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Understanding the challenges faced by adolescents and young adults with allergic conditions: a systematic review

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ABSTRACT

Background

Adolescence represents a vulnerable time for individuals with asthma and allergic conditions. They suffer an unexpected degree of morbidity. This systematic review aimed to understand the challenges faced by adolescents and young adults with these conditions.

Methods

A systematic literature search was undertaken across eight databases. References were checked by two reviewers for inclusion. Study data were extracted and their quality was assessed in duplicate. A narrative meta-synthesis was undertaken.

Results

A total of 108 papers describing 106 studies were retrieved, most focused on asthma. Five themes were identified across studies. (1) Health-related quality of life: impairment was associated with poor disease control, psychosocial issues, adolescent-onset allergic disease and female sex. (2) Psychological factors: asthma and food allergy were associated with anxiety and depression; atopic dermatitis was associated with suicidal ideation; and that parental emotional support may be protective. (3) Adherence: suboptimal adherence was associated with older age, barriers to medication usage, poor symptom perception and failure to take responsibility; positive factors were routines, simpler treatment regimes, better knowledge and perceptions about medications. (4) Self-management: facilitated by education, knowledge and a positive attitude. (5) Supportive relationships: families could modify barriers to adherence and foster positive views about self-management; adolescents suggested that their peers should be more involved in supporting them; adolescents also wished to have support from non-judgemental healthcare professionals.

Conclusions

We have some understanding of the challenges faced by adolescents with asthma, less so for other allergic conditions. This knowledge will be used to support guidelines for managing adolescents.

ABBREVIATIONS

AD Atopic Dermatitis

CASP Critical Appraisal Skills Programme

HRQL Health Related Quality of Life

PRISMA Preferred Reporting Items for Systematic Reviews and Meta-Analyses

INTRODUCTION

Adolescents and young adults are generally regarded as a healthy age group, rarely seeking medical advice. Healthcare resources are therefore not focused on them. However, for adolescents and young adults with allergic conditions or asthma, this is a period of time that is associated with poor clinical and mental health outcomes. For those with food allergy, this age group is most at risk for fatal anaphylaxis[1] and those with asthma are at increased risk of attacks or fatalities[2,3]. Food allergy and asthma are also associated with an increased risk of clinically significant anxiety and depression respectively, in adolescents and young adults[4]. Allergic rhinitis peaks in this age group and is associated with impaired school performance[5]. Atopic dermatitis (AD) impacts negatively on quality of life, self-esteem and identity, particularly in girls[6,7].

Adolescence and young adulthood is a critical age involving profound physical, emotional, cognitive and social changes. Some age-specific factors may contribute to a lack of engagement with self-care, making adolescents and young adults more vulnerable and in need of additional targeted resources[8-11]. A desire for independence, autonomy and exploring their limits, along with a low risk perception, can often lead to poor adherence, erratic self-medication and risk-taking behaviours. Peer pressure, denial, embarrassment and common misbeliefs regarding their conditions further contribute to poor self-management[8-10,12,13]. Communication between healthcare professionals and adolescents can be complex and the conventional medical didactic - sometimes paternalistic - approach is largely ineffective in this age group[9-11]. As a result, adolescents and young adults can experience poor clinical outcomes such as life-threatening exacerbations of asthma and anaphylaxis[14].

Developmentally appropriate health care is recommended to support young people and in the biopsychosocial changes that take place at this time to allow them to learn progressively in managing a chronic illness[15]. The period from adolescence to young adulthood offers a great opportunity, in additional to the challenges, for education, motivated by a desire for personal independence. Self-management skills learnt at this age can support the patient throughout adulthood. Adolescents and young people need a form of adaptive health care that is different from the one children and adults receive[16]. To achieve this, it is necessary to identify and understand challenges faced by this age group, so that our clinical practice can be modified to address these. The European Academy of Allergy and Clinical Immunology Task Force on Allergic Diseases in Adolescents and Young Adults has undertaken this systematic review to examine literature on challenges and specific needs of adolescents and young adults with allergic conditions, including asthma. It was anticipated that many of the papers would not differentiate between related allergic- and non-allergic manifestations (e.g. allergic and non-allergic

asthma). Similarly, while the term AD is widely used, papers describing eczema were also included. This and a related systematic review focused on specific strategies to improve the self-management in this age group[17] will underpin and shape a guideline to support the management of adolescents and young adults with allergic conditions.

METHODS

The protocol for this systematic review was registered in Prospero (CRD42018104868). Reporting was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Appendix 1).

Search strategy

This was designed to retrieve articles about challenges faced by adolescents with allergic disease including asthma. The search strategy was developed on OVID MEDLINE (Appendix 2) and then adapted for other databases. The following databases were searched: Cochrane Database of Systematic Reviews, MEDLINE (OVID), Embase (OVID), Psychinfo, Clinicaltrials.gov, Clinical Trials Register (www.clinicaltrialsregister.eu), current controlled trials (www.controlled-trials.com) and the Australian and New Zealand Clinical Trials Registry (http://www.anzctr.org.au). Databases were searched from inception to March 30, 2018. An updated search was run on February 10, 2019. Additional references were identified by searching the references cited in the primary studies and through discussion with experts in the field.

Inclusion criteria

Studies conducted on adolescent or young adult (11-25 years) patients with allergic conditions (asthma, food allergy, anaphylaxis, allergic rhinoconjunctivitis, AD, chronic urticaria and/or angioedema, allergic gastrointestinal conditions, insect venom allergy, complex multisystem allergic conditions) were included. Study designs included case series, cohort studies, case-control studies, controlled trials and qualitative studies. Study outcomes included the challenges and specific needs of adolescents and young adults with allergic conditions including measures of self-management and wellbeing.

Exclusion criteria

The following were excluded: abstracts, reviews, discussion papers, non-research letters, editorials and animal experiments plus studies where results from other age groups were presented together with no subgroup analyses.

Study selection

All references were de-duplicated in Ovid before being uploaded into the systematic review software Rayyan. Study titles were independently checked by two reviewers according to the above selection criteria and categorized as: included, not included or unsure. Any discrepancies were resolved through discussion and, if necessary, a third reviewer (GR) was consulted. Full text copies of potentially relevant studies were examined by two reviewers for eligibility, with discrepancies again resolved through discussion involving if necessary, a third reviewer (GR).

Quality assessment strategy

Quality assessments were independently carried out on each study by two reviewers using the relevant Critical Appraisal Skills Programme (CASP) quality assessment tool[18] or the Mixed Methods Appraisal Tool for cross-sectional studies[19]. Any discrepancies were resolved by discussion or a third reviewer (GR).

Data extraction, analysis and synthesis

Data were independently extracted onto a customized data extraction sheet by two reviewers, and any discrepancies were resolved by discussion or by a third reviewer (GR). A descriptive synopsis with data tables was produced to summarize the literature. Given that a significant minority of the data was qualitative in nature, a meta-synthesis approach was undertaken using the objective framework described above with an interpretation of the original insights to deliver a narrative synthesis[20].

RESULTS

A total of 108 papers describing 106 studies were included in the systematic review (Figure 1); a substantial minority were qualitative studies (20). Most were from USA (50), others from the Netherlands (12), Sweden, (11), UK (11), other European countries (8), Asia (8) and Australia (3) (Figure S1). The main focus was on asthma (69), food allergy (19) or multi-system allergic conditions (9) (Figure S2). The quality of the evidence was reasonable (only 4 high and 20 intermediate risk of bias studies).

Five themes were identified across studies in the systematic review: (1) Health-related quality of life; (2) Psychological factors; (3) Adherence; (4) Self-management; and (5) Supportive relationships.

Quality of life

A number of survey-based studies assessed the impact of allergic conditions, mainly asthma, on health-related quality of life (HRQL), using either generic[21-24] or condition specific[25-30] questionnaires (Table 1).

Asthma

Risk factors associated with impaired quality of life (Table 2). Symptomatic asthma was associated with worse self-rated health, impaired physical and mental health in a USA population-based study[21]. A number of asthma associated factors were linked with impaired HRQL in adolescents with asthma including asthma severity[26,29], poor disease control[23,25-28,30] or exacerbations[27]. Other factors associated with impaired HRQL were female gender[23,25,27-29], onset in adolescence[23,31], poor adherence[29,30], lack of physical activity[23], smoking[21,23], maternal smoking, single parent in the household and co-existing AD[23].

Mental health and psychological issues play a major role in HRQL. A population-based study assessing the impact of allergic conditions in HRQL[22] found that most of the variation in HRQL was explained by mental health. However, in this study the independent effect of AD and rhinitis on HRQL remained after adjustments for mental health. Specifically, behavioural and emotional disorders[25], including depression[27] were associated with impaired HRLQ with asthma.

Protective factors associated with better quality of life. A number of factors were found to be associated with better HRQL in individuals with asthma including better overall health[27], regular exercise in females[29], growing older as an adolescent/young adult[29,30] and specific psychological aspects such as trait mindfulness (through better control of asthma-specific stress)[32], extroversion, agreeableness and low neuroticism/anxiety, possibly through its impact on coping strategies and symptoms reporting[33].

Rhinitis

A population-based study in Thailand[24] showed that rhinitis was associated with reduced generic HRQL, especially for emotional functioning.

Atopic dermatitis

In a Swedish observational, birth cohort study[34] and in a German national cohort[22], AD-specific HRQL was impaired in both males and females; the impact was greater in females and in those with moderate/severe AD[34]. Females with AD also had lower self-perceived health than females without AD[34]. A study on adolescents aged 11-16 with AD from a tertiary dermatology clinic in Singapore also found a greater HRQL impairment with increasing AD severity[35]. The domains most frequently impacted were disruption of physical activities, constant itch and soreness, and interference with sleep.

Food allergy

A Swedish observational, clinic-based study assessing condition-specific HRQL in adolescents aged 13-17 with milk, egg or wheat allergy found that allergen avoidance and lifestyle restrictions affected the adolescents more adversely than the risk of accidental exposure[36]. Food allergy had a higher adverse emotional impact in females than males.

