Can schools promote the health of children with asthma?

Jenny McWhirter\textsuperscript{1}, Donna McCann\textsuperscript{2*}, Helen Coleman\textsuperscript{3}, Marguerite Calvert\textsuperscript{4} and John Warner\textsuperscript{5}

**Abstract**

This report describes the evaluation of a whole-school intervention to improve morbidity and psychosocial well-being in pupils with asthma. In all, 193 children with asthma (7–9 years) from 23 primary/junior schools in the south of England participated. Schools (n = 12) randomly assigned to the intervention group (IV) received a staff asthma training session, advice on asthma policy and practice and an emergency \( \beta_2 \)-agonist inhaler with spacer. Pupils participated in an asthma lesson. Staff and pupils in non-intervention (NI) schools (n = 11) received no asthma-oriented input. While wheeze reports improved for all children with asthma, only the IV group showed lower requirement for medication (\( P < 0.01 \)), clinically significant improvement (\( P < 0.05 \)) in activity related quality of life (QOL) and increased self-esteem (SE: social \( P = 0.01 \); athletic \( P = 0.05 \); behaviour \( P = 0.001 \)) in girls. SE decreased for NI girls but there was no change for non-asthmatic peers in NI or IV schools which had similar baseline levels of SE and QOL. There was a marginal improvement in the establishment of asthma policies/practices and no change in school absence or staff knowledge. The significantly increased peer group understanding of asthma seen in the intervention schools may have mediated increased well-being in the IV group. Primary schools are a potentially important context for improving asthma morbidity and psychosocial well-being of children with asthma.

**Introduction**

In the UK, 1.1 million children, equivalent to 1 child in 10, have asthma, or three in every classroom [1]. Asthma therefore represents a major public health issue and a potential challenge for school managers and teachers. One of the ‘aspirations’ of Asthma UK is that children should ‘achieve their full potential free from the impact of asthma in pre-school, school and college’ and that all carers ‘should be confident that their children are in a safe, asthma-friendly place whenever they are studying or at play’. Schools harbour many triggers for asthma including house dust mite and pet danders [2, 3] and encourage activities which may provoke symptoms, including physical exercise and outdoor play in cold weather. It has been recommended that schools should have written asthma policies and that children at school should have immediate access to reliever medication [4] and inhalers should not be locked away by school staff [5]. Reliever medication (\( \beta_2 \) agonists) widens the airways and relieves symptoms quickly, while preventer therapies (inhaled steroids) ease chronic inflammation, reducing the frequency of symptoms.

Despite these recommendations, it is often reported that children are not allowed to keep their
reliever medication with them or take them to physical education lessons [6–9]. Other studies have shown that teachers and head teachers lack knowledge and confidence to support pupils with asthma symptoms [10–13] and many schools do not have asthma policies [6, 9, 14, 15]. Pre-dosing with reliever medication before exercise has been shown to prevent exercise-induced wheeze [16] but many teachers remain unaware of such benefit [17].

Several studies have attempted to address some of the factors influencing asthma management in schools through teacher education [12] and sometimes through the school nursing service [15, 18] and by offering support for the development of school asthma policies [19, 20]. A number of schools and clinics have also worked together as part of a ‘Healthy Schools, Healthy Communities’ programme [21]. The evidence suggests that such interventions can increase the knowledge and confidence of teachers with respect to asthma.

Wolf et al. [22] have completed a review of studies of asthma education for school-age children who can face a number of limitations to their lives, including restrictions on play [23–25], physical activity [26, 27] and greater school absence [28–31]. Night-time cough can result in daytime sleepiness and inattention at school [28]. A meta-analysis of the psychosocial impact of asthma found that children with asthma are at higher risk of having behavioural difficulties [32], experience more generalized anxiety and are at more risk for poor self-competence and self-esteem (SE) than their non-asthmatic peers [33]. Girls may be particularly at risk for poor self-concept [34]. Resilience among children with asthma has also been associated with a positive sense of coherence and SE, as well as with coping skills and a positive family environment [35].

