Appendix

Appendix 1: Extension of case definition.

After the trial had been recruiting for two months, 10% of potentially eligible children were excluded, because they did not have a diagnosis of asthma from their doctor, despite the fact that they had been:

- issued a SABA, children with asthma or a high probability of asthma, and
- had either been diagnosed with bronchiolitis more than 12 months ago, but had continued to have SABA prescriptions filled, or
- had been instructed to take a SABA regularly with a prescribed dosage, but had not been diagnosed with asthma.

Teaching staff in the ECE centres felt that use of SABAs had a significant effect on relieving breathing difficulties in these excluded children, and felt that the trial inclusion criteria of "diagnosed asthma" was too stringent.

After review of the issue, members of the trial clinical reference group agreed to broaden the asthma diagnosis eligibility criterion, to include children with "a high probability of asthma". This change applied to all children recruited thereafter—that is, previously excluded children did not become eligible.

"A high probability of asthma" was defined by whether the child currently used an asthma inhaler (whatever type), *and* had at least one of the following:

- Recurrent wheeze episodes in the last year that had responded to treatment with a SABA, *and/or*
- A dry cough in the last year, especially at night and/or on exertion, *and/or*
- A personal history or family history of atopy (ie asthma, eczema, dermatitis, hayfever, and/or allergic conjunctivitis).

Appendix 2: Full details of the intervention.

Preschools (ie staff/teachers and children) randomised into the intervention group received the following:

- "Space to Breathe" days, consisting of an asthma-specific, curriculum-linked learning and activity unit consisting of eight lesson plans, one introductory lesson and a professional development session for preschool staff/teachers;
- A "Space to Breathe" toolkit consisting of an asthma-specific, curriculum-based teacher resource, indoor house activity for all children, stickers, policy templates and a story book about asthma;
- A "Space to Breathe" participating centre accreditation and asthma policy including a two-level, standards-based accreditation, a risk management plan, and policies and procedures relating to the management of asthma (including pragmatic information such as storage and record keeping related to asthma medication use by children at the centre), and an accreditation certificate for display and website badge. Risk management covered:
  - Keeping surfaces, soft furnishings, bedding and toys clean and dust/mould free
  - Ensuring rooms had good ventilation, were dry and had good heating (ie no non-flued gas heating)
  - Removing or limiting furred or feathered pets, keeping pet litter boxes in an area away from children with asthma, and good hygiene around animals.
  - Ensuring cleaning products were "sensitive choice" products
  - Good ventilation to ensure strong smells (such as cleaners, perfumes and air freshers) did not linger
  - Ensuring a smoke-free workplace (which is law in New Zealand)
  - Preschool staff that smoked were encouraged to make their homes and cars smokefree, plus were supported to become smokefree (through the provision of vouchers for low-cost nicotine patch, gum and/or lozenges). All GASP trained nurses were qualified providers of the vouchers
  - Staff were encouraged to support parents to make their homes and cars smoke-free
  - The preschools were asked to check their premises for Tree Privet (*Ligustrum lucidum*)—a common plant in New Zealand that is linked to hayfever and asthma. If the plant was present, the local council were contacted to remove it at no cost
  - Bracelets for all preschool children with asthma or with a high probability of asthma. Such bracelets were used in the preschool only and provided a visual reinforcement mechanism for teachers and guardians/caregivers to identify children with asthma and any asthma management events that occurred during the school day;
  - Access to related "Space to Breathe" education resources via a password protected website.

"Space to Breathe" days, held at baseline and four months at each preschool, were used to facilitate pre-arranged appointments with guardians/caregivers of participating children with asthma. These appointments occurred throughout the day, with Ministry of Done staff running the "Space to Breathe" day activities with the wider preschool, while GASP nurses conducted one-on-one sessions with the children who had asthma and their guardians/caregivers. GASP nurses were also available to provide advice and support to preschool staff around establishing medicine policies and guidance on use and what to do with a child having an asthma attack. This advice and support was standardised across all participating preschools.

In addition to standard asthma management by their usual health professionals, eligible and participating children with asthma attending the preschools randomised to the intervention received:

- A GASP assessment to determine asthma symptomology, plus associated education on asthma medication use and asthma management. This assessment was undertaken by a trained GASP nurse employed by Waitematā Primary Health Organisation;
- A personalised asthma self-management plan (SMP) produced by the GASP tool, outlining prescribed medication, dosage and directions for use, and known triggers. A copy of the SMP was also given to each child's guardian/caregiver and preschool staff. Children with shared custody

arrangements were given more than one copy of their personalised asthma SMP. A copy of the associated decision support (but not the SMP) was sent to the child's usual primary care physician (PCP). If the GASP assessment identified a required change to the child's asthma medication, the guardians/caregivers was referred back to the child's usual PCP;

- Medication reminders. Adherence with medication dose/timing/frequency was stressed to the child's guardians/caregivers (note: medication is not normally taken while at a preschool). Various strategies were used to improve adherence, with a focus on the child taking the required medication twice daily (ideally 12 hours apart);
    - An "everyday" medication reminder chart was given to each child on an inhaled corticosteroid (ICS). Children were encouraged to scratch off a sun and moon on the chart twice daily, revealing a pictorial story behind Children were encouraged to use the charts over the period of one month. Children with shared custody arrangements were given more than one chart.
    - Medication reminders for guardians/caregivers. These reminders were delivered in the format preferred by the guardians/caregivers. Different options were made available, including twice daily reminders in the form of text messages, phone alarms and clock alarms.
- Guardians/caregivers (and other family members at the child's home) that smoked were supported to become smokefree (through the provision of vouchers for nicotine patch, gum and/or lozenges).

