Linköping University Medical Dissertation
No. 1597

**Treatment adherence in
Asthma
and
Attention Deficit Hyperactivity Disorder (ADHD),
Personality traits, Beliefs about medication
and
Illness perception**

Maria Emilsson

Center for Social and Affective Neuroscience (CSAN)
Department of Clinical Experimental Medicine (IKE)
Linköping University, SE-581 85 Linköping, Sweden
Linköping 2017

© Maria Emilsson, 2017

Cover illustration: “Vi är alla unika” by Margaretha Herrman

Figure 1 Personality System, Figures reproduced with permission from copyright holder, Professor Costa, as per 5 June 2016.

The previously published articles are reprinted with the permission of the respective publishing journal.

Printed in Sweden by LiU-Tryck Linköping 2017

ISBN 978-91-7685-416-7

ISSN 0345-0082

“Nothing is impossible. The impossible just takes a little longer”
Winston Churchill

Emilsson M (2017). Treatment adherence in Asthma and Attention Deficit Hyperactivity Disorder (ADHD), Personality traits, Beliefs about medication and Illness perception. Linköping University Medical Dissertation No. 1597, Child and Adolescent Psychiatry, Center for Social and Affective Neuroscience. Department of Clinical and Experimental Medicine. Linköping University, SE-581 83 Linköping, Sweden. ISBN 978-91-7685-416-7, ISSN 0345-0082

ABSTRACT

Adherence to medication in asthma and attention deficit hyperactivity disorder (ADHD) is important because medication may prevent serious consequences, possibly with lifelong effects. Several factors have been identified that influence adherence to medication in these disorders, but the importance of personality traits, beliefs about medication and illness perception has been insufficiently explored.

The overall aim of this thesis was to study adherence to medication in asthma and ADHD, and in particular factors associated with adherence.

The participants (n=268) in Study I were recruited epidemiologically and consisted of young adults with asthma, aged 22 years (± 1 year). Impulsivity and, in men Antagonism and Alexithymia were associated with low adherence among respondents with regular asthma medication (n=109).

The participants (n=35) in Study II were recruited from primary care clinics and consisted of adults (mean age 53 years). In men, Neuroticism was associated with low adherence, but Conscientiousness with high adherence. Beliefs about the necessity of medication were positively associated with adherence behaviour in women. In the total sample, a positive necessity-concern differential of beliefs predicted higher adherence. The participants in Study III, IV (n=101) and V (n=99) were recruited from Child and Adolescent Psychiatric clinics and consisted of adolescents with ADHD on long-term ADHD medication. Study IV assessed the reliability and validity of Swedish translations of the Beliefs about Medicines Questionnaire-specific (BMQ-Specific) and Brief Illness Perception Questionnaire (B-IPQ) for use in adolescents with ADHD. Exploratory Principal Component Analysis (PCA) loadings of the BMQ-Specific items confirmed the original components, the specific-necessity and specific-concerns. The exploratory PCA for B-IPQ revealed two components; the first one, B-IPQ Consequences, captured questions regarding perceptions of the implication of having ADHD (items 1, 2, 5, 6 and 8) and the second one, B-IPQ-Control, the perceptions of the ability to manage the ADHD disorder (items 3, 4 and 7). Adherence correlated positively with BMQ-necessity-concern differential but negatively with beliefs about medication regarding concerns and side effects as well as Antagonism. Adolescents with more beliefs in the necessity, but with less concerns and side effects were less intentionally non-adherent. Adolescents with more perceptions that ADHD affected life showed less unintentional non-adherence. Negative Affectivity was associated with beliefs in the necessity of

medication, but also with concern about medication and side effects. Negative Affectivity was positively associated with perceived consequences in life caused by ADHD and less control over ADHD. Hedonic Capacity was associated with less concerns about medication.

In conclusion: In asthma and ADHD, adherence was associated with personality and beliefs about medications treatment. The personality traits showed numerous associations with perception about ADHD and beliefs about asthma and ADHD medication. This thesis increases our understanding of these person-related underlying factors of non-adherence, which may enable targeted actions intended to turn non-adherence into adherence as well as to identify individuals at risk for non-adherence. The Swedish translation of BMQ-Specific and B-IPQ proved to be valid and reliable, suggesting that the scales are useful in clinical work to identify risks of low adherence and to increase knowledge about how adolescents perceive ADHD.

Keywords: ADHD, adherence, asthma, beliefs about medication, illness perception, personality

POPULÄRVETENSKAPLIG SAMMANFATTNING

Följsamhet till läkemedelsbehandling vid astma och ADHD (attention deficit hyperactivity disorder) är viktigt eftersom optimal behandling kan förebygga allvarliga och livslånga konsekvenser. Flera faktorer som påverkar följsamhetsbeteendet har tidigare identifierats exempelvis ekonomiska faktorer, men vikten av personlighetsdrag, uppfattning om läkemedel och sjukdomsuppfattning har tidigare inte undersökts tillräckligt. Det övergripande syftet för avhandlingen var att studera följsamhet till läkemedel hos personer med astma och ADHD och i synnerhet påverkande faktorer. Avhandlingen utgörs av fem delstudier.

Personlighet kan beskrivas som grundläggande egenskaper som kännetecknar likheter och skillnader mellan individer, den så kallade egenskapsteorin. Personlighet kan beskrivas utifrån fem grundläggande personlighetsdrag: känslomässig instabilitet, utåtriktning, öppenhet, vänlighet och målmedvetenhet, den så kallade fem-faktor modellen. När det gäller uppfattning om läkemedel så vägs uppfattningen om nödvändigheten av läkemedelsbehandlingen för att kontrollera sjukdomen mot oron för läkemedlens negativa effekter-biverkningar. Följsamhetsbeteendet beror på vilken uppfattning som dominerar. Uppfattning om sjukdom påverkas bland annat av personens uppfattning om hur mycket sjukdomen påverkar personens liv och sjukdomens varaktighet.

Resultaten av denna avhandling visar att följsamheten var högre hos tonåringar med ADHD än hos vuxna med astma. Följsamheten till astma- och ADHD-medicinering var signifikant associerad med uppfattning att läkemedel var nödvändigt såväl som personlighetsdragen, särskilt antagonism. Följsamheten var inte associerad med ålder eller kön. Med anledning av att kön är relaterad till andra faktorer bör det beaktas i utredning av följsamhet till läkemedel. Personlighetsdraget känslomässig instabilitet, var relaterat till många uppfattningar om läkemedlen och sjukdomsuppfattningar. Avhandlingen visar på sambandet mellan vissa personrelaterade faktorer och följsamhet till läkemedel, hos personer med astma och ADHD. Den svenska översättningen av frågeformulären: Uppfattning om läkemedel (BMQ-Specific) och Uppfattning om ADHD (B-IPQ) visade sig ha god kvalitet för användning i kliniska utvärderingar och forskning som involverar ungdomar med ADHD.

ABBREVIATIONS

ACT	Asthma Control Test
ADHD	Attention Deficit Hyperactivity Disorder
ATX	Atomoxetine
BMQ	The Beliefs about Medicines Questionnaire Specific
B-IPQ	The Brief Illness Perception Questionnaire
FFM	Five-Factor Model
FFT	Five-Factor Theory
GINA	Global Initiative for Asthma
HP5i	Health-relevant Personality 5-factor inventory
HRQL	Health-Related Quality of Life
ICS	Inhaled corticosteroids
LABA	Long-acting β_2-agonist
MARS	Medication Adherence Report Scale
MCS	Mental Component Score
MPH	Methylphenidate
NEO-FFI	NEO Five-Factor Personality Inventory
PCS	Physical Component Score
SABA	Short-acting β_2-agonist
SF-8	Short-Form Health Survey
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization

This thesis is based on five papers.

- I. Axelsson M*, Emilsson M*, Brink E, Lundgren J, Torén K, Lötval J. (2009). Personality, adherence, asthma control and health-related quality of life in young adult asthmatics. *Respiratory Medicine*, 103(7):1033-1040.
- II. Emilsson M, Berndtsson I, Lötval J, Millqvist E, Lundgren J, Johansson Å, Brink E. (2011). The influence of personality traits and beliefs about medicines on adherence to asthma treatment. *Primary Care Respiratory Journal*, 20(2):141-147.
- III. Emilsson M, Gustafsson PA, Öhnström G, Marteinsdottir I. (2017). Beliefs regarding medication and side effects influence treatment adherence in adolescents with attention deficit hyperactivity disorder. *European Child Adolescent Psychiatry*, 26(5): 559-571.
- IV. Emilsson M, Berndtsson I, Gustafsson PA, Marteinsdottir I. Reliability and validation of Swedish translation of Beliefs about Medicines Questionnaire-Specific and Brief Illness Perception Questionnaire for use in adolescent with attention-deficit hyperactivity disorder. Submitted
- V. Emilsson M, Gustafsson PA, Öhnström G, Marteinsdottir I. Personality traits play a role in adherence, beliefs about ADHD medicines, and perception of ADHD in adolescents. Submitted

* The authors have contributed equal amounts of work.

CONTENTS

INTRODUCTION	1
BACKGROUND	3
Medication treatment behaviour.....	3
Intentional and unintentional non-adherent behaviour	4
Measuring adherence	4
Asthma	6
Attention Deficit/Hyperactivity Disorder (ADHD)	8
Personality.....	11
Personality traits	11
Personality development	13
Personality and health behaviour.....	14
Personality traits in asthma and ADHD	14
Personality and side effects	15
Beliefs	15
Beliefs about medication	15
Illness perception	16
The common-sense model of self-regulation	16
Health-related quality of life	17
Factors with possible influence on adherence behaviour in asthma and ADHD	18
Effects of low adherence in asthma and ADHD	20
RATIONALE FOR THE THESIS.....	21
AIMS OF THE THESIS	22
METHOD	23
Procedure.....	23
Participants	24
Epidemiological asthma sample (Study I).....	24
Clinical asthma sample (Study II)	25
ADHD sample (Study III, IV and V)	26
Data collection	28
Questionnaires.....	28
Medication Adherence Report Scale (Epidemiological, clinical asthma and ADHD samples).....	28

The Health-relevant Personality 5-factor inventory (HP5i) (Epidemiological asthma and ADHD samples).....	28
NEO Five-Factor Inventory (NEO-FFI) (Clinical asthma sample).....	29
Beliefs about Medicines Questionnaire specific (Clinical asthma and ADHD samples)	29
The Brief Illness Perception Questionnaire (ADHD sample)	30
Asthma Control Test (Epidemiological asthma sample).....	31
Short Form-8 Health Survey (SF-8) (Epidemiological asthma sample)	31
Statistical analyses	31
Epidemiological asthma sample (Study I).....	31
Clinical asthma sample (Study II)	32
ADHD sample (Study III)	32
ADHD sample (Study IV)	33
ADHD sample (Study V)	33
ETHICAL CONSIDERATION.....	35
RESULTS	36
Adherence to medication in the epidemiologic, clinical asthma and ADHD samples...	36
Personality traits in the epidemiologic, clinical asthma and ADHD samples.....	37
Beliefs about medication in the clinical asthma and ADHD samples.....	37
Perceptions of ADHD	38
Adherence behaviour and Personality in the epidemiologic, clinical asthma and ADHD samples.....	38
The beliefs about medication and adherence to medication in the clinic asthma and the ADHD samples	39
Perceptions of ADHD and adherence to medication in the ADHD sample.....	40
Reliability and Validation of Beliefs about medicines questionnaire specific and Brief Illness Perception Questionnaire in the ADHD sample	40
Personality traits and Beliefs about medication in the clinical asthma and ADHD samples	41
Personality and perceptions of ADHD.....	42
Personality traits and asthma control in the epidemiologic asthma sample	42
Personality traits and health-related quality of life according to SF-8 in the epidemiologic asthma sample	43
Predictive factors for adherence to medication	44
Epidemiologic asthma sample.....	44

Clinical Asthma sample.....	44
ADHD sample	44
DISCUSSION	47
Adherence to medication.....	47
Personality traits and adherence to medication	49
Validation of BMQ-Specific and B-IPQ	50
Beliefs about medication, adherence to medication and personality traits	51
Perceptions of ADHD, adherence to medication and personality traits.....	53
LIMITATIONS AND METHODOLOGICAL CONSIDERATIONS	55
CLINICAL IMPLICATIONS AND FURTHER RESEARCH	58
CONCLUSION.....	59
ACKNOWLEDGEMENTS	60
REFERENCES	62

INTRODUCTION

Adherence captures the extent to which a person's actions corresponded to the treatment agreement recommendations of the health care providers and is a multidimensional phenomenon including factors related to the socio-economy, therapy, health care system, condition and the persons themselves (2003). Regarding person factors, the individual's personality and beliefs play a role. Personality traits have been shown to affect adherence to medication in lifelong conditions (Axelsson, Brink, Lundgren, & Lotvall, 2011; Cheung, LeMay, Saini, & Smith, 2014; van de Ven, Witteman, & Tiggeleman, 2013).

Low adherence to long-term therapy may influence treatment effects (Gau et al., 2008; Hong et al., 2013; Murphy et al., 2012), which in turn affect people's health (Sabaté, 2003; Stern et al., 2006; Williams et al., 2011). This is a concern, because some studies have found that about 50% of those on prescribed medication are reported to not adhere to the pharmacological therapy recommended by health care providers (Sabaté, 2003). Adherence behaviour varies between different disorders (Gatti, Jacobson, Gazmararian, Schmotzer, & Kripalani, 2009; Horne & Weinman, 1999) and age groups, although somewhat inconsistently (Barner, Khoza, & Oladapo, 2011; Darba et al., 2016; Faraone, Biederman, & Zimmerman, 2007; Mosnaim et al., 2014; Taylor, Chen, & Smith, 2014). This explains the recommendation of World Health Organization (WHO), which claims that adherence assessment is needed for every disorder and developmental stage (Sabaté, 2003). Therefore, adherence needs to be studied in different groups and different ages.

Asthma and Attention Deficit Hyperactivity Disorder (ADHD) are both lifelong disorders (Barkley, 2006b; GINA, 2014; Guldborg-Kjär, Sehlin, & Johansson, 2013) that may require long-term pharmacologic therapy (GINA, 2014; Swedish Medical Products Agency, 2009).

The prevalence of asthma differs from country to country and is estimated to be between 4% and 32% in Europe (20 to 44 years old) (Lisspers, 2015). In a meta-analysis of studies from different countries (Willcutt, 2012) based on DSM-IV criteria, ADHD prevalence in children and adolescents ranged between 6 % and 7%.

Because suboptimal adherence in these disorders may have serious consequences (Gau et al., 2008; Murphy et al., 2012; Stern et al., 2006), it is important to identify those individuals at risk of non-adherence. Several risk factors for low adherence are known, but the impact of person-related factors, such as personality traits, beliefs about medication and illness perception, has been insufficiently explored in relation to both asthma and ADHD.

In clinical work, validated screening instruments to detect individuals at risk for non-adherence would be of value so they may be given correct prophylactic or counteractive support.

The overall aim of this thesis was to explore adherence behaviour in relation to medication treatment for asthma and ADHD and in particular factors association with adherence.

BACKGROUND

Medication treatment behaviour

According to Haynes (1979) and Vrijens et al. (2012), the first case of human non-compliance was when Eve ate the fruit of the Tree of Knowledge in the Judeo-Christian tradition. Hippocrates (ca 460 BC -370 BC) wrote of this topic:

Keep a watch also on the faults of the patients, which often makes them lie about the taking of things prescribed (p. 297) (Hippocrates & Jones, 1923).

When describing medication treatment behaviour, different aspects may need to be addressed and these are reflected by different concepts: the time on medication, discontinuation (also called persistence) (Cramer et al., 2008; Vrijens et al., 2012), compliance, adherence and concordance (Sabaté, 2003; Vrijens et al., 2012).

The concept ‘compliance’ was defined by Haynes (1979):

..the extent to which a person’s behavior (in terms of taking medications, following diets, or executing lifestyle changes) coincides with medical or health advice (p. 1-2) (Haynes, 1979).

The concept of compliance, however, has been criticized for implying an undertone of paternalism (Bissonnette, 2008). In other words, it is thought to assign the patient a passive role, as obedient and blindly following the doctor’s orders (Horne, 2006; Levensky & O’Donohue, 2006). For example, when the patient does not take the medication in accordance with doctor’s orders, this may be interpreted as incompetence or lack of ability or even as intentional self-injurious behaviour (Horne, 2006).

Rand (1993) defined adherence/compliance as follows:

.. the extent to which a patient’s behavior corresponds to the physician’s therapeutic recommendations (p. 68D) (Rand, 1993).

By merging this definition with the one Haynes (1979) suggested for compliance, a new definition emerged and was put forward by WHO (Sabaté, 2003). The WHO definition of adherence to long-term therapy is the one used here:

The extent to which a patient’s behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider (p. 3) (Sabaté, 2003).

When comparing the concept of compliance with WHO’s definition of adherence, the main difference is that adherence requires the patient’s agreement with the recommendations (Sabaté, 2003) and also implies that the patient takes an active role and is a collaborator in the treatment (Levensky & O’Donohue, 2006). These differences between compliance and adherence explains why the adherence concept was chosen in this thesis. Later on, the concept ‘concordance’ was introduced (Vrijens et al., 2012); it

refers to the therapeutic alliance and the interaction between person in question and the health care provider(s) (Bell, Airaksinen, Lyles, Chen, & Aslani, 2007), also in medicine-taking settings.

Intentional and unintentional non-adherent behaviour

Horne and Clatworthy (2010) argued that the behaviour of not following the medications recommendations should be considered as a behavioural attribute, but not a trait character.

Non-adherence can be divided into two types: intentional and unintentional non-adherence behaviour (Horne, 2006; Horne & Clatworthy, 2010), both of which are important concepts in attempts to clarify non-adherence behaviour (Vrijens et al., 2012.). Intentional non-adherence refers to the active decision of whether or not to take the medication as prescribed. It is influenced by motivation to take the medication and beliefs about the medication. The most common intentional non-adherence behaviour is that the individual reduces the doses or number of medications down to a level he/she finds appropriate (Horne, 2006). Unintentional non-adherence captures the behaviour of not taking medication as prescribed due to lack of capacity, resources or other constraints, such as forgetfulness, or for economic reasons (Horne, 2006; Horne & Clatworthy, 2010).

In addition, depression may contribute to both intentional and unintentional behaviour (Horne, 2006).

Measuring adherence

Various methods can be used for measuring adherence. These methods can be divided into two different groups: direct and indirect (Ahmed & Aslani, 2013; Horne & Clatworthy, 2010; Osterberg & Blaschke, 2005; Otsuki, Clerism-Beaty, Rand, & Riekert, 2008). However, no measurement methods are optimal (Sabaté, 2003), and this dilemma has been addressed in the literature by stating, there is no “gold standard” method for adherence measurements (Horne & Clatworthy, 2010; Sabaté, 2003). All methods have their advantages and disadvantages (Horne & Clatworthy, 2010).

Two direct methods are biological analysis and observation (Horne & Clatworthy, 2010). According to Otsuki et al. (2008), biological available is the only available method for secure measurement of adherence behaviour where blood or urine can be used to detect the presence of drugs (or metabolites of drugs). Hence, this enables clarification of whether or not the patient has actually taken the medication, and also allows quantitative dose-related assessments. However, this is not possible for all medications (Lehmann et al., 2014; Otsuki et al., 2008), and is also costly (Lehmann et al., 2014). Of note, an observation of the individuals consuming the prescribed medication is the method internationally recommended for controlling adherence to

tuberculosis medication (World Health Organization, 2016). It is also a costly method, labour intensive and quite intrusive (Riekert, 2006).

Among the indirect methods are self-reports, pill counts, electronic monitoring and prescription refills counts (Horne & Clatworthy, 2010; Lehmann et al., 2014; Otsuki et al., 2008).

The self-report measurement is one of the most frequently used methods of assessing adherence behaviour (Lehmann et al., 2014; Osterberg & Blaschke, 2005) and can be conducted by interviews, diaries or questionnaires (Horne & Clatworthy, 2010; Otsuki et al., 2008). The main benefit of using the self-report methods is that they are inexpensive, simple, (Horne & Clatworthy, 2010; Lehmann et al., 2014), flexible (Lehmann et al., 2014) and quick (Lehmann et al., 2014; Otsuki et al., 2008; Riekert, 2006). Furthermore, questionnaires used to measure adherence usually have the advantage of having good face validity (Otsuki et al., 2008), which refers to the acceptance of the respondents (Vitolins, Rand, Rapp, Ribisl, & Sevrick, 2000). In addition, for adherence assessments, some self-reports allow a distinction to be made between intentional and unintentional non-adherence behaviour (Horne & Clatworthy, 2010; Lehmann et al., 2014) which is beneficial. Nonetheless, the utilization of self-reports for adherence assessments has been criticized for entailing the risk of overestimation of adherent behaviour (Horne & Clatworthy, 2010). One way to mitigate such risk is to choose a scale with questions that are asked in such way that non-adherent behaviour is “normalised in order to minimise self-report bias” (Horne & Clatworthy, 2010).

Another common indirect method is to count pills at return visits, which is simple to perform and cheap (Vitolins et al., 2000), although it cannot confirm that the medication was actually swallowed as supposed to or thrown away before returning the container (Vitolins et al., 2000).

Electronic monitors usually contain a computer chip that records information about adherence behaviour and may, for example, be situated in a medicine container (Vitolins et al., 2000). This method provides detailed data (Vitolins et al., 2000) and is suitable for longitudinal measurements of adherence behaviour (Lehmann et al., 2014). This method also has limitations, as it is costly and may interfere in the person’s life (Lehmann et al., 2014). Moreover, awareness of electronic monitoring may influence adherence behaviour (Otsuki et al., 2008).

Prescription refills can be used to assess adherence behaviour by following up the time between refills and estimating whether it is adequate with regard to the prescribed dosage and amount of medication expedited. One advantage of this type of adherence assessment is that the data are objective and the assessment can be conducted without inconveniencing the person in question. Nonetheless, the data do not give information about whether the person has actually taken the medication (Lehmann et al., 2014).

