ELSEVIER

Patient Education and Counseling 43 (2001) 161–169

Patient Education and Counseling

www.elsevier.com/locate/pateducou

Behavioural effect of self-treatment guidelines in a self-management program for adults with asthma

Job van der Palen[a,*], Jakob J. Klein[a], Gerhard A. Zielhuis[b], Cees L.A. van Herwaarden[c], Erwin R. Seydel[d]

[a]*Department of Pulmonary Medicine, Medisch Spectrum Twente, Postbus 50000, 7500KA Enschede, The Netherlands*
[b]*Department of Epidemiology, University of Nijmegen, Nijmegen, The Netherlands*
[c]*Department of Pulmonary Medicine, University Hospital, Nijmegen, The Netherlands*
[d]*Department of Psychology, University of Twente, Twente, The Netherlands*

Received 5 January 2000; received in revised form 20 May 2000; accepted 29 July 2000

Abstract

To assess the efficacy of self-management programs it is important to know what behavioural changes take place. This paper assesses whether including self-treatment guidelines (action plans) in a self-management program for adult asthmatics, leads to greater behavioural changes than a program without these guidelines. Patients were randomised into a self-treatment group ($n = 123$) or an active control group ($n = 122$). All subjects received self-management training. Discussed topics included the pathophysiology of asthma, medication and side-effects, triggers, symptoms, smoking, physical exercise, and compliance. The only difference was that the self-treatment group received instructions about self-treatment of exacerbations and the control group did not. At 1 year of follow-up asthma-specific self-efficacy expectancies, outcome expectancies, and asthma-specific knowledge improved significantly in all patients. Only self-treatment group patients demonstrated favourable changes in generalised self-efficacy, social support, and self-treatment and self-management behaviour, in case of a hypothetical scenario of a slow-onset exacerbation. We conclude that our self-management program is effective in changing the behavioural variables, and including self-treatment guidelines (action plans) has added benefit.

Keywords: Asthma; Patient education; Self-management; Self-treatment; Randomised controlled trial; Attitude

1. Introduction

Asthma self-management training is thought to be essential in the treatment of adult asthma [1,2]. In this paper, *self-management* is defined as effective behaviour regarding asthma, based on sufficient knowledge about asthma and its provoking factors, adequate coping behaviour, compliance with inhaled medication, attention to changes in disease severity, adequate inhalation technique, and the correct use of a peak flow meter. One of the components of self-management believed to be important is the self-adjustment of the inhaled medication by the patient with changing disease severity. We use the term *self-treatment* when patients are provided with written guidelines to self-adjust their inhaled steroids or to start a short course of oral steroids when necessary, based on symptom perception and/or peak expiratory flow

* Corresponding author. Tel.: +31-53-4872023; fax: +31-53-4872638.
E-mail address: vdpalen@euronet.nl (J. van der Palen).

0738-3991/01/$ – see front matter
PII: S0738-3991(00)00155-5

(PEF) values. In some countries, this is referred to as an *action plan*.

Many studies have evaluated the efficacy of such self-management programs by measuring outcome parameters such as lung function, quality of life, the number of symptom-free days, or reductions in hospital admissions [3–8], while others measured changes in parameters such as asthma-specific knowledge, inhalation technique, or compliance [3,9–12]. The latter are considered to be intermediate variables, representing behavioural changes necessary for improvements in the outcome parameters. In the course of a self-management program, improvements in, for example, lung function can be caused by more effective medical therapy and/or positive behavioural changes. It would be of interest to determine, what these two considerations contribute in the period between the intervention and the outcome assessment.

Bandura has described a social cognitive theory, a model of behavioural change, of which Fig. 1 is an adaptation [13]. According to this theory, knowledge is a necessary but insufficient factor to realise the change in behaviour of asthmatic patients. Therefore, an increase in asthma-specific knowledge would not in itself lead to improved health [14]. To achieve behavioural changes, the patient's general and asthma-specific self-efficacy expectancies and outcome expectancies should be increased, and more social support by important others should be established, in order to increase the intentions towards self-management behaviour. This should preferably be done by letting the patient experience successful behaviour. Issuing self-treatment guidelines (action plans) for exacerbations would fit very well in this approach. Self-efficacy expectancy refers to beliefs in one's capabilities to execute the recommended courses of action successfully, which influences the quality and nature of decisions related to medical recommendations [15]. For example, an individual may be convinced that early treatment of exacerbations of asthma may reduce the duration and severity of the exacerbation (high outcome expectancy). At the same time, this person may not consider himself capable of recognising the onset of an exacerbation at an early stage, or may not know how to stop the developing deterioration (lack of knowledge). According to the model of Bandura, increased self-efficacy expectancies could also directly lead to a change in behaviour.

