Enabling and hindering factors influencing adherence to asthma treatment among adolescents: A systematic literature review

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Abstract

Objectives: The aim of this systematic literature review is to study the enabling and hindering factors influencing adherence to asthma treatment among adolescents. Furthermore, it explores the role of caregivers and the healthcare provider in terms of supporting adolescents to manage and live with asthma. Data sources: The literature review was conducted using the MeSH terms asthma, adherence, health literacy, behavior, adolescents, tools, healthcare provider, caregiver, peer influence, self-management, quality of life, morbidity and mortality in PubMed, PsycInfo, MEDLINE and CINAHL. Study selection: The literature search resulted in 652 articles of which 304 were screened based on title and abstracts. Ninety-one of the screened articles were then selected for full-text assessment resulting in 42 articles for in-depth analysis. Results: The literature review identified nine enabling and hindering factors relevant for adherence to asthma treatment among adolescents: behavior, belief, self-management, health literacy, role of health provider, assessment of adherence, role of caregiver, role of peers and the national asthma guidelines. Conclusion: Working with this particular age group is complex and further research in understanding adolescent’s behavior, motives, beliefs and perceptions towards adherence to asthma treatment is required to guide them towards better self-management and acceptance of their condition.

Introduction

Asthma is one of the major non-communicable diseases worldwide. The prevalence of asthma has continuously increased over the last five decades, resulting in 235 million people suffering from it [1,2]. Although, effective asthma therapy regimes, which can alleviate or help to control symptoms are available, many patients do not adhere to treatment. In fact, only 50% to 60% of asthma medication is being taken as prescribed [3], which constitutes as a risk factor for morbidity and mortality [4]. Furthermore, non-adherence to asthma treatment reflects a decreased control of the disease which results in poor health outcomes, decreased quality of life [5] and increased healthcare costs [6,7]. Moreover, it leads to sleep disruption, missed school and work days, limited sports or recreational activities, and increased emergency visits [8]. On the contrary, well-controlled asthma leads to fewer symptoms and almost normal lung functionality regardless of the severity of the disease [8]. Despite these enhancing effects, adherence to asthma is still a misunderstood problem which results in poor asthma control [9].

Understanding the underlying concerns of patients will lead to better adherence to recommended treatment regimes, increased patient and physician satisfaction and increased involvement of patients in treatment [10]. Medical non-adherence is known to be triggered by the complex and long duration of asthma treatment and reinforced by a lack of self-management skills and health literacy knowledge; “the ability to read and comprehend medical information” [11]. Furthermore, research has shown that caregiver have a profound role in their child’s asthma management. In fact, caregivers with sufficient level of asthma knowledge are more likely to support their children’s adherence behavior [12]. The doctor-patient relationship has also been emphasized as a decisive factor in adolescents’ adherence behavior. More precisely, the role of the healthcare provider is to support their asthma patients by building and maintaining a trustworthy relationship and by providing tailored information and advice [13].

To get an in-depth understanding of the reasons behind non-adherent behavior, patient’s beliefs, concerns, needs and personality traits must be evaluated. This information can be used to identify individuals at risk for poor adherence and intervene in accordance. Although Lindsay and Heaney [14] found that children between the ages of 7 and 9 years are more likely to adhere to treatment than young adolescents between the ages of 10 and 16 years; it remains unclear why adolescents adhere poorly to treatments.

Notably, to relieve the burden posed by non-adherence to asthma treatment among adolescents, barriers that hinder...
adherence behavior need to be ameliorated. This requires a comprehensive and in-depth understanding of the reasons behind non-adherent behavior. Hence, this literature review aims to identify the enabling and hindering factors of adherence to asthma treatment including the role of caregivers and health provider for young people’s adherence to treatment. The outcome of this study can serve as a reference point for the development of effective interventions that aim to tackle the problem of medical non-adherence to asthma treatment among adolescents.

Methods

The systematic literature search was performed in February 2014 by using the databases PubMed, PsycInfo, MEDLINE and CINAHL. The search terms were related to the key concepts: asthma, adherence, health literacy, behavior, adolescents, tools, healthcare provider, caregiver, peer influence, self-management, quality of life, morbidity and mortality that were guided by the PICO(S) (Table 1), and were entered into the databases in different combinations. For each database the search was limited to abstract or title in order to narrow down the search results.

After removing duplications, articles with promising titles and abstracts were identified by both authors under consideration of the predefined eligibility criteria consisting of articles written in English or German, studying populations preferably adolescents only or if necessary young adults under asthma treatment and articles analyzing the reasons for non-adherence to asthma treatment. All articles that were eligible for the literature review were analyzed in terms of indicators relevant for non-adherence (Figure 1). This resulted in 91 articles for which the full-texts were assessed for eligibility yielding 42 articles to be included in the literature review (Table 2).

