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Effect of Type D personality on medication adherence in early adolescents with asthma☆

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ABSTRACT

Objective: Medication adherence for daily preventive asthma medication is especially low during adolescence. In the present study, we aimed to test whether Type D personality (both as a category and with its constituent components (negative affectivity: NA and social inhibition: SI) separately and in interaction) predicts medication adherence of early adolescents with asthma.

Methods: In a prospective study, 188 early adolescents with asthma who were prescribed daily preventive asthma medication completed questionnaires on Type D personality, medication adherence, socio-demographic and clinical information, and depressive symptoms in the Spring/Summer of 2011 (T1) and again 12 months later (T2). Multiple regression analyses, controlling for demographic and clinical information and for depressive symptoms, were conducted to test whether Type D personality (either as a categorical or dimensional construct) predicted changes in medication adherence over time.

Results: Adherence was significantly lower at T2 than at T1 and this decrease was predicted by the categorical construct of Type D personality. Analyses of the two separate dimensions NA and SI and their interaction showed that higher scores on NA at T1 predicted more decrease in adherence over time. Neither SI nor the interaction between NA and SI predicted changes in adherence.

Conclusion: This is the first study to test the relationship between Type D personality and medication adherence in adolescents. Although categorical Type D personality predicts mediation adherence of adolescent with asthma over time, dimensional analyses suggest that this is due to negative affectivity only, and not to the combination of negative affectivity and social inhibition.

Introduction

The World Health Organization estimates that 235 million people worldwide currently suffer from asthma [1]. Among 13–14 year olds, the prevalence of current asthma is 14.1% [2], which makes asthma one of the most prevalent chronic diseases in childhood and adolescence. Having asthma is associated with adverse outcomes during adolescence, such as limited physical activity, school absenteeism, reduced quality of life and more problems socialising with peers [3]. It is not possible to cure asthma, but it is possible to achieve and maintain control over asthma with pharmacological treatment, thereby reducing the negative impact that asthma could have. The most effective way to control asthma is by preventing airway inflammation through the use of daily asthma medication. Inhaled corticosteroids are most often prescribed [4]. The effects of daily asthma medication are significantly reduced in case of non-adherence [5,6]. Adherence is defined as the extent to which taking medication corresponds with the recommendations by a health care provider [7].

Non-adherence is very common in childhood [8], and in adolescence adherence rates are even lower than in children [9]. A recent study using electronic monitoring of adherence showed that adherence rates in 5–14 year old patients with uncontrolled asthma were as low as 31.2% [10]. It has been suggested that non-adherence by 5 to 16 year olds is due to simply forgetting and to an 'only-as-needed' approach, which means that these children do not understand the importance of the corticosteroid as preventive measures [11]. Possible explanations for an increase in the risk of non-adherence in adolescence are the onset of depressive symptoms and the presence of risk-taking behaviours that typically occur in adolescence, as well as the transfer of asthma management from parents to their children [12]. Given that adolescents with asthma are at risk for low adherence and consequently for uncontrolled asthma, it is important to look more closely into factors that could predict adherence in this group.

One factor that could potentially play a role in medication adherence of adolescents with asthma is Type D (distressed) personality. Type D personality refers to the combination of negative affectivity (NA; i.e., the tendency to experience negative emotions) and social

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inhibition (SI; i.e., inhibited self-expression towards others) [13]. There is a rapidly growing number of studies that have investigated the relation between Type D personality and various health outcomes, both in clinical populations and in the general population [14,15]. Initially, Type D personality was proposed as a categorical construct: individuals high on both NA and SI were categorised as Type D. However, a study using taxometric procedures showed that Type D might be better represented as a dimensional construct [16]. It has also been argued that it would be better to look at the interaction of continuous NA and SI scores to test whether it is indeed the synergistic effect of NA and SI that could explain results [17].

Some studies have related Type D personality to adherence in adult patients [18–21]. A person with a Type D personality may be non-adherent through concerns about negative side-effects of medication and an inability to talk about these concerns. Using Type D as a categorical construct it was shown that adherence was significantly lower in patients with Type D personality than in patients without Type D personality in adult patient samples with coronary heart disease [20], myocardial infarction [21], sleep apnoea [18], and sleep-disordered breathing [19].