A recent study by Henry et al. [36] showed that collaboration with teachers to develop a universal curriculum intervention for 12- to 13-year olds resulted in improved asthma knowledge and tolerance to asthma among all students and also improved quality of life (QOL) in those with asthma. Few school-based studies, however, have measured the effectiveness of asthma education in terms of morbidity and we are not aware of any which have evaluated a whole-school approach to asthma management, which seeks to educate all school staff, children with asthma and their peers, using educational as well as clinical and psychological outcome indicators. In 2002, we described the context of this evaluation, including the rationale for a whole-school approach [37]. This paper reports on the impact of a nurse-led intervention for pupils aged 7–9 years in these schools. The influence of home-based factors on the outcomes of this intervention are reported elsewhere [38].

Methods

Participants

Enlistment of schools and participants is outlined in Figure 1. All primary and junior schools in three neighbouring local authorities were invited to participate in a survey of schools’ asthma record keeping during 2000–01. Subsequently, 33 schools in two geographically distinct but demographically similar areas were invited to apply to participate in the evaluation project. There were no differences in demographic characteristics of school type, area, geographical location, total school roll and percentage of children receiving free school meals between those schools participating (25/33) and those not participating (8/33).

The parental International Study of Asthma and Allergies in Childhood (ISAAC) asthma questionnaire [39] was distributed to parents of all children in Years 3 and 4. On the basis of information relating to a current diagnosis of asthma, the use of asthma medication and symptoms of wheeze over the previous 12-month period, 361 children and their parents in 24 schools were invited to participate in the study, of whom 219 agreed. Pairs of schools were matched on demographic characteristics and randomly assigned within pairs to the non-intervention (NI) group (12 schools; 113 pupils with asthma: 66 boys, 47 girls) and intervention (IV) group (12 schools; 106 pupils with asthma: 56 boys, 50 girls). Two schools (one NI and one IV) were participating in the local Healthy Schools
Fig. 1. Participation in study. *Inclusion criteria: only primary/junior schools with school role of ~200 children or more, **one school withdrew after ISAAC completion because of failed Office for Standards in Education inspection.
Award scheme. The number of pupils with asthma participating in the study varied from 3 to 20 per school. Pupils without asthma from the same school year volunteered to participate in some measures for comparison purposes.

Factors with a possible confounding effect on the intervention were measured at baseline, including a proxy measure of social and material deprivation [40]; a measure of urinary eosinophil protein X (U-EPX), a marker of allergic inflammatory activity [41] with results expressed as micrograms of U-EPX per millimole of creatinine and school exposure to house dust mite (HDM) levels associated with a risk of sensitization was determined from dust samples collected from classrooms [42, 43].

**Intervention**

The nurse-led intervention consisted of a staff workshop, support for policy development, distribution of metered-dose $\beta_2$ agonist (reliever) inhalers and valved spacers for use in emergencies and a 45-min interactive lesson for all pupils aged 7–9 years, in which the class teacher also participated. The staff workshop included information on asthma prevalence, psychosocial impact of asthma on children of school age, identification of asthma symptoms, the identification and purpose of different asthma inhalers, how to administer the reliever inhaler using a spacer, the importance of having inhalers with the child at all times and when to seek medical help and the role of triggers such as exercise and dust. Schools were also offered a model policy [18, 44] and offered further support and advice when writing their own policies.

The workshop was preceded by a draw-and-write activity (see ‘Measures’ below) following which children in intervention schools took part in a 45-min interactive lesson focused on: asthma as a cause of cough, a description of the respiratory system consistent with the science National Curriculum for pupils aged 7–9 years, and what it feels like to have asthma and how to help a friend who is coughing and finding it difficult to breathe. The latter involved a role play with the school nurse as the teacher, where the importance of taking the teacher to a child who is coughing, rather than the child to the teacher, was emphasized. Those with asthma were invited to participate in the lesson as expert pupils if they wished.

