

1 **TITLE PAGE**

2 Original Article

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

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35

36 **ABSTRACT**

37 Perceived self-efficacy is the belief that one can manage prospective situations. Good asthma
38 self-management self-efficacy is associated with better asthma outcomes. However, a well-
39 developed and validated tool to measure adolescent asthma self-management self-efficacy is
40 lacking. Our objective was to develop and validate an Adolescent Asthma Self-Efficacy
41 Questionnaire (AASEQ).

42 The first stage of the study included a review of the literature, interviews with adolescents with
43 asthma and consultations with parents and relevant healthcare professionals to develop a
44 prototype scale. To assess reliability and validity, a further group of adolescents completed the
45 prototype scale, the General Self-Efficacy Scale and KidCope (measures coping styles). Re-
46 testing was undertaken to assess longitudinal validity.

47 Interviews with 28 adolescents and consultations with other stakeholders resulted in a 38-item
48 prototype scale. Key themes were medication, symptom management, triggers, knowledge,
49 attitude and beliefs around asthma, supportive relationships, schools and healthcare
50 professionals. The prototype scale was completed by 243 adolescents. Factor and reliability
51 analysis reduced it to a 27-item scale with 4 sub-sections: symptom management; medication;
52 friends, family and school; asthma beliefs. The 27-item scale had respectable to excellent
53 internal consistency (α 's 0.78-0.91) with results that were stable over time (ICC=0.82) in 63
54 who completed it twice. Better adolescent asthma self-efficacy was associated with better
55 general self-efficacy and indices of better asthma management.

56 The AASEQ is a reliable and valid tool that is likely to aid future research and practice focused
57 on adolescent asthma self-management and could be a useful intermediate outcome measure
58 to assess the impact of behavioural interventions.

59

60 INTRODUCTION

61 Many adolescents with asthma have suboptimal disease control despite the availability of
62 effective therapies.¹ For some, poor asthma control will be a consequence of sub-optimal self-
63 management, particularly adherence to treatment.² Research has identified several
64 psychosocial and behavioural factors that influence asthma self-management in adolescence,
65 e.g. forgetting treatment; lack of knowledge about asthma and treatments; treatment burden;
66 erroneous beliefs; embarrassment at having asthma; and communication difficulties with
67 healthcare practitioners (HCPs).³

68

69 Self-management self-efficacy in chronic disease is an important concept.⁴ Perceived self-
70 efficacy is defined as ‘the belief in one’s capabilities to organize and execute the courses of
71 action required to manage prospective situations’.⁵ Improving self-efficacy can lead to
72 individuals feeling more confident to master challenging problems, developing a stronger sense
73 of commitment to dealing with tasks and not feeling that situations are beyond their
74 capabilities.⁵ In asthma, self-management self-efficacy would cover strategies to prevent
75 symptoms including the use of preventers, preparation to manage symptoms as well as
76 managing them. Good asthma self-efficacy has been found to be associated with better asthma
77 outcomes including less hospitalization⁶⁻¹⁰. There is also some evidence that interventions
78 designed to improve self-efficacy may improve asthma outcomes.¹¹

79

80 A child asthma self-efficacy measure exists that was developed in the US for 7-15 year olds.¹²
81 Studies using this measure, to explore the role of self-efficacy in adolescents with asthma, have
82 reported inconclusive results. Rhee et al¹³ found that self-efficacy predicted barriers to self-
83 management such as poor relationships with healthcare professionals, negative perceptions to
84 medication, and difficulties with adherence. Meanwhile, Sleath et al¹⁴ and Zebracki and Drota¹⁵
85 found that asthma self-efficacy associated with better adherence to asthma medications in
86 adolescents. In contrast, Zebracki et al¹⁶ and Riekert et al¹⁷ found better self-efficacy was not
87 associated with improvements in other aspects of self-management. Improvements in self-
88 efficacy have been shown in intervention studies following the use of a mobile asthma action

89 plan¹⁸ and peer-led education¹⁹ but not following the use of motivational interviewing
90 intervention.¹⁷

