

Obesity Management

The impact of extended care on the long-term maintenance of weight loss: a systematic review and meta-analysis

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Summary

Behavioural weight management interventions consistently produce 8–10% reductions in body weight, yet most participants regain weight after treatment ends. One strategy for extending the effects of behavioural interventions has been the provision of extended care. The current study is a systematic review and meta-analysis of the literature on the effect of extended care on maintenance of weight loss. Through database searches (using PubMed, PsychInfo and Cochrane Reviews) and manual searches through reference lists of related publications, 463 studies were identified. Of these, 11 were included in the meta-analysis and an additional two were retained for qualitative analysis. The average effect of extended care on weight loss maintenance was $g = 0.385$ (95% confidence interval: 0.281, 0.489; $P < 0.0001$). This effect would lead to the maintenance of an additional 3.2 kg weight loss over 17.6 months post-intervention in participants provided extended care compared with control. There was no significant heterogeneity between studies, $Q = 5.63$, $P = 0.845$, and there was minimal evidence for publication bias. These findings suggest that extended care is a viable and efficacious solution to addressing long-term maintenance of lost weight. Given the chronic disease nature of obesity, extended care may be necessary for long-term health benefits.

Keywords: Extended care, lifestyle intervention, weight maintenance.

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Introduction

A predominate challenge in the treatment of obesity is the long-term maintenance of weight loss. Researchers have been generally successful in designing programmes that induce weight losses of 8–10% of initial body weight (1–3). After the end of treatment, however, individuals tend to experience significant weight regain, regaining, on average, one-third to one-half of lost weight within the first year following treatment and returning to baseline weight within 3–5 years after the end of treatment (4,5). Furthermore, only about 20% of individuals who lose 10% of their initial body weight are able to maintain this weight loss for at least 1 year post-treatment (6). As a result,

increasing research has focused on methods to improve the long-term maintenance of weight loss. One promising area of research involves the impact of extended care on weight regain after cessation of active treatment.

Extended care derives from the conceptualization of obesity within a ‘continual care’ model (7), in which obesity is treated as a chronic disease and individuals are provided with continued therapist contact to prevent weight regain following initial loss. Extended care sessions have typically been delivered weekly or biweekly and have consisted of either in-person (in groups or individual) or telephone-delivered interventionist contact. These contacts have served to reinforce behavioural strategies used during the intervention, assist with problem

solving and provide ongoing motivation for sustaining behavioural changes. Therapist contact may be essential to maintaining behavioural changes in light of diminishing positive feedback (e.g. the lack of continued change in weight when moving from weight loss to maintenance).

Several randomized-controlled trials have demonstrated a positive impact of extended care on weight regain (8–20); however, the methodology and extended care interventions involved in each of these trials vary. Previous reviews have focused on weight regain trends after initial treatment (21–23) or the impact of exercise on long-term maintenance (24), but there has not been a similar review or meta-analysis of the impact of extended care on long-term weight loss maintenance. Thus, the purpose of the current study was to conduct a systematic review and meta-analysis of randomized-controlled trials investigating the impact of extended care on long-term weight loss maintenance.

Methods

Study identification

Studies in the current review were identified using searches on MEDLINE (PubMed), PsychInfo and Cochrane Reviews, from 1980 until June 2011, and through review of reference lists of related book chapters and journal articles. Search terms included 'weight loss', 'weight reduction', 'obesity', 'intervention', 'treatment', 'randomized', 'extended care', 'long term', 'maintenance' and 'regain'. MESH terms (PubMed) used included 'weight loss', 'humans', 'obesity/therapy' and 'long-term care'. Potentially eligible articles were first screened for relevance by the first author using article titles and then abstracts. Articles that initially appeared to meet the eligibility criteria after this initial review were then reviewed independently by the first and second authors using the measures described below.

Inclusion criteria

The current review included randomized-controlled trials that assessed the impact of extended care on weight regain, after initial weight loss, in overweight and obese individuals. Due to the differences in intervention format and treatment goals for weight loss programmes involving children and adolescents, the current review was restricted to studies investigating weight loss and maintenance in adults (age ≥ 18). To be eligible for inclusion, studies must have included a randomized extended care component that focused on maintenance of weight loss. Extended care was defined as at least two sessions, delivered either in-person or via telephone by a trained interventionist, which focused on providing continuing support for behaviours associated with weight management (e.g. decreasing caloric intake

and increasing physical activity). For the current review, extended care interventions delivered via the Internet were excluded due to concerns regarding the heterogeneity of methods used in these studies.