When looking at type D as a dimensional construct, the personality traits NA, SI and their interaction could influence medication adherence. Negative affectivity has been found to be highly correlated to increased reporting of subjective health complaints, likely because people with high NA have biased attention to and interpretation of normal symptoms as painful [22]. At the same time, people high on NA might adhere less to medication prescription because they are more negative about the effects of medication and expect more side-effects. With young adults, higher NA was significantly correlated with higher health-related cognitive distortions, which in turn predicted lower objective and self-reported medication adherence of diabetes medication [23]. The proposed explanation is that people with negative or irrational health beliefs do not believe in the benefit of medication. With regard to SI, people high on SI might have lower medication adherence, especially when medication has to be taken in a social situation. Additionally, people high on SI might adhere less because they tend to use more avoidant and passive coping strategies (e.g. denial) when dealing with (medical) problems [24].

Two recent studies investigated Type D as a dimensional construct and studied the interaction between NA and SI as well as the separate effect of the components NA and SI in predicting medication adherence [20,21]. A study with myocardial infarction patients found that both higher levels of NA in itself as well as higher levels of the components NA and SI in interaction predicted lower medication adherence after controlling for demographic and clinical risk factors [21]. However, in a study among patients with coronary heart disease, only higher levels of NA and not SI or the interaction between NA and SI predicted lower adherence [20]. The relationship between Type D personality and adherence has, to our knowledge, never been studied in adolescents.

In the present study, we aimed to test whether Type D personality (both as a category and with its constituent components (NA and SI) individually and in interaction) predicts medication adherence in early adolescents with asthma. In line with previous studies on adherence, it was expected that adolescents with a Type D personality (as a category) would have lower adherence rates than adolescents without a Type D personality. In addition, we expected more negative affectivity, but not more social inhibition, to predict poorer adherence when Type D personality was measured as a dimensional construct. Because of conflicting results in previous studies, no hypothesis was formulated in the current study about the interaction between the dimensions of negative affectivity and social inhibition.

Table 1
Demographic characteristics of the participating adolescents at T1 (n = 188)

Gender[a]	Male	112 (59.57)
	Female	76 (40.43)
Age[b]		11.89 (1.03)
Years asthma[b]		7.48 (3.89)
Country of birth[a]	Netherlands	183 (97.86)
	Other	4 (2.14)
School adolescents[a]	Primary	92 (50.00)
	Secondary	92 (50.00)
Asthma severity[a,c]	Low	64 (34.04)
	Mild	87 (46.28)
	Moderate	24 (12.77)
	Severe	13 (6.91)
Asthma control[a,d]	Controlled	30 (15.96)
	Partly controlled	113 (60.11)
	Uncontrolled	45 (23.94)

[a] Values represent numbers and valid percentage (numbers may not add up to 188 due to missing values).
[b] Values represent the mean and standard deviation.
[c] Asthma severity is based on the Functional Severity Index [31].
[d] Asthma control is based on the Global Initiative for Asthma (GINA) guidelines [4].

Method

Procedure

The protocol of the study was approved by the ethics committee of the Faculty of Social Sciences of the Radboud University Nijmegen. A sample of 280 primary and 140 secondary schools in The Netherlands (excluding schools for special education) received a letter asking for the school's participation in this study. A total of 213 primary schools and 73 secondary schools agreed. These schools circulated letters to seventh and eighth graders in primary schools or first graders in secondary schools, and these children were asked to give the letter to their parents. The letter contained information about asthma in general, about the purpose and procedure of the study, an invitation for families with a 10–14 year old child with asthma to sign up, and information about the gift vouchers participating families would receive. In addition to approaching schools, an announcement of the study was published in the magazine of the Lung Foundation Netherlands to recruit participants. Interested families were included if the adolescent met the following criteria: (1) diagnosed with asthma by a physician, (2) having used asthma medication or experienced asthma-related symptoms at least once in the last twelve months, and (3) having adequate Dutch language skills. Of the 311 families that signed up, 261 families (83.9%) met the inclusion criteria; 46 families (14.8%) did not and were excluded, and four families (1.2%) cancelled for different reasons.

The families were visited at home twice, in March–September 2011 (Baseline: T1) and again a year later, in March–September 2012 (Follow-up: T2). Before visiting the families at home, research assistants were trained in administering the questionnaires and in performing a lung function test (using a portable spirometer and the Spida 5 software). Of the 261 participating families at T1, 258 families also participated at T2 (98.85%). On each visit, after brief instructions and the guarantee of anonymity, adolescents and at least one of their parents signed an informed consent form and completed the questionnaires. Additionally, adolescents performed the lung function test. The visits took one hour and fifteen minutes on average. The family received a gift voucher of 20 Euros for participation on each occasion.