91

92 A number of other groups have examined self-efficacy in asthma using other approaches. Van
93 Dellen et al²⁰ reported that higher self-efficacy was associated with better adherence with self-
94 efficacy being measured using a single question 'How difficult will it be for you to take your ICSs
95 on a daily basis in the near future?'. Van Es et al used a short questionnaire to measure self-
96 efficacy and did not find any improvements following an intervention program.²²

97

98 One possible reason for the equivocal results found here is the way in which the child asthma
99 self-efficacy scale was developed. Patient-reported outcome measures should be developed
100 and validated using rigorous and established methods that establish content validity and
101 reliability. Preliminary qualitative work using open-ended questions should be used to gain a
102 meaningful perspective with adolescents with asthma as the population of interest.²³ Self-
103 efficacy instruments in particular need to identify the challenges that people face to perform
104 activities; questions should be formulated to include a judgment of perceived capability ("I can
105 do") for carrying out specific activities; and the measurement scale should ideally range from 0
106 to 100.^{24,25}

107

108 The asthma self-efficacy measure developed by Bursch et al¹² used structured interviews rather
109 than semi-structured ones. There is also a lack of information regarding how scale items were
110 selected, whether their construction involved adolescents, and test-retest reliability data. In
111 addition, the measure may not be appropriate to use with adolescents given it was developed
112 with children aged 8-17 years and so have a very different experience to younger children.²⁶ A
113 further adolescent asthma self-efficacy questionnaire was developed 25 years ago in The
114 Netherlands with participants aged 10-18 years.²⁷ It has similar methodological limitations
115 (reviewed in Frei et al²⁸).

116

117 In this study we describe the initial development and validation of a new measure, the
118 Adolescent Asthma Self-Efficacy Questionnaire (AASEQ). This has been developed for use
119 with 12-18 year olds following contemporary scale guidelines and focusing on asthma self-
120 management self-efficacy.

121

122 **METHODS**

123 Ethical approval was provided by the NHS Ethics Committees (see online supplement). All
124 participants and parents/carers gave informed consent.

125

126 **Item Generation**

127 *Participants and procedures*

128 This phase was conducted between October 2014 and March 2015 in the South of England.
129 Participants were aged 12-18 years with doctor-diagnosed asthma (as coded in medical notes),
130 prescribed regular prophylactic asthma medication and with no other significant long-term
131 medical condition (apart from hay fever, eczema or food allergy), recruited from 3 general
132 practitioners and two hospitals. Purposive sampling was used to ensure a range of participant
133 ages, gender and asthma control were included. A number of their parents and healthcare
134 professionals were also consulted (details in online supplement).

135

136 *Interviews and analysis*

137 Interviews and focus groups were conducted by a psychologist (SH), not previously known to
138 them, with experience in conducting focus groups and interviews with adolescents. They were
139 audiotaped and transcribed verbatim, then analysed by inductive thematic analysis,²⁹ further
140 details can be found in the online supplement. The multidisciplinary group of authors used the
141 themes from the initial analysis and the literature review to form items for inclusion in a prototype
142 questionnaire. Feedback on the items and rating scale was then sought from parents and
143 healthcare practitioners working with adolescents with asthma (including four paediatric
144 consultants with an interest in respiratory disease and three paediatric asthma nurses). Six
145 adolescent participants who had taken part in the qualitative interviews also reviewed the

146 prototype questionnaire to check that items and the rating scale were understandable; no
147 changes were deemed necessary. Based on guidelines provided by Bandura,²⁴ items were
148 worded as statements with a rating scale of 0 to 100 where participants are asked to rate how
149 confident they are that they could do each item with 0 being cannot do at all, 50 being
150 moderately can do and 100 being highly certain can do. This process resulted in a 38 item
151 prototype Adolescent Asthma Self-Efficacy Questionnaire (AASEQ).