Measures

To assess the quality of the studies included in the current review, we used the Physiotherapy Evidence Database (PEDro) scale, a valid and reliable measure of quality in randomized-controlled trials (25,26). The PEDro scale was based on the Delphi scale (27) and includes all items on the Delphi scale plus two additional questions regarding intent-to-treat analyses and attrition. Scores on the 11-item PEDro range from 0 to 10, with the total score consisting of a sum of all item scores for items 2 through 11. Two reviewers (KMR and SMP) independently assessed and rated study quality using the PEDro.

Data abstraction and analyses

After scoring, data were abstracted from selected articles, including authors, year of publication, title, number of treatment arms, number of participants, length of intervention, type of intervention (e.g. delivered in-person vs. via telephone), length of follow-up, and pre- and post-weight means and standard deviations (SDs) (where these pre- and post-means were missing, mean weight changes and *F*-statistics were recorded). For studies using more than one treatment arm (or those using factorial designs), only data related to the current review were used (e.g. if a study included an intervention arm, control arm and Internet-based extended care arm, we only used data from the first two). If more than one intervention arm met the criteria for inclusion, data were combined to create pooled estimates (included *N* for each study is available in Table 1).

Effect sizes for each study, using Hedge's *g*, were estimated through the use of mean differences between an intervention and a control group and associated standard deviations, if available, or next through the use of either pre- and post-test means and standard deviations, group *n* and *F* ratio. Random-effects modelling was used to account for variance between studies due to differing populations and study design. To assess heterogeneity between studies, we calculated a *Q*-statistic. Finally, potential publication bias was assessed using visual examination of a funnel plot and a fill-and-trim analysis (28). All analyses were conducted using Comprehensive Meta-Analysis (29), a dedicated meta-analysis programme developed by researchers at the National Institutes of Health.

Results

Four hundred and sixty-three potential studies were identified through the described search strategies. Of these, 36

Table 1 Descriptions of studies included in the meta-analysis, by year

First author and year	Initial intervention	Extended care (EC) intervention	Extended care control	Length of EC intervention	N	Length of follow-up	Differential weight regain by group
Perri <i>et al.</i> (1984) (15)	14 weekly group sessions	6 biweekly maintenance training sessions; weekly postcards to be returned with progress recorded; weekly interventionist telephone calls	6 biweekly 'booster' sessions; no additional contact	12 months	30 EC; 26 control	21 months	1.58 kg regained for EC; 5.27 kg regained in control ($P < 0.01$)
Perri <i>et al.</i> (1984) (18)	15 weekly group sessions	Weekly postcard to be returned with progress recorded; 19 interventionist telephone calls	No additional contact	6 months	32 EC; 36 control	12 months	1.12 kg regained in EC; 3.40 kg regained in control ($P < 0.05$)
Perri <i>et al.</i> (1986) (14)	20 weekly group sessions	Weekly postcards to be returned with progress recorded; weekly interventionist telephone calls	No additional contact	12 months	51 EC; 16 control	18 months	4.52 kg regained in EC; 6.87 kg regained in control ($P < 0.001$)
Perri <i>et al.</i> (1987) (30)	20 weekly group sessions	15 biweekly maintenance sessions	No additional contact	7.5 months	41 EC; 22 control	18 months	1.85 kg regained in EC; 3.26 kg regained in control ($P < 0.05$)
Perri <i>et al.</i> (1988) (16)	20 weekly group sessions	26 biweekly maintenance sessions	No additional contact	12 months	25 EC; 21 control	18 months	1.76 kg regained in EC; 7.2 kg regained in control ($P < 0.001$)
Baum <i>et al.</i> (1991) (8)	12 weekly group sessions	4 monthly maintenance sessions; self-monitoring forms to be mailed weekly; 8 interventionist telephone calls	Self-monitoring forms to be mailed weekly	3 months	16 EC; 16 control	23 months	0.26 kg regained in EC; 2.4 kg regained in control ($P < 0.01$)
Perri <i>et al.</i> (2001) (17)	20 weekly group sessions	26 biweekly maintenance sessions	No additional contact	12 months	62 EC; 18 control	12 months	0.53 kg regained in EC; 5.39 kg regained in control ($P = 0.001$)
Wing <i>et al.</i> (2006) (20)	Verified weight loss of at least 10% of body weight	4 weekly maintenance sessions, 17 monthly maintenance sessions	Quarterly mailed newsletters	18 months	105 EC; 105 control	18 months	2.5 kg regained in EC; 4.9 kg regained in control ($P = 0.05$)
Perri <i>et al.</i> (2008) (13)	24 weekly group sessions	26 biweekly maintenance sessions, delivered in person or via telephone contact with interventionist	26 mailed biweekly newsletters	12 months	155 EC; 79 Control	18 months	1.2 kg regained in EC; 3.7 kg regained in control ($P = 0.03$)
Svetkey <i>et al.</i> (2008) (19)	20 weekly group sessions	Monthly telephone contact; in-person maintenance session every 4th month	Printed guidelines with diet and physical activity recommendations; brief meeting with interventionist after 12 months	30 months	342 EC; 342 control	30 months	4.0 kg regained in EC; 5.5 kg regained in control ($P = 0.001$)
Carels <i>et al.</i> (2008) (9)	16 weekly group sessions	6 weekly maintenance sessions	No additional contact	1.5 months	25 EC; 26 control	6 months	2.54 kg weight loss in EC; 1.50 kg regained in control ($P < 0.01$)

Note: only the results from treatment arms used in the meta-analysis were included in this table.