Participants

For the present study, we included only the adolescents who were prescribed long-term asthma control medication at both T1 and T2 (N = 188). Their characteristics are presented in Table 1.

Measures

Type D personality

At T1, Type D personality was measured using the DS14 [13], which consists of two seven-item subscales assessing respectively negative

affectivity (NA; e.g., "I often make a fuss about unimportant things"; Cronbach's alpha was .79) and social inhibition (SI; e.g., "I would rather keep other people at a distance"; Cronbach's alpha was .77). Items were rated on a 5-point Likert scale ranging from 0 (false) to 4 (true). Adolescents with scores ≥ 10 on both subscales were categorised as Type D personality. These cut-off scores are based on adult populations [13,25] but have been used for adolescent populations as well [26–28]. To test whether the synergistic effect of NA and SI indeed explained the results rather than NA or SI alone, we standardised NA and SI scores and constructed an interaction term NA * SI.

Medication adherence

At T1 and T2, a Dutch translation of the Medication Adherence Report Scale for Asthma (MARS-A) was used to assess medication adherence [29]. Adolescents were asked to describe their typical pattern of medication use in ten items (e.g., "I alter the dose of my medication" and "I forget to take my medication") on a 5-point Likert scale, ranging from 1 (very often) to 5 (never). Adolescents were asked to report their usual medication adherence without reference to a particular time frame. Higher scores indicated better medication adherence. Cronbach's alpha was .80 at both T1 and T2.

Control variables: demographic information, clinical information, and depressive symptoms

Adolescents' gender and age, asthma duration (the difference between age at T1 and the age of asthma onset), asthma control, asthma severity, and depressive symptoms were used as control variables in the analyses. Asthma control was measured using a Dutch translation of the Asthma Control Questionnaire (ACQ) [30], consisting of 7 items answered on a 7-point scale ranging from 0 (complete control) to 6 (very little control). Five items addressed the most common symptoms of asthma (e.g., "During the past week, how often were you woken by your asthma during the night?"), one item was about daily rescue bronchodilator use, and one item was the FEV1% predicted (assessed with a spirometer test). Cronbach's alpha of this 7 item scale was .77. Asthma severity was measured using a Dutch translation of the Functional Severity Scale [31] filled out by the mothers of the adolescents. This questionnaire consisted of 6 items (e.g., in the last 12 months, how often was your child's wheezing troublesome first thing in the morning; Cronbach's alpha was .80). Depressive symptoms were measured using a Dutch translation [32] of the Hospital Anxiety and Depression Scale (HADS) [33], consisting of seven items answered on a 4-point scale, ranging from 0 (no, not at all) to 3 (yes, definitely) (e.g., "I look forward with enjoyment to things", Cronbach's alpha was .61).

Statistical analyses

Data were analysed with the Statistical Package for Social Sciences (SPSS) for Windows, version 19. First, means, standard deviations and correlations of all variables in this study were computed. To test whether adherence rates changed significantly between T1 and T2, paired t-tests were conducted. Next, to test whether Type D personality measured at T1 predicted change in medication adherence over time, hierarchical regression analyses were conducted. First, to test Type D as categorical predictor, a hierarchical regression analysis was conducted with medication adherence at T2 as dependent variable, and Type D and adherence at T1 included as predictors in the first step. Next, control variables (age, gender, asthma duration, asthma control, asthma severity and depressive symptoms; all measured at T1) were included in the second step in order to test whether any effect of Type D personality would remain significant after controlling for demographic and clinical information and for depressive symptoms. Subsequently, a hierarchical multiple regression analysis with Type D as a dimensional predictor was conducted with medication adherence at T2 as dependent variable, with NA, SI, and adherence at T1 included as predictors in the first step, and with the interaction between NA and SI in the second step. Again, the control variables were included in the last step in order to test whether any effect of NA, SI, or the interaction would remain significant after controlling for demographic and clinical information and for depressive symptoms.

Results

Descriptive statistics

Table 2 shows means, standard deviations and correlations between the main variables of this study. The prevalence of Type D personality in this sample was 16% (mean Type D = 0.16). Slightly more than 24% of the adolescents met the cut-off score (of over 10) on NA, and 39% of the adolescents scored more than 10 on SI (not in the Table). Bivariate correlations showed that categorical Type D, NA and SI were not significantly related to adherence at T1. NA and SI, but not categorical Type D, were related to adherence at T2. Paired t-tests (not in the Table) showed that adherence was significantly lower at T2 than at T1 ($t(185) = 2.51$; $p = 0.013$).

