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# Stage-Based Lifestyle Interventions in Primary Care Are They Effective?

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**Background:** To systematically review the literature concerning the effect of stages-of-change–based interventions in primary care on smoking, physical activity, and dietary behavior.

**Methods:** An extensive search (until July 2002) was performed using the following inclusion criteria: (1) (randomized) controlled trial (RCT/CT), (2) intervention initiated in primary care, (3) and intervention aimed at changing smoking, physical activity, or dietary behavior, and stages-of-change-based outcomes, and (4) behavioral outcomes. Methodologic quality was assessed, and conclusions on the effectiveness at short-, medium-, and long-term follow-up were based on a rating system of five levels of evidence. Odds ratios were calculated when methodologically appropriate.

**Results:** A total of 29 trials were selected for inclusion. Thirteen studies included a physical activity intervention, 14 aimed at smoking cessation, and five included a dietary intervention. Overall methodologic quality was good. No evidence was found for an effect on stages of change and actual levels of physical activity. Based on the strength of the evidence, limited to no evidence was found for an effect on stages of change for smoking and smoking quit rates. Odds ratios for quitting smoking showed a positive trend. Strong evidence was found for an effect on fat intake at short- and long-term follow-up. Limited evidence was found for an effect on stages of change for fat intake at short-term follow-up.

**Conclusions:** The scientific evidence for the effect of stages-of-change–based lifestyle interventions in primary care is limited. Limiting aspects in the stages-of-change concept with respect to complex behaviors as physical activity and dietary behavior are discussed.

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## Introduction

Smoking, unhealthy diet, and physical inactivity are now considered classic risk factors in the development of various chronic diseases.<sup>1,2</sup> This knowledge, however, does not seem to have an overwhelming effect on the prevalence of these risk factors. Finding ways to stimulate positive changes in these lifestyle behaviors is one of the major challenges of behavioral medicine.<sup>3</sup> In the last decades, theory-based lifestyle interventions have been developed and evaluated throughout the world. After the first description in 1983,<sup>4</sup> the transtheoretical model (TTM, or stages-of-change model) was adopted as an appropriate and possibly effective basis for lifestyle interventions.<sup>5</sup> The TTM describes the stages a person goes through in changing his or her behavior. The TTM identifies five

stages of change; precontemplation (not intending to change), contemplation (intending to change within 6 months), preparation (intending to change within 1 month and already making small changes), action (changed for a short period of time), and maintenance (changed for 6 months or longer). The TTM can be applied to a number of health behaviors (e.g., smoking, physical activity, and drug intake), and TTM-based interventions are tailored to a person's current stage of change, constructing an individually suitable advice.

Lifestyle interventions in primary care settings, in addition to, for example, mass media campaigns and community interventions, have become more popular in recent years. Primary care physicians have the benefit of seeing their patients frequently and knowing them for several years. Furthermore, the content of the consultation with the primary care physician can often be related to a lifestyle behavior, which makes primary care physicians ideal counselors on changes in lifestyle.<sup>6,7</sup> Although several barriers have to be overcome,<sup>8,9</sup> the individual character of the setting, the health problems discussed during a consultation, and the knowledge and status of the physician may have an additional effect on the lifestyle advice given.

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**Table 1.** Criteria list for the methodologic quality assessment of (randomized) controlled trials on the effectiveness of stage-based lifestyle interventions in primary care

Item	Description
A	<b>Randomization:</b> Is randomization described and adequately performed? Positive if a random assignment to the research groups was performed and had been described explicitly.
B	<b>Control condition:</b> Is there an adequate control condition? Positive if the control group is from the same setting as the experimental group and (1) an alternative treatment was given, (2) if there was a comparable condition that controlled for a part of the intervention, (3) if usual care was given, or (4) if nothing was done.
C	<b>Research groups comparable at commencement:</b> Positive if the comparability of the research groups was statistically tested before the start of the intervention and the tests showed that the experimental group and control group did not differ with respect to age and at least one of the relevant outcome measures. In case the groups did differ, positive if this difference was corrected for in the analysis.
D	<b>Dropout described and acceptable:</b> Positive if (selective) dropout was described and when dropout was <20% at short-term follow-up (6 months or less) and <30% at long-term follow-up (longer than 6 months).
E	<b>Was the person conducting the measurements blind for group assignment (or was an attempt made at blindness?):</b> Positive if the measurements were conducted by a person blind for group assignment or if data collection was done with questionnaires that the respondent could fill out in a situation not influenced by the researcher.
F	<b>Respondent blind for group assignment:</b> Positive if the respondent had (or could have had) no knowledge on the results of the group assignment.
G	<b>Timing of measurements is comparable for the different research groups:</b> Positive if the measurements were conducted at comparable moments for both the control group and the experimental group.
H	<b>Is the length of the follow-up described and acceptable?</b> Positive if a follow-up of 6 months or longer was described.
I	<b>Intention to treat—analysis:</b> Positive if all initially included and group-assigned participants are mentioned and analyzed in the original groups.
J	<b>Control for potential confounders:</b> Positive if the analysis controlled for potential confounders.

TTM-based lifestyle interventions in primary care have been described frequently in the last decade. This systematic review of the literature aims to assess the effectiveness of these specific interventions on dietary behavior, smoking, and physical activity.

## Methods

### Literature Search

A search of three electronic databases (MEDLINE, Psychlit/Psychinfo, and EMBASE) was conducted from the year of their inception up to July 2002. Using the terms appropriate to each database, the search strategy concentrated on four elements, namely (1) primary care medicine (e.g., “general practice”, “primary care”); (2) the specific nature of the experimental intervention (e.g., “stages of change”, “trans-theoretical model”, “behavioral change”); (3) the three lifestyle behaviors (e.g., “smoking”, “tobacco”, “physical activity”, “exercise”, “nutrition”, “diet”); and (4) research design (e.g., “controlled trial”). These terms were used as Medical Subject Headings (MeSH) and as free-text words. They were truncated, and additional terms were used where appropriate. Additionally, references for published reviews on the topic of lifestyle interventions in primary care were checked, and the references of the articles retrieved were checked as well.

This review was restricted to published trials that investigated the effectiveness of lifestyle advice initiated from primary care and that was based on the stages-of-change con-

struct. Every medical setting providing directly accessible health care to the general population (including first-contact care and continuity of care over time) was defined as primary care. The advice did not have to be verbal but could have been computerized or given as written material. Studies were included if it could be established that a comparison was made between an intervention group, which received a TTM-based behavioral intervention, and a no-intervention or usual-care group. Studies were excluded when the intervention involved additional aids, for example, nicotine gum or free tickets for sporting facilities. The intervention had to concentrate on at least one of the chosen three lifestyle behaviors (smoking, nutrition, and physical activity) and should have been given to an adult population (older than 18 years). Furthermore, effect on behavioral outcome measures had to be available on at least one follow-up measurement. The selection was not restricted to language.

Two independent reviewers (MP, ES) reviewed the initial selection and selected articles for inclusion. In cases where the reviewers' opinions were initially different, consensus was reached. The first author of an article was contacted when the information given in the article was not sufficient for the selection.

### Methodologic Quality

The methodologic quality of the included studies was assessed using a quality assessment scale, developed by combining previously used scales (Table 1).<sup>10,11</sup> Methodologic quality was assessed in four dimensions: quality of the study design

(A and B); research population (C and D); quality of the measurements (E, F, G, and H); and quality of the analysis (I and J). Possible score on each item was + (positive), – (negative), or ? (not, or insufficiently described), which could lead to a perfect score of 10 (9 for CTs). Only the positive scores were accumulated for the final score. Two independent reviewers (MP, ES) assessed the quality of the included studies. In case of disagreement, consensus was reached by discussion. The methodologic quality of a study was defined as high when a score of six or more was attained.

