



The Common Sense Model in early adolescents with asthma: Longitudinal relations between illness perceptions, asthma control and emotional problems mediated by coping



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ABSTRACT

Objective: The present study examined the longitudinal relations between illness perceptions and asthma control and emotional problems (i.e., anxiety, depression, stress), respectively, in adolescents with asthma. Furthermore, the mediating effects of asthma-specific coping strategies on these relations were examined, as specified in the Common Sense Model (CSM).

Methods: In 2011, 2012, and 2013, adolescents (aged 10–15) with asthma were visited at home ($N = 253$) and completed questionnaires about their illness perceptions, asthma-specific coping strategies, asthma control, symptoms of anxiety and depression, and perceived stress. Path analyses were used to examine the direct relations of illness perceptions with asthma control and emotional problems and the mediating effects of coping strategies cross-sectionally and longitudinally.

Results: Perceptions of less perceived control and attributing more complaints to asthma were associated with better asthma control. Perceptions of more concern, less coherence, and increased influence of asthma on emotional well-being were associated with more emotional problems. Longitudinally, perceptions of more treatment control and fewer concerns predicted less emotional problems over time. More worrying mediated the cross-sectional relation between perceiving more concern about asthma and less asthma control and the longitudinal relation between perceiving more concern about asthma and more emotional problems.

Conclusion: Illness perceptions were associated with asthma control and emotional problems; however, over time, illness perceptions only predicted changes in emotional problems. Most coping strategies did not mediate the relation between illness perceptions and outcomes. Interventions aimed to change illness perceptions in adolescents with asthma could decrease emotional problems.

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Introduction

Asthma is the most common chronic disease in childhood [1] and is characterized by chronic inflammation of the airways. A major problem in adolescent asthma is the lack of control over their asthma, which can result in exacerbated symptoms [2]. In addition to experiencing symptoms, adolescents with asthma experience increased anxiety [3,4] and depression [5–7] compared to their non-asthma peers. However, adolescents with asthma do not explicitly experience more stress than do their healthy peers [8], but stress has a major negative influence on asthma [9]. These emotional challenges affect adolescents' lives [10,11].

To maximize control over asthma and minimize emotional problems (i.e., anxiety, depression, stress), it is imperative to examine which factors relate to these problems. The Common Sense Model (CSM) [12] is a framework in which illness perceptions (i.e., subjective and emotional beliefs in response to the disease) are expected to affect illnesses and emotional problems. Therefore, the main aim of this study was to examine whether illness perceptions related to asthma control and emotional problems, respectively. Furthermore, the CSM states that coping strategies mediate the relation between illness perceptions and outcomes. Consequently, the second aim of this study was to clarify whether asthma-specific coping strategies mediated the relations between illness perceptions and outcomes.

Illness perceptions are personal perspectives that individuals create when they try to make sense of a threat to their health and obtain control over that threat. These perceptions are divided into six cognitive representations: cognitive representations about the chronicity of a disease (timeline), the influence of the disease on daily life (consequences),

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patients' perceptions of their abilities to control the illness (personal control), perceptions of the effectiveness of asthma treatment (treatment control), the amount and nature of complaints attributed by patients to the illness (identity), and the degree to which patients are able to make sense of the illness (coherence). Two emotional representations also exist: concern regarding the disease (concern) and the influence the illness has on emotional well-being (emotional representation).

In the CSM, relations are described between illness perceptions, on the one hand, and by illness and emotional problems on the other. Cross-sectionally, research has shown that, in adult patients with asthma, perceptions of high personal and treatment control, perceiving asthma as a chronic disease, and perceiving a low influence of asthma on emotional well-being related to better illness-related problems and higher quality of life [13]. In adolescents with asthma, no studies have yet examined the relations between illness perceptions and illness and emotional problems, respectively, over time. Results based on adult studies and other studies on other chronic diseases (e.g., coronary artery disease, survivors of esophageal cancer) [14,15] cannot be generalized easily to adolescents with asthma.