Insect venom allergy

One Polish observational clinic-based study, assessing condition-specific HRQL in adolescents and young adults aged 14-21 undergoing allergen immunotherapy for venom allergy, found that the reaction severity was an independent predictor of the anxiety subscale of the quality of life questionnaire[37]. Anxiety correlated with caution and caution correlated with limitations and hypervigilance for bees/wasps.

Multiple allergic conditions

A population-based, observational study in Thailand assessing the impact of asthma and rhinitis on generic HRQL showed that having both asthma and rhinitis had a detrimental and summative impact with significantly lower HRQL scores in all domains[24]. The impact of asthma was greater than that of rhinitis, especially on psychosocial health. Similarly, lower HRQL in asthmatic adolescents was associated with having current atopic dermatitis[28]. A population-based, observational study in Germany assessing the impact of asthma, AD and rhinitis on generic HRQL showed a significant linear correlation between the number of conditions within the previous year and worsening HRQL after controlling for potential confounders[22]. However, a Swedish study in asthmatic adolescents did not replicate this finding[38].

Psychological factors at the individual level

Most papers focused on asthma, with a minority investigating AD and food allergy (Table 3). Most investigators used quantitative, cross-sectional designs and validated questionnaires.

Mood disorders

A study from the USA found a relationship between self-reported social anxiety and asthma in a community sample of adolescents, which was attributed to concerns about exhibiting symptoms or taking medication with peers present[39]. A later study focused on ethnic minorities and asthma[40]; increasing anxiety was found to be associated with taking more preventive steps to prevent asthma exacerbations. Three groups[41-43] found that self-reported asthma was associated with internalizing disorders (e.g. depression and anxiety) in USA minority adolescents.

Adolescents with asthma, from primary and secondary care, were found to have experienced symptoms of anxiety with higher anxiety associated with poorly controlled asthma[44,45]. Illness perceptions mediated

the relationship between anxiety and asthma symptoms. An association was found between greater anxiety symptoms and perceptions that asthma negatively impacted one's life and emotions and was difficult to control. The association was bi-directional in that negative illness perceptions were, in turn, related to more asthma symptoms.

The relationship of suicidal ideation, mental health problems, and social functioning with AD has been assessed in a community sample[46]. Among those with current AD, 15.5% reported suicidal ideation compared with 9.1% among those without AD. In a subgroup analysis, the prevalence of suicidal ideation in those with both AD and itch was 23.8%. AD was also found to be significantly associated with mood disorders[46]. Relationships between AD, mood disorders and suicidal ideation were also demonstrated in subsequent Korean based AD and asthma studies[47-50]. Psychological distress was shown to increase with severity[48].

Food allergy has been found to be associated with higher internalising (e.g. depression, anxiety) but lower externalising (e.g. aggressive behaviour) problems, in adolescents and young adults with food allergy from a tertiary allergy clinic compared to community controls without food allergy[51]. In a birth cohort, significant associations were seen between food allergy and maternal but not adolescent, reported emotional and behavioural problems[52].

Stress and coping

Psychological stressors were found to predict asthma symptoms in a small study of Hispanic adolescents[53]. Being outdoors and experiencing disagreements with parents, or teasing and arguing were associated with more severe self-reported asthma symptoms in the following few hours. With regard to the impact of stress and conflict in peer and family interactions, peer conflict has been strongly associated with self-reported asthma symptoms[54,55]. Furthermore, daily reports of negative caregiver-youth interactions uniquely predicted asthma symptoms.

Gender

It is reported that females with AD have greater depressive moods and poorer sleep than males, and are more likely to overestimate their body weight[50]. Additionally, males with AD are less likely to have romantic relationships than females[46]. Furthermore, social anxiety has been reported to be higher in boys with food allergy[56]. Social anxiety was correlated with parental worry and level of control.

Age and development

Anxiety relating to asthma has been shown to be more prevalent in adolescents compared to young adults and was also associated with higher anxiety scores in parents in a birth cohort[4].

Personality and co-morbidity

Type D (Distressed) personality has been found to be associated with poorer treatment adherence in asthma[57]. This personality type accords with the traits discussed above (including worry and anxiety). Co-existing asthma and allergic rhinitis were found to be associated with higher levels of anxiety[58].

Protective factors

Parental emotional support was a protective factor in asthma, leading to a lower likelihood of mental health problems, and perceptions of more treatment control and fewer concerns predicted fewer emotional problems over time[59]. Emotional support from family and friends slightly reduced the impact of stress from new asthma in adolescents and young adults[60].

Adherence

Adherence to treatment has been found to be suboptimal in adolescence[61]. Most available data has focused on asthma (Table 4), generally suggesting figures of adherence of below 50%[61,62] (Table 4). Methods employed to assess asthma treatment adherence range from asthma diaries[63] to structured questionnaires[62].

Asthma

A number of studies have used a qualitative approach (interviews, focus groups or one-to-one) to understand adherence in asthma[64-67], whilst others used questionnaires[62,65,68-75].

Factors that were associated with poor adherence in young adults with asthma were (Table 5) older age, barriers to medication usage, poor symptom perception, psychological factors and not taking responsibility. Barriers to using medications included hurrying, forgetfulness, competing demands related to school preparedness, social priorities and accessibility of medication at school[64-66,74,75]. Other factors linked to poor adherence were misinformation, incorrect assumptions about asthma, busy schedules, family crises[67] and lack of perceived need or beneficial effects of asthma medication[65]. Overreliance on quick relief medications, such as short acting bronchodilators, was associated with reduced adherence to preventers[63]. Negative asthma symptoms perception, certain personality traits (e.g. impulsivity[68]), and lack of regulation of emotions and behaviour were linked with poor adherence[63,66]. Young Americans with African heritage tended to downplay or normalize asthma symptoms by expressing neutral to positive feelings[69]. Older adolescents in the US with Puerto Rican or African heritage[69,70] had poorer adherence

and were less likely to seek help. Perception of caregivers as having more responsibility was linked to poorer adherence in Americans with African heritage[69].

Factors associated with better adherence in asthma were routines[64,70], better perception of self-management ability (i.e. better self-efficacy)[74], combined rather than multiple inhalers[68] and improved knowledge and perceptions about medications[73,76]. Many adolescents associated daily medication use with fewer asthma symptoms, which incentivized adherence[64,76]. Support from peers[65], school nurse[64] or smartphone apps[65] have been proposed to improve adherence. Good communication with healthcare professionals, assessing health beliefs according to age[66] and transferring responsibility gradually from early adolescence[69] were seen by the young patients as crucial to improve adherence.

Atopic dermatitis

In a Dutch qualitative study many adolescents and young adults with AD did not completely adhere to treatment and instead had developed their own routine of topical corticosteroids, emollients and moisturizers[77]. The authors found that many had incorrect beliefs about the mechanisms of action.

Food allergy

Four papers investigated adherence to carrying/using adrenaline auto-injectors in food allergy[71,72,78,79]. One observational study found that perception of 'burden-of-treatment', measured with a validated questionnaire, was significantly related to adherence with carrying the auto-injector[79]. However, no relationship existed with quality-of-life assessments. The second study used a qualitative approach to explore factors affecting auto-injector carriage /use in adolescents with food and venom allergy[78]. Adolescents usually made complex risk assessments to determine whether or not to carry their auto-injector and most decisions were found to be rational and at least partially informed by knowledge. The authors found that location, environment, attitudes of others, physical features of the auto-injector and the hassles of carrying it had most influence on carrying-adherence although they generally wanted to remain safe. Personalized education packages were suggested to empower adolescent allergic patients to make and act upon informed risk assessments. Membership of a patient support group and having an anaphylaxis management plan were found to be associated with adherence[71,72]. The authors suggested that addressing adolescents' perceptions of the severity of anaphylaxis and reducing barriers to condition management may improve adherence.

Self-management

Self-management behaviours in adolescents have been found to be influenced by intra-personal and interpersonal factors. Intrapersonal factors include condition knowledge and beliefs, cognitive characteristics, education level, attitudes, personal outcomes and emotional burden of treatment (Table 6). Interpersonal factors refer to social relationships and communication processes with family, peers and health care providers[80-82].

Knowledge and beliefs

A lack of knowledge about symptoms, triggers and treatments represented one of the main barriers to self-management among adolescents with both asthma and food allergy (Table 5). Adolescents felt the need to be able to identify, prevent and manage severe symptoms especially anaphylaxis[83,84]. Incorrect health beliefs about indications and use of therapeutic devices, overestimation of symptoms control, low perception of disease severity and risk involved in exposure to triggers were reported as further barriers to self-management choices for asthma and food allergy[12,13,81,82,85-88].

To counteract these barriers, education and knowledge were seen as facilitators to adolescents' ability to "assess, decide and respond" to their conditions[81,82,89,90]. Poor health literacy has been associated with uncontrolled disease in adolescents[91,92]. Adolescents with a greater understanding of their condition, a greater perception of the consequences of the condition and those attending an asthma education program demonstrated better asthma self-management[93]. For those at risk of anaphylaxis, maintaining the balance between taking the risk seriously and not allowing the risk to dominate their lives was reported to be difficult[83,84,94,95]. Thus, risk-taking behaviours were less common in adolescents with an established education plan for their food allergy[96].

Motivation and self-efficacy

Adolescents with asthma and food allergy demonstrated variability in self-advocacy behaviours. Many adolescents did not take responsibility for the regular use of asthma medications or interacting with health care professionals, instead relying on their parents[81,86,97]. In one qualitative study, adolescents with food allergy said that they often carried their auto-injectable adrenaline only when they thought they were particularly at risk of a reaction[12]. Self-efficacy (perception that one can undertake a behaviour) was a key component of self-management[80,81,89]. Increased asthma knowledge and positive attitudes toward the condition lead to higher self-efficacy, which in turn lessened barrier perception in self-management[89]. Adolescents with food allergy who reported greater responsibility and empathy were also less likely to engage in risk-taking behaviours[96].