## Strength of the Evidence

Two methods for assessing the effectiveness of the interventions were used, namely a best-evidence synthesis and odds ratios (ORs). A rating system of levels of evidence, based on previously used best-evidence syntheses,<sup>11–13</sup> was used to determine the effectiveness on the main behavioral outcome measure and on stages of change. The following four levels were defined:

- **Strong evidence:** multiple RCTs of high quality with consistent positive results;
- **Moderate evidence:** one RCT of high quality and one or more relevant low-quality RCTs or high-quality CTs; consistent positive outcomes of the studies was needed;
- **Limited evidence:** only one RCT of high quality or multiple low-quality RCTs, and CTs of high or low quality; consistent positive outcomes of the studies was needed; and
- **No evidence:** only one low-quality RCT or one CT (high or low quality), or no relevant studies, or negative or contradictory outcomes of the studies.

To determine the level of evidence for a given outcome measure, two independent reviewers (ES, MP) scored whether the outcome was either positive (a significant difference ( $p < 0.05$ ) in favor of the intervention on a relevant outcome measure) or negative (a nonsignificant difference or a significant difference in favor of the control condition). In case of disagreement, consensus was reached by discussion. Overall results were considered consistent if at least 75% of the studies involved reported positive results.

Where methodologically appropriate, ORs were calculated for the main behavioral outcome measure (not stages of change). ORs were calculated to compare the odds of the intervention group positively changing behavior at follow-up with those of the control group. The 95% confidence intervals (CI) were calculated using the formula, anti-log ( $\log_e \text{OR} \pm 1.96 \text{ SE}$ ), with the following standard error (SE) = square root of  $(1/a + 1/b + 1/c + 1/d)$ , for a standard two by two table. When available, intention-to-treat numbers were used in the calculations.

With both methods, effects at short-term follow-up (less than 6 months), medium-term follow-up (6 months), and long-term follow-up (longer than 6 months) were assessed.

## Data Extraction

Data extraction was performed on four occasions during the review process. To assess the methodologic quality, two independent reviewers (MP, ES) extracted data on the randomization procedure, baseline characteristics, loss to follow-up, blinding, timing of the measurements, length of follow-up,

and on the statistical analyses. Second, the two independent reviewers extracted data on the effectiveness to assess the levels of evidence. Third, the number of included patients and the number of patients positively changing their behavior were extracted to calculate the ORs. Fourth, data on the number and mean age of the included participants, main inclusion criteria, the effect of the intervention on both behavior and on stage of change, and details about the specific intervention were extracted for the description of the studies.

## Results

Approximately 300 potentially relevant references were located during the initial search. Eighty-three articles were selected as still potentially relevant after the preliminary selection, and retrieved in full text. The most common missing information in the title and abstract were the nature of the intervention (i.e., whether or not based on TTM) and the setting of the intervention. Reference checking revealed another 101 potentially relevant publications, of which 30 were retrieved in full text. Definite inclusion in the review followed after agreement about the inclusion criteria. A total of 29 trials (21 RCTs and 8 CTs), described in 33 published articles, was selected for inclusion in this review after this last selection.<sup>14–46</sup>

Most of the selected studies described interventions aimed at the promotion of one lifestyle behavior. However, two studies described multiple interventions.<sup>31,41,42</sup> Including these, a total of 13 studies was found aimed at the promotion of physical activity,<sup>15,18,19,25,27–30,32,36–38,40–42</sup> another 14 studies aimed at smoking cessation,<sup>16,17,21,22,26,31–35,39,43–46</sup> and 5 studies aimed at changing dietary behavior.<sup>14,20,23,24,32,41,42</sup> ORs were calculated only for the outcome measure “smoking cessation.” Because of the heterogeneity of the outcome measures for physical activity and dietary behavior, no meaningful ORs could be calculated and compared.

## Methodologic Quality

In the assessment of the methodologic quality, the two independent reviewers reached an initial agreement on 199 (70.6%) of the 282 items scored ( $\kappa$  statistic: 0.40). Disagreement resulted mostly from incomplete description of the study and reading or interpretation errors and was solved in a single consensus meeting. Most disagreements were on the items concerning blinding (E and F), and as Table 2 shows, the most prevalent missing information was on Item F. Overall, the methodologic quality was good. The quality scores attained ranged from 4 to 10 for the RCTs and 4 to 8 for the CTs. Only 7 studies (4 RCTs and 3 CTs) were of low quality (score of 5 or less).

**Table 2.** Overall scores of the methodologic quality rating for the included studies (only first author mentioned)

First author (year)	A	B	C	D	E	F	G	H	I	J	Total
Beresford (1997) <sup>14</sup>	+	+	+	+	?	-	+	+	+	+	8
Bull (1999) <sup>15</sup>	?	+	+	-	?	+	+	-	-	-	4
Butler (1999, 1997) <sup>16,17</sup>	+	+	+	-	-	?	+	+	+	-	6
Calfas (1996, 1997) <sup>18,19</sup>	-	+	+	+	?	-	+	-	+	+	6 <sup>a</sup>
Campbell (1994) <sup>20</sup>	?	+	+	+	+	-	+	-	+	+	7
Cornuz (1997) <sup>21</sup>	-	+	+	-	+	?	+	+	-	+	6 <sup>a</sup>
Cornuz (2002) <sup>22</sup>	+	-	+	+	-	+	+	+	+	?	7
Delichatsios (2001, 2001) <sup>23,24</sup>	?	+	+	+	+	?	+	-	+	+	7
Eckstrom (1999) <sup>25</sup>	-	+	+	+	+	?	?	-	+	-	5 <sup>a</sup>
Goldberg (1994) <sup>26</sup>	-	-	+	-	+	?	+	+	-	-	4 <sup>a</sup>
Goldstein (1999) <sup>27</sup>	?	+	+	+	?	?	+	+	?	+	6
Graham-Clarke (1994) <sup>28</sup>	?	+	-	-	+	?	+	+	?	-	4
Green (2002) <sup>29</sup>	+	+	+	+	+	?	+	+	+	+	9
Harland (1999) <sup>30</sup>	+	+	?	+	+	?	+	+	+	-	7
Hughes (2000) <sup>31</sup>	+	+	+	-	-	?	+	+	?	-	5
Kreuter (1996) <sup>32</sup>	?	+	+	+	+	?	+	+	+	+	8
Lancaster (1999) <sup>33</sup>	+	+	+	+	+	+	+	+	+	-	9
Lennox (1998) <sup>34</sup>	+	+	+	-	+	+	?	+	-	+	7
Lennox (2001) <sup>35</sup>	+	+	+	-	+	?	+	+	+	+	8
Marcus (1997) <sup>36</sup>	-	+	+	-	-	?	-	-	+	+	4 <sup>a</sup>
Naylor (1999) <sup>37</sup>	-	+	+	-	+	+	+	-	+	+	7
Norris (2000) <sup>38</sup>	?	+	+	+	?	?	+	+	+	+	7
Pieterse (2001) <sup>39</sup>	+	+	+	+	+	+	+	+	+	+	10
Smith (2000) <sup>40</sup>	-	-	+	+	?	+	+	+	+	+	7 <sup>a</sup>
Stepoe (1999) <sup>41,42</sup>	+	+	-	-	?	+	+	+	+	-	6
Stotts (2002) <sup>43</sup>	+	+	+	-	?	?	+	+	-	+	6
Stretcher (1994) <sup>44</sup>	?	+	?	-	?	+	+	-	+	+	5
Valanis (2001) <sup>45</sup>	-	+	+	+	-	+	+	+	+	+	8 <sup>a</sup>
Wang (1994) <sup>46</sup>	?	+	+	+	?	?	+	+	+	-	6

<sup>a</sup>Controlled trial (CT): the maximum score for methodological quality is nine.

+, positive; -, negative; ?, not or insufficiently described. All trials are randomized controlled trials, except for the trials indicated with a superscript "a".

