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Maintenance of Physical Activity and Dietary Change Following a Telephone-Delivered Intervention

Elizabeth Eakin, Marina Reeves, Elisabeth Winkler, Sheleigh Lawler, and Neville Owen
University of Queensland

Objective: To examine the maintenance of behavioral changes 6 months following a telephone-delivered physical activity and diet intervention. Design: Patients (n = 434) with Type 2 diabetes or hypertension were recruited from 10 primary care practices in a disadvantaged community; practices were randomized to a telephone-counseling intervention (TC; 5 practices, n = 228) or usual care (UC; 5 practices, n = 206). Main Outcome Measures: Validated, self-report measures of physical activity and diet were taken at baseline, 12 months (end-of-intervention), and 18 months (6 months postintervention completion).

Results: For physical activity, the significant (p < .001) within-groups improvements from baseline observed at 12 months remained at 18 months, in both the TC (62.2 ± 14.2 minutes/week; 2.2 ± 0.3 sessions/week) and UC (74.7 ± 14.9 minutes/week; 2.1 ± 0.4 sessions/week) groups. For all dietary outcomes, significant (p < .05) between-groups maintenance effects, similar to end-of-intervention outcomes, remained [TC-UC changes from baseline to 18 months (95% CI)]: total fat [−1.33 (−2.16, −0.50)% energy/day], saturated fat [−1.06 (−1.70, −0.43]% energy/day], fiber intake [1.90 (0.72, 3.15) grams/day], and fruit [0.22 (0.05, 0.40) servings/day)], except vegetables [0.59 (−0.01, 1.17) servings/day; p = .05]. Intervention effects across all health behavior outcomes were stronger for the subgroup (n = 145) adhering to the study protocol. Conclusion: Telephone-delivered interventions can promote maintenance of health behavior change. Studies with longer-term follow-up are needed, particularly to determine how intervention duration and intensity might further enhance maintenance.

Keywords: Type 2 diabetes, hypertension, telephone counseling, primary care, behavior change

Engaging in regular, moderate-intensity physical activity and following a healthy diet are important and ongoing management targets for Type 2 diabetes and hypertension (Eyre, Kahn, & Robertson, 2004), as well as for most chronic medical conditions. There is now a large literature on health behavior interventions delivered in and around the primary care context, and utilizing a wide variety of intervention delivery modalities (i.e., individual and group counseling; telephone counseling; tailored print and website-delivered interventions). This body of work shows strong support for the efficacy of such interventions in producing short-term improvements in physical activity, diet and related disease management outcomes in a wide range of primary and secondary prevention contexts (Goldstein, Whitlock, & DePue, 2004). However, the majority of health behavior intervention studies do not include evaluations of maintenance—defined here as a follow-up assessment occurring at least 6 months after the final intervention contact (Bock, Marcus, Pinto, & Forsyth, 2001). Stronger evidence is needed to guide dissemination efforts—especially evidence which addresses the extent to which intervention effects are maintained following intervention completion (Eakin, Lawler, Vandelanotte, & Owen, 2007).

A comprehensive set of reviews of the health behavior intervention literature with a focus on maintenance was published in 2000 (Kumanyika et al., 2000; Marcus et al., 2000; Orleans, 2000). These reviews recommended, based on the very limited evidence base at that time, that a much more concerted focus on behavioral maintenance was needed in future trials, in particular, one that addressed strategies for assisting special populations and for intervening upon more than one behavioral risk factor at a time. However, no subsequent reviews of the health behavior intervention literature have focused specifically on the issue of maintenance. This may be, in part, because the field has become so large that reviews tend to focus on the efficacy of specific intervention delivery modalities (i.e., telephone, web, tailored print) for example, (Eakin et al., 2007; Kroeeze, Werker, & Brug, 2006; Vandelanotte, Spathonis, Eakin, & Owen, 2007) or settings (primary care, worksite, community) for example, (Goldstein et al., 2004; Proper et al., 2003; Task Force on Community Preventive Services, 2002).
In the context of telephone-delivered interventions for physical activity and dietary change, a recent review of 26 studies found only seven that reported on maintenance of outcomes (Eakin et al., 2007). Among these seven studies, the length of time between the last intervention contact and the final assessment ranged from 1 to 6 months. Significant intervention effects at the maintenance follow-up, relative to a control group, were observed in three studies, and two of the seven studies demonstrated maintenance of significant within-group increases in the intervention group. However, maintenance was only demonstrated for short periods, 4 months at most.

We examined maintenance of behavior change outcomes following a 12-month telephone-delivered intervention for physical activity and diet, targeting patients with Type 2 diabetes or hypertension. The intervention took place entirely over the telephone; the primary, end-of-intervention, and post-intervention outcomes have previously been reported (Eakin et al., 2009; Graves et al., 2009). This paper addresses three specific research questions: 1) What were the differences in physical activity and diet outcomes between participants allocated to the telephone counseling group versus usual care group 6 months after the end of the 12-month telephone-delivered lifestyle intervention?; 2) What were these differences for the intervention group who adhered to the study protocol versus usual care?; 3) Within the telephone counseling intervention and usual care groups, were the changes from baseline that were observed at the end of intervention (12 months) maintained 6 months later (18 months)?