Asthma

Respiratory conditions such as asthma were already being discussed at the time of Hippocrates (Keeney, 1964).

Asthma is a heterogeneous disease, usually characterized by chronic airway inflammation. It can be defined according to Global Initiative for Asthma (GINA) (2016):

By the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation (p. 14) (GINA, 2016).

Asthma is a chronic respiratory inflammatory disease in which many cells and cellular components are involved. Chronic inflammation causes a hyperactivity of the airways, which in turn leads to recurrent episodes of wheezing, shortness of breath, chest tightness and/or cough. Episodes pass either spontaneously or through treatment (GINA, 2016).

Asthma has different phenotypes, which are the observable characteristics of the underlying disease processes. The most common of the five phenotypes is *allergic asthma*, which often presents itself in childhood in families with a history of allergic disease, e.g., eczema, allergic rhinitis. *Non-allergic asthma* is a form of adult asthma with no allergic associations. *Fixed airflow limitation* can develop in persons with long-standing asthma, and it is thought to be related to airway wall remodelling. Obese persons may have prominent respiratory symptoms, so-called *asthma with obesity*. The fifth phenotype is called *Late-onset asthma* and is often found in adult women, when asthma symptoms debut for the first time in their adult life (GINA, 2016).

The aetiology of asthma is complex, and several influencing factors have been suggested regarding both the host (genes, obesity and sex) and the environment (e.g., allergens, infections, and exposure to tobacco smoke) (GINA, 2015).

In a book from 1859, strong coffee is described as a treatment for asthma (Persson, 1985). Since “bronchospasm” was noted in asthma exacerbation, bronchodilators such as theophylline, ephedrine and adrenaline have been used for treatment. Later, asthma came to be treated with selective β_2 -adrenoceptor agonists, in the form of either inhalation or oral medication (Holgate, 2010). Nowadays, the inflammatory component of the airway restriction is more acknowledged, and an important part of the treatment is inflammation reduction (GINA, 2016).

Pharmacological medical treatment of asthma is divided into the sub-categories of controller and reliever medications. Controller asthma medication is intended to be taken regularly, i.e., one to four times a day (The research-based pharmaceutical industry, 2016) to reduce airway inflammation, control asthma symptoms and reduce the risk of exacerbations and decline of lung function. Available controller asthma medications to date are: inhaled corticosteroids (ICS), leukotriene receptor antagonists (LTRA) and long-acting β_2 -agonists (LABA) (GINA, 2016).

Corticosteroids have anti-inflammatory effects in asthma through inhibition of multiple inflammatory mediators and through effects on inflammatory and structural cells (Barnes & Adcock, 2003). In *Allergic asthma*, inhaled corticosteroids (ICS) often have a good effect, while *Non-allergic asthma* actually responds less to ICS; *Late-onset asthma* generally requires higher doses of ICS and may occasionally be refractory (GINA, 2016). Corticosteroids with inhaled steroids may cause local side effects like candidiasis and hoarseness (Swedish Medical Products Agency, 2015).

Leukotriene receptor antagonists (LTRA) work by acting on the asthmatic inflammatory process and by giving a certain degree of protection against stimuli that lead to bronchial obstruction. LTRA may increase the effect of ICS. LTRA generally causes few side effects (Swedish Medical Products Agency, 2015).

Long-acting β_2 -agonists (LABA) are bronchodilators that interact with the bronchial β_2 -adrenoceptors, thus leading to bronchodilation, and are effective for over 12 hours (Johnson, 2001). Combinations of ICS and LABA are available in a single inhaler (The research-based pharmaceutical industry, 2016).

Reliever medication is taken as needed, for example when exacerbation relief is desired. The most commonly used medications are short-acting β_2 -agonists (SABA). SABA work in the same way as LABA, i.e. through interaction with the β_2 -adrenoceptors. They have quick effects that last from four to six hours (Johnson, 2001). The most common side effects of β_2 -agonists are tremor, palpitations and muscle cramps (Swedish Medical Products Agency, 2015).

Medical decisions concerning asthma treatment should be based on the individual's phenotype of asthma, treatment response, inhaler technique, the cost of treatment and the exhibited adherence behaviour in relation to the treatment. Long-term goals for asthma management are good symptom control, reduction of exacerbations, fixed airflow and avoiding side effects. In order to achieve this, personal goals concerning the asthma and the treatment should be taken into account (GINA, 2016).

Asthma control is described in terms of two domains, i.e. asthma symptom control and future risk, both of which should be assessed during treatment (GINA, 2016). The Asthma Control Test (ACT) is an alternative for assessment of the first domain (Nathan et al., 2004). Future risk refers to adverse outcomes of longstanding asthma such as fixed airflow limitation and medication side effects (e.g., tremor, Candida infections in the oral cavity and throat). Evaluation of future risks should include assessment of adherence (GINA, 2016).

Signs of good symptom control in persons with asthma according to the Global Initiative for Asthma (GINA, 2016) are: not waking up at night due to asthma, symptoms of asthma less than twice a week, asthma relief medication needed less than twice a week and the ability to perform all activities without limitation due to asthma.

Several factors are known to reduce asthma control such as; active smoking (Yildiz & Group, 2013; Zahran, Bailey, Qin, & Moorman, 2014), rhinitis (Yildiz & Group, 2013), obesity (Yildiz & Group, 2013; Zahran et al., 2014) depression (Zahran et al., 2014) and gender (Lisspers, Stallberg, Janson, Johansson, & Swardsudd, 2013). Socio-economic factors also play a role, for instance low household income and low education (Zahran et al., 2014). In cases of signs of failing asthma control, treatment adherence needs to be assessed first of all, prior to an eventual step-up of the treatment (GINA, 2016).

Attention Deficit/Hyperactivity Disorder (ADHD)

Symptom clusters of inattention, hyperactivity and impulsivity have been described by various authors over the past 200 years (Lange, Reichl, Lange, Tucha, & Tucha, 2010).

For instance, a chapter outlining “attention deficits” was included in a medical textbook around the year 1770 (Gillberg, 2014).

The present definition of ADHD, as specified by The Diagnostic and Statistical Manual of Mental Disorders, is shown in Table 1 (DSM-5) (American Psychiatric Association & American Psychiatric Association. DSM-5 Task Force., 2013). The DSM-5 has been used in Sweden since 2015, but the differences between DSM-IV and 5 are small for children and adolescents (American Psychiatric Association & American Psychiatric Association. DSM-5 Task Force., 2013; American Psychiatric Association. & American Psychiatric Association. Task Force on DSM-IV., 2000). Some of these changes, however, may be relevant for this thesis. The age of onset of ADHD symptoms was changed from 7 years in DSM-IV to 12 years in DSM-5. In addition, the DSM-5 allows the diagnosis of ADHD although autism is present (American Psychiatric Association. & Association., 2013).

There are three different ADHD presentations: predominantly inattentive, predominantly hyperactive/impulsive and a combination of inattentive and hyperactive/impulsive (American Psychiatric Association & American Psychiatric Association. DSM-5 Task Force., 2013).

Problems with *inattention* may be expressed by failure to pay attention to details, and/or sustain attention and difficulties in organizing activities. Individuals with ADHD may appear as careless due to mistakes in schoolwork or work, forgetfulness and repeatedly losing things (American Psychiatric Association & American Psychiatric Association. DSM-5 Task Force., 2013).

Hyperactivity is expressed as difficulties with remaining still or seated, and continuously moving one's hands or feet. *Impulsivity* refers to hasty action performed without first thinking, difficulties with waiting in queues or for a reply in a discussion and a tendency to interrupt others (American Psychiatric Association & American Psychiatric Association. DSM-5 Task Force., 2013).

A person with ADHD with a combination of *inattention* and *hyperactivity/impulsivity* is characterized by difficulties in both of the previously described areas, which in more severe cases may be accompanied by severe impairment of the ability to handle many situations in everyday life (Gillberg, 2014).

Table 1. ADHD diagnostic criteria from DSM-5 (American Psychiatric Association & American Psychiatric Association. DSM-5 Task Force., 2013)

Criteria	Symptoms
Criterion A	The essential feature of ADHD is a persistent, at least for six months, pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development. Inconsistent with development level and negative influence directly on social and academic/occupation activates.
Criterion B	Symptoms of hyperactive-impulsive or inattentive symptoms that cause impairment must have been present before age 12.
Criterion C	Symptoms must be present in at least two settings.
Criterion D	Evidence of interference with or reduce the quality of social, academic or occupational function.
Criterion E	The disturbance does not occur exclusively during the course of another mental disorder.

ADHD may be comorbid with other psychiatric disorders (Barkley, 2006a), e.g., anxiety disorder, conduct disorder and specific learning disorder (American Psychiatric Association & American Psychiatric Association. DSM-5 Task Force., 2013).

The exact cause of ADHD is not known, but a multifactorial aetiology has been postulated, as it cannot be explained by a single risk factor (Thapar, Cooper, Eyre, & Langley, 2013). According to Gillberg (2014), ADHD is heritable in 60-70% of cases, although non-genetic factors also play a role in ADHD (Thapar & Cooper, 2016). Brain damage and environmental factors together may be responsible for about 20% to 30% of cases (Gillberg, 2014). More precisely, several perinatal factors have been reported to be of importance, such as maternal smoking (Joelsson et al., 2016), premature birth (Halmøy, Klungsøyr, Skjaeraeven, & Haavik, 2012; Lindström, Lindblad, & Hjern, 2011; Sucksdorff et al., 2015), low birth weight and low Apgar scores (Halmøy et al., 2012). However, linking environmental factors to ADHD is not straightforward, as exposure to multiple risk factors does not necessarily lead to ADHD (Thapar et al., 2013).

Functional brain disturbances, such as difficulties distinguishing signals from noise, are associated with ADHD (Stahl, 2009). Recent imaging studies have reported smaller volume, slower maturation and reduced activity of the prefrontal cortex. In addition, Nucleus caudate and cerebellum have also been suggested to play a role (Sharma & Couture, 2014; Shaw et al., 2012).

Pharmacological treatment of ADHD is one of multiple components in a broader support and treatment programme (Swedish Medical Products Agency, 2016), which includes, for example, psychological, behavioural and educational advice (National Institute for Health and Clinical Excellence, 2013). The selection of medication is based on several factors, such as the symptoms profile over a day, interactions with other drugs, side effects, prior treatment experiences and comorbidities. Hence, to attain an optimal effect, assessments of each individual's needs and treatment effects should be undertaken (Swedish Medical Products Agency, 2016). Recommended start doses should be low and the dosage successively increased to find equilibrium between effectiveness and side effects. The occurrence of side effects indicates that the dosage should be decreased. In cases of absent or insufficient medication efficacy, adherence behaviour should be investigated (Bolea-Alamanac et al., 2014). When the ADHD symptoms are refractory to the chosen medication, not due to lack of adherence or side effects, another ADHD medication should be tested and consequently evaluated (Swedish Medical Products Agency, 2016). Drug holidays are recommended if the medication causes reduced physical growth (Sharma & Couture, 2014).

The first time, treatment with stimulants was used for behavioural disturbances in children and adolescents was in 1937 (Connor, 2006). At the time of the study, Methylphenidate (MPH) and Atomoxetine (ATX) were mainly used, while Lisdexamfetamin had just recently been introduced and was seldom prescribed for adolescents. MPH has a stimulant effect on the central nervous system (Banaschewski et al., 2006) through presynaptic inhibition of both dopamine and norepinephrine reuptake (Connor, 2006). The effect duration varies; for example, for the immediate-release preparations it can be about three-four hours and for extended-release preparations about 10-12 hours. The daily dose for immediate-release preparations is two to three doses, while one dose is typically enough for the extended-release preparations (Connor, 2006). However, the MPH treatment will not be the optimal choice in approximately 30% of cases due lack of adequate response or intolerance (Spencer, 2006). Stimulant medications are generally well tolerated per se. However, common side effects of stimulant medications such as MPH are; decreased appetite, insomnia, anxiety, irritability, and/or susceptibility to crying, hypertension and tachycardia (Connor, 2006).

Atomoxetine (ATX) is a selective norepinephrine reuptake inhibitor (Stahl, 2008) whose full effects appear after 6 to 8 weeks (or longer) of medication, while some effects are achieved after 4 weeks of treatment (Banaschewski et al., 2006). The dosing of ATX

is once or twice daily (Sharma & Couture, 2014). Common side effects of ATX include sedation, mild gastrointestinal symptoms and decreased appetite (Spencer, 2006).

Personality

Personality traits

Interest in personality has grown over the centuries, starting in antiquity when individual differences in personality were addressed by Aristotle (384 – 322 BC) in terms of dispositions such as modesty, morality and immorality (Matthews, Deary, & Whiteman, 2009).

In the 1930s, Allport and Obdet studied the dictionary looking for natural language terms that describe personality and found almost 18,000 terms. Catell selected a subset of 4,500 traits terms from the original 18,000. Eventually, Catell succeeded in paring these down. Using factor analyses, he sorted them into 12 groups of personality factors. Cattell's work stimulated research on personality traits, which has led to the development and classification of the "Big Five" dimensions, also known as the Five Factor Model (FFM) (John & Srivastava, 1999): Neuroticism, Extraversion, Openness to Experiences, Agreeableness and Conscientiousness (John & Srivastava, 1999; McCrae & Costa, 2003). When rating the dimensions in self-reports, the lowest and highest scores reflect the bipolarity of each dimension. The FFM has a hierarchical structure in which the dimensions give a general description of personality dimensions found in all individuals to varying degrees, while the six facets posited beneath describe more specific aspects (Table 2) (McCrae & Costa, 2003). The FFM is the most widely accepted approach to describing personality traits, although several different personality theories exist (McCrae & Costa, 2003). The personality traits are thought to develop through childhood and into adult life (McCrae & Costa, 2003; McCrae et al., 2000). However, the FFM is *not* a theory of personality, as it does not explain the function of personality traits in daily life (McCrae & Costa, 2008), something that the Five Factor Theory (FFT) does. The FFT depicts the way the individual acclimatizes to a particular context, or the way attitudes are formed and changed. The FFT is a description of the so-called Personality System (see Figure 1), which illustrates the personality traits in the broader context of the person and the world (McCrae & Costa, 2003), where the personality traits remain stable despite the individual's continuous adaption to a changing world (McCrae & Costa, 2008; McCrae & Costa, 2003).

According to the FFT, personality traits within the individual can be defined as (McCrae & Costa, 2003):

..endogenous Basic Tendencies that give rise to consistent pattern of thoughts, feeling and actions (p. 204-205).

Table 2. The five personality traits of specific aspects with high vs. low values (Costa & McCrae, 1991; Gustavsson, Jönsson, Linder, & Weinryb, 2003)

Basic Personality traits	High Scorer	Low Scorer
Neuroticism	Fear Sadness Negative affectivity*	Emotionally stable Calm
Extraversion	Active Talkative Hedonic capacity*	Reserved Relaxed in tempo
Openness to Experience	Open to fantasy Open-mindedness	Prosaic Limited curiosity Alexithymia*
Agreeableness	Trusting Sincere	Sceptical Self-Centred Antagonism*
Conscientiousness	Well-organized Responsible	Unmethodical Spontaneous Impulsivity*

*Facets evaluated in the Health-relevant Personality 5-factor inventory (Gustavsson et al., 2003)

The personality system is composed of several parts. It illustrates the relation of personality traits and external influences, such as cultural norms, life events and situation, to the more changeable Characteristic Adaptions (Allik & McCrae, 2002; McCrae & Costa, 2008; McCrae & Costa, 2003), which covers attitudes, beliefs and personal striving. Although the Self-Concept through which we understand ourselves is also a part of the Characteristic Adaptions, it is more stable, alike the personality traits. Nevertheless, roles and relationships can change over time (McCrae & Costa, 2003) and subsequently also the Self-Concept (Allik & McCrae, 2002; McCrae & Costa, 2003). In the personality system, one's Objective Biography is the outcome of the other components' interactions, which may be expressed through emotional reactions as well as behaviour (Allik & McCrae, 2002; McCrae & Costa, 2008; McCrae & Costa, 2003).

Figure 1. The Personality System according to the Five Factor Theory p. 192 (McCrae & Costa, 2003)

The FFT and the personality system can be used to illustrate health-related behaviour, such as adherence. In that case, adherence is to be considered an outcome of the interaction between personality, beliefs (Axelsson, Cliffordson, Lundback, & Lötval, 2013; McCrae & Costa, 2003) and external influences, such as medical information and health care providers

Personality development

The five personality traits mature up to the age of 30 years (McCrae & Costa, 2003) and fewer changes are notable after that age (McCrae et al., 2000).

Neuroticism increases in girls between 12 and 18 years of age (McCrae et al., 2002), but declines in both genders between 21 to 29 years (Wängqvist, Lamb, Frisén, & Hwang, 2015) and continues to decline up to 80 years of age (Terracciano, McCrae, Brant, & Costa, 2005).

Openness to Experience may increase between early and late adolescence (McCrae et al., 2002), but no changes have been documented in the years afterwards up to 29 years of age (Wängqvist et al., 2015) when it begins to decrease up to 90 years (Terracciano et al., 2005).

No changes in Extraversion are reported up to 29 years of age (McCrae et al., 2002; Wängqvist et al., 2015) while it begins to decrease around the age of 50 years and continues up to 90 years (Terracciano et al., 2005).

The impact of age on Agreeableness and Conscientiousness is more unclear, as they are reported to decrease between 12 and 18 years of age (Allik, Laidra, Realo, & Pullmann, 2004) to become stronger again in early adulthood up to 29 years (Wängqvist et al., 2015). However, one study found them to be stable during adolescence (McCrae et al., 2002). Agreeableness increases from 30 up to 90 years of age (Terracciano et al., 2005). Finally, Conscientiousness increases from 30 years of age up to 70 years when it starts to decrease (Terracciano et al., 2005).

Personality and health behaviour

Personality is an important factor for health and treatment outcomes and therefore beneficial to include in studies of health behaviour, quality of life and treatment outcome (Gustavsson et al., 2003). Several studies have shown that personality significantly affects health behaviour (Bogg & Roberts, 2004; Booth-Kewley & Vickers, 1994; Ingledew & Brunning, 1999; Vollrath & Torgersen, 2002; Vollrath & Torgersen, 2008). More precisely, Openness to Experience has been related to risk taking (Booth-Kewley & Vickers, 1994), while Agreeableness (Hong & Paunonen, 2009) and Neuroticism in combination with low Conscientiousness (Terracciano & Costa, 2004) – have been related to smoking. Neuroticism has also has been associated with more medical visits (Costa & McCrae, 1987). On the other hand, high Extraversion and Agreeableness are associated with more positive health behaviours such as physical activity (Booth-Kewley & Vickers, 1994) and preventive health behaviour (Ingledew & Brunning, 1999). In addition, personality traits play a role in adherence behaviour, has described more in detail below.

Personality traits in asthma and ADHD

The literature to date is inconsistent regarding the association between personality traits and asthma, although high Neuroticism has been reported (Huovinen, Kaprio, & Koskenvuo, 2001; Loerbroks, Li, Bosch, Herr, & Angerer, 2015; McCann, 2011). Nevertheless, high Openness to Experience, but low Extraversion, Agreeableness and Conscientiousness have also been described in persons with asthma (≥ 25 years old) (McCann, 2011).

ADHD has been related to high Neuroticism/Negative Emotionality, and low Agreeableness and Conscientiousness in 14- to 17-year-old adolescents as well as in 7- to 13-year-olds (Martel, Nigg, & Lucas, 2008). The severity of ADHD has been related to high Neuroticism along with low Agreeableness and Conscientiousness in young people 16 to 22 years of age (Miller, Miller, Newcorn, & Halperin, 2008). Attention difficulty symptoms have been associated with low Conscientiousness and high Neuroticism, while symptoms of hyperactivity-impulsivity with low Agreeableness in young adults (mean age 21.6) (Nigg et al., 2002).

Personality and side effects

Personality may influence the experience of side effects, as has been shown in asthma and obstructive sleep apnoea syndrome (Broström et al., 2007; Foster, Sanderman, van der Molen, Mueller, & van Sonderen, 2008), where the experience of side-effects of inhaled corticosteroids was linked to higher Negative Affectivity (Foster et al., 2008).

In ADHD, no studies were found regarding the possible association of personality traits on beliefs about side effects.

Beliefs

A belief may simply describe something the person in question holds to be true (Aylward, 2006). According to the Five Factor Theory, beliefs result from the interaction between personal traits and external influences, whereas beliefs belong to one of the three central components, namely the Characteristic Adaptions (McCrae & Costa, 2003).

Beliefs about medication

The Necessity-Concerns Framework (NCF) is a theoretic framework that has been developed to operationalize the relation between beliefs about medication and adherence (Horne, 2003). It is the basis for one of the most used questionnaires, the Beliefs about Medicines Questionnaire - specific (BMQ - specific) (Horne, Weinman, & Hankins, 1999).

There is a balance between beliefs about the *necessity* of medical treatment to control illness/disability and to maintain health and *concerns* about the negative effects of medications, all of which may be of importance for adherence (Horne, 2003; Horne & Weinman, 1999; Horne et al., 1999).

Regarding asthma, several studies (Axelsson, Ekerljung, & Lundback, 2015; Koster, Philbert, Winters, & Bouvy, 2014; Menckeberg et al., 2008; Van Steenis et al., 2014) have shown that beliefs in the necessity of medication are associated with higher adherence. Conversely, concerns about medication are associated with lower adherence (Cooper et al., 2015; Horne & Weinman, 2002; Menckeberg et al., 2008; Ponienman, Wisnivesky, Leventhal, Musumeci-Szabo, & Halm, 2009). It is noteworthy that individuals with strong concerns about the negative side effects of asthma medication also have reported more side effects (Cooper et al., 2015).

Concerning adolescents with ADHD, information is lacking about the impact of beliefs on adherence, although some evidence suggests there is an association. Two studies (Charach, Yeung, Volpe, Goodale, & Dosreis, 2014; Ferrin et al., 2012) have reported that beliefs and attitudes influence the use of medication. Furthermore, beliefs about the effectiveness of medication coupled with minimal experience of side effects have been linked to willingness to use ADHD medication (Bussing et al., 2012). Negative beliefs

about medication, for example about depletion of energy, have been reported in young persons between 10 and 21 years of age (Walker-Noack, Corkum, Elik, & Fearon, 2013).