Emotional burdens

Most adolescents, especially those with asthma or food allergy since early childhood, recognised and reported the burden of accepting the condition and the need for continuous care. The inconvenience of using and carrying asthma medication devices, and the embarrassment about having the condition or using treatments, often resulted in denial or normalisation of symptoms, intentional non-adherence to medications and negativity toward healthcare providers[80,81,85,86,89,97,98]. Despite not being commonly recognised by healthcare providers, adolescents with asthma also felt anxious and fearful[80,81]; some withdrew from exercise due to fear of an asthma attack[99] or used smoking as a coping strategy to decrease stress[88]. Similarly, adolescents living with food allergy described the burden of coping with continued allergen avoidance and the increased responsibility in assessment of what constituted an acceptable risk, which resulted in varying levels of stress and precaution-taking[12,13]. This transfer of greater responsibility for food allergy caused anxiety in some adolescents, especially in those with a history of life-threatening allergic reaction[100]. In a qualitative study adolescents reported that fear of reactions persisted even after the resolution of food allergy was demonstrated with a negative oral challenge[101]. Adolescents reported a desire for better food labelling to lessen the stress of trying to establish which food was safe[12].

Supportive relationships

Families

Asthma, allergy and the risk of anaphylaxis have been shown to affect not only the young person but also all family members[84,94,95,102,103] (Table 7). However, adolescents often do not report asthma symptoms to caregivers[82].

Studies comparing perspectives from adolescents with asthma or food allergy, their caregivers and healthcare providers showed that communication, supportive environments and family support are important facilitators of self-management[80-82,86,89], asthma control[103,104] and better quality of life[84,95,103]. Family support was also found to modify barriers to adherence, ultimately leading to improvement in management and outcomes[103]. Adolescents also needed help with transition to self-care, balancing restrictions with safety, social isolation, and loneliness. Families supported this through effective negotiation and communication, fostering positive views about self-management and treatment[83,84,95,102,103].

An unsupportive family atmosphere (without good communication, supervision and division of responsibility) may make it difficult for adolescents to adhere to daily asthma, allergy or anaphylaxis

management [83,94,95,103]. Divergent perceptions on management within adolescent-caregiver pairs about management have been associated with suboptimal management[84,95,103].

Friends, peers and school

Although parents provide an important source of support, adolescents expressed a desire for support from friends and peers[83,84,95,103,105]. Adolescents suggested that supportive online networks, facilitated by older adolescent peers and health professionals to share information, experience, advice and encouragement, might be helpful[95].

Adolescents reported feeling embarrassed for being perceived as different from their peers due to having asthma, food allergy or experiencing anaphylaxis[12,80,81,98]. This could lead to social isolation and loneliness due to lack of understanding from their social network[83,94,95,106,107]. Unfortunately, many adolescents and young adults with asthma and food allergy reported experiencing bullying, usually in the school environment[106,108]. Social relations with new family members or friends could be challenged by lack of knowledge about the potential severity of asthma or allergy[84,94,95,107]. Therefore, knowledge needs to be transferred to new friends and new social contexts.

Adolescents wanted to be like their peers[12,80,81,98]. Peer influence might lead to participation in risk-taking behaviours. Adolescents with asthma sometimes made decisions about self-treatment according to personally relevant outcomes, which included perceived benefits, accessibility of treatment and the social risk of having to leave their peer group[82,85]. Increased knowledge of peers and teachers about asthma and food allergy was another recognized facilitator of self-management in adolescents[12,81,96]. Furthermore, in adolescents with asthma, replacement of activities with more inclusive sports that are less likely to trigger symptoms could facilitate better experience and promote exercise[99].

Healthcare professionals

Both parents and adolescents expected healthcare providers to be both competent and understanding, addressing beliefs, perceptions of illness and knowledge as part of the consultation[80,81,98]. Adolescents with asthma and food allergy reported valuing the need for exploration of knowledge and information about self-management in a non-judgemental healthcare environment[12,81,96].

Support with transition

Most adolescents wanted to take an active role in managing their asthma and allergies and parents tried to encourage this[83,94,95]. Caregivers seemed to be unaware of gaps in their adolescents' food allergy management[100] and expressed difficulties with their child's transition to independence and their

subsequent loss of control[109]. Readiness for transition was associated with greater perceived medication independence but this was not associated with improved responsibility or medication adherence in the young person[110]. Successful transition required systematic support, developmentally appropriate and adaptive health care from health care professionals[84,94,95,111].

DISCUSSION

This review was undertaken to provide an understanding of the gaps in the healthcare of adolescents and young adults with allergies and asthma. A meta-synthesis of the data across all study types showed that allergic conditions have a negative impact on adolescents and young adults' quality of life, with a stronger adverse burden reported by females with co-existent AD, rhinitis and/or asthma having a cumulative effect. Impaired quality of life in adolescents with asthma is associated with mental health issues, poor control, smoking, lack of adherence and adolescent onset. Asthma and food allergy are both associated with anxiety and depression; AD is associated with suicidal ideation. Suboptimal adherence is associated with older age, barriers to medication usage such as forgetfulness, competing demands, social priorities, misinformation and lack of perceived need, poor symptom perception and failure to take responsibility; positive factors are routines, simpler treatment regimes, better knowledge and perceptions about medications. Parental emotional support is protective for asthma. A supportive social environment, including family, peers and healthcare providers, with good communication and knowledge can facilitate self-management in adolescents with asthma and allergic conditions. This is summarised in Figure 2.

Although we found over 100 studies, there was very limited evidence in most allergic conditions, other than asthma. The vast majority of studies were observational in nature. Many were qualitative, useful for generating hypotheses and understanding potential reasons for specific behaviours. Others were quantitative but cross-sectional, providing evidence of association but not causality. Longitudinal studies focusing on describing temporal relationships would provide better evidence for potential causation. These are the data needed to inform the design of future interventional studies to improve the experience of adolescents and young adults with asthma and allergies.

The published HRQL studies were often suboptimal regarding small sample size[42,53,54,77,112] or lacking objective condition definitions[4,39,49,52,55,56] and/or outcomes[46,47,52]. More data are required for HRQL with allergic conditions other than asthma and particularly in those with more than one condition. Multi-system allergy is a very common occurrence and might have a synergistically detrimental impact on

HRQL[22,24,28,58]. There are no data on HRQL in chronic urticaria, angioedema and anaphylaxis in adolescents and young adults. A better understanding is required of the complex interplay of key factors potentially impacting on HRQL, such as mental health (e.g. depression, anxiety), psychosocial problems, adherence, symptoms perception and reporting (and therefore reported disease control) and coping strategies, within a longitudinal framework (Table 2, Figure 2). There are similar issues for the studies looking at other psychological outcomes. Additionally, it is important that protective as well as risk factors (and their mediators/modifiers) are investigated[11].

Adherence in asthma has been linked to demographic, social and psychological factors, as well as to condition knowledge, peer support and routines at home and in school. Studies investigating adherence outside of asthma are scarce. They are impeded by poor assessment of adherence. Many of these studies, including those in asthma patients, have been undertaken in very specific populations leading to questions about generalisability. This is reflected in the self-management literature which is equally poor outside asthma. For example, while we now have a self-efficacy assessment tool for asthma[113], and for parents of children with food allergy[114], these are lacking for other allergic conditions. Such tools might help the assessment of adolescent and young adults to self-manage in the future. There is a need to gather information on how to best achieve a successful transition of management responsibilities from caregivers to patients and from paediatrician to adult physicians[9]. There is also a need to better define facilitators for self-management of food allergy.

The literature shows that both adolescents and young adults and their parents agree that the transition to adulthood is very important but they also find it extremely challenging. There is therefore a need to understand both adolescents' and their parents' perspectives on how to best achieve a successful transition, including clarifying their needs and expectations regarding the health care system[89,94,102]. The adolescents' call for supportive networks facilitated by older adolescents and peers to improve self-management needs to be investigated[95].

Recent policy reports emphasise the benefits of self-management and integrated care in health systems[115,116]; this systematic review on adolescents and young adults aligns with these themes and highlights the core ingredients to healthcare commissioners and policy makers. To create a sustainable health system for those with long-term conditions governments are investing in supporting and empowering patient centred care. The 'house of care' describes some key components such as organisational processes, responsive commissioning, engaged patients, health care workers in partnership and personalised care planning[117]. Allergy services for this age group could be arranged around this

framework. This may be assisted by patient activation measures, which are a validated way of assessing patients' understanding of their condition[118].

We have some understanding of the challenges faced by adolescences with asthma, less so with other allergic conditions. This lack of data and the minimal number of longitudinal studies prevent any firm conclusions being made. More studies on the various allergic conditions are required, paying particular attention to the effects of several allergic co-morbidities. The available data do though provide a helpful knowledge base to support the development practice guidelines for managing adolescents and young adults with asthma and allergic conditions.