Appendix 3: List of all trial outcomes.

Appendix 3.1: Preschool-specific outcomes.

The following data were collected from the lead teacher prior to randomisation, then again at 12 months:

- Number of children aged 2–5 years that attend
- Gender of children aged 2–5 years
- Number of staff who worked with 2–5-year-olds
- Number of years lead teacher has worked at centre
- Smoking status of lead teacher
- Number of staff who smoke and worked with 2–5-year-olds
- Current smoke-free policies and adherence to these policies (also measured at one month)
- Number of asthma related events/interventions on the preschool register in the last year
- Whether all children with asthma are known to the lead teacher (also measured at one month)
- Current asthma/medication policies and adherence to these policies (also measured at one month)
- Knowledge of asthma triggers, and confidence in recognising asthma symptoms and how to administer first aid in the event of an asthma attack (also measured at one month)
- Healthy building status: including location relative to traffic, heating, condensation, the presence of mould and pets, insulation, and frequency of cleaning
- Asthma accreditation status (also measured at one month).

At 12 months, the lead teacher was asked about their perceptions of the study, including their views on the effectiveness of the education session and resources provided. Options for answering these questions were given using a Likert scale of one to five, where one was "not very" and five was "very".

Appendix 3.2: Child-specific outcomes.

The following data were collected from each child or their guardians/caregivers at a baseline assessment:

- Demographic data for the child – date of birth, gender, ethnicity;
- Child's medical history – history of other atopic reactions and vaccination history (eg full, partial, none);
- Asthma history – age at diagnosis of asthma, triggers, family history of asthma (defined as immediate blood relatives, namely grandparents, parents, biological brothers or sisters), current medication for asthma (frequency, dose and type, plus use of combination ICS and long-acting beta$_2$-adrenoceptor agonist [LABA] inhalers was recorded).

Data collected at eight months occurred over the phone, while all other data collects occurred via a face-to-face meeting. The following data were collected from each child or their guardians/caregivers at the baseline assessment, then again at one, four, eight and 12 months:

- Flu vaccinations
- Frequency of short-acting beta$_2$-adrenoceptor agonist (SABA) use in the last four weeks (baseline) or since last seen (other time points).
- Diagnosis of asthma made during the study (in those who had a high probability of asthma at baseline).
- Current asthma medication (frequency, dose and type, including use of combination ICS/LABA inhalers).
- Whether a medication change was recommended at the last GASP assessment (intervention group only), and if so whether the guardian/caregiver took the child to the doctor and whether the doctor changed the medication.
- Adherence with asthma medication – inhaler technique was assessed by the GASP nurse (for the

guardians/caregiver giving the child their inhaler) as per the guidelines shown in Appendix 3.3 of this document, with technique categorised as good, medium, or poor. Guardians/caregivers were also asked if they ever forgot to give their child their preventer inhaler during the week. Responses were categorised as:
    - Good –The child was given their inhaler twice a day every day
    - Medium – The child was missing ≤3 doses per week
    - Poor – The child was missing more than three doses per week
- Asthma symptoms in the last four weeks (baseline) or since last seen (other time points), that is daytime symptoms, nocturnal awakenings, and activity limitations. Guardians/caregivers were asked how many times the child woke up during the night or had symptoms of asthma (wheezing, coughing, shortness of breath, chest tightness or chest pain) or required a bronchodilator. Options to answer the questions were "not at all", "1–2 times per week", "3–6 times per week" and "every night".
- Absenteeism from preschool or other activities due to asthma in the last four months (baseline) or since last seen (other time points).
- Level of asthma control,[1] as measured by the GASP tool (intervention group only), categorised as:
    - Controlled – all of the following: no daytime symptoms (twice or less per week), no limitations on activities, no nocturnal waking, no use of a reliever or rescue testament (twice or less per week) and no exacerbations.
    - Partially controlled – presence of any of the following: daytime symptoms (more than twice a week), limitations on activities, nocturnal waking, use of a reliever or rescue testament more than twice a week, one or more exacerbations each year.
    - Uncontrolled – presence of three or more of the features of partly controlled asthma present in any week.
- Number of unscheduled (urgent) medical or emergency department attendances (including hospital admission) for asthma in the last 12 months.
- Time to first unscheduled medical or emergency department attendance (or hospital admission) for asthma, after baseline.