152

153 **Scale reliability and validity**

154 *Participants and procedure*

155 To assess reliability and validity of the scale in a large sample, participants with asthma were
156 recruited from the general population to take part in an online questionnaire. Recruitment took
157 place between July 2015 and June 2016. A convenience sample was recruited from 19 hospital
158 outpatients and eight primary care general practitioner centres across England. Asthma UK
159 and the Anaphylaxis Campaign advertised the study through social media outlets (Facebook
160 and Twitter) and newsletters. Participants were provided with information about the study and
161 a secure internet URL address where they could access the questionnaire after completing an
162 online consent. Participants were informed that on completion of the questionnaire they would
163 be entered into a prize draw to win a gift voucher (1 prize of £50, 5 runner-up prizes of £10).
164 The inclusion criteria were 12-18 years with doctor-diagnosed asthma and no other chronic
165 illness that has a major impact on daily life (apart from hay fever, eczema and food and animal
166 allergy given the high level of co-morbidity of these with asthma). Participants could complete
167 the questionnaire anonymously, although email addresses were requested in order to conduct
168 the AASEQ repeat test.

169

170 *Cross-sectional validation measures*

171 Adolescents completed two scales to assess convergent construct validity - the KIDCOPE³⁰
172 and the General Self-Efficacy Scale (GSES)³¹. These scales are well-used, have excellent
173 reliability and validity for the age range of our participants, are quick to complete and measure
174 constructs we hypothesised would correlate with the AASEQ. Further details are in the online

175 supplement. Adolescents also provided details about their asthma such as length of time since
176 diagnosis, triggers, medication and number of hospital admissions due to asthma. They were
177 also asked to rate how often they forgot their preventer inhaler on a 6-point scale from never to
178 always.

179

180 *Consistency over time*

181 Participants were sent an email asking them to repeat the AASEQ four weeks after completing
182 the baseline questionnaire. They were asked whether they had experienced any asthma-
183 related events during that time interval.

184

185 **Statistical analysis**

186 Data analyses were conducted using SPSS version 22, missing data was treated listwise.
187 Standard analysis to explore reliability and validity was then applied.³² Principal components
188 analysis was conducted to shorten the questionnaire to remove redundancy. Cronbach's α
189 coefficient and Guttman's split-half coefficient were conducted to assess internal reliability of
190 the scale. Agreement with other validated questionnaires (construct validity) was assessed
191 using Pearson's bivariate correlations. Consistency of the questionnaire over time (test-retest
192 reliability) was assessed by Intra-Class Correlations (ICC). All tests were 2-tailed with a
193 significance level set at $p < 0.05$. Further details are available in the online supplement.

194

195 **RESULTS**

196 **Item Generation**

197 A total of 28 adolescents aged 12-18 years with doctor-diagnosed asthma participated. Six
198 adolescents took part in one focus group and 22 adolescents took part in a 1:1 interview. Full
199 details of this qualitative phase (Table S1), item generation and prototype AASEQ scale (Box
200 S1) development can be found in the online supplement.

201

202 **Scale reliability and validity**

203 A total of 243 participants completed the baseline questionnaires. Demographic information
204 and asthma characteristics of these participants can be found in Table 1. Three participants did
205 not complete the AASEQ and were removed from analysis to assess scale reliability and
206 validity. There were only 36 missing items across the whole dataset for the AASEQ (n=9,234
207 data points). Details of missing data and floor and ceiling effects are shown in the online
208 supplement (Figure S1).

209

210

211 Table 1 Demographic information and asthma characteristics of participants

	Baseline N=243	Re-test N=63
Mean age in years (s.d.)	14.6 (1.8)	14.8 (1.9)
Age range in years	12 – 18	12 – 18
Mean age of onset of asthma in years (s.d.)	4.8 (4.2)	
Mean length of time since diagnosis in years (s.d.)	9.8 (4.3)	
Gender (%)		
Male	97 (39.9)	16 (25.4)
Female	146 (60.1)	47 (74.6)
Ethnicity (%)	White British	206 (84.8)
Managed by (%):	Primary care	102 (42.0)
	Secondary care	139 (57.2)
Recruited from (%):	Hospital	184 (75.7)
	GP	23 (9.5)
	Social media	34 (14.0)
Self-reported asthma triggers (%)	Weather	187 (77.0)
	Pollen	161 (66.3)
	Emotions	164 (67.5)
	Fumes	136 (56.0)
Self-reported asthma triggers (%)	Dust	73 (30.0)
	Pets	140 (57.6)
	Colds or flu	42 (17.3)
	Cigarette smoke	118 (48.6)
	Food or drinks	206 (84.8)
	Soaps / sprays	147 (60.5)
Self-report of forgetting preventer medication (%)	Never	59 (24.3)
	Occasionally	95 (39.1)
	Once a week	21 (8.6)
	Half the time	20 (8.2)
	Most of the time	28 (11.5)
	All the time	18 (7.4)
Mean number of asthma exacerbations in last year (s.d.)*	3.5 (5.0)	
Mean number of oral corticosteroid courses in last year (s.d.)**	3.2 (5.4)	
Mean total number of hospital visits due to asthma (s.d.)	7.7 (20.3)	
Other allergic disease (%)	Eczema	107 (44)
	Hay fever	187 (77)
	Food allergy	66 (27.2)
	Animal allergy	115 (47.30)