Method

A detailed description of the methods of this trial has been published elsewhere (Eakin et al., 2008). This cluster-randomized trial was conducted in 10 primary care clinics in a socioeconomically disadvantaged community bordering Brisbane, Australia (the capital city of the state of Queensland). Data were collected from February 2005 to June 2008, with analysis from January to March 2009. The study protocol was approved by The University of Queensland, Human Research Ethics Committee.

Practices were randomized to telephone counseling intervention (TC) or usual care (UC). Patients with Type 2 diabetes or hypertension, who were 30 years or older, and had a telephone number were identified from electronic medical records, screened for contraindications to participation in an unsupervised physical activity and diet intervention by their doctor (Eakin et al., 2008), then sent a recruitment letter from the practice. Eligibility was confirmed and consent was then solicited by a phone call from study staff.

Telephone counseling intervention.

The intervention aimed to increase physical activity levels and improve diet (i.e., reduce total fat and saturated fat intake, and increase intakes of fruit, vegetables, and fiber). Patients from TC practices were mailed a workbook with information on physical activity and healthy eating, along with a pedometer to supplement their telephone counseling calls, which followed the 5 A’s approach (Goldstein et al., 2004). The advice on physical activity and diet was consistent with Australian national guidelines (Australian Government Department of Health and Ageing & National Health & Medical Research Council, 2005; Department of Health & Aged Care, 1999). The intervention was underpinned by Social Cognitive Theory (Bandura, 1986) and the Social Ecological Model (Green, Richard, & Potvin, 1996); intervention delivery was guided by techniques of motivational interviewing and a chronic disease self-management intervention model developed in previous trials (Glasgow & Eakin, 2000).

Maintenance-enhancement elements of the intervention.

Several aspects of the intervention were designed to promote the maintenance of behavior change. The intervention was implemented over a relatively long (12-month) period, with a 4-month intensive call phase (10 calls) and an 8-month maintenance-enhancement phase (8 calls). During the maintenance-enhancement phase of the intervention, increasing emphasis was placed on identification of multilevel supports for health behavior change (Glasgow & Eakin, 2000). Participants were encouraged to use a variety of supports including family and friends, their health care team, and community supports (e.g., walking groups; identified from a community reference guide compiled at study outset).

Usual care condition.

After each assessment, patients from UC practices were mailed a one-page letter with brief feedback on their assessment results. They also received a quarterly project newsletter on general health tips, along with brochures on various health topics, including physical activity and diet.

Assessment.

All study outcomes were obtained using computer-assisted telephone interviews (CATI) at baseline, 4, 12, and 18 months, by interviewers who were blind to group allocation. Baseline and 12-month (end-of-intervention) data have previously been reported (Eakin et al., 2009). Physical activity (minutes and sessions of moderate-to-vigorous physical activity per week) was assessed by the Active Australia Survey (Australian Institute of Health & Welfare, 2003). Percent of calories from total fat and saturated fat, and grams of fiber per day, were assessed using a validated food frequency questionnaire (Hodge, Patterson, Brown, Ireland, & Giles, 2000; Ireland et al., 1994), and servings per day of vegetables and fruit were assessed using validated items from the Australian National Nutrition Survey (Rutishauser, Webb, Abraham, & Allsopp, 2001).

Data were also collected on the intervention implementation (i.e., call completion and duration). Call duration was consistent over the intervention [mean 18.2 (SD 4.1) minutes], so adherence to protocol was defined by call completion, with an arbitrary cut point of 12 out of 18 calls (i.e., majority of total calls were completed; 67%).

Statistical analyses.

As described in detail previously (Eakin et al., 2008), the sample size was intended to achieve 90% power at the 5% (two-tailed) significance level to detect differences expected to be clinically relevant, which were defined as: 3% for energy from fat (absolute); 1% for energy from saturated fat (absolute); 1 serving of fruit; 1 serving of vegetables; 5 g of fiber and 60 minutes per week of physical activity. For all tests, statistical significance was set at $p < .05$ (two-tailed).

Characteristics of participants with complete data and those who withdrew or were lost to follow-up were compared using independent sample t tests for continuous variables and chi-square tests for categorical variables and also reporting any differences of at least 10% as potentially important.

In addressing all three main research questions, we examined change scores (post scores minus baseline) as outcomes since these had approximately Normal distributions, while physical activity and some dietary data were skewed. Linear mixed models (SAS, version 9.1, 2003, Cary, NC) were used to determine intervention.
effects at each follow-up time point. Models included the main
effects of group and time, the interaction of group by time and
baseline values of the outcome (to correct for regression to the
mean). Random intercepts were fitted for each subject (to account
for repeated data) and practice (to account for clustering). Changes
from baseline were determined within-groups via least squares
means from these models, and between-groups via differences in
least squares means.

