Development of guidelines for mitigating the health effects of Desert Dust Storms in asthmatic children

Preliminary results of the LIFE MEDEA study

MITIGATING THE HEALTH EFFECTS OF DESERT DUST STORMS USING EXPOSURE-REDUCTION APPROACHES- THE MEDEA STUDY

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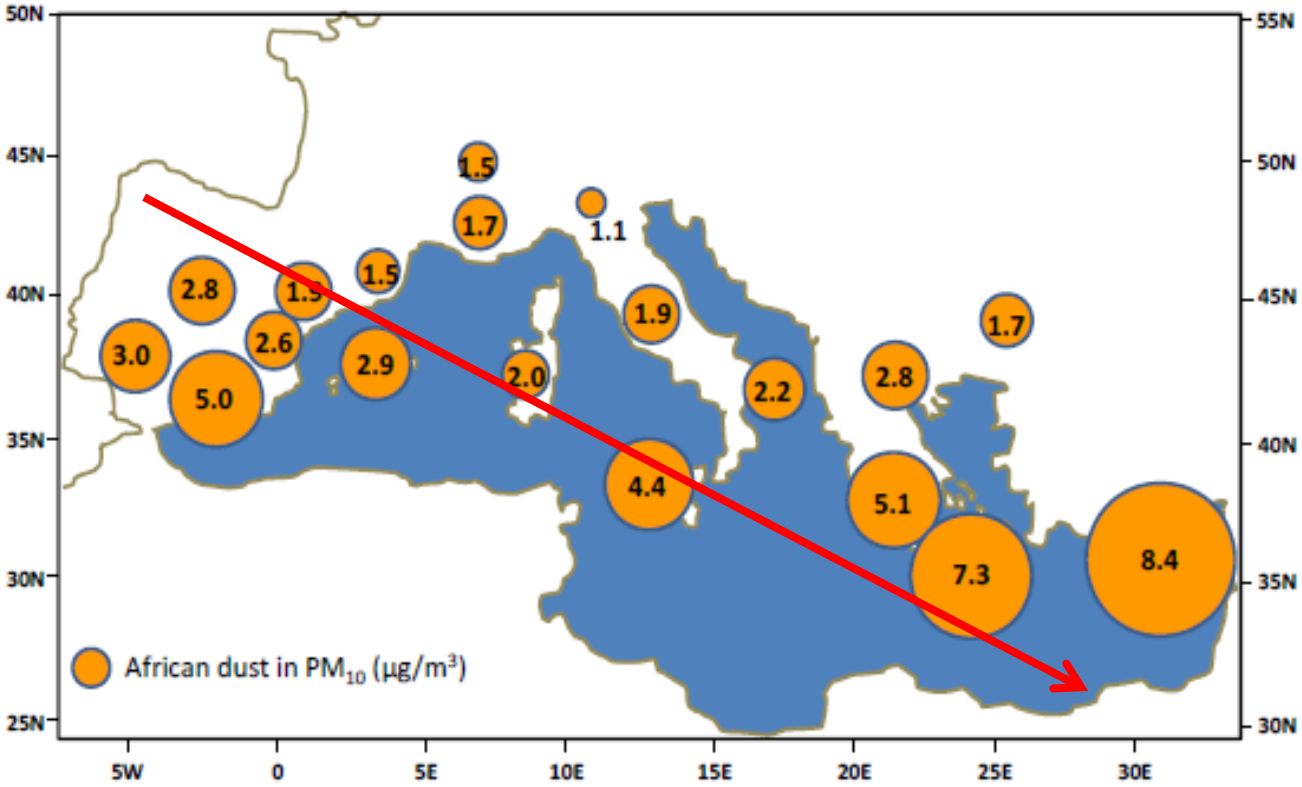
Desert Dust Storms in the Mediterranean region



Frequency and intensity increase in a NW -> SE direction (period 2001-2011)

(Cyprus, Crete and Middle East strongly affected)

Pey et al., 2013

LIFE MEDEA

Project Aim

The LIFE MEDEA primary aim is to provide the necessary evidence, develop a strategic plan for mitigating the health effects of Desert Dust Storms through exposure reduction approaches and inform accordingly EU decision centres.