Adolescents are in a developmental phase with increasing emotional problems [16], and priorities (e.g., the importance of health) of adolescents might differ from those of adults. Furthermore, illness perceptions could have varying consequences for different diseases [17]. Nevertheless, we hypothesized that the following factors would predict increased asthma control and decreased emotional problems: (1) cognitions that reflect asthma as more chronic (timeline), (2) perceptions about asthma having little influence on daily life (consequences), (3) adolescents perceiving themselves as being able to control their asthma (personal control), (4) perceptions of asthma treatment as being effective (treatment control), and (5) perceived little influence of asthma on emotional well-being (emotional representation).

In explaining mechanisms that underlie the relations between illness perceptions and asthma control and emotional problems, respectively, Leventhal and colleagues [12] proposed that these relations could be mediated by coping strategies. Relations were shown in different patient populations between illness perceptions and coping strategies cross-sectionally [13] and longitudinally [18]. However, the relation between illness perceptions and coping in patients with asthma has not yet been studied [19]. We considered it important to formulate coping strategies specific to the challenges that adolescents face when dealing with asthma [20]. Therefore, we examined asthma-specific coping strategies. Relations have been found between coping strategies and health and emotional problems in adolescents with asthma cross-sectionally [20–22]. However, no longitudinal studies exist that have focused on this population. Of note, among populations with chronic diseases other than asthma, like esophageal cancer survivors and those with psoriasis, studies have found that coping affects emotional outcomes [15,23].

Only few cross-sectional studies have examined the actual mediating effects of coping strategies on the relation between illness perceptions and outcomes. These studies have been conducted in populations with chronic diseases other than asthma, and results on the mediating effects of coping have been mixed [24–27]. In adult women with rheumatoid arthritis [24] and adult patients with hepatocellular carcinoma (i.e., the most common form of liver cancer) [25], indirect relations were found between illness perceptions and illness and emotional outcomes via coping strategies. However, other studies did not find these indirect relations via coping [26,27]. Therefore, these results cannot be generalized to the population of the present study, and no specific hypotheses could be formulated about the mediating effects of asthma-specific coping strategies on the relation between illness perceptions and illness and emotional problems.

In sum, the aim of the present study was to examine whether the illness perceptions of adolescents with asthma predicted changes in their asthma control and emotional problems (i.e., anxiety, depression,

stress). Subsequently, the mediating effects of asthma-specific coping strategies on these relations were studied.

Method

Procedure

This study was approved by the ethics committee of the Faculty of Social Sciences of Radboud University-Nijmegen. Participants were recruited through schools, and an announcement of the study was published in the magazine of the Lung Foundation, Netherlands. Detailed information on the recruitment procedure can be found elsewhere [28].

Families were included if the adolescent (1) received an asthma diagnosis by a physician, (2) used asthma medication or experienced asthma-related symptoms at least once in the last 12 months, and (3) had adequate Dutch language skills. Adolescents' parents also had to have adequate Dutch language skills. Of the 311 families that responded to the invitation letter, 261 (83.9%) families met the inclusion criteria at baseline. In total, 257 (98.5%) families participated at follow-up (T2) one year later, and 253 (96.9%) families participated two years later (T3). Participating families were visited at their homes three times, in March–September of 2011, 2012, and 2013. During the home visits, the researchers provide brief instructions and guarantee anonymity, and adolescents and their parents filled out the informed consent forms and completed the questionnaires. Additionally, adolescents performed a lung function test to assess asthma control. In Years 1 and 2, participating families received a 20 Euro voucher for their participation and a 35 Euro voucher in Year 3.

Sample characteristics

At T1, the mean age of the adolescents was 11.9 (see Table 1). Males (59.4%) were overrepresented slightly. Most adolescents (98.1%) were born in the Netherlands. On average, adolescents suffered from asthma for 7.3 years, and most had partly controlled asthma according to the GINA guidelines [29] (57.7%).