We examined whether intervention effects were still present at
18 months, first for the study group as a whole (Research Question
1; Table 2), then in a per-protocol analysis (Research Question 2;
Table 2) that compared the TC participants who received a suffi-
cient “dose” of intervention to UC. For these analyses, we used
intention-to-treat principles and assumed no change for partici-
pants who withdrew from the program or were lost to follow up.
(This approach was more conservative than an analysis of compl-
eters, not reported here.)

Finally, to examine the extent of change over the noncontact
period (Research Question 3; Table 4), we examined whether the
change outcomes at 18 months differed from the change outcomes
at 12 months within the TC and UC groups. For this analysis we
focused on the (n = 315) participants who completed the 18-
month maintenance assessment, most (97%) of whom had also
completed the 12 month assessment. Completers were chosen
because maintenance could be overstated using the “no change”
assumption, where participants who dropped out before end-of-
treatment cannot experience any decline over the following 6
months.

To frame the results in terms of their population health impor-
tance, the percentage of those in each group (TC and UC) meeting
guidelines were reported at each time point (assuming baseline
status for participants who dropped out). Logistic regression mod-
els in STATA were used to calculate the odds of meeting guide-
lines for TC versus UC, separately at baseline, 12-month and
18-month follow-up. All models used a robust sandwich estimator
of variance to correct for clustering within practices (Williams,
2000); follow-up models adjusted for baseline values to correct for
regression to the mean (Research Question 1; Table 3).

Results

Participants. A detailed participant recruitment flowchart
has been reported previously (Eakin et al., 2008). In summary, of
the 434 patients who consented to participate in the study (73% of
those able to be contacted and determined to be eligible), assess-
ments were completed by 341 (78.6%) at 12 months, and by 315
(72.6%) at 18 months. There was no differential attrition between
the study groups, or any significant differences in baseline char-
acteristics between study completers and those who withdrew or
were lost to follow-up. Five participants (TC n = 3, UC n = 2)
died of unknown causes during the course of the study and there-
fore were excluded from the analyses. Invalid food frequency
questionnaire data, where participants overreported or underre-
ported their energy intake (Willett, 1998), were set to missing (n =
8 invalid observations). No participants had invalid data for all
follow-up time points, so only participants lacking valid baseline
data were excluded from analyses (n = 5).

A comparison of the two study groups (see Table 1) on demo-
graphics and baseline variables revealed no meaningful differences
between the groups. The sample was middle-aged and older adults
(mean age = 58.2, SD = 11.8), with a high prevalence of multiple
comorbidities (61.8%) and overweight/obesity (mean BMI = 31.1,
SD = 6.8). Few (<20%) complied with guidelines, other than fruit
intake (47.7%) and physical activity (25%) and none complied
with all guidelines.

The median number of calls completed by the TC group was 13
(range: 0–18), with sufficient calls (at least 12 out of 18) being
completed by the majority of TC participants (n = 146, 64%) and
the vast majority of TC participants with 18-month follow-up data
(n = 138, 82%). Very few TC participants received no calls during
the maintenance enhancement phase (n = 28, 12.3% in total; n =
5, 3% with 18-month follow-up data).

Physical activity and dietary change 6 months following
intervention completion. At 18-month follow-up, changes from
baseline in physical activity time and sessions were largely the
same at end of intervention: that is, significant change of a
clinically relevant magnitude was present within groups but there