Towards this aim, the LIFE MEDEA project takes place in three desert dust storm affected areas (Cyprus, Crete and Israel) and the following specific objectives were specified ->

LIFE MEDEA project
Special Objectives

1. Demonstrate that is possible to employ models for early Desert Dust Storm event forecasting and early public notification, with a focus on susceptible individuals.
2. Design applicable and viable guidelines for exposure reduction to be implemented during Desert Dust events.
3. Provide evidence of the feasibility and effectiveness of these guidelines in reducing exposure and mitigating the health effects of desert dust storms in groups of Atrial Fibrillation (heart disease) and children with Asthma.
4. Effectively disseminate the project results among competent authorities, scientific communities, social stakeholders and the general public in Cyprus, Crete and Israel as well as selected stakeholders in other Desert Dust Exposed regions of south-eastern Europe.

MEDEA asthma panel study

Inclusion criteria:

- Children with active asthma from primary schools in Nicosia/Limassol (Cyprus) and Heraklion (Crete)
- 6-11 years old
- Clinician diagnosis of asthma in combination with:
  - Daily asthma preventive medication
  - Unscheduled clinician visits for asthma during the last 12 months
  - Wheezing episodes during the last 12 months

Year of study

- 2019
- 2020 – Year COVID-19
- 2021

Participants randomised in 1:1:1 ratio in three parallel intervention legs:

- α) No intervention (controls)
- β) Outdoor intervention only
- γ) Outdoor and indoor intervention (combined intervention)

Asthma panel study

Indoor & Outdoor Air Quality measurements:

- Home

- Schools

DDS events

- Forecasting
- Measurements

Clinical Data:

- ACT questionnaire
- Medication use
- Clinician visits
- Spirometry & FeNO
- Aeroallergens

Bidirectional online platform

Data analysis

DDS alert and exposure reduction guidelines

Physical activity & GPS data:

- Accelerometer
- Pulse rate
- Time spent in indoor environment

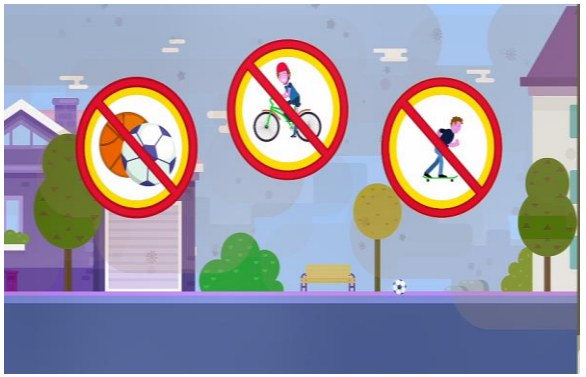
Parents
Email, SMS & mobile app notification

Teachers
Email, SMS & mobile app notification

Exposure reduction guidelines

Applicable and viable guidelines for exposure reduction during DDS:

- ✓ Limit time spend outdoors
- ✓ Limit physical activity
- ✓ Reduce exposure in indoor environment
  - Minimise ventilation
  - Use of indoor air cleaning devices
    - Homes and classrooms
    - Filter and remove suspended particles, other pollutants, microbes and odours (HEPA filters)



Recruitment of asthmatic children

1ο year of study (2019)

- 91 children participated (Cyprus: n=39, Crete: n=52)

2ο year of study (2020)

- 108 children participated (Cyprus: n=53, Crete: n=55)
- Covid-19 pandemic

3ο year of study (2021)

- 91 children participated (Cyprus: n=50, Crete: n=41)

Assessment of compliance to guidelines (GPS, Accelerometer)

Participants were equipped with smartwatch during the period of February – May 2019/2021, recording:

- Pulse rate
- Physical activity
- Calories
- GPS

Assessment of clinical parameters Asthmatic children

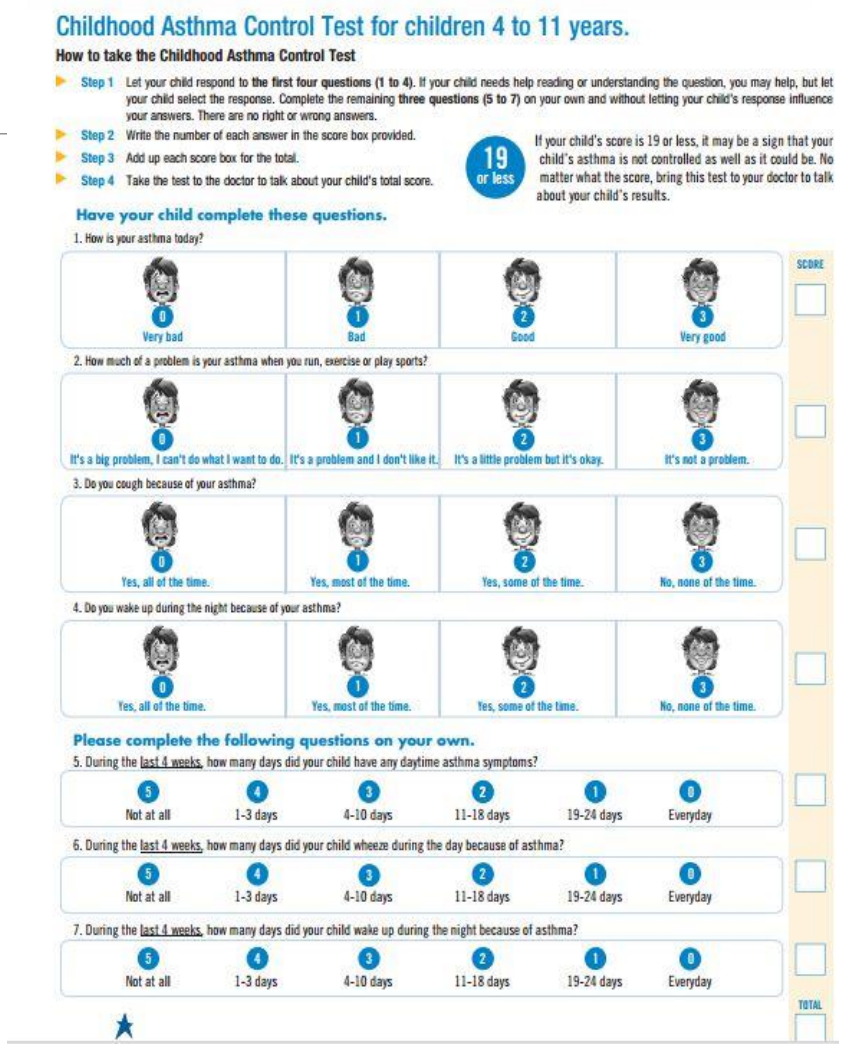
Clinical parameters were assessed every month during the high DDS period.

Main Outcome:

- Telephone Asthma Control Test (ACT):
  - Validated Greek version
  - Information on asthmatic symptoms during the day and night are collected based on the answers of parents and children

Secondary outcomes:

- Asthma medication
- Unscheduled clinician visits for asthma



Childhood Asthma Control Test for children 4 to 11 years.

How to take the Childhood Asthma Control Test

- Step 1 Let your child respond to **the first four questions (1 to 4).** If your child needs help reading or understanding the question, you may help, but let your child select the response. Complete the remaining **three questions (5 to 7)** on your own and without letting your child's response influence your answers. There are no right or wrong answers.
- Step 2 Write the number of each answer in the score box provided.
- Step 3 Add up each score box for the total.
- Step 4 Take the test to the doctor to talk about your child's total score.

19 or less

If your child's score is 19 or less, it may be a sign that your child's asthma is not controlled as well as it could be. No matter what the score, bring this test to your doctor to talk about your child's results.

Have your child complete these questions.

1. How is your asthma today?

0	1	2	3	SCORE
Very bad	Bad	Good	Very good	

2. How much of a problem is your asthma when you run, exercise or play sports?

0	1	2	3	
It's a big problem, I can't do what I want to do.	It's a problem and I don't like it.	It's a little problem but it's okay.	It's not a problem.	

3. Do you cough because of your asthma?

0	1	2	3	
Yes, all of the time.	Yes, most of the time.	Yes, some of the time.	No, none of the time.	

4. Do you wake up during the night because of your asthma?

0	1	2	3	
Yes, all of the time.	Yes, most of the time.	Yes, some of the time.	No, none of the time.	

Please complete the following questions on your own.

5. During the last 4 weeks, how many days did your child have any daytime asthma symptoms?

5	4	3	2	1	0	
Not at all	1-3 days	4-10 days	11-18 days	19-24 days	Everyday	

6. During the last 4 weeks, how many days did your child wheeze during the day because of asthma?

5	4	3	2	1	0	
Not at all	1-3 days	4-10 days	11-18 days	19-24 days	Everyday	

7. During the last 4 weeks, how many days did your child wake up during the night because of asthma?

5	4	3	2	1	0	
Not at all	1-3 days	4-10 days	11-18 days	19-24 days	Everyday	

TOTAL

Participating asthmatic children

In total 182 participants (excluding year 2020)