Measures

Illness perceptions

Illness perceptions were assessed using the Dutch translation [30] of the Brief-Illness Perception Questionnaire (B-IPQ) [31], which was shown as reliable in a population of adolescents with type I diabetes. Cognitive perceptions were measured with six items: timeline ('How long do you think your illness will continue?'), consequences ('How much does your illness affect your life?'), coherence ('How well do

Table 1
Demographic characteristics of adolescents with asthma and their mothers

Mean age ^a	11.9 (1.0)
Mean years asthma ^a	7.3 (3.9)
Gender ^b	
Male	160 (59.4%)
Female	108 (40.6%)
Country of birth ^b	
Netherlands	255 (98.1%)
Other	5 (1.9%)
Grade adolescent ^b	
Primary	123 (47.1%)
Secondary	138 (52.9%)
Asthma control ^{b,c}	
Controlled	47 (17.5%)
Partly controlled	153 (57.7%)
Uncontrolled	68 (25.4%)
Education mother ^b	
Lower	30 (11.3%)
Intermediate	105 (39.5%)
Higher	131 (49.2%)

^a Education mother: Lower = Elementary, lower vocational; Intermediate = Intermediate general, intermediate vocational; Higher = higher general, higher vocational, university.

^a Values represent the mean and standard deviation.

^b Values represent numbers and percentage.

^c Asthma control is based on the Global Initiative for Asthma (GINA) guidelines [29].

you feel you understand your illness?'), personal control ('How much control do you feel you have over your illness?'), treatment control ('How much do you think your treatment can help your illness?'), and identity ('How much do you experience symptoms from your illness'). Emotional perceptions were measured with two items: concern ('How concerned are you about your illness?') and emotional representation ('How much does your illness affect you emotionally? [e.g., does it make you angry, scared, upset, or depressed?]'). Participants rated their perceptions on a scale of 1 to 10.

Asthma-specific coping

A Dutch translation [20] of the Asthma-Specific Coping Scale (ASCS) [32] was used to measure coping strategies. Answers were given on a 4-point Likert scale and ranged from 1 ('hardly ever') to 4 ('almost always'). The ASCS consists of six subscales: worrying about asthma (three items; e.g., 'I am afraid that my asthma will get worse.' T2 α = .63); ignoring asthma (four items; e.g., 'I avoid thinking about my asthma.' T2 α = .61); information seeking (four items; e.g., 'I try to find out more about my asthma.' T2 α = .67); positive reappraisal (four items; e.g., 'I try to learn something positive about my falling ill and related experiences.' T2 α = .60); hiding asthma (four items; e.g., 'I avoid talking about my asthma.' T2 α = .72); and restricted lifestyle (four items; e.g., 'I avoid exertion.' T2 α = .62).

Asthma Control Questionnaire

The Dutch translation of the Asthma Control Questionnaire (ACQ) [33] consists of seven items in which answers were given with respect to experiences over the previous week. Five items were on the five most common symptoms of asthma (e.g., 'During the past week, how often were you woken by your asthma during the night?'), one item on the FEV1% predicted (assessed with a spirometer test using the Spida 5 software), and one item on daily rescue bronchodilator use. Answers were given on a 7-point scale (T1 α = .77, T3 α = .81), and items were recoded such that higher scores reflected more control.

Symptoms of anxiety and depression

Symptoms of anxiety and depression were measured with the Dutch version [34] of the Hospital Anxiety and Depression Scale (HADS) [35]. This scale is divided into seven items about symptoms of anxiety (e.g., 'I feel tense or wound up.' T1 α = .75, T3 α = .73) and seven questions about depressive symptoms (e.g., 'I look forward to things with enjoyment.' T1 α = .61, T3 α = .53). Items are answered on a 4-point scale and higher scores indicate more symptoms.

Perceived stress

Adolescents' perceived stress was measured using the Dutch translation of the Perceived Stress Scale-10 (PSS-10) [36]. Answers to the 10 items (e.g., 'In the last month, how often have you felt confident about your ability to handle your personal problems?') were rated on a 5-point Likert scale that ranged from 0 (never) to 4 (very often) (T1 α = .75, T3 α = .82).