In summary, the implications of beliefs about medication for adherence have not been fully studied in relation to asthma and ADHD, and further studies are needed.

Illness perception

Synonymous terms exist for illness representation, for example, illness cognitions, illness perceptions, illness beliefs and illness schemata (Cameron & Moss-Morris, 2010). In this thesis, the concept of perception will be used.

The common-sense model of self-regulation

Leventhal and colleagues developed a framework, the Common-Sense Model of Self-Regulation (CSM) (Diefenbach & Leventhal, 1996) to explain the associations between perceptions of illness, coping strategies, underlying health and illness behaviour (Cameron & Leventhal, 2003). In research, the model may improve our understanding of the role of illness perceptions in health-related decisions (Leventhal, Diefenbach, & Leventhal, 1992).

CSM is also known as the Illness Perception Model, the Illness Representation Model, the Parallel Process Model, the Self-Regulation Model, or Leventhal's Model (Hale, Treharne, & Kitas, 2007). However, it will be referred to as the Common-Sense model (CSM) in this thesis. The CSM became the foundation of the above-mentioned Necessity-Concerns Framework, which describes the relation between beliefs about medication and adherence (Horne, 2003).

One of the fundaments of CSM is the conception that people are active problem solvers. The first step in CSM begins at the time point when the individual is faced with internal and/or external signs of illness. This initiates a process aimed at solving the health problem by creating action plans for coping (Diefenbach & Leventhal, 1996); the second step aims at reducing both the health threat and associated emotional reactions (Leventhal, Brissette, & Leventhal, 2003). The coping plans and subsequent reactions to health threats are influenced by the personal history, social and cultural context as well as personality traits (Diefenbach & Leventhal, 1996). The third step of the model is the person's evaluation of the effectiveness of the coping strategy (Leventhal et al., 2003). In summary, the CSM is a widely used theoretical framework that explains the processes people create to manage health threats (Leventhal, Phillips, & Burns, 2016).

One questionnaire used in assessing illness perceptions is the Brief Illness Perception Questionnaire (B-IPQ) (Broadbent, Petrie, Main, & Weinman, 2006), which is based on CSM. Five illness domains are examined in the B-IPQ (Broadbent et al., 2006): identity,

timeline, cause, controllability and consequences. *Identity* refers to the symptoms that the person attributes to the illness and to the name given to the condition, e.g., asthma or ADHD. The *Timeline* dimension pertains to people's expectations of the duration of the illness, i.e. if it is expected to be acute, chronic or cyclic. The *Cause* dimension refers to perceived causes of the illness, e.g., infection (external) or genes (internal). The *Controllability* dimension covers the perceived ability, of the persons themselves or possibly with the aid of others, to cure the disease or to alleviate symptoms. The *Consequences* dimension covers the impact of illness on a person's life (Leventhal et al., 2003; Leventhal et al., 1992).

Regarding asthma, illness perceptions, according to CSM, have been described (Byer & Myers, 2000; Horne & Weinman, 2002; Unni & Shiyabola, 2015). For instance, perceptions concerning life consequences (Horne & Weinman, 2002), duration (Timeline) and asthma symptoms (Identity) (Byer & Myers, 2000) have been linked to adherence to asthma treatment. Moreover, an association between the perception of the asthma as threatening and concerns about medication has been documented (Unni & Shiyabola, 2015).

Concerning ADHD, one study (Kosse, Bouvy, Philbert, de Vries, & Koster, 2017) on perception of ADHD in adolescents, which is based on CSM, exists in the literature. It shows that adolescents scored highest on perception of treatment control.

Health-related quality of life

Quality of life is a broad concept and reflects a person's perception of his/her position in the every context of life (The Whoqol, 1998). The quality of life differs across individuals and also may have an individualized meaning based on different environmental influences (Fayers & Machin, 2007). According to Fayers and Machin (2015), no universally accepted definition of quality of life exists, although the WHO (2017) definition of health has been the same since 1948:

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

In medical research the concept of health-related quality of life (HRQoL) is frequently used (Fayers & Machin, 2015), which is non-committal as to which aspects of quality of life should be included. In general, there is agreement that general health, physical functioning, physical symptoms and toxicity, emotional functioning, cognitive functioning, role functioning, social well-being and functioning, sexual functioning and existential issues should be included in the definition (Fayers & Machin, 2015).

Asthma is generally accompanied by lower HRQoL (Sullivan et al., 2013), especially in young women (Lisspers et al., 2013), certain personality types (Kim et al., 2015), and when there is coexisting smoking (Leander et al., 2012). Moreover, low HRQoL is associated with asthma that is not being successfully controlled (Kim et al., 2015; Lisspers, Stallberg, Hasselgren, Johansson, & Svardsudd, 2007; Sullivan et al., 2013)

and greater respiratory symptoms (Joshi et al., 2006; Leander et al., 2012). However, HRQoL has not been found to influence adherence to asthma medication, although research in the field is limited (Joshi et al., 2006).

ADHD is associated with low quality of life (Coghill & Hodgkins, 2016; Topolski et al., 2004). In addition, low quality of life is linked to ADHD symptoms (Coghill & Hodgkins, 2016), while ADHD treatments may improve quality of life (Danckaerts et al., 2010).

Factors with possible influence on adherence behaviour in asthma and ADHD

According to WHO (Sabaté, 2003), adherence to long-term treatment is a multi-dimensional phenomenon determined by the interplay between five types of factors: *social/economic, therapy-related, health care-related, condition-related* and *patient-related*.

Socioeconomic factors may have a different impact on adherence depending on age, which may be stronger in adult samples (DiMatteo, 2004). The impact of age on adherence may follow somewhat unpredictable pattern within different populations. The younger individuals with asthma showed lower adherence to medication than the older ones in the age span between 12 to 65 years old (Taylor et al., 2014), in one study, but the opposite directions emerged in another asthma population with age range between 29 to 96 years old (Darba et al., 2016). Moreover, amongst adolescents between 11 and 16 years of age, the younger individuals in the group showed higher adherence (Mosnaim et al., 2014), in agreement with findings on young people with ADHD (Barner et al., 2011; Faraone et al., 2007). Accordingly, WHO pointed out that separate evaluations are required for every disease and for different age groups at varying developmental stages (Sabaté, 2003). The above-mentioned findings illustrate the importance of following the WHO recommendation and exploring adherence in different age groups separately.

Income may be of importance to adherence, for example in asthma in which it has been positively associated with adherence to inhaled corticosteroids (Janson, Earnest, Wong, & Blanc, 2008). The family history of ADHD needs to be taken into account in children and adolescents treated for ADHD, because it may have negative effects on adherence to ADHD medication in children (Gau et al., 2008; Hong et al., 2013).

Regarding possible gender effects on adherence, available findings on different disorders are inconsistent. For instance, no gender differences regarding adherence behaviour were detected in a study on asthma (Axelsson et al., 2015), whereas lower adherence to medication was revealed in boys compared to girls between 3-18 years old with ADHD (Barner et al., 2011).

Several *therapy-related factors* should be taken into consideration when assessing adherence, such as the form of the active substance (Sabaté, 2003). In asthma, the type of inhalator is reported to be of relevance (Darba et al., 2016), as well as the substances in the inhaler. Inhaled long-acting β_2 -agonist substances have yielded higher adherence than inhaled corticosteroids (Murphy et al., 2012). In ADHD, adherence to immediate-release stimulants is less than to non-stimulant treatment (Barner et al., 2011). Additionally, duration of treatment should be taken into account. For example in ADHD, adherence is known to diminish as the treatment time increases (Hodgkins, Sasané, & Meijer, 2011; Hong et al., 2016; Wehmeier, Dittmann, & Banaschewski, 2014). The importance of quantity and frequency of the dosages should also be kept in mind in order to assure adherence. In asthma, one review reported that increasing number of medications was associated with lower adherence (Ahmad & Sorensen, 2016). In children with ADHD, increased dose frequency of ADHD medication had a negative effect on adherence (Gau et al., 2008).

There are additional *health care* factors that may influence adherence negatively, such as brief consultation times and health care providers' lack of knowledge and training in taking care of chronic diseases (Sabaté, 2003). In asthma, annual return visits to health care have been associated with higher adherence (Axelsson et al., 2015), although conversely more than one doctor's consultation a month has been associated with low adherence (Darba et al., 2016). In ADHD, the health care contact with parents after the children had started ADHD medication or medication adjustment had a positive influence on medication taking (Brinkman et al., 2016).

Condition-related factors include severity of disorder and co-occurring disorders such as depression, drug and alcohol abuse (Sabaté, 2003). Adherence behaviour can differ between different conditions (Gatti et al., 2009; Horne & Weinman, 1999). In asthma, concomitant depressive symptoms were accompanied by less adherence to the prescribed medication (Krauskopf et al., 2013; Smith et al., 2006). In ADHD, children with a high Body Mass Index (BMI) were prone to show low adherence to ADHD medication treatment (Hong et al., 2013). Severity may impact on adherence differently depending on which disease is involved. In asthma, more severity has been shown to promote adherent behaviour (Bolman, Arwert, & Völlink, 2011). In ADHD, children with more serious ADHD symptoms had poor adherence (Gau et al., 2008).

Several *patient-related* factors – comprising memory, personality and beliefs about the disability and medication – are of interest to mention when discussing adherence (Sabaté, 2003). To follow prescriptions correctly, one must remember the treatment instructions as well as to take the dosages (Horne & Clatworthy, 2010). Forgetfulness may therefore be one crucial underpinning of non-adherence, something that in fact has been confirmed in relation to asthma (Koster et al., 2014) and ADHD (Gau et al., 2006).

There is a growing body of evidence showing that personality traits affect adherence (Axelsson, 2013; Axelsson et al., 2011; Cheung et al., 2014; Skinner, Bruce, Davis, & Davis, 2014; van de Ven et al., 2013). In asthma, Conscientiousness has been identified

as a possible determinant of adherence (Axelsson, Ekerljung, Lundback, & Lotvall, 2016; Cheung et al., 2014).

To the best of my knowledge, regarding ADHD, there is no research available to date on the association between personality and adherence.

Beliefs have an impact on people's health-related behaviour, including adherence (Sabaté, 2003). In asthma, beliefs about the necessity (Axelsson et al., 2015; Koster et al., 2014; Menckeberg et al., 2008) and effectiveness (Ulrik et al., 2006) of medication as well as having more knowledge about medication (ICS) mechanisms are known to relate positively to adherence (Koster et al., 2014; Mosnaim et al., 2014), while having concerns relates negatively (Cooper et al., 2015; Horne & Weinman, 2002; Menckeberg et al., 2008; Ponienman et al., 2009). In ADHD, beliefs and attitudes are reported to influence the use of medication (Charach et al., 2014; Ferrin et al., 2012). For instance, having concerns about the safety of stimulant treatment has been related to low adherence in children (Gau et al., 2008), while positive attitudes have been associated with higher adherence in adolescents (Ferrin et al., 2012). In addition, feeling knowledgeable about the ADHD medication has been demonstrated to influence the willingness to use it (Bussing et al., 2012).

Effects of low adherence in asthma and ADHD

There is some evidence demonstrating the implications of adherence behaviour in persons with asthma. Suboptimal adherence to asthma medications has been associated with poorer lung function measures, (Murphy et al., 2012), higher risk of exacerbation (Stern et al., 2006; Williams et al., 2011), higher levels of sputum eosinophils (Murphy et al., 2012) and more frequent health care consultations (Darba et al., 2016; Williams et al., 2004).

Non-adherence behaviour related to ADHD medication is linked to less symptom improvement (Gau et al., 2008; Hong et al., 2013), encompassing less active interaction with parents and more severe behaviour problems at home in children (Gau et al., 2006), as well as lower academic grades in students (Marcus & Durkin, 2011).

Despite some research on adherence, not everything has been clarified concerning the reason for low adherence, thus further research is needed so that the effects of low adherence to medication treatment can be minimized.

RATIONALE FOR THE THESIS

Adherence to long-term medication is crucial to assure the efficacy of the medication. Adherence behaviour may vary across disease type, age and population. Despite growing evidence suggesting several factors of importance to adherence behaviour, the association with personality traits, beliefs about medication and illness perception on adherence is unclear in relation to asthma and ADHD. Clarification of these issues could outline some relevant information that may directly benefit clinical work to prevent non-adherence to prescribed treatment in these two long-lasting disorders. Essential in this context is having validated instruments, for use in clinical as well as research work that allow quick investigation of possible risk factors for non-adherence behaviour. This thesis should add an important piece of the puzzle for designing individualized care that contributes to increased adherence to asthma and ADHD medication.

AIMS OF THE THESIS

The overall aim of this thesis was to explore adherence behaviour in relation to medication treatment for asthma and ADHD and in particular factors associated with adherence.

Aims of the separate papers:

The aim of Study I (epidemiological asthma sample) was twofold: first, to determine whether personality traits in young adult asthmatics are related to asthma control and HRQoL and, second to examine the influences of personality traits on adherence to regular asthma medication treatment.

The aim of Study II (clinical asthma sample) was to explore the influence of personality traits and beliefs about medicines on adherence to asthma medication treatment.

The aim of Study III (ADHD sample) was to increase knowledge regarding adherence in adolescents on long-term ADHD medication prescription and in particular the influence of beliefs about medication and perception of ADHD, in addition to age, time on medication and gender.

The aim of Study IV (ADHD sample) was to assess the reliability and validity of the Swedish translation of the questionnaires BMQ-Specific and B-IPQ, for use in adolescents with ADHD.

The first aim of Study V (ADHD sample) was to explore possible associations of personality traits on adherence, beliefs about the medication and perception of ADHD in adolescents on long-term ADHD medication. The second aim was to investigate whether personality traits were associated with adherence through beliefs about the medication.

METHOD

Procedure

This thesis consists of five papers. An overview of the study settings, populations, instruments and analysis is presented in Table 3.

Table 3. Summary of Study I – V: study settings, populations, questionnaires and statistical analyses

Study	Settings	Population	Measures	Statistical analyses
I	Previous epidemiological sample	268 young adults with asthma, mean age 22 (± 1) Study Group I n=268 (103 men, 165 women) Study Group 2 n=109 (36 men, 73 women)	MARS, Hp5i, SF-8, ACT	Spearman's and Pearson's correlation coefficient, <i>t</i> -test, multiple regression, multiple regression using spline functions
II	Clinical sample Primary care	35 adults (10 men, 25 women) with asthma, mean age 52.8	MARS, NEO-FFI, BMQ	Pitman's test, Pearson's correlation coefficient, Mann-Whitney's U-test, simple and multiply linear regression
III	Clinical sample Child psychiatric clinics	101 adolescents (66 boys, 35 girls) with ADHD, mean age 15.6	MARS, BMQ, B-IPQ	Pearson's correlation coefficient, Mann-Whitney's U-test, Chi-2, stepwise multiple regression model
IV	Clinical sample Child psychiatric clinics	Based on same sample as Study III (n=101) (66 boys, 35 girls)	BMQ, B-IPQ	Exploratory Principal Component Analysis (PCA) using oblique rotation (Direct Oblimin) and orthogonal (Varimax) methods of rotation. The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's sphericity. Pearson's correlation coefficient
V	Clinical sample Child psychiatric clinics	Based on same sample as Study III (two boys did not answer Hp5i) n=99 (64 boys, 35 girls)	MARS, Hp5i, BMQ, B-IPQ	Pearson's correlation coefficient, Mann-Whitney's U-test, One sample <i>t</i> -test, stepwise multiple regression, mediation analysis

MARS= Medication Adherence Report Scale, Hp5i= Health-relevant Personality 5-factor inventory, SF-8= Short Form-8 Health Survey, ACT= Asthma Control Test, NEO-FFI=NEO Five-Factor Inventory, BMQ-Specific= Beliefs about Medicines Questionnaire specific, B-IPQ = Brief Illness Perception Questionnaire.

Participants

Epidemiological asthma sample (Study I)

The respondents in the epidemiological asthma sample had participated in an epidemiological study in the autumn of 2000 (Sundberg, Toren, Hoglund, Aberg, & Brisman, 2007). The original sample (n=792) consisted of young adults with asthma born during the period 1984 to 1986. At the time the investigation was performed (2006-2007) they were 22 years of age (± 1 year). Of the original sample, 268 (men n=103, women n= 165) respondents (response rate 73.3%) reported still having medically diagnosed asthma (Figure 2) and were included in Study Group 1. Of the 268 respondents 110 reported (1 missing report of adherence) using prescribed controller asthma medication and were included in Study Group 2 (n=109). Of these, 40.0% were using prescribed single inhaler combination corticosteroids (ICS) together with long-acting β_2 -agonist (LABA), and 60% were receiving monotherapy (e.g., ICS or LABA and short-acting β_2 -agonist inhalation (SABA)).

Figure 2. Participants in epidemiological asthma sample (Study I)

Clinical asthma sample (Study II)

The respondents in the clinical asthma sample were recruited as they were participating in a study on the relation between asthma and sensory hyperactivity (Johansson, 2008). In total, 42 persons with asthma were invited to participate (Figure 3), and the response rate was 83.3 % (n=35, 10 men and 25 women). The mean age was 52.8 years (SD 14.7). All participants were on prescribed controller asthma medication. Of the respondents, 17 were using a combination of ICS and LABA inhalers, eight ICS and LABA in separate inhalers and 10 were receiving a monotherapy (either ICS or LABA).

Figure 3. Participants in clinical asthma sample (Study II)

ADHD sample (Study III, IV and V)

Participants in Study III and IV were recruited from two child and adolescent psychiatric clinics (CAP) in Sweden. All adolescents (13-17 years of age) on ADHD medication for at least six months were approached about participation in the study. The ADHD diagnosis was established by an experienced CAP specialist based on DSM-IV criteria. Exclusion criteria were autism spectrum disorder, intellectual disability (intellectual development disorder [IQ < 70]), neurological disorder and language barriers (not being able to complete the questionnaires). In total, 148 (92.50%) of 160 possible participants gave their written informed consent, and 101 (68.24%) completed the questionnaires (Figure 4). Of the 101 participants (mean age 15.6 years [SD 1.37]) 66 (65.35 %) were boys and 35 (34.65%) were girls. On average, participants had been receiving medication for 50.7 (SD 29.3) months; 81 (80.20%) had Methylphenidate (MPH) while 9 (8.91%) had solely Atomoxetine (ATX), and 11 (10.89%) had ATX in combination with MPH. The guardians reported comorbidities in 11 (10.89%) of the participants: asthma (n=4, 3.96%), allergy (n=2, 1.98%), diabetes (n= 1, 0.99%), heart defects (n= 1, 0.99%), hyperthyroidism (n= 1, 0.99%), epilepsy (n= 1, 0.99%), combined depression and anxiety (n= 1, 0.99%).

The results from Study V are based on the same participants as in Study III/IV. Of the 101 adolescents with an ADHD diagnosis, two boys did not complete the personality questionnaire (Figure 4) and were excluded. The total number of participants was 99, and the mean age was 15.6 years (SD 1.4). Sixty-four (64.65%) were boys and thirty-five (35.35%) were girls. On average, participants had been receiving medication for 51.3 months (SD 29.2); 80 of the patients (80.81 %) were taking MPH, 9 (9.09%) ATX only, and 10 ATX (10.10%) in combination with MPH.

Figure 4. Participants in ADHD sample (Study III, IV and V)

Data collection

Questionnaires

Medication Adherence Report Scale

(Epidemiological, clinical asthma and ADHD samples)

The Medication Adherence Report Scale (MARS) is a 5-item self-report scale for assessment of non-adherent behaviour. The items are rated on a 5-point scale, ranging from 1= 'very often to' 5 = 'never' (Sum range 5 to 25). Lower scores indicate lower levels of adherence to the medication treatment. The scale has 2 subscales representing unintentional non-adherence behaviour (item 1: 'I forgot to take them') and intentional non-adherence behaviour (item 2: 'I altered the dosage; item 3: I stopped taking medication; item 4: I missed a dose; item 5: I take less than instructed) (Horne & Hankins, 2004). The MARS was translated from English to Swedish by the first authors of Study I and then translated back to English by a professional translator, a native speaker of English. The final English translation was accepted by the original author, Professor Robert Horne. The original author of MARS wanted a new Swedish translation for investigation of the ADHD population in Study III and V, so the same process was conducted as in Study I. An additional last step was added to check the translation. The researcher asked a few pilot adolescents to check whether they understood the items. All the adolescents reported understanding them so no changes were needed. MARS was dichotomized in Study III. High adherence was defined as total MARS score of $\geq 92\%$ of the maximal MARS score (23 of 25). In the present studies, Cronbach's alpha values for MARS were between 0.52-0.77.

The Health-relevant Personality 5-factor inventory (HP5i)

(Epidemiological asthma and ADHD samples)

The Health-relevant Personality 5-factor inventory (HP5i) measures five health-relevant facets of personality traits based on the Big Five: *Negative Affectivity* (as a facet of Neuroticism), *Impulsivity* (as a facet of and at the opposite end of Conscientiousness), *Hedonic Capacity* (as a facet of Extraversion), *Alexithymia* (as a facet of and at the opposite end of Openness to experiences) and *Antagonism* (as a facet of and at the opposite end of Agreeableness). This inventory contains 20 items, four for each personality factor, and the scores are from 1 = "does not apply at all" to 4 = "applies completely", from which a final mean values is calculated (Sum range 4 to 16). If one value was missing, the mean value of the three remaining items was used instead (Gustavsson et al., 2003). The HP5i has been validated for use in adolescents (Hemphälä, Gustavsson, & Tengstrom, 2013). For the Cronbach's alpha values of the HP5i in the samples, see Table 4.

