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Article Title: Systematic review of the effectiveness of stage based interventions to promote smoking cessation

Year of publication: 2003

Link to published article:

<http://dx.doi.org/10.1136/bmj.326.7400.1175>

Publisher statement: None

Systematic review of the effectiveness of stage based interventions to promote smoking cessation

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Abstract

Objective To evaluate the effectiveness of interventions using a stage based approach in bringing about positive changes in smoking behaviour.

Design Systematic review.

Data sources 35 electronic databases, catalogues, and internet resources (from inception to July 2002). Bibliographies of retrieved references were scanned for other relevant publications, and authors were contacted if necessary.

Results 23 randomised controlled trials were reviewed; two reported details of an economic evaluation. Eight trials reported effects in favour of stage based interventions, three trials showed mixed results, and 12 trials found no statistically significant differences between a stage based intervention and a non-stage based intervention or no intervention. Eleven trials compared a stage based intervention with a non-stage based intervention, and one reported statistically significant effects in favour of the stage based intervention. Two studies reported mixed effects, and eight trials reported no statistically significant differences between groups. The methodological quality of the trials was mixed, and few reported any validation of the instrument used to assess participants' stage of change. Overall, the evidence suggests that stage based interventions are no more effective than non-stage based interventions or no intervention in changing smoking behaviour.

Conclusions Limited evidence exists for the effectiveness of stage based interventions in changing smoking behaviour.

Introduction

The health hazards of smoking are important and well established. Diseases that are more common in smokers than in the general population include lung cancer, other lung disease, and cardiovascular disease.¹ Smoking is the greatest single cause of illness and premature death in the United Kingdom, with more than 120 000 deaths in 1995 of people aged over 35 years attributable to smoking.^{2 3}

In the United Kingdom in 1997, more than 11 million adults—about 27% of the adult population—were regular smokers. The proportions of men and women

who currently smoke are about the same. Over the past five years the proportion of smokers in the population has stabilised or may even be increasing, as about 25% of 15 year olds are regular smokers.^{3 4}

The risk of disease is reduced after smoking cessation. People who stop smoking before middle age can avoid most of the excess risk they would have carried.¹ After only one year of abstinence the excess risk of death related to myocardial infarction and cerebral arterial disease is decreased by one half as is the risk of dying from smoking related disease in those who stop before the age of 50.⁵ Depending on the number of years of abstinence, the risk of developing lung cancer can be reduced by 20% to 90%.⁶ Treatment for smoking related disease costs the NHS around £1500m (\$2414m; €2095m) annually.³

Several methods are currently used for smoking cessation, including pharmacological methods such as nicotine replacement therapy or antidepressants (bupropion), hypnotherapy, and exercise based interventions. Behavioural approaches include stage based interventions, which largely use the transtheoretical model.⁷ This model separates individuals into five different stages: precontemplation, contemplation, preparation, action, and maintenance. Progression through the stages is sequential, although relapse to an earlier stage can occur. The model also recognises 10 processes of change, the theory being that the effectiveness of the different processes of change will vary according to the patient's stage, although this has not always been supported in empirical studies.⁸⁻¹⁰

Interventions derived from stage theories of behaviour change usually incorporate several key elements. It is necessary to identify accurately an individual's stage of change (or readiness to change), so that an intervention based on stage specific processes of change can be applied. Stage of change needs to be reassessed frequently, and the intervention should reflect changes in the individual's readiness to change. These elements of the intervention are repeated until the individual achieves and maintains the change in behaviour. In this way, stage based interventions evolve and adapt in response to the individual's movement through the stages of change.^{7 11}

Stage based models propose that interventions that take into account the current stage of the individual will be more effective and efficient than "one size fits

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bmj.com 2003;326:1175



A table of the included studies and references appear on bmj.com

all” interventions. Services aimed at smoking cessation have made extensive use of the approach. A recent survey on training in smoking cessation in England found that the stages of change model and motivational interviewing were the main topics covered in training courses, as well as the primary theory used to explain behaviour change.¹² Between April 2001 and March 2002 the UK government’s expenditure on smoking cessation services in England was £24.7m.¹³ This does not include nicotine replacement therapy or bupropion but does include training in smoking cessation for staff in primary and secondary care.^{13 14}

Despite the widespread use of stage based models, evidence on the effectiveness of this approach may be limited.^{15–18} We assessed the available evidence.