Table 1. PICO(S).

| PICOS          | Defined PICOS                          | Additional search terms |
|----------------|----------------------------------------|-------------------------|
| Population     | Adolescents with asthma                | Young people, youth, teenage, children |
| Indicator      | Non-adherence to asthma treatment       | Non-compliance          |
| Comparison     | Adherence to asthma treatment           | Compliance              |
| Outcome        | Behavioral reasons for non-adherence    | Determinants, personality, self-management, beliefs, concerns, barriers, health literacy, knowledge, education, support, parents, caregiver, peers, doctor, healthcare provider |
| Setting        | Not limited                             |                         |

Results

The literature search resulted in 652 relevant articles, of which 348 articles were duplicates and the remaining 304 articles were screened for relevance based on their title and abstracts (Figure 1). This resulted in 91 articles for which the full-texts were assessed for eligibility yielding 42 articles to be included in the literature review (Table 2).

Enabling and hindering factors influencing adherence to asthma treatment among adolescents

The literature review illuminated nine cross-cutting perspectives and themes relevant for non-adherence to asthma treatment among adolescents that were subordinated into patients’ perspectives, systemic perspectives, societal perspectives and policy perspectives, which are described in the following (Figure 2).

Patient perspective: Behavior

Adherence to medication is a voluntary behavior that can be affected by multiple factors such as medication beliefs, concerns, personality traits and co-morbidities [15]. Regarding co-morbidities, mood disorders such as psychosocial problems [5] or depression have been associated with non-adherence to asthma treatment [16]. The most common reasons identified in Axellson’s [6] study are ‘no perceived need’ where the target population stated that they feel well without medicine or that they are trying to manage their disease without medicine. The second-most common reason identified was ‘insufficient routines’ due to side effects or medication dislike [6]. In addition, various findings have shown that adherence behavior decreases due to long treatment durations, decreasing symptoms, and increasing quantity of medications, whereas, unlike some assumptions, adherence behavior does not increase with the severity of asthma [14,17,18].

With regard to adherence to asthma treatment, two types of behaviors were identified: intentional and unintentional. Intentional is where adolescents do not adhere to treatment as a result of a conscious decision due to e.g., concerns or lack of trust in medicine [4,6]. Health-related risk-taking behavior of adolescents such as smoking and drinking alcohol or general disregard of health consequences is also associated with medication non-adherence [4]. Those who do not trust in medicine avoid triggers or tolerate symptoms rather than adhering to treatment [6,19]. Unintentional is where treatment is not followed due to unawareness, faulty inhaler technique or forgetfulness [6]. Adolescents reported that their busy, hectic and sometimes chaotic lifestyle makes it difficult to stick to routines [20]. Both behavioral types require different types of intervention [6,9,14]. From both types, those who do not adhere to treatment intentionally are the most difficult to treat, hence, both types require tailored intervention strategies [6,9,14,19].

Patient perspective: Beliefs

Patients beliefs are important to identify because they have a “powerful impact on patient adherence” [21]. Those who see their disease as unpredictable do not see the need to adhere
Figure 1. Flow chart (adapted from PRISMA 2009 Flow Diagram).

Figure 2. Overview of enabling and hindering factors.
Table 2. Overview of included studies.

| Author, year          | Location    | Target Group            | Disease | Aim                                                                 | Methods                  | Definition of Adherence                                                                 | Outcome                                                                 | Limitations and Overall Quality |
|-----------------------|-------------|-------------------------|---------|----------------------------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|---------------------------------|
| Axelsson et al., 2013 | Sweden      | All ages n = 516        | Asthma  | Determine the mediating effects of beliefs about asthma medication between personality traits and adherence | Questionnaire            | Not stated                                                                              | Personality traits could be used to identify asthma patients who need support with their adherence behavior. Concerns partial mediator for influencing effects of agreeableness, conscientiousness, neuroticism | Good                           | Self-reported adherence            |
|                       |             |                         |         |                                                                      |                          |                                                                                          | Sparse data on SES                                                        |                                 |
| Axelsson, 2013         | Sweden      | 216 Young adults (22 years) | Asthma  | Identify young adults stated reasons for not taking asthma medication | Questionnaire            | Not stated                                                                              | Important parameters for non-adherence to asthma treatment are negative affectivity and perceived asthma control | Good                           | Selection bias                    |
|                       |             |                         |         |                                                                      |                          |                                                                                          |                                                                           |                                 |
| Bender, 2006           | USA         | Adolescents and young adults | Asthma  | Reviews association between depression, risk behavior and nonadherence | Literature review         | Not stated                                                                              | New behavioral studies must be more well-designed in order to show a reliable associations and correlations | Not systematically Medium       |                                 |
| Bourdin et al., 2012   | France      | All ages                | Asthma  | Discuss new definitions of therapeutic adherence in the scope of severe asthma, its assessment, the reasons for poor therapeutic adherence, and potential solutions | Review                   | The ability to take medication accordingly. A partnership between patients and healthcare provider | Adherence is a vast domain of competency where a pluridisciplinary approach is required. | Medium                         |                                 |
| Braido et al., 2010    | Italy       | Healthcare provider     | Asthma  | Investigate physician-related factors that can influence successful asthma management | Questionnaire            | Not stated                                                                              | level of GPs and asthma specialist regarding the use of asthma control tool was not optimal. Respondents were also unable to correctly identify the level of asthma control. A large majority did not believe in the effectiveness of self-management plans | Good                           |                                 |