This paper assesses whether including self-treatment guidelines (action plans) in a self-management program for adult asthmatics leads to greater behavioural changes than a similar program without these guidelines. This will be done by evaluating parameters indicating behavioural changes, such as compliance, inhalation technique, generalised and asthma-specific self-efficacy, outcome expectancies, intentions regarding self-management, and the level of social support, following the program. In addition, alterations in asthma-specific knowledge are reported. Finally, an evaluation of the social cognitive theory of Bandura will be performed. Changes in outcome parameters such as lung function and quality of life are reported separately.

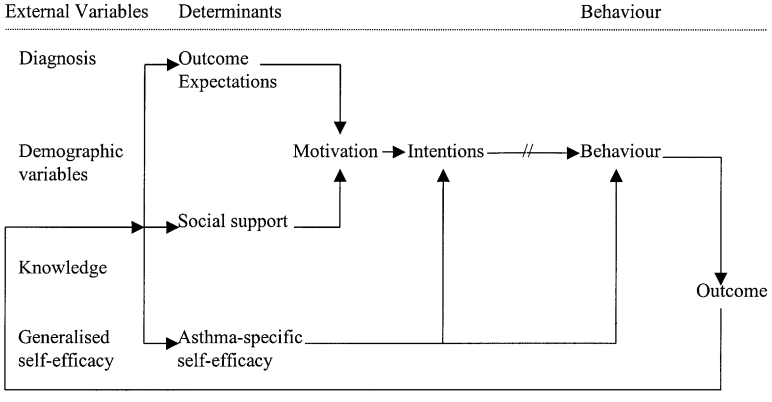

Fig. 1. Model of the social learning theory, adapted to Bandura.

2. Methods

2.1. Study design

The study was performed as a single centre, randomised parallel group trial with a 1 year follow-up. Patients were randomised into a self-treatment group (group S) or an active control group (group C) by a closed envelope method. All subjects received self-management training and education by a specialised asthma nurse in three 90 min small group sessions (5–10 patients, partners were also invited to attend). Patients were given brief information on the pathophysiology of asthma, the role of medication and side-effects, allergic and non-allergic triggers, and symptoms indicating an impending exacerbation. Patients were encouraged to ask questions and discuss personal matters related to their disease. Discussed topics included smoking cessation, problems due to tobacco smoke in the environment, the importance of physical exercise, lack of understanding concerning asthma in neighbourhood and working environments, and compliance with maintenance therapy. In addition, all patients were instructed in the correct use of their inhaled medication and a peak flow meter. The only difference between the two groups was that group S also received instructions about the self-treatment of exacerbations during the third session and group C did not. Prior to the intervention and after 1 year patients were asked to keep a diary for 2 weeks, reporting on symptoms, medication use, and PEF.

2.1.1. Compliance

Two aspects of compliance will be addressed: self-reported compliance with inhaled steroids and self-reported compliance with self-treatment guidelines (action plans) (for group S only). The data were extracted from the 2-week diaries that patients had to complete every 4 months. The diaries contained information about medication, peak flow values and symptoms. Compliance was defined as the number of actual inhalations used divided by the number of inhalations prescribed $\times$ 100%, and was deemed good if it was 75% or above, and poor if below 75%. Compliance with self-treatment guidelines (action plans) was evaluated on days when patients experienced more asthma symptoms and/or PEF was between 60 and 80% of their personal best value on two consecutive days. If this was the case, patients in group S were instructed to double the number of inhalations of inhaled steroids. Some patients already did this prior to the self-management program on the instigation of their chest physician. Therefore, the percentage of patients doubling their inhaled steroids was calculated both prior to the intervention and 1 year after the self-management program.