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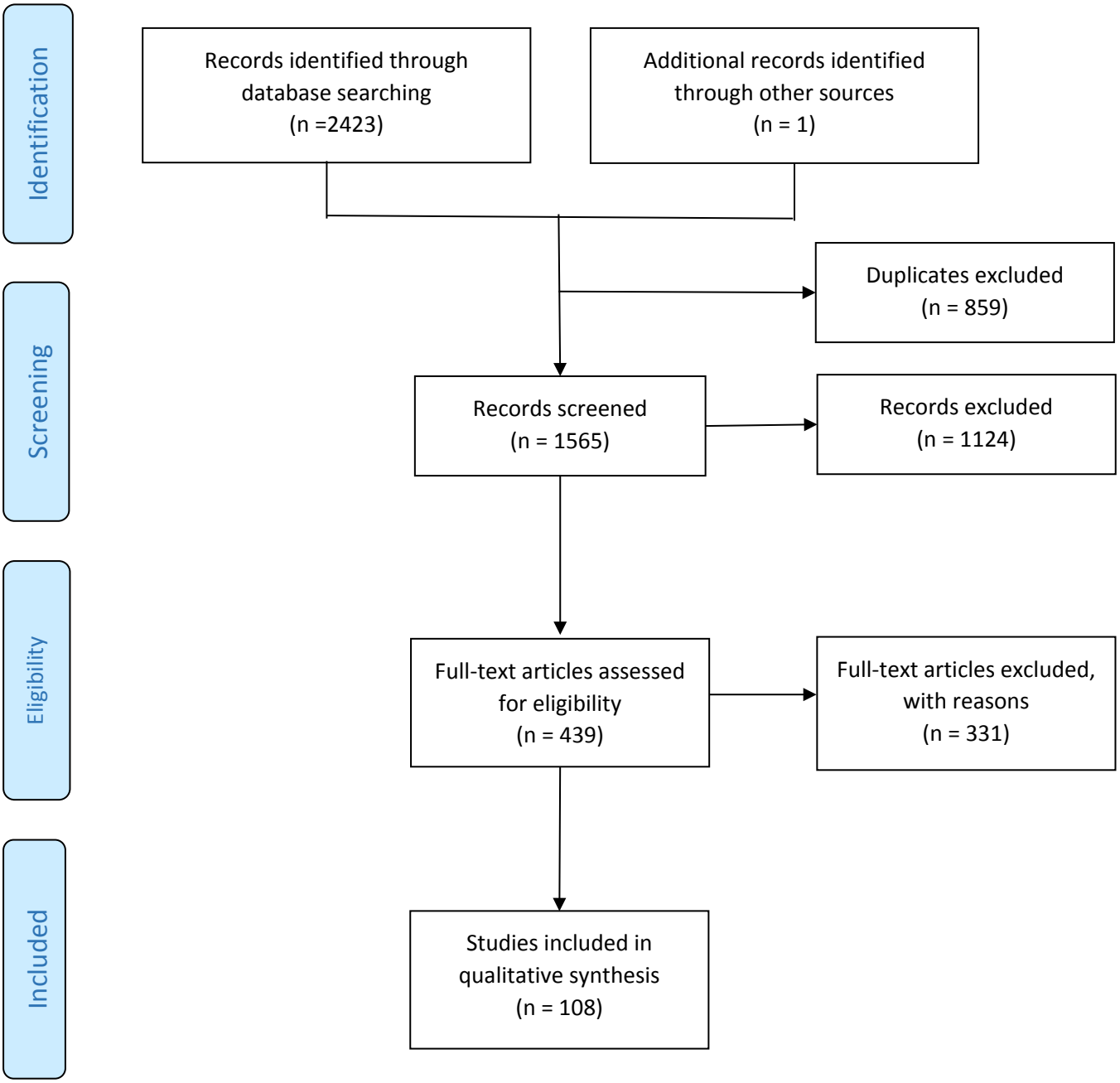
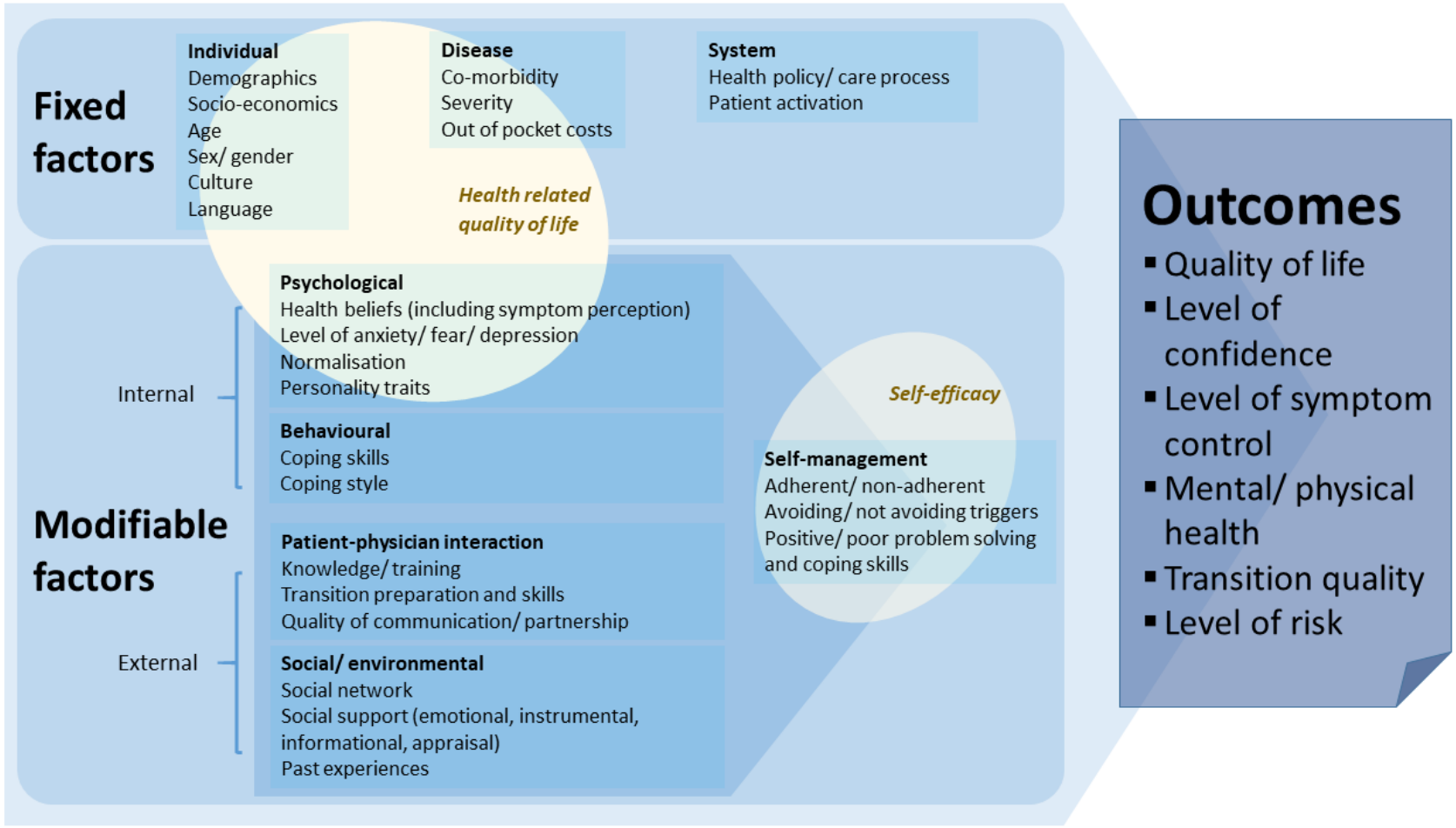
Figure 1. Prisma figure demonstrating literature examined in systematic review



Details of excluded papers can be found in Table S1.

Figure 2. Schematic summary of factors influencing quality of life, self-efficacy and other outcomes



Factors influencing quality of life, self-efficacy (level of confidence) and other outcomes in adolescents with allergies and asthma are divided into fixed and modifiable factors. Pale circles highlight the areas involved in health related quality of life and self-efficacy.

Table 1. Summary of papers focusing on quality of life

Author, year, country	Areas	Condition(s)	Study design	Population, number, and setting	Key results	Risk of bias
Alvim, 2009, Brazil[25]	Quality of life	Asthma	Quantitative cross-sectional questionnaire study	14-15y, N=146, school based, asthmatic adolescents	Asthma quality of life lower in females and with night-time symptoms, emotional and behavioural disorders and more medical visits.	Low
Amaral, 2014, Brazil[26]	Quality of life	Asthma	Quantitative, case series	12-18y, N=114, doctors diagnosed asthma, pneumology clinic	Asthma quality of life lower with lower asthma control, daytime symptoms, night-time symptoms, limitation of physical activities, and the presence of domestic animals.	Low
Ballardini, 2014, Sweden[34]	Quality of life	Atopic dermatitis	Quantitative cross sectional, questionnaire in a population cohort	11-14y, N=2756, BAMSE birth cohort	Atopic dermatitis (doctor diagnosed) quality of life lower in females and in those with moderate/severe atopic dermatitis. Atopic dermatitis associated with impaired self-perceived health in girls, not boys.	Low
Braig 2015, Germany[31]	Quality of life	Asthma	Quantitative cross-sectional questionnaire nested in population	11-14y, N=1541 GABRIELLA birth cohort	Participants with self-reported late-onset wheeze had significantly lower generic health related quality of life compared to never wheezers. Early transient wheezers also	Low

			cohort		had reduced quality of life.	
Burkhart 2009, USA & Iceland[27]	Quality of life, psychology	Asthma	Quantitative case series	13-17y, N=30 doctors diagnosed asthma, asthma clinics in USA and Iceland	Asthma quality of life poorer with female gender, worse overall health, recent severe asthma attack and higher depression symptoms.	High
Cichocka-Jarosz, 2012, Poland[37]	Quality of life	Venom allergy	Quantitative case series	14-21y, N=87, venom immunotherapy clinics	Limitations of activities associated with venom allergy associated with females, and caution. Anxiety lower in older boys than younger boys or girls of any age. Anxiety worse with grade 4 (shock) versus grade 3 reactions.	Low
Cillesen 2017, Netherlands[32]	Quality of life, psychology	Asthma	Quantitative, cross sectional questionnaire study	14-18y, N=268, with daily asthma medication, school based	Trait mindfulness directly related to asthma-related quality of life but not to asthma control. Relationship with quality of life explained by asthma-specific stress. Indirect relationship from mindfulness to asthma control via asthma-specific stress.	Low
Cui, 2015, USA[21]	Quality of life	Asthma	Quantitative cross-sectional questionnaire study	12-17y, N=7063, with and without asthma from 2001–2010 NHANES data	Self-rated health worse with asthma with dry cough or wheezing compared to those without asthma. Currently smoking and limited physical functioning was associated with more ill health. Symptomatic asthma was more likely in those	Intermediate

				set	who were black, non-Hispanic, obese and reported limited physical functioning.	
Hedman, 2017, Sweden[23]	Quality of life	Asthma	Quantitative, cross sectional nested in population cohort	14-15y, N= 2181, from OLIN school cohort	Health related quality of life worse in girls with current asthma than those without asthma (not for boys). Worse quality of life also associated with uncontrolled asthma and adolescent onset of asthma.	Low
Hullmann 2013, USA[119]	Quality of life	Asthma and allergies	Cross sectional survey	Mean age 19.65y, N=74 (allergies), N=74 (asthma), undergraduates	Worse mental health related quality of life associated with higher illness uncertainty in participants with allergies and higher illness intrusiveness in participants with asthma. Worse physical quality of life associated with higher illness uncertainty with asthma and higher illness intrusiveness with allergies and asthma.	Intermediate
Jonsson, 2015, Sweden[38]	Quality of life	Asthma	Quantitative cross-sectional questionnaire nested in population cohort	15-18y, N=2946, BAMSE birth cohort	Quality of life lower with asthma compare to those without it. Partly controlled and uncontrolled asthma associated with poorer quality of life. No difference in quality of life in asthma plus atopic dermatits/rhinitis compared to asthma only.	Low
Matterne 2011, Germany[22]	Quality of life	Atopic dermatitis, asthma, hayfever	Quantitative, cross-sectional questionnaire nested in population cohort	11-17y, N=6518, population based national cohort	Health related quality of life reduced by atopic dermatitis and hay fever compared to those without, but not asthma.	Low

