

ORIGINAL ARTICLE

Healthy habits: efficacy of simple advice on weight control based on a habit-formation model

P Lally, A Chipperfield and J Wardle

*Department of Epidemiology and Public Health, Health Behaviour Unit, University College London, London, UK***Objective:** To evaluate the efficacy of a simple weight loss intervention, based on principles of habit formation.**Design:** An exploratory trial in which overweight and obese adults were randomized either to a habit-based intervention condition (with two subgroups given weekly vs monthly weighing; $n = 33$, $n = 36$) or to a waiting-list control condition ($n = 35$) over 8 weeks. Intervention participants were followed up for 8 months.**Participants:** A total of 104 adults (35 men, 69 women) with an average BMI of 30.9 kg m^{-2} .**Intervention:** Intervention participants were given a leaflet containing advice on habit formation and simple recommendations for eating and activity behaviours promoting negative energy balance, together with a self-monitoring checklist.**Main outcome measures:** Weight change over 8 weeks in the intervention condition compared with the control condition and weight loss maintenance over 32 weeks in the intervention condition.**Results:** At 8 weeks, people in the intervention condition had lost significantly more weight (mean = 2.0 kg) than those in the control condition (0.4 kg), with no difference between weekly and monthly weighing subgroups. At 32 weeks, those who remained in the study had lost an average of 3.8 kg, with 54% losing 5% or more of their body weight. An intention-to-treat analysis (based on last-observation-carried-forward) reduced this to 2.6 kg, with 26% achieving a 5% weight loss.**Conclusions:** This easily disseminable, low-cost, simple intervention produced clinically significant weight loss. In limited resource settings it has potential as a tool for obesity management.*International Journal of Obesity* (2008) 32, 700–707; doi:10.1038/sj.ijo.0803771; published online 11 December 2007**Keywords:** automaticity; habits; weight control; leaflet

Introduction

Obesity rates have reached epidemic proportions in many parts of the world.¹ Although cognitive behaviour therapy (CBT) is acknowledged to be the most effective non-medical treatment,² the need for specialist skills poses a significant barrier to widespread implementation. Interventions that do not depend on health professional support would be an attractive alternative,³ and could also be useful for people who are unable to attend treatment sessions.⁴ Internet CBT offers one option,⁵ although some programmes incorporate individualized feedback from a health professional,⁶ thereby increasing the delivery costs. But even Internet CBT requires more commitment than some people are willing to invest.⁷ Simple weight control advice in written form,

requiring no computer literacy, could therefore make a useful contribution.

An implicit goal of many behaviour change programmes—including those to treat obesity—is that the new behaviours should become ‘habits’, that is acquire the quality of ‘automaticity’ and no longer require conscious effort. However few behavioural interventions have been underpinned by theory related to habit formation. Habits have been defined as ‘behavioural dispositions to repeat well-practiced actions given recurring circumstances’⁸ and are assumed to develop through repetition of the behaviour in the presence of consistent stimuli.⁹ By definition, habits are resistant to change, even in circumstances when they are in opposition to intentions,^{9–11} and behaviour change interventions are less successful at changing habitual behaviours (those performed frequently in consistent contexts) than non-habitual behaviours.¹² People also pay less attention to information about their habits and are therefore less likely to form intentions in opposition to them even when the information provided is compelling.^{13,14}

Although early research on habitual behaviour suggested that explicit rewards are required after a response to an

Correspondence: Dr J Wardle, Department of Epidemiology and Public Health, Health Behaviour Unit, University College London, Gower Street, London WC1E 6BT, UK.

E-mail: j.wardle@ucl.ac.uk

Received 14 August 2007; revised 14 September 2007; accepted 30 September 2007; published online 11 December 2007

environmental cue,¹⁵ these studies were on arbitrary behaviours in laboratory settings. Rewards may not be necessary when the behaviour is intrinsically rewarding (it is one the individual wants to perform) external rewards are not necessary. Simply repeating an eating or activity behaviour in a consistent context has been found to result in increased automaticity following an asymptotic curve (Lally *et al.*^a, paper submitted for publication).

Advice on context-dependent repetition is straightforward enough to be able to be described in a leaflet. There is also reasonable consensus on the kinds of behaviours that facilitate weight control (for example, take 10 000 steps a day, choose low-calorie drinks). We therefore hypothesized that a habit-formation model could provide the basis for a simple weight control intervention. We developed a leaflet based around a set of everyday eating and activity behaviours that have been shown to be associated with weight loss,^{16–25} and incorporated advice on repetition in consistent contexts to promote habit formation (see Table 1). The leaflet also contained a brief self-monitoring form.