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Table 2. (Continued)

| Author, year | Location | Target Group | Disease | Aim | Methods | Definition Adherence | Outcome | Limitations and Overall Quality |
|--------------|----------|--------------|---------|-----|---------|----------------------|---------|---------------------------------|
| Bruzzese et al., 2004 | USA | Adolescents | Asthma | discuss developmental transition in cognition, knowledge, autonomy, identity development, and peer relations in term of their influence on adolescents’ asthma management | discussion about developmental transition of adolescents and its influence on asthma management randomized control trial of a school based asthma education program | Not stated | Adolescents are at higher risk for asthma and its negative consequences compared to children. The presented intervention was shown to be feasible. | Feasibility study, has not assessed efficacy of study | Poor |
| Bruzzese et al., 2014 | USA | 168 adolescents | Asthma | Test the self-determination theory to explain adherence to asthma medication regimens in African American adolescents | Interviews | Not stated | Helping families to better integrate asthma care in daily schedules may be an important intervention strategy to improve medication adherence among high risk African-American adolescents. | Self-reported data Baseline date from larger RCT | Medium |
| Chen et al., 2013 | Taiwan | 65 children (6–14 years) and caregiver | Asthma | Evaluated effectiveness of a self-management interactive support (SMIS) program for caregivers of children with asthma | Randomized Control Trial | Not stated | Interactive support interventions reinforce learning incentives and encourage self-care and adherence to therapeutic regimens | Short follow-up period (1 year) |
| Chen et al., 2007 | Canada | Children and adolescents 9–18 years (n = 78) | Asthma | Test associations of neighborhood, peer, and family factors with asthma outcomes in youth and to determine the pathways through which these social factors operate | Questionnaire | not stated | Family factors may affect youth’s asthma via physiological changes, whereas community factors may help shape the health behaviors of youth with asthma | Self-reported adherence → bias cross sectional study design | Good |

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| Author, year | Location | Target Group | Disease | Aim | Methods | Adherence | Outcome | Overall Quality | Limitations and Overall Quality |
|--------------|----------|--------------|---------|-----|---------|-----------|---------|----------------|--------------------------------|
| Corsico et al., 2007 | 12 countries | 971 | asthma | Identify factors affecting changes in asthma treatment adherence in an international cohort | Follow-up study, structured clinical interviews, questionnaire logistic model used to study adjusted effect of determinants | Not stated | Doctors and nurses have a key role in educating and regularly reviewing the patients. The findings support efforts for better improvement of clinical communication | Self-reports of adherence not most accurate method | Good |
| Desai and Oppenheimer, 2011 | USA | Children and adolescents | Asthma | Shed light on the frequency and forms of nonadherence in children and adolescents, its consequences and methods to monitor medication usage | Review | The extent to which a person’s behavior, taking medication, and/or executing lifestyle changes, corresponds with agreed recommendations from a healthcare provider | Adolescents and minorities appear to be at higher risk of non-adherence and increased mortality and thus require special attention and monitoring | Not a systematic literature review | Medium |
| Edgecomb et al., 2010 | UK | 22 adolescents (11–18 years) | Asthma | Understand adolescents’ health experiences with difficult asthma | Interviews | Not stated | Adolescents have a poor understanding of their medication and using it is often conflicted with other activities. They are very reliant on their parents. Results may be biased through Hawthorne effect | Medium |
| Foster et al., 2012 | Australia | 99 patients ages > 14 | Asthma | Identify potentially modifiable beliefs and behaviors that predict electronically recorded adherence with controller therapy | Questionnaire | Not stated | Experienced side-effects and opinions of friends/family about patient’s medication use associated with poor adherence. Other influencing themes are e.g.: perceived necessity, safety concerns, effectiveness, motivation, ease of use | Good |

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| Author, year | Location | Target Group | Disease | Aim | Methods | Definition Adherence | Outcome | Limitations and Overall Quality |
|-------------|----------|--------------|---------|-----|---------|----------------------|---------|-------------------------------|
| Guglani et al., 2013 | USA | 422 urban adolescents | Asthma | Assess self-reported symptoms of depression as an effect modifier of the relationship between randomization group and controller medication adherence at 6-month follow-up | Randomized control trial | Not stated | Interventions aimed at improving medical adherence need to be tailored to for adolescents with depressive symptoms | Did not identify which component of intervention instrumental in motivating participant to be more adherent | Medium |
| Harrington et al., 2013 | USA | 277 parents of asthma patients 14 healthcare provider | Asthma | Assess how healthcare provider perceptions of parental health literacy influences treatment recommendations and instructions | Questionnaire | Not stated | Healthcare providers’ perceptions about parents’ health literacy can influence treatment recommendations and instructional practices | Study may not be applicable to samples that differ demographically | Medium |
| Irwin and Richardson, 2006 | USA | general | Asthma | Highlight the importance and effectiveness of patient-focused care | Review | Not stated | Patient-focused care has shown to improve adherence to medication. Communication, continuity of care and concordance are highly relevant for effective and should be a key component in asthma management | good |
| Lasmar et al., 2009 | Brazil | Children and adolescents with asthma | Asthma | Assess rates and factors related to Poor adherence to ICS over time in asthmatic children and adolescents | Randomized cohort study | Not stated | Adherence rates decreased over time even if the medication was provided for free. Factors related to Poorer adherence change over time. Adherence has a dynamic pattern wherefore its determinants need to be re-evaluated continuously | Data collection through pharmacy records is not very accurate | Medium |

