**ONLINE SUPPLEMENT TEXT**

Original Article

**Title: Development and validation of the Adolescent Asthma Self-Efficacy Questionnaire (AASEQ)**

Simone Holley1\*, PhD, Rebecca Knibb2\*, PhD, Sue Latter3, PhD, Christina Liossi4, DPsych, Frances Mitchell5, BSc, Ruth Radley RSCN, Graham Roberts1,5,7, DM

\*Equal contribution

1. Clinical and Experimental Sciences and Human Development in Health Academic Units, University of Southampton, UK.

2. Department of Psychology, Aston University, Birmingham, UK. Faculty of Medicine, Southampton, UK.

3. School of Health Sciences, University of Southampton, UK.

4. School of Psychology, University of Southampton, UK and Department of Paediatric Psychology, Great Ormond Street Hospital for Children NHS Foundation Trust, London, UK

5. The David Hide Asthma and Allergy Research Centre, St Mary’s Hospital, Isle of Wight, UK.

6. NIHR/Wellcome Trust Clinical Research Facility, University Hospital Southampton NHS Foundation Trust, Southampton, UK.

7. NIHR Southampton Respiratory Biomedical Research Unit, University Hospital Southampton NHS Foundation Trust, Southampton, UK.

Running Head: Development of the Asthma Self-Efficacy Questionnaire

Corresponding Author

Corresponding Author: Professor Graham Roberts, Paediatric Allergy and Respiratory Medicine (Mailpoint 805), Southampton University Hospital NHS Foundation Trust, Tremona Road, Southampton SO16 6YD, UK. Telephone: 02381206160. Fax: 02380878847

Email: g.c.roberts@soton.ac.uk

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**Methods**

**Ethical considerations**

Ethical approval for the scale development phase was provided by the East of England National Research Ethics Committee – Cambridge Central (reference 14/EE/0172). Ethical approval for the scale reliability and validity phase was provided by the NRES Committee North West – Liverpool Central (reference 15/NW/0551). All participants and parents/carers gave informed consent.

**Item generation: approach to thematic analysis**

Development of interview topic guide

Following scale development guidelines,1,2 a topic guide was developed for interviews and focus groups which asked about self-management, what was easy or difficult about managing asthma and how others influenced their self-management. The guide was informed by discussion with experts in the area, including psychologists with expertise in child and adolescent long-term medical conditions and self-efficacy for management of long-term conditions, including asthma and allergy; a paediatric allergy and asthma consultant; and a specialist asthma and allergy nurse. Relevant literature was also reviewed.3

Analysis of interview data

An interim analysis of adolescent transcripts was conducted by SH and GR to assess whether data saturation had been achieved. This involved reading and re-reading the manuscripts to identify themes that were emerging. Although it was clear at this point that no new themes were emerging, further interviews were conducted until information had been obtained from participants with an even spread of gender, ages and asthma severity.

Three authors (SH, GR, RR) were involved in generating the initial themes. Adolescent transcripts were analysed first and the early phases involved independently reading (and re-reading) a selection of the adolescent transcripts to become familiar with the data and generating initial codes. The three investigators met to discuss the initial codes and review the transcripts. Over a number of weeks all the transcripts were read and reviewed in this manner, with the three researchers refining and combining initial codes into themes. The same procedure was conducted with the parent and HCP transcripts, which were reviewed and discussed in tandem.

**KIDCOPE** 4

A measure of coping was selected as it is theorised that perceptions of self-efficacy are related to the initiation of coping behaviour, the effort given to coping in a particular situation and how long coping will last during a stressful experience.5 The adolescent version of the KidCope is a 10-item, brief self-report measureof child coping strategiesthatpresents children with a problem scenario and they rate the level of negative affect (anxiety, sadness, or anger) elicited by the situation. Respondents indicate the incidence (yes or no) and frequency with which they use a given strategy on a scale of 0-3 (0=not at all; 1= sometimes; 2= a lot of the time; 3= always). It identifies 10 specific cognitive and behavioural coping strategies: distraction, social withdrawal, problem-solving, emotion regulation, wishful thinking, cognitive restricting, self-criticism, blaming, social support and resignation. The scale has demonstrated convergent and construct validity and has moderate test-retest reliability.4,6

