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***published in***

Patient Education and Counseling  
2001

***DOI (link to publisher)***

[10.1016/S0738-3991\(00\)00195-6](https://doi.org/10.1016/S0738-3991(00)00195-6)

***document version***

Publisher's PDF, also known as Version of record

[Link to publication in VU Research Portal](#)

***citation for published version (APA)***

van Es, S. M., Nagelkerke, A. F., Colland, V. T., Scholten, R. J. P. M., & Bouter, L. M. (2001). An intervention programme using the ASE-model aimed at enhancing adherence in adolescents with asthma. *Patient Education and Counseling*, 44(3), 193-203. [https://doi.org/10.1016/S0738-3991\(00\)00195-6](https://doi.org/10.1016/S0738-3991(00)00195-6)

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Patient Education and Counseling 44 (2001) 193–203

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Patient Education  
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## An intervention programme using the ASE-model aimed at enhancing adherence in adolescents with asthma

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Received 17 October 1999; received in revised form 20 August 2000; accepted 15 October 2000

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### Abstract

A randomised controlled trial, involving 112 adolescents with asthma, and a 2-year follow-up was conducted to assess the impact of an intervention programme aimed at enhancing adherence to asthma medication. This programme had a duration of 1 year and consisted of an experimental group which received usual care from a paediatrician, but additionally attended individual and group sessions with an asthma nurse, and a control group which received usual care only. The programme aimed at enhancing adherence by stimulating a positive attitude, increasing feelings of social support, and enhancing self-efficacy. At baseline, and after 12-month (T1) and 24-month (T2) follow-up, the participants filled in questionnaires which were based on the concepts of the ASE-model. Adherence was assessed by self-report (range: 1–10) at the same points in time. After 12 months, 97 adolescents (87%) were available for follow-up, decreasing to 86 adolescents (77%) after 24 months. No statistically significant differences were found between the control and the experimental group, except for one. At T2, self-reported adherence appeared to be statistically significantly higher in the experimental group. In conclusion, there seems to have been no substantial effect of the intervention programme. © 2001 Elsevier Science Ireland Ltd. All rights reserved.

*Keywords:* Adherence; Adolescents; Asthma; ASE-model; RCT

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### 1. Introduction

Asthma is a chronic inflammatory condition of the airways and a widespread disease among adolescents [1,2]. Most patients with a more serious form of asthma need to inhale anti-inflammatory and/or anti-allergic drugs as a prophylactic (corticosteroids, cromones) on a daily basis to prevent and reverse airway inflammation [3]. In addition, bronchodilatory drugs are indicated when patients suffer from asthma symptoms such as shortness of breath, coughing or

wheezing. Non-adherence to prophylactic medication is a common cause of treatment failure, and may have serious consequences [4]. In a study investigating the causes of death among adolescents suffering from asthma, the authors concluded that poor adherence played a substantial role [5].

Adolescence is an important stage in life, and involves a transition from primarily parental regulation of behaviour to ultimate self-regulation. This implies that during this period most adolescents with asthma gain responsibility for the management of their asthma (e.g. [6,7]). Furthermore, many health-related habits are developed during adolescents which are

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likely to influence health throughout the entire lifespan. Simultaneously, cognitive and moral developments are taking place which enable adolescents to understand and utilise health-related information, making adolescence a prime period for effective and relevant health education [8]. Therefore, it is important to obtain more knowledge of the effectiveness of interventions directed towards improving adherence in adolescents with asthma.

Self-reporting is the most common method used in the assessment of adherence to asthma medication (e.g. [9,10]). Adherence can also be defined as the percentage of prescribed doses actually taken. Reported degrees of adherence to inhaled prophylactic medication in children and adolescents with asthma vary between 30 [11] and 58% [12]. By calculating self-reported adherence on a scale of 0–10 in adolescents and adults with asthma, a mean of 8 was found [13].