<table>
<thead>
<tr>
<th>SCENARIO 1: Chris has woken in the night coughing and is finding it difficult to breathe.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Invitation 1:</strong> What can Chris’ Mum or Dad do to help?</td>
</tr>
<tr>
<td><strong>Invitation 2:</strong> What can Chris do to help him/herself?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCENARIO 2: Chris is in the school playground, running and playing on a cold day. Chris is coughing and finding it difficult to breathe.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Invitation 1:</strong> What can Chris’ friends do to help?</td>
</tr>
<tr>
<td><strong>Invitation 2:</strong> What can Chris do to help him/herself?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCENARIO 3: Chris is in the classroom and is coughing and finding it difficult to breathe.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Invitation 1:</strong> What does Chris say to the teacher?</td>
</tr>
<tr>
<td><strong>Invitation 2:</strong> What does the teacher say to Chris?</td>
</tr>
<tr>
<td><strong>Invitation 3:</strong> What is the matter with Chris?</td>
</tr>
</tbody>
</table>

Fig. 2. Draw-and-write scenarios and invitations.
Staff and pupils in NI schools received no asthma-oriented input. Pupils in NI schools took part in a lesson about the respiratory system and how the body defends itself against infection, also consistent with the National Curriculum. No mention of asthma was made during this interactive lesson. On completion of the study, NI schools were offered and accepted the interactive lesson, and model policies were made available to all schools via the local authority.

Measures
All the following outcome measures were collected in the 6-month period prior to and following the intervention, i.e. at least 12 months apart.

Knowledge and understanding of asthma in pupils
To assess knowledge and understanding of asthma and its management, all pupils completed a novel draw-and-write exercise [45]. Pupils were invited to add to illustrations and write about three scenarios involving a child called Chris (who could be male or female) who was ‘coughing and finding it difficult to breathe’ in bed at night, in the playground and in the classroom (Figure 2). Pupils’ responses were analysed by two members of the research team and quality checks carried out to ensure at least 90% inter-rater reliability. Response categories were grounded in the data, but only responses which would best help a child with asthma were deemed ‘appropriate’. Children also made many positive suggestions, which would be helpful to a child with a non-specific cough, which were not incorrect, but not appropriate for a person with asthma.

Knowledge and understanding of asthma in staff
All members of staff in NI and IV schools were invited to complete a questionnaire about the cause and treatment of asthma, record keeping, the location of medication, use of inhalers in the playground and gym, experience of asthma and confidence in responding to incidents of asthma [10].

School asthma policies
Information on school policies and procedures for the management of asthma were collected by questionnaire from the head teacher and interviews with staff with responsibility for elements of asthma management, including the school secretary, caretaker, teacher with responsibility for Personal, Social and Health Education and class teachers.

\[
\begin{align*}
\text{BTS 1:} & \text{ occasional use of relief bronchodilators} \\
\text{BTS 2:} & \text{ regular inhaled anti-inflammatory agents i.e. up to 800mcg beclamethasone daily or up to 400mcg fluticasone daily} \\
\text{BTS 3:} & \text{ high dose inhaled steroids plus long acting inhaled } \beta_2\text{-agonist bronchodilator} \\
\text{BTS 4:} & \text{ high dose inhaled steroids and regular bronchodilators plus a sequential therapeutic trial of listed agents} \\
\text{BTS 5:} & \text{ addition of regular steroid tablets}
\end{align*}
\]

Fig. 3. Prescribed medication using BTS treatment steps [46].
Asthma morbidity
School attendance was recorded from the class register for the school year (days absent for all reasons over school year) prior to and following the intervention. Information on prescribed medication was also obtained from General Practitioner (GP) records and assigned a British Thoracic Society (BTS) treatment step (Figure 3) [46]. The prevalence of wheeze was obtained from parents of pupils aged 7–9 years in all schools, using the asthma section of the ISAAC questionnaire [39].

Daily well-being
The child’s perception of their own well-being was recorded in novel daily diaries completed in school by those with asthma, in both NI and IV groups, for a period of 11 weeks before and after the intervention. The child’s choice of a range of ‘smiley faces’ enabled a score of 1 (low) to 3 (high) to be allocated to measures of general well-being (OK), well-being in terms of cough and wheeze during the day (Day) and cough and wheeze at night (Night).

Quality of life
Participants with asthma and their volunteer peers provided a measure of QOL through completion of the Childhood Asthma Questionnaire [47] at school, a previously validated child self-report measure that provides scores for two generic measures of active QOL (physical activity such as sport) and passive QOL (leisure-related activities such as reading). Two further measures were completed only by the children with asthma: ‘distress’ reflects the child’s emotions related to having asthma and ‘severity’ their perception of the frequency of physical symptoms.