Table 1
Baseline Characteristics by Group

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All (n = 434)*</th>
<th>Telephone counseling (n = 228)*</th>
<th>Usual care (n = 206)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 2 diabetes, n (%)</td>
<td>197 (45.4)</td>
<td>112 (49.1)</td>
<td>85 (41.3)</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>371 (85.5)</td>
<td>199 (87.3)</td>
<td>172 (83.5)</td>
</tr>
<tr>
<td>Diagnosed with &gt; 3 chronic conditions, n (%)</td>
<td>268 (61.8)</td>
<td>145 (63.6)</td>
<td>114 (55.4)</td>
</tr>
<tr>
<td>Age, y</td>
<td>58.2 (11.8)</td>
<td>58.7 (11.7)</td>
<td>57.8 (11.9)</td>
</tr>
<tr>
<td>Gender, n (% female)</td>
<td>265 (61.1)</td>
<td>142 (62.3)</td>
<td>123 (59.7)</td>
</tr>
<tr>
<td>Ethnicity, n (% Caucasian)</td>
<td>395 (91.0)</td>
<td>206 (90.4)</td>
<td>189 (91.7)</td>
</tr>
<tr>
<td>Education, n (% high school graduate)</td>
<td>195 (44.9)</td>
<td>105 (46.0)</td>
<td>90 (43.7)</td>
</tr>
<tr>
<td>Employment, n (% retired)</td>
<td>157 (36.2)</td>
<td>83 (36.4)</td>
<td>74 (35.9)</td>
</tr>
<tr>
<td>Body mass index, kg/m²</td>
<td>31.1 (6.8)</td>
<td>31.5 (7.1)</td>
<td>30.6 (6.5)</td>
</tr>
<tr>
<td>Moderate-to-vigorous physical activity (minutes/week)</td>
<td>142.4 (212.7)</td>
<td>142.5 (226.2)</td>
<td>142.4 (197.3)</td>
</tr>
<tr>
<td>Moderate-to-vigorous physical activity (sessions/week)</td>
<td>2.9 (3.6)</td>
<td>2.9 (3.8)</td>
<td>2.9 (3.5)</td>
</tr>
<tr>
<td>Total fat (% calories/day)</td>
<td>36.9 (5.2)</td>
<td>36.8 (5.0)</td>
<td>36.9 (5.5)</td>
</tr>
<tr>
<td>Saturated fat (% calories/day)</td>
<td>14.4 (3.3)</td>
<td>14.5 (3.3)</td>
<td>14.2 (3.4)</td>
</tr>
<tr>
<td>Fiber (grams/day)</td>
<td>22.0 (8.0)</td>
<td>22.4 (7.8)</td>
<td>21.6 (8.1)</td>
</tr>
<tr>
<td>Vegetables (serves/day)</td>
<td>3.0 (1.7)</td>
<td>3.0 (1.7)</td>
<td>3.0 (1.7)</td>
</tr>
<tr>
<td>Fruit (serves/day)</td>
<td>1.5 (1.2)</td>
<td>1.6 (1.0)</td>
<td>1.5 (1.3)</td>
</tr>
</tbody>
</table>

* Data are given as mean (SD) unless otherwise indicated.
was no meaningful or significant between-groups difference in level of physical activity (see Table 2). At the 18-month follow-up, improvements in dietary outcomes from baseline were still significant for the TC group and significant between-groups differences (favoring the TC group) remained for all dietary outcomes except vegetable intake (where the difference was borderline \( p = .051 \)). Six months after intervention completion, clinically meaningful and statistically significant intervention effects were still present for saturated fat intake. Compared to the UC group, the TC group at 18-month follow-up had greater reductions in their total and saturated fat intake of over 1% of total energy intake, approximately 2 g greater increase in daily fiber intake, and slightly greater increases in daily fruit (almost a quarter of a serving) and vegetable intakes (over half a serving).

There were clear increases over the course of the intervention in the proportion of participants meeting recommended guidelines, particularly in the TC group (see Table 3). Adherence to guidelines did not differ substantially or significantly between groups at baseline, except for a nonsignificant difference in meeting recommendations for fiber intake. Adjusted for baseline levels, 6 months following intervention completion (18 months), TC participants had over 50% higher odds of meeting guidelines for dietary behaviors than the UC participants (see Table 3) although only differences for fiber intake and vegetable intake reached statistical significance. Relative to UC participants, TC participants had almost three times the odds of meeting guidelines for fiber intake and more than double the odds of meeting vegetable guidelines 6 months following intervention completion. More participants met physical activity guidelines 6 months after intervention completion compared to at baseline, but the increase was similar among the TC (37.3% vs. 25.0%) and UC groups (38.7% vs. 26.0%).

**Adherence to intervention protocol (12 or more calls).** Intervention effects at the end of intervention and 6 months following intervention completion were consistently stronger in magnitude in the subgroup adhering to the intervention protocol than for the TC group as a whole (see Table 2). However, there were a few instances where different conclusions about clinical relevance or statistical significance were reached, always such that larger or more significant effects were seen for the group adhering to protocol. In particular, the previously borderline intervention effects at 18 months for vegetable intake became statistically significant.

**Maintenance of intervention effects.** Table 4 presents the difference in change from baseline at 18 months versus 12 months

---

**Table 2**

*Adjusted Mean Change* in Physical Activity and Diet Outcomes From Baseline and Differences at Follow-Up* Between the Telephone Counseling (TC) and Usual Care (UC) Groups and Between a Per Protocol* Sample of TC Participants and UC Group*

