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Effects of tailored, personalized and general health messages on physical activity

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Abstract

Physical inactivity is a major public health problem. Patient education programs and materials that are customized to address the unique needs and concerns of specific patients have shown promise in changing a range of health related behavior, although findings to date for physical activity have been equivocal. In this study a randomized controlled trial was conducted among 272 adult primary care patients to compare the effectiveness of tailored, personalized and general health messages, and usual medical care in promoting leisure time physical activity (LTA) and physical activities of daily living (PADLs). Patients in the tailored group were more likely to increase PADLs than were patients in the personalized, general and control groups (65% vs. 46% vs. 56% vs. 54%) and less likely to being doing fewer PADLs at follow-up (18% vs. 38% vs. 38% vs. 38%; $\chi^2 = 12.2$, df = 6, $p = 0.056$). There were no significant differences for LTAs. To help maximize the effectiveness of future tailored interventions on physical activity, studies should seek to identify the social, psychological and environmental variables that are most important to include in tailored materials.

Keywords: Physical activity; Exercise; Computers; Health promotion; Tailoring

1. Introduction

Physical inactivity is a major public health problem. In most developed countries fewer than half the adult population engage in 30 min of moderate intensity activity on most days of the week, and about 25% report doing no exercise at all [1–4]. Rates of inactivity appear to be even higher among certain population sub-groups such as older adults, women, minority groups and the physically disabled [1,5–9]. Increasing physical activity can have important health benefits, including helping to manage or prevent a variety of chronic diseases [10–16].

Interventions aimed at increasing physical activity have been undertaken in schools, worksites, communities and in clinical settings [17–30]. Although

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some studies have shown improvements, changes are often short lived and programs frequently suffer high rates of drop out [31,32]. Many interventions have included participation in formal exercise classes or group programs and encouraged participants to reach an exercise goal of ''3 times per week for 20 min at 60–75% of VO_2 max.'' More recently, however, the benefits of physical activities of moderate intensity have been recognized as has the need to help inactive adults to do at least some physical activity [1,16,33]. The US Surgeon General's Report on Physical Activity and Health recommends all American adults engage in at least ''30 min of moderate intensity physical activity on most days of the week'' [1]. This message has now been adopted as the focus of several national and state public health campaigns aimed at increasing participation in physical activity in the United Kingdom, Australia and the USA [12,34–38]. However, as yet little is known about the efficacy of interventions designed to promote adherence to the new Surgeon General's guidelines on physical activity.

Patient education programs and materials that are customized to address the unique needs and concerns of specific patients have shown promise in changing a range of health related behaviors [29,39–44]. The elaboration likelihood model [45] suggests people are more likely to thoughtfully process information when they perceive it to be personally relevant. Thus, tailored materials which address an individual's specific problems and concerns should be more likely to stimulate change than untailored materials. Indeed, studies have found that compared to untailored materials, tailored messages are more likely to be read and remembered [40,41,43], saved [43], discussed with others [43], and be perceived by readers as interesting [40,43], personally relevant [43,46], and having been written especially for them [43].

The application of computer technology to the development of individually tailored patient education materials for exercise has been limited. In a few studies [22,47–49], principles from the Transtheoretical model of behavior change [50] have been applied in matching intervention materials to participants' stage of readiness to engage in physical activity [51]. Although such studies represent the earliest attempts to ''tailor'' physical activity interventions to individual needs, the full potential of automated computer-based programs to tailor on a wide range of social and psychological variables was not realized. The data-driven and highly individualized messages generated by tailoring programs can provide much more specific information than pre-printed materials matched to specific stages, or mass-produced pamphlets and brochures designed for the general population. Because a vast array of tailored messages can be quickly and easily generated by computer, this approach holds the promise of providing individualized guidance on a population basis [44].