2.1.2. Inhalation technique

Inhalation technique prior to instruction was assessed by one of 12 well-trained lung function technicians by means of inhaler-specific checklists adapted from checklists of the Dutch Asthma Foundation. Details are described elsewhere [16]. For each inhaler, items essential for delivering the active drug into the lungs were identified. When errors are made regarding to these key actions, it is likely that no or only an insignificant amount of medicine will be inhaled. These essential manoeuvres were different for the various types of inhalers. Every patient was assessed by one lung function technician only. When errors in inhalation technique were observed, patients were individually instructed by the lung function technician in the correct use of their devices. A videotaped instruction for use at home and a copy of their inhaler-checklist were provided to each patient. After 1 year of follow-up, the proficiency with the inhaler was re-evaluated using the same checklist.

2.1.3. Self-efficacy

Generalised and asthma-specific self-efficacy, outcome expectancies, intentions regarding self-management, and the level of social support were measured by a self-administered questionnaire before and 1 year after the intervention. The questionnaires were adapted from Schwarzer [17] and from Boer [18]. Higher scores represent greater generalised self-efficacy expectancies, outcome expectancies, intentions towards self-management, and more social support. For asthma-specific self-efficacy a lower score indicates higher asthma-specific self-efficacy expectancies. Cronbach's alpha was 0.87 for the generalised self-efficacy questionnaires, 0.86 for the asthma-specific self-efficacy questionnaires, 0.67 for outcome expectancies, 0.74 for the intentions regarding self-management, and 0.88 for questions regarding the

level of social support. Further details of these questionnaires have previously been reported [19,20].

2.1.4. Knowledge

Asthma-specific knowledge and knowledge of what to do in case of an exacerbation are also reported on. Asthma-specific knowledge was assessed using seven questions related to asthma medication. Medication knowledge scores are expressed as the percentage of correct answers given (0–100%). Knowledge of correct self-management and self-treatment behaviour was operationalised through a hypothetical scenario, in which patients were asked, how they would act in case of a slow-onset asthma exacerbation. This has the advantage that it is possible to assess likely behaviour in a situation that is familiar to them. A limitation is that the answers might reflect 'ideal behaviour', that is not achieved in reality. Patients had three options:

1. Refrain from any action at all or start or increase bronchodilating medication only.
2. Start or increase inhaled or oral steroids.
3. Call the general practitioner or chest physician.

Self-treatment behaviour was considered adequate, if patients indicated that they would, on their own initiative, start or increase inhaled or oral steroids (option 2), whether or not in combination with seeking medical help (option 3). Patients were considered to adequately *manage* themselves if they would seek medical assistance (option 3) irrespective of starting or increasing inhaled or oral steroids with increasing symptoms (option 2). Defined in this way, self-treatment is a part of the broader concept of self-management. Option 1 is considered inadequate behaviour; it should be noted that bronchodilators will alleviate acute symptoms but will not diminish the inflammation responsible for the exacerbation.

The study protocol was approved by the hospital's ethics committee, and all subjects signed the informed consent form.

2.2. Patients

Adults (age between 18 and 65 years) with a clinical diagnosis of asthma who were in a stable phase of their disease during the last 6 weeks were eligible for enrolment. Additionally, they should have used inhaled steroids (at least 200 μg/day by metered dose inhaler (MDI) or 400 μg/day by dry powder inhaler) for at least 3 months. Patients with other serious internal disease or with psychiatric morbidity were excluded.

2.3. Statistical analysis

Analyses of inhalation technique are based on the proportion of patients performing all essential inhalation manoeuvres on the checklist correctly. Before-after comparisons for continuous variables were done with the paired t-test. Between-group differences were analysed with the unpaired t-test. Ninety-five percent confidence intervals (95CI) are presented. Differences in proportions were tested using the Chi-square test and before-after changes in proportion were assessed by McNemar's test.

3. Results

3.1. Patient characteristics

Between August 1995 and April 1996, a search of the outpatient clinic database of the Department of Pulmonary Medicine of a 1100 bed teaching hospital in Enschede, The Netherlands, identified 485 patients with a diagnosis of asthma. They were all invited by mail to participate in a self-management trial, and within 10 days they were contacted by telephone. Of these subjects 157 (32%) declined to participate. The most mentioned reasons were ''no time'' or ''not interested''. Their average age was 40.4 years (S.D. 13.1), and 68 (44.7%) were men. The remaining 328 patients were invited for inclusion tests at the pulmonary function laboratory. After these tests, 83 patients were excluded, because they did not fulfil our lung function criteria. The remaining 245 patients — 123 in group S and 122 in group C — took part in the educational sessions. Characteristics are presented in Table 1. The groups were comparable in terms of demographic and clinical characteristics. The patients who refused were slightly younger, but had a comparable gender distribution. After 1 year, only seven patients were lost to follow-up (Fig. 2).