Information on the usefulness of the medication remainders and the "everyday" chart, used as part of the study intervention, was collected at one month for those in the intervention group only. The following data were collected from each child or their guardians/caregivers at the baseline assessment, then again at 12 months:

- Frequency of corticosteroid use for asthma in the last 12 months (oral and inhaled).
- Exposure to second-hand smoke (tobacco and other) at home, preschool and other places.
- Household crowding (the number of people living in the household with the child divided by the number of rooms in the house where people sleep).
- Quality of Life for the child, as assessed by the main guardian/caregiver using the Preschool Children Quality of Life Questionnaire (TNO-AZL, also referred to as the TAPQoL).[2] This questionnaire was delivered on an iPad, and was designed to measure the health-related quality of life in preschool children and to evaluate the impact of disease and treatments on the different domains of a child's life, namely physical, social, cognitive and emotional functioning. The questionnaire has good reliability and validity,[3] and has been previously used in preschool children with wheezing and dyspnea.[4]
- Guardians/caregivers absenteeism from work or other activities due to child's asthma in the last year.

At 12 months, guardians/caregivers were asked about how helpful they thought the study was and how satisfied they were with how the study was run. Options for answering these questions were given using a Likert scale of one to five, where one was "not very" and five was "very".

Appendix 3.3: Assessment of inhaler technique.

Method to be assessed:	**Incorrect**	**Correct**	**Total**
MDI with spacer			
Sit upright			
Shake the inhaler			
Attach MDI to spacer			
Good seal with lips			
Press inhaler *once*			
Breathe in and out 5–6 times slowly			
Repeat steps 1–5 *if* 2 puffs are required			
If repeat is necessary, wait 30 seconds before you repeat steps 1–5			
Turbuhaler			
Sit upright			
Hold turbuhaler *upright to "click"*			
Empty lungs (do not breath into device)			
Good seal with lips			
Head up and chin slightly tilted up			
Breathe in *deeply* and *forcefully*			
Hold your breath for about 10 seconds and breathe out through your nose			
If repeat is necessary, wait 30 seconds before you repeat steps 1–5			
Accuhaler			
Sit upright			
Open the inhaler			
Hold it in a *horizontal position*			
Empty Lungs (do not breath into device)			
Good seal with lips			
Breathe in *deeply* and *forcefully*			
Hold your breath for about 10 seconds and breathe out through your nose			

MDI: good technique–must have stages correct; medium technique–were correct with stages 2, 4, 5, 6; poor technique–did NOT perform 2,4, 5, 6 correctly.
Turbuhaler: good technique–all stages correct; medium technique–stages 2, 4, 6, 7 correct; poor technique–did NOT perform 2, 4, 6, 7 correct.
Accuhaler: good technique–all stages correct; medium technique–stages 3, 5, 6, 7 correct; poor technique– did NOT perform 3, 5, 6, 7 correct.

Appendix 4: Additional results (preschools).

Appendix 4.1: Additional baseline variables.

Additional baseline variables related to the preschools are presented below in Table S1. Data were provided by the lead teacher.

Table S1: Additional preschool baseline variables

	Intervention N=85 (%)	**Control N=86 (%)**
Number of children aged 2–5 years that were female		
Mean per preschool (SD)	26.1 (12.3)	27.8 (14.2)
Number of staff working with 2–5 year old children		
Mean per preschool (SD)	7 (4)	7 (4)
Number of months lead teacher had worked at preschool		
Mean per preschool (SD)	97 (80)	89 (69)
Lead teacher's smoking status		
Never smoked	65 (76)	67 (78)
Ex-smoker	15 (18)	14 (16)
Current smoker	5 (6)	5 (6)
Number of staff that were smokers and worked with 2–5-year-olds		
Mean (SD)	0.7 (1.1)	(1.2)
Preschool had a smokefree policy	**84 (99)**	**86 (100)**
Policy was not dated	27 (32)	47 (55)
Preschool had a plan for managing asthma while away on trips	20 (24)	27 (31)
Asthma medication stored in one location	(82)	71 (83)

SD: standard deviation.

Preschools also had their "Healthy Building" status assessed for potential asthma triggers, such as air pollution (using proximity to a high traffic road as a proxy), inadequate heating, pets, and infrequent cleaning. The majority of preschools had good forms of heating such as electric heaters and heat pumps, and correspondingly the observed presence of condensation on windows and mould was low (Table S2). Almost two thirds of centres had pets, although "high allergy" pets such as birds and rabbits were less common (Table S2).

Table S2: "Healthy Building" status at baseline.

	Intervention N=85 (%)	**Control N=86 (%)**
Location relative to traffic		
2 lane side road (low traffic)	38 (45)	37 (43)
2 lane side road (medium traffic)	20 (24)	23 (27)
2 lane side road (high traffic)	5 (6)	9 (11)
2 lane main road	6 (7)	4 (5)
>2 lane main road	15 (18)	13 (15)
Preschool heated by		
Electricity	53 (62)	45 (52)
Heat pump	33 (39)	43 (50)
Flued gas	0	2 (2)
Piped gas	1 (1)	4 (5)
Non-flued gas	1 (1)	0
Other[a]	12 (14)	8 (9)
Condensation present	4 (5)	5 (6)
Mould present	6 (7)	4 (5)
Preschool had pets	**54 (64)**	**55 (64)**
Fish/tortoise/axolotls/frogs/lizards	49 (58)	50 (58)
Birds	17 (20)	17 (20)
Rabbits	8 (9)	10 (12)
Cats/kittens	2 (2)	1 (1)
Rice/rats/guinea pigs	4 (5)	6 (7)
Goats/lambs/chickens	5 (6)	3 (3)
Insulated[b]		
Roof	41 (48)	42 (49)
Walls	38 (45)	38 (44)
Floor	32 (38)	27 (31)

[a] Included air conditioning, central heating, fan heaters, HRV systems, underfloor heating, oil heaters.
[b] Some missing data.