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| Author, year | Location | Target Group | Disease | Aim | Methods | Definition Adherence | Outcome | Limitations and Overall Quality |
|-------------|----------|--------------|---------|-----|---------|----------------------|--------|-------------------------------|
| Lindsay and Heaney, 2013 | UK | All ages | Asthma | Explore the facts and myths surrounding the factors driving nonadherence as well as how it can be identified and addressed | Review | The extent to which a person’s behavior corresponds with agreed recommendations from a healthcare provider | Nonadherence is difficult to identify. Therefore, the assessment of non-adherence is of paramount importance in difficult asthma management. | Medium |
| Mäkelä et al., 2013 | Scandinavia (Finland, Denmark, Sweden) | all ages adolescents specifically mentioned | Asthma and COPD | identify reasons behind non-adherence to therapies for asthma and COPD and examine evidence for correlations between the correct use of inhaler devices and improved adherence | Literature review | The extent to which patients were perceived to follow their physician’s prescribing instructions/advice | Electronic assessment of medical adherence is the most accurate method. | Literature search not rigorous, search terms very limited | Medium |
| Mancuso and Rincon, 2006 | USA | 175 adults with asthma Mean age 42 83% women | Asthma | Measure association between HL and asthma outcomes And assess how HL affects asthma through covariates | Questionnaire Emergency department utilization measured every 3–6 months for 2 years | Not stated | Less health literacy was associated with worse quality of life, worse physical function, and more emergency department utilization for asthma over 2 years | Selection bias | Medium |
| Mosnaim et al., 2014 | USA | Adolescents (11–16 years) | Asthma | Identify factors associated with non-adherence to daily ICS in minority adolescents | Questionnaire | Not stated | Older age and Poor ICS knowledge are both associated with poor adherence to ICS in minority adolescents. No control group Other factors that affect adherence were not considered | Poor |
| Munzenberger et al., 2010 | USA | 104 Caregiver and child (7–17 years of age) pairs | Asthma | Explores the relationship between children, caregiver, family, and asthma characteristics and responsibility for self-management activities. | Interview and chart review | Not stated | Responsibility for asthma management task is perceived differently by caregiver and children. (Sample not generalizable) Study did not explore relationship between perceived level of responsibility and actual adherence Poor Parents were asked about their children’s behavior towards asthma medication responsibility and adherence not accurate | Poor |
| Orrelle-Valente et al., 2008 | USA | Children and adolescents (age 4–19) | Asthma | Examine [1] association between child age and extent of daily controller medication responsibility [2] role of caregiver in this [3] association between child’s medication responsibility and overall adherence | Telephone survey with 351 parents | Not stated | Medication responsibility increases with age, child’s age and parents race/ethnicity are significantly associated with medication adherence | Poor |

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| Author, year       | Location | Target Group | Disease | Aim                                                                 | Methods                  | Definition Adherence                                                                 | Outcome                                                                 | Limitations and Overall Quality |
|-------------------|----------|--------------|---------|----------------------------------------------------------------------|--------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------|---------------------------------|
| Petermann, 2004   | Germany  | All ages     | Asthma  | Overview of facts regarding the characteristics, costs and consequences of non-compliant behavior | Summary of main facts    | Uses the word compliance: The extent to which patient's behavior corresponds with the recommendations of the healthcare system. Improved doctor-patient relationship and education leads to better self-management of asthma and hence better health outcomes | Non-compliance leads to high costs for the healthcare system. Improved doctor-patient relationship and education leads to better self-management of asthma and hence better health outcomes | Poor Based on the author's work mainly |
| Petteway et al., 2011 | USA      | 835 elementary aged children (up to 15 years) and caregiver | Asthma  | Described association between peer interactions and asthma related emotional experience, asthma control, and outcomes | Exploratory study (interviews) | Not stated Providing children with communication strategies for disclosure of asthma status to peers that results in more supportive interactions may be needed | Providing children with communication strategies for disclosure of asthma status to peers that results in more supportive interactions may be needed | Sample predominately African American; findings not generalizable, emotional concepts and terms used were not tested for target group's level of understanding |
| Price and Thomas, 2006 | UK       | Asthma guidelines | Asthma  | Review the limitations of current asthma guidelines and describe important issues and remaining questions regarding asthma guidelines for use | Review                  | Adherence to physicians' recommendations Country-specific or ideally local guidelines could provide more practical solutions for asthma care that influence patient choice and adherence to therapy. | Country-specific or ideally local guidelines could provide more practical solutions for asthma care that influence patient choice and adherence to therapy. | No systematic review Poor |
| Rastogi et al., 2013 | USA      | 268 caregivers of ethnic minority children with asthma | Asthma  | Assess whether educational interventions for parents decrease emergency department visits and hospitalization | Randomized Control Trial | Not stated Those who underwent the intervention had fewer emergency department visits two years after the intervention | Those who underwent the intervention had fewer emergency department visits two years after the intervention | Selection bias Medium |
| Rhee et al., 2010  | USA      | 126 adolescents (13–20 years) | Asthma  | Examine the role of barriers to adherence in mediating the effect of family support in asthma outcomes | Questionnaire             | Patient’s range of behaviors such as taking medications […] that align with medical and health advice to achieve optimum health outcomes. Family support is beneficial for improving asthma outcomes in adolescents. It ameliorated the barriers to treatment adherence | Family support is beneficial for improving asthma outcomes in adolescents. It ameliorated the barriers to treatment adherence | Good |