Table 1
Baseline characteristics of the patients in the self-treatment (S) and control (C) group

	Group S ($n = 123$)	Group C ($n = 122$)
Gender (M/F)	51/72	60/62
Mean age in years (S.D.)	43.5 (11.8)	45.2 (12.0)
Education (%)		
Low	38.0	32.0
Medium	35.5	41.0
High	26.5	27.0
Mean duration of asthma in years (S.D.)	21.5 (15.4)	18.4 (14.2)
Skin Prick Test (% positive)	68.1	68.3
Smoking (%)		
Non-smokers	54.4	51.7
Ex-smokers	35.8	35.2
Smokers	9.8	13.1
Inhaled steroids in μg/day, MDI equivalent (S.D.)[a]	627 (443)	561 (341)
FEV_1%predicted (S.D.)	76.0 (19.9)	76.9 (20.0)
Morning PEF in l/min (S.D.)	380.6 (112.6)	388.4 (106.5)

[a] The dose of inhaled steroids in dry powder inhalers was considered equipotent to half the dose in metered dose inhalers. Fluticasone propionate was considered twice as potent as beclomethasone dipropionate and budesonide.

3.2. Self-reported compliance with medication

Because no differences in self-reported compliance were found between group S and group C, the pooled results are presented. For 23 patients no data of the two-week period prior to the intervention were available. Of the remaining 222 subjects, 94.1% showed good compliance at baseline. After a year compliance dropped slightly (90.1%) in 213 patients for whom data were available ($p = 0.08$).

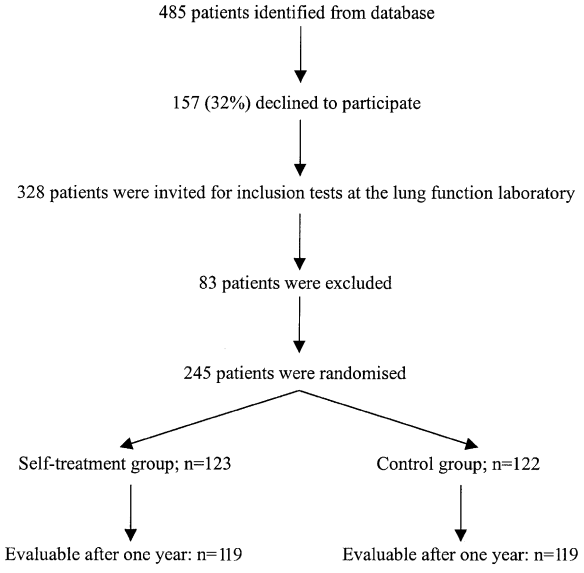

Fig. 2. Sequence of recruitment, measurements, and interventions.

3.3. Self-reported compliance with self-treatment guidelines (action plans) (group S only)

During the 2-week run-in-period, 31 patients experienced a deterioration of their asthma. Of these, seven (20.6%) already doubled their inhaled steroids according to symptoms and/or PEF values before the individual self-treatment guidelines (action plans) were issued to them. During the last 2 weeks of the study there was a slight but insignificant increase in the proportion of patients who adjusted their medication in case of an increase in symptoms or a decline in PEF (eight out of 24 patients (33.3%); $p = 0.37$).

3.4. Inhalation technique

The same type of inhaler was used by 171 patients throughout the study period. The percentage of

patients with faulty inhalation technique was similar in both groups. Therefore, the pooled results are presented. Prior to the instruction, 125 out of 171 patients (73.1%) demonstrated the correct inhalation technique. After 1 year, this had increased to 82.5% ($p = 0.041$).

3.5. Generalised and asthma-specific self-efficacy expectancies, outcome expectancies, intentions towards self-management, and social support

Only in group S was a small (3.5%) but statistically significant improvement in generalised self-efficacy found. Both groups S and C showed large improvements in asthma-specific self-efficacy expectancies (14% and 13% increase, respectively). Significant but small (4%) increases in outcome expectancies for both groups were also found, but intentions towards self-management remained unchanged. Finally, social support increased by 7% for group S and by 5% for group C. The level of social support at follow-up was higher for group S than for group C (Table 2).