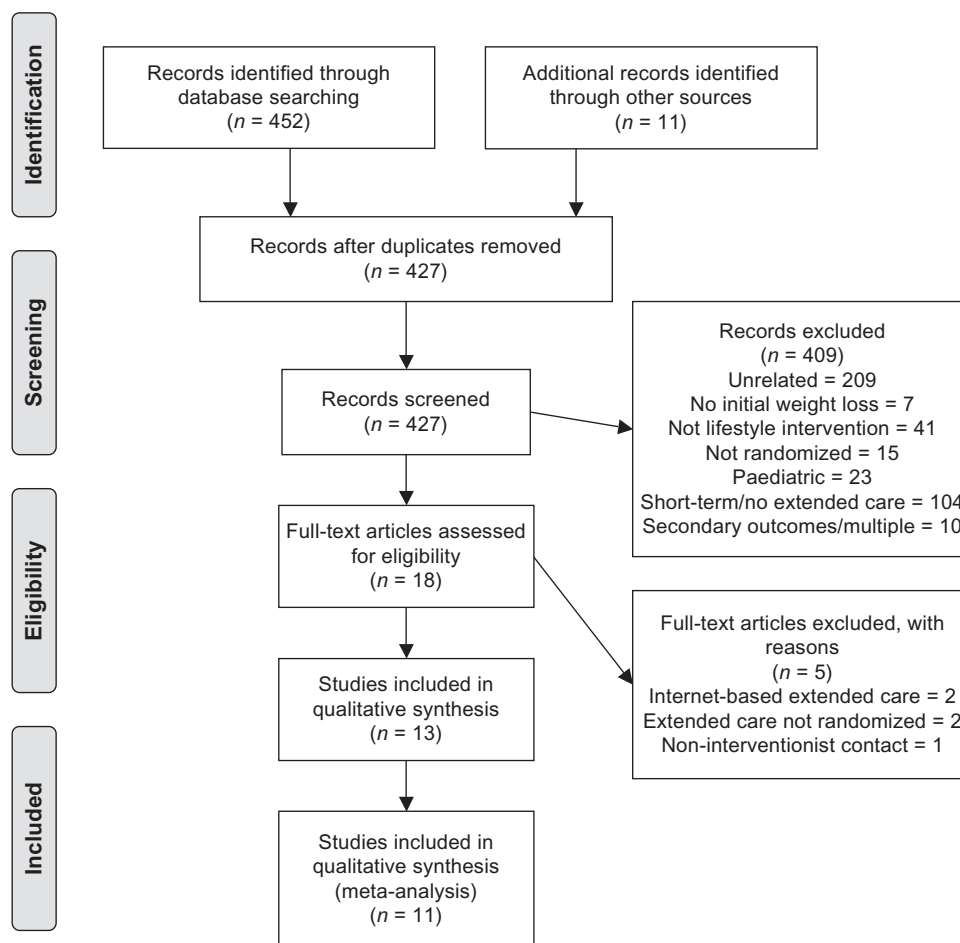


Figure 1 PRISMA flow chart for study inclusion.

results were excluded for duplicate records (i.e. the same paper appearing in both the PubMed and the PsychInfo search), 409 were excluded after title/abstract review and an additional 5 were excluded after a full-text review (2 were excluded for using Internet-based extended care, 2 for not randomizing individuals to extended care and 1 for having non-interventionist based contact; see Fig. 1). After two studies were excluded from the meta-analysis (but retained for the qualitative review), 11 studies were ultimately included in the meta-analysis (see Table 1 for summary).

The effect of extended care on long-term weight loss maintenance varied by study, from $g = 0.270$ to 0.933 (see Fig. 2), with the mean of the distribution of effects $g = 0.385$ (95% confidence interval [CI]: $0.281, 0.489$, $P < 0.0001$). Using the pooled means and standard deviations from each of the control groups in the included studies, this effect would lead to maintenance of an additional 3.20 kg of weight loss for participants provided extended care, over the mean length of 17.6 months post-intervention.