## Physical Activity Interventions

Of the 13 studies promoting physical activity, eight were high-quality RCTs,<sup>27,29,30,32,37,38,41</sup> two were CTs of high quality,<sup>18,40</sup> and two RCTs<sup>15,28</sup> and two CTs<sup>25,36</sup> were of low quality (Table 3). All interventions were aimed at increasing physical activity in daily living but varied widely. In several studies the intervention consisted of only one contact moment,<sup>15,28,30,32,37</sup> whereas three studies included interventions with 6 or more contact moments.<sup>27,30,38</sup> Diverse delivery methods were used, varying from mailed letters only<sup>15,32</sup> to mailed letters with additional personal contact<sup>29</sup> and personal contact only (e.g., via telephone or in person).<sup>18,25,27,28,30,36-38,40,41</sup> The combination of the intensity and delivery methods used leads to a very heterogeneous set of interventions included in this review.

**Stages of change for physical activity.** At short-term follow-up, one high-quality RCT,<sup>27</sup> one RCT of low quality,<sup>28</sup> and two CTs of high quality<sup>18,37</sup> reported on changes in stages of change. Results were inconsistent. The RCT of high quality<sup>27</sup> and one CT of high quality<sup>18</sup> reported positive results. Graham-Clarke and Oldenburg<sup>28</sup> found a significant effect on stages of change in

favor of the control group, which was classified as a negative outcome. At medium-term follow-up, two studies, an RCT<sup>38</sup> and a CT,<sup>37</sup> both of high quality, reported on stages of change. Results were inconsistent. The RCT<sup>38</sup> found a positive effect, whereas the CT<sup>37</sup> reported a significant difference in stage of change over time in all study groups, but no differences between groups. At long-term follow-up, two RCTs, one of high<sup>27</sup> and one of low quality,<sup>28</sup> were retrieved. Results were negative in both studies. In conclusion, there is no evidence for effect at short-, medium-, and long-term follow-up.

**Level of physical activity.** Four RCTs, three of high quality<sup>27,30,41</sup> and one of low quality<sup>28</sup>; three high-quality CTs<sup>18,37,40</sup>; and two CTs of low quality<sup>15,36</sup> measured short-term effects on levels of physical activity. Results were inconsistent. Only three high-quality studies, two RCTs<sup>27,41</sup> and one CT,<sup>18</sup> reported a significant difference between study groups in favor of the intervention. Graham-Clarke and Oldenburg<sup>28</sup> reported a significant result in favor of the control group. At medium-term follow-up, three high-quality RCTs,<sup>29,32,38</sup> one CT of high quality,<sup>37</sup> and one low-

**Table 3.** Description of studies with physical activity interventions (only first author is mentioned).

Author (year) <sup>ref</sup> (design)	Subjects <sup>a</sup>	Intervention	Follow-up	Outcome measurements	Results <sup>b</sup>
Bull (1999) <sup>15</sup> (RCT)	272 (39 years; cont/ prep-phase and PA goal)	Mailed thank-you letter (1×) with one of the following: 1. Personalized tailored two-page printed material 2. Personalized general two-page printed material 3. General two-page printed material 4. Nothing extra	3 months	A. Total PA (% increased) B. Leisure-time PA (% increased) C. Preferred activity (% increased)	A. 1 v 4: 82 v 72 (ns) B. 1 v 4: 53 v 44 (ns) C. 1 v 2: 50 v 31 (sig.), 1 v 4: 50 v 43 (ns)
Calfas (1996, 1997) <sup>18,19</sup> (CT)	255 (39 years, active vig., <3×/wk or mod., <2 hr/wk)	1. PACE assessment in waiting room, enforcement by physician (1×) and 10-min booster phone call (1×) 2. Usual care	4–6 weeks	A. Total minutes walking (change) B. Overall PA (change in hours per week) C. Contemplation→action (%)	A. 34 v 20 (sig.) B. 0.2 v −0.6 (ns) C. 52 v 12 (sig.)
Eckstrom (1999) <sup>25</sup> (CT)	560 (62 years, patient in practice)	1. Physician training on stage-based PA counseling (2 × 2 hrs). 2. Usual care	6 months	A. Total activity (1–12, change from baseline)	A. 0.4 v 0.7 (ns)
Goldstein (1999) <sup>27</sup> (RCT)	355 (66 years, not meeting PA guidelines)	1. Stage and preference assessment in waiting room, followed by tailored PA advice by GP (1×) + follow-up by GP (1×) + mailings (5×). 2. Usual care	6 weeks and 8 months	A. Level of PA (PASE score) B. Stage of change (% in prep/act.) C. Stage of change (% in action)	A. 120 v 122 (ns) B. 89 v 74 (sig.) C. 49 v 42 (ns)
Graham-Clarke (1994) <sup>28</sup> (RCT)	758 (52 years, BMI >25 or smoking or hypertension or elevated cholesterol)	Risk assessment with feedback from GP (1×) + 1. Stage-based lifestyle counseling with videos 2. Stage-based lifestyle counseling with videos and self-help material 3. Routine care	4 and 12 months	A. Energy expenditure due to PA B. Progression of intention to change (%)	A. 12 months: sig. (no group differences) B. 23 v 17 v 27 (sig., in favor of group 3)
Green (2002) <sup>29</sup> (RCT)	316 (18–65 years, <15 min/day exercise and interested in increasing)	1. Motivation letter from provider (1×) + monthly telephone calls from behavioral specialist (3×, 20–30 min) 2. Usual care	6 months	A. PACE score (11 items) B. Change in PACE score	A. 5.37 v 4.98 (sig.) B. 0.426 v 0.102 (ns)
Harland (1999) <sup>30</sup> (RCT)	523 (40–64 years, <3× vig/wk. for 6 months)	Feedback on baseline results + information packet + 1. Motivational interview (1×, 40 min) 2. (1) + 30 vouchers 3. Motivational interview (6×, 40 min) 4. (3) + 30 vouchers 5. Nothing extra	12 weeks 1 year	A. Increased PA score (%) B. More sessions vig. PA (%) C. More sessions mod. PA (%)	A. 36 v 28 v 35 v 55 v 16 (sig.) B. 26 v 18 v 31 v 40 v 11 (sig.) C. 31 v 24 v 30 v 36 v 13 (sig.)
Kreuter (1996) <sup>32</sup> (RCT) <sup>c</sup>	206 (ages unknown, exercise <3×/ week and planning to change)	1. Mailed enhanced HRA feedback 6 months (risk information and individually tailored behavior change information; 1×) 2. Mailed typical HRA-feedback (risk information only; 1×) 3. No feedback	6 months	A. Aerobic exercise 3×/week (%)	A. 25 v 14 v 15 (ns)
Marcus (1997) <sup>36</sup> (CT)	63 (67 years, <3×/ week 20 min PA)	1. Physician and office staff training (1×, 2 hr) and individualized patient counseling in practice (2×) 2. Usual care	6 weeks	A. Level of PA (change in PASE score)	A. 6 v 0.4 (ns)

(continued on next page)