Methods

We searched 35 electronic databases from inception to July 2002 and the internet using several search

engines. The bibliographies of retrieved references were scanned for further relevant publications. The authors of abstracts in conference proceedings were contacted for further information.

Eligible for inclusion were randomised controlled trials evaluating the effectiveness of stage based interventions in influencing smoking behaviour—such as actual behaviour change or movement through different stages. No restrictions were applied to participants other than they had to be smokers, and there were no restrictions on language or publication date.

Two reviewers independently assessed the titles and abstracts and then assessed relevant papers against the predetermined selection criteria. Data were extracted by one reviewer into structured summary tables and checked by a second reviewer. Extracted data included smoking behaviour, movement through stages, adverse effects, and cost effectiveness.

Each included trial was assessed for methodological quality and the quality of the implementation of the

Table 1 Methodological quality of included studies with stage based interventions aimed at smoking cessation

Reference	Methodological quality*	1. Randomisation	2. Concealment of allocation	3. Blinding of participants	4. Blinding of outcome assessors	5. Blinding of care providers	6. Baseline comparability	6a. Adjustment for baseline differences	7. Completeness of follow up	8. Inclusion criteria
Berman et al 1995 ^{w1}	4/13	Yes	Not stated	Not stated	Not stated	No	Not stated	Not stated	No	Yes
Butler et al 1999 ^{w2}	9/13	Yes	Yes	Not stated	Yes	No	Yes	Not applicable	No	Yes
Cornuz et al 2002 ^{w3}	12/13	Yes	Yes	Yes	Yes	Yes	Yes	Not applicable	No	Yes
DiClemente et al 1991 ^{w4}	5/13	Yes	Not stated	Not stated	Not stated	No	No	No	Yes	Yes
Dijkstra et al 1999 ^{w5}	6/11	Not stated	Not stated	Not applicable	Not stated	Not applicable	No	Yes	Yes	Yes
Emmons et al 2001 ^{w6}	9/13	Yes	Yes	No	Not stated	No	Yes	Not applicable	Yes	Yes
Etter and Perneger 2001 ^{w7}	9/13	Yes	Not stated	No	Not stated	Not applicable	Yes	Not applicable	Yes	Yes
Gritz et al 1993 ^{w8}	3/13	Not stated	Not stated	Not stated	Not stated	No	Not stated	No	No	Yes
Lennox et al 1998 ^{w9}	8/13	Not stated	Yes	Yes	Not stated	No	No	Yes	No	Yes
Lennox et al 2001 ^{w10}	7/13	Yes	Not stated	Not stated	Not stated	Not stated	No	Yes	No	Yes
Morgan et al 1996 ^{w11}	5/13	Not stated	Not stated	Not stated	Not stated	No	No	No	Yes	Yes
Pallonen et al 1994 ^{w12}	2/12	Not stated	Not stated	Not applicable	Not stated	No	Not stated	Not stated	No	Yes
Pallonen et al 1998 ^{w13}	6/12	Yes	Not stated	Not stated	Not stated	Not applicable	Yes	Not applicable	No	Yes
Pieterse et al 2001 ^{w14}	8/13	Yes	No	Yes	Not stated	Not stated	No	Yes	No	Yes
Pletsch 2002 ^{w15}	6/13	No	Not stated	Not stated	Not stated	Not stated	Yes	Not applicable	Yes	Yes
Prochaska et al 2001 ^{w16}	5/13	Not stated	Not stated	Not stated	Not stated	Not applicable	Yes	Not applicable	No	Yes
Prochaska et al 2001 ^{w17}	5/13	Not stated	Not stated	Not stated	Not stated	Not stated	Yes	Not applicable	No	Yes
Reeve et al 2000 ^{w18}	3/13	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	No	No	Yes
Resnicow et al 1997 ^{w19}	7/13	Not stated	Not stated	Not stated	Not stated	No	No	Yes	Yes	Yes
Sinclair et al 1999 ^{w20}	3/13	Not stated	Not stated	Not stated	Not stated	No	Not stated	Not stated	Yes	Yes
Stotts et al 2002 ^{w21}	6/13	Yes	Yes	Not stated	Not stated	Not stated	No	Yes	No	Yes
Tappin et al 2000 ^{w22 w24}	8/13	Yes	Yes	Not stated	Not stated	Not stated	Yes	Not applicable	Yes	Yes
Wang 1994 ^{w23}	6/13	Not stated	Not stated	Not stated	Not stated	No	Yes	Not applicable	Yes	Yes