Regarding study quality, PEDro scores ranged from 5 to 8, and the mean PEDro score for the included studies was

6.3 ± 1.2 . The inter-class correlation coefficient for PEDro scores between the two reviewers was $\alpha = 0.913$. While all of the studies included were randomized-controlled trials, only four had post-test data with less than 15% attrition (8,13,19,20) and only three studies were conducted with intent-to-treat analysis (using multiple imputation or pattern mixture modelling) (13,19,20). Furthermore, only two studies (13,19) reported that the assessors who measured the main outcome were blinded to treatment allocation.

The funnel plot (not shown) displayed a scattering of points across the horizontal axis; however, when filled (using fill-and-trim analysis for publication bias) (28) did demonstrate the potential for missing studies with smaller sample sizes and smaller effects. Filling in the plot with symmetrical studies demonstrating negative results titrated the effect slightly to $g = 0.321$. The fail-safe N calculation suggested that 160 studies with null results would be required to bring the current effect to non-significance, suggesting that the effect is not likely to be affected by unpublished null results. The Q -statistic, a test

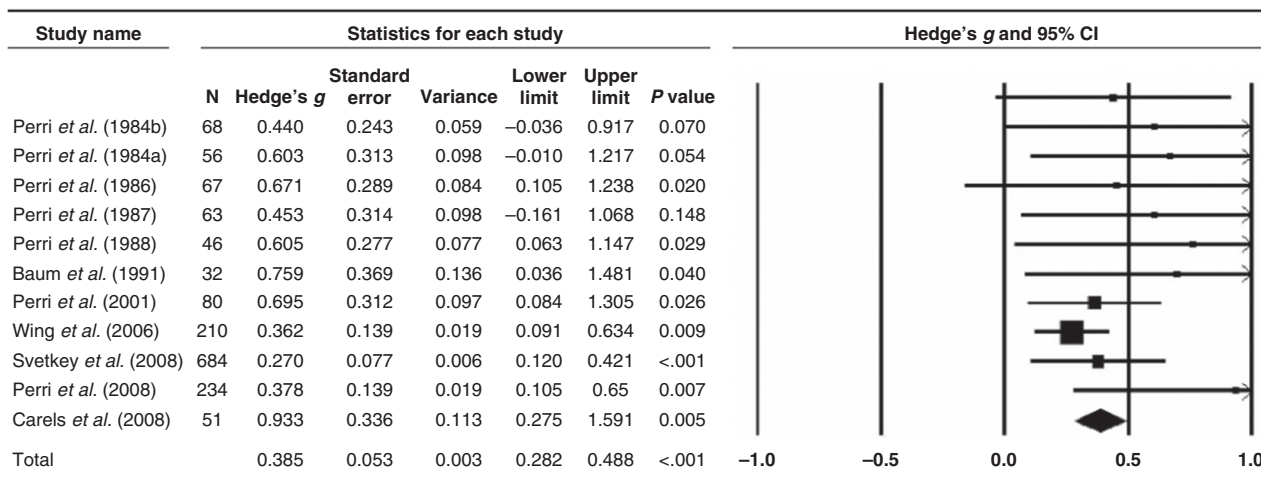


Figure 2 Forest plot for studies included in the meta-analysis, by publication year. Study weight indicated by size of marker in the forest plot. Total effect size indicated by diamond. CI, confidence interval.

of heterogeneity between studies, was not significant, $Q = 5.63, P = 0.845$.

Interventions included in the current review all contained extended care conditions modelled on cognitive-behavioural treatment for weight loss. Specifically, extended care contact was based on reinforcing behavioural changes made during initial intervention, including meeting goals for reduced caloric intake and increased physical activity. A majority of the studies used a problem-solving component (9,13–19,30), utilized by interventionists to help participants overcome barriers to maintaining behaviour change, and three further included relapse prevention training (8,17,19).

Studies included in the meta-analysis had a mean follow-up period of 16.1 months (range = 6–30 months), and during this time provided an average of 28.6 treatment contacts (either in-person or delivered via telephone; range = 6–52 sessions). In-person contact was typically delivered in group setting, with sessions lasting from 45 to 90 min. Contact via telephone was typically delivered in 5–20 min individual telephone calls with original interventionists.

Two studies were not included in the meta-analysis but were retained for qualitative review. First, the study by Kumanyika *et al.* (12) was excluded from the meta-analysis due to the lack of an effective weight loss intervention prior to provision of extended care. This study included a 10-week, non-prescriptive (e.g. no calorie goals were given) intervention designed to encourage Africa–American participants to improve their eating and exercise behaviours. Overall, participants lost 1.5 kg over the course of these 10 weeks, a much lower weight loss than typically observed in weight management programmes (3,5,31). After this initial

intervention, Kumanyika *et al.* found no additional effect of extended care.