3.6. Asthma-specific knowledge

No differences were found between group S and group C, so pooled results are given ($n = 236$). Prior to the intervention 60.4% (S.D. 24.3) of the questions were answered correctly. This increased to 80.7% (S.D. 20.9) at 1 year following the self-management program. The mean individual increase in knowledge (20.3; 95%CI 17.3; 23.1) was substantial.

3.7. Hypothetical self-treatment and self-management behaviour

Only group S patients showed improvements in both self-treatment and self-management behaviour in case of a hypothetical scenario of a slow-onset exacerbation. Changes in group C were small and not significant (Table 3).

Table 2
Generalised and asthma-specific self-efficacy expectancies, outcome expectancies, intentions towards self-management, and social support before and 1 year after a self-management program in the self-treatment (S) group and the control (C) group[a]

	Group S ($n = 115$)	Group C ($n = 116$)	p-Value
Generalised self-efficacy (scale 1–4)			
Before	2.87 (0.39)	2.83 (0.36)	0.472
After	2.97 (0.40)	2.86 (0.36)	0.036
Mean change over 1 year (95CI)	0.10 (0.04; 0.16)	0.03 (−0.03; 0.10)	
Asthma-specific self-efficacy(scale 1–5)			
Before	2.45 (0.55)	2.44 (0.58)	0.911
After	2.10 (0.56)	2.12 (0.47)	0.769
Mean change over 1 year (95CI)	−0.35 (−0.44; −0.26)	−0.32 (−0.41;−0.24)	
Outcome expectancies (scale 1–5)			
Before	3.71 (0.46)	3.66 (0.49)	0.412
After	3.87 (0.48)	3.82 (0.47)	0.437
Mean change over 1 year (95CI)	0.16 (0.06; 0.26)	0.16 (0.06; 0.26)	
Intentions (scale 1–5)			
Before	4.16 (0.52)	4.13 (0.58)	0.656
After	4.22 (0.56)	4.16 (0.62)	0.391
Mean change over 1 year (95CI)	0.06 (−0.03; 0.15)	0.03 (−0.06; 0.12)	
Social support (scale 1–5)[b]			
Before	3.66 (1.02)	3.41 (0.91)	0.096
After	3.90 (0.88)	3.59 (0.90)	0.023
Mean change over 1 year (95CI)	0.24 (0.08; 0.40)	0.18 (−0.02; 0.36)	

[a] Data are means (S.D.).
[b] Data available for 86 patients in group S and 82 in group C.

Table 3
Proportion (%) of patients reporting adequate self-treatment and self-management behaviour in a hypothetical scenario of a slow-onset exacerbation before and one year after a self-management program in the self-treatment (S) group and the control (C) group

	Group S ($n = 115$)	Group C ($n = 116$)	p-Value
Adequate self-treatment behaviour			
Before	51 (41.5)	50 (41.0)	0.94
After	76 (66.7)	54 (47.4)	0.003
p-Value for difference[a]	$p < 0.001$	$p = 0.36$	
Adequate self-management behaviour			
Before	65 (52.8)	59 (48.8)	0.48
After	84 (73.7)	66 (56.9)	0.008
p-Value for difference[a]	$p = 0.001$	$p = 0.127$	

[a] McNemar's test.

4. Discussion

Following the self-management program, all patients demonstrated great improvements in asthma-specific self-efficacy expectancies and knowledge of asthma-medication, while a modest improvement in inhalation technique was found. Also, small but significant increases in outcome expectancies were found for all patients.

For group S only, self-treatment and self-management behaviour in case of a hypothetical scenario of an asthma-exacerbation changed for the better and small favourable changes were observed in generalised self-efficacy and social support.

Intentions towards self-management did not change. This was not really to be expected, firstly because at baseline these intentions were already strongly established with an average score of over 4.1 on a five-point scale, and secondly because all patients voluntarily participated in the self-management program.