Perceived self-competence and SE
The Harter Questionnaire [48] was completed at school by pupils with asthma and the volunteer sample of school peers without asthma. The Harter questionnaire is a previously validated tool for use with this age group and provides scores for perceived self-competence and SE over six childhood domains (scholastic competence, Social acceptance, athletic competence, appearance, behaviour and global self-worth). Gender differences in domain scores and the relationship between domains can change over time [48, 49]. A teacher version of the questionnaire for the children with asthma was completed by class teachers [48].

Statistical analysis
Chi-square, McNemar and marginal homogeneity tests were used to examine differences in draw-and-write responses and changes in responses over the period of the study. Spearman’s rho was used to measure correlation. Multivariate analysis of variance was used to detect differences between groups in changes in scores (SE, QOL, daily well-being). The overall sample was considered too small for cluster analysis.

Ethics
Local education authorities gave consent for the study to be carried out in schools and the necessary approval was received from the local research ethics committees. Informed consent was received from all participants.

Results
Participants
Twenty-four schools were recruited, of which 23 (95.8%) schools completed the study (Figure 1). One school withdrew following a change of head teacher. Following completion of the ISAAC questionnaire, 219 parents of children with asthma agreed their children could participate, of whom 193 (88.1%) completed the study. Twenty children moved out of area and a further six were withdrawn from the study because they did not wish to participate further or attended the school that withdrew. There were no differences in following range of measures between those who dropped out and those completed: gender, asthma severity, age, deprivation level and parents’ occupation.

Parental employment status was similar for the IV and NI groups (mother employed 10 versus 8.6%, father employed 24 versus 21.5%, both parents employed 56 versus 61.3%, unemployed
9.0 versus 7.5%). No differences were found between the NI and IV groups at baseline in markers of social deprivation or in allergic inflammatory activity as measured by U-EPX. School environments were found to be relatively HDM allergen free with dust levels in most classrooms being low. Four schools (2 NI and 2 IV) had a Der p 1 level higher than 2 \( \text{lg/g} \), the level associated with a risk of sensitization, but well below 10 \( \text{lg/g} \) at which there is a risk of acute reactions in a sensitized individual [43].

### Outcomes

**Knowledge and understanding of asthma in pupils**

All pupils aged 7–9 years were asked to draw and write their responses to three asthma-related scenarios on a worksheet. The nurse researcher and teacher acted as scribes for pupils who requested assistance. Scribes wrote exactly what the child said about their picture, without prompts. The scenarios, the criteria denoting an ‘appropriate’ response and the proportion of appropriate responses recorded, are presented in Table I.

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>Baseline</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invitation 1: Chris has woken in the night coughing and is finding it difficult to breathe. What can Chris’s Mum or Dad do to help?</td>
<td>11.6</td>
<td>15.6</td>
</tr>
<tr>
<td>Appropriate answer: Includes mention of asthma medication</td>
<td>( \chi^2 = 2.39, \text{ ns} )</td>
<td>( \chi^2 = 14.42, P &lt; 0.0005 )</td>
</tr>
<tr>
<td>Invitation 2: What can Chris do to help him/herself?</td>
<td>7.7</td>
<td>7.8</td>
</tr>
<tr>
<td>Appropriate answer: Includes mention of inhaler and/or call someone</td>
<td>( \chi^2 = 0.75, \text{ ns} )</td>
<td>( \chi^2 = 5.90, P = 0.02 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 2</th>
<th>Baseline</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invitation 1: Chris in the school playground, running and playing on a cold day. He is coughing and finding it difficult to breathe. What can Chris’ friends do to help?</td>
<td>54.2</td>
<td>59.0</td>
</tr>
<tr>
<td>Appropriate answer: Get or tell teacher and/or get inhaler</td>
<td>5.1</td>
<td>7.6</td>
</tr>
<tr>
<td>Invitation 2: What can Chris do to help him/herself?</td>
<td>5.1</td>
<td>4.7</td>
</tr>
<tr>
<td>Appropriate answer: Includes mention of inhaler and/or get adult</td>
<td>( \chi^2 = 0.10, \text{ ns} )</td>
<td>( \chi^2 = 9.53, P = 0.002 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 3</th>
<th>Baseline</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invitation 1: Chris is in the classroom and is coughing and finding it difficult to breathe. What does Chris say to the teacher?</td>
<td>31.1</td>
<td>34.2</td>
</tr>
<tr>
<td>Appropriate answer: Includes clear description of symptoms and/or mention of inhaler and/or asthma</td>
<td>( \chi^2 = 1.71, \text{ ns} )</td>
<td>( \chi^2 = 10.78, P = 0.001 )</td>
</tr>
<tr>
<td>Invitation 2: What does the teacher say to Chris?</td>
<td>5.4</td>
<td>7.0</td>
</tr>
<tr>
<td>Appropriate answer: Includes mention of inhaler and/or asthma</td>
<td>( \chi^2 = 0.06, \text{ ns} )</td>
<td>( \chi^2 = 19.19, P &lt; 0.005 )</td>
</tr>
<tr>
<td>Invitation 3: What is the matter with Chris?</td>
<td>39.1</td>
<td>59.8</td>
</tr>
<tr>
<td>Appropriate answer: Includes mention of asthma</td>
<td>( \chi^2 = 4.57, P = 0.03 )</td>
<td>( \chi^2 = 23.0, P &lt; 0.0005 )</td>
</tr>
</tbody>
</table>
made the following appropriate response ‘Get the teacher if she is astmatic give her her inhaler’ (pupil’s own spelling). Significant increases in the proportion of appropriate responses by the IV compared with the NI group were found for all categories of responses at post-intervention ($P < 0.0005$). When participants known to have asthma ($n = 164$) were removed from the analysis, the results remained significant for the peer group in IV schools demonstrating significantly increased knowledge and understanding of asthma 12 months after a single 45-min lesson.