Second, a study by Woo *et al.* (32) was excluded because initial weight loss was induced via treatment with Orlistat, a weight-loss medication. Orlistat treatment was ended after 6 months, at which time individuals were randomized to an extended care lifestyle programme or ‘usual care’ (no-contact control). At the end of the 6-month maintenance period, Woo *et al.* found that individuals in the no-contact control group regained a significant amount of weight during the maintenance period (mean \pm SD = 2.2 ± 0.74 kg), while individuals that were provided extended care did not (-0.15 ± 0.35 kg).

Discussion

Eleven articles were identified for inclusion in the current meta-analysis, which revealed evidence for a moderate effect of extended care on long-term weight loss maintenance. This effect translated to an additional maintenance of 3.20 kg over 17.6 months for participants provided with extended care, compared with educational or no-contact control groups. Components of these effective interventions include interventionist contact, group time spent reinforcing behavioural changes made during the initial intervention, including continued support for meeting eating and exercise goals, utilizing problem-solving skills to address barriers to maintaining behaviour changes and training in relapse prevention. More importantly, attendance at extended care groups appears to affect long-term outcome, such that individuals who regularly attended groups were more likely to be adherent to caloric intake and physical activity goals and thus regain less weight (13).

Each study found a significant positive effect of extended care, although the strength of this effect appeared to slightly decrease over time (oldest to most recent published study). The decrease in effect by year of published study was likely due to methodological differences. Earlier studies often included more frequent contact (e.g. weekly or biweekly contact), did not achieve at least 85% follow-up and did not conduct intent-to-treat analysis (14–16,18,30). These last two factors are particularly important as research has suggested that individuals who drop out of weight management programmes are more likely to regain weight than those who do not (33). As a result, later studies that conducted intent-to-treat analysis and adjusted for drop-out observed a smaller effect of extended care (13,19,20).

For the three trials that conducted intent-to-treat analysis (13,19,20), a consistent, albeit smaller effect of extended care was still observed. The variations in effect between these studies were likely due to methodological differences, including frequency of contact and length of follow-up. The largest study, by Svetkey *et al.* (19), had only monthly therapist contact, which was predominately delivered via phone (except for in-person sessions delivered every fourth month). This study had the largest weight in the current meta-analysis due to large sample, which likely offset the inflated effect sizes found by earlier studies with fewer participants. In contrast, the recent study by Perri *et al.* (13) included biweekly therapist contact, delivered either via in-person groups or telephone, and demonstrated a larger impact of extended care. In terms of follow-up time, the study by Svetkey *et al.* (19), with a 30-month follow-up period, showed a smaller effect of extended care compared with the studies by Perri *et al.* (13) and Wing *et al.* (20), which completed follow-up 12 and 18 months after the end of initial intervention, respectively.

Two studies demonstrated that contact alone might not affect weight regain. The first, by Wing *et al.* (34), found that extended care contact, made via telephone, by non-interventionists (the researchers used phone bank employees), was not effective in preventing weight regain following the end of treatment. Furthermore, Perri *et al.* (15) demonstrated that a behaviour therapy-based extended care group had superior long-term weight loss maintenance than a contact-only condition (groups that met solely to review strategies learnt during treatment). In terms of peer contact, an additional study by Perri *et al.* (35) demonstrated no effect of peer-led maintenance groups on weight regain compared with no-contact control. Thus, it appears that interventionist contact is a critical component of successful maintenance programmes.

A major weakness of the current literature was that included studies were predominately conducted with Caucasian individuals; few included significant proportions of non-Caucasian individuals, and studies excluded from the

meta-analysis but included in the systematic review suggest that there may be a differential effect of extended care for African-American participants than for Caucasian participants (12,36–38). One study included in the qualitative review demonstrated no additional benefit for extended care vs. control in African-American participants (12); however, in this study, a traditional initial lifestyle intervention did not precede extended care. Rather, individuals were given a non-prescriptive approach (e.g. no calorie goals) to gradually improve eating and exercise behaviours over the course of 10 weeks. Other studies that did not randomize participants to extended care further demonstrate that the effect of this long-term care on weight regain may be different for African-American and Caucasian participants (36–38). We agree with Kumanyika *et al.* (36) that not enough research has been conducted on culturally sensitive factors of weight loss interventions and extended care, and thus, we recommend that further research be conducted, including ways these programmes can be optimally tailored to assist non-Caucasian participants. Furthermore, while there has been preliminary research on differential effects of extended care in African-American and Caucasian participants, there has been little research in other ethnic groups or on related factors (e.g. socioeconomic status, acculturation) that may interact with the effect of ethnicity and response to interventions. Without this knowledge, the field risks creating programmes that are helpful to some with the exclusion of others.