In a case series of 10 people who were given the leaflet and weighed on a weekly basis, the programme was well received, rated as easy to follow and achieved acceptable weight loss (3 kg) over 8 weeks (Lally *et al.*^b, paper submitted for publication). This study is the next stage of the evaluation; an exploratory trial²⁶ designed to examine the impact of the intervention on weight loss and quality of life compared with a no treatment control condition.

Table 1

Ten Top Tips for Weight Loss

1. *Keep to your meal routine*

Try to eat at roughly the same times each day, whether this is two or five times a day.

2. *Go reduced fat*

Choose reduced fat foods (e.g. dairy foods, spreads, salad dressings) where you can. Use high fat foods (e.g. butter and oils) sparingly, if at all.

3. *Walk off the weight*

Walk 10 000 steps (equivalent to 60–90 min moderate activity) each day. You can use a pedometer to help count the steps.

4. *Pack a healthy snack*

If you snack, choose a healthy option such as fresh fruit or low calorie yogurts instead of chocolate or crisps.

5. *Learn the labels*

Be careful about food claims. Check the fat and sugar content on food labels when shopping and preparing food.

6. *Caution with your portions*

Do not heap food on your plate (except vegetables). Think twice before having second helpings.

7. *Up on your feet*

Break up your sitting time. Stand up for ten minutes out of every hour.

8. *Think about your drinks*

Choose water or sugar-free squashes. Unsweetened fruit juice contains natural sugar so limit to one glass a day (200 ml/one-third pint). Alcohol is high in calories; limit to one unit a day for women and two for men.

9. *Focus on your food*

Slow down. Do not eat on the go or while watching TV. Eat at a table if possible.

10. *Do not forget your 5 a day*

Eat at least 5 portions of fruit and vegetables a day (400 g in total).

Methods

Design

The design had two phases: (1) an 8-week period where overweight or obese adults who had volunteered to test a new weight control programme were allocated either to one of the two intervention conditions or to a waiting-list control condition and (2) a 6-month follow-up for the intervention groups. The two intervention subgroups differed only in the frequency of weighing: participants in one group had weekly weighing to match the protocol in the pilot study (Lally *et al.*^b, paper submitted for publication), while those in the other had 4 weekly weighing. The primary end points were weight change at 8 and 32 weeks, but we also assessed quality of life. Perceived automaticity of the target behaviours was assessed using items from the self-report habit index (SRHI) completed at baseline, 12 and 32 weeks in the intervention groups.²⁷

All applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research. The study received ethical approval from the University College London Committee on the Ethics of Non-NHS Human Research.

The intervention

The programme (named 'Ten Top Tips') consisted of a list of seven simple behaviours associated with negative energy balance (choose low-fat options, low-calorie snacks, low-calorie drinks, eat five servings of fruit and vegetables a day, have small portions and no second helpings, walk 10 000 steps a day, sit for no more than 50 min of each hour), two behaviours designed to improve awareness of food intake (do not perform other activities while eating and read food labels) and one to promote routines (eat at the same times each day; see Appendix). Together, the negative energy balance behaviours were estimated to create a daily deficit of 800–900 kcal for a person changing from doing none to doing all of them, although we recognized that many people would already be doing some and would therefore achieve a lower energy deficit.

The leaflet was designed to be accessible, so the 'tips' were written in easy language with memorable names and the leaflet was attractively designed. In order to encourage habit development in the first 8 weeks, participants were advised to plan ahead to find ways to incorporate the tips into their daily routines. Self-monitoring is a valuable component of behaviour change programmes^{28–30} and therefore we incorporated a simple daily monitoring form in the leaflet. If participants were consistently failing to achieve a tip they had space to make notes and to plan how to achieve it the next week. Space was also included on the form to record weight.

Sample size and recruitment

A power calculation based on the pilot results showed that 54 participants were needed to detect a difference of 3 kg between two groups with a power of 0.95. Because the

present study had three groups, and to allow for attrition, 120 participants were recruited. Managers of local businesses (including the University) sent an e-mail inviting employees to contact the research team if they were interested in participating in a study of a new weight loss programme. Inclusion criteria were age over 18 years and body mass index (BMI) at least 25 kg m^{-2} .

Procedure

Potential participants were offered one of three weekdays (to a maximum of 45 participants per day) to attend an information meeting. The days were then randomly designated (by a researcher who was not involved in the trial) as the three experimental conditions. Weight outcomes were recorded at baseline, weeks 4 and 8, for all three conditions, with intervention participants being weighed weekly or monthly for another 6 months (to 32 weeks). Participants in the waiting-list group were offered the intervention after 8 weeks (data not included).