**Knowledge and understanding of asthma in staff**

A pre-intervention questionnaire was completed by 481 staff members. After three reminders, 297 returned a follow-up questionnaire, of whom 149 (31%) had completed the pre-intervention questionnaire. Low response due to pressure of work, a high staff turnover and the withdrawal of one school made interpretation of the data difficult within the context of a whole-school approach to asthma management. While questionnaires were returned by a wide range of staff, responses to questions related to asthma practice and management were inconsistent within schools. Responses relating to knowledge of asthma varied with the type of question. For example, responses to closed questions about triggers of asthma suggested a higher level of knowledge compared with those elicited by open-ended questions. At baseline, 48% of all teachers were ‘not concerned’ about having children with asthma in their class, but 40% reported not being confident about dealing with an asthma attack. There was no change after the intervention in either measure.

**School asthma policies**

All schools had ‘procedures’ for the use of medicines in school. Eight of 24 schools (33.3%) had written policies at the start of the study [IV: 5/12 (41.7%); NI: 3/12 (25%)] and three schools had ‘written guidelines’ [IV: 1/12 (8.3%); NI: 2/12 (16.7%)]. At the end of the study, six (50%) IV schools had written policies and one had written guidelines. In addition, three of the five IV schools with policies had amended or updated these policies. There was no change in the NI group. No school took up the offer of further support in relation to policy development.

**Asthma morbidity**

A low level of recorded absence for all reasons was found for the children with asthma [186/193 (96.4%)] at baseline (mean 7.0 days, SD 7.4, range 0–42.5 days) and a similar level was recorded after intervention (mean 6.8 days, SD 6.1, range 0–34.5 days). No effect of the intervention was found.

GP-prescribed medication ($n = 176$ children) recorded prior to the intervention (no medication 47.2%, BTS1 9.1%, BTS2 38.6%, BTS3 5.1%) decreased in the post-intervention period ($P = 0.05$). However, the within group positive change in treatment level was significant only for the IV group ($P = 0.01$) but not for the NI group ($P = 0.83$). The IV group had a more positive improvement overall in prescribed medication levels with 23.5% (NI = 19.8%) on no or milder medication post-intervention and 10.6% (NI = 18.7%) receiving an increased level of medication. Most improvement was from $\geq$BTS2 to taking no medication (IV 35.7 versus 25.7% NI) while, compared with the IV group, twice as many children in the NI group increased medication to $\geq$BTS2 (IV 11.6 versus 21.4% NI). There was also a general reduction of symptoms of wheeze over time for all children with an increase in the proportion of parents reporting that no wheeze had been experienced by their child ‘in the past 12 months’ ($\chi^2 = 20.9, P < 0.0005$) but no intervention effect was found. Overall, a fall in asthma symptom reporting for all children was associated with a reduction in medication use only for those children who received the intervention.