A potentially informative model which can be used to analyse the determinants of adherence among adolescents with asthma is the attitude–social influence–self-efficacy model or ASE-model [14,15]. This model was derived from the theory of reasoned action (TRA) [16,17] and the social cognitive theory [18] (Fig. 1).

In the ASE-model, it is assumed that intention and behaviour are primarily determined by the following cognitive variables: attitudes; social influences and self-efficacy expectations. Moreover, the model postulates that intention predicts behaviour. A person's attitude towards a specific behaviour (e.g. inhaling asthma medication) is a result of the consequences that a person expects from performing the behaviour (e.g. "inhaling medication will make me fat"). Social influences can be described as the processes whereby

people directly or indirectly influence the thoughts, feelings, and actions of others. Self-efficacy expectations can be seen as a person's belief in his or her ability to perform the desired behaviour [19]. The ASE-model makes a distinction between distal or descriptive predictors (e.g. demographic variables) and proximal or mediating predictors (the above-mentioned attitudinal, normative and self-efficacy beliefs). The proximal variables are important for health educators because they can be influenced through behavioural interventions. The distal variables serve to identify specific target groups for these interventions.

The ASE-model can be extended to include external factors which might also have an influence on behaviour. The following determinants of adherence have been described in the literature and are, therefore, included as external factors in the ASE-model: the quality of the doctor–patient relationship [20–23] and feeling ashamed about having asthma [24]. This adapted ASE-model was utilised to explain the current [25] and future adherence [26] of adolescents. The analyses indicated that this model only moderately predicted current and future self-reported adherence to prophylactic asthma medication in adolescents.

An intensive intervention programme was developed, based on a review of literature on asthma education, focus group interviews with adolescents with asthma [27] and recommendations from paediatricians, asthma nurses and other experts in the field of asthma management. The objective of the programme was to enhance adherence to the prescribed medication by stimulating a positive attitude, increasing feelings of social support, and enhancing self-efficacy. The intervention also aimed at improving spirometry and morbidity variables. The effects of the intervention on these variables have been presented elsewhere

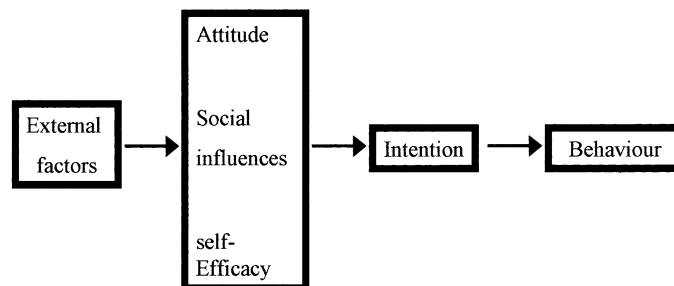


Fig. 1. ASE-model.

[28]. The aim of the present study was to assess the effects of this intervention programme on adherence and the proximal variables of the adapted ASE-model.

## 2. Methods

### 2.1. Respondents and procedure

Patients were recruited from six paediatric out-patient clinics. Two of these clinics were in academic teaching hospitals, one was in a specialised asthma centre, and the other three were in district hospitals. The criteria for inclusion were: asthma diagnosed by a physician; treatment prescribed by a paediatrician with daily inhalation of prophylactic asthma medication during a preceding period of at least 2 months; aged from 11 to 18 years; attending secondary school, ability to fill in a questionnaire in the Dutch language. Patients who met the inclusion criteria were informed about the study by their paediatrician, and both the patient and the parent(s) received written information regarding the study. Patients had at least 24 h to decide on whether or not they were willing to participate. The study protocol was approved by the Medical Ethical Review Board of each participating hospital or centre, and all participants and their parent(s) gave informed consent.

### 2.2. Measurements

Data were collected at baseline (T0), and after 12-month (T1) and 24-month follow-up (T2). The participants filled in questionnaires which were based on the concepts of the ASE-model and other psychological and demographical variables. The physicians filled in a form on which they were asked to provide medical data.