At the initial meeting, participants were given information about the study and those who chose to participate gave written consent. Baseline measures were taken by members of the research team. Participants in the intervention conditions were given the leaflet, but they received no more therapeutic contact. Follow-up weight measurements were taken in drop-in sessions by the first author or one of a team of assistants. Unlike some studies, no payment was offered for attending follow-up appointments.^{7,31}

Measures

At baseline, participants completed a demographic questionnaire. Their height was measured using a Leicester freestanding stadiometer and weight with the TANITA body composition analyzer (model TBF-410M, Sindelfingen, Germany). The shortened extended satisfaction with life scale (ESWLS³²) was completed at baseline, and weeks 8 and 32.

To assess development of habits, the seven automaticity items from the SRHI²⁷ were completed by intervention participants at baseline, weeks 12 and 32 for each of 14 behaviours targeted by the intervention. The SRHI has a stem '[the behaviour] is something that...' followed by items such as 'I do without thinking'. At the end of the study, participants completed a questionnaire asking which tips were most useful in helping them to manage their weight, whether the behaviours felt habitual, and if so, how long the process of habit formation had taken.

Data analysis

The first analyses compared changes in weight for the three groups over the first 8 weeks, using one-way analysis of variance. Data were analysed both using cases with valid data at both time points (completer analysis) and with an intention-to-treat (ITT) analysis using last-observation-carried forward (LOCF). Longer-term weight trends in the intervention groups were also analysed using data from

those who returned to be weighed (completers), and with the whole group using LOCF for missing data points. At 32 weeks a further ITT analysis with baseline values carried forward (BCF) was performed. Change in automaticity was assessed by averaging each individual's change score from baseline to 12 and 32 weeks across the 14 behaviours. Analyses were done using Statistical Package for the Social Sciences (version 14).

Results

A total of 104 individuals out of 120 who came to the information talks chose to take part in the study (Figure 1). Their characteristics are shown in Table 2. Three quarters were women, and they were predominantly white, married and well educated. Mean BMI was 30.9 kg m^{-2} .

The three treatment groups differed in baseline weight ($F(2,101) = 3.77$, $P = 0.026$) with the control group being lighter than the monthly weighing (I-MW) group, but they were not significantly different in BMI. The waiting-list group was younger than the two intervention groups ($F(2,100) = 4.96$, $P = 0.009$).

The majority of participants ($n = 89$, 86% of those who started the programme) provided data at 8 weeks. There were no significant baseline differences in BMI, gender, age or education between completers and those who dropped out.

Table 3 shows the 8-week changes in weight. In the completers analysis the two intervention groups respectively lost 2.4 kg (monthly weighing, I-MW) and 1.6 kg (weekly weighing, I-WW), compared with 0.4 kg in the control group (WL). Weight loss was significantly different in the three groups ($F(2,86) = 9.480$, $P < 0.001$), with both intervention

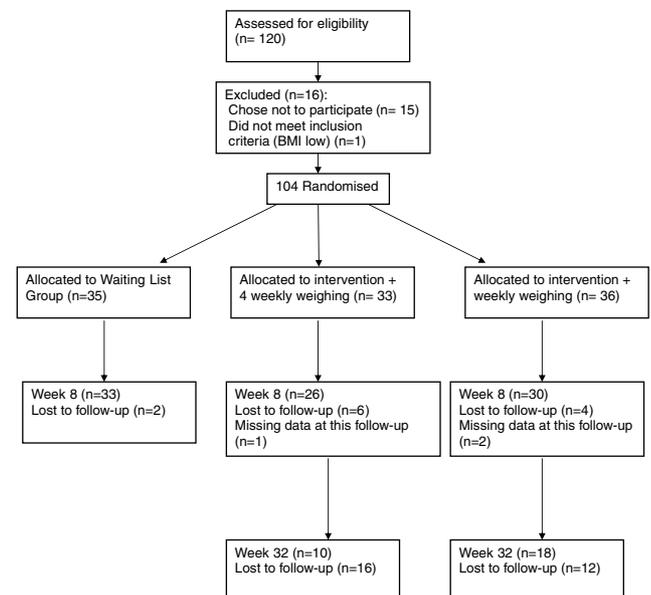


Figure 1 Participant flow.

Table 2 Baseline characteristics

	Waiting list control (N = 35)	Intervention with monthly weighing (N = 33)	Intervention with weekly weighing (N = 36)
Age ^a , mean (s.d.), years	36.0 (9.8)	42.1 (9.9)	43.3 (11.4)
Weight, mean (s.d.), kg	84.1 (11.6)	93.6 (17.6)	91.6 (15.7)
BMI, mean (s.d.), kg m ⁻²	29.5 (3.0)	31.7 (5.1)	31.6 (5.5)
Number of previous weight loss attempts ^a , mean (s.d.)	2.4 (1.8)	2.1 (1.7)	2.7 (2.4)
Gender balance (male/female)	8/27	15/18	12/24
<i>Education, n (%)</i>			
No university education	4 (11)	11 (33)	9 (25)
University education	31 (89)	22 (67)	27 (75)
<i>Marital status, n (%)</i>			
Married/cohabiting	18 (51)	23 (70)	26 (72)
Not married	17 (49)	10 (30)	10 (28)
Ethnic group (n (%) white)	27 (77)	29 (88)	28 (78)

Abbreviation: BMI, body mass index. ^aSome participants did not provide this information. Ns for age were 35, 33, 35 and for number of previous weight loss attempts were 30, 22, 26, respectively.