**Daily well-being**

Daily well-being diaries were completed for an average of 11 weeks, before and after the intervention by 184 of 193 (95.3%) children. Well-being was highly negatively correlated with social and material deprivation, particularly for boys (Table II) and positively correlated with previously validated SE and QOL.
<table>
<thead>
<tr>
<th>Social deprivation</th>
<th>Daily well-being</th>
<th>Active QOL</th>
<th>QOL</th>
<th>Distress</th>
<th>Severity</th>
<th>SE</th>
<th>Scholastic</th>
<th>Social</th>
<th>Athletic</th>
<th>Appearance</th>
<th>Behaviour</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK</td>
<td>–0.25**</td>
<td>–0.34****</td>
<td>–0.38****</td>
<td>–</td>
<td>–</td>
<td>0.29**</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Day</td>
<td>–0.78****</td>
<td>0.74****</td>
<td>0.32****</td>
<td>–0.22*</td>
<td>–0.26*</td>
<td>–0.50****</td>
<td>–</td>
<td>–</td>
<td>–0.31***</td>
<td>0.29***</td>
<td>0.37****</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>0.67****</td>
<td>0.76****</td>
<td>0.30***</td>
<td>0.23*</td>
<td>–0.28*</td>
<td>–0.55****</td>
<td>–</td>
<td>–</td>
<td>0.25*</td>
<td>0.22*</td>
<td>0.30***</td>
<td></td>
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<tr>
<td>Active QOL</td>
<td>–0.22*</td>
<td>–</td>
<td>–0.27***</td>
<td>–0.24*</td>
<td>–0.35****</td>
<td>0.23*</td>
<td>0.26**</td>
<td>0.41****</td>
<td>–</td>
<td>0.41****</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Passive QOL</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–0.23*</td>
<td>–0.24*</td>
<td>–0.37****</td>
<td>–0.38****</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–0.36***</td>
<td>–</td>
</tr>
<tr>
<td>Distress</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–0.24*</td>
<td>–0.38****</td>
<td>–0.30***</td>
<td>–</td>
<td>–</td>
<td>0.30***</td>
<td>0.42****</td>
<td>0.37****</td>
<td>0.28****</td>
</tr>
<tr>
<td>Scholastic</td>
<td>–</td>
<td>0.26*</td>
<td>0.30***</td>
<td>–</td>
<td>–</td>
<td>0.30***</td>
<td>–</td>
<td>–</td>
<td>0.30***</td>
<td>0.42****</td>
<td>0.37****</td>
<td>0.28****</td>
</tr>
<tr>
<td>Social</td>
<td>–</td>
<td>0.22*</td>
<td>–</td>
<td>0.26*</td>
<td>0.26*</td>
<td>–0.24*</td>
<td>–</td>
<td>–</td>
<td>0.30***</td>
<td>0.42****</td>
<td>0.37****</td>
<td>0.28****</td>
</tr>
<tr>
<td>Athletic</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.25*</td>
<td>0.26*</td>
<td>–0.24*</td>
<td>–</td>
<td>–</td>
<td>0.40****</td>
<td>0.32****</td>
<td>–</td>
<td>0.36****</td>
</tr>
<tr>
<td>Appearance</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.25*</td>
<td>0.32***</td>
<td>–</td>
<td>–</td>
<td>0.30***</td>
<td>0.46****</td>
<td>0.29****</td>
<td>0.26**</td>
</tr>
<tr>
<td>Behaviour</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.21*</td>
<td>0.33***</td>
<td>–</td>
<td>–</td>
<td>0.45****</td>
<td>0.36****</td>
<td>–</td>
<td>0.45****</td>
</tr>
<tr>
<td>Global</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.25*</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.50****</td>
<td>0.50****</td>
<td>0.36****</td>
<td>0.68****</td>
</tr>
</tbody>
</table>

*P < 0.05, **P < 0.01, ***P < 0.005, ****P < 0.0005.
measures, well-being improved over the study period for all children \( (F[3,174] = 5.82, P = 0.001) \) again, particularly for boys \( (P < 0.0005) \). There was no significant effect of the intervention on well-being. Univariate tests indicated an effect that approached significance for boys in the intervention group in terms of cough and wheeze through the day \( (F[1,90] = 2.64, P = 0.095) \), but not for cough and wheeze at night \( (F[1,90] = 0.91, P = 0.342) \) or generally feeling OK \( (F[1,90] = 2.44, P = 0.122) \).