Continued on next page

Table 1 Methodological quality of included studies with stage based interventions aimed at smoking cessation—*continued from previous page*

Reference	Methodological quality*	9. Point estimates and variability	10. Drop outs (intention to treat)	11. Description of statistical methods	12. Sample size calculation	13. Comparability of treatment	14. Stage of change assessed at baseline	15. Stage of change instrument validated	16. Interventions tailored	17. Quality of implementation	18. Details of training reported
Berman et al 1995 ^{w1}	4/13	No	No	Yes	Not stated	Yes	Yes	Not stated	Partial	Yes	Not stated
Butler et al 1999 ^{w2}	9/13	Yes	Yes	Yes	Yes	No	Yes	Not stated	Yes	Not stated	Yes
Cornuz et al 2002 ^{w3}	12/13	Yes	Yes	Yes	Yes	Yes	Yes	Not stated	Yes	Yes	Yes
DiClemente et al 1991 ^{w4}	5/13	No	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Dijkstra et al 1999 ^{w5}	6/11	No	Yes	Yes	Not stated	Yes	Yes	Not stated	Yes	Not stated	Not applicable
Emmons et al 2001 ^{w6}	9/13	No	Yes	Yes	Yes	Yes	Yes	Not stated	Yes	No	Yes
Etter and Perneger 2001 ^{w7}	9/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not applicable
Gritz et al 1993 ^{w8}	3/13	No	Yes	Yes	Not stated	No	Yes	Not stated	Partial	Yes	Yes
Lennox et al 1998 ^{w9}	8/13	Yes	No	Yes	Yes	Yes	Yes	Yes	Health professionals	Yes	Yes
Lennox et al 2001 ^{w10}	7/13	No	Yes	Yes	Yes	Yes	Yes	Not stated	Yes	Yes	Not applicable
Morgan et al 1996 ^{w11}	5/13	No	Yes	Yes	Not stated	Yes	Not stated	Not stated	Yes	Yes	Yes
Pallonen et al 1994 ^{w12}	2/12	No	No	Yes	No	No	Yes	Not stated	Yes	Yes	Not stated
Pallonen et al 1998 ^{w13}	6/12	Yes	No	Yes	Not stated	Yes	Yes	Not stated	Yes	Yes	Not applicable
Pieterse et al 2001 ^{w14}	8/13	Yes	Yes	Yes	No	Yes	Yes	Not stated	Yes	Yes	Yes
Pletsch 2002 ^{w15}	6/13	Yes	No	Yes	No	Yes	Yes	Not stated	Yes	No	No
Prochaska et al 2001 ^{w16}	5/13	No	Yes	Yes	No	Yes	Yes	Not stated	Yes	No	Not applicable
Prochaska et al 2001 ^{w17}	5/13	No	Yes	Yes	No	Yes	Yes	Not stated	Yes	No	Not applicable
Reeve et al 2000 ^{w18}	3/13	No	No	Yes	No	Yes	Yes	Not stated	Yes	No	No
Resnicow et al 1997 ^{w19}	7/13	Yes	No	Yes	Yes	Yes	Yes	Not stated	Yes	Yes	Yes
Sinclair et al 1999 ^{w20}	3/13	No	Not stated	Not stated	Not stated	Yes	Not stated	Not stated	Yes	Yes	Yes
Stotts et al 2002 ^{w21}	6/13	No	No	Yes	No	Yes	Yes	Not stated	Yes	Yes	Yes
Tappin et al 2000 ^{w22 w24}	8/13	No	Yes	Yes	No	Yes	Yes	Not stated	Yes	Yes	Yes
Wang 1994 ^{w23}	6/13	Yes	Not stated	Yes	Not stated	Yes	Yes	Not stated	Health professionals	Not stated	Yes