**Table 3.** (continued)

Author (year) <sup>ref</sup> (design)	Subjects <sup>a</sup>	Intervention	Follow-up	Outcome measurements	Results <sup>b</sup>
Naylor (1999) <sup>37</sup> (RCT)	294 (42 years, visiting health check)	1. Stage-oriented material + counseling (once) 2. Stage-oriented material (once) 3. Non-staged material + counseling (once) 4. Usual care	8 and 24 weeks	A. Stage of change (change) B. Level of PA	A. 8 and 24 weeks: sig. (no group differences) B. ns
Norris (2000) <sup>38</sup> (RCT)	847 (55, scheduled for visit)	1. PACE assessment in waiting room, enforcement by physician (1×) and 10-min booster phone call (1×) 2. (1) + 3 extra booster phone calls and 4 postcard reminders 3. Usual care	6 months	A. PACE score (11 items) B. Total PA (min/week) C. Increase PA 30 min/week (%)	A. 1 + 2 v 3: 6.2 v 5.7 (sig.) B. 1 + 2 v 3: 331.1 v 330.7 (ns) C. 1 + 2 v 3: 53.0 v 47.1 (ns) No differences 1 v 2
Smith (2000) <sup>40</sup> (CT)	1142 (60, scheduled for routine visit)	1. PA advice + stage-matched booklet (1×) 2. PA advice (1×) 3. Routine visit (no advice)	6–10 weeks and 7–8 months	A. Total minutes PA (change) B. 60 minute PA increase (%)	A. 15.3 v 15.6 v -5.7 (ns) B. 35.7 v 34.2 v 29.1 (ns)
Step toe (1999, 1999) <sup>41,42</sup> (RCT) <sup>d,e</sup>	883 (47, BMI ≥ 25 and <12× 20 min. exercise per month)	1. Counseling session with practice nurse (2 or 3×, 20 min) + telephone call (1 or 2× in between sessions) 2. Usual care	4 and 12 months	A. No. of sessions of exercise in past 4 weeks (change)	A. 7.6 v 3.8 (sig.), 12 months: 8.2 v 4.3 (sig.)

<sup>a</sup>Number of subjects (mean age, main inclusion criterion).

<sup>b</sup>The results given are mostly of the first follow-up measurement. In cases in which no further results are given, these results were neither relevant nor significant.

<sup>c</sup>A total of 1317 patients were included in the study (mean age: 40 years). Answers to the baseline questionnaire on seven health risk behaviors determined the main topic of the intervention.

<sup>d</sup>The number of counseling sessions depended on the number of risk factors (smoking, fat intake and physical inactivity/increased BMI). Patients with one risk factor were invited for two sessions; patients with two or more risk factors were invited for three sessions.

<sup>e</sup>Displayed results are of total study group (N = 883); only 699 subjects received physical activity counseling.

act, action stage; BMI, body mass index; cont., contemplation stage; CT, controlled trial; GP, general practitioner; HRA, Health Risk Assessment; hrs, hours; min, minutes; mod, moderate intensity; ns, nonsignificant; PA, physical activity; prep, preparation stage; RCT, randomized controlled trial; sig., significant; vig., vigorous intensity; wk, week.

quality CT<sup>25</sup> were identified. Results were inconsistent. Only one study, an RCT of high quality,<sup>29</sup> reported a positive result. At long-term follow-up, four RCTs, three of high quality<sup>27,30,41</sup> and one of low quality,<sup>28</sup> and one high-quality CT<sup>40</sup> were identified. Only one study, a high-quality RCT,<sup>41</sup> reported a significant result in favor of the intervention group. In conclusion, there is no evidence for effect at short-, medium-, or long-term follow-up.

## Smoking Cessation Interventions

The studies aimed at smoking cessation included nine high-quality RCTs,<sup>16,17,22,32–35,39,43,46</sup> two low-quality RCTs,<sup>31,44</sup> two CTs of high quality,<sup>24,45</sup> and one low-quality CT (Table 4).<sup>26</sup> One smoking cessation intervention was excluded because the intervention was supplemented with nicotine replacement therapy when appropriate, and no information was available on its possible additional effect.<sup>41,42</sup> Three studies aimed the intervention at pregnant women,<sup>31,43,45</sup> and of these studies, only the data on the smoking status after birth were used, because of the specific situation these women experience during the pregnancy. One study included both infertile and pregnant women.<sup>31</sup> For this review, only the data of the pregnant women were included.

The methods used to deliver the smoking cessation interventions differed from a mailed letter<sup>32,35,44</sup> to a possible six contact moments with individual counseling.<sup>33</sup> The most minimal interventions were those consisting of only one mailed letter.<sup>32,35,44</sup> In several studies, the number of contact moments could not be established precisely.<sup>16,21,22,26,31,33,34,39,45,46</sup>

**Stages of change for smoking.** No studies reported on changes in stage of change for smoking for the total population at short-term follow-up. At medium-term follow-up, one high-quality RCT<sup>16</sup> and one low-quality CT<sup>26</sup> were identified, both reporting positive outcomes. At long-term follow-up, two high-quality RCTs<sup>22,33</sup> and one RCT of low quality<sup>31</sup> were identified. None of the studies reported differences between the study groups. In conclusion, there is no evidence for effect at short and long-term follow-up. Limited evidence for an effect was found at medium-term follow-up.

**Quitting smoking.** At short-term follow-up, three RCTs of high quality<sup>33,39,43</sup> and one low-quality RCT<sup>44</sup> reported smoking quit rates. Results were inconsistent. Only one high-quality RCT<sup>39</sup> reported a positive outcome. One low-quality RCT<sup>44</sup> only showed a significant effect of the intervention in the group of moderate to light smokers (<20 cigarettes/day). At medium-term follow-up, six RCTs of high quality,<sup>16,32,35,39,43,46</sup> one high-quality CT,<sup>21</sup> and one low-quality CT<sup>26</sup> reported smoking quit rates. Results were inconsistent. Three studies<sup>16,39,46</sup> reported a significant difference in favor

of the intervention group. At long-term follow-up, four RCTs of high quality,<sup>22,33,34,39</sup> one RCT of low quality,<sup>31</sup> one high-quality CT,<sup>21</sup> and one low-quality CT<sup>45</sup> reported on quit rates. Results were inconsistent. Two high-quality RCTs<sup>22,39</sup> and the CT<sup>44</sup> showed a positive effect in favor of the intervention. In conclusion, based on the strength of evidence syntheses, there is no evidence for effect at short-, medium-, and long-term follow-up.

In the quantitative method, three studies were excluded. Reasons for exclusion were including both non- and light smokers in the data,<sup>43</sup> total numbers of subjects in the intervention and control group not available,<sup>44</sup> and only data available on maintained cessation.<sup>31</sup> Because of the statistical heterogeneity of the results, pooling was not considered appropriate. Only two studies reported quit rates at short follow up (Table 5).<sup>33,39</sup> Although both reported a positive result in favor of the intervention, this result was significant in only one study. The odds ratios of the seven studies reporting quit rates at medium-term follow-up<sup>16,21,26,32,35,39,46</sup> ranged from 0.67 (95% CI: 0.24, 1.91) to 9.31 (95% CI: 1.12, 77.68). Of the five studies showing a positive result, three were statistically significant.<sup>16,39,46</sup> At long-term follow-up, three of the six studies reported a significant positive effect.<sup>22,39,45</sup>

## Dietary Interventions

Five RCTs of high quality described an intervention aimed at improvements in dietary behavior (Table 6).<sup>14,20,23,24,32,41,42</sup> Although one study included a referral to a dietitian on an as-needed basis,<sup>23,24</sup> this study was included because only 3% (7/230) of the subjects were referred. All interventions were aimed at reducing dietary fat intake. Further aims of the interventions were the following: increasing fruit and vegetable intake,<sup>20,23,24,41,42</sup> increasing dietary fiber intake,<sup>14</sup> and changing meat consumption.<sup>23,24</sup> As was the case in the smoking cessation and the physical activity interventions, the delivery methods used and intensity of the interventions were diverse. Most of the studies mailed back dietary feedback once,<sup>14,20,23,24,32</sup> and two studies complemented this with verbal advice.<sup>14,23,24</sup> In only one study the intervention consisted solely of verbal advice on multiple occasions.<sup>41,42</sup>

**Stages of change for fat intake.** Only one high-quality RCT<sup>23</sup> was identified reporting on changes in stage of change for fat intake at short-term follow-up. The results were positive. No studies were identified reporting changes in stage of change at medium and long-term follow-up. In conclusion, there is limited evidence for an effect at short-term follow-up and no evidence for effect at medium and long-term follow-up.