To date only two randomized studies have been conducted using this more comprehensive, robust and computer approach to customizing printed materials for physical activity [29,52]. In the first study, tailored messages were added to health risk appraisal (HRA) feedback and their effectiveness evaluated relative to HRA feedback alone, and to a usual medical care control group in a population of adult primary care patients. Messages were tailored based on patients' stage of readiness, perceived barriers to exercise, motives for exercising, self efficacy for exercise, and beliefs about the health benefits of exercise [29]. Among 111 patients who reported engaging in no aerobic-type physical activity at baseline, those who received the tailored materials and HRA feedback appeared to be more likely to report exercising three days per week, 20 min a day at follow-up compared to patients who received HRA feedback only or no feedback (25% vs. 14% vs. 15%; OR = 1.34, 95% C.I. = 0.94, 1.97) [29].

In the second study, 763 sedentary adults from 10 family medical practices in Perth, Western Australia were randomly assigned to receive a tailored pamphlet on physical activity, a standard pamphlet, or no pamphlet (usual care control group) [52]. Tailored pamphlets were composed of pictures and messages based on patients' age, sex, stage of readiness, perceived barriers to exercise, preferred type of exercise and the main health benefit they can gain from exercise as identified by their doctor. At follow-up at one, six and 12 months patients receiving either a tailored or standard pamphlet were more likely than control patients to report engaging in some physical activity (61% vs. 55% vs. 43% at one month; 62% vs. 62% vs. 50% at six months; 63% vs.

62% vs. 53% at 12 months), although tailored pamphlets were no more likely to promote these changes than standard pamphlets [52].

Given these equivocal findings as well as new national guidelines for physical activity, more information is needed to determine the effectiveness and appropriateness of using tailored interventions to promote physical activity. The present study sought to evaluate the effects of a tailored intervention based on goal-setting and exercise preferences on leisure time physical activities (LTAs) and physical activities of daily living (PADLs). We conducted a randomized controlled trial among 882 adult primary care patients to compare the effectiveness of tailored, personalized and general health messages, and usual medical care on physical activity in a multi-focus cardiovascular risk reduction program (Change of Heart) in southeastern Missouri, USA.

2. Methods

2.1. Study design

The study used a four-group randomized controlled design with pre- and post-intervention measures to determine the relative effectiveness of three minimal contact interventions and usual medical care in promoting physical activity. After completing a baseline questionnaire in their physicians' offices, patients were randomly assigned to receive materials that were either; tailored and personalized (TAP), general and personalized (GAP), general and not personalized (GNP), or to a usual care control group receiving no educational materials. For members of the TAP, GAP and GNP groups, educational materials were mailed to their homes within three days of completing the baseline questionnaire. Follow-up surveys were mailed to patients at their homes three months after the baseline assessment was completed.

2.2. Study population

Participants were 882 adult patients (ages 18 and older) from four community-based family medicine clinics in southeastern Missouri, USA. This region was selected because it has the highest rates of cardiovascular disease in the state and lower than average rates of preventive counseling by physicians [53]; the four clinics were selected based on their comparatively high patient volume for the region. Patients enrolled in the study by completing a self-administered questionnaire in the waiting area of their doctor's office. Survey items collected baseline data on level of physical activity, dietary habits and smoking status (see Section 2.3). These data were used to identify patients' eligibility to receive health information on physical activity, dietary fat consumption, reading of nutrition labels and smoking cessation. Patients who met the following criteria received educational materials on physical activity: (1) be in the contemplation or preparation stage of change for increasing their level of physical activity; (2) had set a physical activity goal; and, (3) have no contraindications to exercise as measured by the physical activity readiness questionnaire (PAR-Q) [54]. Two hundred and seventy two patients met these criteria. Of the 610 patients who were not eligible to receive feedback on physical activity, three quarters had responded positively to at least one of the seven PAR-Q items which indicated the presence of a contraindication to exercise. The remaining patients were ineligible due to their stage of readiness (those in precontemplation or action stage were excluded) or because they did not respond to the goal setting item in the questionnaire ($n = 6$).