* Maximum score for the 13 items is 11 or 12 if blinding of care providers, participants, or both not applicable. Quality assessment was carried out, using an existing quality assessment tool by one reviewer and checked by a second, using following predefined criteria: 1. method of intervention allocation reported; 2. intervention allocation concealed; 3. participants blind to existence of other conditions (scored as "not applicable" if group receiving no intervention at all was included; then blinding considered not possible); 4. outcome assessors blinded to intervention allocation; 5. care providers or educators blind to existence of other conditions (not applicable if intervention did not involve educators); 6. groups similar at baseline (if not similar, 6a. were analyses adjusted for these differences); 7. last follow up includes 80% or more of randomised participants; 8. eligibility criteria specified; 9. point estimates and measure of variability presented for primary outcome measure (behaviour change); 10. intention to treat analysis used or differences between drop outs and patients who completed trial explained; 11. statistical methods described; 12. calculation of statistical power or required sample size reported; 13. groups treated identical other than named interventions (scored as "yes" unless clear that contamination of interventions may have been present); 14. participants' stage of change assessed before intervention; 15. stages of change instrument validated; 16. interventions tailored to individual stage of change (yes, partial (for example, only booster sessions stage matched), intervention aimed at health professionals including some data on participants); 17. quality of implementation recorded; 18. details of training of people giving intervention reported where applicable.

intervention.¹⁹ Quality assessment was performed by one reviewer and checked by a second reviewer. Disagreements were resolved by discussion. We were unable to carry out pooling because the studies were too heterogeneous for interventions, participants, settings, and outcomes; therefore we present a qualitative synthesis.

Results

We identified 23 randomised controlled trials meeting our inclusion criteria^{w1-w23}; two included an economic evaluation.^{w2 w20}

Quality assessment

The methodological quality of the trials varied (table 1). We assessed 13 criteria for quality; the number present ranged from two to 12. The main limitations were: lack of blinding of participants, outcome assessors, or care providers; lack of details about methods of randomisation and concealment of allocation; failure to report a sample size calculation, point estimates, and measures of variability; poor follow up; and no intention to treat analysis.

The main problem with the quality of the implementation was the lack of information about

the validity of the instruments used to assess stage of change. This is important because stage based interventions depend on accurate assessment of the stages. It was therefore difficult for us to determine the extent to which interventions were stage based.

Effectiveness

In eight trials we found statistically significant differences in cessation rate in favour of the intervention group (table 2).^{w3 w4 w7 w11 w12 w14 w16 w23} In seven of these the comparator was usual care^{w3 w7 w11 w12 w14 w16 w23} and in one a non-stage based intervention.^{w4}

In 12 trials we found no statistically significant differences between groups in smoking behaviour after the intervention.^{w1 w5 w6 w8-w10 w13 w15 w18-w20 w22} In five of these the comparator was usual care,^{w5 w8 w15 w20 w22} and in eight a non-stage based intervention.^{w1 w5 w6 w9 w10 w13 w18 w19}