**Fat intake.** At short-term follow-up, four high-quality RCTs<sup>14,20,23,41</sup> reported on the effect on fat intake.

**Table 4.** Description of studies with smoking cessation interventions (only first author is mentioned).

Author (year) <sup>ref</sup> (design)	Subject <sup>a</sup>	Intervention	Follow-up	Outcome measurements	Results <sup>b</sup>
Butler (1999, 1997) <sup>16,17</sup> (RCT)	536 (41, smokers consulting GP)	1. Motivational counselling (patient rating confidence and motivation to quit; GP responds by building motivation and confidence, patient sets meaningful targets) (?×) 2. Brief standard smoking cessation advice	6M	A. Abstinence in last month (%) B. Abstinence in last 24hrs (%)	A. 3.0 v 1.5 (ns) B. 8.1 v 3.0 (sign).
Cornuz (1997) <sup>21</sup> (CT)	402 (39, ≥1 cig. in previous week)	1. Resident training in stage-based smoking cessation (1 1/2hr group session + 1/2hr individual session with role play) (?×) 2. No training (period prior to training)	6 and 12M	A. Smoking cessation (%) B. Attempt to quit at 6 or 12M	A. 7 v 5 (ns) B. OR = 1.57 (sign)
Cornuz (2002) <sup>22</sup> (RCT)	251 (36, ≥1 cig. in previous week)	1. Resident training in stage-based smoking cessation with educational objectives (e.g. identify smokers, advise quitting, assess stage of change, follow up) (2× 1/2 day) 2. Control resident training	12M	A. Smoking abstinence (%) B. Progression of one stage (%)	A. 13 v 7 (sign) B. 13 v 14 (ns)
Goldberg (1994) <sup>26</sup> (CT)	252 (56, ≥1 cig. in last 24 hrs)	1. Resident training in stage-based smoking cessation + manual (incorporated in a 10-week lecture series) (?×) 2. No resident training	6M	A. Self reported cessation (%) B. Stages progressed (mean) C. Positive stage-progression (%)	A. 14.7 v 16.2 (ns) B. 0.63 v 0.34 (sign) C. 51 v 41 (ns)
Hughes (2000) <sup>31</sup> (RCT)	110 (26, ≥3 cig. in past 6 months)	1. Staged advice and stage-specific information booklet (1×) + booklets at follow-up visits (?×) 2. Usual care	12M	A. Mean delta stage-of-change B. Maintained cessation(%)	A. Ns B. 62 v .65 (ns)
Kreuter (1996) <sup>32</sup> (RCT) <sup>c</sup>	180 (? , 'a puff' in the last 7 days and planning change)	1. Mailed enhanced HRA-feedback (risk information & individually-tailored behavior change information) (1×) 2. Mailed typical HRA-feedback (risk information only) (1×) 3. No feedback	6M	A. Quitting smoking (%)	A. 12 v 13 v 17 (ns)
Lancaster (1999) <sup>33</sup> (RCT)	479 (44, ≥1 cig./day)	1. Brief advice + personalized individual counseling (1–6 sessions: 15–65 min.) 2. Brief advice	3 and 12M	A. Not smoking (%) B. Sustained non-smoker (%) C. Stage of change (progression, %)	A. 9.2 v 8.1 (ns) B. 3.6 v 4.4 (ns) C. 12M: 20.9 v 26.6 (ns)
Lennox (1998) <sup>34</sup> (RCT)	2588 (? , smoking every/most days) <sup>f</sup>	1. Training in stage-based smoking cessation and motivational interviewing for health professionals from the practices (1 day) (?×) 2. No training	8 and 14M	A. Not smoking in last 24hrs (%) B. Change in readiness to change (mean change)	A. 8.0 v 9.4 (ns) B. 0.60 v 0.27 (ns)
Lennox (2001) <sup>35</sup> (RCT)	2610 (17–65, current smoker)	1. Tailored letter (1×) 2. Non-tailored letter (1×) 3. Thank-you letter	6M	A. Not smoking (%) B. Shift in stage of change (OR)	A. 3.5 v 4.4 v 2.6 (ns) B. (>20 cig./day): 1 v 3: OR: 1.76 (sign)

(continued on next page)

**Table 4.** (continued)

Author (year) <sup>ref</sup> (design)	Subject <sup>a</sup>	Intervention	Follow-up	Outcome measurements	Results <sup>b</sup>
Pieterse (2001) <sup>39</sup> (RCT)	530 (36, smoking)	1. Brief behavioral advice (assessment, motivation, setting quit date, self help manual, possible follow-up) (1× 10min) 2. Usual care	1, 6 and 12M	A. Smoking quit rate (%) B. Consecutive abstinence (OR)	A. 18.6 v 3.8 (sign), 6M: 11.9 v 3.8 (sign), 12M: 13.4 v 7.3 (sign) B. OR 12M: 3.04 (sign)
Stotts (2002) <sup>43</sup> (RCT)	269 (28, 'puff' in past 28 days and pregnant in 28th week)	1. Motivational interviewing (MI) telephone counseling (2× 20–30 min) + tailored feedback letter (1×) 2. Usual care	3 and 6M post-partum	A. Quit smoking (%)	A. 16.9 v 17.1 (ns)
Strecher (1994) <sup>44</sup> (RCT)	72 (50, smoked 'even a puff' in previous week)	1. Tailored health letter (1×) 2. Standard health letter	4M	A. Not smoking (%)	A. 20.8 v 7.4 (ns)
Valanis (2001) <sup>45</sup> (CT)	3079 (24, pregnant, smoking or stopped recently)	1. Stage-based verbal advice + follow-up advice at subsequent visits (?×) 2. Usual care	1Y post-partum	A. Smoking 1 year postpartum (% not smoking past 6 months)	A. 18.4 v 14.9 (sign)
Wang (1994) <sup>46</sup> (RCT)	93 (62% ≥40, ≥1 cig./day)	1. Stage-matched advice in clinic visit (?×) 2. Poster-reminder in practice 3. Usual care	6M	A. Not smoking (%)	A. 28.6 v 8.3 v 4.3 (1 v 3: sign)

<sup>a</sup>Number of subjects (mean age, main inclusion criterion).

<sup>b</sup>The results given are mostly of the first follow-up measurement. In cases where no further results are given, these results are not relevant or significant.

<sup>c</sup>A total of 1317 patients was included in the study (mean age: 40 years). Answers to the baseline questionnaire on seven health risk behaviors determined the main topic of the intervention.

<sup>d</sup>A pragmatic design was used: general practices were randomized and included subjects were patient in practice. However, it is unknown whether they actually visited their GP and received smoking cessation advice during the intervention-phase.

cig, cigarette(s); CT, controlled trial; GP, general practitioner; HRA, Health Risk Assessment; hrs, hours; M, months; min, minutes; ns, non-significant; OR, odds ratio; RCT, randomized controlled trial; sign, significant; W, weeks; wk, week; Y, years.