**General Self-Efficacy Scale (GSES)**

The GSE is a 10 item measure of general perceived self-efficacy with satisfactory psychometric properties indicating the scale is reliable and valid.7 Responses are given on a 4 point scale from 1 (not at all true) to 4 (exactly true). Example questions include: “It is easy for me to stick to my aims and achieve my goals” and “I can remain calm when facing difficulties because I can rely on my coping abilities”.

**Statistical analysis**

Data analyses were conducted using SPSS version 22, missing data was treated listwise. Floor and ceiling effects for each item were checked to ensure that questions were not scored as zero or hundred by most participants.2 Standard analysis to explore reliability and validity was then applied. Principal components analysis with a varimax rotation was conducted to assess internal structural validity to enable identification of questions that correlated together which may form sub-sections of the questionnaire and to identify questions that correlated too highly with others or did not correlate with any items at all, which could then be considered for removal. Cronbach’s α coefficient and Guttman’s split-half coefficient were conducted to assess internal reliability of the scale to explore how the items in the questionnaire and in the sub-sections correlated with each other. Agreement with other validated questionnaires (construct validity) was assessed using Pearson’s bivariate correlations. Consistency of the questionnaire over time (test-retest reliability) was assessed by Intra-Class Correlations. Following criteria set out by Pesudov *et al* 8 and DeVellis2 and results reported by other similar scales9, *a priori* hypotheses were set regarding reliability and validity. We expected Cronbach’s alpha of >0.7 and <0.9 and moderate construct validity correlations of >0.3 with sub-scales measuring similar aspects to the scale. All tests were 2-tailed with a significance level set at p<0.05.

**Results**

**Qualitative research findings underpinning questionnaire development**

A total of 75 adolescents were approached. Six adolescents took part in one focus group and a further 22 adolescents were interviewed 1:1 by SH. Twenty-four adolescents declined to take part and follow up contact was unsuccessful in the remaining 23 who did not respond to telephone calls or messages. Additionally, to triangulate the findings, we interviewed some of their parents and asthma healthcare professionals. Eighteen parents/guardians were approached, four declined (due to lack of time) and two did not attend the focus group as arranged. Twelve parents took part in the study, in two focus groups (4 participants in each) and four 1:1 interviews. Seventeen HCPs were approached to take part. Three were unable to attend the agreed focus group or 1:1 interview due to unforeseen circumstances. Fourteen HCPs took part in two focus groups (n=3, n=8) and three 1:1 interviews. The HCPs included respiratory paediatricians, secondary care asthma nurse specialists, primary care nurse, school nurse and general practitioners (GP). The focus groups lasted approximately 1.5 hours and interviews lasted 20-60 minutes. A summary of the themes and illustrative quotes are presented in Table S1.