In three studies the findings were inconclusive, for three reasons.^{w2 w17 w21} Firstly, when there were multiple outcomes for smoking behaviour, some were positively influenced by the intervention (self reported abstinence in previous 24 hours, percentage smoking within five minutes of waking), whereas others were not (self reported abstinence in previous month, attempts at quitting, and numbers of cigarettes cut down).^{w2} Secondly, when the effectiveness of more than one stage based intervention was examined and the direction of the effects of these interventions differed—for example, two stage based interventions (interactive expert system and expert system plus counsellor calls) showed statistically significant effects in comparison with the no intervention control group, favouring the stage based interventions, whereas the third stage based intervention (expert system plus stimulus control computer) showed no statistically significant effects at six

and 12 months and statistically significant effects favouring the no intervention control group at 18 months.^{w17} Thirdly, when participants were assessed at different points of follow up, and the short term follow up (six weeks) showed statistically significant effects of the intervention, but at longer term follow up (three and six months) differences were no longer statistically significant.^{w21} In each case, whether multiple outcomes, multiple interventions, or multiple assessments, there was no clear evidence on the effectiveness of the interventions, and we therefore classified them as inconclusive. Only 10 trials reported movement through stages as an outcome.^{w2 w3 w5 w9 w12 w13 w15 w18 w21 w22} In five trials this was in comparison with a non-stage based intervention.^{w2 w5 w9 w13 w18} One trial showed statistically significant effects in favour of the stage based intervention.^{w2} In another trial, findings were inconclusive,^{w5} and in three trials no statistically significant differences between groups in movement through stages were found.^{w9 w13 w18} In six trials this was in comparison with usual care.^{w3 w5 w12 w15 w21 w22} In two trials, findings were inconclusive.^{w5 w12} In four trials, no statistically significant differences between groups in movement through stages were found.^{w3 w15 w21 w22}

Differences in effectiveness between studies

The trials reporting positive effects for the stage based interventions were compared in a qualitative way with the remaining trials on several dimensions that could have influenced the findings. These included methodological quality, number, mean age and sex of respondents, type of respondents, year of publication, setting, and type of outcome measures (table 3). Overall, larger studies tended to report more positive outcomes of the stage based interventions than smaller

Table 2 Summary results of included studies with interventions aimed at smoking cessation

Reference	Methodological quality*	Stage based versus non-stage based			Stage based versus no intervention		
		Mainly significant†	Mixed outcomes‡	No significant difference	Mainly significant†	Mixed outcomes‡	No significant difference
All interventions		1	2	8	7	2	6
Berman et al 1995 ^{w1}	4/13	—	—	Yes	—	—	—
Butler et al 1999 ^{w2}	9/13	—	Yes	—	—	—	—
Cornuz et al 2002 ^{w3}	12/13	—	—	—	Yes	—	—
DiClemente et al 1991 ^{w4}	5/13	Yes	—	—	—	—	—
Dijkstra et al 1999 ^{w5}	6/11	—	—	Yes	—	—	Yes
Emmons et al 2001 ^{w6}	9/13	—	—	Yes	—	—	—
Etter and Perneger 2001 ^{w7}	9/13	—	—	—	Yes	—	—
Gritz et al 1993 ^{w8}	3/13	—	—	—	—	—	Yes
Lennox et al 1998 ^{w9}	8/13	—	—	Yes	—	—	—
Lennox et al 2001 ^{w10}	7/13	—	—	Yes	—	—	Yes
Morgan et al 1996 ^{w11}	5/13	—	—	—	Yes	—	—
Pallonen et al 1994 ^{w12}	2/12	—	—	—	Yes	—	—
Pallonen et al 1998 ^{w13}	6/12	—	—	Yes	—	—	—
Pieterse et al 2001 ^{w14}	8/13	—	—	—	Yes	—	—
Pletsch 2002 ^{w15}	6/13	—	—	—	—	—	Yes
Prochaska et al 2001 ^{w16}	5/13	—	—	—	Yes	—	—
Prochaska et al 2001 ^{w17}	5/13	—	—	—	—	Yes	—
Reeve et al 2000 ^{w18}	3/13	—	—	Yes	—	—	—
Resnicow et al 1997 ^{w19}	7/13	—	—	Yes	—	—	—
Sinclair et al 1999 ^{w20}	3/13	—	—	—	—	—	Yes
Stotts et al 2002 ^{w21}	6/13	—	—	—	—	Yes	—
Tappin et al 2000 ^{w22 w24}	8/13	—	—	—	—	—	Yes
Wang 1994 ^{w23}	6/13	—	Yes	—	Yes	—	—