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| Author, year | Location | Target Group | Disease | Aim | Methods | Definition Adherence | Outcome | Limitations and Overall Quality |
|--------------|----------|--------------|---------|-----|---------|---------------------|---------|-------------------------------|
| Rosas-Salazar et al., 2012 | USA | Children and adults | Asthma | Raise awareness of the problem of Poor health literacy and asthma health outcomes, summarize current evidence linking health literacy and asthma, offer strategies to strengthen communication between patients and healthcare providers | Literature review | Not stated | Poor health literacy is a key barrier to asthma knowledge. Poor parental health literacy is associated with poor outcomes for their children | Methods were Not stated | Medium |
| Shone et al., 2009 | USA | Parents of children with asthma | Asthma | Examine association between parental health literacy and measures related to child asthma | Interviews | Not stated | Poor parent health literacy was independently associated with greater parent worry, parent perception of greater asthma burden and Poorer parent-reported quality of life | Selection bias (Poor HL, Poor income) Sample limited in asthma severity | Medium |
| Stewart et al., 2011 | Canada | 44 mothers of children with asthma (4 – 16 years) | Asthma | Parents’ intervention preferences were elicited. Based on this an online peer support group intervention was designed and piloted | Interviews (N = 44) Pilot intervention (N = 23) | Not stated | Parents prefer support interventions for children and parents in order to interpret available information and apply it in their situation. Small sample size for pilot study | | Medium |
| Stewart et al., 2011 | Canada | 20 children (6–12 years) 35 caregivers | Asthma | Assess the support and education needs and preferred intervention | Semi-structured individual interviews | Not stated | Parents and children prefer a combination of in-person meetings and internet support | Good |
| Terpstra et al., 2012 | USA | middle school youth | Asthma | Evaluation of a pilot asthma management intervention of middle school-ages youth and their adult network members (caregiver) | Randomized control trial | Not stated | Intervention increased caregivers’ self-efficacy and adolescents sense of responsibility | Selection bias: only those took part who agreed to participate Differences at baseline between both groups | Medium | (Continued on next page)
Table 2. (Continued)

| Author, year | Location | Target Group | Disease | Aim | Methods | Definition Adherence | Outcome | Limitations and Overall Quality |
|--------------|----------|--------------|---------|-----|---------|----------------------|---------|-------------------------------|
| Tibosch et al., 2010 | The Netherlands | 339 Children and adolescents (6–16 years) and their caregiver | Asthma | Assess relationship between asthma related QoL and psychosocial problems | Questionnaire | Not stated | Prevalence of psychosocial problems in children and adolescents with asthma is considerable. They affect medication adherence. Assessment of asthma related QoL alone is insufficient. | Good |
| Ting, 2004 | USA | | Asthma | Use of simplified asthma tools to improve asthma care | Review | Not stated | NAEPP and GINA asthma guidelines are too complex for daily use, whereas the MSAGR is more user friendly. | Medium |
| Tumiel-Berhalter and Hershey, 2005 | USA | Medical directors of 13 academic primary care sites | Asthma | Provide a descriptive account of the preparedness of academic primary care sites to follow national asthma guidelines | Cross-sectional (questionnaire) | Not stated | The findings highlight the importance of the practice environment on the implementation of national guidelines | Limited generalizability | Medium |
| Ulrik et al., 2006 | Denmark | 509 adults between 18 and 45 | Asthma | Explore patient-related aspects of adherence among adult asthmatics | Online questionnaire | Non-adherence: deliberate deviation from recommended therapy. The authors differentiate between intentional and accidental non-adherence. Lack of perceived symptoms main reason for non-adherence; reasons for suboptimal adherence seem to be accessible through education of patients and caregivers. | Selection bias: online questionnaire (selected group from a panel who replied) | Poor |
| Van Steenis et al., 2014 | The Netherlands | 93 (18–80) | Asthma | Investigate relationship between beliefs about asthma medication (ICS) and measure adherence (subjectiveley and objectively) and the agreement between these measures. | Questionnaire | Not stated | High necessity is associated with higher self-reported adherence | Selection bias (high educational level of participants, while among majority of Dutch asthma patients only 24.2% highly educated); only data from pharmacy used | Medium |