Carpets and rugs tended to be cleaned daily or once a term, curtains and blinds were rarely cleaned, and toys were mainly cleaned weekly, monthly or every term (Table S3).

Table S3: Frequency of cleaning of preschools at baseline.

	Intervention N=85 (%)	**Control N=86 (%)**
Carpet/rugs cleaned		
Have none	4 (5)	1 (1)
Never	2 (2)	0
Once a year	9 (11)	10 (12)
Twice a year	10 (12)	23 (27)
Four times a year	33 (39)	17 (20)
Monthly	1 (1)	8 (9)
Weekly	6 (7)	3 (4)
Daily	17 (20)	21 (24)
Other	3 (4)	3 (4)
Curtains/blinds cleaned		
Have none	13 (15)	18 (21)
Never	53 (62)	47 (55)
Once a year	6 (7)	9 (11)
Twice a year	2 (2)	4 (5)
Four times a year	5 (6)	3 (4)
Monthly	4 (5)	2 (2)
Weekly	1 (1)	1 (1)
Daily	1 (1)	2 (2)
Toys cleaned		
Never	0	1 (1)
Once a year	1 (1)	2 (2)
Four times a year	25 (29)	22 (26)
Monthly	26 (31)	14 (16)
Twice a month	2 (4)	3 (4)
Weekly	29 (34)	34 (40)
Daily	0	7 (8)
Other	1 (1)	3 (3)

Appendix 4.2: Outcomes specific to the intervention group only.

Appendix 4.2.1: Asthma accreditation programme.

"Space to Breathe" days in the intervention group consisted of an extensive range of educational resources and staff training around asthma (culminating in asthma accreditation of the preschool). The majority of staff working with 2–5-year-olds within each preschool attended the baseline training days, and the majority of preschools achieved their level one accreditation (Table S4). After the initial baseline "Space to Breathe" lesson, preschool were left to schedule the other eight lessons as and when they wished. Approximately a third of these additional resources/lessons were delivered by preschool staff during the year. Level two accreditation was achieved by less than 20% of the preschools. Consistent use of the bracelets to help identify children with asthma was relatively low and decreased with time.

Table S4: Preschool asthma accreditation programme

	Baseline N=85 (%)	**1 month N=85 (%)**	**12 months N=85 (%)**
Number of staff working with 2–5 year old children Mean (SD)	7 (4)	–	–
Number of staff working with 2–5 year old children, who attended the training Mean (SD)	6 (3)	–	–
Level 1 achieved	83 (98)	–	–
Level 2 achieved	–	15 (18)	7 (8)
Teaching resources were used	–	55 (66)	64 (76)
Only the first lesson delivered to children	–	39 (46)	13 (16)
Number of additional lessons delivered to children Mean (SD)	–	2.3 (1.5)	3.4 (2.1)
Bracelets were consistently used	–	29 (35)	8 (10)

SD: standard deviation.

Appendix 4.2.2: Change in confidence and understanding of asthma.

One of the aims of the study was to improve confidence and an understanding of asthma amongst preschool staff. At baseline and 12 months, the lead teachers were asked about their knowledge of asthma triggers, as well as their confidence in recognising asthma symptoms, and how to administer first aid in the event of an asthma attack. Answers were not normally distributed (ie they were skewed to the right), and thus median data are presented. At baseline teachers in both groups were relatively confident in their asthma understanding; however, by 12 months teachers in the intervention group were significantly more confident than their peers in the control group (Table S5).

Table S5: Lead teachers' asthma confidence at baseline.

	Baseline N=85 (%)			**12 months N=85 (%)**		
	Intervention median (IQR)	**Control median (IQR)**	**P value***	**Intervention median (IQR)**	**Control median (IQR)**	**P value***
Know how to recognise asthma symptoms[a]	4 (3–4)	4 (3–4)	0.773	5 (4–5)	4 (3–5)	0.003
Are confident that know asthma triggers[a]	3.5 (3–4)	3 (3–4)	0.670	5 (4–5)	4 (3–5)	0.0004
Are confident that can administer first aid for asthma attack[a]	4 (3–4)	4 (3–5)	0.422	5 (4–5)	4.5 (4–5)	0.006

* p-value comparing difference between groups using Mann–Whitney test.
[a] Measured using a Likert scale of 1 to 5, where 1 was "not very" and 5 was "very".
IQR: interquartile range.

Appendix 5: Additional results (children).

Appendix 5.1: Additional baseline variables.

Additional baseline variables related to asthma in children are presented below in Tables S6 and S7. In terms of other atopic reactions, a baseline imbalance was observed for eczema, hyperventilation, and reflux (Table S6).