A further weakness within the extended care literature reviewed involves blinding of assessment staff. While blinding participants and therapists to treatment conditions is extremely difficult due to the nature of lifestyle intervention, when possible the investigators and assessment staff should be blinded to the allocation of participants to treatment groups. However, in the current review, only two studies reported the blinding of assessors who measured at least one key outcome (13,19).

There are several strengths of the current review. We conducted an exhaustive literature search and completed the first meta-analysis of randomized-controlled trials investigating the independent effect of extended care on weight loss maintenance. Using only trials that randomized participants to extended care allowed us to estimate the mean effect of extended care independent of the effects of time and assessment contact (which are impossible to disentangle when using pre-post data from non-randomized extended care conditions). Furthermore, the finding of a significant effect, minimal heterogeneity and little evidence of publication bias suggest that the effect observed in this meta-analysis is likely a good estimate of the overall mean effect of extended care programmes on long-term weight loss maintenance.

Limitations to the current review include the relatively small number of articles included in the meta-analysis, the

age of many of these articles (several were published prior to 1990), the small number of authors conducting research in this area and the variability of methods used for extended care across studies. Many of the early studies in long-term maintenance were conducted by Perri *et al.*, and a total of seven of the included studies (13–18,30) were conducted by this research group. We do not believe, however, that this has caused undue bias in the current meta-analysis, as due to the small sample size, the six early (14–18,30) studies were not weighted highly in the meta-analysis, especially in comparison to the later trials, and the one later study included (13) demonstrated similar effects to similar trials conducted by other research groups (19,20).

The potential impact of publication bias cannot be excluded from any meta-analysis, as research has shown that studies with non-significant effects or small effects are less likely to be published (39). In the current review, however, there was minimal evidence of publication bias. The fail-safe *N* analyses revealed that a very large number of studies with null results would be needed to adjust the current effect to non-significance, and the fill-and-trim analysis demonstrated that even when the funnel plot was filled with studies demonstrating symmetrical negative effects, the overall effect was reduced only slightly.

All of the included studies used therapist contact as a core component of extended care; however, the frequency (weekly, biweekly or monthly) and type of this contact (e.g. in-person or by phone) varied considerably. While results of the *Q*-statistic demonstrate little heterogeneity in the current meta-analysis, we recommend research into the standardization of extended care programmes. For this, additional research will need to focus on optimal timing and frequency of contact, effective methods of contact and cost-effectiveness. Because only 11 studies were identified for inclusion in the meta-analysis portion of this review, we were unable to address related questions such as the impact of type of contact (e.g. phone vs. in-person) or schedule of contact (weekly vs. biweekly or monthly).

With current evidence demonstrating the effect of long-term extended care, strategic next steps are to investigate standardization of these programmes, improve cost-effectiveness and formulate methods to improve accessibility and dissemination. Indeed, it may be hard to justify long-term care, e.g. to insurance companies or funding agencies, without the continued weight loss normally observed during the first 6 months of treatment. Without this care, however, individuals are likely to regain lost weight and further see reductions in the associated health benefits (5,40).

Internet interventions have demonstrated some promise in terms of improving cost-effectiveness of long-term extended care. Results of randomized trials using the Internet as extended care, however, have been mixed. While one

study has shown better weight loss maintenance for individuals provided with an Internet-based extended care condition (11), two others demonstrated no added benefit of Internet-based extended care compared with no-contact control (10,41). The variety of treatment approaches in this literature has likely led to these differences, as Internet-based treatment has ranged from merely providing a website (interactive or static) to providing online group sessions with other participants and a group leader. Based on the previous literature in weight management, it is likely that the feedback and accountability provided by therapist contact may make Internet interventions more successful. Despite the small number of studies currently available in this area, a recent meta-analysis (42) assessing the impact of Internet-based interventions on weight loss further included an analysis of studies including a maintenance component. This review found that Internet-based interventions were not more effective than no-contact control at helping people maintain weight loss. The authors commented that the lack of effect may have been due to diminished social support compared with face-to-face programmes and boredom with online tools. The authors did caution, however, that so few studies have been done on Internet-based maintenance programmes that conclusive statements regarding their effectiveness should not be made. As this area holds considerable promise for improving access and cost-effectiveness of maintenance programmes, we recommend further research be conducted in this area. We believe this is increasingly important as improved technology (e.g. video chat programmes and smartphones) has allowed for higher levels of interactivity within Internet-based interventions.