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| Author, year | Location | Target Group | Disease | Aim | Methods | Definition Adherence | Outcome | Limitations and Overall Quality |
|-------------|---------|--------------|---------|-----|---------|----------------------|---------|--------------------------------|
| Wamboldt et al., 2011 | USA | 26 adolescents (12–20 years) | Asthma | Examine beliefs, feelings, and behaviors about inhaled asthma controller medication | Focus group interviews | Not stated | A variety of beliefs, feelings and behaviors influence decision about asthma medication use, misinformation, incorrect assumptions about their asthma and current life situations lead to poor adherence. | Selection bias (participants with high IQ and parents with high educational attainments) Good |
| Yang et al., 2010 | UK | Young adolescents 9–14 years 86 parent-adolescent dyads | Asthma | Investigate the association between social support variables and healthy lifestyle for asthma management among early adolescents | Questionnaire | Not stated | The developmental change of social support during early adolescence need to be recognized | Some omitted variables that hamper internal validity, other aspects of social support remain uninvestigated in this study such as adolescent’s relationship with parents Other relevant variables missing (i.e., self-efficacy) Poor |
| Yawn, 2008 | USA | All ages | Asthma | Reviews recent articles dealing with asthma variability, environmental factors, and co-morbidity that affect asthma control | Review | Not stated | Co-morbidities have a significant impact on asthma variability. Documenting asthma variability and adherence can lead to the development of treatments that can anticipate the level of symptoms |
| Zebracki and Drotar, 2004 | USA | 77 adolescents 11–17 years and their caregivers | Asthma | Relation of outcome expectancy and perceived self-efficacy for asthma prevention and management in adolescents to asthma self-management, adherence to treatment and asthma morbidity | Questionnaire and interviews | Not stated | High outcome expectancy was associated with greater asthma morbidity but unrelated to self-management or treatment adherence. Self-efficacy was related to treatment adherence but unrelated to asthma morbidity or self-management | Self-reported adherence Correlational study, wherefore causal inferences are precluded Good/Medium |
to prescribed medicine [6]. The personality traits low agreeableness, low conscientiousness and high neuroticism, meaning being reluctant, disorganized and moody, are associated with perceived concerns about asthma medication and adherence behavior [22]. However, Axelsson et al. [22] found out that medication beliefs can mediate the influencing effects of those three personality traits on adherence to treatment.

There are different types of beliefs such as concerns and necessities which influence adherence behavior. An example for concerns is fear due to side-effects or the fear to become dependent on medicine; whereas patients with high necessities believe that medication is needed for controlling their asthma; therefore, they have a higher tendency to self-reported adherence [23]. In contrast to the patients with concerns, people who believe in the effectiveness of their medicine are more likely to adhere to it. More precisely, patients with a skeptic attitude are less likely to adhere to treatment than patients with an accepting attitude who believe in the importance of medication [20, 22].

**Patient perspective: Health literacy**

Health literacy is defined as an “individual’s capacity to access, understand, communicate, evaluate, utilize, and make decisions based on health information” [24]. Health literacy is a key factor for good asthma management in children and adults. In contrast to this, poor health literacy poses a key barrier to obtain and apply adequate asthma knowledge [12]. Furthermore, limited health literacy is associated with a lower quality of life, poor physical functionality and increased emergency visits [11].

To improve asthma outcomes, patients need to learn how to understand and implement self-management approaches [25]. Improved asthma education is associated with effective symptom control, better self-management of the disease and better asthma control, whereas, poor understanding of treatment and its importance pose a risk to adherence [18]. Research has shown that asthma is less well controlled especially among adolescents of lower socioeconomic status and ethnic minorities [4, 26]. The main reason for this appears to be a low level of understanding health related information, low health literacy and language barrier [26]. For ethnic minorities, both older age and low asthma knowledge are associated with poor adherence [26]. The complexity of treatment regimens and the lack of comprehension of treatment benefits set a barrier to adherence and therefore create a lack of trust between patient and healthcare provider.

**Systemic perspective: Role of health provider**

The doctor-patient relationship and the patient’s level of education are decisive factors for non-adherence [31]. However, this relationship differs depending on whether an asthma specialist or a General Practitioner (GP) is consulted. In contrast to asthma specialists, GPs are more likely to have a paternalistic approach because they are inclined to limit the patients’ liberty and autonomy by not actively involving them in the treatment process [31]. Wamboldt et al. [20] found out that adolescents perceive it as beneficial when they have a good relationship to their doctor. In fact, those who did not have a good relationship were more likely to withhold information in order to avoid confrontation and to minimize the time spent with their doctors [20]. The key role of doctors is to educate and review their patients on a regular basis and to support them when needed. Moreover, they need to make an effort to establish and keep a good relationship with their patients [13]. This involves good communication, which cannot only avoid the provision of incorrect and incomplete knowledge about medication intake but also enhance adherence to medication [32].

Assessing adherence is an ongoing and crucial process for asthma management. It is a major step in reducing exacerbations, occurrence of side-effects, hospitalization, emergency care visits, wrong treatment and avoidable healthcare costs [14]. There are several methods to measure non-adherence among asthma patients (e.g., direct, indirect, subjective or objective) all of which differ in accuracy, effort and cost [7,23]. One method is prescription records, which give a proportion of the number of inhalers used over a certain period of time. This proportion can then be compared to the recommended proportion in order to evaluate long-term use. This method, however, is unable to detect short-term behavioral changes towards adherence. A second method is inhaler weighing and dose counting, a process which can be confounded by “test
doses or dumping” by discharging medication for a “satisfactory level” [14]. In contrast to these methods, electronic measures are costly but also more objective and accurate for monitoring inhaled medication [21,33].