Statistical analyses

SPSS 19 was used to calculate descriptive statistics and Pearson correlations of illness perceptions at T1, coping strategies at T2, and outcome variables at T3 (Table 2). Path analyses in Mplus 6 were conducted to examine, cross-sectionally, the direct relations of adolescents' illness perceptions (T1) with asthma control (T1) and emotional problems (T1) (Model 1) and to examine the indirect relation of illness perceptions with asthma control and emotional problems via asthma-specific coping strategies (T1) (Model 2, tested using bootstrapped [N = 5000] standard errors). Longitudinally, the direct relations of illness perceptions (T1) with asthma control (T3) and emotional problems (T3) (Model 3) and the indirect model, via coping strategies (T2) (Model 4), were also tested.

Table 2
Descriptive statistics and intercorrelations among model variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Timeline T1	–																	
2. Consequences T1	.31***	–																
3. Personal control T1	.04	.23***	–															
4. Treatment control T1	–.18**	–.03	.12	–														
5. Identity T1	.25***	.50***	.17***	.16***	–													
6. Coherence T1	.04	.09	.35***	.18**	.15***	–												
7. Concern T1	.25	.59***	.25***	.08	.50***	.18*	–											
8. Emotional representation T1	.12	.47***	.27***	.08	.39***	.14*	.59***	–										
9. Worry T2	.06	.29***	.16***	.07	.22***	.04	.20***	.30***	–									
10. Ignoring T2	.00	.14*	.01	.16*	.14*	–.04	.22***	.09	.24***	–								
11. Information seeking T2	.10	.23***	.02	–.06	.17***	–.03	.22***	.21***	.46***	.16*	–							
12. Positive reappraisal T2	.00	.02	.00	–.06	.03	–.14*	.01	–.04	.29***	.29***	.46***	–						
13. Hiding T2	.04	.02	.02	.10	.03	–.02	.33***	.02	.02	.43***	.42***	.25***	–					
14. Restricted lifestyle T2	.15*	.31***	.12	–.03	.28***	.04	.33***	.25***	.45***	.31***	.42***	.15*	.08	–				
15. Asthma control T3	–.11	–.32***	–.22***	.06	–.28***	–.05	–.31***	–.22***	–.27***	–.12*	–.15*	–.07	.22***	.23***	–			
16. Anxiety T3	.01	.13*	.12	.21***	.19***	.13*	.35***	.24***	.38***	.30***	.07	.27***	.16*	.20*	.42***	–		
17. Depression T3	.02	.12	.13*	.20***	.15*	.00	.34***	.24***	.18***	.15*	–.10	.27***	.03	.16*	.13*	.42***	–	
18. Stress T3	.01	.13*	.10	.24***	.12	.33*	.20***	.33	.25***	.13*	.03	.218	.168	.16*	.70***	.44***	–	
Mean	7.13	4.34	3.68	3.84	3.64	3.69	2.89	3.05	1.46	1.50	1.63	2.18	1.68	1.65	5.14	4.09	2.07	2.09
SD	2.53	2.17	2.08	2.11	2.26	2.01	2.16	2.27	0.53	0.60	0.59	0.72	0.72	0.63	0.72	3.07	2.25	0.61
N	256	256	256	256	255	257	257	256	257	254	254	253	254	254	257	257	254	257

N = 261 at T1.

* < .05.

** < .01.

*** < .001.

Table 3
Fit indices of the direct and indirect models

	N	χ^2	p	CFI	RMSEA
Direct cross-sectional (Model 1)	257	[50] = 79.30	.005	.940	.049
Indirect cross-sectional (Model 2)	257	[94] = 151.14	<.001	.929	.049
Direct longitudinal (Model 3)	257	[64] = 120.08	<.001	.939	.058
Indirect longitudinal (Model 4)	257	[124] = 190.90	<.001	.943	.046

χ^2 = Chi-square; CFI = Comparative fit index; RMSEA = Root mean square error of approximation.

All path analyses controlled for adolescent gender and age and mothers' country of birth (as an indicator of ethnicity) and educational level (as an indicator of socioeconomic class). Models 3 and 4 were also controlled for the outcome variables at T1. A latent variable, emotional problems, was created with anxiety, depression, and stress as indicative variables. Model fit was evaluated by way of the root-mean square error of approximation (RMSEA) and comparative fit index (CFI). Preferably, RMSEA values should be <.10 and CFI values should be >.90 [37]. Associations between variables were evaluated based on standardized path coefficients and *p*-values (*p* < .05). Missing values for predictor variables were estimated in MPLUS by full information maximum-likelihood (FIML) estimation.