Table S6: Prevalence of other atopic reactions, exposure to damp/mould, and vaccination history in participating children

	Intervention N=341 (%)	**Control N=334 (%)**
Eczema	**159 (47)**	187 (56)
Rhinitis	119 (35)	95 (28)
Hayfever	99 (29)	115 (34)
Sinusitis	30 (9)	44 (13)
Hyperventilation	4 (1)	15 (5)
Reflux	66 (19)	102 (31)
Live/play in mouldy, damp place	95 (28)	112 (34)
Immunised		
Fully	313 (92)	296 (89)
Partially	21 (6)	32 (10)
Don't immunise	5 (2)	6 (2)
Don't know	2 (1)	0 (0)
Vaccinated for flu during year	34 (10)	30 (9)

SD: standard deviation.

Guardians/caregivers were asked for their views on what were the key asthma triggers for their child, such that their child would begin wheezing, coughing, shortness of breath, or they would need to use a SABA if exposed. Having a cold or the flu were the key asthma triggers for their child, followed by changes in temperature/cold (Table S7). A baseline imbalance was observed for emotions/stress, food/drinks and cannabis exposure, as triggers. Overall, Māori children were found to have twice the risk of exposure to tobacco smoke in the last seven days compared with non-Māori children (34% vs 16%, respectively; p<0·001).

Table S7: Baseline prevalence of asthma triggers in participating children

	Intervention N=341 (%)	**Control N=334 (%)**
Emotions/stress	43 (13)	93 (28)
Animals	34 (10)	23 (7)
Exercise	145 (43)	147 (44)
Food/drinks	19 (6)	47 (14)
Cold/flu	308 (90)	324 (97)
Change in temperature/cold air	233 (68)	250 (75)
Exposed to non-flued gas heater in home	40 (12)	57 (17)
Dust/mites	87 (26)	82 (25)
Pain relief medication	0	11 (3)
Household over-crowding* Mean (SD)	1·6 (0·5)	1·5 (0·5)
Exposed to tobacco smoke in last seven days	66 (19)	71 (21)
Exposed to cannabis smoke in last seven days	1	5

SD: standard deviation.
* The number of people living in the household with the child divided by the number of rooms in the house where people sleep.

Appendix 5.2: Acute asthma event data.

Self-reported data on acute asthma events revealed under-reporting in both groups of acute asthma events over the 12-month study period, when compared to medical records (Table S8). Hospitalisations were over-reported in both groups, whilst general practitioner and emergency department visits were under-reported.

Table S8: Difference between self-reported and medical records for the primary outcome of at least one acute asthma event over the last 12 months

	Self-reported events				**Events from medical records**			
	Intervention (N=328)		**Control (N=332)**		**Intervention (N=341)**		**Control (N=334)**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
GP/ED	126	38.4	172	51.8	216	63.3	181	54.2
Hospitalisations	11	3.4	10	3.0	7	2.1	1	0.3
Overall	128	39.0	174	52.4	216	63.3	181	54.2

GP/ED: attendance at a general practitioner and/or emergency department.

Appendix 5.3: Inhaler technique and frequency of preventive inhaler use.

Children were assessed to see how good their use of an inhaler was, and spacer use for those children that had one for their medication. At baseline, only 40% of children were considered good at using their inhaler. A baseline imbalance was noted, with more children in the intervention group having poor technique compared with those in the control (p=0.002) (Table S9). The proportion of children with good inhaler technique was significantly higher after 12 months in the intervention group, compared to the control group (p<0.0001) (Table S9).

Only 18% of children were good at using their preventive inhalers each week (ie used twice a day, every day). The proportion of children with good use of preventive inhalers was significantly higher after 12 months in the intervention group compared to the control group (p<0.0001); (Table S9).

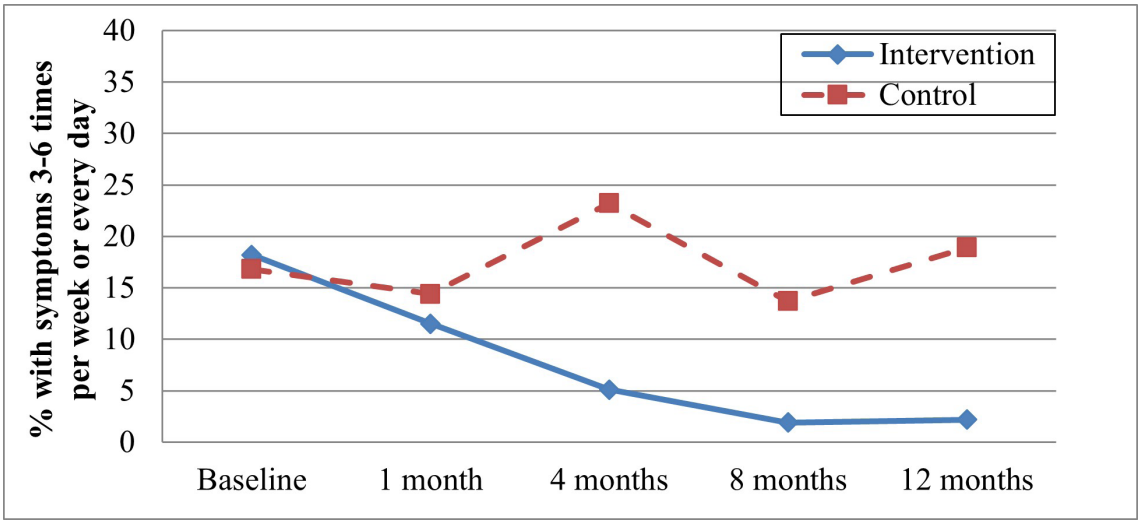
Table S9: Frequency of asthma medication use by children over time.