Table 3 Means and standard deviations of changes in adiposity and quality of life over 8 weeks by group

	Control (completers: N = 33) (ITT: N = 35)	Intervention + MW (completers: N = 26) (ITT: N = 33)	Intervention + WW (completers: N = 30) (ITT: N = 36)	Difference (P-value)
<i>Weight change (kg)</i>				
Completers	-0.42 (1.56) ^a	-2.40 (2.19) ^b	-1.64 (1.59) ^b	<0.001
ITT	-0.44 (1.53) ^a	-2.03 (2.13) ^b	-1.48 (1.54) ^b	0.001
<i>Quality of life (ESWLS) change^a</i>				
Completers	-1.9 (9.1)	-0.7 (6.8)	+2.0 (8.7)	0.202
ITT	-1.7 (8.6)	-0.5 (5.7)	+1.5 (7.5)	0.186

Abbreviations: ESWLS, extended satisfaction with life scale; ITT, intention-to-treat; MW, monthly weighing; WW, weekly weighing. Rows with different letters indicate significant differences between subgroups based on uncontrolled analysis. ^aSome participants did not provide this information. Ns for quality of life were 33, 23, 27.

groups losing significantly more weight than the control group. Mean effect size for weight loss was 0.92 (0.78 for I-WW; 1.06 for I-MW).

The difference in weight loss between the two intervention groups was not significant, indicating that weekly weighing was not the active therapeutic ingredient. When the two intervention groups were combined and compared to the control group (controlling for gender, age and baseline weight), differences were significant both in the completers analysis ($F(1,83)=9.839$, $P=0.002$) and using LOCF ($F(1,98)=8.314$, $P=0.005$). Differences in quality of life favoured the intervention groups, but were not significant over 8 weeks.

32-week results

Data from the two intervention groups ($N=69$) were combined to assess changes over 32 weeks of using the tips. As expected, there was progressive loss to follow-up, with 46 participants providing data at 16 weeks and 28 (41% of those who started the study) at 32 weeks. Those lost to follow-up were not significantly different from completers

on baseline BMI, gender, age or education. Although not significant, there was a trend for dropouts to have lost less weight at both 4 weeks (0.8 vs 1.2 kg) and 8 weeks (1.0 vs 2.1 kg).

Figure 2 shows the mean weight changes at each assessment point for completers and all cases using LOCF. Data from the WL group are shown for the first 8 weeks. Completers showed a pattern of continuing weight loss over follow-up, reaching 3.8 kg at 32 weeks. Using LOCF, this was reduced to 2.6 kg (s.d. 3.2) and a BCF analysis shows a weight loss of 1.5 kg (s.d. 2.9). Of those who completed the study, 54% lost 5% or more of their initial body weight; reduced to 26% using LOCF.

Although quality of Life (ESWLS) did not change significantly more in the intervention conditions than in the control group over the first 8 weeks, it had improved significantly by 32 weeks ($t(23)=2.33$, $P=0.029$) for those still in the study. At baseline the mean score for participants in the intervention groups was 72.90 ($N=69$) and at week 32 it was 79.24 ($N=24$; scale range: 22–110).

Over 32 weeks, the SRHI automaticity scores²⁰ increased by an average of 9 points ($N=36$) on this 42 point scale.

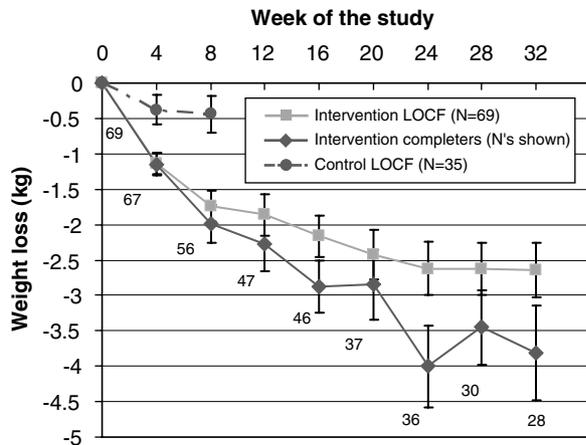


Figure 2 Weight change over 8 months using the tips ($N = 69$). Error bars indicate standard error means.