**Table 5.** Odds ratio (OR) with 95% confidence intervals (CI) for quitting smoking for intervention group (I) and control group (C) at short-term (<6 months), medium-term (6 months), and long-term (>6 months) follow-up (only first author is mentioned)

Study by first author	I	C	OR (CI, 95%)
<b>Short-term follow-up (&lt;6 months)</b>			
Lancaster <sup>33</sup>	23/249	20/248	1.16 (0.62, 2.17)
Pieterse <sup>39</sup>	50/269	10/261	5.73 (2.84, 11.57)
<b>Medium-term follow-up (6 months)</b>			
Butler <sup>16</sup>	22/270	8/266	2.70 (1.19, 6.19)
Cornuz <sup>21</sup>	8/155	9/147	1.42 (0.54, 3.75)
Goldberg <sup>26</sup>	10/89	19/163	0.96 (0.43, 2.16)
Kreuter <sup>32</sup>	7/59	10/60	0.67 (0.24, 1.91)
Lennox <sup>34</sup>	30/857	22/850	1.37 (0.78, 2.39)
Pieterse <sup>39</sup>	32/269	10/261	3.39 (1.63, 7.05)
Wang <sup>46</sup>	10/39	1/28	9.31 (1.12, 77.68)
<b>Long-term follow-up (&gt;6 months)</b>			
Cornuz <sup>21</sup>	9/155	11/247	1.30 (0.53, 3.22)
Cornuz <sup>22</sup>	15/115	7/136	2.76 (1.09, 7.04)
Lancaster <sup>33</sup>	17/249	28/248	0.58 (0.31, 1.08)
Lennox <sup>34</sup>	74/1381	80/1207	0.81 (0.58, 1.12)
Pieterse <sup>39</sup>	36/269	19/261	1.97 (1.10, 3.53)
Valanis <sup>45</sup>	290/2055	116/1028	1.29 (1.03, 1.63)

Three of them reported a positive result.<sup>14,20,41</sup> The other showed a nonsignificant decrease in fat intake.<sup>23</sup> At medium-term follow-up, only one study was identified, a high-quality RCT.<sup>32</sup> A non-significant difference in favor of the stage-based intervention group was observed. At long-term follow-up, two high-quality RCTs<sup>14,41</sup> reported on changes in fat intake, both with positive results. In conclusion, there is strong evidence for an effect of a stage-based intervention on fat intake at short- and long-term follow-up, and there is no evidence for an effect at medium-term follow-up.

## Discussion and Conclusion

With this review, we aimed to shed light on the effectiveness of stage-based lifestyle interventions in primary care. The current popularity of this kind of intervention is confirmed by the fact that only 11 of the 29 included studies were published before the year 1999, with the first studies published in 1994. With this, the frequently mentioned empirical evidence on the effectiveness of interventions based on stages of change seems to be building up.<sup>5,47</sup> However, the results of this review raise questions about the evidence for the effectiveness of these interventions.

## Effectiveness

**Physical activity.** No evidence was found for an effect on the level of physical activity. Although more studies reported positive results at short-term follow-up than at long-term follow-up, more than half of the studies did not find a positive result at short-term follow-up. The outcome measure used appears to be an important factor. The only two studies using the number of physical activity sessions as outcome measure showed a

positive result.<sup>30,41</sup> Except for the study of Calfas et al.,<sup>17</sup> the total time subjects spend on physical activity at follow-up did not differ between the study groups. The question can be raised as to whether people do not become more physically active, but in fact adopt the message of regular physical activity literally and spread the same time over more sessions.

**Smoking cessation.** In the qualitative analyses of the data, the conclusion was drawn that there was limited to no evidence for an effect of the stage-based smoking cessation interventions on quit rates and on stages of change. The quantitative analysis showed a positive trend at all follow-up measurements. Based on these data, the authors conclude that there seems to be a small, but positive, effect of stage-based interventions in primary care on smoking cessation rates. Taking a closer look at the studies, it can be concluded that mailing a tailored letter once is not effective for smoking cessation.<sup>32,35,44</sup> Furthermore, personal advice from the primary care physician, with follow-up advice during subsequent visits (mostly not planned for smoking cessation) seems to be the most effective strategy.<sup>16,22,31,39,45,46</sup>

**Dietary behavior.** The five included studies on dietary behavior paint a positive picture for the effect of stage-based interventions on dietary behavior, or more specifically on fat intake. Two studies also reported on the effect on fruit and vegetable intake, but these results were inconsistent (data not shown).<sup>20,23,24</sup> Based on the qualitative analyses of the effect on fat intake, the conclusion was drawn that there is strong evidence for an effect at short and long-term follow-up. However, there was no evidence for an effect at medium-term follow-up. For an effect on stages of change for fat intake, there was limited evidence at short-term follow-up and

**Table 6.** Description of studies with dietary interventions (only first author is mentioned)

Author (year) <sup>ref</sup> (design)	Subjects <sup>a</sup>	Intervention	Follow-up <sup>d</sup>	Outcome measurements	Results <sup>b</sup>
<b>Beresford</b> (1997) <sup>14</sup> (RCT)	2111 (26% >65, GP appointment)	1. Physician advice, self-help booklet, (1×) and reminder letter (1×) 2. Usual care	3 and 12 months	A. Fat-intake (%en, change) B. Fiber-intake (g/1000kcal, change)	A. -1.52 v -0.48 (sig), 12M: -1.54 v -0.34 (sig.) B. 0.50 v 0.36 (ns)
<b>Campbell</b> (1994) <sup>20</sup> (RCT)	558 (41, GP appointment)	1. Mailed tailored information packet (1×) 2. Mailed non-tailored information packet (1×) 3. No information	4 months	A. Total fat (g/day, change) B. Saturated fat (g/day, change) C. Fruit and vegetable (serv./day, change)	A. 1 v 3: -10.3 v -1.3 (sig.) B. 1 v 3: -4.8 v -0.5 (sig.) C. 1 v 3: -0.3 v -0.3 (ns)
<b>Delichatsios</b> (2001, 2001) <sup>23,24</sup> (RCT)	504 (50, patient in practice)	1. Mailed dietary recommendations with tailored feedback letter and booklets (1×) + verbal advice from physician (1×) + motivational telephone counseling sessions (2×) 2. Mailed non-staged dietary feedback	3 months	A. Fruit/vegetable intake (serv.) B. Whole-fat dairy intake (serv.) C. Progression of stage (fat intake, %)	A. Difference between groups: 0.6 (sig.) B. Difference between groups: -0.4 (ns) C. 47 v 29 (sig.)
<b>Kreuter</b> (1996) <sup>32</sup> (RCT) <sup>c</sup>	155 (? , diet high in fat and planning change)	1. Mailed enhanced HRA-feedback (risk information and individually-tailored behavior change information) (1×) 2. Mailed typical HRA-feedback (risk information only) (1×) 3. No feedback	6 months	A. Reducing dietary fat consumed (%)	A. 93 v 88 v 78 (ns)
<b>Step toe</b> (1999, 1999) <sup>41,42</sup> (RCT) <sup>d,e</sup>	883 (47, cholesterol conc. 6.5–9.0 mmol/l)	1. Counseling session with practice nurse (2/3×20 min) + telephone call (1/2× in between sessions) 2. Usual care	4 and 12 months	A. Fat score (% changed)	A. 26.0 v 11.5 (sig.), 12 months: 23.3 v 15.2 (sig.)

<sup>a</sup>Number of subjects (mean age, main inclusion criterion).

<sup>b</sup>The results given are mostly of the first follow-up measurement. In cases where no further results are given, these results are not relevant or significant.

<sup>c</sup>A total of 1317 patients was included in the study (mean age: 40 years). Answers to the baseline questionnaire on seven health risk behaviors determined the main topic of the intervention.

<sup>d</sup>The number of counseling sessions depended on the number of risk factors (smoking, fat intake and physical inactivity/increased BMI). Patients with one risk factor were invited for 2 sessions, patients with two or more risk factors were invited for 3 sessions.

<sup>e</sup>Displayed results are of total study group (N=883). Only 365 subjects received counseling about reducing dietary fat intake.

%en, % Energy; conc, concentration; g, gram; GP, general practitioner; HRA, Health Risk Assessment; kcal, kilocalories; min, minutes; ns, non-significant; serv, serving; sign, significant.

no evidence at medium and long-term follow-up. The contrast in this evidence is mostly due to the small number of studies published and the choice of the timing of the follow-up measurements. Only one study included a follow-up measurement at 6 months. Although a positive trend was observed, this result was not statistically significant. It needs to be said that a conclusion based on this small number of studies is not very solid, because one additional high-quality study with a negative result could alter the positive conclusion immediately. Therefore, this conclusion must be interpreted with caution. Reviewing the intensities of the interventions, the conclusion can be drawn that both minimal and more intense interventions can produce positive results.