	Intervention N=341 (%)		**Control N=334 (%)**	
Inhaler technique	**Baseline**	**12 months**	**Baseline**	**12 months**
Good	118 (35)	259 (84)	150 (45)	169 (56)
Medium	157 (46)	41 (13)	147 (44)	79 (26)
Poor	66 (19)	9 (3)	36 (11)	53 (18)
Frequency of preventer use				
Good (twice daily)	51 (15)	112 (36)	68 (20)	62 (21)
Medium (miss ≤3 dose/week)	28 (8)	50 (16)	37 (11)	50 (17)
Poor (miss >3 doses/week)	102 (30)	75 (24)	57 (17)	53 (18)
Not applicable as didn't use	160 (47)	72 (23)	172 (52)	136 (45)

Appendix 5.4: Daytime asthma symptoms.

The proportion of children experiencing day-time asthma symptoms 3–6 times a week, or every day was significantly lower after 12 months in the intervention group compared to the control group (p<0.0001) (Figure S1).

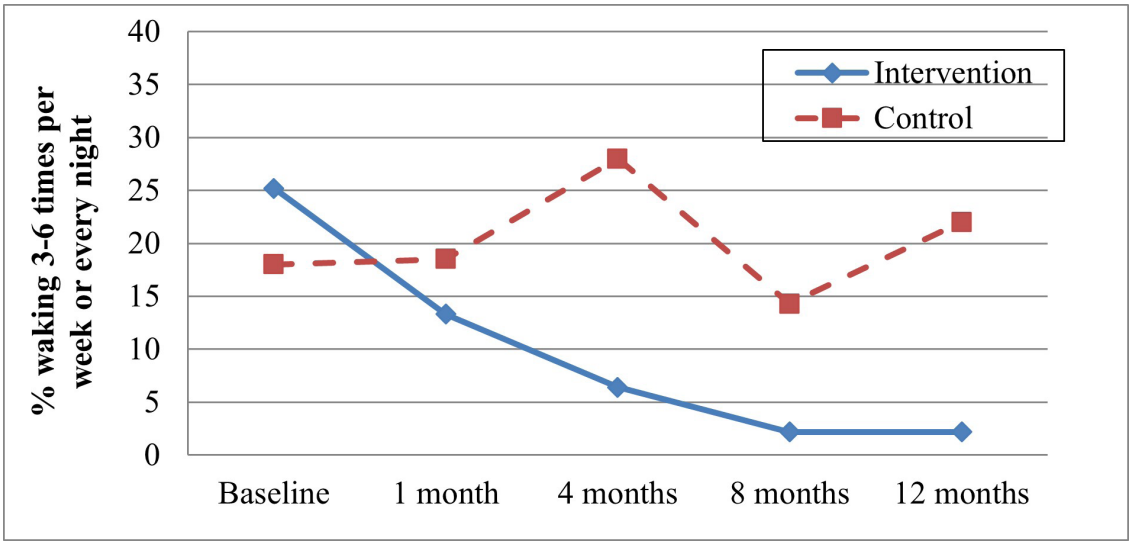
Figure S1: Children with frequent daytime asthma symptoms, over time.



Appendix 5.5: Night time waking due to asthma.

The proportion of children in the intervention group experiencing night time walking 3–6 times a week or every night due to asthma symptoms was significantly lower after 12 months, compared to the control group (P-value <0.0001) (Figure S2).

Figure S2: Children waking frequently with asthma symptoms, over time.



Appendix 5.6: Outcomes specific to the intervention group only.

Appendix 5.6.1: Recommended medication changes

Each GASP assessment reviewed asthma medication requirements and provided asthma education, based on international clinical guidelines. At the one-month visit, about a third of children in the intervention group had a change in medication recommended by the tool, and the guardians/caregivers were advised to take their child to their general practitioner, with a letter copied to the general practitioner (Table S10). Between 27–35% of guardians/caregivers did not take their child to their general practitioner despite a change in medication being recommended by the GASP tool. Reasons given were that they: had a lack of time; did not want to use an ICS; wanted to wait and observe their child's health; hadn't got around to it; did not want to see a locum; did not think their child had asthma; and/or could not afford to visit the GP. For those children that were taken to their general practitioner, the doctor made a medication change in almost 70% of cases (Table S10).

Table S10: Medication changes as a result of the GASP assessment

	1 month (n=322) n (%)	**4 months (n=313) n (%)**	**8 months (n=309) n (%)**	**12 months (n=309) n (%)**
Medication change recommended after GASP assessment	112 (35)	88 (28)	71 (23)	43 (14)
Guardian/caregiver took the child to the doctor	73 (65)	56 (64)	52 (73)	28 (65)
Doctor made medication changes	49 (67)	40 (71)	37 (71)	20 (71)

Appendix 5.6.2: Medication reminders.