Table 4. Cronbach's alpha values for HP5i in epidemiological asthma and ADHD samples

	Epidemiologic asthma sample n=268	ADHD sample n=99
Negative Affectivity ¹	0.62	0.58
Impulsivity ¹	0.72	0.83
Hedonic Capacity ¹	0.70	0.52
Alexithymia ¹	0.72	0.55
Antagonism ¹	0.64	0.77

¹The Health-relevant Personality 5-factor inventory

NEO Five-Factor Inventory (NEO-FFI) ***(Clinical asthma sample)***

The NEO Five-Factor Inventory (NEO-FFI) measures the five personality traits known as the Big Five: Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness. The NEO-FFI is a short, validated version including 60 of the 240 NEO-PI items. Each of the personality domains consists of 12 items. The items are rated on 5-point scales and range from 0 = "Strongly disagree" to 4 = "Strongly agree" (Sum range 0 to 48) (Bergman, 2003; Costa & McCrae, 1991). The Cronbach's alpha values were: Neuroticism $\alpha = 0.88$, Extraversion $\alpha = 0.75$, Openness to Experience $\alpha = 0.68$, Agreeableness $\alpha = 0.75$ and Conscientiousness $\alpha = 0.78$.

Beliefs about Medicines Questionnaire specific ***(Clinical asthma and ADHD samples)***

Beliefs about Medicines Questionnaire specific (BMQ-Specific) assesses respondents' beliefs about their prescribed medication. The English version of BMQ-Specific has been validated (Horne, 2000). The items are rated on a 5-point scale ranging from 1= 'strongly disagree' to 5= 'strongly agree' (Sum range 5 to 25). The BMQ-Specific has two subscales: The specific-necessity scale consists of five questions and assesses respondents' beliefs about the necessity of the prescribed medication for controlling the disorders (asthma or ADHD) and maintaining health (e.g., my health, at present, depends on my asthma/ADHD medication). The specific-concerns scale consists of five questions and assesses concerns about adverse consequences of taking the prescribed medication (e.g., I sometimes worry about the long-term effect of my ADHD medication). A higher score on specific-necessity indicates stronger beliefs about the necessity of treatment, and a higher score on specific-concerns indicates stronger concerns (Horne, 2003; Horne & Weinman, 1999; Horne et al., 1999). A necessity-concerns differential score was calculated by subtracting scores on the specific-concerns scale from scores on the specific-necessity scale (Sum range -20 to 20). A positive differential score indicates stronger beliefs in the necessity of the medication than concerns about the medication, and a negative score indicates stronger concerns (Horne,

2003; Horne & Weinman, 1999). The first translation of BMQ-Specific from English to Swedish was performed by Jörgensen (2003), but after a revision of BMQ-Specific, the original author requested new Swedish translations prior to use in Study III, IV and V. One new item involving side effects had been added, “I get unpleasant side effects from my ADHD medicines” and was analysed separately. The BMQ-Specific used for investigating the group with ADHD was translated from English to Swedish by the first author of Study III and then translated back to English by a professional native speaker of English. The final English translation was accepted by the original author, Professor Robert Horne. The face validity was examined by specialists in child and adolescent psychiatry as well as adult psychiatry. The last step was to test the translation by discussing the BMQ-Specific items with a few pilot adolescents in order to evaluate their comprehensibility. This resulted in a minor change in one word: from health to well-being. Cronbach’s alpha values for the specific-necessity scale were between $\alpha = 0.80 - 0.87$ for the specific-concerns scale between $\alpha = 0.75 - 0.78$ (Study II - V).

The Brief Illness Perception Questionnaire (ADHD sample)

The Brief Illness Perception Questionnaire (B-IPQ) assesses respondents’ perception of ADHD. The same procedure described above for the BMQ-Specific was used for the translation of B-IPQ (Broadbent et al., 2006), which is open for translation (www.uib.no/ipq/html/submitting.html).

To test the translation, the B-IPQ items were discussed with a few pilot adolescents in order to clarify whether they understood the items. All the adolescents reported understanding them. No changes were needed.

The B-IPQ is a 9-item self-report scale. The first eight items are rated on a 0-10 scale. Five of the items assess cognitive illness perception: consequences (item 1), timeline (item 2 chronic vs. acute), personal control (item 3), treatment control (item 4) and identity (item 5). Two items assess emotional perception, concern about ADHD (item 6) and emotionally affected by ADHD (item 8). Item 7 assesses illness comprehensibility. A higher score indicates a stronger perception of the respective items’ meaning regarding ADHD. Item 9 is an open-ended question that assesses perceptions about what caused the ADHD.

In order to receive a more overall results as using B-IPQ, two components of B-IPQ (Timmermans, Versteeg, Meine, Pedersen, & Denollet, 2017) have been used and associations with personality explored in Study V. The first component is called the Consequences component (item 1, 2, 5, 6 and 8) and captures the implications of having ADHD. The second component covers perceived ability to management the disorder and is called the Control component (item 3, 4, and 7). A higher score reflects a more threatening view of ADHD. In the ADHD sample (Study IV-V), the Cronbach’s alpha values for the Consequences component were between $\alpha = 0.73 - 0.74$ and for the Control component $\alpha = 0.44$ in both studies.

Asthma Control Test

(Epidemiological asthma sample)

In the epidemiological sample, the Asthma Control Test (ACT) was used to measure asthma control. The instrument was developed to identify persons with poorly controlled asthma (Nathan et al., 2004), its reliability and validity have been found to be satisfactory (Schatz et al., 2006). The questionnaire consists of five items, the first four measuring the degree of asthma symptoms during the past four weeks. The last item assesses the perception of control over asthma during the same period. The items are rated on a 5-point scale (Sum range 5 to 25). The max score, 25, indicates complete control of asthma. A cut-off point ≤ 19 indicates poorly controlled asthma, while scores of 20 points or more correspond to well-controlled asthma (Kosinski, Bayliss, Turner-Bowker, & Fortin, 2004). The Cronbach's alpha was $\alpha = 0.75$.

Short Form-8 Health Survey (SF-8)

(Epidemiological asthma sample)

The Short form-8 Health Survey (SF-8) is a shorter version of SF-36 and is validated for measuring Health-Related Quality of life (HRQoL). The SF-8 has one item for each of its dimensions, including four physical dimensions (physical function, role limitation related to physical problems, body pain and general health), which are summarized in a physical component score (PCS), and four mental dimensions (vitality, social function, role limitation related to emotional problem and mental health), which are summarized in a mental component score (MCS). The items are rated on a 5- or 6-point scale, which is then transformed to a scale of 0 - 100. Higher scores indicate better health (Ware, Kosinski, Dewey, & Gandek, 2001). The Cronbach's alpha values were $\alpha = 0.83$ for PCS and $\alpha = 0.82$ for MCS.

Statistical analyses

The data were analysed using SPSS (versions 15-21). Descriptive statistics (frequencies, means, and standard deviations) were analysed in the epidemiological, clinical asthma and ADHD samples.

Epidemiological asthma sample (Study I)

Pearson's correlation coefficient was used to explore the associations between personality traits (HP5i), HRQoL (SF-8), Asthma Control (ACT) and adherence behaviour (MARS). Spearman's correlation was used to explore the association between ordinal variables (Physical Activity, Smoking habits) and personality traits (HP5i), Asthma Control (ACT), and HRQoL (SF-8). The *t*-test was used to compare means regarding gender, personality traits, asthma control, HRQoL and adherence behaviour. Two multiple regression models were performed using the following dependent

variables: physical component score (PCS) and mental component score (MCS) of the HRQoL scale. Negative Affectivity, Hedonic Capacity, asthma control and physical activity were independent variables in the regression model that explained the variance in PCS. The model for the MCS had Negative Affectivity, Impulsivity, Hedonic Capacity, Alexithymia, asthma control, smoking habits and gender as independent variables. Two variables (physical activity and smoking) were dichotomous in the regression analyses (0= no, 1= yes) (Altman, 1991). In Study Group 2, the relation between personality traits and MARS was examined by multiple regression using spline functions (Wahba, 1990).

Clinical asthma sample (Study II)

The Pitman's test (< 0.05) and the Pearson's correlation coefficient were used to explore the associations between age, personality traits (NEO-FFI), beliefs about medication (BMQ-Specific) and adherence behaviour (MARS). The Mann-Whitney's U-test was used to compare means regarding gender, personality traits, beliefs about medication and adherence behaviour.

A multiple linear regression analysis was performed on data from the total sample, where total MARS was the dependent variable but the specific-necessity scale and necessity-concerns differential were the independent variables. Multiple linear regression analysis was performed on data from the men in order to predict associations with the dependent variable, i.e. total MARS, where the independent variables were Neuroticism and Conscientiousness. A simple linear regression analysis was conducted on data from women to predict associations with the dependent variable i.e. total MARS, where the specific-necessity scale was the independent variable (Brace, Kemp, & Snelgar, 2006).

ADHD sample (Study III)

Pearson's correlation coefficient was used to explore the correlations between age, time on medication, adherence behaviour (total MARS and un/intentional non-adherence), beliefs about medication (BMQ-Specific) and perceptions about ADHD (B-IPQ). Chi-2 was used to analyse frequencies between two dichotomized variables (high/low adherence vs. gender). Mann-Whitney's U-test was used to compare means between high/low adherence, gender and medication groups. Three stepwise multiple regression models were created with the (a) total MARS, (b) intentional and (c) unintentional non-adherence scores as dependent variables (Altman, 1991; Pallant, 2007; Tabachnick & Fidell, 2013). The independent variables were added to the models if preceding correlation analyses with total MARS, intentional and unintentional non-adherence scores showed a p value less than 0.10. The independent variables included in the model (a) and (b) were: specific-necessity scale, specific-concerns scale, necessity-concern differential, the statement "I get unpleasant side effects from my ADHD medicines" and in model (b) also time on medication. For model (c) specific-concerns scale, necessity-

concern differential and B-IPQ consequence were included as independent variables. The group of adolescents who were prescribed ATX (with or without MPH) was named the “ATX group” and the group of adolescents on MPH prescribed was named the “MPH group”.

ADHD sample (Study IV)

Exploratory Principal Component Analysis (PCA) groups together the scale items, allowing consolidation of the results into only a few components (Norman & Streiner, 2000). It was used to examine the construct validity of BMQ-Specific and B-IPQ. The scale items were found suitable for inclusion in a PCA, as the Kaiser-Meyer-Olkin (KMO) was > 0.5 and the Bartlett’s test of sphericity showed significant p values, thereby indicating correlations between the included items.

For the BMQ-Specific scale, the oblique rotation (Direct Oblimin) was chosen for selection of items, because it had been used in the development of the BMQ-Specific (Horne et al., 1999) as well as in a prior validation study (Matoulkova et al., 2013). For the B-IPQ scale, the orthogonal rotation (Varimax) was chosen, because it was used for validation of B-IPQ (Timmermans et al., 2017). The components of the scales generated by PCA were accepted if the Eigenvalues were > 1 (Kaiser’s criterion). The hypotheses used for the Convergent-related validation were tested by Pearson’s correlation coefficient (Field, 2012). The questionnaires’ internal consistency reliability was evaluated by using Cronbach’s alpha (Connelly, 2011).

ADHD sample (Study V)

Pearson’s correlation coefficient was used to explore associations between personality traits (HP5i), age, adherence behaviour (total MARS and un/intentional non-adherence), beliefs about medication (BMQ-Specific) and perceptions of ADHD (B-IPQ). The Mann-Whitney’s U-test was used to compare means regarding gender, personality traits (Altman, 1991; Pallant, 2007). A comparison between the adolescents with ADHD aged 16 - 17 ($n = 57$, boys $n = 34$, girls $n = 23$) and Swedish normative controls ($n = 70$, boys $n = 41$, girls $n = 29$) of the aged 16 - 19 was performed using a one-sample t -test (Gunnarsson & Gustavsson, 2013). A mediation analysis was planned to determine whether identified associations between personality traits and adherence were mediated by beliefs about medication or perceptions of ADHD. However, the demands of the analysis were not fulfilled, as there were no inter-related variables between these three variables categories (Hayes, 2013). Two stepwise multiple regression models (Altman, 1991; Pallant, 2007; Tabachnick & Fidell, 2013) were created in which variables were selected using the following criteria: In a first step, those MARS scales were selected that correlated at a significance level or $p < 0.10$ with scores of HP5i personality traits. In the second step, those variables derived from the BMQ-Specific and components of B-IPQ were selected that correlated at a significance level or $p < 0.10$ with the chosen MARS scales in step one.

Subsequently, two models were designed where; total MARS was a dependent variable in the first model and intentional non-adherence in the second model. The independent variables used in the analyses in both models were as follows: Negative Affectivity, Antagonism, the BMQ-Specific subscales of specific-necessity scale, specific-concerns scale, necessity-concerns differential and unpleasant side effects. In addition, the variable time on medication was also included in the second model as an independent variable.

ETHICAL CONSIDERATION

The research project was approved by the Research Ethics Committee at The University of Gothenburg for Study I and II (Reg. no. 486-06) and at Linköping University for Study III to V (Reg. no. 2013/402-31). The ethical principles stipulated by the Helsinki Declaration were adhered to (World Medical Association of Helsinki, 2008). All participants were given written information about the aim, utility and confidentiality of the study. Participants in Study III to V gave their written consent, as did their guardians, thus allowing the adolescents to participate in the study project. The participants (Study I - V) were told they could discontinue at any time without giving a reason. All data will be presented such that there are no possibilities of identifying any of the participants.

RESULTS

The results from the different studies are presented together under related headlines.

Adherence to medication in the epidemiologic, clinical asthma and ADHD samples

The mean percentage of total MARS possible maximum score was 76.0% in the epidemiologic asthma sample, 84.8% in the clinical asthma sample and 88.0% in the ADHD sample (Table 5). No gender or age differences regarding adherence were identified in any of the studies.

In the epidemiologic asthma sample (Study I Group 2), those prescribed a single inhaler combining ICS and LABA exhibited higher adherence than the group receiving monotherapy (e.g., ICS or LABA and short-acting β_2 -agonist inhalation [SABA]) ($p < 0.05$). The HRQoL and asthma control were not associated with adherence behaviour (epidemiologic asthma sample, Study Group 2).

Table 5. Mean scores and standard deviations (SD) for total MARS in the epidemiologic and clinical asthma and ADHD samples

	Epidemiologic asthma sample (n=109)	Clinical asthma sample (n=35)	ADHD sample (n=101)
Total group	19.0 (3.89)	21.2 (3.22)	22.0 (2.25)
Men/Boys	19.2 (3.75)	20.2 (3.71)	22.2 (1.86)
Women/Girls	19.0 (3.98) ^{1,ns}	21.6 (3.00) ^{2,ns}	21.7 (2.86) ^{2,ns}

¹t-test, ²Mann-Whitney's U test, ^{ns}not significant

In ADHD, the mean scores for intentional and unintentional non-adherence are shown in Table 6. Unintentional non-adherence mean score was significantly lower in adolescents taking Atomoxetine (ATX) with ($p < 0.05$) or without Methylphenidate (MPH) ($p < 0.05$), than in those receiving a MPH monotherapy.

Table 6. Mean scores and standard deviations (SD) for MARS subscales in the ADHD sample

	Total group (n= 101)	Boys (n= 66)	Girls (n= 35)
Intentional non-adherence ¹	18.3 (1.86)	18.5 (1.62)	18.0 (2.23) ^{2,ns}
Unintentional non-adherence ¹	3.7 (0.77)	3.7 (0.64)	3.7 (0.98) ^{2,ns}

¹Medication Adherent Report Scale, ²Mann-Whitney's U test, ^{ns}not significant

Personality traits in the epidemiologic, clinical asthma and ADHD samples

Significant gender differences regarding personality traits were noted in the epidemiological asthma and ADHD samples. Negative Affectivity was ($p < 0.001$) higher in females than males in both samples. In the epidemiologic asthma sample, women reported lower Antagonism (< 0.05) and Alexithymia (< 0.001) than men. Two personality traits, Negative Affectivity ($r = 0.125$, $p < 0.05$) and Impulsivity ($r = 0.213$, $p < 0.001$), were positively associated with having a smoking habit (epidemiological asthma sample).

Girls with ADHD reported higher Impulsivity ($p < 0.05$) compared to the boys with ADHD and also compared to girls from the normal population ($p < 0.01$). Boys with ADHD showed significantly ($p < 0.01$) higher Hedonic Capacity compared to boys from the normal population.

No significant gender difference in personality traits was found in the clinical asthma sample.

Beliefs about medication in the clinical asthma and ADHD samples

The mean scores of BMQ-Specific, in the clinical asthma and ADHD samples, are reported in Table 7.

In the clinical asthma sample, 32 (91.4%) of the 35 respondents exhibited positive scores on the necessity-concern differential. One (2.9%) had a negative score and two (5.7%) had zero. No gender differences were identified regarding beliefs about medication.

In adolescents with ADHD, a majority of respondents ($n = 84$, 83.2%) had a positive score, 12 (11.9%) had a negative score and 5 (4.9%) zero. Girls reported stronger beliefs in the necessity of ADHD medication ($p < 0.05$) than the boys. The adolescents with prescribed ATX with or without MPH were significantly ($p < 0.01$) more concerned about their medication than those receiving MPH monotherapy.

No gender differences were identified regarding beliefs about side effects of ADHD medicines.

Table 7. Mean scores and standard deviations (SD) for BMQ-Specific in the clinical asthma and ADHD samples

	Total group		Men/Boys		Women/Girls	
	Clinical asthma sample (n= 35)	ADHD sample (n= 101)	Clinical asthma sample (n= 10)	ADHD sample (n= 66)	Clinical asthma sample (n= 25)	ADHD sample (n= 35)
Necessity ¹	18.3 (4.60)	16.1 (4.53)	19.2 (3.88)	15.4 (4.53)	17.9 (4.88) ³	17.4 (4.30) ^{3*}
Concern ¹	10.5 (4.21)	9.3 (3.81)	11.4 (3.81)	8.9 (3.57)	10.1 (4.38) ³	10.1 (4.16) ³
NC-diff ¹²	7.8 (5.66)	6.8 (5.96)	7.8 (5.73)	6.5 (5.63)	7.8 (5.74) ³	7.3 (6.60) ³

¹Beliefs about medicines questionnaire specific, ²necessity-concerns differential, ³Mann-Whitney's U test, * $p < 0.05$

Perceptions of ADHD

The boys' perceptions regarding their ability to manage ADHD were stronger than among the girls' ($p < 0.01$), whereas girls perceived stronger concerns ($p < 0.01$) and being more emotionally affected ($p < 0.05$) by the ADHD. Perceptions about "treatment control" of ADHD symptoms were significantly stronger in the MPH group ($p < 0.05$) than in the ATX group.

Adherence behaviour and Personality in the epidemiologic, clinical asthma and ADHD samples

In the epidemiologic asthma sample, total MARS correlated negatively ($r = -0.19$, $p \leq 0.05$) with Impulsivity. In men, total MARS ($r = -0.37$, $p < 0.05$) and intentional non-adherence ($r = -0.38$, $p < 0.05$) correlated negatively with Antagonism and Alexithymia (total MARS $r = -0.37$, $p < 0.05$ and intentional non-adherence $r = -0.35$, $p < 0.05$). (Table 8).

In the clinical asthma sample, a negative correlation between total MARS ($r = -0.72$, $p < 0.05$) and Neuroticism was shown, while a positive correlation between total MARS ($r = 0.67$, $p < 0.05$) and Conscientiousness was detected in men but not in women.

In adolescents with ADHD, total MARS ($r = -0.20$, $p < 0.05$) and intentional non-adherence ($r = -0.20$, $p < 0.05$) correlated negatively with Antagonism, which in gender analyses remained in the boys (the total MARS $r = -0.29$, $p < 0.05$, intentional non-adherence $r = -0.26$, $p < 0.015$) (Table 8). Negative Affectivity tended to correlate negatively with total MARS ($r = -0.19$, $p = 0.063$) and the intentional non-adherence ($r = -0.19$, $p = 0.058$).

Table 8. Correlation between personality traits (Hp5i) and adherence (MARS) in males in the epidemiological asthma and ADHD samples

	total MARS ¹		Intentional non-adherence ¹	
	Epidemiologic asthma sample (n= 109)	ADHD sample (n= 99)	Epidemiologic asthma sample (n= 109)	ADHD sample (n= 99)
	r	r	r	r
Negative Affectivity ²	0.043	-0.160	-0.011	-0.162
Antagonism ²	-0.368*	-0.290*	-0.379*	-0.257*
Impulsivity ²	-0.115	-0.083	-0.121	-0.055
Hedonic Capacity ²	-0.122	0.113	-0.167	0.162
Alexithymia ²	-0.369*	-0.126	-0.354*	-0.182

¹Medication Adherent Report Scale, ²The Health-relevant Personality 5-factor inventory, r Pearson correlation, $p \leq 0.05$ *

The beliefs about medication and adherence to medication in the clinic asthma and the ADHD samples

In the clinical asthma and ADHD samples, total MARS correlated positively with the specific-necessity scale (asthma $r = 0.38$, $p < 0.05$, ADHD samples $r = 0.21$, $p < 0.05$) and with the necessity-concern differential (asthma $r = 0.42$, $p < 0.05$, ADHD $r = 0.41$, $p < 0.01$). In a gender analysis, positive correlations were found in females between the specific-necessity scale and total MARS in both the clinical asthma ($r = 0.45$, $p < 0.05$) and the ADHD samples ($r = 0.50$, $p < 0.01$) (Table 9).

Table 9. Correlations of adherence behaviour measure with total MARS and BMQ-Specific in the clinical asthma and ADHD samples

	Total group		Men/Boys		Women/Girls	
	Clinical asthma sample (n= 35)	ADHD sample (n= 101)	Clinical asthma sample (n= 10)	ADHD sample (n= 66)	Clinical asthma sample (n= 25)	ADHD sample (n= 35)
	r	r	r	r	r	r
Necessity ¹	0.38*	0.21*	0.35	0.04	0.45*	0.50**
Concern ¹	-0.16	-0.39**	-0.53	-0.42***	0.01	-0.34*
NC-diff ²	0.42*	0.41**	0.59	0.30*	0.36	0.54***

¹Beliefs about medicines questionnaire specific, ²Necessity-concerns differential, r Pearson correlation, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regarding ADHD, total MARS correlated negatively ($r = -0.39$, $p < 0.01$) with the specific-concerns scale. For results on correlation between intentional and unintentional non-adherence with the BMQ-Specific, see Table 10. Furthermore, a significant negative correlation was demonstrated between the BMQ-Specific side effects item and total MARS ($r = -0.28$, $p < 0.01$) and intentional non-adherence ($r = -0.29$, $p < 0.01$).