Although this study was not designed to examine the process through which the intervention promoted weight loss, we performed a *post hoc* analysis to examine associations between automaticity change and weight loss. Average automaticity change across the 14 behaviours at 12 weeks was significantly correlated with total weight loss (Spearman's $r = 0.424$, $P = 0.028$, $N = 27$).

Only 24 participants completed the final qualitative report, of whom 11 (46%) reported that all the behaviours had become habits, 8 (33%) said that some were habits and the remainder (5) said that none were habits. A total of 17 participants gave a figure for how long it had taken to develop habits and the mean was 3.0 months (s.d. 1.8). Moreover, 20 participants answered the question regarding which tips they had found most useful in managing their weight. They often stated more than one tip, so 31 responses were available. Seven people identified 'walk off the weight', and four identified 'pack a healthy snack' and 'caution with your portions'. The remaining tips were mentioned between one and three times.

Discussion

The main outcome of this study was to show that a leaflet containing healthy nutrition and activity recommendations and simple advice on habit formation, with no health professional intervention, achieved a clinically significant weight loss compared with an untreated control group. Furthermore, participants who remained in follow-up (completers) continued to lose weight over the next 6 months, with an average weight loss of 3.8 kg at 32 weeks. This is similar to the weight loss at 6 months (4.1 kg) reported for 'completers' in an Internet-based CBT programme with individual feedback.⁷ Using an ITT analysis (LOCF) reduced the mean weight loss to 2.6 kg, and the more pessimistic BCF analysis reduced it to 1.5 kg.

Although the absolute weight loss was modest, the intervention has the potential to be disseminated at minimal cost to large numbers simply by making the leaflet available. This suggests that an intervention like Ten Top Tips could be very cost effective. Quality of life was non-significantly higher at 8 weeks in the treated groups, but continued to improve over the full 32-week period among those who continued with the study, indicating broader benefits of participation than weight loss alone.

On average, the subjective experience of automaticity across all the behaviours increased during the study, suggesting that for some people at least, the behaviours became more habitual. This was supported by responses to the final questionnaire where 80% of participants reported that at least some of the behaviours had become habits. It also matched results from the pilot study, where participants' description of the behaviours as 'began to feel second nature' or 'worm(ed) their way into your brain' (Lally *et al.*^b) were consistent with development of automaticity. The average time participants felt it took to form habits (3 months) appeared to be longer than most had expected, but this was comparable to findings from another study in which, on average, automaticity reached asymptote at 70 days (Lally *et al.*^a). The significant correlation between automaticity at week 12 and weight loss during the study, suggested that the habit-formation process was instrumental in helping participants perform the behaviours consistently and lose weight, but this finding needs replicating in a larger sample.

The leaflet included the recommendation to plan ways to incorporate the behaviours into daily life. This was to encourage the consistent repetition required for habit acquisition. An extension of this advice would be to ask people to form 'implementation intentions'—plans that specify when, where and how the behaviour will be performed—because these have been hypothesized to accelerate the habit-formation process.³³ In the present study, we decided that asking participants to form detailed plans for so many different behaviours would reduce the appeal of this simple intervention, so we did not emphasize this approach. However, it is possible that participants were forming implementation intentions without being explicitly instructed to do so. Future work could assess whether people spontaneously form implementation intentions when given this type of intervention, or whether they would benefit from being advised to do so.

This is the first study to test the efficacy of a simple leaflet as a weight loss intervention, regardless of theoretical orientation. The nearest previous work has used educational messages presented in monthly mailed newsletters to prevent weight gain, although this failed to achieve a significant effect on weight.³⁴ Interest in this simple intervention is likely to be stimulated by the relatively little effort required either by consumers or health professionals, but an effectiveness trial is needed to assess the impact at a population level.

The greatest challenge for all weight loss interventions is maintenance.³⁵ Encouragingly, the results of this study indicated that participants who returned for weight measurements continued to lose weight over 32 weeks and the behaviours increased in automaticity. The theory of habit formation is that repeated behaviours become automatically cued by the environment and therefore get easier to perform over time. This should aid maintenance of weight loss so long as there are no compensatory changes. However, habits can be lost, especially if the environmental cues change,⁷ so some kind of booster treatment may be an important element of maintenance.

There were a number of limitations to this study. The cluster randomization with three groups was a pragmatic decision, and is not ideal for interpreting causal effects, but it is an appropriate step up from the case series used in the pilot study. The dropout rate for later assessments was high, but attrition is always an issue in weight loss trials.³⁶ Given the low intensity of the intervention and the absence of any incentive to return, this rate of attrition was not surprising. The fact that there were no baseline differences between dropouts and completers is encouraging for generalizing the results, but also means that we lacked any hint about factors that promote participation. Participants in this study had relatively high levels of education and were not representative of the general population. However, there were individuals—both in this study and the pilot study—with very little education, and they appeared to have no difficulty in understanding the leaflet and following the advice. The study would have benefited from continuing for longer to assess maintenance, and ideally all researchers who carried out weighing would have been blind to group allocation, but this was not practical.

