woolsey M, Lowey M, Tribole E. A commentary on the new obesity guidelines from NIH. *J Am Diet Assoc.* 1999;99:918-919.
4. Jeffery RW, Drewnowski A, Epstein LH, Stunkard AJ, Wilson GT, Wing RR, Hill DR. Long-term maintenance of weight loss: Current status. *Health Psychol.* 2000;19(1 suppl):5-16.
5. Ozier AD, Kendrick OW, Knol LL, Leeper JD, Perko M, Burnham J. The Eating and Appraisal Due to Emotions and Stress (EADES) Questionnaire: Development and validation. *J Am Diet Assoc.* 2007;107:619-628.
6. Ozier AD, Kendrick OW, Leeper JD, Knol LL, Perko M, Burnham J. Overweight and obesity are associated with emotion- and stress-related eating as measured by the eating and appraisal due to emotions and stress questionnaire. *J Am Diet Assoc.* 2008;108:49-56.
7. Gluck ME. Stress response and binge eating disorder. *Appetite.* 2006;46:26-30.
8. Volkow ND, Wise RA. How can drug addiction help us understand obesity? *Nat Neurosci.* 2005;8:555-560.
9. Lindeman M, Stark K. Emotional eating and eating disorder psychopathology. *Eat Disord.* 2001;9:251-259.
10. Bekker MH, van de Meerendonk C, Mollerus J. Effects of negative mood induction and impulsivity on self-perceived emotional eating. *Int J Eat Disord.* 2004;36:461-469.
11. Troop NA. Eating disorders as coping strategies: A critique. *Eur Eat Disord Rev.* 1998;6:229-237.
12. Carver CS, Scheier MF, Weintraub JK. Assessing coping strategies: A theoretically based approach. *J Pers Soc Psychol.* 1989;56:267-283.
13. Popkess-Vawter S, Wendel S, Schmoll S, O'Connell K. Overeating, reversal theory, and weight cycling. *West J Nurs Res.* 1998;20:67-83.
14. Solomon M. Eating as both coping and stressor in overweight control. *J Adv Nurs.* 2001;36:563-573.
15. Timmerman G, Acton G. The relationship between basic need satisfaction and emotional eating. *Issues Ment Health Nurs.* 2001;22:691-701.
16. Spoor ST, Bekker MH, Van Strien T, van Heck GL. Relations between negative affect, coping, and emotional eating. *Appetite.* 2007;48:368-376.
17. Blair AJ, Lewis VJ, Booth DA. Does emotional eating interfere with success in attempts at weight control? *J Clin Psychol.* 1990;15:151-157.
18. Manzoni GM, Gorini A, Preziosa A, Pagnini F, Castelnuovo G, Molinari E, Riva G. New technologies and relaxation:an explorative study on obese patients with emotional eating. *J Cyberther Rehab.* 2008;1:182-192.
19. Masheb RM, Grilo CM. Emotional overeating and its associations with eating disorder psychopathology among overweight patients with binge eating disorder. *Int J Eat Disord.* 2006;39:141-146.
20. Borkovec TD, Costello E. Efficacy of applied relaxation and cognitive-behavioral therapy in the treatment of generalized anxiety disorder. *J Consult Clin Psychol.* 1993;61:611-619.
21. Ost LG, Breitholtz E. Applied relaxation vs cognitive therapy in the treatment of generalized anxiety disorder. *Behav Res Ther.* 2000;38:777-790.
22. Beck AT, Steer RA. *Beck Depression Inventory*. San Antonio, TX: The Psychological Corporation; 1993.
23. Clark MM, Abrams DB, Niaura RS, Eaton CA, Rossi JS. Self-efficacy in weight management. *J Consult Clin Psychol.* 1991;59:739-744.
24. Spielberger CD, Gorsuch RL, Lushene RE. *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press; 1970.
25. Siegel S, Castellan NJ. *Nonparametric Statistics for the Behavioral Sciences*. Milan, Italy: McGraw-Hill, Inc; 1992.
26. Manzoni GM, Pagnini F, Castelnuovo G, Molinari E. Relaxation training for anxiety: A 10-year systematic review with meta-analysis. *BMC Psychiatry.* 2008;8:41.
27. Bagheri-Nesami M, Mohseni-Bandpei MA, Shayesteh-Azar M. The effect of Benson Relaxation Technique on rheumatoid arthritis patients: Extended report. *Int J Nurs Pract.* 2006;12:214-219.

28. Riva G, Preziosa A, Grassi A, Villani D. Stress management using UMTS cellular phones: A controlled trial. *Stud Health Technol Inform.* 2006;119:461-463.
29. Riva G, Manzoni M, Villani D, Gaggioli A, Molinari E. Why do you really eat? Virtual reality in the treatment of obese emotional eaters. *Stud Health Technol Inform.* 2008;132:417-419.
30. Freeman J, Lessiter J, Keogh E, Bond FW, Chapman K. Relaxation island: Virtual and really relaxing. Paper presented at: 7th International Workshop on Presence, 2004. Universitat Politecnica de Valencia, Spain.
31. Geliebter A, Aversa A. Emotional eating in overweight, normal weight, and underweight individuals. *Eat Behav.* 2003;3:341-347.
32. Kemps E, Tiggemann M, Woods D, Soekov B. Reduction of food cravings through concurrent visuospatial processing. *Int J Eat Disord.* 2004;36:31-40.
33. McClelland A, Kemps E, Tiggemann M. Reduction of vividness and associated craving in personalized food imagery. *J Clin Psychol.* 2006; 62:355-365.
34. Kavanagh DJ, Andrade J, May J. Imaginary relish and exquisite torture: The elaborated intrusion theory of desire. *Psychol Rev.* 2005; 112:446-467.
35. May J, Andrade J, Kavanagh D, Penfound L. Imagery and strength of craving for eating, drinking, and playing sport. *Cognition Emotion.* 2008;22:633-650.