Cronbach's  $\alpha$ -coefficients of internal consistency were calculated for variables constructed by the summation of items scores at baseline; only those with coefficients  $>0.60$  were selected for further analysis.

### 2.3. Outcome variables

The ASE-variables were operationalised in several questions, and for each variable a sum-score was

calculated. The questions were based on the results of a number of qualitative pilot studies concerning the attitudes, social influences and self-efficacy expectations of adolescents with asthma. The concept of attitude was sub-divided into a positive and a negative attitude to taking medication. The concept of self-efficacy expectations was sub-divided into self-efficacy directed at displaying the desired behaviour, and self-efficacy aimed at overdosing. This last variable was chosen because adolescents sometimes tend to take more medication than was prescribed by the physician to be able to take part in everything they want to.

*Self-reported adherence*: was assessed by asking participants to score their adherence on a 10-point scale (1, never take prophylactic medication to 10, always take prophylactic medication, as prescribed).

*Intention*: was assessed on the basis of one statement on a 7-point scale (1, 'extremely unlikely' to 7, 'extremely likely'). The statement: "I intend to take my asthma medicine every day" had to be scored by indicating the probability of this intention.

*Positive attitude (pro)*: was based on three questions about one statement, involving three different 7-point scales (A: 1, 'very good' to 7, 'very bad'; B: 1, 'very wise' to 7, 'very foolish'; C: 1, 'very harmless' to 7, 'very damaging'). Participants were asked whether they agreed with the following statement: "If I took my asthma medicine every day that would be: ...". Sum-scores were obtained after reverse scoring of the scales. Therefore, high scores indicate a positive attitude towards taking prophylactic asthma medication daily (Cronbach's  $\alpha = 0.70$ ).

*Negative attitude (con)*: was based on six statements on a 4-point scale (1, 'strongly agree' to 4, 'strongly disagree'). Participants were asked whether they agreed with statements regarding their asthma medication, such as "I do not always take my medicine because I do not want people to pity me". High scores indicate a less negative attitude towards taking medication (Cronbach's  $\alpha = 0.67$ ).

*Social influences*: was based on six statements on a 5-point scale (1, 'totally disagree' to 5, 'totally agree'). Participants were asked whether they agreed with statements regarding the opinion of four groups of important people in their environment with regard to taking asthma medication daily. An example of such a statement is: "my parents/carers think I should

take my asthma medicine every day". High scores indicate a high degree of perceived social influence (Cronbach's  $\alpha = 0.87$ ).

*Self-efficacy directed towards the desired behaviour*: was based on four statements on a 4-point scale (1, 'strongly disagree' to 4, 'strongly agree'). Participants could indicate the probability of their ability to perform the desired behaviour with respect to asthma medication. This was intended to determine how participants evaluated their self-efficacy with regard to the desired behaviour. An example of such a statement is: "I always take my medication very carefully". High scores indicate positive expectations of a participant to realise the desired behaviour with respect to asthma medication (Cronbach's  $\alpha = 0.67$ ).

*Self-efficacy aimed at overdosing*: was based on two statements on a 4-point scale (1, 'strongly agree' to 4, 'strongly disagree') to determine what patients think about taking more medication than prescribed by a physician. Participants could indicate the probability of their ability to refrain from taking more medication than prescribed by the physician. An example of such a statement is: "if I am very short of breath, I take more medicine than my doctor told me to take". High scores indicate that the patient is not inclined to take more medication than prescribed by the physician (Cronbach's  $\alpha = 0.71$ ).

*Feeling ashamed about having asthma*: was based on a sub-scale of the 'respiratory illness opinion survey' (RIOS) [29,30], and consists of seven questions on a 5-point scale (1, 'never' to 5, 'always') on the subject of feeling ashamed about having asthma. High sum-scores indicate that the participant is ashamed of having asthma (Cronbach's  $\alpha = 0.62$ ).