2.3. Baseline measures

Baseline questionnaires were distributed and collected by members of each medical office staff, who were paid at the end of the study US$1 for each completed questionnaire. Baseline data were collected during March, 1996, with data collection periods ranging from eight to 12 days by practice. The survey included a multi-item assessment of physical activity as well as questions about cigarette smoking, dietary fat and fiber consumption, and nutrition label reading. Level of physical activity was assessed at baseline and at follow-up by asking patients to report the number of days per week they had participated for ''at least 30 min per day'' in eight different categories of physical activity. Each category included examples of up to seven specific activities that would fall into that category. Re-

sponses to the categories of ''sports'', ''strengthening exercises'', ''dancing'' and ''aerobic-type exercise'' were summed to calculate a total score on leisure time physical activity (LTAs). A total score for PADLs (physical activities of daily living) was created by summing across the categories of ''child care'', ''work in the home'', ''home repair'' and ''yard work''. Scores on all eight responses were summed to form a total score for level of physical activity. The unit ''number of days'' is used as a proxy measure for ''number of sessions'' of 30 min of physical activity.

Patients were classified into one of four stages of readiness to be physical active (precontemplation, contemplation, preparation, action/maintenance) according to their response to one item containing four statements modified from previous research [51]. Those who were ''seriously thinking about increasing their level of physical activity'' in the next six months (contemplators) or next 30 days (preparers) were asked to set a three-month physical activity goal by specifying the number of days per week they would like to get regular physical activity for at least 30 min a day. In addition, patients were asked to identify any barriers that might prevent them from reaching their goal (response options included: lack of time, bad weather, cost of exercise equipment, lack of support and/or no one to exercise with), and the main reason they wanted to reach the goal (response options included: control weight, improve health, reduce stress, or look and feel better). Finally, patients were asked to choose from the eight categories of physical activities previously noted, the *one* type of physical activity they would most prefer to do in order to achieve this goal. Self-reported weight and height were used to calculated body mass index (BMI). Patients were classified as ''overweight'' if their BMI was greater than 27.8 (males) or 27.3 (females) [55].

2.4. Follow-up measures and attrition

Follow-up questionnaires were mailed to patients' homes three months after baseline data collection. After two weeks, non-respondents were sent a second follow-up questionnaire in the mail. Patients who did not respond to either questionnaire were contacted by telephone and asked to complete the survey in a telephone interview with a trained research assistant.

This survey was the same as that administered at baseline except its time-based questions referred only to the study period (i.e., ''In the last 3 months...'') and questions to assess recall and rating of the intervention materials were included. Patients were asked whether they received health information in the mail and, if so, the type of information they received (quitting smoking, eating less fat, physical activity, and/or nutrition labels). Patients were asked to indicate how much of the information they had read (''I didn't read any of the information'', ''I read some of the information'', ''I read most of the information'' or ''I read all of the information'') and how well the information they received applied to them (''it did not apply to me at all'', ''it could have applied to anyone'', or ''it applied to me specifically''). Finally, patients were asked whether they kept the materials (yes/no) or shown the materials to family members or friends (yes/no).

At follow-up 203 of the 272 patients eligible to receive materials on physical activity (75%) completed the second questionnaire. Of these follow-up respondents, 66% returned a questionnaire and 34% completed a telephone interview.

2.5. Interventions

All three interventions (TAP, GAP and GNP) consisted of two pages of computer-generated printed materials. All materials were printed on identical letter size paper with the project name (''Change of Heart'') and logo in color at the top of the page. Materials included text and graphics in a three column format. Tailored materials (TAP) were based on patients' responses to questions assessing their stage of readiness to change, exercise goal, motives for and perceived barriers to reaching the goal and preferred type of physical activity. Content for standard materials (GAP, GNP) was copied verbatim from an American Heart Association brochure on exercise [56]. This brochure addressed the health and psychological benefits of exercise, the factors to consider in choosing a type of physical activity, compared the benefits and risks of exercise, and provided a checklist for getting started and a 13-week walking program to follow. Both GAP and

GNP intervention materials were identical except that GAP letters also carried the name of the patient at the top of the first page (i.e., personalization). All patients, including those assigned to the control group, received a letter thanking them for participating in the project. Table 1 summarizes the content and characteristics of each type of feedback.