212 Figures represent mean (SD) or number (%). *How many asthma exacerbations did you have

213 last year? ** How many courses of steroid (prednisolone) did you need in the last year?

214

215 Internal structural validity of the AASEQ

216 Principal components analysis with a varimax rotation was conducted on the 38 items of the
217 prototype AASEQ (Box S1). Four items with low factor loadings were removed giving a 34 item
218 solution which explained 58.3% of the total variance in the data. A clear interpretation of the
219 factors could be made and factors were called: Friends, Family and School; Symptom
220 Management; Asthma Beliefs; and Medication (see Table 2). Further details are in the online
221 supplement.

222

223 Internal reliability of the AASEQ

224 The 34 items had excellent internal consistency (see Table 3). On inspection of the items, it
225 was felt that some were very similar, for example, items such as 'talking to teachers' and 'talking
226 honestly to teachers' were originally included in the scale to see which item was a more reliable
227 indicator of self-efficacy. As these items contributed equally well in the analysis it was felt that
228 the scale could be made more parsimonious by the removal of the item with the lower factor
229 loading (indicated by a * in Table 2) resulting in a 27-item scale (see Box 1). This did not
230 substantially affect the reliability of the scale (see Table 3). All AASEQ answers are summed
231 and then divided by 27 to get a total mean score (0-100). Sub-scale items are also summed
232 and divided by the number of items in each sub-scale. A higher score indicates greater self-
233 efficacy for management of asthma.

234

235

246 Cross-sectional validity of AASEQ

247 The total AASEQ score significantly correlated with total general self-efficacy with greater
248 asthma management self-efficacy associated with greater general self-efficacy. Each sub-
249 scale of the AASEQ also significantly correlated with the GSES (Table 4). In relation to coping,
250 the total AASEQ score and all the sub-scales had small to medium positive correlations with
251 problem solving coping, indicating that greater use of this coping strategy related to greater
252 asthma self-efficacy (see Table 4).

253

254 Table 2 Factor analysis of the AASEQ 34-item scale

	Factor 1	Factor 2	Factor 3	Factor 4
FRIENDS, FAMILY AND SCHOOL				
I can talk honestly to my teachers about my asthma	.83	.19	-.01	-.04
I can talk to my teachers about my asthma*	.82	.18	.06	.03
I can talk honestly to my friends about my asthma	.81	.07	.20	.14
I can talk to my friends about my asthma*	.81	.05	.16	.09
I can take my inhalers in front of my friends	.75	.20	.16	.04
I can take my inhalers around other people at school	.74	.26	.07	-.02
I can ask my teachers for help if I am having trouble breathing or having an asthma attack	.73	.14	-.002	.04
I can ask my friends for help if I am having trouble breathing or having an asthma attack	.69	.06	.17	.10
I can talk honestly to my doctor or nurse about my asthma	.69	.15	-.02	.05
I can talk to my doctor or nurse about my asthma*	.66	.15	.01	.08
I can talk honestly to my parents about my asthma	.65	-.12	.35	.17
I can talk to my parents about my asthma*	.61	-.14	.33	.20
I can ask my parents for help if I am having trouble breathing or having an asthma attack	.56	-.13	.21	.27
SYMPTOM MANAGEMENT				
I know how to stay calm when I am having trouble breathing	.03	.81	.22	.07
I know how to control my asthma when I am having trouble breathing	.07	.78	.18	.20
I can stay calm when I am having trouble breathing*	.06	.76	.28	.003
I can be prepared to deal with an asthma attack	.06	.69	.12	.32
I know when to use my inhaler to manage a serious breathing problem	.05	.64	.06	.41
I know what to do to avoid triggers for my asthma	.04	.60	.12	.22
I know when I might need to go to hospital because of a serious breathing problem	.19	.56	.01	.34
I know when I am out of breath because of my asthma rather than because I feel a bit panicky	.27	.53	.04	.24
I know when I am out of breath because of my asthma rather than because of exercise	.36	.52	.02	.21
I can have my medication with me at all times*	.16	.43	-.22	.17
ASTHMA BELIEFS				
I can do the things that I want to do	.17	.05	.88	-.02
I can have a normal life	.20	-.001	.87	-.05
I can control my asthma day-to-day	.08	.28	.83	-.004
I can do physical activity such as sports	.23	.15	.74	-.03
I am in control of my asthma	.14	.29	.69	.03
MEDICATION				
I know what my preventer inhaler is for	.02	.21	-.01	.80
I know what my reliever inhaler is for	.01	.18	-.05	.79
I know what my inhalers are for*	.12	.26	-.03	.75
I know which of my inhalers I need to take	.08	.24	.01	.69
I know when to use my asthma medication	.18	.37	-.02	.52
I know how to correctly use my asthma inhaler/ spacer/ medication	.24	.21	.02	.46
EIGENVALUES	7.35	5.00	3.89	3.60
% VARIANCE EXPLAINED	21.61	14.71	11.44	10.57