Ng 2018, Singapore[35]	Quality of life	Atopic dermatitis	Quantitative, cross-sectional questionnaire study	11-16y, N=50, mild to severe atopic dermatitis, tertiary paediatric clinic	Atopic dermatitis related quality of life worse in severe compared to mild or moderate patients. Domains most affected: disruption to physical activities, constant skin itch and soreness and interference with sleep.	Low
Protudjer, 2016, Sweden[36]	Quality of life	Food allergy	Quantitative, cross-sectional questionnaire study	13-17y, N=58, diagnosed allergy to staple foods, hospital-based paediatric allergy clinic	Health related quality of life worse with multiple food allergy and prescription of adrenaline autoinjector. Domains of allergen avoidance and dietary restrictions more negatively affected than risk of accidental exposure.	Low
Slattery, 2011, USA[120]	Quality of life, psychology	Atopic dermatitis	Quantitative, cross-sectional study	13-17y, N=36, diagnosed atopic dermatitis, dermatology and paediatric clinics	Increased rate of anxiety disorder in patients with atopic dermatitis compared to published community estimates; not seen for depression. Sleep loss as measure of atopic dermatitis severity associated with depression.	Intermediate
Sritipsukho, 2015, Thailand[24]	Quality of life	Asthma, rhinitis	Quantitative, cross-sectional questionnaire study	12-14y, N=1,440, school based	Asthma and allergic rhinitis (ISAAC based definition) associated with lower quality of life compared to healthy pupils. Co-existing allergic rhinitis and asthma associated with worse quality of life. Asthma alone associated with worse quality of life compared to allergic rhinitis alone.	Low

Stridsman, 2017, Sweden[28]	Quality of life	Asthma	Quantitative, cross-sectional questionnaire nested in population cohort	14-15y, N=247, from OLIN population cohort with current doctor diagnosed asthma	Low health related quality of life associated with female sex, poor control, severe asthma and current atopic dermatitis.	Low
Sundell, 2011, Sweden[29]	Quality of life	Asthma, adherence	Quantitative, prospective, cohort	15-21y, N=156, mild to severe asthma from clinic	Health related quality of life worse in females compared to males at entry, 2 years and 5 years follow up. Quality of life improved over time. Lower quality of life associated with poor adherence.	Low
Tiggelmann, 2015, Netherlands[30]	Quality of life	Asthma, adherence	Quantitative, prospective, cohort study	10-14y, N=139, doctors diagnosed asthma, schools and Netherlands Lung Foundation, 3y follow up	No association between medication adherence and asthma control over time. Baseline asthma related quality of life predicted increase in medication adherence one year later but not changes in asthma control. Medication adherence significantly decreased over time. Asthma control and quality of life positively correlated.	Intermediate
Van de Ven 2011, Netherlands[33]	Quality of life, psychological	Asthma	Quantitative, cross-sectional questionnaire study	12-16y, N=405, school students with asthma	Asthma quality of life better in those with higher scores on extroversion (mediated by the coping strategy restricted lifestyle) and lower scores on neuroticism (fully mediated by the coping strategy worrying about asthma and by symptom	Low

					reporting).	
Wang, 2012, China[121]	Quality of life	Asthma (epilepsy)	Quantitative, cross-sectional questionnaire study	14-18y, N=85 epilepsy, N=81 asthma, N=87 healthy controls, tertiary care clinics	Lower health related quality of life with epilepsy and asthma participants compared to healthy controls. Lower in those with epilepsy than asthma.	Intermediate

Details of quality assessment can be found in Table S2. Further details about the papers can be found in Table S7.

Table 2. Factors associated with quality of life

Risk factors associated with impaired quality of life	Protective factors associated with better quality of life
Symptomatic condition	Better overall health
Female gender	Regular exercise in females
Onset in adolescence	Growing older as an adolescent/young adult
Poor adherence	
Lack of physical activity	
Smoking	
Mental health and psychological issues	

These factors have mostly been associated with impaired or better quality of life with asthma. Less evidence for other allergic conditions. See text for detail.

Table 3. Summary of papers focusing on psychological issues

Author, year, country	Areas	Condition(s)	Study design	Population, number, and setting	Key results	Risk of bias
Ahmadiafshar, 2016, Iran[122]	Psychological	Asthma	Quantitative cross-sectional questionnaire study	13-14y, N=1500, school based	Depression (beck depression inventory) in 61.8% with asthma verses 36% for controls (major depression: 20% verses 7.6%). Association higher in girls. Asthma severity and depression correlated.	Intermediate
Al Ghriwati, 2018, USA[55]	Psychological	Asthma	Quantitative cross-sectional study nested in longitudinal study	11-17y, N=707, fourth annual assessment of CAMP asthma trial	Adolescents from dyads who agree on the presence of elevated symptoms and those with discrepancies where parents reported elevated symptoms had poorer respiratory function and more parent-rated family conflict. Family conflict was higher with elevated parent-reported adolescent internalizing symptoms.	Low
Bruzzese, 2009, USA[39]	Psychological	Asthma	Quantitative, cross-sectional questionnaire study	14-16y, N=765, school based	Social anxiety not associated with asthma (defined by ISAAC questionnaire). Symptomatic asthma associated with higher social anxiety than peers without asthma - feared being viewed negatively by peers. Students with asthma more likely to be in the clinical range of social anxiety.	Low
Bruzzese, 2016, USA[40]	Psychological	Asthma	Quantitative, cross-sectional	11-14y, N=386 urban schools	Non-linear, relationship between asthma-related anxiety and preventive strategies - plateaued with moderate anxiety. Higher	Low

			questionnaire study		anxiety was associated better management. Higher anxiety was associated with better responsibility.	
Dunton, 2016, USA[53]	Psychological	Asthma	Quantitative with cohort observed over 7 days	12-17y, N=20, low-income Hispanic adolescents recruited from school	Experiencing more severe asthma symptoms than average associated rescue inhaler use. Stress from arguing or teasing associated with more severe asthma symptoms in the next few hours. Stress from teasing, arguing and parental disagreements associated with increased shortness of breath over the next few hours.	Intermediate
Ferro, 2016, Australia[52]	Psychology	Food allergy	Quantitative, birth cohort with assessments at 14 and 21 years	14 and 21y, N=1303, MUSP birth cohort participant – those with diagnosis other than food allergy excluded	No association between adolescent reported emotional and behavioural problems and maternal reported food allergy. Maternal-reported clinically significant symptoms of depression, anxiety, ADHD and oppositional defiant disorder higher for adolescents with food allergy.	Low
Ferro, 2016, Australia[4]	Psychology	Asthma and food allergy	Birth cohort with assessments at 14 and 21 years	14 and 21y, N=5171, MUSP birth cohort participants who completed the 14y	Maternal reported asthma associated with clinically relevant symptoms of depression at 14y. Maternal reported food allergy associated with clinically relevant symptoms of anxiety at 14y. Not seen at 21y.	Low

				follow-up		
Fox, 2017, USA[56]	Psychology	Food allergy	Quantitative cross-sectional questionnaire study	10-17y, N=895, urban school setting	No significant differences in anxiety between self-reported food allergic and non-food allergic participants.	Low
Halvorsen, 2014, Norway[46]	Psychological	Atopic dermatitis	Quantitative, cross-sectional, population based questionnaire study	18-19y, N=3775, school based	Significant association between self-reported atopic dermatitis and suicidal ideation. One in six with atopic dermatitis reported mental health problems compared to one in ten in those without. Itch particularly associated with mental health problems.	Low
Han, 2018, South Korea[47]	Psychological	Asthma, atopic dermatitis, allergic rhinitis	Quantitative, cross-sectional, population based questionnaire study	12–18y, N = 237,022, Korea Youth Risk Behavior Web-based Survey	Young people with asthma reported less and poorer sleep, more drug use, more sexual experience, higher levels of moderate/ severe stress, lower health status, lower mood and more suicidal ideation and attempted suicide compared to those without allergy	Low
Kim, 2015, South Korea[48]	Psychological	Atopic dermatitis	Quantitative, cross-sectional, questionnaire based study	19y, N=120,508, male conscripts	Atopic dermatitis associated with depression, anxiety and somatization after adjusting for confounders. Prevalences increased with increasing atopic dermatitis severity.	Low

Kosse, 2018, Netherlands[77]	Psychology	Atopic dermatitis	Qualitative focus group study	12-18y, N=15 community pharmacies	Generally satisfied with treatment but wanted faster and more persistent effects. Most had little contact with their physicians. Most did not completely adhere to treatment regimen developing their own routine of topical corticosteroids, emollients and moisturizers. They had incorrect beliefs about the mechanisms of action.	Low
Lee, 2017, South Korea[49]	Psychology	Atopic dermatitis	Quantitative, cross-sectional population questionnaire study	12-17y, N=75,149, school based Ninth Korean youth risk behaviour survey	Adolescents with self-reported atopic dermatitis more likely to have felt sadness and hopelessness, considered suicide, planned suicide, or attempted suicide.	Low
Lu, 2014, Singapore[45]	Psychology	Asthma	Quantitative, cross-sectional, questionnaire based study	12-19y, N=137 diagnosed asthma, N=171 healthy neighbourhood controls	Young people with asthma had higher levels of depression, panic attacks, total anxiety, and total internalizing symptoms than control. No associations with social phobia nor, separation anxiety. Poorly controlled asthma associated with neuroticism and perceived stress.	Low
Luberto, 2012, USA[123]	Psychology	Asthma	Quantitative, cohort, questionnaire study, reviews 1y apart	12-19y, N=151 urban adolescents from asthma clinic	No significant relationship between complementary medicine use and psychosocial. Depressive symptoms increased over time while anxiety symptoms and psychosocial health related quality of life were stable.	Low