*Table S1 Themes with Illustrative quotes from adolescents, parents, and healthcare professionals*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Teenager** | **Parent** | **Healthcare professional** |
| **MEDICATION**Have routines and reminders | “ [I have] always lived in a routine... which if I didn’t have it I wouldn’t have been able to manage my asthma as well as I have or at least as I have cause it helps me set out the morning” (M17) | “She’s also got a very regimented regime, because of how much she has to take, I think it’s just ingrained in her now” | “If you can develop it into a habit then it’s free from hassle, you do it automatically.” |
| Take/use/carry medication appropriately |  |  |  |
| Difficulties with inhalers / spacers | “It’s really awkward having a spacer... carrying it everywhere... but some days you’ve got trousers on and you don’t really wanna carry round a rucksack just for this or... and you don’t really want to carry it around in your hand.” (M13) | “She didn’t want to use the spacer … the inhaler itself is quite small, isn’t it, and you can pop it in your pocket, but they don’t like to carry the spacer” |  |
| Forgetting medication | “So sometimes I think I've done it but that might have been the day before… so like I need to remember when I've done it*”* (M13) | “I have to double check him, because he’s forgotten or he’s running late or he can’t be bothered or he feels fine “ | “The patient as well I think might have a false recollection of how much they have taken not because they are trying to mislead you but they might just forget it” |
| **SYMPTOM MANAGEMENT MONITORING** Breathing, being calm, panic | “Cause I feel like I’m gonna have to keep taking those massive breaths and that's what I think when I’m more worried it makes that asthma worse cause I’m breathing so hard” (M14) | “He knows now to calm himself down and sort of moderate his breathing” |  |
| Recognise symptoms |  |  |  |
| **TRIGGERS**Recognise/avoid/ minimise triggers |  |  |  |
| **MEDICATION BELIEFS** Effectiveness | “I love my inhaler… it gives me instant relief” (F17) |  |  |
| **ASTHMA BELIEFS** control, treatment burden |  | “She didn’t want to use the spacer … the inhaler itself is quite small, isn’t it, and you can pop it in your pocket, but they don’t like to carry the spacer” | **“**‘It’s difficult to take regular treatment… If you need to do this for the rest of your life more or less take control of the medication it’s difficult and it doesn’t change in adulthood.” |
| **ATTITUDES TO ASTHMA**Motivation, acceptance, seriousness |  | “They don't think, they don't think things out properly, and everything will happen to everybody else, so it will never happen to me, don't worry about it, don’t stress about it, is <son> word, 'why are you stressing about it - it's my body'” | “It’s a lifestyle choice to not to be bothered about it because adolescents don’t want to be bothered, and they will take the medication when they have to when it’s symptomatic.” |
| Embarrassment, confidence, wanting to be normal |  | “So I think she finds it embarrassing that she’s got asthma, because she’s taking inhalers and things to school and people have gone, Oh my god, what’s that. So she’s found that really embarrassing, really difficult and the devices that go with her inhalers that she should have taken to school and used she doesn’t.” | “They don't like it and they're embarrassed about, taking a big spacer into school”  |
| Taking responsibility | “The worst thing you can ask a teenager is to remember something again and again and again… and their gonna be like ‘oh I’m not gonna do this’ and just give up or something.. they just won’t bother... it sounds odd giving someone who has no sense of responsibility something to be responsible about it.” (M16) | ‘I think she's learnt it’s not worth getting sick and she doesn't enjoy that feeling… so I think I'm quite lucky in that she seems to be quite sensible and I think she realises how ill she can be’ | "Trying to take them seriously as a growing adult now helps, so that they will probably take on their own responsibilities.” |
| **KNOWLEDGE**Understand their treatment and condition | “I guess like I've only just realised when filling out the forms and stuff, that actually I don't 100% know what asthma is… like I get told to take medicines and do this and do that, but I don't actually get told what that will do….just get told to do it.” (F16) | “It’s not just a blue and a brown inhaler, there’s a green one and purple one… so it is understand really what the medication is doing and because it gets changed, for the poor child to understand that when they are still getting to grips with the last regime, I think it can be quite confusing for them.” | “You might have a patient that comes to you from the GP or another clinic and they don’t understand their treatment, they haven’t had it explained to them in the first place, and can sometimes be quite easy to slip through the net.” |
| **PARENTS**Support, reminders, monitor, education, information |  | “Keep him calm when he is a bit off cause he panics and that's even worse it sets their asthma off. |  |
| Communication with HCP consultation: barrier and facilitator | “Mum talks and I sit there and listen, but then I don't think the doctor fully knows how it's been for me, but mum always says I don't talk, but I would talk if I was given the chance to talk… I don’t think they fully know cause when I come out I think I would have said this and I would have said that but I didn’t have the chance to.” (F16) |  | “It is helpful to try and make sure you see teenagers by yourself without their parents, at least for a proportion of the time that they come to see you…But I think that I usually a more constructive consultation with the individual.” |
| **Healthcare professionals**Provide treatment and choices |  | “Luckily when he saw Dr x last time they gave him an easibreathe, and he thinks this is really the bee’s knees… he doesn’t mind flicking that” | "Just changing their volumatic to a vortex they are like, oh wow, I didn’t know there were smaller spacers out there and would make such a difference in our bags, or we put them on easibreath, and just slight changes like that can hopefully motivate them a bit more” |
| Support, educate and inform |  |  | "I find when I’m teaching asthma, I have pictures of the airways and where the treatment, how it works, I have to have something visual to show them and I find that helps” |
| Communication: barrier and facilitator. Conflicting information, honesty | “Say I’m suffering with a specific thing and I want to talk to him about certain… err… things I can just speak to him about... easy... and he will give me an answer that I would understand as a teenager so it’s not going to big words from doctor.” (M14) | “What needs to be done in my mind to re-engage <son> is communicate properly so he needs good communication” | “If they smoke, nobody wants to admit if they smoke. But if they are without the parent they will tell me how often they have tried a cigarette, and then they start to tell me how often have they forgotten the last few weeks of taking medication, not how often have you taken it but how often have you forgotten it” |
| Clinics | “The children and how noisy they are… they're annoying… they are all running round and they've got the little play room with the little cars” (F16) | "Not wanting to miss school… that's proving difficult for appointments and things if you have to come a lot” |  |
| **Friends / peers** Barrier or facilitator | “One of them laughs ‘cause their like ‘we've only walked up that hill and you already need your inhaler’... their making it worse and making me not want to take it which is like making me iller.” (F16) | “She's got quite a close group of friends that she's known a long time and I don't think she would feel uncomfortable saying I don’t feel well I need to go... so that helps” | "Friends can have quite a powerful influence and they might actually stick up for each other and look out for each other if they have the knowledge.” |
| **Schools** Institutional support /Support from teachers  | “I’ve said I can't do PE today cause my asthma's been really bad over the weekend, they'll [the teacher] be like ‘well why can't you do it, everyone else has got to do it, you've got to do it as well’, or they'll say you need to get your PE kit on and stand outside and watch everyone else, which really is not gonna benefit at all, ‘cause if you're stood in the cold, the air’s going to your chest anyway.” (F15) | “Some people in schools seem to kind of view it as if it’s maybe the child making an excuse… And I think sometimes teachers, staff in school maybe don’t understand that it can be very serious and they think that maybe that child’s just trying to skip off of games.” |  |