As part of the programme, guardians/caregivers in the intervention group were offered the choice of a medication reminder service if their child was on an ICS. The services consisted of free text messages sent at specified times (selected by 114 or 33%), or assistance to set-up a clock alarm (selected by 124 or 36%) or a phone alarm (selected by one guardian/caregiver). There was no difference by ethnicity in the proportion of guardians/caregivers that chose text messages or use of the clock alarm (p=0.630).

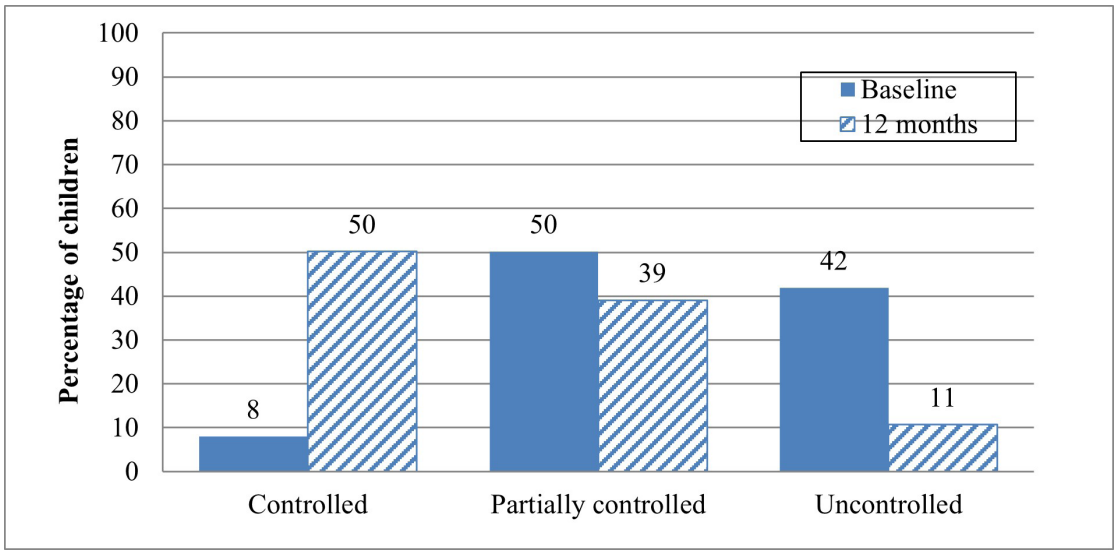
The medication reminder service was more likely to be used by guardians/caregivers who had children with uncontrolled asthma (49% who used the reminders vs the 29% who did not use the reminders; p=0.019). The proportion of children with uncontrolled asthma at 12 months was the same in those who used medication reminders compared with those who did not (11%). Just over half of guardians/caregivers were still using the reminders at one month (189, 57%), decreasing to 12% (36) at four months and 2% (6) at eight months. When asked how useful the reminders were on a scale of 1–5, where one was "not at all" and five was "very", answers were very polarised. At one month 58% of guardians/caregivers rated them as a one, 7% gave a rating of 2–4, and 34% rated them as a five. Results at four months were similar (1=58%; 2-4=8%; 5=33%). However, by eight months, five of the six who were using reminders rated them at 1, and one rated them at 5. Free text comments about the reminder service were provided by 13 guardians/caregivers at one month and all were favourable stating they "found it very useful", children "loved the stories", they "involved the whole family", they helped to "establish a routine", and they were especially helpful if the child was away from home.

Approximately a third of children on an ICS (105, 33%) used the "everyday" charts at one month. Although the children had been told to only use them for a month, 19 (4%) were still using them at four months. Issues with using the everyday chart included: children finding it hard to scratch off the surface and so they gave up; children scratched off everything at once or more than one day at a time; the paper was too thin and so tore easily; other family members used the chart instead; loss of the chart; and loss of interest with time (ie the novelty wore off).

Appendix 5.6.3: Asthma control.

At baseline, asthma control (as measured by the GASP tool) was similar for those children that had a diagnosis of asthma and those that had a high probability of asthma (p=0·095). Less than 10% of children in the study had "controlled" asthma at baseline. Māori and Pacific children were significantly more likely to have "uncontrolled" asthma at baseline, compared with children of other ethnicities (51%, 59%, 35%, respectively; p=0·001). Asthma control improved in the intervention group over time, with 58% of children having "controlled" or "partially controlled" asthma at baseline, increasing to 89% at 12 months (p=0·025) (Figure S3). This improvement in asthma control was observed across all ethnic groups.

Figure S3: Change in asthma control (intervention group only).



Comparing uncontrolled to controlled/partially controlled–change from baseline to 12 months, p=0.025.
Controlled – all of the following: no daytime symptoms (twice or less per week), no limitations on activities, no nocturnal waking, no use of a reliever or rescue testament (twice or less per week) and no exacerbations.
Partially controlled – presence of any of the following: daytime symptoms (more than twice a week), limitations on activities, nocturnal waking, use of a reliever or rescue testament more than twice a week, one or more exacerbations each year.
Uncontrolled – presence of three or more of the features of partly controlled asthma present in any week.

Appendix 5.7: Absenteeism from preschool and work overtime.