Weighing people on a regular basis may have an independent effect on weight loss³⁷ and we are unable to draw conclusions about the long-term efficacy of the intervention if participants are not weighed. However, weight loss over 8 weeks was greater in the intervention group than the control group who were weighed equally often, so we can be confident that the intervention has effects beyond regular weighing. In addition, the intervention group given weekly weighing lost no more weight than the monthly weighing group.

Conclusions and implications

Giving motivated adults the Ten Top Tips leaflet resulted in significant weight loss over 8 months, together with improvement in quality of life. The target behaviours became more subjectively automatic during the study, which bodes well for maintenance. This intervention shows promise as a programme that could be disseminated on a large scale at low cost and has the potential to result in significant benefits relative to the professional effort required.

Acknowledgements

This research was funded by Cancer Research UK and the Medical Research Council.

References

- 1 International Obesity Task Force Data on Levels of Overweight and Obesity. Available at <http://www.who.int/databases/globaladults/August2005.asp>. Accessed 18th July 2007.
- 2 Avenell A, Broom J, Brown TJ, Poobalan A, Aucott L, Stearns SC et al. Systematic review of the long-term effects and economic consequences of treatments for obesity and implications for health improvement. *Health Technol Assess* 2004; **8**: 21.
- 3 Wadden TA, Butryn ML, Bryne KJ. Efficacy of lifestyle modification for long-term weight control. *Obes Res* 2004; **12**: 151S–162S.
- 4 Sherwood NE, Morton N, Jeffery RW, French SA, Neumark-Sztainer D, Falkner NH. Consumer preferences in format and type of community-based weight control programs. *Am J Health Promot* 1998; **13**: 12–18.
- 5 Tate DF, Wing RR, Winett RA. Using Internet technology to deliver a behavioral weight loss program. *JAMA* 2001; **285**: 1172–1177.
- 6 Weinstein PK. A review of weight loss programs delivered via the Internet. *J Cardiovasc Nurs* 2006; **21**: 251–258.
- 7 Verheijden MW, Jans MP, Hildebrandt VH, Hopman-Rock M. Rates and determinants of repeated participation in a web-based behavior change program for healthy body weight and healthy lifestyle. *J Med Internet Res* 2007; **9**: e1.
- 8 Wood W, Tam L, Witt MG. Changing circumstances, disrupting habits. *J Pers Soc Psychol* 2005; **88**: 918–933.
- 9 Neal DT, Wood W, Quinn JM. Habits—A repeated performance. *Curr Dir Psychol Sci* 2006; **15**: 198–202.
- 10 Oullette JA, Wood W. Habit and intention in everyday life: the multiple processes by which past behavior predicts future behavior. *Psychol Bull* 1998; **124**: 54–74.
- 11 Verplanken B, Aarts H, van Knippenberg A, Moonen A. Habit versus planned behaviour: a field experiment. *Br J Soc Psychol* 1998; **37**: 111–128.
- 12 Webb TL, Sheeran P. Does changing behavioural intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychol Bull* 2006; **132**: 249–268.
- 13 Verplanken B, Aarts H, van Knippenberg A. Habit, information acquisition, and the process of making travel mode choices. *Eur J Soc Psychol* 1997; **27**: 539–560.
- 14 Aarts H, Verplanken B, van Knippenberg A. Habit and information use in travel mode choices. *Acta Psychol* 1997; **96**: 1–14.
- 15 Hull CL. *Essentials of Behavior*. Greenwood Press: Westport, Connecticut, 1951.
- 16 Westenhoefer J, von Falck B, Stellfeldt A, Fintelman S. Behavioural correlates of successful weight reduction over 3y. Results from the Lean Habits Study. *Int J Obes* 2004; **28**: 334–335.
- 17 Mulvihill C, Quigley R. *The Management of Obesity and Overweight: An Analysis of Reviews of Diet, Physical Activity and Behavioural Approaches: Evidence Briefing*. 1st edn. Health Development Agency: London, 2003.
- 18 Department of Health. *At least five a week. Evidence on the impact of physical activity and its relationship to health. A report from the chief medical officer*. Department of Health: London, 2004.
- 19 Forslund BH, Torgerson JS, Sjostrom L, Lindroos AK. Snacking frequency in relation to energy intake and food choices in obese men and women compared to a reference population. *Int J Obes* 2005; **29**: 711–719.
- 20 Food Standards Agency. *Concept Testing of Alternative Labeling of Healthy/Less Healthy Foods*. Food Standards Agency: London, 2004.