- Cyprus: 89 participants
- Crete: 93 participants

	Intervention Groups			
Study area	**Control**	**Outdoor intervention**	**Combined intervention**	**Total number of participants**
Cyprus	34	24	31	89
Greece	33	25	35	93
Total	67	49	66	182

Characteristics of asthmatic children

		All participants (n=89)	Controls (n=34)	Outdoor intervention (n=24)	Combined intervention (n=31)	Statistical significance
Male (%)		60/89 (67.4%)	21/34 (61.8%)	15/24 (62.5%)	24/31 (77.4%)	0.338
Age		9.63 (1.58)	9.69 (1.68)	9.57 (1.48)	9.60 (1.59)	0.964
Weight*		35.90 (20.0-99.9)	36.1 (20.0-96.0)	38.65 (20.6-84.0)	31.7 (21.5-99.9)	0.232
Height		138 (113.4-169.0)	140.0 (117.0-165.5)	139.75 (113.4-168.6)	136.75 (120.0-169.0)	0.546
BMI		18.56 (13.14-35.05)	18.60 (14.27-35.05)	20.11 (13.14-29.55)	17.20 (13.43-34.98)	0.132
% Atopic		45/77 (58.4%)	19/31 (61.3%)	12/19 (63.2%)	14/27 (51.9%)	0.684
Asthma severity	Severity 1:	38/89 (42.7%)	20/34 (58.8%)	9/24 (37.5%)	9/31 (29%)	0.135
	Severity 2:	42/89 (47.2%)	12/34 (35.3%)	13/24 (54.2%)	17/31 (54.8%)	
	Severity 3:	9/89 (10.1%)	2/34 (5.9%)	2/24 (8.3%)	5/31 (16.1%)	

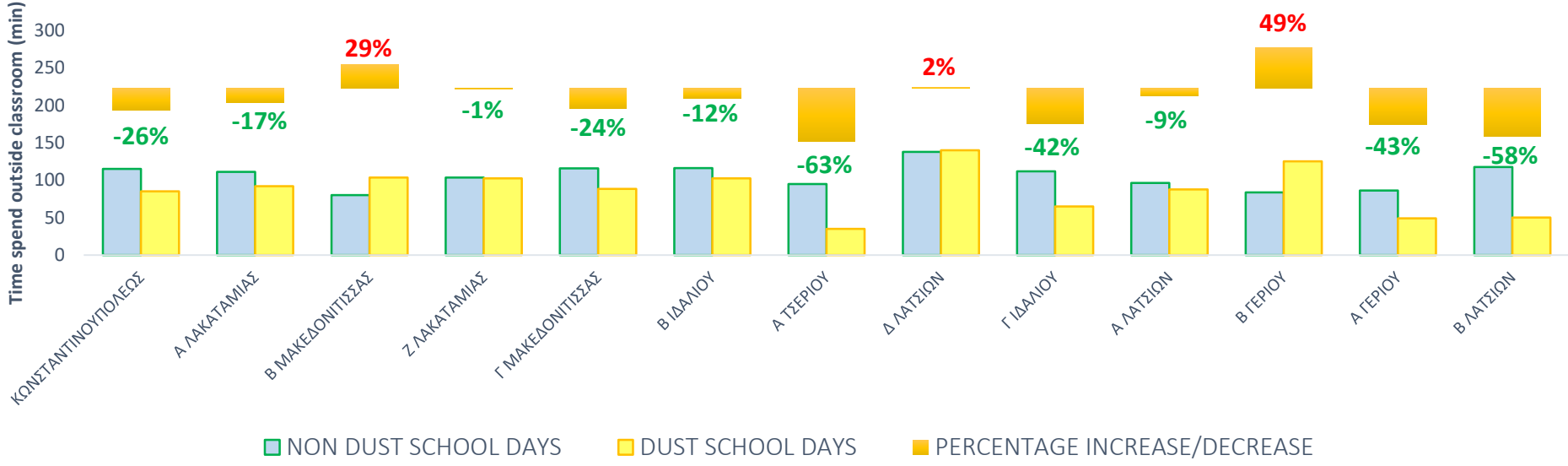
Compliance with guidelines During the schooldays

Times spend outside classrooms

	Controls	Outdoor	Combined
NON DUST DAYS	106	98	109
DUST DAYS	96	80	81
	-9%	-18%	-26%

Steps outside classrooms

	Controls	Outdoor	Combined
NON DUST DAYS	4960	4576	5518
DUST DAYS	4174	4268	5102
	-16%	-7%	-8%