Two additional issues aligned with cost-effectiveness have been treatment standardization and dose–response of contact frequency. Most of the studies included in the current review focused on weekly (9,14,15,18) or biweekly (16,17,30) contact during the maintenance period, although some showed benefits with only monthly contact (8,19,20). Investigating the optimal timing and frequency of extended care contact could lead to programme standardization and increased cost-effectiveness (if, e.g. monthly contact is determined to be as effective as biweekly contact). Alternatively, the effect of providing extended care treatment on a faded schedule (e.g. weekly, followed by biweekly and then monthly sessions) should be investigated.

Finally, culturally appropriate tailoring techniques should be developed to improve the effectiveness of these extended care programmes in non-Caucasian populations. Preliminary evidence has demonstrated that African–American and Caucasian participants demonstrate differential effects to extended care (12,36,38), which may be evidence for inadequate tailoring. If extended care programmes are to be offered to a wider audience, more

research needs to be done in settings outside of academic medical centres and with varied populations.

The current review supports the use of extended care for the long-term maintenance of weight loss, with a moderate effect found for impact of extended care on long-term weight loss maintenance. Thus, the focus of continuing research should not be on whether or not to provide extended care, but how to improve these programmes. Future studies should focus on methods to improve cost-effectiveness and availability of these programmes, and investigation should be made into more cost-effective methods of delivery (e.g. via telephone or Internet). Furthermore, effort should be made to investigate the effect of extended care in wider populations and to develop culturally appropriate tailoring for these programmes.

Conflict of Interest Statement

No conflict of interest was declared.

References

- Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002; **346**: 393–403.
- Espeland M. Reduction in weight and cardiovascular disease risk factors in individuals with type 2 diabetes: one-year results of the Look AHEAD trial. *Diabetes Care* 2007; **30**: 1374–1383.
- Wadden TA, Butryn ML, Wilson C. Lifestyle modification for the management of obesity. *Gastroenterology* 2007; **132**: 2226–2238.
- Jeffery RW, Epstein LH, Wilson GT *et al.* Long-term maintenance of weight loss: current status. *Health Psychol* 2000; **19**: 5–16.
- National Institutes of Health, National Heart, Lung, and Blood Institute. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: the evidence report. *Obes Res* 1998; **6**: 51S–209S.
- Wing RR, Hill JO. Successful weight loss maintenance. *Annu Rev Nutr* 2001; **21**: 323–341.
- Perri MG, Corsica JA. Improving the maintenance of weight lost in behavioral treatment of obesity. In: Wadden TA, Stunkard AJ (eds). *Handbook of Obesity Treatment*. Guilford Press: Hoboken, NJ, 2002, pp. 357–379.
- Baum JG, Clark HB, Sandler J. Preventing relapse in obesity through posttreatment maintenance systems: comparing the relative efficacy of two levels of therapist support. *J Behav Med* 1991; **14**: 287–302.
- Carels RA, Konrad K, Young KM *et al.* Taking control of your personal eating and exercise environment: a weight maintenance program. *Eat Behav* 2008; **9**: 228–237.
- Cussler EC, Teixeira PJ, Going SB *et al.* Maintenance of weight loss in overweight middle-aged women through the internet. *Obesity (Silver Spring)* 2008; **16**: 1052–1060.
- Harvey-Berino J, Pintauro S, Buzzell P, Gold EC. Effect of internet support on the long-term maintenance of weight loss. *Obes Res* 2004; **12**: 320–329.
- Kumanya SK, Shults J, Fassbender J *et al.* Outpatient weight management in African-Americans: the Healthy Eating and Lifestyle Program (HELP) study. *Prev Med* 2005; **41**: 488–502.
- Perri MG, Limacher MC, Durning PE *et al.* Extended-care programs for weight management in rural communities: the Treatment of Obesity in Underserved Rural Settings (TOURS) randomized trial. *Arch Intern Med* 2008; **168**: 2347–2354.
- Perri MG, McAdoo WG, McAllister DA, Lauer JB, Yancey DZ. Enhancing the efficacy of behavior therapy for obesity: effects of aerobic exercise and a multicomponent maintenance program. *J Consult Clin Psychol* 1986; **54**: 670–675.
- Perri MG, McAdoo WG, Spevak PA, Newlin DB. Effect of a multicomponent maintenance program on long-term weight loss. *J Consult Clin Psychol* 1984; **52**: 480–481.
- Perri MG, McAllister DA, Gange JJ, Jordan RC, McAdoo WG, Nezu AM. Effects of four maintenance programs on the long-term management of obesity. *J Consult Clin Psychol* 1988; **56**: 529–534.
- Perri MG, Nezu AM, McKelvey WF, Shermer RL, Renjilian DA, Viegner BJ. Relapse prevention training and problem-solving therapy in the long-term management of obesity. *J Consult Clin Psychol* 2001; **69**: 722–726.
- Perri MG, Shapiro RM, Ludwig WW, Twentyman CT, McAdoo WG. Maintenance strategies for the treatment of obesity: an evaluation of relapse prevention training and posttreatment contact by mail and telephone. *J Consult Clin Psychol* 1984; **52**: 404–413.
- Svetkey LP, Stevens VJ, Brantley PJ *et al.* Comparison of strategies for sustaining weight loss. *JAMA* 2008; **299**: 1139–1148.
- 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.
- Anderson JW, Konz EC, Frederich RC, Wood CL. Long-term weight-loss maintenance: a meta-analysis of US studies. *Am J Clin Nutr* 2001; **74**: 579–584.
- Barte JCM, Ter Bogt NCW, Bogers RP *et al.* Maintenance of weight loss after lifestyle interventions for overweight and obesity, a systematic review. *Obes Rev* 2010; **11**: 899–906.
- Franz MJ, VanWormer JJ, Crain AL *et al.* Weight-loss outcomes: a systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. *J Am Diet Assoc* 2007; **107**: 1755–1767.
- Wu T, Gao X, Chen M, Van Dam RM. Long-term effectiveness of diet-plus-exercise interventions vs. diet-only interventions for weight loss: a meta-analysis. *Obes Rev* 2009; **10**: 313–323.
- de Morton NA. The PEDro scale is a valid measure of the methodological quality of clinical trials: a demographic study. *Aust J Physiother* 2009; **55**: 129–133.
- Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. *Phys Ther* 2003; **83**: 713–721.
- Verhagen AP, de Vet HCW, de Bie RA *et al.* The Delphi list: a criteria list for quality assessment of randomized clinical trials for conducting systematic reviews developed by Delphi consensus. *J Clin Epidemiol* 1998; **51**: 1235–1241.
- Duval S, Tweedie R. Trim and fill: a simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics* 2000; **56**: 455–463.
- Borenstein M, Hedges L, Higgins J, Rothstein H. *Comprehensive Meta Analysis Version 2*. Biostat: Englewood, NJ, 2005.
- Perri MG, McAdoo WG, McAllister DA *et al.* Effects of peer support and therapist contact on long-term weight loss. *J Consult Clin Psychol* 1987; **55**: 615–617.
- Institute of Medicine. *Weighing the Options: Criteria for Evaluating Weight-Management Programs*. National Academies Press: Washington, DC, 1995.