Table 10. Correlations between subscales of MARS and subscales of BMQ-Specific in the ADHD sample

	Total group (n=101)		Boys (n=66)		Girls (n=35)	
	r		r		r	
	Intentional ¹	Unintentional ¹	Intentional ¹	Unintentional ¹	Intentional ¹	Unintentional ¹
Necessity ²	0.19	0.16	0.08	-0.08	0.43**	0.48**
Concern ²	-0.37**	-0.24*	-0.36**	-0.32**	-0.36*	-0.17
NC-diff ^{2,3}	0.38**	0.27**	0.29*	0.14	0.51**	0.42*
Side effects ²	-0.29**	-0.13	-0.14	-0.02	-0.45**	-0.24

¹Medication Adherent Report subscales, ²Beliefs about medicines questionnaire specific, ³Necessity-concerns differential, r Pearson correlation, * $p < 0.05$, ** $p < 0.01$

Perceptions of ADHD and adherence to medication in the ADHD sample

There were no associations between total MARS score and the eight B-IPQ subscales. A positive correlation between the B-IPQ Consequence item and the MARS unintentional non-adherence ($r = 0.25$, $p < 0.05$) was revealed.

In a gender analysis, total MARS ($r = 0.37$, $p < 0.05$) and the intentional non-adherence ($r = 0.40$, $p < 0.05$) correlated positively with the B-IPQ Timeline item in girls. In the boys, the unintentional non-adherence correlated with the B-IPQ comprehensibility item ($r = 0.27$, $p < 0.05$).

Reliability and Validation of Beliefs about medicines questionnaire specific and Brief Illness Perception Questionnaire in the ADHD sample

Exploratory Principal Component Analysis with oblique rotation (Direct Oblimin) was conducted on the 10 items of the Swedish translated BMQ-Specific scale.

The result of the Kaiser-Meyer-Olkin (KMO) (0.748) confirmed that the variables were adequate for use in a PCA. The Bartlett's test was significant ($p < 0.001$), which indicates that the correlations between the variables were significantly different from zero. For a scree plot, see Fig 1 in Manuscript IV. The PCA generated two components with eigenvalues greater than 1, thereby fulfilling Kaiser's criterion and together the components explained 55.5% of the variance. The first component had an eigenvalue of 2.93 and explained 29.3% of the variance. It consisted of the necessity items 1-5, which after rotation showed convergent loadings (0.522 to 0.838) and represented the specific-necessity scale. The second component had an eigenvalue of 2.62 and explained 26.2% of the variance. It contained the concern items 1-5, which after rotation showed convergent loadings (0.606 - 0.777) and represented the specific-concerns scale.

Regarding B-IPQ, the exploratory Principal Component Analysis with orthogonal rotation (Varimax) was conducted on the 8 items of the Swedish translated B-IPQ scale. The result of the KMO (0.669) confirmed that the variables were adequate for use in a PCA. The Bartlett's test was significant ($p < 0.001$), which indicates that the correlations between the variables were significantly different from zero. The two components achieved by the PCA had eigenvalues higher than 1 and in combination explained 54.7% of the variance. The scree plot for B-IPQ is shown in Fig 2 in Manuscript IV. The components loadings after rotation were as follows: The first component had an eigenvalue of 2.76 explaining 34.6% of the variance and consisted of item 1, 2, 5, 6 and 8, which after rotation showed convergent loadings (0.603 - 0.752) and represented the Consequences component. The second component had an eigenvalue of 1.61 explaining 20.1% of the variance and contained item 3, 4 and 7, which showed convergent loadings (0.549 - 0.699) and represented the Control component.

The convergent-related validation hypotheses were confirmed for the BMQ-Specific scale, as the specific-necessity scale was positively ($r = 0.235, p < 0.05$) and the specific-concerns scale negatively ($r = -0.310, p < 0.01$) correlated with the chosen validation statement B-IPQ item: “*How much do you think your treatment can help your ADHD?*” (Broadbent et al., 2006). The convergent-related validity hypotheses were confirmed for the B-IPQ, as the B-IPQ Consequences ($r = 0.233, p < 0.05$) and Control ($r = 0.364, p < 0.001$) components were positively correlated with the specific-concerns scale.

The internal consistency reliability was tested using the Cronbach’s alpha and was $\alpha = 0.80$ for the specific-necessity scale, $\alpha = 0.75$ for the specific-concerns scale, $\alpha = 0.74$ for B-IPQ Consequences component and $\alpha = 0.44$ for the B-IPQ Control component.

Personality traits and Beliefs about medication in the clinical asthma and ADHD samples

In the asthma clinical sample, the personality trait Neuroticism, correlated significantly and positively with the specific-concerns scale ($r = 0.39, p < 0.05$), while Conscientiousness correlated positively ($r = 0.34, p < 0.05$) with the specific-necessity scale. Extraversion correlated negatively with the specific-concerns scale ($r = -0.40, p < 0.05$). In a gender analysis, positive correlations were shown in men between Agreeableness ($r = 0.71, p < 0.05$) and the specific-necessity scale and between Neuroticism and the specific-concerns scale ($r = 0.65, p < 0.05$). Extraversion correlated negatively with the specific-concerns scale ($r = -0.41, p < 0.05$) in women. The significant data showing correlations of four of the five personality traits assessed by the NEO-FFI with the necessity-concerns differential score are found in Table 11.

In the ADHD group, Negative Affectivity ($r = 0.32, p \leq 0.001$) correlated positively with the specific-necessity scale, which in a separate gender analysis, was confirmed ($r = 0.36, p < 0.01$) in boys. In addition, Negative Affectivity correlated significantly and positively with the specific-concerns scale ($r = 0.34, p \leq 0.001$). This association remained significant in the separate boys ($r = 0.27, p < 0.05$) and girls groups ($r = 0.36, p < 0.05$) in a gender analysis. Negative Affectivity correlated significantly and positively with the specific side effects item ($r = 0.33, p \leq 0.001$) which remained significant in boys ($r = 0.34, p < 0.01$). Antagonism (opposite end of Agreeableness) correlated positively ($r = 0.26, p < 0.05$) with the specific-necessity scale in boys. Hedonic Capacity (as a facet of Extraversion) correlated negatively with the specific-concerns scale ($r = -0.22, p < 0.05$). None, of the personality traits correlated significantly with the necessity-concerns differential score in ADHD sample.

Table 11. Personality traits (NEO-FFI) associations related to beliefs about medication score of necessity-concern differentiation (BMQ-Specific) in the clinical asthma sample

	Total group (n=35)	Men (n=10)	Women (n=25)
	r	r	r
Neuroticism ¹	-0.56**	-0.53	-0.60**
Extraversion ¹	0.44**	0.28	0.49**
Openness to Experience ¹	0.35*	-0.31	0.48*
Agreeableness ¹	0.31	0.62	0.23
Conscientiousness ¹	0.45**	0.68*	0.40*

¹NEO Five-Facto Inventory, r Pearson's, $p < 0.05^*$, $p \leq 0.01^{**}$

Personality and perceptions of ADHD

Negative Affectivity ($r = 0.50$, $p < 0.001$) and Impulsivity ($r = 0.32$, $p \leq 0.001$) correlated positively with the B-IPQ "Consequences component". In a gender analysis, the correlation of Negative Affectivity remained in both boys ($r = 0.47$, $p < 0.001$) and girls ($r = 0.39$, $p < 0.05$), while the correlation with Impulsivity remained only in boys ($r = 0.25$, $p < 0.05$). Negative Affectivity ($r = 0.26$, $p < 0.01$), Antagonism (0.32 , $p \leq 0.01$) and Impulsivity ($r = 0.24$, $p < 0.05$) correlated positively with the B-IPQ Control component. In a gender analysis, the correlation with Antagonism remained in both boys ($r = 0.31$, $p < 0.05$) and girls ($r = 0.35$, $p < 0.05$), but the correlation with Impulsivity was found only in girls ($r = 0.34$, $p < 0.05$).

Personality traits and asthma control in the epidemiologic asthma sample

In the epidemiologic study, two personality traits Negative Affectivity ($r = -0.29$, $p < 0.001$) and Impulsivity ($r = -0.15$, $p < 0.05$) were negatively correlated with asthma control. In a gender analysis, the correlation with Negative Affectivity was significant in both men ($r = -0.30$, $p < 0.01$) and women ($r = -0.25$, $p < 0.001$), while the correlation with Impulsivity ($r = -0.34$, $p < 0.001$) remained in men but not in women. In addition, Hedonic Capacity correlated positively ($r = 0.16$, $p < 0.05$) with asthma control in women but not in men.

Personality traits and health-related quality of life according to SF-8 in the epidemiologic asthma sample

Women in the epidemiologic asthma sample showed a significantly lower mental component score compared to men ($p < 0.001$). Asthma control correlated significantly and positively with the mental ($r = 0.29$, $p < 0.001$) and physical health components of the SF-8 ($r = 0.47$, $p < 0.001$).

A multiple regression model explained 43% (Adjusted $R^2 = 0.43$) of the variance in mental component score ($p < 0.001$) by three variables showing negative prediction: Negative Affectivity, Impulsivity and smoking habits and three showing positive prediction: Alexithymia, Hedonic Capacity and asthma control (Table 12).

Table 12. Multiple regression analysis results: Predictive value of personality traits (HP5i), asthma control (ACT), smoking habits and gender on the mental component score (SF8)

Variables	B	SE B
Negative Affectivity ^{1,***}	-6.756	0.966
Impulsivity ^{1,*}	-2.023	0.930
Hedonic Capacity ^{1,***}	6.309	1.112
Alexithymia ^{1,*}	2.381	0.997
Smoking Habits ^{**}	-3.465	1.243
Asthma control ^{2,**}	0.389	0.151
Gender	-0.299	1.179

¹The Health-relevant Personality 5-factor inventory (HP5i)

² Asthma Control Test (ACT)

*Significant at the 0.05 level

**Significant at the 0.01 level

***Significant at the 0.001 level

A multiple regression model for the physical component score ($p < 0.001$) explained 24% (Adjusted $R^2 = 0.24$) of the variance by two significant positive predictors: asthma control and physical activity (Table 13).

Table 13. Multiple regression analysis results: Predictive value of personality traits (HP5i), asthma control (ACT), and physical activity on the physical component score of SF8

Variables	B	SE B
Physical Activity*	1.697	0.821
Hedonic Capacity ¹	1.384	0.802
Negative Affectivity ¹	-0.613	0.666
Asthma control ^{2,***}	0.855	0.113

¹The Health-relevant Personality traits 5-factor inventory

²Asthma Control Test

*Significant at the 0.05 level

***Significant at the 0.001 level

Predictive factors for adherence to medication

Epidemiologic asthma sample

The multiple regression analysis using spline functions showed that two personality traits— Antagonism and Impulsivity— were negatively associated with total MARS score. Lower scores on the personality traits Hedonic Capacity and Alexithymia were positively associated with total MARS score. Higher scores on Hedonic Capacity and Alexithymia were negatively associated with total MARS score. Negative Affectivity was positively associated with total MARS score (see Paper I Figure 2 A-E).

Clinical Asthma sample

A multiple regression analysis showed that the necessity-concerns differential alone explained the variance of total MARS (17%, $R^2=0.17$). For each unit increase in necessity-concerns differential, total MARS score increased by 0.23 units ($p<0.01$).

In men, the results of a multiple regression analysis showed that Neuroticism alone explained 52% ($R^2=0.52$) of the variance in total MARS scores. A one unit increase in Neuroticism decreased total MARS scores by 0.41 units ($p<0.01$).

In females, the results of a simple linear regression, showed that a one-unit increase in the specific-necessity scale increased total MARS score by 0.28 units (20%, $R^2=0.20$, $p<0.01$).

ADHD sample

In a stepwise multiple regression model, two independent variables explained the variance in the total MARS scores ($R^2=0.21$). A one-unit increase in the necessity-concerns differential increased the total MARS score by 0.14 ($p<0.001$), whereas a one-unit increase in the “experienced side effects” score decreased total MARS score by

0.42 ($p < 0.05$). For intentional non-adherence ($R^2 = 0.24$), three independent variables explained the variance. A one-unit increase in the necessity-concerns differential and time on medication increased the intentional non-adherence score by 0.11 ($p < 0.001$) and 0.01 ($p < 0.05$), respectively. In addition, it decreased by 0.38 ($p < 0.01$) for each one-unit increase in the experienced side effects score. For unintentional non-adherence ($R^2 = 0.12$), two independent variables explained the variance. A one-unit increase in the necessity-concerns differential and the B-IPQ consequence item increased the unintentional non-adherence score by 0.03 ($p < 0.01$) and 0.07 ($p < 0.05$), respectively.

In the ADHD sample (Study V) personality traits were added in the models as independent variables in a stepwise multiple regression model explaining the variance of intentional non-adherence ($R^2 = 0.28$). A one-unit increase in Antagonism and in “experienced side effects” decreased the intentional non-adherence score by 0.43 ($p < 0.05$) and 0.36 ($p < 0.05$), respectively. A one-unit increase in the time on medication and the necessity-concerns differential increased the intentional non-adherence score by 0.01 ($p < 0.05$) and 0.11 ($p < 0.001$), respectively.

In a stepwise multiple regression model with total MARS as the dependent variable, no associations were found between Negative Affectivity, Antagonism and perceptions of ADHD (B-IPQ).

In summary, personality traits were associated with lower levels of adherence to prescribed medication. Regarding asthma, Neuroticism was associated with lower levels of adherence to prescribed asthma medication; for ADHD, Antagonism was associated with lower levels of adherence to prescribed ADHD medication.

Belief in the necessity of the medication was associated with higher levels of adherence to prescribed medication in both asthma and ADHD. Concerning ADHD, less experienced side effects was associated with higher levels of adherence to prescribed medication. Perceiving great consequences on life due to ADHD (B-IPQ) predicted unintentional non-adherence (less forgetfulness) in the regression models (Table 14).

Table 14. Predictive factors for adherence to medication in clinical asthma and ADHD samples according to single or multiple regression analyses result

	Clinical asthma sample (n=35)	ADHD sample (n=101 and n=99)
Personality traits ^{1,2}	High Neuroticism – low total MARS **♂	High Antagonism - lower intentional non-adherence (meaning prone to intentionally not take prescribed medication)*#
BMQ-Specific ³	High necessity-concerns differential – higher total MARS **# High Necessity - higher total MARS **♀	High Necessity-Concerns differential – high total MARS***# – higher intentional non-adherence***# (meaning prone to intentionally take prescribed medication) – higher unintentional non-adherence (meaning less forgetful)*#
BMQ side-effects ³	Not used	High experienced side effects - low total MARS *# - lower intentional non-adherence (meaning prone to intentionally not take prescribed medication)*#
B-IPQ ⁴	Not used	High Consequences on life of ADHD – higher unintentional non-adherence (meaning less forgetful) *#

¹The Health-relevant Personality 5-factor inventory, ²NEO Five-Factor Inventory, ³Beliefs about medicines questionnaire specific, ⁴Brief Illness Perception questionnaire # total group, ♀ in females, ♂ in males, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

DISCUSSION

The results of this thesis show that adherence was higher in adolescents with ADHD than in adults with asthma, among whom it was higher in clinically recruited middle-aged adults than among epidemiologically recruited young adults. Adherence to asthma and ADHD medication was significantly associated with beliefs about the medications as well as personality traits, particularly Antagonism. Adherence was not associated with age and gender, although its associations to other factors were partly gender specific which needs to be taken into account in adherence investigations. The personality trait Negative affectivity/Neuroticism was related to numerous beliefs about medication and illness perceptions. The thesis adds clarity to discussions concerning the associations between some person-related factors and adherence to medication in persons with asthma and ADHD. The Swedish translation of BMQ-Specific and B-IPQ proved to be valid and reliable for use in clinical evaluations and research involving adolescents with ADHD.

Adherence to medication

The adolescents with ADHD showed the highest adherence, middle-aged adults with asthma were in the middle, while young adults with asthma showed the lowest adherence measured as percentage of the maximal total MARS score. These findings emphasize the importance of following the WHO recommendation, which is that adherence needs to be assessed specifically for every population with different developmental ages and diseases (Sabaté, 2003). However, the age had no impact on adherence within each of the investigated groups, which may be due to the restricted age spans and subsequently more developmental homogeneity.

There are several other possible explanations for the observed differences in adherence, such as that adherence in adolescents with ADHD may be enhanced by still ongoing parental support (Sabaté, 2003) as well as the potential immediate symptom reduction effects of ADHD medications (Banaschewski et al., 2006). Different recruiting methods probably also influenced results as for instance in the asthma populations, the young adults were recruited epidemiologically, whereas the middle-aged adults were recruited from primary care. This latter clinical group possibly had more symptom severity that could have encouraged adherence. Future studies could clarify the impact of different study design on adherence in asthma and ADHD by using longitudinal models.

In a larger epidemiological adherence study (Axelsson et al., 2011) on chronic disorders, also comprising asthma (11.5%), the mean score of MARS was higher than demonstrated in the asthma samples included in this thesis. The most probable reason for this is the acknowledged difference in adherence across diseases (Sabaté, 2003)

making direct comparisons complicated although a similar observation of lower adherence in asthma than in somatic disorders has been reported previously by Horne and Weinman (1999). To my knowledge, this is the first time MARS (Horne & Hankins, 2004) has been used to study adherence in ADHD, although an epidemical replication study was recently published (Kosse et al., 2017) reporting similar adherence scores on MARS.

Notably, no gender differences regarding adherent behaviour were detected in any of the studies, in agreement with the larger epidemiological adherence study mentioned above on several chronic disorders, also based on MARS (Axelsson et al., 2011). In the ADHD sample, time on medication was not correlated with adherence, in line with previous findings (Gau et al., 2008), however it had a small predictive value on intentional non-adherence.

HRQoL and asthma symptom control measures were not linked to adherence behaviour in the epidemiological asthma sample but a replication study with longitudinal design is required to settle this for certain.

The present results support the call for further studies aimed at discovering the underpinnings of differences in adherence (Gatti et al., 2009; Horne & Weinman, 1999).

If the individual is not experiencing treatment effects, the first step in the clinical work is to assess adherence behaviour which is recommended in any case regularly during treatment according to the Swedish Medical Products Agency (2015, 2016). According to the present results regarding asthma and ADHD, MARS should be useful in that context as it is short and enables assessment of whether possible non-adherence is intentional or unintentional. Of note, the interpretation of MARS is limited by the fact that the Swedish version has not yet been validated, although the original English is validated (Horne & Hankins, 2004).

The negative effects of suboptimal adherence to asthma (Darba et al., 2016; Murphy et al., 2012; Stern et al., 2006; Williams et al., 2011; Williams et al., 2004) and ADHD medication (Gau et al., 2008; Gau et al., 2006; Hong et al., 2013; Marcus & Durkin, 2011) are detrimental to the individual and need to be prevented. This should be possible to some degree, as the beneficial effects of prevention actions directed against non-adherence are recognized. For instance, after thorough investigation of factors underlying non-adherence, individually tailored education (so-called patient-centred education) may be applied and, as a matter of fact, has been shown to improve adherence in adults with asthma aged ≥ 55 years (Goeman, Jenkins, Crane, Paul, & Douglass, 2013).

Personality traits and adherence to medication

The results show associations between adherence to medication and personality traits, although not entirely consistent with regard to which traits related to adherence in the three samples investigated. In adolescents with ADHD, Antagonism was negatively related to adherent behaviour in line with previous studies on somatic disorders (Axelsson et al., 2011; Axelsson, Brink, & Lötval, 2014). However, a gender analysis revealed that this association was significant in boys but not in girls whereas in young adults with asthma it was found in men selectively in agreement with prior findings (Axelsson et al., 2014). More specifically, males with high Antagonism among the young adults with asthma and adolescents with ADHD showed more intentional non-adherence, which captures the active decision not to take medication as prescribed (Horne, 2006; Horne & Clatworthy, 2010). The oppositional behaviour included in the definition of Antagonism possibly plays a role in the observed intentional non-adherence behaviour (Gustavsson et al., 2003). It is noteworthy that Antagonism has also been related to other health risk behaviour (Booth-Kewley & Vickers, 1994) and may therefore be especially important to observe in health work in general and for sustaining adherence in particular. In asthma, high levels of Impulsivity in young adults as well as middle-age men were negatively associated with adherence, in accordance with previous findings (Cheung et al., 2014). The findings on asthma seem reasonable, as Impulsivity is accompanied by difficulties such as poor planning skills (Gustavsson et al., 2003) and low persistence (McCrae & Costa, 2003). Hence, individuals with asthma and elevated Impulsivity are in need of greater support aimed at creating routines and persistence in medication taking, for example, by arranging suitable reminders or other specific action plans.

Regarding ADHD, the association between Impulsivity and adherence was not found. The interpretation of this is complicated since Impulsivity is also one of the core symptoms of ADHD which might have been suppressed by the medication treatment. Furthermore, parental support may have compensated for plausible impact of Impulsivity on adherence. Taken together, the results of this thesis suggest that the association between Impulsivity and adherence may be specific to persons with asthma rather being general in nature although this issue requires further research including more diseases.

Neuroticism was negatively associated with adherence in the middle-aged men with asthma and tended to show a similar association in adolescents with ADHD. This is in line with prior results on asthma and other chronic diseases (Axelsson et al., 2011; Axelsson et al., 2014; van de Ven et al., 2013).

Personality traits were not found to be associated with unintentional non-adherence in any of the current studies, which could be due to the blunted assessment relying on only one MARS question.

This is the first time to my knowledge that an association between personality traits and adherence has been reported among adolescents with ADHD.