2.6. Statistical analyses

The primary outcome of interest in the study was change in level of physical activity. One-way ANOVA with repeated measures were undertaken to assess between group differences over time in total exercise, LTAs, PADLs and patients' preferred type of exercise as stated in the baseline questionnaire. In addition to looking for differences in the magnitude of change between the four groups, we computed the proportion of patients who had increased, decreased or made no change in their level of physical activity at follow-up. Patients were categorized as ''doing more'', ''doing less'' or ''doing the same'' amount of physical activity at follow-up by subtracting the number of sessions of activity at baseline from the number at follow-up. Differences between experimental groups were analyzed using the Chi square test. Secondary pair-wise comparisons were undertaken using an alpha level adjusted for multiple comparisons. The Chi-square test was also used to look for any differences between TAP, GAP, GNP and control subjects on the intermediary variables of recall and rating of the intervention materials.

Logistic regression was used to compare differences between patients who were eligible to receive TAP, GAP, GNP or the control group ($n = 272$) with those not eligible to receive information on exercise ($n = 610$). Similarly, logistic regression was used to compare patients who returned a questionnaire at follow-up ($n = 203$) with those who did not ($n = 69$).

3. Results

3.1. Patient characteristics

Eight hundred and eighty two adult patients were recruited to the overall study to receive patient education on either physical activity, diet and/or smoking cessation. Almost three quarters of these patients were female (74%), a mean age of 49 years (S.D. 16.4 years), 96% were white, 73% had completed 12 or more years of school, and 46% were classified as overweight. Patients were randomly allocated to one of four study groups and there were no significant differences between study groups on age, sex and BMI (data not shown).

Two hundred and seventy two patients met the eligibility criteria for receiving information on in-

Table 1
Content and characteristics of intervention materials

Intervention content and characteristics	TAP tailored and personalized	GAP general and personalized	GNP general not personalized	Control usual primary care
Sent thank you letter for participating in project	Yes	Yes	Yes	Yes
Sent computer-generated educational print materials	Yes	Yes	Yes	No
Educational materials addressed:				
Benefits of physical activity	Yes	Yes	Yes	–
Ways to begin and maintain physical activity	Yes	Yes	Yes	–
Following a three-month physical activity plan	Yes	Yes	Yes	–
Motives for increasing physical activity	Yes	Yes	Yes	–
Barriers to physical activity	Yes	Yes	Yes	–
The patient by name (i.e., personalized)	Yes	Yes	No	–
Caloric expenditure of preferred physical activity	Yes	No	No	–
Specific physical activity goal set by patient	Yes	No	No	–
Types of physical activity patient preferred	Yes	No[a]	No[a]	–

[a] Because the GAP and GNP message described a walking plan, patients in these groups who indicated a preference for aerobic type activity (59%) would have received materials that addressed their preferred type of physical activity.

creasing their current level of physical activity. Compared with the 610 ineligible patients, these patients ($n = 272$) were significantly more likely to be younger (mean age 39 years vs. 53 years; $t = 13.3$, $df = 876$, $p < 0.001$) and female (83% vs. 70%; $\chi^2 = 19.6$, $df = 1$, $p < 0.001$), and they were more likely to have 12 or more years of education (89% vs. 66%; $\chi^2 = 47.3$, $df = 1$, $p < 0.001$). There was no difference between the two groups in the proportion of subjects who were classified as overweight (45% and 46%, respectively). At follow-up at three months, 203 of the 272 (75%) patients completed the second questionnaire. There was no significant difference in response across study groups nor did responders and non responders differ by age or sex. However, responders ($n = 203$) were significantly less likely to be overweight compared with the group of non-responders ($n = 69$; 41% vs. 55%; $\chi^2 = 3.9$, $df = 1$, $p < 0.05$) and less likely to have completed 12 or more years of education (86% vs. 96%; $\chi^2 = 5.4$, $df = 1$, $p < 0.02$). A breakdown of the 203 subjects by age, sex, education, BMI and baseline level of physical activity is shown in Table 2.