- 21 Ello-Martin JA, Ledikwe JH, Rolls BJ. The influence of food portion size and energy density on energy intake: implications for weight management. *Am J Clin Nutr* 2005; **82** (Suppl): 236S–241S.
- 22 Mummery WK, Schofield GM, Steele R, Eakin EG, Brown WJ. Occupational sitting time and overweight and obesity in Australian workers. *Am J Prev Med* 2005; **99**: 91–97.
- 23 Schulze MB, Manson JE, Ludwig DS, Colditz GA, Stampfer MJ, Willett WC *et al*. Sugar-sweetened beverages, weight gain, and incidence of type 2 diabetes in young and middle-aged women. *JAMA* 2004; **292**: 927–934.
- 24 Stroebele N, de Castro JM. Television viewing is associated with an increase in meal frequency in humans. *Appetite* 2004; **42**: 111–113.
- 25 National Health Service. *Health Benefits—5 a Day*. <http://www.Saday.nhs.uk/original/professionals/HealthBenefits.aspx>. Accessed 3rd July 2006.
- 26 Campbell M, Fitzpatrick R, Haines A, Kinmonth AL, Sandercock P, Spiegelhalter D *et al*. Framework for design and evaluation of complex interventions to improve health. *BMJ* 2000; **321**: 694–696.
- 27 Verplanken B, Orbell S. Reflections on past behavior: a self-report index of habit strength. *J Appl Soc Psychol* 2003; **33**: 1313–1330.
- 28 Boutelle KN, Kirschenbaum DS. Further support for consistent self-monitoring as a vital component of successful weight control. *Obes Res* 1998; **6**: 219–224.
- 29 Hill JO, Thompson H, Wyatt H. Weight maintenance: what's missing? *J Am Diet Assoc* 2005; **105** (Suppl 1): S63–S66.
- 30 Costain L, Croker H. Helping individuals to help themselves. *Proc Nutr Soc* 2005; **64**: 89–96.
- 31 Harvey-Berino J, Pintauro S, Buzzell P, Gold E. Effect of internet support on the long-term maintenance of weight loss. *Obes Res* 2004; **12**: 320–329.
- 32 Gregg PM, Salisbury PS. Confirming and expanding the usefulness of the extended satisfaction with life scale (ESWLS). *Soc Indic Res* 2001; **54**: 1–16.
- 33 Gollwitzer PM, Brandstatter V. Implementation intentions and effective goal pursuit. *J Pers Soc Psychol* 1997; **73**: 186–199.
- 34 Jeffery RW, French SA. Preventing weight gain in adults: the pound of prevention study. *Am J Public Health* 1999; **89**: 747–751.
- 35 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.
- 36 Davis MJ, Addis ME. Predictors of attrition from behavioural and medicine treatments. *Ann Behav Med* 1999; **25** (Suppl): 339–349.
- 37 O'Neil PM, Brown JD. Weighing the evidence: benefits of regular weight monitoring for weight control. *J Nutr Educ Behav* 2005; **37**: 319–322.
- 38 Gorin AA, Phelan S, Wing RR, Hill JO. Promoting long-term weight control: does dieting consistency matter? *Int J Obes* 2004; **28**: 278–281.
- 39 Wing RR, Hill JO. Successful weight loss maintenance. *Annu Rev Nutr* 2001; **21**: 323–341.
- 40 Saris WHM, Blair SN, van Baek MA, Eaton SB, Davies PSW, Di Pietro L *et al*. How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st stock conference and consensus statement. *Obes Rev* 2003; **4**: 101–114.
- 41 Tudor-Locke C, Bassett JDR. How many steps a day are enough? Preliminary pedometer indices for public health. *Sports Med* 2004; **34**: 1–8.
- 42 House of Commons Health Select Committee. Obesity: Third report of sessions 2003–2004: London, UK Parliament, 2004.
- 43 Nielsen SJ, Popkin BM. Patterns and trends in food portion sizes 1977–1998. *JAMA* 2003; **289**: 450–453.
- 44 Young LR, Nestle M. Expanding portion sizes in the US marketplace: Implications for nutrition counseling. *J Am Diet Assoc* 2003; **103**: 231–234.
- 45 Hu FB, Li TY, Colditz GA, Willett WC, Manson JE. Television watching and other sedentary behaviors in relation to risk of obesity and Type 2 diabetes mellitus in women. *JAMA* 2003; **289**: 1785–1791.
- 46 Nielsen SJ, Popkin BM. Changes in beverage intake between 1977 and 2001. *Am J Prev Med* 2004; **27**: 205–210.
- 47 National Health Service. 5 a day: just eat more (fruit and veg). Available at <http://www.Saday.nhs.uk/original/professionals/default.aspx>. Accessed 18th July 2007.