One limitation worth discussing concerns the generalizability of the results from the ADHD studies. The literature has previously described that some personality traits are more prominent in ADHD populations (Martel et al., 2008; Miller et al., 2008). These differences were, however, only partly reproduced in the presented study, as the girls with ADHD exhibited higher Impulsivity compared to the normal population, consistent with previous reports (Martel et al., 2008; Miller et al., 2008), while the boys with ADHD showed higher Hedonic Capacity (as a facet of Extraversion), which has not been documented earlier. This deviation between studies may depend on the different populations or even more likely on the small sizes of the gender groups in the present study, which may have limited the statistical power and the possibilities to detect all associations.

Validation of BMQ-Specific and B-IPQ

The Swedish translation of the latest version of the BMQ-Specific was validated for use in adolescents with ADHD. The PCA used for construct validation confirmed the original pattern of the English version (Horne et al., 1999), also replicated in other validation studies (Alsous et al., 2017; Fall, Gauchet, Izaute, Horne, & Chakroun, 2014; Gatt, West, Calleja, Briffa, & Cordina, 2017; Perpiñá Tordera, Moragón, Fuster, Bayo, & Císcar, 2009). Hence, the two previously described components of the BMQ-Specific, the so-called specific-necessity scale and specific-concerns scale, were re-established. The internal consistency test based on Cronbach's alpha showed that the level of reliability was satisfactory for both the BMQ-Specific components. The conclusion is that the Swedish translation of the BMQ-Specific retained the psychometric qualities of the original version and, thus, provides a valid and reliable picture of beliefs about medication in adolescents with ADHD. This translation may be useful in both clinical and research settings aimed at elucidating beliefs about medication among adolescents with ADHD. Moreover, the findings lend support to the robustness of the original BMQ-Specific scale and the original validation. Taken together with prior validations, the BMQ-Specific seems suitable for use in different cultures and disorders.

The Swedish translation of the B-IPQ was validated for use in adolescents with ADHD. The construct validation by PCA showed two components, although the original version did not present any components at all (Broadbent, 2006; Broadbent et al., 2006). Nevertheless, two previous studies have described these same two components (Karatas, Ozen, & Kutluturkan, 2017; Timmermans et al., 2017), naming them the Consequences and Control components (Timmermans et al., 2017). In the ADHD population, the loading of items was in accordance with previous descriptions (Karatas et al., 2017; Timmermans et al., 2017), except for the timeline item. It belonged to the Control component in the present study, as the individual KMO value for the timeline was acceptable for that placement. However, it was not included in either of the components in the previous validation studies performed on cancer and heart failure samples (Karatas et al., 2017; Timmermans et al., 2017), whereas in a study of older adults with

multiple illnesses it stood out as a distinct factor (Schuz, Wolff, Warner, Ziegelmann, & Wurm, 2014). This discrepancy between the studies regarding the timeline could be due to the different age spans of the populations and different courses of the disorders. ADHD is usually a lifelong but non-fatal disorder whereas the nature of some somatic disorders may provoke perceptions of non-survival (Karatas et al., 2017; Schuz et al., 2014; Timmermans et al., 2017).

The item composition of the components indicate that the B-IPQ represents perceptions regarding the emotional and cognitive implications of ADHD, on the one hand, and perceived capability of self-care maintenance of ADHD, on the other. This is partly incongruent with Leventhal's Common-Sense model (Leventhal et al., 2003), in which two parallel processes of illness perceptions in the form of a cognitive and an emotional component are hypothesized.

The internal consistency reliability evaluated by the Cronbach's alpha was considered satisfactory for the Consequences component. The Control component only consisted of three items, which probably compromised its Cronbach's alpha (Cortina, 1993; Field, 2012; Tavakol & Dennick, 2011). Nevertheless, given that the number of items included in the component tested must be taken into account when interpreting Cronbach's alpha results (Cortina, 1993; Field, 2012), internal consistency reliability was considered acceptable for the Control component as well.

The conclusion is that the Swedish translated version of the B-IPQ gives a fairly valid and reliable picture of adolescents' perceptions of having ADHD which seems to be useful in clinical work and research.

Beliefs about medication, adherence to medication and personality traits

One of the main findings of this thesis is that beliefs about medication are significantly associated with adherence behaviour and personality in individuals with asthma and ADHD. More specifically, beliefs about the necessity of medication and the necessity-concerns differential were positively related to adherence in the clinical asthma and ADHD samples. With regard to ADHD, concerns about medication and beliefs about side effects were also related to lower adherence.

The finding of an association of beliefs about the necessity of medication for controlling the disease and maintaining health with adherence was consistent in these two unrelated disorders and is in line with previous reports on these and other somatic disorders (Alsous et al., 2017; Axelsson et al., 2015; Bussing et al., 2012; Byer & Myers, 2000; Ferrin et al., 2012; Horne & Weinman, 1999; Koster et al., 2014; Matoulkova et al., 2013; Menckeberg et al., 2008; Van Steenis et al., 2014). Taken together, accessible evidence to date highlights the importance of beliefs about the necessity of the medication for adherence, irrespective of disease. The necessity-concerns differential was associated with adherence in both disorders, in accordance with prior studies on asthma and other somatic disorders (Fernandez-Arias, Acuna-Villaorduna, Miranda, Diez-Canseco, & Malaga, 2014; Horne & Weinman, 1999; Menckeberg et al., 2008;

Wileman et al., 2015). In summary, the balance of beliefs about necessity versus concerns seems to play a role in adherence to medication that may exist irrespective of disease. Notably, the presented study is the first to reveal such an association in ADHD by using the BMQ-Specific.

Surprisingly, concerns about medication showed no relation to adherence in the clinical asthma sample, something that may be a consequence of the small sample size, which limits the statistical power. This is, however, in accordance with one previous report (Koster et al., 2014), but not with three others showing a negative relation between medication concerns and adherence (Cooper et al., 2015; Horne & Weinman, 1999; Menckeberg et al., 2008). This incompatibility is probably due to different populations and age, but addressing these conflicting results requires larger replications studies.

In the ADHD sample, beliefs about medication's negative consequences were related to low adherence, in agreement with previous results on ADHD (Charach et al., 2014; Ferrin et al., 2012), depression (Brown et al., 2005), and somatic disorders (Horne & Weinman, 1999). Collectively, the available data suggest that concerns about medication play a role in adherence behaviour in both mental and somatic disorders.

Furthermore, beliefs about side effects of ADHD medication were linked to lower adherence, in agreement with previous findings (Gau et al., 2008; Gau et al., 2006).

The present study is among the first to explore possible associations between beliefs about medication, measured with the BMQ-Specific, and adherence in ADHD which makes comparisons with existing literature difficult.

Note that more clear-cut knowledge about the association between beliefs about medication and adherence should be based on longitudinal approaches, which awaits future studies.

The conclusion is that the growing body of evidence along with the present results indicate that beliefs about medication should be routinely investigated in long-term medication treatment as a part of ensuring adherence. The BMQ-Specific should be a useful inventory for this purpose in the area of asthma and ADHD care. Eventually, individual preventions could be undertaken to target distinct beliefs about medication to avoid and handle non-adherence in the clinical work.

In adults with asthma and adolescents with ADHD, Neuroticism/Negative Affectivity was related to more concerns about medication, while Extraversion/Hedonic Capacity was related to fewer concerns. In addition, Negative Affectivity was associated with beliefs about the necessity of ADHD medication. These observations appear to be reasonable with regard to the characteristics of the personality traits (Gustavsson et al., 2003).

The results are in line with a previous report on an association between Neuroticism and somatic concerns (Costa & McCrae, 1987). It seems logical that the fearfulness associated with Neuroticism/Negative Affectivity may generate more concerns about medication as well as about disease symptoms, which in turn may lead to belief in the

necessity of the medication. The positivism of Extraversion/Hedonic Capacity may, on the other hand, counteract such concerns (Gustavsson et al., 2003).

The intention was to explore whether associations between beliefs and adherence are to some degree mediated by personality traits. In the ADHD sample, the requirement of the mediation analysis regarding intercorrelations between included variables was not fulfilled. The interpretation, however, is not that the hypothesis is wrong, rather that the ADHD sample was also too small for illustrating all correlations, and therefore this research question needs to await future replications studies using larger samples.

However, the finding of a relation between personality and beliefs about medication is important in the clinical care of persons on long-term medication treatment and may form the basis of individualized care (personality-centred care).

Perceptions of ADHD, adherence to medication and personality traits

Perceptions of ADHD (according to the B-IPQ) had minimal associations with adherence. It was only the perception that ADHD affected life that was associated with the unintentional non-adherence. A likely explanation is that disturbances owing to ADHD have negative effects on life which in turn make gains of taking the medication more obvious, so forgetfulness to take the medication declines. Such a notion is supported by evidence showing that adherence yields improvement in ADHD symptoms in youths (Gau et al., 2008; Hong et al., 2013) and higher attainment of academic grades (Marcus & Durkin, 2011), while low adherence yields less active interaction and more severe behaviour problems at home (Gau et al., 2006).

This finding is in line with the conclusion of a meta-analysis including 26 studies on adherence to medication prescribed to treat numerous diseases (Brandes & Mullan, 2014), in which a weak relation between illness perception and adherence behaviour emerged, while a recent study on persons with asthma found however no associations (Smits, Brigis, Pavare, Maurina, & Barengo, 2017). Note that the illness perception assessments in these studies, as in the present one, were based on scales derived from the Common-Sense Model (CSM), in which perceptions of illness are theorized to explain health behaviour (Cameron & Leventhal, 2003; Leventhal et al., 2003). Hence, the conclusion is that CSM are only weakly linked with adherence to medication, and therefore the CSM framework is only poorly supported by our and others' results (Brandes & Mullan, 2014; Smits et al., 2017). In addition, the B-IPQ seems to be of limited value in adherence assessments in adolescents with ADHD. However, it may give information about perception of ADHD of relevance to health care providers as aiming at maximal wellbeing of the adolescent in question. It is noteworthy that some gender differences were observed regarding perception of illness. The boys' perceptions of their ability to manage their ADHD were stronger than the girls' perceptions in this regard, whereas the girls' perceptions of how emotionally affected they were by ADHD were stronger. Hence, the girls could gain from more information about ADHD, and learning coping strategies to minimize the emotional effect of ADHD might also be helpful.

Interestingly, three of the five personality traits – Negative Affectivity, Antagonism and Impulsivity – were associated with perceptions of ADHD. Negative Affectivity and Impulsivity were related to the perception that ADHD had more consequences in life and together with Antagonism also with perceived low ability to manage ADHD. These associations seem adequate with regard to the definitions of Negative Affectivity and Impulsivity, as described above. For Antagonism, it seems possible that having a hostile interpersonal style may be a hinder to achieving assistance from others (Gustavsson et al., 2003), which actually could compromise the individual's ability to manage ADHD.

The finding of relations between personality and ADHD perceptions may give individual information that may be useful in person-centred care.

LIMITATIONS AND METHODOLOGICAL CONSIDERATIONS

There are several aspects of the included populations that should be mentioned, for example, the attrition rate. In the epidemiologic asthma sample presented in Study I, 792 initially participated of whom 92 declined this part and 120 did not return questionnaires. In other words, 580 or 73.2% completed the investigation, which is acceptable attrition in an epidemiological investigation. However, 312 were not included, despite responding to the survey, due to remission of asthma, and therefore the final number was 268 participants. In retrospect, it is possible that some of these individuals still had asthma, although it is not clear how this may have influenced the results.

Sample size is the main weakness of the clinical asthma study ($n = 35$) and may have limited the findings. Therefore, larger clinical replication studies are desirable. However, the results are partly consistent with those obtained in the epidemiological asthma sample and previous findings regarding asthma (Axelsson et al., 2014) as well as the present ADHD sample. This suggests that at least some of the findings are valid. Of the 42 adults with asthma invited to participate, seven declined, giving an attrition rate of 16.7%, which is also quite acceptable in a clinical investigation.

In the asthma studies, attrition analyses were not performed because the necessary information was not registered. It was, thus, not possible to evaluate the impact of attrition on the results. Nevertheless, all individuals in the epidemiological sample were of the same age (± 1 years), which often is a period when young people move for education and work which probably explains some of the attrition. This, along with an attrition rate of 26.8%, suggests only a limited effect on the results. In the clinical sample, seven individuals were non-responders, which are too few for a meaningful attrition analysis.

In the ADHD sample, 160 adolescents were invited to participate, of whom 148 accepted and 101 or 68.2% completed the questionnaires. No significant differences regarding gender, age at the start of medication and duration of medication were detected in an attrition analysis where the 47 dropouts were compared with the 101 participants. Hence, the effect of attrition on the results was assumed to be marginal, although it cannot be ruled out that non-responders were less adherent, in which case an underestimation of low-adherence behaviour and compromised elucidation of the underlying factors are possible.

Note that the DSM-IV criteria were used, which may have generated a more homogenous population compared to the actual DSM-5 criteria, as only those with impairing symptoms before the age of seven and not comorbid autism were included, based on the DSM-IV criteria. This limits to some, but probably a small, degree the generalizability of the present data to populations based on DSM-5 criteria (American

Psychiatric Association & American Psychiatric Association. DSM-5 Task Force., 2013).

In the ADHD sample, the decision not to investigate adolescents at the start of medication limits information about initial adherence problems and dropouts. On the other hand, the population was more homogeneous. Consequently, the results can only be interpreted in relation to adolescents on longstanding stable medication.

The choice of including different age spans in each of the included studies in the thesis may in part depict the implications of age for adherence although other design factors complicate the interpretation. The epidemiological asthma and ADHD studies were both performed on young people, but at different developmental stages, which may interfere on adherence behaviour (Sabaté, 2003). On the other hand, comparison of the two asthma groups' results is not straightforward either, as there are differences in sample size, age span and recruiting method. Note that the results obtained in each study cannot be generalized to account for all age groups, particularly not pertaining to personality traits, which are fully developed first after the age of 30 years (McCrae & Costa, 2003) and may even show some changes after that (Terracciano et al., 2005).

The choice of using self-reports to gather information may be questioned. Self-reports assessing adherence are shown to generate higher adherence prevalence than objective measurements such as physiological assays (Pappadopulos et al., 2009). One other limitation of self-reports may be that the person does not remember whether or not they took their medication, e.g., a week ago (Lehmann et al., 2014). Nevertheless, self-report scales are validated and ethical as well as inexpensive and easy to administrate compared to electronic medicine monitors (Lehmann et al., 2014; Rand & Sevrick, 2000; Vitolins et al., 2000) and physiological assays (Riekert, 2006). Using self-reports seemed the best way to obtain information about adherence with regard to the design, along with other benefits.

The self-report approach may give some bias due to social desirability effects on answers. To minimize such effects, the questions in MARS are posed in such a way that non-adherent behaviour is "normalized" (Horne & Clatworthy, 2010). The decision not to go further and validate MARS during this research work was because it seems necessary to develop MARS further. One interfering factor for a correct interpretation of adherence results is the wording of the MARS questions, not all of which are suitable in every disease. For example, the item "*I alter the dose*" may have generated too high intentional non-adherence, as it does not take into consideration that the doses should be adjusted according to asthma symptom severity. In ADHD, the item "*I stopped taking the medication for a while*" may also have yielded too high intentional non-adherence, as health care providers recommend drug holidays. Hence, it seems necessary to further develop the questionnaire in order to suite all diseases, rather than to change and validate it for each and every disease.

Finally, the unintentional non-adherence requires more comprehensive assessment since the actual version of MARS comprises only one question regarding forgetfulness, while unintentional non-adherence may be due to several other possible factors (Horne, 2006; Horne & Clatworthy, 2010). For instance factors, such as not understanding the instructions about taking the medication and the financial cost (Horne & Clatworthy, 2010) need to be taken into account. This is a limitation for interpretation of the present data as well as for using MARS in clinical context, in particular because the various factors underlying unintentional non-adherence may require entirely different counteraction plans. In sum, further development of MARS is of importance but awaits future studies.

In the ADHD sample, the MARS Cronbach's alpha was a bit low (Bland & Altman, 1997) and along with the fact that the questionnaire only relies on one type of validation (item inter-correlations) (Connelly, 2011).

In summary, there may be some difficulties in interpretation of self-reports, but no method of assessing adherence is optimal (Horne & Clatworthy, 2010; Sabaté, 2003).

In the ADHD sample, stepwise regression was used for identification of predictive factors for adherence and was considered to be the most appropriate multiple regression method, compared to the enter (Tabachnick & Fidell, 2013), forward or backward methods (Zar, 2010), in order to avoid overfitting.

Some prior validation studies of the B-IPQ have used confirmatory factor analysis (Karatas et al., 2017; Schuz et al., 2014) instead of the Principal Component Analysis (PCA) (Timmermans et al., 2017). PCA was preferred instead because the plan was to proceed with a regression analysis in which components attained by PCA are supposed to give greater predictive ability (Djurfeldt & Barmark, 2009).

The weak correlations of the components of BMQ-Specific and B-IPQ with the statements chosen for the respective convergent validations may to some degree limit the interpretation of the components concepts in the Swedish translation. Possibly, the choice of validation statements was not optimal, although they were the best alternatives in the available material.

The instruments were not test-retested to confirm stability over time (Behling & Law, 2000). Such reliability testing should be included in future studies.

In this research, treatment outcome was not evaluated except in the asthma epidemiological sample where asthma control was used to gain some information on link between the clinical condition and adherence which however was not found. In the ADHD sample, clinical evaluations were not included and therefore the question regarding the valence of adherence on treatment outcome cannot be addressed.

CLINICAL IMPLICATIONS AND FURTHER RESEARCH

The present findings demonstrate that person-related factors, in particular personality and beliefs about medication, are associated with adherence in adults with asthma and adolescents with ADHD.

One crucial part of this thesis is the validation of the scales used to assess beliefs about medication and perception of illness, which is the cornerstone of the qualitative future use of these scales in clinical as well as research contexts in Sweden. In clinical care, such assessments may increase the understanding of the person, which in turn may facilitate alliance between the person and health care providers besides being guidance to the best approach for aiding and supporting adherence. Elucidating negative perceptions of illness opens up possibilities for health care providers to turn these perceptions towards the positive in order to augment the persons' wellbeing.

This thesis provides the foundation for taking an additional step towards person-centred asthma and ADHD care for optimizing adherence to treatment based on assessments of personality, beliefs about medication and perception of illness. By offer such tailored and most appropriate care available, more engagement and adherence to treatment may be expected to generating better outcomes (Davidson et al., 2012). Eventually, these findings may contribute to improved health for some of those many individuals with these common disorders.

Follow up studies should comprise identification of effective interventions such as suitable support and care for persons with asthma and ADHD, the goal being to ensure adherence to medication. In addition, the association between adherence and treatment outcome needs to be explored in future studies. Another important step is to further develop the MARS, so it gives a more comprehensive picture of adherence behaviour. Particularly, the unintentional non-adherence scale needs expansion to cover more aspects of unintentional non-adherence.

CONCLUSION

In conclusion, adherence was associated with personality and beliefs about asthma and ADHD medication. The personality traits showed numerous associations with perceptions of ADHD and beliefs about asthma and ADHD medication. The Swedish translations of the BMQ-Specific and B-IPQ were found to be valid and reliable for future use in clinical work and research in adolescents with ADHD. In a clinical context, the BMQ-Specific seems useful for identifying risks of low adherence, to be counteracted by specific interventions, while the B-IPQ may be used to capture perceptions of ADHD so that suitable information and possibly teaching of strategies to minimize the emotional effects of ADHD can be offered. An improved understanding of the role these person-related factors play in non-adherence may enable targeted actions to turn non-adherence into adherence and also to identify individuals at risk for non-adherence. Taken together, the findings may open the door to a person-centred health care approach aimed at improving adherence.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to all persons who in various ways supported, guided, encouraged and believed in me on the way to completing my thesis. I would especially like to thank all participants who took the time to answer all the questions. This thesis would not have been possible without you. Thank you. I would also like to express my gratitude to following people:

My supervisor *Ina Marteinsdottir*, thank you for your never-ending enthusiasm, dedication and your advice, as well as *Per Gustafsson* thank you for your dedication, support and constructive criticism during in the different phases of my work.

Ina Berndtsson, my "big sister", mentor and friend, because you have always been there, believed in me, supported and guided me, and for all our educational and fun discussions.

Pia Alsén, "my former neighbour" and friend, for all support over the years and for being a sounding board when I needed to put my thoughts into words.

Gisela Öhnström, research nurse and friend, for your support and help with recruiting of adolescents with ADHD. But not least for all our conversations.

The Department of Health Science at University West for being one part of making this thesis possible through financial support and giving me time to be a doctoral student.

All my friends and colleagues at the Department of Health Science at University West for all the discussions, enduring listening to me and for all the laughter.

Kerstin Johansson, my former teacher, you are a very important part of the fact that I am where I am today.

To all the staff at the; library at University West, for all assistance with references that I needed during the work on my thesis and the IT department at University West for important help when my computer was not working properly.

Margaretha Herrman for making my thesis unique with the beautiful cover illustration.

Martin Gellerstedt for explaining and helping with the statistics analysis when I was lost in the world of statistics.

Swedish Asthma Allergy and COPD Nursing Association for a grant that allowed me to leave my work for some weeks so I could fully concentrate on my thesis.

To *Child and Youth Studies* at University West, for financing some the time to write.

FORSS for part of the funding for this project.

Christina Olsson, my aunt and friend, for always being there, letting me know I could call you anytime.

Folke Lundh, my father, for all support through my life, for giving me an interest in educating, and always being there for me.