**Item Generation and prototype scale development**

Themes generated from interviews with adolescents with asthma, healthcare professionals involved in management of asthma and the published literature were reviewed by a multi-disciplinary study team. A prototype scale was developed which was further reviewed by healthcare practitioners working with adolescents with asthma and adolescent participants who had taken part in the qualitative interviews. No changes were deemed necessary giving a 38 item prototype Adolescent Asthma Self-Efficacy Questionnaire (AASEQ) (Box S1).

**Floor and ceiling effects and missing data**

Floor and ceiling effects were checked for all items in the prototype scale. No item had an overall mean more than 95. The highest was for the item ‘I can ask my parents for help if I am having trouble breathing or having an asthma attack’ with 94.78. A total of 79.4% of the sample scored 100 for this item. There were three additional items where over 70% of the sample scored 100. These were ‘I can talk to my parents about my asthma’ with 78.6%; ‘I can talk honestly to my parents about my asthma’ with 74.1% and ‘I can talk to my doctor or nurse about my asthma’ with 72.8%. Two items on the prototype scale had one missing answer from across the whole dataset, one item had four missing answers and five items had six missing answers. These five items were at the end of the prototype scale and missing items could be due to questionnaire fatigue. All items were all retained in the factor analysis to explore how well they loaded onto the model. Figure S1 shows the distribution of scores for each item.