Other self-management programs have also demonstrated increases in compliance, inhalation technique, or asthma-specific knowledge [9–12,21]. It is not surprising that in the present study no favourable changes in medication compliance were found, because almost all patients (94.1%) reported to be compliant at baseline. It must be noted, however, that self-report of compliance tends to overestimate actual medication use [22,23]. In a pilot study of our self-management program, we measured compliance using electronic inhalers and electronic PEF meters [24]. Before the educational intervention 83% of the patients took at least 75% of the prescribed number of inhalations, and this increased to 92% following the program. These percentages correspond reasonably well with the self-reported compliance, in this study. Compliance with the self-treatment guidelines (action plans) for patients in group S increased by more than 60% compared to baseline values, but was still low because only one-third of the patients increased their inhaled steroids when their asthma deteriorated. Also, these data relate to self-reported behaviour so a potential for overestimation exists. The study by Lahdensuo et al. showed that patients seem remarkably compliant with self-treatment guidelines (action plans) that involve self-administration of steroid tablets [8].

Two review articles, relating to outcome parameters such as hospital admissions, doctor and emergency room visits, lung function, and symptoms have been produced by the Cochrane collaboration; one on the value of limited information alone for adults with asthma [25], and another on self-management programs [26].

Self-management behaviour in a hypothetical scenario has been investigated before [27–30]. However, to our knowledge this has not been done both before and after a structured self-management program except in a pilot-study of the same self-management program with 24 participating adults with asthma [19]. In that trial, prior to the intervention more than 60% of the patients lacked practical knowledge of self-treatment of a slow-onset exacerbation of asthma, which is

identical to what was observed in the present study. The educational program of the pilot study resulted in a significant increase of this knowledge to 86% at 5 months after its completion. The lower percentage of the present study (67%) might be explained by the longer period of follow-up. Actual self-treatment behaviour in the pilot-study, as recorded by the patients 5 months after completing the educational program, was adequate in only one-fifth of patients who experienced an exacerbation during the study period compared to one-third in the current larger study with 1 year of follow-up. Dekker et al. [27] found that only one-third of patients took appropriate medication in case of an impending exacerbation, which is somewhat lower than in the present study, in which approximately 40% of patients knew what to do in a hypothetical scenario of an exacerbation. As indicated by Bandura [13], this argues for including practical skills in a self-management program, apart from increasing knowledge. Kolbe et al. [29], asked 80 patients with moderate to severe asthma who previously had experienced a serious asthma exacerbation to describe the action they would take in response to a hypothetical evolving attack of gradually increasing severity. Most patients (85%) indicated that they would increase inhaled beta-agonist and use their action plan and/or seek urgent medical advice at an appropriate time (74%). When a severe life-threatening situation was described, only 50% indicated that they would call emergency services, despite the fact that these patients had received considerable education and training about how to manage asthma. Kolbe et al. [30] also found that 56% of 137 patients admitted to the hospital for severe asthma had insufficient knowledge of what to do, while in practice as many as 84% had acted inadequately. These results show that there is a large discrepancy between knowledge and behaviour, which is confirmed both in our present study and in our previously mentioned pilot study [19].

The GRASSIC study looked at asthma-specific self-efficacy, but no difference between the intervention group and control group was found [31]. Results at baseline are not presented, so a possible increase is unknown. Furthermore, in this study the self-treatment guidelines (action plan) only provided an option for taking steroid tablets or seeking help. The option to increase inhaled steroids was lacking. This might explain the more negative results of this study. Also, Snyder et al. described asthma-specific self-efficacy in a trial of self-management, but no actual results concerning self-efficacy are reported [21].

In both of our study groups, asthma-specific knowledge, asthma-specific self-efficacy, and outcome expectancies increased, which, according to the model adapted to Bandura (Fig. 1), should have positively influenced the intentions towards self-management. This should have occurred even more so in group S, because generalised self-efficacy expectancies, social support, and knowledge of what to do in case of an imminent exacerbation also improved. However, because prior to the self-management program these intentions were already firmly present with an average score of over 4.1 on a five-point scale, an improvement was barely possible. There was also little room for better medication compliance, because baseline compliance was already over 90%.

When evaluating the social cognitive theory of Bandura, it seems that only the increased general and asthma-specific self-efficacy expectancies can explain the observed modest changes in behaviour, because these are the only variables that can directly influence behavioural change. Although outcome expectancies also increased, this did not result in increased intentions towards self-management because of the high level of prior intentions.

We conclude that the social cognitive theory of Bandura can help explain the observed changes, and that our self-management program is effective in changing behavioural variables, and including self-treatment guidelines (action plans) has added benefit.

Acknowledgements

This research has been sponsored by The Netherlands Asthma Foundation, the ‘Stichting Astmabestrijding Nederland’, and GlaxoWellcome.

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