### Methodologic Issues

A potential limitation of this review, and most reviews in general, is the literature search. It is possible that the search did not identify all trials published, which could lead to a selection bias, but this was minimized by checking the references of previously published reviews and the articles retrieved in the search. Furthermore, the organization of primary care differs worldwide, and a clear and worldwide-accepted definition of primary care is not available. A different definition or interpretation of primary care could have led to the inclusion of a different set of studies. The criterion to exclude unpublished trials might cause publication bias, which is known to cause bias to positive findings.<sup>48</sup>

There is no evidence-based consensus on which criteria should be used for assessing the methodologic quality of RCT/CT. Consequently, the items included are, to some extent, arbitrarily chosen. The large number of “?” scored suggests that unclear descriptions of the research procedures might be of source of bias,<sup>49</sup> and this could substantially limit the interpretation of the methodologic quality. The overall methodologic quality of the included studies can be considered as good, ranging from 4 to a perfect 10. Although a number of reviews has been published on the topic of lifestyle interventions in primary care,<sup>10,50–57</sup> methodologic quality rating was not always included, and none of the reviews focused solely on stages-of-change-based interventions. However, the conclusions of the majority of the reviews are comparable with the conclusions drawn in this review; that is, there seems to be a marginal effect on smoking quit rates, and the physical activity interventions have varying success. No previous reviews are available on the effectiveness of dietary advice in primary care.

Because of the heterogeneity of the interventions and outcome measures used, the authors decided not to calculate and compare effect sizes. The information provided in the tables and in the text provides sufficient

information about the effectiveness of the studies included.

Although it was established that all interventions were based on the TTM-model, the extent to which this was the case was not systematically assessed and included in the conclusions. Some interventions were exclusively based on the TTM model,<sup>18,25,46</sup> whereas others used the TTM model in combination with other theories.<sup>14,16,44</sup> However, because of the heterogeneity of the interventions, a conclusion as to whether interventions more accurately based on the TTM model produce better results could not be drawn.

### Stages of Change as Basis for Interventions

The use of the stages-of-change model in changing a very diverse set of behaviors is becoming more popular but is also controversial,<sup>5,58</sup> and questions on the internal validity of the model can be raised. Originally developed for use in smoking cessation, its application to dietary behavior and physical activity has several tricky aspects. The transition of the stages of change model from cessation activities such as smoking and drug abuse to initiation activities such as healthy eating, screening, and sexual behavior has been questioned in the literature.<sup>58,59</sup> Furthermore, smoking is a dichotomous behavior; either one smokes or one does not smoke. Although physical activity and dietary behavior can be grasped in a dichotomous manner as well (e.g., sufficiently/insufficiently physically active), there exists a large gray area between the two ends of both continuums. It is confusing that becoming physically active on 4 days of the week does not place someone in the action stage (according to the current recommendations), where this is obvious when one is only reducing the number cigarettes smoked. Furthermore, smoking is a conscious behavior of which a person is aware, where in the case of physical activity and dietary behavior usually a great deal of knowledge is required to classify oneself in either the healthy or the unhealthy group.<sup>60,61</sup> As is described in the literature,<sup>5,58–62</sup> misclassifications are often observed in self-report of stages of change for physical activity and dietary behavior. An intervention based on such misclassification might just not deliver the right message to the right person.

The reduction of a complex behavior to a small aspect (e.g., focusing on reducing dietary fat intake instead of on the more general concept of healthy eating) might explain some of the observed differences in effect, as such a reduction is hard to accomplish in the physical activity interventions. Although these interventions were mostly focused on moderate intensity physical activity in daily living, this still encompasses a wide variety of behaviors and possible intensities of these behaviors. The overall message of regular physical activity may therefore be harder to follow.

Despite these limiting aspects of the stages-of-change model, it can still be viewed as a valuable model for changing behavior, especially in primary care. It enables the primary care physician to obtain important information for behavior change in a short period of time, and it seems to be a logical basis for a behavior change intervention.<sup>63</sup> However, although a number of authors have suggested focusing health behavior change interventions on the individual stage of change,<sup>8,64,65</sup> this review does not provide substantial evidence for its effectiveness. The still-growing number of studies in this field might provide new evidence and insights.