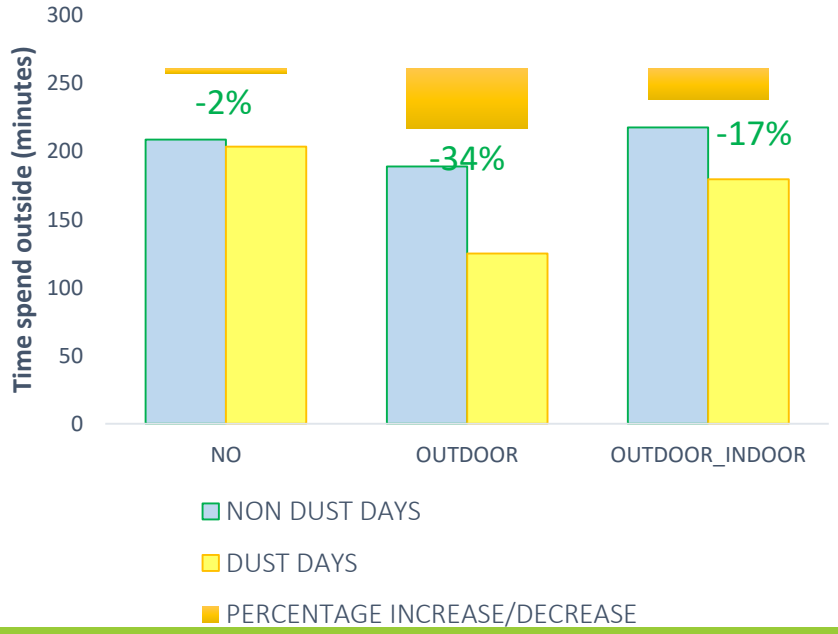
Compliance with guidelines outside areas (except school hours)

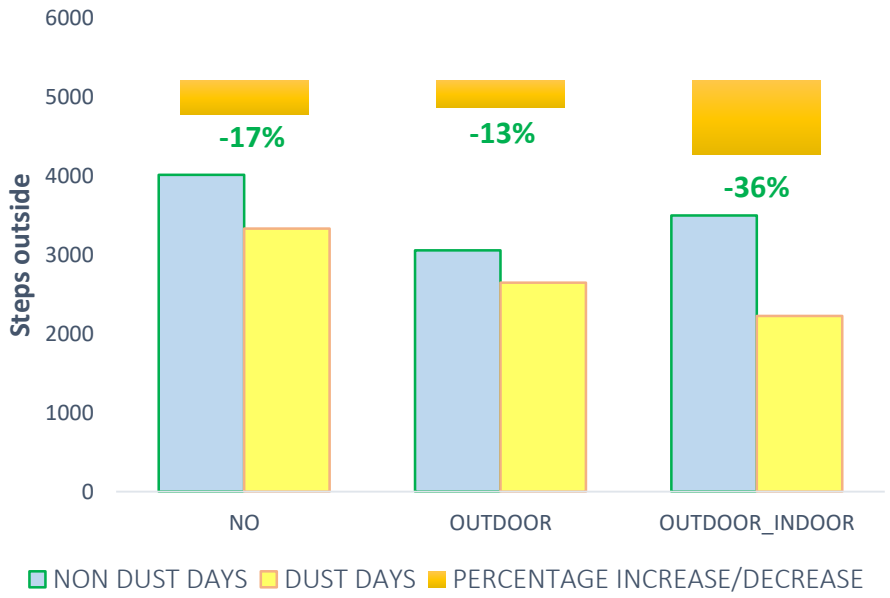
Time spend outside (non school hours)