*Maximum score for the 13 items is 11 or 12 if blinding of care providers, participants, or both, not applicable.

†Mainly significant outcomes in favour of stage based intervention.

‡Either one stage based intervention showed significant effects and another stage based intervention did not; some behavioural outcomes showed significant effects in favour of stage based intervention and others did not; or analyses were not conclusive.

Table 3 Summary table of issues related to effectiveness of interventions aimed at smoking cessation

Study details	No	Stage based versus non-stage based intervention			Stage based versus no intervention		
		Mainly significant*	Mixed outcome†	No significant difference	Mainly significant*	Mixed outcome†	No significant difference
Quality of studies (No of items addressed):							
≤4	5	0	0	2	1	0	2
5-8	14	1	1	5	4	2	4
>8	4	0	1	1	2	0	0
No of participants:							
≤100	4	0	1	1	1	0	2
101-500	8	0	0	3	2	1	2
501-1000	4	0	1	1	2	0	1
>1000	7	1	0	3	2	1	1
Year of publication:							
Before 1996	5	1	1	1	2	0	1
1996-98	4	0	0	3	1	0	0
1999-2000	5	0	1	2	0	0	3
2001 or later	9	0	0	2	4	2	2
Setting:							
Community	9	1	0	4	3	1	1
Clinic	13	0	2	3	4	1	5
School	1	0	0	1	0	0	0
Mean age (years):							
≤30	5	0	0	2	0	1	2
31-40	7	1	0	2	3	1	0
41-50	5	0	2	2	2	0	1
>50	3	0	0	0	2	0	1
Respondents:							
Patients	2	0	0	0	1	0	1
People on low income	4	0	0	3	0	0	1
Students	1	0	0	1	0	0	0
Pregnant women	2	0	0	0	0	1	1
Volunteers	14	1	2	4	6	1	3
Sex:							
>60% female	9	1	1	3	1	1	3
>60% male	5	0	1	1	3	0	1
Self report measures:							
Only self report	16	1	2	6	5	1	3
Self report with verification	7	0	0	2	2	1	3

*Mainly significant outcomes in favour of stage based intervention.

†Either one stage based intervention showed significant effects and another stage based intervention did not; some behavioural outcomes showed significant effects in favour of stage based intervention and others did not; or analyses were not conclusive.

studies. This was also the case for studies that relied on smoking status being self reported rather than validated. For studies that compared a stage based intervention with a non-stage based intervention, more recent studies were less likely to report positive outcomes related to stage based interventions. None of the other factors seemed to differ between studies that reported positive outcomes of stage based interventions and studies that failed to find positive effects. Studies that compared a stage based intervention with usual care, studies of a higher quality, studies that were set in the community, or studies where the participants were male, volunteers, or people aged between 30 and 60 years tended to report more positive effects in favour of stage based interventions. The usefulness of this information is not clear, however, as these findings may have resulted from chance, because of the small number of studies in each group.

Cost effectiveness

Two trials included an economic evaluation.^{w2 w20} In a 1999 study evaluating the effects of motivational consulting delivered by general practitioners, the marginal cost per person who quit was estimated at £450.65, which could fall to an extreme of £265.00 with increased use.^{w2} In another 1999 study, in which

pharmacists provided tailored advice on smoking cessation, the incremental cost effectiveness ratio for the intervention was estimated at £300.00 per person who quit.^{w20}

Stage assessment

Only two trials evaluating stage based interventions reported information on the validation of the instrument used to assess stage of change (Biener's contemplation ladder and the University of Rhode Island change assessment).^{w1 w9} The level of validation of the instruments was limited both for internal reliability and construct validity.