*Quality of communication with the physician as perceived by the patient*: to determine the perceived quality of communication with the physician, a questionnaire was developed, partly based on the questionnaire developed by Richards et al. [31]. It also contained a question concerning the perceived quality of treatment provided by the physician and a question concerning the perceived empathic attitude of the physician. In total, the questionnaire consisted of 11 questions. A high score indicates that the participant had a positive perception of the quality of communication with the physician (Cronbach's  $\alpha = 0.80$ ).

## 2.4. Descriptive variables

The following descriptive variables were recorded: age; sex; ethnic origin and the severity of asthma, according to the physician [32]. The severity of asthma was based on the prescribed amount and type of medication, in the following categories: mild to moderate (stable with cromones); moderate to severe (stable with  $\leq 400 \mu\text{g}$  inhaled corticosteroids per day); severe ( $>400 \mu\text{g}$  inhaled corticosteroids per day). The paediatricians recorded the severity of asthma at baseline (T0).

## 2.5. Protocol

### 2.5.1. Control group

All participants received usual care from the paediatricians [33], who were instructed to provide the same care as they normally gave to adolescent patients with asthma. Participants visited a paediatrician every 4 months. The paediatricians agreed not to refer participants in the control group to an asthma nurse.

### 2.5.2. Experimental group

Participants in the experimental group received the same usual care from a paediatrician every 4 months. However, during these visits the paediatrician also discussed an asthma management zone system [3] with the participants. This system has been developed to instruct patients about disease characteristics, triggers for airway obstruction and treatment objectives. The paediatricians also discussed the peak expiratory flow (PEF) measurements which the participants had registered during the 2 weeks preceding the visit to the paediatrician. Furthermore, the four visits to the paediatrician were each combined with a visit to an asthma nurse. These experienced asthma nurses were specifically trained to apply their part of the intervention programme. The asthma nurses discussed several aspects of the disease individually with the participants, making use of drawings [34] and written information (based on [35]). This written information was also intended to be read by the parent(s) of the participants at home. For instance, the asthma nurse provided additional information on asthma medication and pulmonary conditions, and instructed patients how to use their inhaler. At each visit, the asthma nurse started by checking whether the participant still remembered and understood the information given

Table 1  
Baseline characteristics of the experimental and the control group

	Experimental		Control	
	<i>n</i>	Mean (S.D.)	<i>n</i>	Mean (S.D.)
Age (year)	58	13.6 (1.4)	54	13.8 (1.3)
Duration of asthma (year)	57	10.9 (3.1)	53	9.9 (4.0)
The severity of asthma				
Mild to moderate	2		4	
Moderate to severe	38		31	
Severe	17		18	
Subjective severity of the asthma	58	4.0 (1.0)	54	3.8 (1.2)
Male/female ratio	31/27		27/27	
Ethnic origin: Caucasian/non-Caucasian	39/17		45/8	

during the preceding visit. The participants were encouraged to ask questions and to indicate what they wanted to know about having asthma. Every participant also attended three group sessions (four to eight participants per group). These group sessions took place once a week, after the three individual sessions with the asthma nurse had taken place. During the group sessions, participants discussed how they coped with their asthma, and role-played several difficult situations under the supervision of the same asthma

nurse. The discussions included the following issues: communication with a doctor, talking with peers about having asthma, attitude towards asthma and asthma medication, and refusing to accept a cigarette. To support this discussion, the participants were shown a video film which was purpose-made for the group sessions and showed several situations in which having asthma can be difficult for adolescents. After the three group sessions had been completed, a fourth individual visit to the asthma nurse took place. The

Table 2  
Outcome variables in the intervention group and the control group at baseline