*Figure S1. Distribution of participant scores for Adolescent Asthma Self-Efficacy Questionnaire items*

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**Box S1. 38 item prototype Adolescent Asthma Self-Efficacy Questionnaire (AASEQ)**

This questionnaire is designed to help us get a better understanding of how you manage your asthma. Please rate how certain you are that you can do each of the things described below by writing the appropriate number.

*For each of the following statements, rate how confident you feel by choosing a number from 0 to 100 using the scale given below:*

0 10 20 30 40 50 60 70 80 90 100

Cannot do at all

Moderately can do

Highly certain can do

|  |  |  |
| --- | --- | --- |
| **Question** |  | **Confidence (0-100)** |
| **medication** |  |  |
| **I am confident that:** |  |  |
| I know how to correctly use my asthma inhaler/spacer/medication |  |  |
| I know when to use my asthma medication |  |  |
| I know which of my inhalers I need to take |  |  |
| I can have my medication with me at all times |  |  |
| I know what my inhalers are for |  |  |
| I know what my preventer inhaler is for |  |  |
| I know what my reliever inhaler is for |  |  |
| I can remember to take my inhalers without being reminded |  |  |
| **symptom management** |  |  |
| **I am confident that:** |  |  |
| I can be prepared to deal with an asthma attack  |  |  |
| I can stay calm when I am having trouble breathing |  |  |
| I know how to stay calm when I am having trouble breathing |  |  |
| I know when I am out of breath because of my asthma rather than because of exercise |  |  |
| I know when I am out of breath because of my asthma rather than because I feel a bit panicky |  |  |
| I know how to control my asthma when I am having trouble breathing |  |  |
| I know when to use my inhaler to manage a serious breathing problem |  |  |
| I know when I might need to go to hospital because of a serious breathing problem |  |  |
| **environment** |  |  |
| **I am confident that:** |  |  |
| I know what to do to avoid triggers for my asthma |  |  |
| I can avoid people when they are smoking |  |  |
| I am able to go my doctor’s appointments about my asthma |  |  |
| **asthma beliefs** |  |  |
| **I am confident that:** |  |  |
| I am in control of my asthma |  |  |
| I can do physical activity such as sports |  |  |
| I can have a normal life |  |  |
| I can do the things that I want to do |  |  |
| I can control my asthma day-to-day |  |  |
| My inhalers help me control my asthma |  |  |
| **friends, family and school** |  |  |
| **I am confident that:** |  |  |
| I can take my inhalers in front of my friends |  |  |
| I can take my inhalers around other people at school |  |  |
| I can talk to my friends about my asthma |  |  |
| I can talk to my parents about my asthma |  |  |
| I can talk to my doctor or nurse about my asthma |  |  |
| I can talk to my teachers about my asthma |  |  |
| I can talk honestly to my friends about my asthma |  |  |
| I can talk honestly to my parents about my asthma |  |  |
| I can talk honestly to my doctor or nurse about my asthma |  |  |
| I can talk honestly to my teachers about my asthma |  |  |
| I can ask my parents for help if I am having trouble breathing or having an asthma attack |  |  |
| I can ask my teachers for help if I am having trouble breathing or having an asthma attack |  |  |
| I can ask my friends for help if I am having trouble breathing or having an asthma attack |  |  |

**Internal structural validity of the AASEQ**

Principle components analysis with a varimax rotation was conducted on the 38 items of the prototype ASSE-Q. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.85, exceeding the recommended value of 0.6 10 and Bartlett’s Test of Sphericity (5966.31, *df* = 561, p<0.001) was significant, indicating that factor analysis on the correlations between items should produce meaningful factors. The initial solution produced 10 factors with eigenvalues over 1 but the scree plot suggested a solution with 4 or 6 factors would be optimal and so factor analysis forcing 4 and 6 factors was run.

A 6-factor solution resulted in some of the items loading onto more than one factor and a meaningful interpretation was unclear. In the 4-factor solution, 4 items had low factor loadings (less than 0.4) and communalities less than 0.20. These were removed and the analysis re-run, resulting in a solution with 34 items which explained 58.3% of the total variance in the data. All the items loaded onto factors above 0.4 and a clear interpretation of the factors could be made. Factors were called Friends, Family and School; Symptom Management; Asthma Beliefs; and Medication (see Table 2).