Discussion

Despite the widespread and uncritical use of stage based interventions in smoking cessation, we found only limited evidence for their effectiveness.^{20 21} This could be due in part to problems with the way in which stage based interventions have been used or implemented in practice rather than to problems with the model. Studies with positive outcomes may have utilised more fully the processes of change within their design. However, the studies included in our review provided little evidence to support this assumption.

Similarly, participants' degree of exposure to the intervention did not seem to be related to the effectiveness of the intervention either.

From a theoretical perspective, the effectiveness of any stage based intervention depends on accurate classification of a participant's particular stage of change. However, only two of the 23 included trials used a previously validated instrument, and the level of validation was limited.

Many of the included studies provided only a limited description of the content of the intervention, making it difficult for us to determine if, how, and to what extent stages of change were used in tailoring the intervention. In particular, it was unclear whether the intervention was tailored to a participant's particular stage of change.

Finally, the duration of follow up may have been inadequate to assess changes in movement through stages or smoking behaviour. Twelve of the studies lasted between three and nine months, whereas the action stage was often defined as having quit smoking within the past six months and the maintenance stage as having quit smoking more than six months previously.

Conclusion

Although there is a substantial volume of research focusing on stages of change, much of it does not address the effectiveness of the approach in changing smoking behaviour. Studies that have evaluated effectiveness have often used designs that are not optimal for establishing evidence of effect. There is a need for well designed and appropriately implemented randomised controlled trials that are based on appropriately staged interventions. These can only be derived from accurate measurement of the individual's stage of smoking, involving frequent reassessment of readiness to change to provide evolving, stage specific interventions.

We evaluated the effectiveness of interventions based on one theoretical approach—stage based approaches to smoking cessation. The evidence suggests that stage based interventions are no more effective than non-stage based interventions or no intervention in changing smoking behaviour. Further systematic reviews are needed to evaluate the effectiveness of interventions based on other theoretical approaches.

Evidence for the effectiveness of the stages of change approach in changing smoking behaviour is limited. The methodological quality of the included randomised controlled trials was mixed and few reported any validation of the instrument used to assess participants' stage of change. There was little consistency in the types of interventions employed once participants were classified into stages, and often the description of the intervention was so limited that it was unclear whether the intervention was properly stage based. Methodologically sound and theoretically consistent intervention studies are required to assess adequately the efficacy of stage based approaches to changing smoking behaviour.

Contributors: RPR drafted the paper and the original health technology assessment report and selected, quality assessed, and analysed the data; he will act as guarantor for the paper. JP and CB commented on the paper and were involved in writing the original health technology assessment report and selected and quality assessed the data. JP contributed to the original research

What is already known on this topic

The health hazards of smoking are significant and well established

It costs the NHS around £1500m a year to treat patients with smoking related disease

Stage based interventions are widely used in smoking cessation in England

What this study adds

Limited evidence exists for the effectiveness of stage based interventions when compared with non-stage based or no interventions in changing smoking behaviour

proposal. AJS commented on the paper and original health technology assessment report, was responsible for the overall management of the review, wrote the proposal for the research funding, contributed to the protocol, and was involved in decisions about the inclusion or exclusion of papers and quality assessment. LM commented on the paper and the original health technology assessment report and developed the search strategies. ISW contributed to the research proposal and the development of the protocol, assisted in the management of the review, was involved in discussions about the inclusion or exclusion of papers and quality assessment, and commented on the paper and the original health technology assessment report. AW contributed to the development of the protocol and commented on the paper and the original health technology assessment report.

Funding: NHS research and development health technology assessment programme.

Competing interests: None declared.

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(Accepted 11 April 2003)