McGrady, 2010, USA[44]	Psychology	Asthma	Quantitative, cross-sectional, questionnaire based study	11-18y, N=151, urban adolescents from a 2-year primary care study	Anxiety associated with more self-reported asthma symptoms. Association partially mediated by illness perceptions - elevated anxiety was associated with feeling that asthma negatively impacted life and emotions and was difficult to control.	Low
Noh, 2016, South Korea[50]	Psychology	Atopic dermatitis	Quantitative, cross-sectional web-based questionnaire study	13-18y, N=74,186, school based using Eighth KYRBS in 2012	Self-reported, doctor diagnosed atopic dermatitis associated with suicidal behaviours and greater depressive moods, stress, and unsatisfactory sleep in girls only. Distorted weight perception was also associated with suicidal behaviours in girls.	Low
Polloni, 2015, Italy[51]	Psychology	Food allergy	Quantitative, cross-sectional, questionnaire based study	11-17y, N=116 food allergy Food Allergy Referral Centre, N=116 community controls	Food allergy associated with internalizing problems and impact on everyday life. Food allergy associated with lower scores for externalizing problems. Previous anaphylaxis associated with internalizing and externalizing scores. Adrenaline prescription negatively associated with internalizing and externalizing problems.	Low
Ramos Olazagasti, 2012, USA and Puerto Rico[41]	Psychology	Asthma	Quantitative, cohort, questionnaire assessments over	10-13y at enrolment, n= 1271 split between New York and Puerto Rico, community	Both persistent and intermittent asthma (defined by ISAAC questionnaire) were related to anxiety and depression in New York (even after adjusting for confounders) but not Puerto Rico.	Intermediate

			3 years	sample		
Shams, 2018, USA[42]	Psychology	Asthma	Quantitative, cohort, questionnaire assessments over 1y	12-21y, N=86, black inner city adolescents with objectively confirmed asthma	Anxiety associated with poorer asthma control, more impaired quality of life, and more insomnia symptoms. Adolescents with probable anxiety disorders more likely to have persistent uncontrolled asthma and emergency department visits.	Intermediate
Shankar, 2018, USA[43]	Psychology	Asthma	Quantitative, cross-sectional questionnaire based study	12-16, N=277, 12 - 16, school based with asthma	Depressive symptoms associated with less symptom-free days. Asthma related quality of life lower in those with depression symptoms.	Low
Slattery, 2011, USA[58]	Psychology	Asthma, allergic rhinitis, atopic dermatitis	Quantitative, questionnaire assessment nested in a birth cohort	Assessments at 7,9,11,13y, N=367, longitudinal study (Wisconsin Study of Families and Work)	Anxiety associated with asthma and allergic rhinitis – stronger association when co-existence. Depressive symptoms not associated with atopic conditions.	Intermediate
Tibosch, 2012, Netherlands[112]	Psychology	Asthma	Quantitative, cross-sectional study	11-16y, N=48, paediatric clinic	Asthma control not associated with age, gender, lung function, exhaled nitric oxide or psychosocial problems. Moderate agreement between adolescents and caregivers about how well asthma was controlled.	High

Tiggelman, 2014, Netherlands[124]	Psychology	Asthma	Quantitative, 1y cohort, questionnaire based study	10-15y, N=261	Better control associated with perceiving more personal control and attributing fewer complaints to asthma. Over time, illness perceptions did not predict changes in asthma control. Perceiving treatment as ineffective and perceiving more concern about asthma predicted increased emotional problems over time.	Low
Tobin, 2015, USA[54]	Psychology	Asthma	Quantitative, cross-sectional questionnaire based pilot study	10-17y, N=81, hospital clinic	Interpersonal conflict and caregiver-youth conflict (4 day electronically activated recorder assessment) strongly associated with asthma symptoms.	Low
van de Ven 2013, Netherlands[57]	Psychology	Asthma	Quantitative, 1y cohort, questionnaire based	11-14y, N=188, asthma clinic	Adherence lower at 1y compared to baseline. Type D personality (negative affectivity, social inhibition) predicted lower adherence at follow up.	Low

Details of quality assessment can be found in Table S3. Further details about the papers can be found in Table S8.

Table 4. Summary of papers focusing on adherence

Author, year, country	Areas	Condition(s)	Study design	Population, number, and setting	Key results	Risk of bias
Axelsson 2009, Sweden[68]	Adherence, quality of life, psychological	Asthma	Quantitative questionnaire	22y, N=268, population study	Better adherence associated with combination inhaler Asthma control not associated with adherence Impulsivity correlated negatively with adherence.	Low
Blaakman 2014, USA[64]	Adherence	Asthma	Qualitative semi-structured interviews	12-15y, N=28, physician diagnosed persistent asthma at school	Adherence associated with routines. Independence with medications helpful as associated with avoiding parental nagging and feeling of responsible/maturity. Many associated daily medication use with fewer asthma symptoms, incentivizing adherence. Poor adherence associated with hurrying and forgetfulness, competing demands related to school preparedness, social priorities, accessibility of medication at school.	Low
Bruzzese 2012, USA[69]	Adherence	Asthma	Cross-sectional questionnaire	11-14y, N=392, Hispanic (n = 187) and African American adolescents with uncontrolled persistent asthma at New York City public middle schools	Asthma self-management suboptimal, worse with increasing age. Less likely to seek help with increasing age	Low
Bruzzese 2014, USA[70]	Adherence	Asthma	Quantitative questionnaire	12-17y, N=168, urban African American from	Better adherence associated with amending family routines to improve routine.	High

				outpatient immunology clinic or after hospital admission		
Jones 2014, Jones 2015 UK[71,72]	Adherence, self-management, psychological	Food allergy	Quantitative questionnaire	13–19y, N=188, prescribed adrenaline autoinjector, Allergy clinic	Good adherence associated with membership of patient support group and having an anaphylaxis management plan Health belief model, particularly perceived severity and barriers, and common sense self-regulation model, particularly illness identity, timeline cyclical beliefs and emotional representations, both partially explain adherence based behaviours. Addressing adolescents' perceptions of the severity of anaphylaxis and reducing barriers to disease management may improve adherence.	Low
Koster 2015, Netherlands[65]	Adherence, self-management	Asthma	Qualitative focus group semi-structured interviews	12-16y, N=21, community pharmacies	Forgetfulness major reason for non-adherence. Lack of perceived need or beneficial effects. Parents involved in reminding to take medication and collecting refills. Young people suggestions for improving adherence: smartphone applications with a reminder, easy access to online information, peer support.	Intermediate
Koster 2015, Netherlands[76]	Adherence	Asthma	Cross-sectional online survey	12-18y, n=182, filled 2 ICS prescriptions in the last year at community pharmacies.	Self-reported ICS adherence only 40%. Adherence associated with knowledge and patients' perceptions about medicines. ICS adherence associated with good control.	Intermediate
Macadam	Adherence, self-	Prescribed	Qualitative semi-	12-18y, N=20, prescribed an	Usually made complex risk assessments to determine whether	Low

2012, UK[78]	management	adrenaline autoinjector	structured interviews	auto-injector, allergy clinic	to carry auto-injector. Most decisions rational and at least partially informed by knowledge. Made frequent risk assessments when deciding whether to carry their auto-injectors and generally wanted to remain safe.	
Martin 2012, USA[62]	Adherence	Asthma	Quantitative, cross-sectional questionnaire study	5-18, N=101 families, 50 with high school child, Puerto Rican heritage with uncontrolled asthma	Significant minority did not have a reliever inhaler Self-reported controller use was higher than actual controller medications visualized in home.	Intermediate
Mosnaim 2014, USA[73]	Adherence	Asthma	Quantitative, cross-sectional questionnaire study	11-16y, N=93, African American or Hispanic, prescribed ICS clinic	Poor adherence associated with older age and low ICS knowledge	Intermediate
Naimi 2009, USA[66]	Adherence	Asthma	Qualitative semi-structured interviews	15-18y, N=40, prescribed fluticasone/salmeterol combination inhaler	Combination inhaler use inconsistent. Adherence not associated with lung function or emergency department visits. Young people believe combination inhaler is ‘‘supposed to help me breathe’’, may feel they are unnecessary, ambivalence about benefits, dislike their taste, are ‘‘too busy’’ and ‘‘forget’’. oung people believe combination inhaler is ‘‘supposed to help me breathe’’, may feel they are unnecessary, ambivalence about benefits, dislike their taste, are ‘‘too busy’’ and ‘‘forget’’. They recommend ‘‘reminder’’ solutions to improve adherence.	Intermediate

Rhee 2014, USA[89]	Adherence, self-management	Asthma	Quantitative diary and audio-recorded symptoms for 24h	13-17y, N=29, uncontrolled asthma from clinic or emergency department outpatient clinics or pediatric emergency	High discordance between adherence according to audio diary and medical records	Low
Rhee 2018, USA[74]	Adherence	Asthma	Quantitative, cross-sectional questionnaire	12-20y, N=373, From clinic, school or community with persistent asthma	Higher self-efficacy associated with lower barrier perceptions and higher outcome expectations. Higher self-efficacy associated with better asthma control and adherence. Barrier perceptions associated with poorer asthma control and adherence. Self-efficacy independently associated with better adherence.	Low
Saleh-Langenberg 2016, Netherlands[79]	Adherence, self-management	Food allergy	Quantitative, cross-sectional questionnaire study	13-17y, N=55, prescribed adrenaline autoinjector, allergy clinic or Dutch food allergy support organizations	Adolescents and parents were extremely positive about adrenaline autoinjector. Burden of treatment greater in those reporting not carrying their adrenaline autoinjector. Burden of treatment not associated with quality of life, illness severity and perception, or trait anxiety, severity and perception, or trait anxiety.	Low
Sleath 2018, USA[75]	Adherence	Asthma	Quantitative, cross-sectional questionnaire study	11-17y, N=359, pediatric primary care practice	Young people reported that hard to remember asthma medication and found it hard to use asthma medication at school. Young children more likely to report difficulty in understanding how to use medication.	Low

Wamboldt 2011, USA[67]	Adherence	Asthma	Qualitative, focus groups	7-16y, N=26 persistent asthma prescribed ICS from school or health maintenance organization	Only some adolescents understood the importance of daily medication and were committed to their treatment plan Poorer adherence associated with misinformation, incorrect assumptions about their asthma and current life situations.	Low

Details of quality assessment can be found in Table S4. Further details about the papers can be found in Table S9.