	Intervention			Control	
	Range	<i>n</i>	Mean (S.D.)	<i>n</i>	Mean (S.D.)
Self-reported adherence	1–10	58	7.4 (1.7)	54	7.3 (2.0)
Intention	1–7	58	6.0 (1.1)	54	5.7 (1.2)
Attitude					
Pro	3–21	57	19.3 (1.9)	54	19.5 (2.1)
Con	6–24	54	9.9 (3.1)	53	9.7 (2.6)
Social influences					
Parents	1–5	58	4.7 (0.5)	54	4.8 (0.5)
Peers	3–15	58	9.6 (3.3)	54	9.5 (3.2)
Teachers	1–5	57	3.3 (1.1)	53	3.3 (1.1)
Physicians	1–5	58	4.8 (0.4)	54	4.9 (0.4)
Self-efficacy					
Directed at desired behaviour	4–16	55	7.7 (2.2)	53	8.2 (2.3)
Aimed at overdosing	2–8	57	4.1 (1.7)	52	4.1 (1.5)
External factors					
Feeling ashamed about having asthma	7–35	50	12.0 (3.5)	50	11.6 (3.2)
Quality of communication with the physician	11–56	52	47.4 (5.7)	51	48.9 (3.9)

objective of this final visit was to review all aspects of the preceding visits to the asthma nurse. The participants also received a written summary of the group sessions they had attended. Each individual session with the asthma nurse lasted approximately 30 min, and each group session 90 min. The various sessions of the intervention programme were spread out over a period of 1 year. During the second year, all participants in both the control group and the experimental group received the same usual care from their paediatrician.

## 2.6. Study design

Patients were randomly allocated either to usual care by a paediatrician (control group) or the inter-

vention programme (experimental group). Randomisation was stratified according to hospital. Prior to the start of the trial, the principal investigator (SvE), who was not involved in the selection and inclusion of patients, prepared numbered, opaque and sealed envelopes containing the treatment allocation. Due to the nature of the intervention, blinding of the paediatricians and the patients was not feasible.

## 2.7. Statistical analyses

Calculations were made in SPSS, version 5.02. Between-group comparisons were made for self-reported adherence, the ASE-variables, intention, and the external factors (the proximal variables only).

Table 3  
Outcome variables in the intervention group and the control group at 12-month follow-up

	Intervention			Control		P-value
	Range	n	Mean (S.D.)	n	Mean (S.D.)	
Self-reported adherence	1–10	47	7.8 (1.6)	39	7.3 (1.8)	0.14
Δ Self-reported adherence <sup>a</sup>		47	0.1 (1.2)	39	0.0 (1.6)	0.61
Intention	1–7	47	6.3 (0.9)	39	6.0 (1.0)	0.35
Δ Intention <sup>a</sup>		47	−0.2 (0.9)	39	0.3 (1.3)	0.23
Attitude						
Pro	3–21	46	19.4 (1.8)	39	19.3 (2.0)	0.75
Δ Attitude pro <sup>a</sup>		45	−0.1 (1.7)	39	0.1 (2.6)	0.66
Con	6–24	46	8.5 (2.5)	35	9.2 (2.5)	0.23
Δ Attitude con <sup>a</sup>		44	−1.3 (2.7)	35	−0.7 (2.7)	0.33
Social influences						
Parents	1–5	46	4.7 (0.6)	39	4.8 (0.4)	0.48
Δ Social influences parents <sup>a</sup>		46	0.0 (0.6)	39	0.1 (0.6)	0.79
Peers	3–15	46	10.0 (3.4)	39	11.1 (2.8)	0.12
Δ Social influences peers <sup>a</sup>		46	0.2 (3.1)	39	1.6 (3.2)	0.04
Teachers	1–5	46	3.4 (1.2)	39	3.7 (1.0)	0.12
Δ Social influences teachers <sup>a</sup>		46	0.0 (1.1)	38	0.4 (1.0)	0.17
Physicians	1–5	47	4.9 (0.3)	39	4.9 (0.3)	0.89
Δ Social influences physician <sup>a</sup>		47	0.1 (0.4)	39	0.1 (0.3)	0.87
Self-efficacy						
Directed at desired behaviour	4–16	47	7.1 (2.0)	35	7.1 (1.7)	0.96
Δ Self-efficacy desired behaviour <sup>a</sup>		45	−0.7 (2.6)	35	−1.2 (2.1)	0.39
Aimed at overdosing	2–8	43	5.3 (2.0)	39	5.4 (1.5)	0.98
Δ Self-efficacy overdosing <sup>a</sup>		42	1.5 (1.9)	37	1.3 (1.7)	0.72
External factors						
Feeling ashamed about having asthma	7–35	43	11.5 (5.0)	37	11.5 (3.4)	1.00
Δ Feeling ashamed <sup>a</sup>		36	−0.2 (5.0)	35	−0.1 (2.4)	0.96
Quality of communication with the physician	11–56	44	45.9 (6.1)	33	47.2 (6.1)	0.35
Δ Quality of communication <sup>a</sup>		42	−1.5 (5.7)	33	−2.1 (5.2)	0.63