Societal perspective: Role of peers

The particular age group of young adolescents is going through a “developmental transition in cognition, knowledge, autonomy, identity development and peer relations,” which impacts their asthma self-management [34]. Apart from this, the social environment is an important determinant of health [35]. Social support influences human beliefs and attitudes towards their health [36]. During adolescence there are two main sources of support coming from parents and peers [37]. Peer influence has a large impact on the health behavior of young adults because they spend a vast amount of time interacting with peers [34,36]. More precisely, positive attitudes, values and behaviors of peers contribute to adolescent’s development whereas negative attitudes have an adverse effect on asthma management and predict negative asthma outcomes. Peers who are not accepting of the disease make the patients feel different and uncomfortable [34]. Studies have shown that young people diagnosed with asthma face a higher rate of rejection by peers than non-asthma patients. Social rejection in turn is associated with social stress which can result in the occurrence of asthmatic symptoms such as inflammatory responses. Therefore, peer support and peer acceptance is an important determinant for building up self-esteem, increasing positive coping and relieving social isolation [36,38]. In fact, social support has been proven to promote adherence to asthma medication [21]; whereas social barriers such as “not wanting to take medication in the presence of peers” serve as a hindering factor to medical adherence [4].

Societal perspective: Role of caregiver

The developmental stage of adolescents from becoming independent from their caregivers is a crucial stage. It includes the shift from parental control to adolescent control with regards to their disease. Along with age, the child’s responsibility towards his/her health increases simultaneously. In this stage it is very important that parents learn to give their children more autonomy in managing their asthma [39]. According to Orrell-Valente et al. [40] children at the age of 11 take on average 50% of the responsibility of their medication intake. This percentage increases to approximately 75% by the age of 15 and 100% by the age of 19. Due to these changes, a constant partnership between patient, caregiver and healthcare provider is important for optimal health outcomes as each party has their own roles and responsibilities that change over time [41].

The most common problem of caregivers of children with asthma is their lack of understanding of the concept of asthma treatment and not acting in accordance to the symptoms. The literature review revealed that low parental health literacy is associated with increased emergency visits, missed school days and inappropriate medication use amongst children with asthma [24]. On the contrary, increasing caregivers’ asthma knowledge via educational programs has been proven to be effective in asthma management [42].

Parents, including parents of ethnic minorities [43] need guidance to interpret information, and translate it into knowledge in order to facilitate their judgment about the severity of their child’s disease in order to support the child to act in accordance to need [19,44]. Another contributing factor to medical non-adherence is parental motivation and their belief in their child’s asthma medication [4]. Furthermore, family stability and family support in general was found to reduce adolescents’ negative attitude towards their asthma medication and their healthcare provider which has a positive effect on adherence [4,45]. Among ethnic minorities, family support for integrating asthma care into adolescents’ daily routines also showed a positive effect towards medical adherence [46].

Policy Perspective: Adherence to National Asthma guidelines

The literature review also illuminated how national asthma guidelines are implemented. The Global Initiative for Asthma (GINA) is a “program to reduce asthma prevalence, morbidity, and mortality in collaboration with the World Health Organization and the National Heart, Lung, and Blood institute of the National Institutes for Health in the United States” [47]. It has developed evidence-based asthma guidelines that list common risk factors, emphasize the need to follow treatment on a regular basis, provide criteria for determining asthma severity and recommends treatment and asthma management according to asthma severity [47]. Adherence to national asthma guidelines leads to health improvements and better quality of life of asthma patients. More precisely, it leads to decreased asthma-related hospitalization and emergency care use [48]. Guidelines are important for disease diagnosis and management [49].

Putting those guidelines into practice requires the collaboration of the healthcare provider, the patient and the system [48]. In fact, the guidelines “recommend understanding patient’s knowledge, beliefs, and concerns, increasing patient involvement and providing information” for better asthma outcomes [32]. However, these guidelines are frequently not followed by physicians. The reasons for it are “lack of awareness, lack of familiarity, lack of agreement, lack of self-efficacy, lack of outcome expectancy, inertia of previous practice, [and] time limitations” [48]. Other barriers which hinder the incorporation of these guidelines into practice are lack of equipment and complexity of their applicability in real life. Physicians claim that the guidelines are disease-oriented rather than patient-oriented and that patient variations and heterogeneity of asthma is not always taken into account [48,49].

Discussion

The findings of this literature review reveal that multiple perspectives and factors affect adherence and one single factor cannot fully explain the reasons behind non-adherence to asthma treatment [9]. However, before going in-depth into the identified factors, it is noteworthy to mention that among recent literature, the term compliance has been replaced by the term adherence because the term compliance is being associated with patients being subordinated to medical advice. In contrast to this, adherence is thought to be more accurate in reflecting and acknowledging a patient’s right to decide whether they want to follow treatment or not [7,14]. It supports the concept of a partnership between patient and healthcare provider. This
standpoint is in line with the identified enabling and hindering factors in this review.

More precisely, it is suggested that a partnership on eye-level between patient and healthcare provider and a more patient-focused approach needs to be strengthened in order to establish a link between adherence to asthma treatment and self-management [27]. However, there are barriers to this approach which need to be considered. One of these barriers is that although patients are able to monitor their asthma, their assessment is mostly unreliable because they commonly underestimate the severity of their disease, leading to false management. Moreover, they are unable to detect changes and adjust treatment accordingly due to inadequate supervision, assistance and asthma education [50].