**Quality of life**

Those with asthma reported similar levels of active and passive QOL when compared with their peers \( (n = 609) \). No differences in QOL scores were found for the non-asthmatic peer groups in IV or NI schools at the end of the study.

Table II shows significant but expected relationships between active QOL and asthma distress and severity measures for boys. For this group, higher perceived severity QOL was also significantly related to greater levels of social deprivation and higher levels of U-EPX, reflecting increased allergic inflammatory activity. Over the period of the study, all children with asthma, as a group, reported significantly improved QOL related to asthma, particularly in relation to perceptions of severity. Multivariate analysis, controlling both for social deprivation and U-EPX measures, indicated no multivariate effect of the intervention over all QOL scores (Pillai’s: \( F[4,138] = 1.43, P = 0.226 \)). However, a significant univariate effect of the intervention on the active QOL subscale \( (F[1,141] = 5.13, P = 0.025) \) was found for all children in the IV group. A quarter (27.1%) of children in the NI group showed a clinically relevant improvement in active QOL (an increase of ≥2 points) compared with 42.9% in the IV group \( (\chi^2 = 8.1, P = 0.02) \).

**Self-esteem**

No differences in SE scores were found between those with asthma and their school peers \( (n = 601) \) at baseline. Girls reported more positive behaviour scores \( (P < 0.0005) \) while boys reported higher athletic competence scores \( [48, 49] (P < 0.0005) \). After conversion to z-scores \([48]\), no differences were found between child self-report and teacher scores. SE measures at baseline were highly correlated with other psychosocial measures, particularly for boys (Table II).

SE scores were obtained both pre- and post-intervention for 186 of 193 (96.4%) children with asthma. Girls receiving the IV reported increased...
SE while girls in the NI group reported falls in SE (Figure 4). This multivariate difference between groups over all domains of the Harter questionnaire was significant (Pillai's: $F[6,80] = 2.75, P = 0.018$) with univariate tests indicating significance particularly for the social ($F[1,85] = 6.54, P = 0.012$), athletic ($F[1,85] = 4.37, P = 0.039$) and behaviour subscales ($F[1,85] = 11.11, P = 0.001$). In terms of effect sizes for each domain these were as follows: social = 0.54 (CI: 0.12–0.97), athletic = 0.41 (CI: 0.02–0.80) and behaviour = 0.69 (CI: 0.28–1.11). No difference was found for non-asthmatic peer group scores in the same schools. However, in comparison with their respective peer groups, the increase in the SE domain scores for the IV group was significant (Pillai's: $F[6,177] = 2.56, P = 0.02$) as was the NI fall in SE (Pillai's: $F[6,172] = 2.57, P = 0.02$). The intervention effect on SE, therefore, was brought about by independent changes in SE scores for both NI and IV groups of girls with asthma. No effect of the intervention on SE was found for boys (Figure 5) and no differences were found in the non-asthmatic peer group scores for IV and NI schools.

Discussion

Despite the complex nature of the findings of this small school-based evaluation study, and the limitations set out below, the results suggest that the primary school is a potentially important setting to reduce the asthma morbidity and promote the health and psychosocial well-being of children with asthma.

Our original primary end point of attempting to reduce school absences was not achieved. However, absence for all reasons in this community-based sample of asthmatic children was low at the outset (7 days per school year). A meta-analysis by Wolf et al. [22] found only a modest improvement ($-0.14$ days) in school absence with the greatest benefit for those with moderate to severe asthma. Thus, school absence may not be a good marker of asthma morbidity in the UK.

Asthma morbidity decreased significantly for all children over the duration of this study. A lower requirement for medication was found to be significant only for the IV group and these children also reported a clinically relevant change in QOL related to physical activity, a finding consistent with previous IV studies [36]. There was also evidence of psychosocial benefits for girls in terms of SE in IV schools. The gender differences are discussed in more depth in elsewhere [38].

How then were these important changes mediated?