Guardians/caregivers were asked about absenteeism of their child from preschool and usual activities due to asthma, and their own absenteeism from work as a result of their child's asthma. Data were non-normally distributed and so median data are presented.

No significant difference was found in the median change from baseline, in the number of sessions missed between the treatment (median=3; IQR=2-6) and control group (median=4; IQR=2-7) after 12 months (p=0.080). Furthermore, no significant difference between the two groups was found after 12 months in the median change from baseline, in the number of times their child had to miss any other usual activities because of their asthma (intervention: median=2; IQR=1–4; control group: median=2; IQR=1–4; p=0.642).

No significant difference between the two groups was found after 12 months in the median change from baseline in the number of days guardians/caregivers had to take off work because of their child's asthma (intervention: median=2; IQR=1–4; control group: median=2; IQR=1–4; p=0.646). Furthermore, no significant difference between the two groups was found after 12 months in the median change from baseline in the number of times guardians/caregivers had to miss any other usual activities because of their child's asthma (intervention: median=2; IQR=1–4; control group: median=2; IQR=2–4; p=0.343).

Appendix 5.8: Quality of life.

Guardians/caregivers were asked the TAPQoL as a measure of their child's quality of life, as the children were too young to be asked these questions directly. Each subscale of the TAPQoL ranges from 0–100, with higher scores indicative of better quality of life. At baseline 317 (93%) guardians/caregivers in the intervention group and 214 (64%) in the control group completed the questionnaire. At 12 months, 297 (96%) guardians/caregivers in the intervention group and 203 (67%) in the control group completed the questionnaire. There were no significant changes from baseline to 12 months for the majority of the subscales, with the exception of the sleeping, skin, motor skills and communication subscales which showed significantly greater improvement in these attributes in the intervention group compared with the control group (Table S11).

Table S11: Change from baseline to 12 months in TAPQoL scores[a]

Scales	Baseline Mean (SE)	12 months Mean (SE)	ANOVA[a] Mean difference (95% CI)	P-value
Sleeping	21.7 (1.4)	14.6 (1.8)	7.1 (2.5–11.6)	0.0023**
Appetite	11.0 (1.1)	9.0 (1.5)	2.0 (-1.7–5.6)	0.2864
Lungs	16.2 (1.2)	12.5 (1.5)	3.7 (-0.1–7.5)	0.0589
Stomach	5.3 (1)	4 (1.3)	1.3 (-1.9, 4.5)	0.417
Skin	6.9 (1)	3.3 (1.3)	3.6 (0.3, 6.9)	0.032*
Motor skills	2.4 (0.5)	0.7 (0.7)	1.7 (0, 3.3)	0.048*
Social	1.7 (0.9)	1.9 (1.2)	-0.2 (-3.1, 2.7)	0.892
Problems	4.6 (1)	3.2 (1.3)	1.4 (-1.9, 4.7)	0.395
Communication	4.6 (0.7)	2.3 (0.9)	2.4 (0.2, 4.5)	0.033*
Anxiety	2.1 (1.3)	0.2 (1.6)	1.9 (-2.1, 6)	0.348
Positive mood	0.2 (0.9)	-0.5 (1.2)	0.7 (-2.3, 3.7)	0.665
Liveliness	1.3 (0.9)	1.2 (1.1)	0.2 (-2.7, 3)	0.905

[a] Change from baseline in TAPQoL scores was analysed using linear mixed models with ECE centre fitted as a random effect.
SE: standard error.

Appendix 5.9: Participant satisfaction.

The study was well received by both preschool teachers and guardians/caregivers of the children involved, with those in the intervention group reporting more positive views than those in the control group for all outcomes except the effectiveness of the curriculum material (Table S12).

Table S12: Participant's views on the study after 12 months

Lead teachers' views	**Intervention N=85**	**Control N=86**	**T-test P-value**
How helpful have you found this study for staff? [a]			
Mean (SD)	4.3 (0.8)	3.1 (1.2)	<0.0001
Median (IQR)	5 (4–5)	3 (2–4)	
How helpful have you found this study for the children? [a]			
Mean (SD)	4.0 (0.9)	3.0 (1.2)	<0.0001
Median (IQR)	4 (3–5)	3 (2–4)	
How satisfied are you with how the study was run? [a]			
Mean (SD)	4.5 (0.8)	3.9 (1.1)	0.0001
Median (IQR)	4 (4–5)	4 (3–5)	
How effective was the curriculum? [a]			
Mean (SD)	4.2 (0.8)	4.1 (0.9)	0.3789
Median (IQR)	4 (4–5)	4 (4–5)	
How user-friendly were the resources? [a]			
Mean (SD)	4.5 (0.7)	4.2 (0.9)	0.0137
Median (IQR)	5 (4–5)	4 (4–5)	
Guardians/caregivers views	**Intervention N=309**	**Control N=301**	**T-test P-value**
How satisfied are you with how the study was run? [a]			
Mean (SD)	4.9 (0.4)	4.5 (0.8)	<0.0001
Median (IQR)	5 (5–5)	5 (4–5)	

[a] Measured using a Likert scale of 1 to 5, where 1 was "not very" and 5 was "very".
SD: standard deviation.
QR: interquartile range.

APPENDIX

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