Table 5. Summary of barrier and facilitators for self-management including adherence

Barrier themes	**Facilitator themes**
Forgetting treatment	Reminders and routines
Burden of treatment *Inconvenience of spacers*	Acceptance of asthma/ allergies and medication
Lack of knowledge *About asthma/ allergies and treatments*	Knowledge *Having the right knowledge in the right format*
Feeling anxiety or panic	Staying calm
Triggers and allergies *Such as pets, people smoking*	Having strategies to avoid triggers
Feeling embarrassed About having asthma/ allergies or using treatments	Confidence and support from friends
Apathy and lack of motivation	Taking responsibility for asthma/ allergy management
Difficult communication with healthcare professionals	Good communication and support from healthcare professionals
Clinic structure and environment *Appointments are time consuming*	Objective feedback and consultations without parents *Measures such as spirometry*
Lack of understanding from school	Supportive school staff

Modified from Holley *et al*.[81]

Table 6. Summary of papers focusing on self-management

Author, year, country	Areas	Condition (s)	Study design	Population, number, and setting	Key results	Risk of bias
Annunziato, 2015, USA[100]	Self-management	Food allergy	Quantitative, cross-sectional questionnaire based study	8-17y, N=59 adolescents, clinic	Caregiver and patient report of self-management was inconsistent. History of a life-threatening allergic reaction among adolescents, was associated with greater anxiety.	Low
Bae, 2015, USA[125]	Self-management	Asthma	Quantitative analysis nested in national cohort	13-18, 18-26, 24-32y assessments, N=12,244, National Longitudinal Study of Adolescent to Adult Health	Regardless of self-reported asthma status, the trajectory means of cigarette use behaviours were found to increase, and then slightly decrease during the transition to adulthood.	Low
Britto, USA, 2011[87]	Self-management	Asthma	Quantitative, cross sectional questionnaire	12-22y, N=201 primary care clinic	Most overestimated their impairment-related control. Confidence was independently associated with control.	Low

			based study			
Chisolm, USA, 2011[90]	Self-management	Asthma (diabetes)	Quantitative, cross sectional questionnaire based study	13-18y, N=89 asthma, N=91 diabetes, clinic	Almost all participants had adequate health literacy and more than half had previously searched online for health information. Being >15 y was the only predictor of health information search. Young people with lower and higher health literacy searched online equally; higher health literacy and stronger perceived usefulness were associated with greater intent for regular use.	Intermediate
Crowder, 2015, USA[93]	Self-management	Asthma	Quantitative, cross-sectional questionnaire based	14-16y, N=133, African American, who had received asthma treatment in past year	Asthma self-management expertise associated with: attending an asthma education program, perceiving more consequences of their asthma, reporting greater understanding of asthma as an illness.	Low
Edgecombe, 2010, UK[97]	Self-management	Asthma	Qualitative semi-structured interview study	11-18y, N=22, uncontrolled severe asthma from respiratory clinic	Most adolescents did not take their inhaled medication; many did not use their spacer device. Most adolescents did not take responsibility for their asthma nor for interacting with health professionals relying instead on their parents.	Low
Flokstra-de Blok, 2011,	Self-	Food	Qualitative interview	11-20y, N=120,	Less than a tenth of young people with food allergy had an adrenaline	Intermediate

Netherlands [126]	management	allergy	study	school based	autoinjector.	
Frey, 2018, USA[127]	Self-management	Asthma	Quantitative cross-sectional questionnaire based study	12-15y, N136, physician diagnosed persistent asthma from clinic	More caregivers than young people identified medications. No difference between caregivers and young people in the ability to state correct indications for use. More young people than caregivers endorsed "full teen responsibility" for medication. Medication responsibility is not associated with knowledge about inhaled therapies.	Low
Gibson-Scipio, 2015, USA[86]	Self-management	Asthma	Qualitative, focus group study	14-18y, N=13 urban African American adolescents with asthma from schools and clinics	Four core themes were identified: medication self-management, social support, independence verses interdependence and self-advocacy. Medication self-management included subthemes of rescue medications, controller medications and medication avoidance. The social support theme included three subthemes: peer support, caregiver support and healthcare provider support.	Low
Holley, 2018, UK[81]	Self-management	Asthma	Qualitative, semi-structured focus group and interview	12-18y, N=28 adolescents with asthma, N= 12 parents, N=14 healthcare	Adolescents, their parents and their healthcare professionals. Highlighted very similar barriers and facilitators to self-management. Barriers are mirrored by facilitators to self-management.	Low

			study	professionals		
Jones, 2019, USA[110]	Self-management		Quantitative, cross-sectional questionnaire based study	12-16y, N=251, school based	Third were classified as "Ready" according to transition readiness assessment questionnaire. Readiness for talking with healthcare professionals associated with greater perceived medication independence. Readiness was not associated with increased young person responsibility or adherence to medication. Adherence among young people using controller medications was low (<50%).	Low
Jonsson, 2014, Sweden[98]	Self-management	Asthma	Qualitative focus group study	13-18y, N=9 young people with doctor diagnosed asthma on daily ICS and parents	Three themes relevant to the participants' experiences of living with asthma were presented: strategies, frustrations and expectations. Adolescents wanted to be like their peers and developed their own strategies for self-management of asthma, which included not always taking medication as prescribed. Parents emphasized frustration regarding not being believed, lack of understanding feelings of loneliness, or anxiety. Parents and young people expected to be met by competent and understanding health care professionals.	Low
Jordan, 2018, USA[92]	Self-management	Asthma	Quantitative, cross-sectional questionnaire based study	14-18y, N=243, young people with asthma and parents	Half of adolescents and caregivers had below their expected level of health literacy - African Americans reporting lower scores. Limited agreement between adolescent and caregiver health literacy suggesting that students are not predominantly acquiring health literacy from their parents/caregivers.	Low
Mackenzie, 2010, UK[13]	Self-management, psychological	Food allergy	Qualitative semi-structured interview	13-18y, N=21, food hypersensitivity	Four main themes. Young people described living with (or coming to know) food allergy as a way of life but still found it burdensome. Necessary part of living with food allergy was coping with associated burden; a variety of coping strategies were employed. Young people described ways in which the burden of living with	Low

			study	from clinic	food hypersensitivity was alleviated or exacerbated by others. Management of food allergy was based on an assessment of acceptable risk resulting in varying levels of precaution taking	
Mammen, 2018, Mammen, 2017, USA[82,85]	Self-management	Asthma	Qualitative semi-structured interview study	13-17y, N=14, adolescents with asthma and parents	Operational definition and conceptual model of asthma self-management. Self-management was defined as the iterative process of assessing, deciding, and responding to specific situations in order to achieve personally important outcomes. Self-management processes were reciprocally influenced by intrapersonal factors (both cognitive and physical), interpersonal factors (family, social and physical environments), and personally relevant asthma and non-asthma outcomes. Perceptions and experiences underlying self-management and reporting of symptoms. Young people thought of their asthma symptoms as normal or unusual relative to their personal baseline symptom pattern. Young peoples' decisions to treat symptoms of asthma with rescue medication were based on perceived benefits, burdens and accessibility of treatment balanced against perceived normalcy of symptoms. Young people never reported perceived normal symptoms of asthma to parents or providers, who were thus only aware of unusual or visible/audible symptoms. Young people with uncontrolled asthma normalized higher levels of asthma symptoms, substantially higher treatment thresholds and delayed responses to symptoms compared to controlled peers.	Low
Monks,	Self-	Food	Qualitative	11-18y, N=18,	Three key themes emerged: avoidance of allergens, preparation for reactions and	Low

2010, UK[12]	management	allergy	semi-structure interview study	peanut or tree nuts allergy from clinic	the treatment of reactions. Majority of young people reported eating foods labelled as 'may contain' an allergen as they perceive that they are actually very unlikely to contain an allergen. Many of the young people only carried their auto-injectable adrenaline when they thought they are particularly at risk of a reaction. Some do not know how to appropriately treat an allergic reaction. Majority believed that educating other students at school about the seriousness of food allergies would make it easier to live with their food allergy.	
Rhee, 2009, USA[89]	Self-management, psychological	Asthma	Quantitative, cross-sectional questionnaire based study	13-20y, N=126, self-reported asthma from clinic, school, community	Most frequently barrier was adolescents' unwillingness to give up ''the things the doctors say I have to give up,'' followed by difficulty in remembering to take care of their asthma, and then ''trying to forget'' that they have asthma. Psychosocial factors (including knowledge, attitudes and self-efficacy) were powerful predictors of barriers to self-management in adolescents. Self-efficacy was found to be the most influential factor with strong negative associations barrier. Poor attitudes toward asthma were also associated with barriers of cognitive difficulty and social influence after adjusting for other factors. Males consistently reported higher total barriers and barriers of negativity, social influence and denial.	Low
Scal, 2008, USA[128]	Self-management	Asthma	Quantitative, cross-sectional study using	12-24y, N=2372, self-reported asthma using National Health	Young adults with asthma have rates of delay in receiving care and unmet needs for care because of financial barriers compared to adolescents. Young adults with asthma more likely to lack health insurance or a usual source of care than adolescents. Moving into adulthood, independent of insurance, accounts for some of delays and unmet needs.	Low