<table>
<thead>
<tr>
<th></th>
<th>TC (n = 225)</th>
<th>UC (n = 204)</th>
<th>TC – UC (95% CI)</th>
<th>( p^1 )</th>
<th>TC per protocol (n = 145)</th>
<th>TC per protocol–UC (95% CI)</th>
<th>( p^1 )</th>
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<tbody>
<tr>
<td><strong>Moderate-to-vigorous</strong></td>
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<td>(minutes per week)</td>
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<tr>
<td>12 months</td>
<td>71.19 (14.20)**</td>
<td>82.23 (14.91)**</td>
<td>-11.14 (-51.56, 29.28)</td>
<td>0.589</td>
<td>97.75 (18.62)**</td>
<td>-13.19 (-34.64, 61.02)</td>
<td>0.588</td>
</tr>
<tr>
<td>18 months</td>
<td>62.19 (14.20)**</td>
<td>74.73 (14.91)**</td>
<td>-12.54 (-52.95, 27.88)</td>
<td>0.543</td>
<td>74.36 (18.62)**</td>
<td>-2.70 (-50.53, 45.13)</td>
<td>0.912</td>
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<td><strong>Moderate-to-vigorous</strong></td>
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<td>physical activity</td>
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<td>(sessions per week)</td>
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<td></td>
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<tr>
<td>12 months</td>
<td>2.61 (0.33)**</td>
<td>2.22 (0.35)**</td>
<td>0.39 (-0.55, 1.33)</td>
<td>0.491</td>
<td>3.60 (0.42)**</td>
<td>1.37 (0.30, 2.45)</td>
<td>0.0124</td>
</tr>
<tr>
<td>18 months</td>
<td>2.24 (0.33)**</td>
<td>2.13 (0.35)**</td>
<td>0.11 (-0.83, 1.05)</td>
<td>0.815</td>
<td>2.93 (0.42)**</td>
<td>0.79 (-0.29, 1.86)</td>
<td>0.1497</td>
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<tr>
<td><strong>Total fat (% of calorie</strong></td>
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<td>intake)†</td>
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<tr>
<td>12 months</td>
<td>-1.97 (0.29)**</td>
<td>-0.83 (0.31)**</td>
<td>-1.15 (-2.00, 0.32)</td>
<td>0.007</td>
<td>-2.52 (0.35)**</td>
<td>-1.71 (-2.61, 0.81)</td>
<td>0.0002</td>
</tr>
<tr>
<td>18 months</td>
<td>-2.39 (0.29)**</td>
<td>-1.07 (0.31)**</td>
<td>-1.33 (-2.16, -0.50)</td>
<td>0.002</td>
<td>-3.23 (0.35)**</td>
<td>-2.17 (-3.07, -1.28)</td>
<td>&lt;0.001</td>
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<tr>
<td><strong>Saturated fat (% of calorie</strong></td>
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<td>intake)†</td>
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<tr>
<td>12 months</td>
<td>-1.58 (0.22)**</td>
<td>-0.57 (0.23)*</td>
<td>-1.01 (-1.64, -0.37)</td>
<td>0.002</td>
<td>-2.10 (0.24)**</td>
<td>-1.51 (-2.15, -0.87)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>18 months</td>
<td>-1.58 (0.22)**</td>
<td>-0.52 (0.23)*</td>
<td>-1.06 (-1.70, -0.43)</td>
<td>0.001</td>
<td>-2.25 (0.24)**</td>
<td>-1.71 (-2.35, -1.07)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Fiber (grams per day)</strong></td>
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<td></td>
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<tr>
<td>12 months</td>
<td>1.84 (0.43)**</td>
<td>-0.32 (0.45)</td>
<td>2.17 (0.95, 3.38)</td>
<td>&lt;0.001</td>
<td>2.36 (0.63)**</td>
<td>2.76 (1.10, 4.42)</td>
<td>0.0012</td>
</tr>
<tr>
<td>18 months</td>
<td>1.55 (0.43)**</td>
<td>-0.38 (0.45)</td>
<td>1.94 (0.72, 3.15)</td>
<td>0.002</td>
<td>2.16 (0.63)**</td>
<td>2.62 (0.95, 4.28)</td>
<td>0.0021</td>
</tr>
<tr>
<td><strong>Vegetable (servings per</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 months</td>
<td>1.07 (0.21)**</td>
<td>0.33 (0.21)</td>
<td>0.73 (0.13, 1.31)</td>
<td>0.015</td>
<td>1.36 (0.20)**</td>
<td>1.05 (0.50, 1.60)</td>
<td>0.0002</td>
</tr>
<tr>
<td>18 months</td>
<td>0.77 (0.21)**</td>
<td>0.18 (0.21)</td>
<td>0.59 (-0.01, 1.17)</td>
<td>0.051</td>
<td>1.00 (0.20)**</td>
<td>0.84 (0.29, 1.38)</td>
<td>0.0003</td>
</tr>
<tr>
<td><strong>Fruit (servings per day)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 months</td>
<td>0.50 (0.06)**</td>
<td>0.20 (0.06)**</td>
<td>0.30 (0.13, 0.47)</td>
<td>&lt;0.001</td>
<td>0.67 (0.08)**</td>
<td>0.49 (0.30, 0.69)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>18 months</td>
<td>0.47 (0.06)**</td>
<td>0.24 (0.06)**</td>
<td>0.22 (0.05, 0.40)</td>
<td>&lt;0.001</td>
<td>0.65 (0.08)**</td>
<td>0.43 (0.23, 0.62)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Data are given as mean (SE) change from baseline, adjusted for baseline levels as covariates and corrected for clustering by random effects (subject and practice), under intention-to-treat assumptions of no change for participants who withdrew or were lost to follow-up. **Table presents data from 12-month (end-of-intervention) and 18-month follow-up periods only (but model includes previously reported data from a 4-month interim follow-up period). *Per protocol defined as completing 12 or more out of 18 possible calls. † Due to invalid food frequency questionnaire data, \( n = 223 \) (TC), \( n = 143 \) (TC per protocol), and \( n = 201 \) (UC). *For between groups comparison. * Significant change from baseline: \( p < .05 \). ** \( p < .01 \). *** \( p < .001 \).
within the TC and UC groups (i.e., changes in the amount of behavioral improvement following the end of the intervention). Participants in the TC group mostly maintained the level of improvement from baseline 6 months after the end of the intervention. Regression toward baseline levels was observed in physical activity (sessions and minutes), vegetable, fruit, and fiber intake, but these were only statistically significant for vegetable intake (which was less than half a gram of fiber; 12 minutes, and approximately half a session of physical activity). Both saturated fat and total fat intake were improved further at 18 months compared with the end of the intervention, significantly so for total fat intake (which was further reduced by 0.8% of energy). Among the UC group, there was no evidence of a systematic return toward baseline levels or further improvement as none of the differences between the 18-month and 12-month outcomes were statistically significant; and, the direction of these differences reflected a mixture of small improvements (intake of total fat, saturated fat, and fruit) and small returns to baseline levels (physical activity minutes and sessions, intake of vegetables and fiber).