255

256 Figures represent the factor loading for each question for each of the 4 factors. An eigenvalue
 257 of more than 1 indicates a factor as being important. * items removed to create a more
 258 parsimonious 27-item scale.

259 *Table 3 Internal consistency and consistency over time of the 27-item AASEQ scale and sub-scales*

AASEQ	All repeat participants (N=63)		Only repeat participants reporting no change (N=22)		Cronbach's alphas		Intra-class correlations for test re-test	
	Initial assessment	Repeat assessment	Initial assessment	Repeat assessment	34-item scale	27-item scale	All re-test participants (N=63)	Participants reporting no change (N=22)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)				
Total Scale	82.32 (12.67)	82.92 (14.24)	83.27 (11.29)	85.13 (10.52)	.92	.91	.82	.81
Sub-Scales								
Friends, family and school	86.46 (17.27)	82.55 (21.66)	88.02 (12.04)	86.95 (12.89)	.93	.90	.90	.72
Symptom management	76.22 (18.36)	77.92 (18.23)	70.74 (17.32)	75.82 (18.45)	.88	.87	.65	.58
Asthma beliefs	77.33 (22.17)	82.05 (20.15)	90.94 (10.44)	90.21 (11.94)	.90	.90	.90	.72
Medication	90.35 (12.25)	92.48 (8.56)	87.14 (12.77)	91.68 (9.85)	.84	.78	.58	.64

260
261 Cronbach's alphas represent the consistency of the questionnaire and the sub-scales. Intra-Class Correlations (ICC) represent the consistency of the
262 questionnaire over time (test-retest reliability). No change related to having not experienced an asthma attack; not being admitted to hospital due to their
263 asthma; not being seen a healthcare professional for their asthma; no change in asthma medication; and having had no new asthma education since
264 completing the initial questionnaire.

265 Greater asthma management self-efficacy (total score and all sub-scales apart from symptom
266 management) significantly related to less use of social withdrawal, with small to medium sized
267 correlations. Poorer asthma management self-efficacy for the family, friends and school sub-
268 scale was associated with greater use of blaming others (medium sized correlation) and less
269 use of social support as a way of coping (small correlation). Better symptom management and
270 medication self-efficacy related to greater use of cognitive restructuring as a way of coping
271 (Table 4). Together these results demonstrate good construct validity of the AASEQ compared
272 to general self-efficacy and moderate construct validity compared to general coping styles.

273

274 The relationship between markers of poor asthma control and the AASEQ showed small to
275 medium sized negative correlations (Table 5). A greater number of self-reported asthma
276 exacerbations in the past year was significantly associated with poorer total asthma self-
277 efficacy, asthma beliefs and use of friends, family and school. More self-reported use of oral
278 corticosteroids in the past year and more self-reported hospital visits for asthma were
279 associated with poorer asthma beliefs, but a belief in better symptom management,
280 demonstrating that adolescents knew what to do if they had an asthma attack or needed to go
281 to hospital, but felt that they were not able to have a normal life or be in control of their asthma.