To my beloved husband and soul mate, *Hasse*, for you have always been there, supporting me in many, many ways, giving me the energy to continue, believed in me, listening to my thoughts and feelings. Thank you for being in my life! $99^{33} + 7$; -X

REFERENCES

- Ahmad, A., & Sorensen, K. (2016). Enabling and hindering factors influencing adherence to asthma treatment among adolescents: a systematic literature review. *J Asthma*, 58(8), 862-878.
- Ahmed, R., & Aslani, P. (2013). Attention-deficit/hyperactivity disorder: an update on medication adherence and persistence in children, adolescents and adults. *Expert Rev Pharmacoecon Outcomes Res*, 13(6), 791-815.
- Allik, J., Laidra, K., Realo, A., & Pullmann, H. (2004). Personality development from 12 to 18 years of age: changes in mean levels and structure of traits. *European Journal of Personality*, 18(6), 445-462.
- Allik, J., & McCrae, R. R. (2002). A Five-Factor Theory Perspective. In R. R. McCrae & J. Allik (Eds.), *The Five-Factor Model of Personality Across Cultures* (pp. 303-322). Boston, MA: Springer US.
- Alsous, M., Alhalaiqa, F., Abu Farha, R., Abdel Jalil, M., McElnay, J., & Horne, R. (2017). Reliability and validity of Arabic translation of Medication Adherence Report Scale (MARS) and Beliefs about Medication Questionnaire (BMQ)-specific for use in children and their parents. *PLoS One*, 12(2), e0171863.
- Altman, D. G. (1991). *Practical statistics for medical research*. London: Chapman and Hall.
- American Psychiatric Association, & American Psychiatric Association. DSM-5 Task Force. (2013). *Diagnostic and statistical manual of mental disorders : DSM-5* (5th ed.). Arlington, Va.: American Psychiatric Association.
- American Psychiatric Association., & American Psychiatric Association. Task Force on DSM-IV. (2000). *Diagnostic and statistical manual of mental disorders : DSM-IV-TR* (4th ed.). Washington, DC: American Psychiatric Association.
- American Psychiatric Association., & Association., A. P. (2013). Highlights of changes from DSM-IV-TR to DSM-5.
- Axelsson, M. (2013). Report on personality and adherence to antibiotic therapy: a population-based study. *BMC Psychol*, 1(1), 24.
- Axelsson, M., Brink, E., Lundgren, J., & Lotvall, J. (2011). The influence of personality traits on reported adherence to medication in individuals with chronic disease: an epidemiological study in West Sweden. *PLoS One*, 6(3), e18241.

- Axelsson, M., Brink, E., & Lötval, J. (2014). A personality and gender perspective on adherence and health-related quality of life in people with asthma and/or allergic rhinitis. *J Am Assoc Nurse Pract*, 26(1), 32-39.
- Axelsson, M., Cliffordson, C., Lundback, B., & Lötval, J. (2013). The function of medication beliefs as mediators between personality traits and adherence behavior in people with asthma. *Patient Prefer Adherence*, 7, 1101-1109.
- Axelsson, M., Ekerljung, L., & Lundback, B. (2015). The Significance of Asthma Follow-Up Consultations for Adherence to Asthma Medication, Asthma Medication Beliefs, and Asthma Control. *Nurs Res Pract*, 2015, 139070.
- Axelsson, M., Ekerljung, L., Lundback, B., & Lotvall, J. (2016). Personality and unachieved treatment goals related to poor adherence to asthma medication in a newly developed adherence questionnaire - a population-based study. *Multidiscip Respir Med*, 11, 42.
- Aylward, M. (2006). Beliefs: Clinical and vocational interventions; tackling psychological and social determinants of illness and disability. In P. Halligan & M. Aylward (Eds.), *The power of belief : psychosocial influence on illness, disability and medicine* (pp. xxvii-xxxvii). New York: Oxford University Press.
- Banaschewski, T., Coghill, D., Santosh, P., Zuddas, A., Asherson, P., Buitelaar, J., . . . Taylor, E. (2006). Long-acting medications for the hyperkinetic disorders. A systematic review and European treatment guideline. *Eur Child Adolesc Psychiatry*, 15(8), 476-495.
- Barkley, R. (2006a). Comorbidity Disorders, Social and Family Adjustment and Subtyping. In M. J. Barker (Ed.), *Attention-Deficit Hyperactivity Disorder. A Handbook for Diagnosis and Treatment* (3 ed., pp. 184-218). New York: The Guilford Press.
- Barkley, R. A. (2006b). A theory of ADHD. In R. A. Barkley (Ed.), *Attention-deficit hyperactivity disorder : a handbook for diagnosis and treatment* (3rd ed., pp. 297-334). New York: Guilford Press.
- Barner, J. C., Khoza, S., & Oladapo, A. (2011). ADHD medication use, adherence, persistence and cost among Texas Medicaid children. *Curr Med Res Opin*, 27 Suppl 2, 13-22.
- Barnes, P. J., & Adcock, I. M. (2003). How Do Corticosteroids Work in Asthma? *Annals of Internal Medicine*, 139(5), 359.

- Behling, O., & Law, K. S. (2000). *Translating questionnaires and other research instruments: problems and solutions*. Thousand Oaks, Calif.: SAGE.
- Bell, J. S., Airaksinen, M. S., Lyles, A., Chen, T. F., & Aslani, P. (2007). Concordance is not synonymous with compliance or adherence (Vol. 64, pp. 710-711): Wiley-Blackwell.
- Bergman, H. (2003). *NEO PI-R Manual -svensk version*. Stockholm: Psykologiförlaget
- Bissonnette, J. M. (2008). Adherence: a concept analysis. *J Adv Nurs*, 63(6), 634-643.
- Bland, J. M., & Altman, D. G. (1997). Cronbach's alpha. *BMJ*, 314(7080), 572.
- Bogg, T., & Roberts, B. W. (2004). Conscientiousness and Health-Related Behaviors: A Meta-Analysis of the Leading Behavioral Contributors to Mortality. *Psychol Bull*, 130(6), 887-919.
- Bolea-Alamanac, B., Nutt, D. J., Adamou, M., Asherson, P., Bazire, S., Coghill, D., . . . Young, S. J. (2014). Evidence-based guidelines for the pharmacological management of attention deficit hyperactivity disorder: Update on recommendations from the British Association for Psychopharmacology.
- Bolman, C., Arwert, T. G., & Völlink, T. (2011). Adherence to prophylactic asthma medication: Habit strength and cognitions. *Heart & Lung - The Journal of Acute and Critical Care*, 40(1), 63-75.
- Booth-Kewley, S., & Vickers, R. R. (1994). Associations Between Major Domains of Personality and Health Behavior. *J Pers*, 62(3), 281-298.
- Brace, N., Kemp, R., & Snelgar, R. (2006). *SPSS for psychologists : a guide to data analysis using SPSS for Windows* (3. ed.). Basingstoke: Palgrave Macmillan.
- Brandes, K., & Mullan, B. (2014). Can the common-sense model predict adherence in chronically ill patients? A meta-analysis. *Health Psychology Review*, 8(2), 129-153.
- Brinkman, W. B., Baum, R., Kelleher, K. J., Peugh, J., Gardner, W., Lichtenstein, P., . . . Epstein, J. N. (2016). Relationship Between Attention-Deficit/Hyperactivity Disorder Care and Medication Continuity. *J Am Acad Child Adolesc Psychiatry*, 55(4), 289-294.
- Broadbent, E. (2006). The Brief Illness Perception Questionnaire Scoring Instructions.

- Broadbent, E., Petrie, K. J., Main, J., & Weinman, J. (2006). The brief illness perception questionnaire. *J Psychosom Res*, 60(6), 631-637.
- Broström, A., Strömberg, A., Mårtensson, J., Ulander, M., Harder, L., & Svanborg, E. (2007). Association of Type D personality to perceived side effects and adherence in CPAP-treated patients with OSAS. *J Sleep Res*, 16(4), 439-447.
- Brown, C., Battista, D. R., Bruehlman, R., Sereika, S. S., Thase, M. E., & Dunbar-Jacob, J. (2005). Beliefs about antidepressant medications in primary care patients: relationship to self-reported adherence. *Med Care*, 43(12), 1203-1207.
- Bussing, R., Koro-Ljungberg, M., Noguchi, K., Mason, D., Mayerson, G., & Garvan, C. W. (2012). Willingness to use ADHD treatments: a mixed methods study of perceptions by adolescents, parents, health professionals and teachers. *Soc Sci Med*, 74(1), 92-100.
- Byer, B., & Myers, L. B. (2000). Psychological correlates of adherence to medication in asthma. *Psychology, Health & Medicine*, 5(4), 389-393.
- Cameron, L. D., & Leventhal, H. (2003). Self-regulation, health and illness. An Overview. In L. D. Cameron & H. Leventhal (Eds.), *The self-regulation of health and illness behaviour* (pp. 1-13): Routledge.
- Cameron, L. D., & Moss-Morris, R. (2010). Illness-related cognition and behaviour. In D. French, V. K. A., & J. Weinman (Eds.), *Health Psychology* (2 ed., pp. 149-161). Chichester, West Sussex: Wiley-Blackwell.
- Charach, A., Yeung, E., Volpe, T., Goodale, T., & Dosreis, S. (2014). Exploring stimulant treatment in ADHD: narratives of young adolescents and their parents. *BMC Psychiatry*, 14(1), 110.
- Cheung, M. M., LeMay, K., Saini, B., & Smith, L. (2014). Does personality influence how people with asthma manage their condition? *J Asthma*, 51(7), 729-736.
- Coghill, D., & Hodgkins, P. (2016). Health-related quality of life of children with attention-deficit/hyperactivity disorder versus children with diabetes and healthy controls. *European Child & Adolescent Psychiatry*, 25, 261-271.
- Connelly, L. M. (2011). Research Roundtable. Cronbach's Alpha. *MEDSURG Nursing*, 20(1), 45-44.
- Connor, D. F. (2006). Stimulants. In B. R. A. (Ed.), *Attention-Deficit Hyperactivity Disorder* (3 ed., pp. 608-647). New York: Guilford Publication.

- Cooper, V., Metcalf, L., Versnel, J., Upton, J., Walker, S., & Horne, R. (2015). Patient-reported side effects, concerns and adherence to corticosteroid treatment for asthma, and comparison with physician estimates of side-effect prevalence: a UK-wide, cross-sectional study. *NPJ Prim Care Respir Med*, 25, 15026.
- Cortina, J. M. (1993). What Is Coefficient Alpha? An Examination of Theory and Applications. *Journal of Applied Psychology*, 78(1), 98-104.
- Costa, P. T., & McCrae, R. R. (1987). Neuroticism, Somatic Complaints, and Disease: Is the Bark Worse than the Bite? *J Pers*, 55(2), 299-316.
- Costa, P. T., & McCrae, R. R. (1991). *Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEO FFI) Professional Manual* Odessa, FL: Psychological Assessment Resource
- Cramer, J. A., Roy, A., Burrell, A., Fairchild, C. J., Fuldeore, M. J., Ollendorf, D. A., & Wong, P. K. (2008). Medication compliance and persistence: terminology and definitions. *Value Health*, 11(1), 44-47.
- Danckaerts, M., Sonuga-Barke, E. J. S., Banaschewski, T., Buitelaar, J., Döpfner, M., Hollis, C., . . . Coghill, D. (2010). The quality of life of children with attention deficit/hyperactivity disorder: a systematic review. *European Child & Adolescent Psychiatry*, 19(2), 83-105.
- Darba, J., Ramirez, G., Sicras, A., Garcia-Bujalance, L., Torvinen, S., & Sanchez-de la Rosa, R. (2016). Identification of factors involved in medication compliance: incorrect inhaler technique of asthma treatment leads to poor compliance. *Patient Prefer Adherence*, 10, 135-145.
- Davidson, L., Roe, D., Stern, E., Zisman-Ilani, Y., Connell, M., & Corrigan, P. (2012). If I Choose it, Am I More Likely to Use it? *2012*, 2(3), 16.
- Diefenbach, M. A., & Leventhal, H. (1996). The common-sense model of illness representation: Theoretical and practical considerations. *Journal of Social Distress & the Homeless*, 5(1), 11-38.
- DiMatteo, M. R. (2004). Variations in patients' adherence to medical recommendations: a quantitative review of 50 years of research. *Med Care*, 42(3), 200-209.
- Djurfeldt, G., & Barmark, M. (2009). *Statistisk verktygslåda 2 : multivariat analys*. Stockholm: Studentlitteratur.

- Fall, E., Gauchet, A., Izaute, M., Horne, R., & Chakroun, N. (2014). Validation of the French version of the Beliefs about Medicines Questionnaire (BMQ) among diabetes and HIV patients. *Revue Européenne de Psychologie Appliquée/European Review of Applied Psychology*, 64(6), 335-343.
- Faraone, S. V., Biederman, J., & Zimmerman, B. (2007). An analysis of patient adherence to treatment during a 1-year, open-label study of OROS methylphenidate in children with ADHD. *J Atten Disord*, 11(2), 157-166.
- Fayers, P. M., & Machin, D. (2007). *Quality of life : the assessment, analysis, and interpretation of patient-reported outcomes* (2. rev. ed.). Chichester: Wiley.
- Fayers, P. M., & Machin, D. (2015). *Quality of Life: The Assessment, Analysis and Reporting of Patient-reported Outcomes* (Third Edition ed.). Chichester: Wiley.
- Fernandez-Arias, M., Acuna-Villaorduna, A., Miranda, J. J., Diez-Canseco, F., & Malaga, G. (2014). Adherence to Pharmacotherapy and Medication-Related Beliefs in Patients with Hypertension in Lima, Peru. *PLoS One*, 9(12), 1-11.
- Ferrin, M., Ruiz-Veguilla, M., Blanc-Betes, M., Abd, S. E., Lax-Pericall, T., Sinclair, M., & Taylor, E. (2012). Evaluation of attitudes towards treatment in adolescents with attention deficit hyperactivity disorder (ADHD). *Eur Child Adolesc Psychiatry*, 21(7), 387-401.
- Field, A. P. a. (2012). *Discovering Statistics using IBM SPSS Statistics* (Fourth Edition ed.).
- Foster, J. M., Sanderman, R., van der Molen, T., Mueller, T., & van Sonderen, E. (2008). Personality influences the reporting of side effects of inhaled corticosteroids in asthma patients. *J Asthma*, 45(8), 664-669.
- Gatt, I., West, L. M., Calleja, N., Briffa, C., & Cordina, M. (2017). Psychometric properties of the Belief about Medicines Questionnaire (BMQ) in the Maltese language. *Pharmacy Practice*, 15(1), 886.
- Gatti, M. E., Jacobson, K. L., Gazmararian, J. A., Schmotzer, B., & Kripalani, S. (2009). Relationships between beliefs about medications and adherence. *American Journal of Health-System Pharmacy*, 66(7), 657-664.
- Gau, S. S., Chen, S. J., Chou, W. J., Cheng, H., Tang, C. S., Chang, H. L., . . . Huang, Y. S. (2008). National survey of adherence, efficacy, and side effects of methylphenidate in children with attention-deficit/hyperactivity disorder in Taiwan. *J Clin Psychiatry*, 69(1), 131-140.

- Gau, S. S., Shen, H. Y., Chou, M. C., Tang, C. S., Chiu, Y. N., & Gau, C. S. (2006). Determinants of adherence to methylphenidate and the impact of poor adherence on maternal and family measures. *J Child Adolesc Psychopharmacol*, 16(3), 286-297.
- Gillberg, C. (2014). *ADHD and Its Many Associated Problems*: Oxford University Press.
- GINA. (2014). Global Initiative for Asthma; Global Strategy for Asthma Management and Prevention, 1-146. Retrieved from http://www.ginasthma.org/local/uploads/files/GINA_Report_2014_Jun11.pdf website:
- GINA. (2015). Global Initiative for Asthma. Global strategie for asthma management and prevention. Online appendix. *Global initiative for asthma. Online appendix*. Retrieved from http://www.ginasthma.org/local/uploads/files/GINA_Appendix_2015_May19.pdf website:
- GINA. (2016). Global Initiative for Asthma; Global Strategy for Asthma Management and Prevention. Retrieved from
- Goeman, D., Jenkins, C., Crane, M., Paul, E., & Douglass, J. (2013). Intervention: Educational intervention for older people with asthma: A randomised controlled trial. *Patient Education and Counseling*, 93, 586-595.
- Guldborg-Kjär, T., Sehlin, S., & Johansson, B. (2013). ADHD symptoms across the lifespan in a population-based Swedish sample aged 65 to 80. *Int Psychogeriatr*, 25(4), 667-675.
- Gunnarsson, M., & Gustavsson, P. (2013). *Normativ data för HP5i baserat på SOM undersökningen 2011*. Göteborg.
- Gustavsson, J. P., Jönsson, E. G., Linder, J., & Weinryb, R. M. (2003). The HP5 inventory: Definition and assessment of five health-relevant personality traits from a five-factor model perspective. *Personality and Individual Differences*, 35(1), 69-89.
- Hale, E. D., Treharne, G. J., & Kitas, G. D. (2007). The common-sense model of self-regulation of health and illness: how can we use it to understand and respond to our patients' needs? *Rheumatology (Oxford)*, 46(6), 904-906.

- Halmøy, A., Klungsøyr, K., Skjaeraeven, R., & Haavik, J. (2012). Pre- and perinatal risk factors in adults with attention-deficit/hyperactivity disorder. *Biol Psychiatry*, 71(5), 474-481.
- Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis : a regression-based approach*. New York: Guilford.
- Haynes, R. B. (1979). Introduction. In R. B. Haynes, D. W. Taylor, & D. L. Sackett (Eds.), *Compliance in health care* (pp. 1-7). Baltimore: Johns Hopkins University Press.
- Hemphälä, M., Gustavsson, J. P., & Tengstrom, A. (2013). The validity of the Health-Relevant Personality Inventory (HP5i) and the Junior Temperament and Character Inventory (JTCl) among adolescents referred for a substance misuse problem. *J Pers Assess*, 95(4), 398-406.
- Hippokrates, & Jones, W. H. S. (1923). *Hippocrates. Vol. 2*. Cambridge, Mass.London: Harvard Univ. Press ;Heinemann.
- Hodgkins, P., Sasané, R., & Meijer, W. M. (2011). Pharmacologic Treatment of Attention-Deficit/Hyperactivity Disorder in Children: Incidence, Prevalence, and Treatment Patterns in The Netherlands. *Clinical Therapeutics*, 33(2), 188-203.
- Holgate, S. T. (2010). A brief history of asthma and its mechanisms to modern concepts of disease pathogenesis. *Allergy Asthma Immunol Res*, 2(3), 165-171.
- Hong, J., Novick, D., Treuer, T., Montgomery, W., Haynes, V. S., Wu, S., & Haro, J. M. (2013). Predictors and consequences of adherence to the treatment of pediatric patients with attention-deficit/hyperactivity disorder in Central Europe and East Asia. *Patient Prefer Adherence*, 7, 987-995.
- Hong, M., Kim, B., Hwang, J. W., Bhang, S. Y., Choi, H. Y., Oh, I. H., . . . Bahn, G. H. (2016). Naturalistic Pharmacotherapy Compliance among Pediatric Patients with Attention Deficit/Hyperactivity Disorder: a Study Based on Three-Year Nationwide Data. *J Korean Med Sci*, 31(4), 611-616.
- Hong, R. Y., & Paunonen, S. V. (2009). Personality traits and health-risk behaviours in university students. *European Journal of Personality*, 23(8), 675-696.
- Horne, R. (2000). Assessing perceptions of medication: psychological percepec. In H. McGavock (Ed.), *Handbook of drug use research methodology*. Newcastle-Upon-Tyne: United Kingdom Drug Utilisation Research Group.

- Horne, R. (2003). Treatment perceptions and self-regulation. In L. D. Cameron & H. Leventhal (Eds.), *The self-regulation of health and illness behaviour* (pp. 138-153). New York: Routledge.
- Horne, R. (2006). Compliance, adherence, and concordance: implications for asthma treatment. *Chest*, 130(1 Suppl), 65S-72S.
- Horne, R., & Clatworthy, J. (2010). Adherence to Advance and Treatment. In D. French & B. P. Society (Eds.), *Health Psychology* (2nd ed., pp. 175-188). Chichester, West Sussex Leicester: Wiley-Blackwell ; British Psychological Society.
- Horne, R., & Hankins, M. (2004). *The Medication Adherence Report Scale (MARS)*. Brighton UK: University of Brighton.
- Horne, R., & Weinman, J. (1999). Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. *J Psychosom Res*, 47(6), 555-567.
- Horne, R., & Weinman, J. (2002). Self-regulation and self-management in asthma: exploring the role of illness perceptions and treatment beliefs in explaining non-adherence to preventer medication. *Psychology & Health*, 17(1), 17-32.
- Horne, R., Weinman, J., & Hankins, M. (1999). The Beliefs about Medicines Questionnaire: The development and evaluation of a new method for assessing the cognitive representation of medication. *Psychology & Health*, 14(1), 1-24.
- Huovinen, E., Kaprio, J., & Koskenvuo, M. (2001). Asthma in relation to personality traits, life satisfaction, and stress: A prospective study among 11 000 adults. *Allergy: European Journal of Allergy and Clinical Immunology*, 56(10), 971-977.
- Ingledeu, D. K., & Brunning, S. (1999). Personality, preventive health behaviour and comparative optimism about health problems. *Journal of Health Psychology*, 4(2), 193-208.
- Janson, S. L., Earnest, G., Wong, K. P., & Blanc, P. D. (2008). Predictors of asthma medication nonadherence. *Heart Lung*, 37(3), 211-218.
- Joelsson, P., Chudal, R., Talati, A., Suominen, A., Brown, A. S., & Sourander, A. (2016). Prenatal smoking exposure and neuropsychiatric comorbidity of ADHD: a finnish nationwide population-based cohort study. *BMC Psychiatry*, 16, 306.