**Discussion**

Maintenance outcomes from our 12-month telephone-delivered intervention for physical activity and dietary behavior change demonstrated that the intervention was effective in promoting

### Table 3

*Adjusted* Odds of Meeting Physical Activity and Diet Guidelines at 12 and 18 Months for Participants Receiving Telephone Counseling (TC) Compared With Usual Care (UC)

<table>
<thead>
<tr>
<th>Guideline</th>
<th>TC (n = 225)</th>
<th>UC (n = 204)</th>
<th>Odds ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity (≥150 mins, ≥5 times per week)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>25.0</td>
<td>26.0</td>
<td>0.92</td>
<td>0.53, 1.60</td>
</tr>
<tr>
<td>12 months</td>
<td>45.1</td>
<td>34.8</td>
<td>1.34</td>
<td>0.90, 2.00</td>
</tr>
<tr>
<td>18 months</td>
<td>37.3</td>
<td>38.7</td>
<td>0.96</td>
<td>0.64, 1.45</td>
</tr>
<tr>
<td>Total fat (% of calorie intake)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>10.6</td>
<td>9.3</td>
<td>1.10</td>
<td>0.54, 2.24</td>
</tr>
<tr>
<td>12 months</td>
<td>20.6</td>
<td>10.3</td>
<td><strong>2.41</strong></td>
<td><strong>1.74, 3.32</strong></td>
</tr>
<tr>
<td>18 months</td>
<td>18.2</td>
<td>12.9</td>
<td>1.72</td>
<td>0.95, 3.11</td>
</tr>
<tr>
<td>Saturated fat (% of calorie intake)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>5.3</td>
<td>5.4</td>
<td>0.98</td>
<td>0.41, 2.33</td>
</tr>
<tr>
<td>12 months</td>
<td>23.4</td>
<td>14.8</td>
<td><strong>1.79</strong></td>
<td><strong>0.85, 3.78</strong></td>
</tr>
<tr>
<td>18 months</td>
<td>18.2</td>
<td>10.4</td>
<td>2.34</td>
<td>0.86, 6.35</td>
</tr>
<tr>
<td>Fiber (≥30 g/day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>17.3</td>
<td>11.8</td>
<td>1.51</td>
<td>0.71, 3.25</td>
</tr>
<tr>
<td>12 months</td>
<td>21.7</td>
<td>9.4</td>
<td><strong>3.41</strong></td>
<td><strong>1.68, 6.94</strong></td>
</tr>
<tr>
<td>18 months</td>
<td>21.8</td>
<td>10.4</td>
<td><strong>2.92</strong></td>
<td><strong>1.90, 4.51</strong></td>
</tr>
<tr>
<td>Vegetable (≥5 servings/day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>16.7</td>
<td>16.7</td>
<td>1.02</td>
<td>0.40, 2.59</td>
</tr>
<tr>
<td>12 months</td>
<td>42.3</td>
<td>20.1</td>
<td><strong>2.35</strong></td>
<td><strong>1.43, 3.88</strong></td>
</tr>
<tr>
<td>18 months</td>
<td>32.4</td>
<td>17.6</td>
<td><strong>2.37</strong></td>
<td><strong>1.48, 3.80</strong></td>
</tr>
<tr>
<td>Fruit (≥2 servings/day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>49.6</td>
<td>45.6</td>
<td>1.18</td>
<td>0.78, 1.79</td>
</tr>
<tr>
<td>12 months</td>
<td>79.4</td>
<td>26.9</td>
<td><strong>1.99</strong></td>
<td><strong>1.33, 2.99</strong></td>
</tr>
<tr>
<td>18 months</td>
<td>72.0</td>
<td>59.3</td>
<td>1.65</td>
<td>0.94, 2.91</td>
</tr>
</tbody>
</table>

* a Adjusted for baseline values, corrected for clustering by random effects for practice and subject, baseline values carried forward for participants with missing data. b Due to invalid food frequency questionnaire data, n = 223 (TC) and n = 201 (UC).