<sup>a</sup> Δ Change in comparison to baseline.

These comparisons were made by means of two-sided *t*-tests.

### 3. Results

Of the 165 eligible patients identified, 53 adolescents were unwilling to participate in the trial, but were willing to make self-reports of their adherence. The mean self-reported adherence among these adolescents was 7.5 (S.D. = 1.6), which showed no statistically significant difference from that of the participants at baseline. The remaining 112 adolescents were willing to participate in the trial. At baseline (T0), no differences were observed between

participants in the control and the experimental group (Tables 1 and 2). At the 12-month follow-up (T1), four participants no longer needed prophylactic asthma medication (three in the control group). The same applied for five participants at T2 (four in the control group). These participants were excluded from the analysis of adherence, because to assess their adherence would be meaningless. Fifteen participants withdrew from the study between T0 and T1 (seven in the control group). Reasons for the withdrawal of participants in the control group were: family circumstances ( $n = 1$ ); moving to another hospital ( $n = 1$ ); lack of motivation or no reason given ( $n = 5$ ). Reasons for the withdrawal of participants in the experimental group were: lack of time ( $n = 1$ ); moved ( $n = 1$ );

Table 4  
Outcome variables in the intervention group and the control group at 24-month follow-up

	Intervention			Control		P-value
	Range	<i>n</i>	Mean (S.D.)	<i>n</i>	Mean (S.D.)	
Self-reported adherence	1–10	33	7.7 (2.0)	34	6.7 (2.3)	0.05
Δ Self-reported adherence <sup>a</sup>		33	–0.1 (2.0)	33	–0.4 (2.0)	0.55
Intention	1–7	34	5.9 (1.2)	34	5.4 (1.8)	0.15
Δ Intention <sup>a</sup>		34	–0.4 (0.9)	33	–0.4 (1.8)	0.89
Attitude						
Pro	3–21	34	19.1 (1.9)	34	18.4 (3.0)	0.31
Δ Attitude pro <sup>a</sup>		33	–0.5 (1.8)	33	–1.0 (2.5)	0.32
Con	6–24	34	9.4 (2.7)	32	9.9 (2.6)	0.45
Δ Attitude con <sup>a</sup>		32	0.1 (2.8)	31	–0.1 (3.1)	0.74
Social influences						
Parents	1–5	35	4.5 (0.9)	34	4.5 (0.9)	0.84
Δ Social influences parents <sup>a</sup>		35	–0.2 (0.8)	33	–0.3 (0.9)	0.83
Peers	3–15	35	10.5 (3.0)	34	10.0 (3.0)	0.48
Δ Social influences peers <sup>a</sup>		35	0.8 (3.0)	33	0.9 (3.3)	0.88
Teachers	1–5	35	3.4 (1.0)	34	3.2 (0.9)	0.47
Δ Social influences teachers <sup>a</sup>		35	0.1 (1.0)	33	–0.1 (1.2)	0.42
Physicians	1–5	35	4.7 (0.5)	33	4.7 (0.7)	0.91
Δ Social influences physician <sup>a</sup>		35	–0.1 (0.5)	32	–0.2 (0.8)	0.62
Self-efficacy						
Directed at desired behaviour	4–16	32	7.4 (1.4)	33	7.6 (1.7)	0.66
Δ Self-efficacy desired behaviour <sup>a</sup>		30	–0.3 (2.3)	32	–0.5 (2.6)	0.75
Aimed at overdosing	2–8	33	5.6 (2.0)	31	5.1 (1.7)	0.24
Δ Self-efficacy overdosing <sup>a</sup>		32	2.1 (2.1)	29	1.0 (2.3)	0.06
External factors						
Feeling ashamed about having asthma	7–35	33	11.8 (3.5)	32	11.1 (3.2)	0.41
Δ Feeling ashamed <sup>a</sup>		28	0.4 (4.5)	31	–0.3 (2.9)	0.44
Quality of communication with the physician	11–56	32	46.6 (6.3)	33	46.6 (5.6)	0.98
Δ Quality of communication <sup>a</sup>		31	–0.8 (5.5)	32	–1.8 (3.9)	0.42