Results

Intercorrelations

Table 2 presents the intercorrelations, means, and standard deviations of adolescents' illness perceptions at T1, coping strategies at T2, and outcome variables at T3. Intercorrelations of variables at T1 can be obtained by contacting the first author of this article. The indicative variables of emotional problems (i.e., anxiety, depression, stress) showed moderate to strong positive intercorrelations, which supported the integration of these variables into one latent variable.

Path analyses

All models showed satisfactory fit indices (Table 3).

Cross-sectional results

Results of the direct cross-sectional model (Model 1, Table 4) showed that perceiving less personal control and attributing more complaints to asthma (identity) were associated with less control over asthma. More perceived concerns about asthma, perceiving not being able to make sense of asthma (coherence), and more perceived influence of asthma on emotional well-being were related to more emotional problems (i.e., anxiety,

depression, stress). In this model, illness perceptions and the control variables accounted for 23.5% of the variance in asthma control and 43.7% of the variance in emotional problems.

The indirect cross-sectional model (Model 2, Fig. 1) showed that attributing more complaints to asthma (identity) did not relate to asthma control; however, more perceived personal control and more coping by worrying about asthma related to better actual asthma control. Thus, after the inclusion of asthma-specific coping strategies in the direct cross-sectional model, the relation between attributing more complaints to asthma (identity) and having less control over asthma disappeared. Based on the results, it cannot be specified which coping strategy accounted for this mediating effect because none of the specific indirect effects were significant. Furthermore, more perceived concerns, perception of not being able to make sense of asthma (coherence), more perceived influence of asthma on emotional well-being, and more coping by hiding asthma were associated with more emotional problems. Several illness perceptions were also related to different coping strategies (Fig. 1). One indirect path was found between more perceived concerns about asthma and less actual control over asthma, which was mediated by more worrying about asthma ($\beta = -.10, p = .01$). In this model, illness perceptions, asthma-specific coping strategies, and the control variables accounted for 30.2% of the variance in asthma control and 46.2% of the variance in emotional problems.

Longitudinal results

Model 3 (direct longitudinal model, Table 4) showed that none of the illness perceptions predicted changes in asthma control over time. Perceptions of less treatment control and more concern predicted increased emotional problems over time. Additionally, in Model 3, illness perceptions and control variables accounted for 34.5% of the variance in asthma control and 53.2% of the variance in emotional problems.

Model 4 (indirect longitudinal model, Fig. 2) showed that illness perceptions did not predict changes in asthma control over time. In line with Model 3, less perceived treatment control and more concern about asthma predicted increased emotional problems. In addition, perceiving more influence of asthma on daily life (consequences) predicted reduced emotional problems over time. Several illness perceptions related to asthma-specific coping strategies and one mediating pathway were found. Perceptions of more concern about asthma related to more emotional problems; this relation could partly be explained by more worrying about asthma ($\beta = .09, p = .04$). Also in Model 4, illness perceptions, coping strategies, and control variables accounted for 37.7% of the variance in asthma control and 63.2% of the variance in emotional problems.

Discussion

Results showed that perceiving more personal control and attributing fewer complaints to asthma (identity) were associated with better actual asthma control. Additionally, perceiving more concern about asthma, perceiving not being able to make sense of asthma (coherence), and perceiving more influence of asthma on emotional well-being were associated with more emotional problems.

Over time, illness perceptions did not predict changes in asthma control. However, perceiving treatment as ineffective and perceiving more concern about asthma predicted increased emotional problems over time. Considering the mediating effect of coping strategies, worrying about asthma mediated the association between perceiving more concern about asthma and having less actual asthma control as well as the relation between perceiving more concern about asthma and experiencing more emotional problems over time.

Cross-sectionally, more perceived personal control over asthma was associated with more actual asthma control, which is in line with a previous study [19]. In addition, attributing more complaints to asthma (identity) was associated with actual asthma control. However, these illness perceptions did not predict changes in actual asthma control over time. This finding suggests that adolescents are aware that their asthma is not well controlled and may cause complaints, but this awareness does not seem to influence actual asthma control over time.