3.2. Recall and rating of materials

We were interested to see if there were any differences between the study groups on recall and reading of the newsletter and whether the patients' had kept or shown the newsletter to a member of their family, a friend or their primary care physician. These data are shown in Table 3. Two thirds of all subjects in the intervention groups recalled receiving the Change of Heart materials, as did one quarter of patients in the control group (in error). Among patients in TAP, GAP and GNP groups, three quarters specifically recalled receiving information about exercise, and 72% reported reading ''all'' or ''most'' of the material. Although 61% of patients

Table 2
Description of eligible patients who completed follow-up ($n = 203$)

	TAP ($n = 51$)	GAP ($n = 48$)	GNP ($n = 54$)	Control ($n = 50$)
Mean age (years)	40.6	38.7	37.3	41.8
% Female	82.4	88.0	92.6	76.0
% With 12 or more years of education	84.3	95.8	87.0	78.0
% Overweight[a]	47.9	46.8	34.6	36.7
% Insufficiently active[b]				
Total activity[c]	20.4	23.4	26.4	26.1
LTAs[d]	83.0	79.6	81.3	78.1
PADLs[e]	36.7	36.2	39.6	34.8

[a] BMI ≥ 27.3 for females and BMI ≥ 27.8 for males.
[b] Insufficiently active = less than five sessions of physical activity/week.
[c] Total activity = sum of LTAs and PADLs.
[d] LTAs = sum of sports, strengthening exercises, dancing and aerobic-type exercise.
[e] PADLs = sum of childcare, work in the home, home repair and yard work.

Table 3
Comparison of recall, reading and use of the health education materials across the four study groups ($n = 203$)

	TAP	GAP	GNP	Control	p-value
Recalled receiving newsletter, n (%)	32 (66%)	31 (66%)	33 (62%)	12 (24%)[a]	ns
Of those that recalled newsletter...n (%)					
Recalled feedback on physical activity	24 (75%)	21 (72%)	26 (81%)	na	ns
Read ''all'' or ''most''	21 (68%)	18 (72%)	25 (78%)	na	ns
Responded that materials applied specifically to them	9 (30%)	10 (25%)	12 (39%)	na	ns
Shared material with friend/family (% yes)	9 (30%)	9 (36%)	15 (47%)	na	ns
Kept newsletter (% yes)	16 (53%)	15 (60%)	22 (71%)	na	ns

[a] In error: control group did receive a thank you letter from Change in Heart project, but it did not contain health information per se.

kept the newsletter they received, only one third showed it to a member of their family or to a friend, and no-one reported showing it to their doctor. There were no group differences in the rate of keeping, reading and sharing the materials, nor were there differences in patients ratings of how much the materials ''applied specifically'' to them (TAP 30%, GAP 25%, GNP 39%).

3.3. Physical activity

Across all study groups, the mean number of sessions of LTAs, PADLs and total activity at baseline were 2.2, 7.3 and 9.4, respectively, and there were no differences between study groups. At follow-up, all study groups showed an increase in the total number of sessions of physical activity however there were no significant differences between study groups (mean change TAP = + 2.5, GAP = + 1.0, GNP = + 2.8 and control = + 1.9). Similarly, while all groups increased both in PADLs and LTAs, there were no differences between experimental groups (mean change in PADLs: TAP = + 1.9, GAP = + 0.3, GNP = + 1.7 and control = + 0.9 and mean change in LTAs: TAP = + 0.6, GAP = + 0.7, GNP = + 1.1 and control = + 0.8). At follow-up the mean number of sessions of LTAs, PADLs and total activity for all groups combined were 3.0, 8.3 and 11.3, respectively.

Number of sessions of activity at follow-up and at baseline were used to categorize patients as ''doing more'', ''doing less'' or ''doing the same'' amount of physical activity at follow-up. These data are presented in Table 4. There were no significant differences between study groups in total exercise or leisure time activities although over half of patients (54%) who received any materials were doing more LTAs (aerobics, jogging, dance or strength exercises) compared with 44% of control patients. Patients in the tailored group appeared to be more likely to increase PADLs than were patients in the personalized, general and control groups (65% vs. 46% vs. 56% vs. 54%, respectively) and less likely to report ''doing less'' at follow-up (18% vs. 38% vs. 38% vs.