Longitudinal analyses: Type D as a categorical construct

The decrease in adherence between T1 and T2 was predicted by categorical Type D personality (Table 3), and this remained significant after controlling for demographic and clinical information and for depressive symptoms. Adolescents with a Type D personality showed a larger decrease in adherence rates from T1 to T2 than adolescents without a Type D personality.

Longitudinal analyses: Type D as a dimensional construct and the interaction of NA and SI

The results of testing the dimensions NA and SI separately as well as their interaction showed that there was a main effect of NA on changes in adherence over time (Table 4), and this remained significant after controlling for demographic and clinical information and for depressive symptoms. Higher scores on NA at T1 predicted a stronger decrease in adherence over time. Neither SI nor the interaction between NA and SI predicted changes in adherence.

Discussion

We tested the role of Type D personality in predicting medication adherence of adolescents with asthma. Medication adherence is central to asthma control. Our results showed that, as expected, Type D as a categorical construct predicted a decrease in adherence from one year to the next after controlling for clinical and socio-demographic variables and for depressive symptoms. The negative affectivity component of Type D also predicted a lowering of adherence over time, while the social inhibition component did not and neither did the interaction between the two dimensions.

The prevalence of Type D personality in our study was 16%. That means that one in six adolescents showed the combination of high negative affect and high social inhibition. This percentage is comparable to other studies in adolescents. In a community sample of 15 to 18 year old Swedish adolescents the prevalence was somewhat lower: 12.5% [26,27]. In a Korean sample of 13 to 18 year olds the prevalence was 18.2% [28].

The majority of previous studies that investigated the relation between the categorical (i.e., binary) construct Type D personality and adherence in different adult patient populations showed that those

Table 2
Means, standard deviations and correlations of categorical Type D personality, negative affectivity (NA), social inhibition (SI), adherence at baseline (T1), and adherence at follow-up (T2)

	Mean	SD	Correlations			
			Type D	NA	SI	Adherence T1
1. Type D	0.16	0.37				
2. NA	6.74	4.32	0.61***			
3. SI	8.49	4.54	0.55***	0.56***		
4. Adherence T1	3.98	0.72	−0.08	−0.13	−0.14	
5. Adherence T2	3.85	0.77	−0.14	−0.24**	−0.18*	0.56***

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Table 3
Multiple linear regression analysis predicting medication adherence at follow-up (T2) from categorical Type D personality

Predictor	Adherence T2				
	B	*SE B*	β	R^2	ΔR^2
Step 1:				.35***	.35***
Adherence T1	.61	.07	.56***		
Type D personality (categorical)	−.30	.13	−.15*		
Step 2:					
Adherence T1	.60	.07	.55***	.37***	.02
Type D personality (categorical)	−.35	.13	−.17**		
Control Variables:					
Gender	.05	.10	.04		
Age	.02	.05	.03		
Asthma duration	−.02	.01	−.09		
Asthma control	−.12	.07	−.12		
Asthma severity	.06	.08	.05		
Depressive Symptoms	.02	.02	.07		

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 4
Hierarchical linear regression analysis predicting medication adherence at follow−up (T2) from negative affectivity (NA), social inhibition (SI), and the interaction between NA and SI

Predictor:	Adherence T2				
	B	*SE B*	β	R^2	ΔR^2
Step 1:				.36**	.36**
Adherence T1	.59	.07	.54**		
NA	−.13	.06	−.17*		
SI	−.04	.06	−.05		
Step 2:				.36**	.00
Adherence T1	.59	.07	.54**		
NA	−.13	.06	−.17*		
SI	−.03	.06	−.04		
NA * SI	−.03	.04	−.04		
Step 3:				.39**	.03
Adherence T1	.57	.07	.53**		
NA	−.14	.06	−.19*		
SI	−.06	.06	−.08		
NA * SI	−.02	.04	−.03		
Control variables:					
Gender	.09	.10	.06		
Age	.04	.05	.05		
Asthma duration	−.02	.01	−.11		
Asthma control	−.12	.07	−.12		
Asthma severity	.10	.08	.08		
Depressive symptoms	.03	.02	.09		

* $p < .05$.
** $p < .001$.

with a Type D personality were at higher risk of non-adherence than those without a Type D personality [18–21]. The present study is the first to replicate these results in an adolescent sample. Results of our and previous studies on adherence are in line with results of studies on Type D and a broader range of self-care behaviours, which showed that Type D was related to self-care behaviours such as sensible eating [34] and consultation behaviour [35,36].