The cross-sectional findings also showed that adolescents who perceived many concerns about asthma, perceived not being able to make sense of asthma (coherence), and felt that asthma affected emotional well-being (emotional representation) experienced more emotional problems. In the longitudinal analyses, coherence and emotional representation did not predict changes in emotional problems; therefore, no evidence for a causal role of illness perceptions in emotional problems of adolescents with asthma was found. However, perceiving treatment as ineffective and perceiving more concern about asthma predicted

Table 4
Cross-sectional and longitudinal relations between illness perceptions and outcomes

Relation	Cross-sectional		Longitudinal	
	β	<i>p</i>	β	<i>p</i>
<i>Asthma control</i>				
Timeline	.02	.70	.00	.96
Consequences	-.12	.12	-.08	.24
Personal control	.23	<.001	.04	.51
Treatment control	.10	.07	-.07	.19
Identity	-.14	.03	-.06	.31
Coherence	.00	.94	-.04	.47
Concern	-.07	.40	-.03	.70
Emotional representation	-.01	.95	.08	.25
<i>Emotional problems</i>				
Timeline	-.08	.22	-.04	.57
Consequences	-.01	.86	-.14	.07
Personal control	.09	.15	-.08	.21
Treatment control	.10	.12	-.13	.03
Identity	.09	.22	-.04	.56
Coherence	-.15	.02	.09	.15
Concern	.30	.001	.29	.001
Emotional representation	.28	<.001	.12	.12