Table 4
Change in level of physical activity at follow-up by type of physical activity and by study group

Change in level of activity (%)	TAP	GAP	GNP	Control	Significance
Total exercise[c]	$n = 51$	$n = 48$	$n = 54$	$n = 50$	
% Doing more at follow-up	82	79	81	72	
% No change at follow-up	6	8	4	6	
% Doing less at follow-up	12	13	15	22	ns
Sum of LTAs[d]					
% Doing more at follow-up	53	52	57	44	
% No change at follow-up	16	21	17	34	
% Doing less at follow-up	31	27	26	22	ns
Sum of PADLs[e]					
% Doing more at follow-up	65	46	56	54	
% No change at follow-up	18	17	6	8	
% Doing less at follow-up	18	38	39	38	0.056[a]
Preferred activity[f]	$n = 46$	$n = 42$	$n = 50$	$n = 43$	
% Doing more at follow-up	50	31	40	42	
% No change at follow-up	37	31	34	49	
% Doing less at follow-up	13	38	26	9	0.025[b]

[a] $\chi^2 = 12.2$, df = 6, $p = 0.056$.
[b] $\chi^2 = 7.20$, df = 6, $p = 0.025$.
[c] Total activity = sum of all eight responses.
[d] Sum of LTAs = sum of sports, strengthening exercises, dancing and aerobic-type exercise.
[e] Sum of PADLs = sum of childcare, work in the home, home repair and yard work.
[f] Preferred activity was identified on screening questionnaire and subjects in TAP received information referring to the activity.

38%; $\chi^2 = 12.2$, df = 6, $p = 0.056$). Pair-wise analysis revealed the difference lay between subjects in TAP and the control group although this was not significant with the adjusted alpha at 0.02 ($\chi^2 = 6.2$, df = 2, $p = 0.04$).

In addition to looking for changes in total physical activity and the two sub scores (LTAs and PADLs), we also looked at change in the level of the specific type of physical activity each subject had indicated at baseline as their ''preferred type of physical activity to reach their physical activity goal'' (Table 4). The results indicate a significant difference between study groups in the proportions of patients who were ''doing more'' or ''doing less'' of their preferred activity at follow-up ($\chi^2 = 14.4$, df = 6, $p = 0.025$). Almost half of the control group (49%) did not change the level of their preferred activity compared with approximately one third of subjects in the three experimental groups (37% TAP, 31% GAP and 34% GNP, respectively). Furthermore, although one third of patients in GAP and one quarter of patients in GNP were ''doing less'' of their preferred activity at follow-up this was true for significantly fewer patients (13%) who had received a tailored newsletter. Pair-wise analyses revealed the significant difference was between subjects in TAP and GAP ($\chi^2 = 7.8$, df = 2, $p = 0.02$).

4. Discussion

While computer tailored patient education materials have shown promising effects in helping individuals change health-related behaviors like cigarette smoking and diet, only equivocal evidence exists to support tailoring as an effective approach to promoting physical activity. Findings from the present study are also inconclusive. Patients who received tailored materials were more likely than those receiving standard materials to increase levels of their preferred type of physical activity and their physical activities of daily living (PADL), but no more likely to increase leisure time activity (LTA) or total physical activity.

It is possible that physical activity is less amenable to change via computer tailored interventions than are to other behaviors. However, data from this study suggest this is not necessarily the case. Where the tailored materials in this study were most different from the standard materials, such as in promoting the patients' preferred type of physical activity (which for some patients was a PADL), the greatest effects of tailoring were observed. We think these findings point out an important consideration in the development of tailored health communications, namely, the need to identify which variables are most useful and which are not. Much of the value of tailoring lies in its ability to address important determinants of behavior change in ways that are most relevant to individuals. When there is great variability among members of a population on a particular determinant of behavior change, tailoring should be especially useful. However when there is less variability within a population, the difference between tailored and standard educational materials will be minimal. For example, in the UK, USA and Australia, the majority of survey respondents cite ''lack of time'' as the leading barrier to physical activity [54,57]. This fact is well known by all who endeavor to promote physical activity, and is thus addressed in some way in most programs and materials. Consequently, tailored materials addressing barriers to physical activity may be quite similar to standard materials for many of the participants [52].