32. Woo J, Sea MMM, Tong P *et al.* Effectiveness of a lifestyle modification programme in weight maintenance in obese subjects after cessation of treatment with Orlistat. *J Eval Clin Pract* 2007; **13**: 853–859.
33. Ayyad C, Andersen T. Long-term efficacy of dietary treatment of obesity: a systematic review of studies published between 1931 and 1999. *Obes Rev* 2000; **1**: 113–119.
34. Wing R, Jeffery R, Hellerstedt W, Burton L. Effect of frequent phone contacts and Optional Food Provision on maintenance of weight loss. *Ann Behav Med* 1996; **18**: 172–176.
35. Perri MG, McAdoo WG, McAllister DA *et al.* Effects of peer support and therapist contact on long-term weight loss. *J Consult Clin Psychol* 1987; **55**: 615–617.
36. Kumanyika SK, Espeland MA, Bahnson JL *et al.* Ethnic comparison of weight loss in the trial of nonpharmacologic interventions in the elderly. *Obes Rev* 2002; **10**: 96–106.
37. Rickel KA, Milsom VA, Ross KM, Hoover VJ, Peterson ND, Perri MG. Differential response of African-American and Caucasian women to extended-care programs for obesity management. *Ethn Dis* 2011; **21**: 170–175.
38. Smith West D, DiLillo V, Bursac Z, Gore SA, Greene PG. Motivational interviewing improves weight loss in women with type 2 diabetes. *Diabetes Care* 2007; **30**: 1081–1087.
39. Begg CB. Publication Bias. In: Cooper H, Hedges LV (eds). *The Handbook of Research Synthesis*. Russell Sage Foundation: New York, 1994, pp. 339–408.
40. Wadden TA, Anderson D, Foster G. Two-year changes in lipids and lipoproteins associated with the maintenance of a 5% to 10% reduction in initial weight: some findings and some questions. *Obes Res* 1999; **7**: 170–178.
41. Harvey-Berino J, Pintauro S, Buzzell P *et al.* Does using the Internet facilitate the maintenance of weight loss? *Int J Obes Relat Metab Disord* 2002; **26**: 1254–1260.
42. Kodama S, Saito K, Tanaka S *et al.* Effect of a web-based lifestyle modification on weight control: a meta-analysis. *Int J Obes (Lond)* 2011; doi: 10.1038/ijo.2011.121. epub ahead of print.