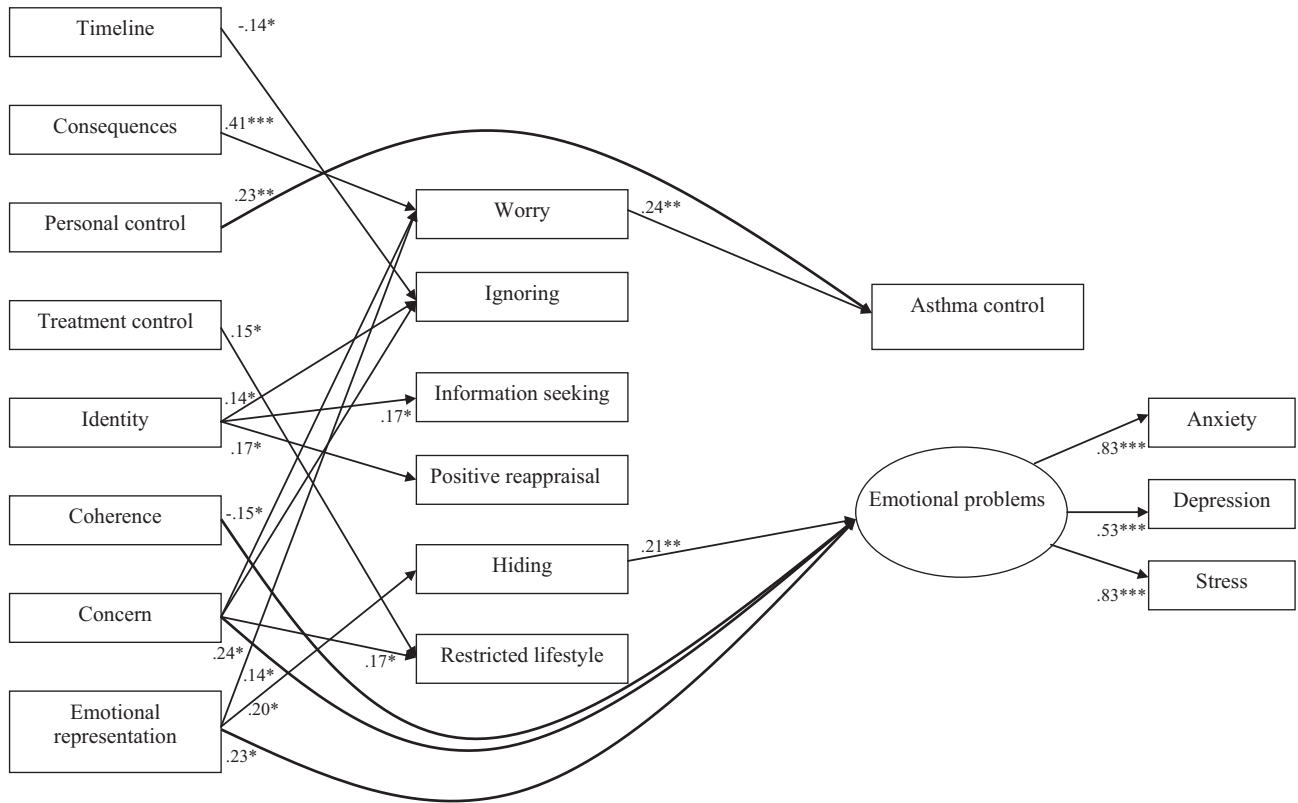


Fig. 1. The indirect cross-sectional model of the relations of illness perceptions with asthma control and emotional problems via coping strategies. *Note.* Only significant relations are presented in this model.

increased emotional problems over time. This finding is in line with previous research in that perceptions of asthma treatment as being effective predicted decreased emotional problems over time [15]. Although

no previous studies have shown that perceiving more concern about asthma predicted increased emotional problems, this is a fairly logical finding. When people have many concerns, they also experience

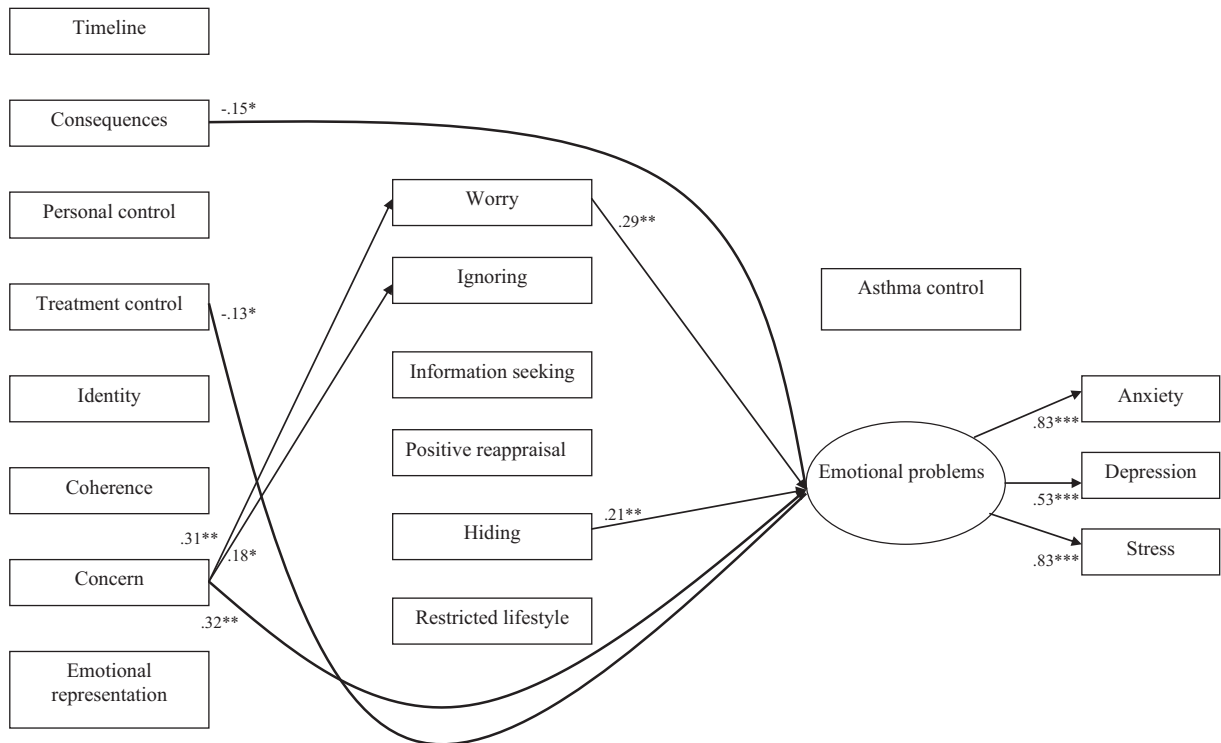


Fig. 2. The indirect longitudinal model of the relations of illness perceptions with asthma control and emotional problems via coping strategies. *Note.* Only significant relations are presented in this model.

increased psychological distress and, thus, an increased risk of developing symptoms of anxiety, depression, and stress [38].