				Interview Survey		
Simons, 2012, USA, Canada[129]	Self-management	Anaphylaxis	Quantitative, cross-sectional questionnaire based study	88 healthcare professionals - members of American Academy of Pediatrics Section on Allergy & Immunology	Few allergists expected to begin transferring responsibilities for anaphylaxis recognition and adrenaline auto-injector use to children younger than 9 -11y. Most paediatric allergists expected that by age 12-14y, patients should begin to share responsibilities with adults for anaphylaxis recognition and autoinjector use. Healthcare professionals individualized timing for transferring responsibilities based on medical history and patient readiness factors.	Intermediate
Simons, 2013, US, Canada[109]	Self-management	Anaphylaxis	Cross-sectional survey	319 caregivers of children or adolescents at risk of anaphylaxis returned questionnaires	Caregivers expected to begin gradual transfer of responsibilities at ages 6-8y for anaphylaxis recognition adrenaline auto-injector administration. They individualized timing, depending on the child's history and readiness factors.	High
Strinnholm, 2017,	Self-	Food	Qualitative semi-	14-15y, N=17, recent food	Experiences during the challenge were described in three themes: facing fears in a secure environment, being hesitant but curious about unknown tastes and waiting	Low

Sweden[101]	management	allergy	structured interview study	challenge	for unknown food reactions. Experiences after the challenge were described in two themes: gaining control and freedom and continuing old habits. Negative challenge was not consistently associated with the reintroduction of the challenged food - did not like the taste of the offending food, normal to live life without the foods or fearful of food reactions.	
Valerio, 2016, USA[91]	Self-management	Asthma	Quantitative, cross-sectional questionnaire based study	15-19y, N=181, urban African-American students with self-reported asthma in school	Inadequate health literacy score associated with young students, no Medicaid, at least one hospitalization and lower quality of life. Those lacking confidence in filling out medical forms, needing help reading hospital materials, and having difficulty understanding written information were more likely to not have a rescue inhaler, have an emergency visits or hospitalizations.	Low
van Zundert, 2008, Netherland[130]	Self-management	Asthma	Quantitative, cross-sectional questionnaire based study	14-18y, N=10,265 of which 1,120 smoked, 83 with self-reported asthma, school based	Adolescents with asthma felt more ready to quit than those without asthma. Best friends' smoking seemed more relevant to the thoughts of adolescents with asthma. Nicotine dependence and craving were strongly related to thoughts, and to readiness to quit in all. The relation between craving and readiness to quit, however, was stronger among participants with asthma.	Low
Vazquez-	Self-	Asthma	Quantitative	13-19y,	Adolescents with asthma more likely to smoke and to have some degree of	Intermediate

Nava, 2017, Mexico[88]	management		cross-sectional questionnaire based study	N=3383, smokers with and without asthma	nicotine dependence. Adolescents with asthma continue smoking because this habit decreases their anxiety and stress. Adolescents know that smoking is addictive and often smoke on waking up in the morning or when they are sick. Adolescents do not consider smoking to be a problem	
Warren 2017, USA[96]	Self-management	Food allergy	Quantitative, cross-sectional questionnaire based study	14-22y, N=200, self-report food allergy via patient organizations	Two distinct food allergy behavioral risk classes were identified: less and more risky subpopulations After adjusting for age, sex, and anaphylaxis history, odds of more risky class membership were reduced for peanut allergy, supportive female friends, overprotective mothers, teachers who are aware of their FA, a history of being bullied, and an established education plan. Participants also reported positive outcomes of their FA, such as greater responsibility, empathy, and improved diet, which reduced odds of risky class membership	Intermediate
Winn, 2017, UK[99]	Self-management	Asthma	Qualitative semi-structured group interviews	11-14y, N=26 with asthma, N=28 without asthma, school based	Fear of an asthma attack emerged as the main barrier to exercise. Many healthy adolescents perceived this withdrawal as laziness or an excuse. Majority of adolescents with asthma reported exercise to be their most enjoyable activity.	Low

Details of quality assessment can be found in Table S5. Further details about the papers can be found in Table S10.

Table 7. Summary of papers focusing on supportive relationships

Author, year, country	Areas	Condition(s)	Study design	Population, number, and setting	Key results	Risk of bias
Brew, 2019, Sweden[131]	School	Asthma, allergic rhinitis, atopic dermatitis	Quantitative, questionnaire study nested in a longitudinal cohort study	9-12y and 15-16y assessments, N=10,963, Childhood and Adolescent Twin Study of Sweden cohort	Having reported asthma or an atopic conditions during childhood or adolescence does not negatively impact on academic performance	Low
Bruzzese, 2016, USA[111]	Healthcare practitioners	Asthma	Cross-sectional study	14-17y, N=349, school with history suggestive of asthma	Seeing a medical provider for asthma like symptoms more likely if anxious or depressed. Reasons for non-care included symptoms not perceived as serious, past medical visits not diagnosed as asthma, fear of diagnosis, being too busy and resistance to medication.	Low
Chua, 2013, USA[104]	Healthcare practitioners	Asthma	Quantitative study using national routine data	14–17y or 19-25y, cross-sectional analyses: N=5458, longitudinal analyses: N=740 participants,	Many adolescents with asthma have less routine care and more emergency care as they become young adults. Disruptions to use healthcare practitioner predicted by a loose of insurance, discontinue schooling and moving away from home.	Low

				medical expenditure panel survey		
Fong, 2018, Australia[108]	Peers, school	Food allergy	Quantitative cross-sectional questionnaire based study	10-19y, N=93, paediatric allergy clinic	43% children with food allergy subject to bullying. Majority of bullying occurred in the school environment, usually playground or sportsground.	Low
Gallagher, 2011, Gallagher, 2012, UK[83,132]	Family, peers, self-management adherence	Anaphylaxis	Qualitative, in-depth interviews and focus groups	13-19y, N=26, experience of anaphylaxis from school nurses, allergy specialists, primary care, a patient support group and a press release	Barriers to effective adrenaline autoinjector use: carriage and storage; difficulty of making the decision to use; experiences of training; auto-injector technique. For many, management involved finding a balance between taking their allergies seriously whilst not allowing these concerns to dominate their lives. Risks often difficult to judge, with reactions sometimes occurring even after checking ingredients. Most admitted taking some risks with trace-labelled foods. Most adolescents took an active role of some kind in managing their allergies with their parents' support. Most adolescents did not think that written anaphylaxis management plans were helpful. Suggested approaches to improve management: regular retraining, supportive follow-up, less bulky autoinjector, more support to independent self-management, improved public awareness of anaphylaxis.	Low/ Intermediate
Gibson-Young, 2014,	Peers, school	Asthma	Quantitative , cross-sectional	15-18y, N=6212, school based	Self-reported bullying and cyberbullying were associated with self-reported asthma. More girls reported bullying. Self-reported depressive symptoms	Low

USA[106]			questionnaire based study		associated with more bullying and cyberbullying.	
Heyduck, 2015, Germany[102]	Family	Asthma	Qualitative, focus group and telephone interviews	11-17y, N=15 inpatient rehabilitation centre	Four main theme area: asthma beliefs, representations of asthma treatment, perceptions about individual asthma management and perceptions about family asthma management. Patient-mother analyses revealed congruence in most themes. Divergence with perceptions of asthma's impact on adolescents' life or who took the main responsibility for management.	Low
Hullmann, 2012, USA[107]	Peers	Food allergy	Cross-sectional study	18-24y, N=41 with self reported food allergy, N=41 with no history of allergies or other chronic illness, undergraduates	Food allergies had no impact on health related quality of life. Females with food allergy reported poorer mental health related quality of life. Food allergies associated with more dating anxiety and fear of negative evaluation by members of the opposite sex.	Low
Nilsson, 2018, Sweden[133]	School	Asthma	Quantitative analysis nested in a birth	Assessed at 1, 2, 4, 8, 12,16y, N=1715 population-based prospective birth	Adolescents with ever asthma had lower grades, even worse for persistent asthma. Current asthma was not associated with the lower grades.	Low

				cohort BAMSE		
Rhee, 2010, USA[103]	Family, adherence	Asthma	Quantitative, cross-sectional questionnaire study	13-20y, N=173, outpatient clinic	Family support associated with better asthma control and quality of life. Mediated by reduced barriers to treatment adherence, especially adolescents' negative attitudes toward medication and healthcare providers.	Low
Stensgaard, 2017, Denmark[84]	Family, quality of life	Food allergy	Quantitative, cross-sectional questionnaire based study	13-17y, N=49, clinic	Female adolescents reported greater impact of food allergy on HRQL than males. Both parents scored their child's HRQL better than the child's own assessment.	Low
Stensgaard, 2017, Denmark[94]	Family	Peanut allergy	Qualitative with In- depth interviews of patients, sibs and parents	15-16y, N=5	Peanut allergy affected all family members. Managing peanut allergy required knowledge and understanding from all family and the wider social network. Siblings took responsibility and were worried about sib's wellbeing. Parents had concerns about transition into independence and loss of control. When the nuclear family is challenged (e.g. divorce) the risk management is changed.	Low
Stewart, 2012, Canada[95]	Support, peers	Asthma, allergies	Qualitative with survey and focus group interview	11-16, N=57, asthma and/or allergies from paediatric asthma and allergy clinics, pharmacies, and	Young adolescents' challenges included transition to self-care, balancing restrictions with safety, social isolation, and loneliness. They recommended supportive networks facilitated by older adolescent peers and wanted to meet with other young adolescents living with asthma and allergies online for information, advice and encouragement.	Intermediate

				professional web sites		
Suorsa, 2016, USA[105]	Peers, family, psychological	Asthma allergies	Quantitiative, cross-sectional questionnaire based study	18-22y, N=611, undergraduates with self-reported asthma or allergies	Exercise-related self-efficacy and social support from friends were associated with higher rates of weekly moderate to vigorous physical activity.	Low
Walker, 2007, UK[5]	School	Allergic rhinitis	Case control study	15-17y, N=662 cases who dropped ≥1 grade between winter mock and N=1172 summer exams controls who did not drop grades	Dropped grades between winter mocks and summer exams was more likely to have allergic rhinitis, allergic rhinitis medication or a sedating antihistamines and to have a diagnosis of asthma.	Low

Details of quality assessment can be found in Table S6. Further details about the papers can be found in Table S11.

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