Some indicators showed positive changes while others showed no change. There were modest changes in asthma policies in intervention schools only. However, other studies have shown that school-based interventions can be more productive in terms of policy development when a more school-centred approach is adopted, with local involvement in development and active teacher commitment to change [21, 50]. It is possible that as volunteers, the schools in this study were already relatively ‘asthma friendly’: all schools had procedures or policies for managing medicines and low allergen levels at the start of the study. However, commitment to change may have varied widely. In the lifetime of this study, there may have been insufficient time for the usual cycle of school policy review to come into effect [36].

Completion rates for staff questionnaires were low and we also noted that although the nurse-led staff training sessions were offered to all staff, they were attended mainly by teachers. Other staff, such as lunchtime supervisors, school secretaries and administrative staff, identified by the schools as key persons dealing with asthma management on a day-to-day basis, were effectively excluded by the head teachers’ requests to hold the meetings after school hours. The pre and post-intervention questionnaires were, therefore, completed by some staff who had not had the opportunity to attend the workshop. The wide variation in knowledge of asthma policy and practice among school staff at both baseline and follow-up is, therefore, unsurprising and we may have underestimated any change among teaching staff. It is unlikely, then, that either policy change or teacher knowledge alone could explain the changes observed.
Significantly increased knowledge and understanding of asthma among the peer group in IV schools, achieved through active participation by the pupils and their teacher in a brief asthma workshop, may have made an important contribution to the changes which have been observed, however. Such a nurse-led pedagogical approach has not been included in other interventions previously. Other studies have found that peer education is a useful means of delivering asthma education [51] and health education generally [52, 53] and it is well known that peer approval is an important factor in shaping children’s identity and behaviour [54].

Vinson’s model of resilience in childhood asthma demonstrated that parental support is an important co-factor [35]. It is possible that peer support and approval could be of similar importance to young people with asthma, helping them to feel confident that others recognize and understand their asthma, and will respond appropriately if needed. As well as increasing knowledge and understanding of asthma among peers, the workshop may have increased the expectation among children with asthma that peers would demonstrate greater tolerance of their condition (as Henry et al. [36] observed with older pupils) and of their associated difficulty in sport and physical activity. It is interesting that the most marked psychosocial changes we observed were increases in social, athletic and behaviour domains of SE in girls and in a clinically relevant improvement in active QOL for both boys and girls in IV schools.

We believe it is unlikely that such a change could be brought about simply through a pedagogical intervention and schools without appropriate policies or procedures for managing medicines in school may not achieve the same outcome.

Negative changes in SE found in NI children observed in this study may also be an important finding for schools wishing to improve the way asthma is managed for their pupils. This finding is consistent with the view that a whole-school approach has contributed to the changes observed. Simply establishing an asthma register without either policy change or pedagogical support may label or even stigmatize those affected and have an adverse effect on their psychosocial well-being. Likewise, studies such as ours which may make asthma more visible to peers but which provide no support may have unintended consequences, particularly for girls, impacting on their perception of their social acceptance and behaviour in relation to their peers. Further research is needed to establish the generalizability of these findings to other schools and to explore the links between school policy, peer support and the well-being of children with asthma.

Limitations of the study
Ideally, whole-school approaches would include a parent component. While parents provided responses to ISAAC questionnaires and were invited to attend school-based meetings during the study, attendance at these was low. Future studies should offer further opportunities for the involvement of the wider family and community in promoting the well-being of children with asthma, as part of a whole-school approach. Schools participating in the evaluation study were selected from a larger sample in the same county, participating in a questionnaire survey. Schools which responded to the original survey may have had different characteristics to those which did not. The contribution of school staff may have been underestimated due to missing data. Baseline measures, intended to establish whether the NI and IV groups were similar demographically and experienced similar school environments, could have been repeated at the end of the study to monitor possible changes.

Conclusions
We recommend that primary schools maintain up to date records of pupils with asthma and that all school staff (not just teachers) are actively engaged in the development of asthma friendly policies that promote the health and well-being of children with asthma. In an asthma friendly school, all staff should be regularly updated about asthma, its triggers and its management. Brief interactive asthma
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education for all children within a programme for Personal Social and Health Education has the potential to promote the health of children with asthma. We support the view that children with asthma should be allowed to carry their reliever medication at all times.

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Conflict of interest statement

None declared.

References


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