## References

- Pearson TA, Blair SN, Daniels SR, et al. AHA guidelines for primary prevention of cardiovascular disease and stroke: 2002 update. *Circulation* 2002;106:388–91.
- Grundy SM, Garber A, Goldberg R, et al. Diabetes and cardiovascular disease, writing group IV: lifestyle and medical management of risk factors. *Circulation* 2002;105:e153–8.
- Van Mechelen W. A physically active lifestyle—public health's best buy? *Br J Sports Med* 1997;31:264–5.
- Prochaska JO, DiClemente CC. Stages and processes of self-change of smoking: toward an integrative model of change. *J Consult Clin Psychol* 1983;51:390–5.
- Whitelaw S, Baldwin S, Bunton R, et al. The status of evidence and outcomes in stages of change research. *Health Educ Res* 2000;15:707–18.
- Hulshof NA, van Essen GA, Andela M, et al. Patiënten over preventie door hun huisarts. *Huisarts Wetenschap* 1998;41:117–20.
- Albright CL, Cohen S, Gibbons L, et al. Incorporating physical activity advice into primary care: physician-delivered advice within the Activity Counseling Trial. *Am J Prev Med* 2000;18:225–34.
- Cornuz J, Ghali WA, Di Carantonio D, et al. Physicians' attitudes towards prevention: importance of intervention-specific barriers and physicians' health habits. *Fam Pract* 2000;17:535–40.
- Long BJ, Calfas KJ, Wooten W, et al. A multisite field test of the acceptability of physical activity counseling in primary care: project PACE. *Am J Prev Med* 1996;12:73–81.
- Ashenden R, Silay C, Weller D. A systematic review of the effectiveness of promoting lifestyle change in general practice. *Fam Pract* 1997;14:160–76.
- Proper KI, Staal BJ, Hildebrandt VH, et al. Effectiveness of physical activity programs at worksites with respect to work-related outcomes. *Scand J Work Environ Health* 2002;28:75–84.
- Proper KI, Koning M, van der Beek F, et al. The effectiveness of worksite physical activity programs on physical activity, physical fitness and health. *Clin J Sports Med* 2003. In press.
- Van Poppel MNM, Koes BW, Smid T, et al. A systematic review of controlled clinical trials on the prevention of back pain in industry. *Occup Environ Med* 1997;54:841–7.
- Beresford SAA, Curry SJ, Kristal AR, et al. A dietary intervention in primary care practice: the Eating Patterns Study. *Am J Public Health* 1997;87:610–6.
- Bull FC, Kreuter MW, Scharff DP. Effects of tailored, personalized and general health messages on physical activity. *Patient Educ Couns* 1999;36:181–92.
- Butler CC, Rollnick S, Cohen D, et al. Motivational consulting versus brief advice for smokers in general practice: a randomized trial. *Br J Gen Pract* 1999;49:611–6.
- Rollnick S, Butler CC, Stott N. Helping smokers make decisions: the enhancement of brief intervention for general medical practice. *Patient Educ Couns* 1997;31:191–203.
- Calfas KJ, Long BJ, Sallis JF, et al. A controlled trial of physician counseling to promote the adoption of physical activity. *Prev Med* 1996;25:225–33.
- Calfas KJ, Sallis JF, Oldenburg B, et al. Mediators of change in physical activity following an intervention in primary care: PACE. *Prev Med* 1997;26:297–304.
- Campbell MK, DeVellis B, Strecher VJ, et al. Improving dietary behavior: the effectiveness of tailored messages in primary care settings. *Am J Public Health* 1994;84:783–7.
- Cornuz J, Zellweger J-P, Mounoud C, et al. Smoking cessation counseling by residents in an outpatient clinic. *1997;26:292–6.*
- Cornuz J, Humair J-P, Seematter L, et al. Efficacy of resident training in smoking cessation: a randomized, controlled trial of a program based on application of behavioral theory and practice with standardized patients. *Ann Intern Med* 2002;136:429–37.
- Delichatsios HK, Hunt MK, Lobb R, et al. EatSmart: efficacy of a multifaceted preventive nutrition intervention in clinical practice. *Prev Med* 2001;33:91–8.
- Hunt MK, Lobb R, Delichatsios HK, et al. Process evaluation of a clinical preventive nutrition intervention. *Prev Med* 2001;33:82–90.
- Eckstrom E, Hickam DH, Lessler DS, et al. Changing physician practice of physical activity counseling. *J Gen Intern Med* 1999;14:376–8.
- Goldberg DN, Hoffman AM, Farinha F, et al. Physician delivery of smoking-cessation advice based on the stages-of-change model. *Am J Prev Med* ;10:267–74.
- Goldstein MG, Pinto BM, Marcus BH, et al. Physician-based physical activity counseling for middle-aged and older adults: a randomized trial. *Ann Behav Med* 1999;21:40–7.
- Graham-Clarke P, Oldenburg B. The effectiveness of general-practice-based physical activity intervention on patient physical activity status. *Behav Change* 1994;11:132–44.
- Green BB, McAfee T, Hindmarsh M, et al. Effectiveness of telephone support in increasing physical activity levels in primary care patients. *Am J Prev Med* 2002;22:177–83.
- Harland J, White M, Drinkwater C, et al. The Newcastle exercise project: a randomised controlled trial of methods to promote physical activity in primary care. *BMJ* 1999;3:828–32.
- Hughes EG, Lamont DA, Beecroft ML, et al. Randomized trial of a "stages of change" oriented smoking cessation intervention in infertile and pregnant women. *Fertil Steril* 2000;74:498–503.
- Kreuter MW, Strecher VJ. Do tailored behavior change messages enhance the effectiveness of health risk appraisal? Results for a randomized trial. *Health Educ Res* 1996;11:97–105.
- Lancaster T, Dobbie W, Vos K, et al. Randomized trial of nurse-assisted strategies for smoking cessation in primary care. *Br J Gen Pract* 1999;49:191–4.
- Lennox AS, Bain N, Taylor RJ, et al. Stages of change training for opportunistic smoking intervention by primary health care team. Part 1: randomised controlled trial of the effect of training on patient smoking outcomes and health professional behaviour as recalled by patients. *Health Educ J* 1998;57:140–9.
- Lennox AS, Osman LM, Eiter E, et al. Cost effectiveness of computer tailored and non-tailored smoking cessation letters in general practice: randomised controlled trial. *BMJ* 2001;322:1–7.
- Marcus BH, Goldstein MG, Jette A, et al. Training physicians to conduct physical activity counseling. *Prev Med* 1997;26:382–8.
- Naylor PJ, Simmonds G, Riddoch C, et al. Comparison of stage-matched and unmatched interventions to promote exercise behaviour in the primary care setting. *Health Educ Res* 1999;14:653–66.
- Norris SL, Grothaus LC, Buchner DM, et al. Effectiveness of physician-based assessment and counseling for exercise in a staff model HMO. *Prev Med* 2000;30:513–23.
- Pieterse ME, Seydel ER, De Vries H, et al. Effectiveness of a minimal contact smoking cessation program for Dutch general practitioners: a randomized controlled trial. *Prev Med* 2001;32:182–90.
- Smith BJ, Bauman AE, Bull FC, et al. Promoting physical activity in general practice: a controlled trial of written advice and information materials. *Br J Sports Med* 2000;34:262–7.
- Steptoe A, Doherty S, Rink E, et al. Behavioural counselling in general practice for the promotion of healthy behaviour among adults at increased risk of coronary heart disease: randomised trial. *BMJ* 1999;319:943–8.
- Hilton S, Doherty S, Kendrick T, et al. Promotion of healthy behaviour among adults at increased risk of coronary heart disease in general practice: methodology and baseline data from the Change of Heart study. *Health Educ J* 1999;58:3–16.
- Stotts AL, DiClemente CC, Dolan-Mullen P. One-to-one. A motivational intervention for resistant pregnant smokers. *Addict Behav* 2002;27:275–92.
- Strecher VJ, Kreuter M, Den Boer D-J, et al. The effects of computer-tailored smoking cessation messages in family practice settings. *J Fam Pract* 1994;39:262–70.
- Valanis B, Lichtenstein E, Mullooly JP, et al. Maternal smoking cessation and relapse prevention during health care visits. *Am J Prev Med* 2001;20:1–8.

46. Wang WD. Feasibility and effectiveness of a stages-of-change model in cigarette smoking cessation counseling. *J Formos Med Assoc* 1994;93:752-7.
47. Ashworth P. Breakthrough or bandwagon? Are interventions tailored to stage of change more effective than non-staged interventions? *Health Educ J* 1997;56:166-74.
48. Egger M, Smith GD. Bias in location and selection of studies. *BMJ* 1998;316:61-6.
49. Schulz KF, Chalmers I, Hayes RJ, et al. Empirical evidence of bias: dimensions of methodological quality assessment associated with estimates of treatment effects in controlled trials. *JAMA* 1995;273:408-12.
50. Eaton CB, Menard LM. A systematic review of physical activity promotion in primary care office settings. *Br J Sports Med* 1998;32:11-6.
51. Kahn EB, Ramsey LT, Brownson RC, et al. The effectiveness of interventions to increase physical activity: a systematic review. *Am J Prev Med* 2002;22(suppl):73-107.
52. Eakin EG, Glasgow RE, Riley KM. Review of primary care-based physical activity intervention studies. *J Fam Pract* 2000;49:158-68.
53. Riddoch C, Puig-Ribera A, Cooper A. Effectiveness of physical activity promotion schemes in primary care: a review. London: Health Education Authority, 1998.
54. Whitlock EP, Orleans T, Pender N, et al. Evaluating primary care behavioral counseling interventions: an evidence-based approach. *Am J Prev Med* 2002;22:267-84.
55. Petrella RJ, Lattanzio CH. Does counseling help patients get active? Systematic review of the literature. *Can Fam Physician* 2002;48:72-80.
56. Lawlor DA, Hanratty B. The effect of physical activity advice given in routine primary care consultations: a systematic review. *J Public Health Med* 2001;23:219-26.
57. Sigaly C, Stead LF. Physician advice for smoking cessation. *Cochrane Database Syst Rev* 2001;2:CD002850.
58. Clarke P, Eves F. Applying the transtheoretical model to the study of exercise on prescription. *J Health Psychol* 1997;2:195-207.
59. Ni Murchu C, Margretts BM, Speller VM. Applying the stages-of-change model to dietary change. *Nutr Rev* 1997;55:10-6.
60. Povey R, Conner M, Sparks P, et al. A critical examination of the application of the transtheoretical model's stages of change to dietary behaviours. *Health Educ Res* 1999;14:641-51.
61. Brug J, Van Assema P, Kok G, et al. Self-rated dietary fat intake: association with objective assessment of fat, psychosocial factors, and intention to change. *J Nutr Educ* 1994;26:218-23.
62. Ronda G, Van Assema P, Brug J. Stages of change, psychological factors and awareness of physical activity levels in the Netherlands. *Health Promot Int* 2001;16:305-14.
63. Zimmerman GL, Olsen CG, Bosworth MF. A "stages of change" approach to helping patients change behavior. *Am Fam Physician* 2002;61:1409-16.
64. Richmond R, Andersen P. Research in general practice for smokers and excessive drinkers in Australia and the UK. III. Dissemination of interventions. *Addiction* 1994;89:49-62.
65. Oldenbrug B, Glanz K, French M. The application of staging models to understanding health behaviour change and the promotion of health. *Psychol Health* 1999;14:503-16.