### Table 4

Maintenance of Physical Activity and Diet Changes* From Baseline in the Telephone Counseling (TC) and Usual Care (UC) Groups

<table>
<thead>
<tr>
<th>Guideline</th>
<th>TC (n = 168)b</th>
<th>p</th>
<th>UC (n = 147)b</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate-to-vigorous physical activity (minutes/week)</td>
<td><strong>−11.89 (−56.17, 32.39)</strong></td>
<td>0.5976</td>
<td><strong>−3.49 (−50.99, 44.00)</strong></td>
<td>0.8850</td>
</tr>
<tr>
<td>Moderate-to-vigorous physical activity (sessions/week)</td>
<td><strong>−0.49 (−1.47, 0.49)</strong></td>
<td>0.3229</td>
<td><strong>−0.08 (−1.13, 0.97)</strong></td>
<td>0.8786</td>
</tr>
<tr>
<td>Total fat intake (% of calorie intake)</td>
<td><strong>−0.78 (−1.45, −0.10)</strong></td>
<td>0.0241</td>
<td><strong>−0.68 (−1.41, 0.04)</strong></td>
<td>0.0649</td>
</tr>
<tr>
<td>Saturated fat intake (% of calorie intake)</td>
<td><strong>−0.07 (−0.44, 0.31)</strong></td>
<td>0.7272</td>
<td><strong>−0.18 (−0.58, 0.22)</strong></td>
<td>0.3851</td>
</tr>
<tr>
<td>Fiber (grams per day)</td>
<td><strong>−0.39 (−1.49, −0.71)</strong></td>
<td>0.4909</td>
<td><strong>−0.26 (−1.44, 0.92)</strong></td>
<td>0.6598</td>
</tr>
<tr>
<td>Vegetable (servings per day)</td>
<td><strong>−0.34 (−0.62, −0.06)</strong></td>
<td>0.0177</td>
<td><strong>−0.16 (−0.46, 0.14)</strong></td>
<td>0.3052</td>
</tr>
<tr>
<td>Fruit (servings per day)</td>
<td><strong>−0.02 (−0.16, 0.13)</strong></td>
<td>0.8154</td>
<td><strong>0.11 (−0.04, 0.27)</strong></td>
<td>0.1600</td>
</tr>
</tbody>
</table>

*a Data are given as mean (95% confidence interval) of difference in least squared means, adjusted for baseline levels as covariates and corrected for clustering by random effects (subject and practice). b Analysis is restricted to participants who provided follow-up data at the maintenance period; difference (Δ18m−Δ12m) (95% CI). *Due to invalid food frequency questionnaire data, n = 166 (TC), and n = 145 (UC).
sustained behavior change following a 6-month period of no intervention contact. Even under conservative intention-to-treat assumptions, the program had significant intervention effects for all diet outcomes (intake of total fat, saturated fat, fiber, fruit and vegetables), and with one exception (vegetable intake), these were still present after a 6-month period of no contact. Furthermore only vegetable intake declined significantly over the noncontact period (within the TC group); all other outcomes were unchanged or improved. Because the intervention did not result in substantial or significant between-groups intervention effects for physical activity, we cannot establish that the program produced behavioral changes that were sustained in the long term. However, some supporting evidence can be gleaned from the fact that the clinically meaningful change in the TC group remained at 18 months and there was no significant decay in physical activity over the noncontact period. Looking at the proportions meeting national health behavior guidelines highlights the potential population health impact of these maintenance outcomes. Adherence to guidelines tended to increase over the course of the intervention with the TC group remaining more likely than the UC group to meet guidelines 6 months after intervention completion, significantly so for some health behaviors (fiber and vegetable intake).

The best evidence to date of the potential for a primarily telephone-delivered intervention to produce maintenance of initial physical activity improvements comes from a recent primary care-based physical activity intervention involving two nurse-led counseling sessions and monthly telephone calls over 9 months delivered to 1089 women (Lawton et al., 2008). In this large study, there were significant within- and between-groups improvements in the proportion meeting physical activity guidelines at 12 months (3 months after the end of a 9-month intervention; intervention vs. usual care: 43% vs. 30%), which were still statistically significant at 24-months follow-up, although the intervention group had declined somewhat (39% vs. 33%). Also of note from this study are the large and sustained improvements observed in the usual care group which were present in our study and other recent trials (e.g., van Sluijs, van Poppel, Twisk, & van Mechelen, 2006), which warrant further investigation as their cause is not well understood.