After including asthma-specific coping strategies in the direct cross-sectional model, the relation between attributing more complaints to asthma (identity) and having less actual control over asthma disappeared. This finding suggests that this relation could be explained (mediated) by coping strategies. However, it cannot be specified which coping strategy accounted for this mediating effect (i.e., no significant indirect effects). After including asthma-specific coping strategies in the longitudinal model, the relation between perceiving fewer consequences about asthma and increased emotional problems appeared. This finding is counterintuitive, and future studies should replicate these results and examine why this occurred.

With respect to the indirect relations via coping, only one mediating effect was found in the cross-sectional model; perceiving more concern about asthma predicted decreased asthma control, which could be partly explained by worrying about asthma. Similarly, one mediating effect was found in the longitudinal model; perceiving more concern about asthma predicted more emotional problems over time, which could be explained by worrying about asthma. Although a few cross-sectional studies [24,25] have found some mediating effect of coping, these results contribute to the general finding that most relations between illness perceptions and outcomes cannot be explained by coping strategies. Our results offer further support for the limited role of coping in that adding asthma-specific coping strategies to the cross-sectional model accounted for a small increase of 6.7% of variance in asthma control and an increase of 2.5% in emotional problems. In the longitudinal model, asthma-specific coping strategies accounted for an increase of 3.2% of variance in asthma control and an increase of 10% in emotional problems. Therefore, we cannot conclude that asthma-specific coping strategies are the primary mechanism in explaining the indirect relations between illness perceptions and problems.

For health professionals, it is important to pay attention to the illness perceptions of adolescents with asthma because they may function as early signals to develop emotional problems. Some adolescents could have righteous reasons to perceive more concerns about asthma and perceive treatment as ineffective, because asthma is actually not well controlled. For these adolescents, it is imperative to examine whether they take their medication adequately and adhere to their medication prescriptions to increase their asthma control. For adolescents who still perceive concerns about asthma and asthma treatment as ineffective, even when asthma is well controlled, intervention programs could be used to alter their illness perceptions and, with that, decrease their emotional problems. Future research could examine, based on the study of Petrie et al. [39], if a text message program similar to that used in patients with asthma between 16 and 45 years old, could effectively change adolescents' illness perceptions related to the concerns about asthma and the effectiveness of asthma treatment to decrease emotional problems. Participants could regularly be sent individualized text messages for 18 weeks. These messages should be tailored to the maladaptive illness perceptions that patients could report at the beginning of the study. The adolescents who perceive asthma treatment as ineffective could receive a text message such as, 'Your preventer medication, when taken every day, is effective to control your asthma.'

Another option for future research could be to examine whether other variables (e.g., adolescents' psychosocial status, parenting, personality) explain the relations of illness perceptions with illness-related and emotional problems in adolescents with asthma. Another suggestion for future studies lies in the generalizability of the results. The current results have limited generalizability because, in this sample, most adolescents had partly controlled asthma and were mainly of Dutch origin, and most mothers were highly educated. Therefore, replicating this study with a representative sample of adolescents with asthma is preferred.

To conclude, a major strength of this study is that CSM was examined over time, which enabled us to test whether illness perceptions

predict changes over time in the outcome variables. Our results support the notion that illness perceptions are associated with asthma control and emotional problems; however, illness perceptions only predicted changes in emotional problems over time and not in asthma control. Furthermore, asthma-specific coping strategies did not seem to be the main explanatory mechanism for the relation of illness perceptions with asthma control and emotional problems.

Competing interest statement

All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf and declare that Dana Tiggeleman, Monique O.M. van de Ven, Onno C.P. van Schayck, Marloes Kleinjan, and Rutger C.M.E. Engels have no competing interests to report.

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