282

283

284 Table 4 Pearson's correlations between the AASEQ scale and sub-scales, the GSES and the KIDCOPE

	AASEQ	AASEQ sub-scales			
	Total	Friends, family and school	Symptom management	Asthma beliefs	Medication
GSES	.47**	.30**	.36**	.41**	.23**
KIDCOPE					
Distraction	-.09	-.10	.001	-.13	-.08
Social withdrawal	-.31*	-.32**	-.10	-.23*	-.26*
Cognitive restructuring	.14	-.09	.22**	-.09	.19*
Self-criticism	-.22	-.19	-.18	-.20	-.15
Blaming others	-.23	-.35*	-.05	-.16	-.18
Problem solving	.33**	.16*	.30**	.19*	.25**
Emotional regulation	-.01	-.01	-.01	-.03	.06
Wishful thinking	.09	.13	.02	.06	.00
Social support	.14	.18*	.07	.01	.11
Resignation	-.004	-.04	.09	-.01	.03

285

286 Figures represent Pearson's correlation coefficients to assess how well the AASEQ agrees with
 287 other questionnaires. * $p < 0.05$; ** $p < 0.01$.

288

289

290

291

292 Factors likely to be related to self-management were also examined (Table 5). A greater
 293 frequency in forgetting their preventer inhaler significantly correlated with lower total asthma
 294 self-efficacy scores and lower sub-scale scores for friends, family and school, symptom
 295 management and use of medication. Having asthma for a longer duration was significantly
 296 correlated with better asthma symptom management. Poorer asthma self-efficacy also related
 297 to having co-morbid hay fever and food allergy (see online supplement).

298

299 Consistency over time of the AASEQ

300 A total of 183 participants were sent an email asking them to complete the AASEQ for a second
301 time. Of these, 63 (34.4%) responded to the request to complete the re-test. There were no
302 differences in responders except that they reported forgetting their preventer inhaler more often
303 (mean (SD) 3.00 (1.69) versus 2.53 (1.52), $p < 0.05$). There was a strong intra-class correlation
304 (ICC) of 0.82 between the baseline total scale score and the re-test total scale score (see Table
305 3 for total and sub-scale ICCs). Adolescents reporting no change in their asthma ($n=22$) had
306 similar results (ICC 0.81, Table 3).

307

308

309 Table 5 Pearson's correlations (number of participants) between the AASEQ scale and sub-scales,
 310 asthma control and factors that could affect asthma self-management

	AASEQ	AASEQ sub-scales			
	Total	Friends, family and school	Symptom management	Asthma beliefs	Medication
Asthma Control					
Number of asthma exacerbations in last year	-.19** (224)	-.17* (230)	.05 (234)	-.43*** (236)	.07 (232)
Number of corticosteroid courses in last year	-.01 (217)	-.01 (223)	.22** (225)	-.37** (227)	.12 (223)
Number of hospital visits ever	-.07 (228)	-.03 (234)	.18** (238)	-.14* (240)	.13 (236)
Self-management					
Forgetting of preventer inhaler	-.23** (227)	-.16** (232)	-.34** (236)	.05 (238)	-.18** (235)
Length of time since diagnosis	.13 (227)	.07 (233)	.17** (237)	-.03 (239)	.12 (235)
Age of onset of asthma (years)	-.18** (227)	.15* (233)	-.20** (237)	-.02 (239)	-.10 (235)
Age at completion of the questionnaire (years)	-.12 (228)	-.17** (234)	-.06 (238)	-.10 (240)	.03 (236)

311 Figures represent Pearson's correlation coefficients to assess how well the AASEQ agrees with
 312 asthma parameters. *p<0.05; **p<0.01, p<0.001***