- Johansson, A. (2008). *Airway sensory hyperreactivity linked to capsaicin sensitivity : definitions and epidemiology*. Göteborg: Department of Internal Medicine, Institute of Medicine at Sahlgrenska Academy, University of Gothenburg.
- John, O. P., & Srivastava, S. (1999). The Big Five trait taxonomy: History, measurement, and theoretical perspectives. *Handbook of personality: Theory and research*, 2(1999), 102-138.
- Johnson, M. (2001). Beta2-adrenoceptors: mechanisms of action of beta2-agonists. *Paediatric Respiratory Reviews*, 2(1), 57-62.
- Joshi, A. V., Madhavan, S. S., Ambegaonkar, A., Smith, M., Scott, V. G., & Dedhia, H. (2006). Association of medication adherence with workplace productivity and health-related quality of life in patients with asthma. *J Asthma*, 43(7), 521-526.
- Jørgensen, T., Andersson, K., Bondesson, Å., Eriksson, T., & Calrsten, A. (2003). *The translation of the Beliefs about Medicines Quationnaire to Swedish*. Retrieved from Göteborg:
- Karatas, T., Ozen, S., & Kutluturkan, S. (2017). Factor Structure and Psychometric Properties of the Brief Illness Perception Questionnaire in Turkish Cancer Patients. *Asia Pac J Oncol Nurs*, 4(1), 77-83.
- Keeney, E. L. (1964). The history of asthma from Hippocrates to Meltzer. *J Allergy*, 35, 215-226.
- Kim, S. R., Kim, H. K., Kang, J. H., Jeong, S. H., Kim, H. Y., Kim, S. R., & Kim, M. Y. (2015). Does type D personality affect symptom control and quality of life in asthma patients? *J Clin Nurs*, 24(5-6), 739-748.
- Kosinski, M., Bayliss, M., Turner-Bowker, D., & Fortin, E. (2004). Asthma Control Test: A user's Guid. *Lincoln (RI): QualityMetric Incorporated*.
- Kosse, R. C., Bouvy, M. L., Philbert, D., de Vries, T. W., & Koster, E. S. (2017). Attention-Deficit/Hyperactivity Disorder Medication Use in Adolescents: The Patient's Perspective. *J Adolesc Health*.
- Koster, E. S., Philbert, D., Winters, N. A., & Bouvy, M. L. (2014). Adolescents' inhaled corticosteroid adherence: the importance of treatment perceptions and medication knowledge. *J Asthma*, 1-6.
- Krauskopf, K. A., Sofianou, A., Goel, M. S., Wolf, M. S., Wilson, E. A., Martynenko, M. E., . . . Wisnivesky, J. P. (2013). Depressive symptoms, low adherence, and poor asthma outcomes in the elderly. *J Asthma*, 50(3), 260-266.

- Lange, K. W., Reichl, S., Lange, K. M., Tucha, L., & Tucha, O. (2010). The history of attention deficit hyperactivity disorder. *ADHD Attention Deficit and Hyperactivity Disorders*, 2(4), 241-255.
- Leander, M., Lampa, E., Janson, C., Svärdsudd, K., Uddenfeldt, M., & Rask-Andersen, A. (2012). Determinants for a low health-related quality of life in asthmatics. *Uppsala Journal of Medical Sciences*, 117(1), 57-66.
- Lehmann, A., Aslani, P., Ahmed, R., Celio, J., Gauchet, A., Bedouch, P., . . . Schneider, M. P. (2014). Assessing medication adherence: options to consider. *Int J Clin Pharm*, 36(1), 55-69.
- Levensky, E. R., & O'Donohue, W. T. (2006). Patient adherence and nonadherence to treatment. In W. T. O'Donohue & E. R. Levensky (Eds.), *Promoting treatment adherence : a practical handbook for health care providers* (pp. 3-14). London: SAGA.
- Leventhal, H., Brissette, I., & Leventhal, E. A. (2003). The common-sense model of self-regulation of health and illness. In L. D. Cameron & H. Leventhal (Eds.), *The self-regulation of health and illness behaviour* (pp. 42-65). New York: Routledge.
- Leventhal, H., Diefenbach, M., & Leventhal, E. (1992). Illness cognition: Using common sense to understand treatment adherence and affect cognition interactions. *Cognitive Therapy and Research. Special Issue: Cognitive perspectives in health psychology*, 16(2), 143-163.
- Leventhal, H., Phillips, L. A., & Burns, E. (2016). The Common-Sense Model of Self-Regulation (CSM): a dynamic framework for understanding illness self-management. *J Behav Med*, 39(6), 935-946.
- Lindström, K., Lindblad, F., & Hjern, A. (2011). Preterm birth and attention-deficit/hyperactivity disorder in schoolchildren. *Pediatrics*, 127(5), 858-865.
- Lisspers, K. (2015). *Läkemedelsbehandling vid asthma - bakgrundsdokument*.
- Lisspers, K., Stallberg, B., Hasselgren, M., Johansson, G., & Svärdsudd, K. (2007). Quality of life and measures of asthma control in primary health care. *J Asthma*, 44(9), 747-751.
- Lisspers, K., Stallberg, B., Janson, C., Johansson, G., & Svärdsudd, K. (2013). Sex-differences in quality of life and asthma control in Swedish asthma patients. *J Asthma*, 50(10), 1090-1095.

- Loerbroeks, A., Li, J., Bosch, J. A., Herr, R. M., & Angerer, P. (2015). Personality and risk of adult asthma in a prospective cohort study. *J Psychosom Res*, 79(1), 13-17.
- Marcus, S. C., & Durkin, M. (2011). Stimulant adherence and academic performance in urban youth with attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry*, 50(5), 480-489.
- Martel, M. M., Nigg, J. T., & Lucas, R. E. (2008). Trait Mechanisms in Youth with and without Attention-Deficit/Hyperactivity Disorder. *J Res Pers*, 42(4), 895-913.
- Matoulkova, P., Krulichova, I. S., Macek, K., Vlcek, J., Bastecka, D., Prixova, M., & Horne, R. (2013). Chronically Ill Czech Patients' Beliefs About Medicines: The Psychometric Properties and Factor Structure of the BMQ-CZ. *Therapeutic Innovation & Regulatory Science*, 47(3), 341.
- Matthews, G., Deary, I. J., & Whiteman, M. C. (2009). *Personality traits* (2nd ed.). Cambridge, U.K. ; New York: Cambridge University Press.
- McCann, S. J. H. (2011). Relation of asthma prevalence to the Big Five personality factors at the American state level. *Individual Differences Research*, 9(2), 61-72.
- McCrae, R. R., & Costa, J., P.T. (2008). Empirical and Theoretical Status of the Five-Factor Model of Personality Traits. In G. J. Boyle, G. Matthews, & D. H. Saklofske (Eds.), *The Sage handbook of personality theory and assessment. Vol 1, Personality theories and models* (pp. 273-294). Los Angeles: Sage.
- McCrae, R. R., & Costa, P. T. (2003). *Personality in adulthood : a five-factor theory perspective* (2. ed.). New York: Guilford Press.
- McCrae, R. R., Costa, P. T., Jr., Ostendorf, F., Angleitner, A., Hrebickova, M., Avia, M. D., . . . Smith, P. B. (2000). Nature over nurture: temperament, personality, and life span development. *J Pers Soc Psychol*, 78(1), 173-186.
- McCrae, R. R., Costa, P. T., Terracciano, A., Parker, W. D., Mills, C. J., De Fruyt, F., & Mervielde, I. (2002). Personality trait development from age 12 to age 18: longitudinal, cross-sectional, and cross-cultural analyses. *J Pers Soc Psychol*, 83(6), 1456-1468.
- Menckeberg, T. T., Bouvy, M. L., Bracke, M., Kaptein, A. A., Leufkens, H. G., Raaijmakers, J. A., & Horne, R. (2008). Beliefs about medicines predict refill adherence to inhaled corticosteroids. *J Psychosom Res*, 64(1), 47-54.

- Miller, C. J., Miller, S. R., Newcorn, J. H., & Halperin, J. M. (2008). Personality characteristics associated with persistent ADHD in late adolescence. *J Abnorm Child Psychol*, 36(2), 165-173.
- Mosnaim, G., Li, H., Martin, M., Richardson, D., Belice, P. J., Avery, E., . . . Powell, L. (2014). Factors associated with levels of adherence to inhaled corticosteroids in minority adolescents with asthma. *Annals of Allergy, Asthma & Immunology*, 112(2), 116-120 115p.
- Murphy, A. C., Proeschal, A., Brightling, C. E., Wardlaw, A. J., Pavord, I., Bradding, P., & Green, R. H. (2012). The relationship between clinical outcomes and medication adherence in difficult-to-control asthma. *Thorax*, 67(8), 751-753.
- Nathan, R. A., Sorkness, C. A., Kosinski, M., Schatz, M., Li, J. T., Marcus, P., . . . Pendergraft, T. B. (2004). Development of the asthma control test: a survey for assessing asthma control. *J Allergy Clin Immunol*, 113(1), 59-65.
- National Institute for Health and Clinical Excellence. (2013). *Attention Deficit Hyperactivity Disorder: Diagnosis and Management of ADHD in Children, Young People and Adults*. Leicester UK: The British Psychological Society & The Royal College of Psychiatrists.
- Nigg, J. T., John, O. P., Blaskey, L. G., Huang-Pollock, C. L., Willcutt, E. G., Hinshaw, S. P., & Pennington, B. (2002). Big five dimensions and ADHD symptoms: links between personality traits and clinical symptoms. *J Pers Soc Psychol*, 83(2), 451-469.
- Norman, G. R., & Streiner, D. L. (2000). *Biostatistics : the bare essentials*. Hamilton: B.C. Decker.
- Osterberg, L., & Blaschke, T. (2005). Adherence to medication. *N Engl J Med*, 353(5), 487-497.
- Otsuki, M., Clerism-Beaty, E., Rand, C., & Riekert, K. A. (2008). Measuring adherence to medication regimens in clinical care and research. In S. A. Shumaker, J. K. Ockene, & K. A. Riekert (Eds.), *The handbook of health behavior change* (3rd ed., pp. 309-325). New York: Spring Pub.
- Pallant, J. (2007). SPSS survival manual: A step-by-step guide to data analysis using SPSS version 15. *Maidenhead, Berkshire, England: McGraw-Hill Education*.

- Pappadopulos, E., Jensen, P. S., Chait, A. R., Arnold, L. E., Swanson, J. M., Greenhill, L. L., . . . Newcorn, J. H. (2009). Medication adherence in the MTA: saliva methylphenidate samples versus parent report and mediating effect of concomitant behavioral treatment. *J Am Acad Child Adolesc Psychiatry*, 48(5), 501-510.
- Perpiñá Tordera, M., Moragón, E. M., Fuster, A. B., Bayo, A. L., & Císcar, C. P. (2009). Spanish Asthma Patients' Beliefs About Health and Medicines: Validation of 2 Questionnaires. *Archivos de Bronconeumología ((English Edition))*, 45(5), 218-223.
- Persson, C. G. (1985). On the medical history of xanthines and other remedies for asthma: a tribute to HH Salter. *Thorax*, 40(12), 881-886.
- Ponieman, D., Wisnivesky, J. P., Leventhal, H., Musumeci-Szabo, T. J., & Halm, E. A. (2009). Impact of positive and negative beliefs about inhaled corticosteroids on adherence in inner-city asthmatic patients. *Ann Allergy Asthma Immunol*, 103(1), 38-42.
- Rand, C. S. (1993). Measuring adherence with therapy for chronic diseases: implications for the treatment of heterozygous familial hypercholesterolemia. *Am J Cardiol*, 72(10), 68d-74d.
- Rand, C. S., & Sevick, M. A. (2000). Ethics in Adherence Promotion and Monitoring. *Control Clin Trials*, 21(5, Supplement 1), S241-S247.
- Riekert, K. A. (2006). Integrating Regimen Adherence Assessment into Clinical Practice. In W. T. O'Donohue & E. R. Levensky (Eds.), *Promoting treatment adherence : a practical handbook for health care providers* (pp. 17-34). London: SAGA.
- Sabaté, E. (Ed.) (2003). *Adherence to long-term therapies : evidence for action*. Geneva: World Health Organization.
- Schatz, M., Sorkness, C. A., Li, J. T., Marcus, P., Murray, J. J., Nathan, R. A., . . . Jhingran, P. (2006). Asthma Control Test: reliability, validity, and responsiveness in patients not previously followed by asthma specialists. *J Allergy Clin Immunol*, 117(3), 549-556.
- Schuz, B., Wolff, J. K., Warner, L. M., Ziegelmann, J. P., & Wurm, S. (2014). Multiple illness perceptions in older adults: effects on physical functioning and medication adherence. *Psychol Health*, 29(4), 442-457.

- Sharma, A., & Couture, J. (2014). A review of the pathophysiology, etiology, and treatment of attention-deficit hyperactivity disorder (ADHD). *Ann Pharmacother*, 48(2), 209-225.
- Shaw, P., Malek, M., Watson, B., Sharp, W., Evans, A., & Greenstein, D. (2012). Development of cortical surface area and gyrification in attention-deficit/hyperactivity disorder. *Biol Psychiatry*, 72(3), 191-197.
- Skinner, T. C., Bruce, D. G., Davis, T. M. E., & Davis, W. A. (2014). Personality traits, self-care behaviours and glycaemic control in Type 2 diabetes: The Fremantle Diabetes Study Phase II. *Diabetic Medicine*, 31(4), 487-492.
- Smith, A., Krishnan, J. A., Bilderback, A., Riekert, K. A., Rand, C. S., & Bartlett, S. J. (2006). Depressive symptoms and adherence to asthma therapy after hospital discharge. *Chest*, 130(4), 1034-1038.
- Smits, D., Brigis, G., Pavare, J., Maurina, B., & Barengo, N. C. (2017). Factors related to good asthma control using different medical adherence scales in Latvian asthma patients: an observational study. *NPJ Prim Care Respir Med*, 27(1), 39.
- Spencer, T. (2006). Antidepressant and Specific Norepinephrine Reuptake Inhibitor Treatments *Attention-Deficit Hyperactivity Disorder. A Handbook for diagnosis and treatment*. (3 ed., pp. 647-657). New York: The Guilford press.
- Stahl, S. M. (2008). *Stahl's essential psychopharmacology : neuroscientific basis and practical applications* (3rd ed. ed.). Cambridge: Cambridge University Press.
- Stahl, S. M. (2009). The prefrontal cortex is out of tune in attention-deficit/hyperactivity disorder. *J Clin Psychiatry*, 70(7), 950-951.
- Stern, L., Berman, J., Lumry, W., Katz, L., Wang, L., Rosenblatt, L., & Doyle, J. J. (2006). Medication compliance and disease exacerbation in patients with asthma: a retrospective study of managed care data. *Ann Allergy Asthma Immunol*, 97(3), 402-408.
- Sucksdorff, M., Lehtonen, L., Chudal, R., Suominen, A., Joelsson, P., Gissler, M., & Sourander, A. (2015). Preterm Birth and Poor Fetal Growth as Risk Factors of Attention-Deficit/ Hyperactivity Disorder. *Pediatrics*, 136(3), e599-608.
- Sullivan, P. W., Smith, K. L., Ghushchyan, V. H., Globe, D. R., Lin, S.-L., & Globe, G. (2013). Asthma in USA: its impact on health-related quality of life. *Journal of Asthma*, 50(8), 891-899.

- Sundberg, R., Toren, K., Hoglund, D., Aberg, N., & Brisman, J. (2007). Nasal symptoms are associated with school performance in adolescents. *J Adolesc Health*, 40(6), 581-583.
- Swedish Medical Products Agency. (2009). Läkemedelsbehandling av ADHD -Ny rekommendation.
- Swedish Medical Products Agency. (2015). Farmakologisk behandling vid astma -Behandlingsrekommendation.
- Swedish Medical Products Agency. (2016). Läkemedelsbehandling vid ADHD - Behandlingsrekommendation.
- Tabachnick, B. G., & Fidell, L. S. (2013). *Using Multivariate Statistics*: Pearson.
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *Int J Med Educ*, 2, 53-55.
- Taylor, A., Chen, L.-C., & Smith, M. (2014). Adherence to inhaled corticosteroids by asthmatic patients: measurement and modelling. *Int J Clin Pharm*, 36(1), 112-119.
- Terracciano, A., & Costa, P. T., Jr. (2004). Smoking and the Five-Factor Model of personality. *Addiction*, 99(4), 472-481.
- Terracciano, A., McCrae, R. R., Brant, L. J., & Costa, P. T., Jr. (2005). Hierarchical linear modeling analyses of the NEO-PI-R scales in the Baltimore Longitudinal Study of Aging. *Psychol Aging*, 20(3), 493-506.
- Thapar, A., & Cooper, M. (2016). Attention deficit hyperactivity disorder. *Lancet*.
- Thapar, A., Cooper, M., Eyre, O., & Langley, K. (2013). Practitioner Review: What have we learnt about the causes of ADHD? *Journal of Child Psychology and Psychiatry*, 54(1), 3-16.
- The research-bases pharmaceutical industry. (2016). *FASS : förteckning över humanläkemedel. 2016*
- The Whoqol, G. (1998). The World Health Organization quality of life assessment (WHOQOL): Development and general psychometric properties. *Social Science & Medicine*, 46(12), 1569-1585.

- Timmermans, I., Versteeg, H., Meine, M., Pedersen, S. S., & Denollet, J. (2017). Illness perceptions in patients with heart failure and an implantable cardioverter defibrillator: Dimensional structure, validity, and correlates of the brief illness perception questionnaire in Dutch, French and German patients. *Journal of Psychosomatic Research*, 97, 1-8.
- Topolski, T. D., Edwards, T. C., Patrick, D. L., Varley, P., Way, M. E., & Buesching, D. P. (2004). Quality of Life of Adolescent Males with Attention-Deficit Hyperactivity Disorder. *Journal of Attention Disorders*, 7(3), 163-173.
- Ulrik, C. S., Backer, V., Soes-Petersen, U., Lange, P., Harving, H., & Plaschke, P. P. (2006). The patient's perspective: adherence or non-adherence to asthma controller therapy? *J Asthma*, 43(9), 701-704.
- Unni, E., & Shiyabola, O. O. (2015). Clustering Medication Adherence Behavior based on Beliefs in Medicines and Illness Perceptions in Patients Taking Asthma Maintenance Medications. *Curr Med Res Opin*, 1-25.
- Wahba, G. (1990). *Spline models for observational data*. Philadelphia: Society for Industrial and Applied Mathematics.
- Walker-Noack, L., Corkum, P., Elik, N., & Fearon, I. (2013). Youth perceptions of attention-deficit/hyperactivity disorder and barriers to treatment. *Canadian Journal of School Psychology*, 28(2), 193-218.
- van de Ven, M. O., Witteman, C. L., & Tiggelman, D. (2013). Effect of Type D personality on medication adherence in early adolescents with asthma. *J Psychosom Res*, 75(6), 572-576.
- Van Steenis, M., Driesenaar, J., Bensing, J., Van Hulten, R., Souverein, P., Van Dijk, L., . . . Van Dulmen, A. (2014). Relationship between medication beliefs, self-reported and refill adherence, and symptoms in patients with asthma using inhaled corticosteroids. *Patient Prefer Adherence*, 8, 83-91.
- Ware, J., Kosinski, M., Dewey, J., & Gandek, B. (2001). *How to Score and Interpret Single-Item Status Measures: A Manual for Users of the SF-8 Health Survey*. Lincoln.
- Wehmeier, P. M., Dittmann, R. W., & Banaschewski, T. (2014). Treatment compliance or medication adherence in children and adolescents on ADHD medication in clinical practice: results from the COMPLY observational study. *Atten Defic Hyperact Disord*.

- Wileman, V., Farrington, K., Wellsted, D., Almond, M., Davenport, A., & Chilcot, J. (2015). Medication beliefs are associated with phosphate binder non-adherence in hyperphosphatemic haemodialysis patients. *Br J Health Psychol*, 20(3), 563-578.
- Willcutt, E. G. (2012). The prevalence of DSM-IV attention-deficit/hyperactivity disorder: a meta-analytic review. *Neurotherapeutics*, 9(3), 490-499.
- Williams, L. K., Peterson, E. L., Wells, K., Ahmedani, B. K., Kumar, R., Burchard, E. G., . . . Pladevall, M. (2011). Quantifying the proportion of severe asthma exacerbations attributable to inhaled corticosteroid nonadherence. *J Allergy Clin Immunol*, 128(6), 1185-1191 e1182.
- Williams, L. K., Pladevall, M., Xi, H., Peterson, E. L., Joseph, C., Lafata, J. E., . . . Johnson, C. C. (2004). Relationship between adherence to inhaled corticosteroids and poor outcomes among adults with asthma. *J Allergy Clin Immunol*, 114(6), 1288-1293.
- Vitolins, M. Z., Rand, C. S., Rapp, S. R., Ribisl, P. M., & Sevcik, M. A. (2000). Measuring Adherence to Behavioral and Medical Interventions. *Control Clin Trials*, 21(5, Supplement 1), S188-S194.
- Vollrath, M., & Torgersen, S. (2002). Who takes health risks? A probe into eight personality types. *Personality and Individual Differences*, 32(7), 1185-1197.
- Vollrath, M. E., & Torgersen, S. (2008). Personality types and risky health behaviors in Norwegian students. *Scand J Psychol*, 49(3), 287-292.
- World Health Organization. (2016, 160909). What is DOTS (Directly Observed Chemotherapy, Short Course).
- World Health Organization. (2017). WHO defination of health.
- World Medical Association of Helsinki. (2008). *World Medical Association declaration of Helsinki : ethical principles for medical research involving human subjects ; Seoul 2008*. Guildford: Canary Publications.
- Vrijens, B., De Geest, S., Hughes, D. A., Przemyslaw, K., Demonceau, J., Ruppar, T., . . . Urquhart, J. (2012). A new taxonomy for describing and defining adherence to medications. *Br J Clin Pharmacol*, 73(5), 691-705.
- Wängqvist, M., Lamb, M. E., Frisén, A., & Hwang, C. P. (2015). Child and Adolescent Predictors of Personality in Early Adulthood. *Child Dev*, 86(4), 1253-1261.

- Yildiz, F., & Group, A. S. (2013). Factors influencing asthma control: results of a real-life prospective observational asthma inhaler treatment (ASIT) study. *J Asthma Allergy*, 6, 93-101.
- Zahran, H. S., Bailey, C. M., Qin, X., & Moorman, J. E. (2014). Assessing asthma control and associated risk factors among persons with current asthma - findings from the child and adult Asthma Call-back Survey. *J Asthma*, 1-9.
- Zar, J. H. (2010). *Biostatistical analysis*. Upper Saddle River, N.J.: Pearson Education.

Papers

The papers associated with this thesis have been removed for copyright reasons. For more details about these see:

<http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-142757>