Appendix

Appendix 1: Scientific justification for 'Ten Top Tips'

Tip	Scientific justification	Estimated calorie deficit
1. Keep to your meal routine Try to eat at roughly the same times each day, whether this is two or five times a day.	People who succeed at long term weight loss tend to have a regular meal rhythm (avoidance of snacking and nibbling) and show 'flexible' rather than 'rigid' control of eating ¹⁶). A consistent diet regimen across the week and year also predicts subsequent long-term weight loss maintenance. ³⁸	This tip helps encourage habit development.
2. Go reduced fat Choose reduced fat foods (e.g. dairy foods, spreads, salad dressings) where you can. Use high fat foods (e.g. butter and oils) sparingly, if at all.	There is a great deal of evidence to support the effectiveness of low-fat diets (where 30% or less of total daily energy is from fat), which produce weight loss by decreasing calorie intake ¹⁷). Following a low-fat diet is also associated with better weight maintenance. ³⁹	–200 kcal
3. Walk off the weight Walk 10 000 steps (equivalent to 60–90 min moderate activity) each day. You can use a pedometer to help count the steps.	Achieving the UK government recommendation of at least 30 min of at least moderate intensity physical activity on 5 or more days a week would increase most people's energy expenditure and contribute to weight management. ¹⁸ More activity (45–60 min) may be required to prevent the transition to overweight and obesity and maximize weight loss. ⁴⁰ People who have lost weight may need to do 60–90 min of activity a day to maintain their weight loss. ^{18,40} Doing 10 000 steps per day is approximately the equivalent to at least 60 min of walking at a brisk pace (4.5 m.p.h.). ⁴¹	–100–200 kcal
4. Pack a healthy snack If you snack, choose a healthy option such as fresh fruit or low calorie yogurts instead of chocolate or crisps.	Readily-available snack foods and drinks are often high in energy and tend to be used to supplement rather than replace meals. Between 1993 and 1998 sales of snacks more than tripled in the United Kingdom from £173 million to £541 million. ⁴² Snack consumption is related to a higher daily energy intake. ¹⁹	–100 kcal

(continued)

<i>Tip</i>	<i>Scientific justification</i>	<i>Estimated calorie deficit</i>
5. Learn the labels Be careful about food claims. Check the fat and sugar content on food labels when shopping and preparing food.	Food labels detailing the caloric and nutritional content of foods provide a basis for making healthy food choices. ⁴² Inadequate labelling can have a negative impact on nutrition. ⁴² Providing individuals with simple methods to understand labels will facilitate informed choices. ²⁰	This tip helps people to make informed choices.
6. Caution with your portions Do not heap food on your plate (except vegetables). Think twice before having second helpings.	Portion sizes have increased inside and outside the home in the past 30 years. ^{43,44} Larger portions contain more calories and can contribute to excess energy intake and weight gain. Eating satisfying portions of low-energy-dense foods can help enhance satiety and control hunger while restricting energy intake for weight management. ²¹	–100 kcal
7. Up on your feet Break up your sitting time. Stand up for ten minutes out of every hour.	Inactive people are more likely to be obese than active people. ¹⁸ Time spent in sedentary behaviours (e.g. TV watching, sitting at work) is related to overweight and obesity, independent of physical activity level. ^{22,45} Decreasing sedentary time and increasing light-to-moderate activity such as household chores may bring substantial health benefits. ^{18,22}	–100 kcal
8. Think about your drinks Choose water or sugar-free squashes. Unsweetened fruit juice contains natural sugar so limit to one glass a day (200 ml/one-third pint). Alcohol is high in calories; limit to one unit a day for women and two for men.	Intake of sugar-sweetened soft drinks has increased over the last 30 years; up by 135% (278 kcal) in 5 years. ⁴⁶ Higher consumption of sugar-sweetened beverages is associated with greater weight gain. ²³ Intake of calorific drinks may lead to excess energy intake that is not compensated for elsewhere in the daily diet. ²³	–150 kcal
9. Focus on your food Slow down. Do not eat on the go or while watching TV. Eat at a table if possible.	More TV viewing tends to be associated with a higher calorie intake. Internal cues regulating food intake may not be as effective while distracted by the TV. ²⁴	This tip helps to avoid unconscious slips in their behaviour.
10. Do not forget your 5 a day Eat at least 5 portions of fruit and vegetables a day (400 g in total).	The UK Department of Health recommends 400 g of fruit and vegetables a day. Fruits and vegetables have high nutritional quality and low energy density. Eating the recommended amount produces health benefits including reduction in the risk of cancer and coronary heart disease. ⁴⁷	–50 kcal
Total calorie deficit		–800–900 kcal