<sup>a</sup> Δ Change in comparison to baseline.



family circumstances ( $n = 1$ ); lack of motivation or no reason given ( $n = 5$ ). At T1, all participants were asked if they were willing to participate in the study for another year, during which the long-term effects of the intervention could be studied. Another 11 participants withdrew from the study at that stage (T2). There were no statistically significant differences at baseline between participants who reported their adherence at T1 and participants who did not, those who no longer needed prophylactic asthma medication or those who withdrew from the study (data not shown).

At T1, no statistically significant differences at the 0.05-level were found between the experimental and the control group on adherence, intention, the ASE-variables, or the external factors (Table 3). At T2, only one statistically significant difference was found between the experimental and the control group. Self-reported adherence appeared to be higher in the experimental group, indicating that the participants in this group reported greater adherence than the participants in the control group (Table 4).

#### 4. Discussion

The present study is thought to be the first to address the effects of an intensive intervention aimed at enhancing adherence in adolescents with asthma by using the ASE-model. Enhancing adherence in this age-category is important, because many health-related habits are developed during adolescence which are likely to influence health throughout entire the life-span [8].

Only one statistically significant difference was found between the experimental and the control group. However, this difference in adherence at T2 may well be due to chance, because correction for multiple testing by means of the Bonferonni method [36] resulted in no statistically significant differences between the experimental and the control group. The finding that the intervention was not very effective is in accordance with the conclusions drawn by Haynes et al. [37], who conducted a systematic review of strategies to improve adherence based on a randomised controlled trial, and concluded that the large majority of these strategies were not very effective. Apart from the fact that other investigators have also

found that enhancing adherence is a difficult task, there are other potential explanations for the disappointing effect of the intervention programme, one of which concerns ceiling effects. Ceiling effects might explain the lack of improvement in self-reported adherence. The participants in the present study already had a relatively high level of self-reported adherence at baseline. The same applies to some variables of the ASE-model. At baseline the participants in this study already reported high levels of intention and a positive attitude to taking medication. Another possible explanation for the study results would be that the intervention is not very effective among adolescents, despite the relatively extensive programme. Adolescents tend to test their boundaries by deviating from what is expected, in order to develop their own identity. Unhealthy behaviour, like non-adherence, is sometimes more attractive to them than healthy behaviour, despite the knowledge that this behaviour is not good for their health. Adolescents tend to imbue health-related behaviours with meanings which have nothing to do with their knowledge of what is 'healthy' or 'unhealthy'. These meanings seem to be more important to adolescents than knowledge, and motivate their behaviour accordingly [38]. These characteristics, which are common in adolescents, probably make it more difficult to change their behaviour than the behaviour of adult patients.