This barrier can be linked to the identified role of health literacy regarding adherence to asthma treatment. The review revealed, that the wrong beliefs of most patients regarding their ability to control their asthma in accordance to their symptoms and severity of disease, outlines a mismatch of individual perception and needed control of asthma, which implies the need for more education and support for young patients [8]. Health literacy has been identified as a crucial factor for adolescents’ adherence behavior; however, the extent of its importance is unknown. In fact, McQuaid et al. [3] found out that even though children’s knowledge about asthma increases with age, their medication adherence decreases. This implies that the interaction with other enabling and hindering factors needs to be analyzed in order to figure out the complex reasons behind non-adherence.

Other inferences regarding adherence to asthma treatment show that positive medication beliefs can serve as a mediator to overcome personality traits such as skepticism, intolerance and reluctance, which hinder adherence [22]. Furthermore, removing concerns and emphasizing the need for medication can help to foster adherence whereby one can suggest that it would be more effective to focus on strengthening necessities rather than diminishing concerns in order to improve adherence [23]. Social support from caregivers and peers has also been identified as an important factor that has the ability to enhance adherence to treatment [4].

This literature review also shows that it is crucial to target young adolescents in particular because the developmental and behavioral challenges during this transition period from child to adult have a major impact on effective self-management of asthma [28]. The risk taking and impulsive nature of adolescents, their susceptibility to peer influence, fear of embarrassment, rebellion or their wish for independence from their caregivers comes in the way of making reasoned health choices which can result in non-adherent behavior [20,33]. This emphasizes that caregivers as well as health providers need to consider the special needs of adolescents in order to tackle non-adherence to asthma treatment among this age group.

However, one must also consider that there are no simple tools available to measure adherence and most tools are either inaccurate, biased or costly making it more problematic to approach the problem. Measures such as the peak flow meter can easily be practiced at home; however, the peak flow meter is not as frequently used by patients as reported [51]. Furthermore, the reluctance of patients in this age group to admit non-adherent behavior is a complex contributory factor as well, which makes it difficult to assess adherence [21]. Above it all, the dynamic patterns of asthma require ongoing assessment and re-evaluation of symptoms and adjustment of treatment in accordance [28,29].

To date, different types of interventions have been effective in improving adherence to asthma treatment. On the one hand, an easy and effective intervention on how healthcare provider can improve their patients’ adherence behavior is to monitor adherence at each visit, simplify the asthma medication regimen by minimizing the number of medications and the frequency of their doses and most importantly, making sure the patient understands the given asthma information regarding their asthma severity and the importance of following their treatment as prescribed. Furthermore, understanding the patients’ needs in order to tackle non-adherence and tailoring treatments to their lifestyles and acceptability by developing with the patient an individualized asthma action plan [4,27]. Moreover, it is beneficial to have the same healthcare provider over a long period of time [4]. On the other hand, a more difficult but also effective intervention strategy is the provision of asthma knowledge and the provision of asthma self-management classes delivered by young asthma patients themselves [52]. Regarding the barrier of forgetfulness, Axelson [6] recommends reminder messages or inhalers equipped with reminder functionality.

In spite of efforts to design the literature review as rigorous as possible following the PRISMA guidelines [53] it has some limitations. One limitation is that due to the use of the MEDLINE database (subset of PubMed) in addition to PubMed, the number of duplicates was quite high in the search results. The duplicates however, did not affect the results of this review. Another limitation was that the authors did not use standardized forms for data collection. Furthermore, for three eligible abstracts, the corresponding full articles were not accessible. Three additional articles had to be excluded due to language criteria and some others had to be excluded because of their focus on other age groups. Another limitation is that not all included articles target adolescents only. Some included articles target larger age groups in which adolescents are included. One last limitation of this study is that the included articles were not assessed for the risk of bias. Regarding the overview in Figure 2, a limitation is that some articles could have been clustered to several perspectives and factors but the authors chose to place them to the most fitting factor only.

**Conclusion**

The literature review revealed that there is no typical non-adherent behavior for adolescents. Nevertheless, nine enabling and hindering factors were identified that influence adherence to asthma treatment among adolescents. The factors include behavior, belief, self-management, health literacy, role of health provider, assessment of adherence, role of caregiver, role of peers and the national asthma guidelines. Whereas the importance of behavior, beliefs and self-management were well-described in the literature, it becomes apparent that the role of health literacy of adolescents as well as of caregivers and the importance of a well-balanced doctor–patient relationship regarding adherence to asthma treatment among adolescents need to be researched further. Therefore, this study implies that
further research needs to focus on a multidimensional approach that includes the patient, systemic, societal and political perspectives with its underlying factors in order to enhance the success of adherence to asthma treatment among adolescents.

Acknowledgements

The authors wish to thank Antje Fink-Wagner from the European Federation of Allergy and Airways Diseases Patients Association (EFA) for her input and feedback and Abad-ur-Rahman Hameed for proofreading the manuscript and correcting grammatical and linguistic errors.

Declaration of interest

The authors report no conflicts of interest.

Funding

The presented research was commissioned and funded by the European Federation of Allergy and Airways Diseases Patients Association (EFA).

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