In contrast, variables like preferred type of physical activity may differ considerably from one person to the next within any large group. Conventional educational materials will find it difficult to address all the possible types of physical activity in a meaningful way, but tailored interventions are well-suited for this task. We suggest that tailoring on variables that are both important and that have variability within the target population will be more valuable in helping patients change. It may be that the tailored physical activity interventions tested to date, including the one described here, have not yet taken full advantage of the potential of tailoring. Importantly, this does not mean tailored approaches should not be used to address key determinants of change that have little population variance. Rather, it suggests that the tailoring assessments for such determinants must be more specific and detailed. For example, tailored messages addressing the common barrier ''lack of time'' should seek additional information on related issues, such as, work and home responsibilities and preferred type of exercise. When

combined, these data could be used to tailor advice not only to a specific barrier but also to a specific solution or strategy that would be most useful. Thus, advice on ''lack of time'' could be tailored to an individual's lifestyle and a traveling salesperson on the road four days a week would receive different information than a parent staying at home to care for three young children. Tailoring assessments that go beyond a basic theoretical construct to a deeper understanding of an individual's living patterns should lead to more effective tailored messages.

Although the tailored materials used in this study may have been helpful to patients in increasing some types of activity, the materials were no more likely to be recognized by patients as individualized. Unlike in some previous tailoring research [40,41,43], there were no differences between the three intervention groups on rates of recall or reading the tailored messages, nor were there statistically significant differences between groups in the proportion of patients that thought the materials ''applied to them specifically'' as opposed to ''could have applied to anyone'' or ''didn't apply to me at all.'' This lack of differentiation between the interventions is consistent with the explanation that messages tailored on factors which have little variation may look quite similar to standard messages.

As expected when recruiting patients from primary health care settings, participants were middle aged (mean = 50 years) and more likely to be women. In this sample, just under half of patients were overweight and 26% reported being told by their doctor that they high blood pressure. Unfortunately, use of the PAR-Q screening assessment with this patient population led to widespread exclusion from eligibility to receive the intervention on physical activity. In fact 70% of the 882 patients were found to have contraindications to physical activity based on their answers to the PAR-Q. Clearly it is possible that some of the ineligible patients may have benefited from such advice, particularly information on the new recommendation of 30 min of moderate intensity physical activities. However, while this represents a considerable loss in intervention sample size, there was no other mechanism for determining individuals health status and therefore the appropriateness of information aimed at increasing their participation in physical activity. Thus, the best available self-completed screening questionnaire was used to recruit an adult population free from contraindications to exercise within the constraints of the project design.

The increase in physical activity seen across all groups is not surprising given level of motivation at baseline and the seasonal transition from late winter to spring during the study period. The magnitude of this naturally-occurring variation in physical activity appears to be greater than that attributable to the tailored intervention. However, this is not necessarily surprising given the nature of the intervention, namely, a single, minimal contact, set of printed materials. While this study is among the first to test an intervention promoting the kinds of physical activities of daily living recommended in the recent report from the US Surgeon General [1], it had to do so without the benefit of a ''gold-standard,'' or other well-established measure of such activity. The measure used in this study grouped activities into eight categories including four physical activities of daily living (child care, work in the home, home repair and yard work) and four types of leisure-time activities (sports, dancing, strengthening and aerobic exercise). Sample activities within each category were included if they required at least a moderate level of energy expenditure. Our measure did not, however, assess all forms of leisure time activity or activities of daily living, nor did it assess other forms of activity such as those occurring in an occupational setting. Because psychometric properties of the measure have not yet been established, we cannot be certain of its reliability or validity as a measure of physical activity.

Physical inactivity remains an important public health problem, and promoting more active lifestyles has become a high priority internationally [58]. The US, like many countries has set targets for the reduction in the proportion of adults and children who do no physical activity [55]. However, the findings of several recent reviews of interventions on physical activity in schools, worksites and the community showed that we have not yet found effective strategies to increase both the adoption and maintenance of an active lifestyle [59–61]. The present study provides some evidence that tailored messages could play an important role in future efforts. Although the studies testing tailored materials on

physical activity have, to date, failed to show the magnitude and consistency of effects found for interventions addressing other health-related behaviors, we believe that the application of tailoring principles still holds promise. Future studies should seek to identify the social, psychological and environmental variables that are most important to include in tailored materials and these need to be tested in large, well controlled studies across a variety of settings and with different target populations.

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