According to the social learning theory of Bandura [18,39] modelling is of major influence on behaviour. At a time when their healthy peers are able to establish their independence, adolescents with a chronic disease may find themselves in a situation of enforced dependency, in which they have to rely more on their parents for support than their peers [40]. The results of the present study gave no answer to the question of whether peers are, therefore, of less influence than was assumed, or whether the behaviour of peers supported the attitude of the participants towards taking medication. It is possible that the participants in the group sessions noticed that their peers also failed to take their medication regularly, and that this observation gave them a feeling of support in their non-adherence. It is safe to say that peer modelling did not have the intended effect, and did not make the participants more adherent or change their cognitions.

It is unclear from this study whether it is possible to influence adherence by changing the ASE-variables.

There are two potential explanations as to why the ASE-variables did not change during our study. The first concerns the relevance of these variables in this age-category. Analyses indicated that the adapted ASE-model only moderately predicted current [25] and future [26] self-reported adherence to prophylactic asthma medication in adolescents. These variables are possibly not the most relevant ones in this age-category, and the more relevant variables were perhaps not identified. Brown et al. [41] suggested that adolescent-specific factors need to be incorporated in a model which is used to guide prevention efforts among this group. The authors mentioned the following features of adolescence: cognitive immaturity, struggle for psychological autonomy, peer influences and physical development. This predictive value of these features for adherence could be studied. A second reason might be that the intervention did not succeed in modifying the ASE-variables.

Another possible limitation of this study concerns the use of self-report as method to assess adherence. As has been stated by Berry et al. [42], this method of assessing adherence is probably not related in any one-to-one way to actual adherence behaviour. Ley [9], however, after reviewing the different methods for assessing adherence, stated that the most popular method, i.e. patient reports, correlates significantly with other methods of measurement. The opinion of DiMatteo and DiNicola [43] is that one should seek to understand the reporting of adherence by patients, just as one seeks to understand adherence behaviour itself. It should, therefore, be emphasised that the lack of existence of a feasible method for the assessment of adherence is still one of the drawbacks faced in any study concerning adherence to inhaled asthma medication. It is important that future studies on adherence make use of reliable and valid electronic devices. However, these methods are also open to criticism.

Future research should certainly focus on gaining more knowledge about the major determinants of adherence. Most of the current knowledge about techniques used to improve non-adherence is based solely on anecdotal data [44]. Therefore, more systematic empirical knowledge is a prerequisite for the development of evidence-based interventions. A potentially informative model which might be used to obtain this knowledge is the theory of salient meanings of behaviour [45]. Unlike the concepts of

theories based on attitude and change in attitude, such as the theory of reasoned action [17], the theory of planned behaviour [46] or the ASE-model [14,15], the subjective meaning of specific behaviour the critical determinant of achieving in that behaviour. According to this model, adolescents tend to imbue health-related behaviours with meanings. Taking medication might, for instance, be experienced as having to take it easy, being different or being less important. Changing the meanings attached to taking medication might, perhaps, enhance adherence. The model is not based on the assumption of a basically rational individual, because this assumption does not appear to apply consistently to adolescents [40]. Conceivably, this model could provide a new perspective on health-related behaviour, such as adherence behaviour.

### Acknowledgements

This project was supported by a grant (92.35) from the Netherlands Asthma Foundation. The authors would like to thank all the adolescents who willingly participated. They also thank the paediatricians (O.H. van der Baan-Slootweg, J.E. Dankert-Roelse, Ph.D., E.E.M. van Essen-Zandvliet, Ph.D., R.W. Griffioen, A.G. Ketel, C.E. van Marle, A.F. Nagelkerke, J.C. van Nierop, J.G.M. Rijntjes, R.J. Roorda, Ph.D., M.A.C. Slee and H. Verweij), asthma nurses and pulmonary function technicians for their contribution. Furthermore, they wish to thank Faith Maddever for corrections in the English text and Donna Spruijt-Metz for her valuable detailed comments on the first draft.

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