According to the author of the DS14 [13], Type D personality is the combination (i.e., interaction) of NA and SI. When testing Type D personality as a binary variable, a significantly increased health risk of people with Type D personality (the group with high NA and high SI) compared to people without a Type D personality (a combination of three groups: those with high NA and low SI, those with low NA and high SI, and those with low NA and low SI) could indicate that this increased risk is indeed due to the combination of NA and SI. However, a significant difference between those with and without Type D personality could also indicate other pathways. For instance, results could be due to a main effect of either NA or SI, since two of the three subgroups without Type D personality contain people with low NA and two subgroups contain people with low SI [17]. Therefore, it is important to test the dimensions NA and SI separately as well as their interaction, as we did in the present study. Our results suggest that it is indeed a main effect of NA, and not the combination of NA with SI, that was driving the significant effect of categorical Type D personality on medication adherence. Previous studies showed conflicting results on the interaction effect between NA and SI on adherence. In a study with myocardial infarction patients [21] it was found that high negative affectivity in combination with high social inhibition predicted lower medication adherence. In line with the present study, a study with adult patients with coronary heart disease [20] showed that only higher NA and not SI or the interaction between NA and SI predicted lower adherence. No earlier studies on adherence have been conducted with adolescents, but a recent study on adolescents' psychosomatic symptoms also showed that NA and not the interaction between NA and SI was significantly related to psychosomatic symptoms [27]. More studies on the role of Type D personality and adherence that test the interaction between NA and SI are needed.

One potential explanation for the effect of negative affectivity on adherence could be more concerns about possible side effects of medication. Another explanation could be lower self-efficacy for illness management. In adult patients with coronary heart disease, it was shown that self-efficacy partly mediated the relation between negative affectivity and adherence [20]. An additional explanation for lower adherence in those with high negative affectivity could be external locus of control. Negative affectivity is related to a more external locus of control [37]. In a study with 7–11 year old children with asthma, a more external locus of control was associated with lower adherence to the recommended asthma regimen [38]. However, the results could also be explained by a self-report bias: people high on NA could have been more negative across measures of this study because they tend to focus on the negative side of the world in general [39]. In addition, the results could be explained by a third variable influencing both negative affectivity and medication adherence, such as experiencing more daily stressors or life events. Future studies should examine whether the present results are caused by a self-report bias or a third variable like daily stressors.

We found no evidence of SI predicting medication adherence in early adolescents with asthma. This might be explained by the type of medication studied. In the current study, we focused on adherence to daily preventive asthma medication. Adolescents mostly use their preventive asthma medication at home, on their own, and not in a social context. This would explain why higher SI is not a predictor of lower adherence, which it could have been if adhering required communication with a care-giver or medication had to be taken for example at school, with peers present.

Strengths of this study are the longitudinal design, the small drop-out between the measurement waves, and testing Type D personality both as a category and with its constituent components (NA and SI) individually and in interaction. This study also has some limitations. A first limitation is that adherence was self-reported by the adolescents. Although the MARS questionnaire includes instructions that aim to make non-adherent responses more socially acceptable, adolescents may still have over-reported their adherence rates. Now the effect sizes of Type D categorical and of the NA dimension on medication adherence were significant but small; with a more objective measure of adherence (e.g., electronic monitoring [40]), they might have been larger. Another limitation of this study is that the questionnaire that was used to assess Type D personality was developed for adult populations. Although it has been used in previous studies on adolescent populations [26–28], further research on the validity of the DS14 in adolescent samples is warranted. Despite these limitations, the present study is still a valuable

first study of the relation between Type D personality and medication adherence in adolescents with asthma.

The implication of our study is the suggestion that screening adolescents for negative affectivity (e.g., by using the DS14) could be an easy way to identify adolescents at risk of poor medication adherence. Parents, schools and health care providers could especially pay attention to the medication intake of adolescents with high negative affectivity and those adolescents could be targeted for interventions. Personality itself may not be so easy to change, although more so in adolescents than in adults [41], but knowledge about relationships between personality traits and adherence can be used to develop individualised treatment plans, tailored to the patient's personality [42]. Further research on adolescents could disclose explanatory mechanisms (e.g. self-efficacy [20] or locus of control [37,38]) that could be changed in intervention programmes.

Conclusion

This is the first study to test the relationship between Type D personality and medication adherence in adolescents. Although categorical Type D personality predicts mediation adherence of adolescent with asthma over time, analyses with Type D personality represented as a dimensional construct suggest that this is due to negative affectivity alone instead of the combination of negative affectivity and social inhibition.

Conflict of interest

On behalf of all authors, I wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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