313

314 DISCUSSION

315 The Adolescent Asthma Self-Efficacy Questionnaire (AASEQ) (Box 1) is the first asthma self-
316 efficacy scale developed specifically for adolescents aged 12 to 18 using recommended and
317 robust scientific methods.²⁴ Previous scales for measuring adolescent asthma self-efficacy^{12,27}
318 have lacked rigorous development processes such as a systematic literature search; adequate
319 inclusion of stakeholder opinion; test re-test reliability, and construct validity.²⁸ In contrast we
320 conducted a comprehensive literature search, interviewed several stakeholder groups
321 (adolescents, their parents and their healthcare professionals), and established test re-test
322 reliability and construct validity. As an example, the AASEQ correlates with markers of asthma
323 control. So the AASEQ focuses on the specific challenges that this group face in developing
324 their independent self-management skills.³³

325

326 The overall AASEQ scale and all sub-scales demonstrate good to excellent internal reliability
327 and stability over time. In the test re-test, scores for self-efficacy for asthma medication
328 increased slightly from time one to time two; it may be that completing the scale at time one
329 prompted adolescents to think about and consequently remember information about their
330 asthma medication, resulting in them reporting more confidence in using it when completing
331 the scale again. Finally, the scale has good construct validity, as demonstrated by how it
332 correlated with the General Self-Efficacy Scale and the KidCope (further discussed in the online
333 supplement).

334

335 A strength of this study is the large sample of adolescents who completed the scale, enabling
336 a range of validity analyses to be conducted. The majority were recruited from primary or
337 secondary care, ensuring that the analysis was not completely reliant on self-report of an
338 asthma diagnosis.

339

340 There are a number of limitations that need to be addressed in further work. Although we
341 piloted the scale with adolescents, we did not conduct cognitive interviews and these would be
342 useful to check understanding of the items and the response scale. Although not identified as

343 an issue by adolescents, the scale instructions could be further tested. Confirmatory factor
344 analysis is needed which will enable us to see if the sub-scales found in the exploratory factor
345 analysis reported here can be replicated. Although a large number of participants were included
346 in the development phase, it is possible that a different structure would be apparent with an
347 even larger number of participants. It would also be useful to explore whether greater self-
348 efficacy reported by adolescents relates to better asthma management using more objective
349 indices of asthma control and adherence to medication. The validation work thus far has relied
350 on self-report from adolescents. The ability of the scale to measure change over time in
351 response to an intervention to improve asthma management self-efficacy needs to be
352 ascertained and this is work currently being conducted by the authors. Further work to assess
353 the test re-test reliability, given the small number completing the re-test, would be valuable to
354 provide further evidence for the consistency of the tool over time. It is possible that not all the
355 participants had asthma as 14% were recruited via social media although they reported a
356 doctor's diagnosis of asthma. There is the likelihood of a selection bias in our sample, as the
357 most motivated adolescents (who may be more likely to self-manage asthma better) were
358 probably most likely to participate in the survey.

359

360 We endeavoured to create a scale that could be used in both research and clinical practice.
361 Whilst taking only 5-10 minutes to complete, an even shorter version of the scale may be
362 valuable for use in clinical settings when time pressures may prevent the completion of a longer
363 scale. The scale is self-administered and was developed to be understandable to the majority
364 of adolescents aged 12-18 years and completed with little or no input from parents or other
365 adults. We would suggest that adolescent patients could complete the AASEQ scale prior to a
366 clinic consultation to highlight areas where they may most need support with self-management.
367 Healthcare practitioners could then use this information to inform the areas covered in the
368 consultation, ensuring that it focuses on the needs of the adolescent. With self-efficacy being
369 an important in longterm conditions⁴, we would suggest that the AASEQ scale could be useful
370 in clinical research focused on understanding or improving self-management skills in
371 adolescents with asthma.

372

373 In conclusion, the AASEQ is a reliable and valid tool to use with adolescents with asthma and
374 further work on responsiveness of the scale to interventions and validity in relation to objective
375 measures of asthma management should now be conducted. With self-efficacy being an
376 important in the management of longterm conditions, the AASEQ should be useful in assessing
377 adolescent asthma self-management. It should be a useful surrogate endpoint to assess the
378 impact of interventions designed to optimise asthma self-management.^{17,22} Healthcare
379 practitioners, researchers and educators working with this patient group may find this tool useful
380 as an aid to identifying areas in which adolescents are less confident in their asthma
381 management in order to guide specific asthma management education and advice.

382

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396

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