**Internal reliability of the AASEQ**

The 34 items had excellent internal consistency with a Cronbach’s α of 0.923 overall. Removal of no items improved the overall alpha for the scale. Alphas for all sub-scales can be seen in Table 3. On examination of the 34-item scale it was felt that some items retained by the factor analysis and reliability analysis were very similar. For example, items such as ‘talking to teachers’ and ‘talking honestly to teachers’ were originally included in the scale to see which item was a more reliable indicator of self-efficacy. As these items contributed equally well in the analysis it was felt that the scale could be made more parsimonious by the removal of similar items. The item with the lower factor loading was removed (indicated by a \* in Table 2) resulting in a 27-item scale (Box 2). This did not substantially affect the reliability of the scale, with the overall Cronbach’s alpha reducing from 0.92 to 0.91 (see Table 3).

Split half analysis was calculated which randomly splits the scale into two: Cronbach’s α was 0.871 and 0.811 for the two halves; the Spearman Brown correlation was 0.710 and the Guttman split-half coefficient was 0.799. Cronbach’s alphas for the sub-scales of the 27-item scale can be seen in Table 3.

**Impact of allergic disease co-morbidities and asthma self-efficacy**

Those with co-morbid hay-fever reported lower scores for asthma beliefs than those without hay-fever (mean=75.42, SD=22.69 verses 88.73, SD=19.17; t(103.11)=2.70, p<0.01). Those with co-morbid food allergy reported lower scores for total self-efficacy than those without food allergy (mean=79.3 SD=12.87 verses 83.54, SD=12.44; t(226)=2.25, p=0.025). They also reported lower self-efficacy for friends, family and school than those without food allergy (mean=80.8 SD=17.52 verses 88.50, SD=16.77; t(232)=3.01, p<0.01) and lower asthma beliefs than those without food allergy (mean=69.4 SD=22.30 verses 80.20, SD=21.09; t(238)=3.40, p<0.001). However, those with co-morbid animal allergy reported greater self-efficacy for symptom management than those without animal allergy (mean=79.23 SD=17.64 verses 73.59, SD=18.65; t(236)=-2.38, p=0.02).

**Discussion**

**Construct validity**

The scale has good construct validity, as demonstrated by how it correlated with the General Self-Efficacy Scale and the KidCope. Greater use of adaptive coping strategies such as problem solving and cognitive restructuring of stressful situations correlated with greater asthma self-management self-efficacy and indicates that facilitation of these types of coping skills in adolescents may help them feel more confident in managing their asthma.11,12 Similarly, greater use of social support was related to more confidence in using friends, family and school to support asthma self-management. Although correlations with these coping strategies were significant they were small to medium in size. This was expected and is probably due to the KidCope measuring general coping strategies, not strategies specific to asthma management. The AASEQ correlated with self-reported indices of asthma control, with adolescents with poorer asthma control having lower asthma management self-efficacy. Poorer self-efficacy correlated with asthma exacerbations, use of oral corticosteroids and number of hospital admissions for asthma, as has been seen in earlier studies.13-16

Adolescents who had been diagnosed at a younger age or had their asthma for longer had greater self-efficacy in managing their asthma. Younger adolescents at the time of completing the scale were more confident in using friends, family and school to help them manage their asthma. Research in children and adolescents with food allergy has shown that younger children feel more able to talk to their friends about their allergy whereas older children do not want to appear different or to be identified by their allergy and may only talk about it if they have to.17 This may also be the case with adolescents with asthma as our findings here show that older adolescents are less likely to use the help of friends, family and school to manage their asthma and previous research identified embarrassment as a key barrier to asthma self-management in adolescents.3 These older adolescents may feel embarrassed about their asthma and therefore reluctant to seek support from others when managing their asthma.

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