Recently completed and ongoing trials provide some guidance on what might be important to achieving sustained behavioral changes. Influenced in part by the very large literature on the maintenance of weight loss (Curioni & Lourenco, 2005; Franz et al., 2007; Goldberg & King, 2007; Hollis et al., 2008), there appears to be a trend in the chronic disease prevention and management intervention literature toward longer-term (multiyear) interventions. The WHEL study, which evaluated a 4-year telephone counseling dietary intervention targeting women at risk for breast cancer recurrence is one such example (Pierce et al., 2002). Other exemplars, involving two to four interventions and emphasizing face-to-face individual and group-based counseling, with the telephone used to provide maintenance follow-ups, include the Activity Counseling Trial, (The Writing Group for the Activity Counseling Trial Research Group, 2001) the Diabetes Prevention Program (Diabetes Prevention Program Research, 2002) and the Look AHEAD trial (Ryan et al., 2003). While true maintenance outcomes following an extended period of no intervention contact have yet to be reported from these landmark trials, findings to date suggest that some degree of ongoing intervention contact is likely to be necessary to produce long-term maintenance (Burke, Man- sour, Beilin, & Mori, 2008), and this is a key strength of the telephone delivery modality.

Further research is also needed to better understand the theoretical mechanisms by which maintenance is achieved and intervention attributes that promote maintenance, as these may be different to those relevant to initiation of behavior change (Abraham & Michie, 2008; Rothman, 2004; Rothman, Sheeran, & Wood, 2009; Williams et al., 2008). Our present and previous findings from the Logan Healthy Living program point to the importance of intervention dose, particularly dose of intervention components targeting maintenance (Goode et al., in press), however more work is needed, particularly on underlying theoretical mechanisms.

Strengths of our study include the assessment of maintenance following a 6-month period of no intervention contact, high retention rates and the targeting of a challenging patient sample with multiple comorbid chronic conditions recruited from a socioeconomically disadvantaged community. Notably, the sample was not screened based on baseline levels of the six targeted health behaviors: different end-of-intervention effects and maintenance effects may have occurred with a screened group. The intervention was intensive, and while this may raise feasibility concerns, the program was shown to be cost-effective (Graves et al., 2009), despite its intensiveness and inclusive target population. Limitations include lack of a longer-term (i.e., 12 months or more) follow-up post intervention completion and the use of self-report measures of health behavior change. Underreporting of dietary fat intake (Heitmann & Lissner, 2005) and overreporting of physical activity may have occurred (Sallis & Saelens, 2000). In addition, low responsiveness could explain the lack of between-groups effects on physical activity at end-of intervention as well as 6 months later (Reeves, Marshall, Winkler, Owen, & Eakin, in press), as could the control group change [which might be genuine, e.g., due to repeated assessment (van Sluijs, van Poppel, Twisk, & van Mechelen, 2006), or a methodological artifact]. The use of objective measures of physical activity (e.g., accelerometers) and biomarkers of dietary change, along with longer-term follow-ups will be important goals for future studies.

Our trial showed dietary behaviors, in particular, intakes of total and saturated fat, fiber and fruit can be successfully improved by a telephone-delivered intervention in such a way that these changes are maintained for at least 6 months after intervention ceases. However, findings were inconclusive for physical activity. Findings from the maintenance follow-up of our own trial, along with a growing literature on telephone-delivered physical activity and diet interventions, suggest that telephone-delivered interventions are effective and cost-effective (Graves et al., 2009) for promoting both initiation and maintenance of health behavior change. This appears to be the case when the telephone is used as the sole or predominant mode of intervention delivery, and may also be true when the telephone is used specifically to promote maintenance following a more intensive mode of intervention delivery (Castro, King, & Brassington, 2001; Martinson et al., 2008), although more research is needed regarding the latter. It has been argued that telephone-delivered health behavior interventions hold particular promise because they provide a means of efficiently and cost-effectively delivering the ongoing support that is needed to effect behavioral maintenance (Eakin et al., 2007; King et al., 2007; McBride & Rimer, 1999; Orleans, 2000) but only a limited number of studies have demonstrated telephone-delivered...
interventions to be cost-effective (Elley, Kerse, Arroll, & Robinson, 2003; Emmons et al., 2005; Gordon, Graves, Hawkes, & Eakin, 2007), and this will be an important objective of future trials.

References


health behavior and health service delivery. Patient Education and Counseling, 37, 3–18.


Rothman, A. J. (2000). Is there something more practical than a good theory?: Why innovations and advances in health behavior change will arise if interventions are used to test and refine theory. International Journal of Behavioral Nutrition and Physical Activity, 11, 1.