	CONTROL	OUTDOOR	COMBINED
NON DUST DAYS	209	189	218
DUST DAYS	204	125	180
	-2%	-34%	-17%

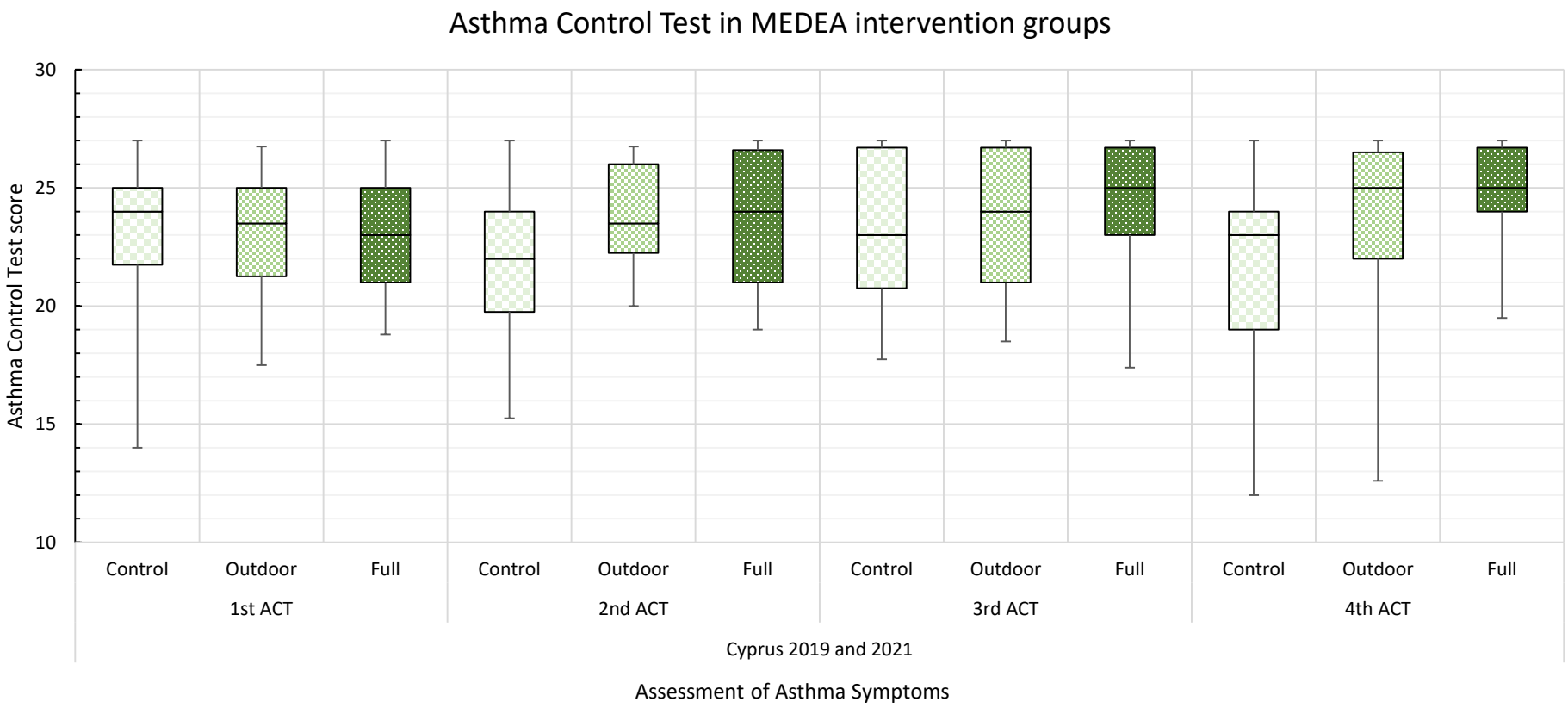
Steps outside (non school hours)

	CONTROL	OUTDOOR	COMBINED
NON DUST DAYS	4016	3059	3502
DUST DAYS	3334	2649	2227
	-17%	-13%	-36%





Impact of MEDEA intervention in asthma symptom control (Asthma Control Test)



Impact of MEDEA intervention in asthma symptom control (Asthma Control Test)

Statistical model (linear mixed model) adjusted for age, gender, BMI, asthma severity and study year)

Parameter	Intervention	Intercept	Statistical significance	Coefficient	Statistical significance
ACT Score	Controls	24.5 (21.7 -27.0)	-	-0.18	-
	Any intervention	24.6 (20.4-27.0)	0.840	0.62	0.019

Impact of MEDEA intervention in asthma symptom control (Asthma Control Test)

Among atopic and non-atopic asthmatic children

Parameter	Intervention	Intercept	Statistical significance	Coefficient	Statistical significance
ACT Score (Atopic)	Controls	24.8 (21.1 -27.0)	-	-0.57	-
	Any intervention	24.4 (18.7-27.0)	0.658	1.14	0.001

Parameter	Intervention	Intercept	Statistical significance	Coefficient	Statistical significance
ACT Score (Non - atopic)	Controls	23.2 (18.3 -27.0)	-	0.51	-
	Any intervention	24.0 (16.7-27.0)	0.503	-0.07	0.876

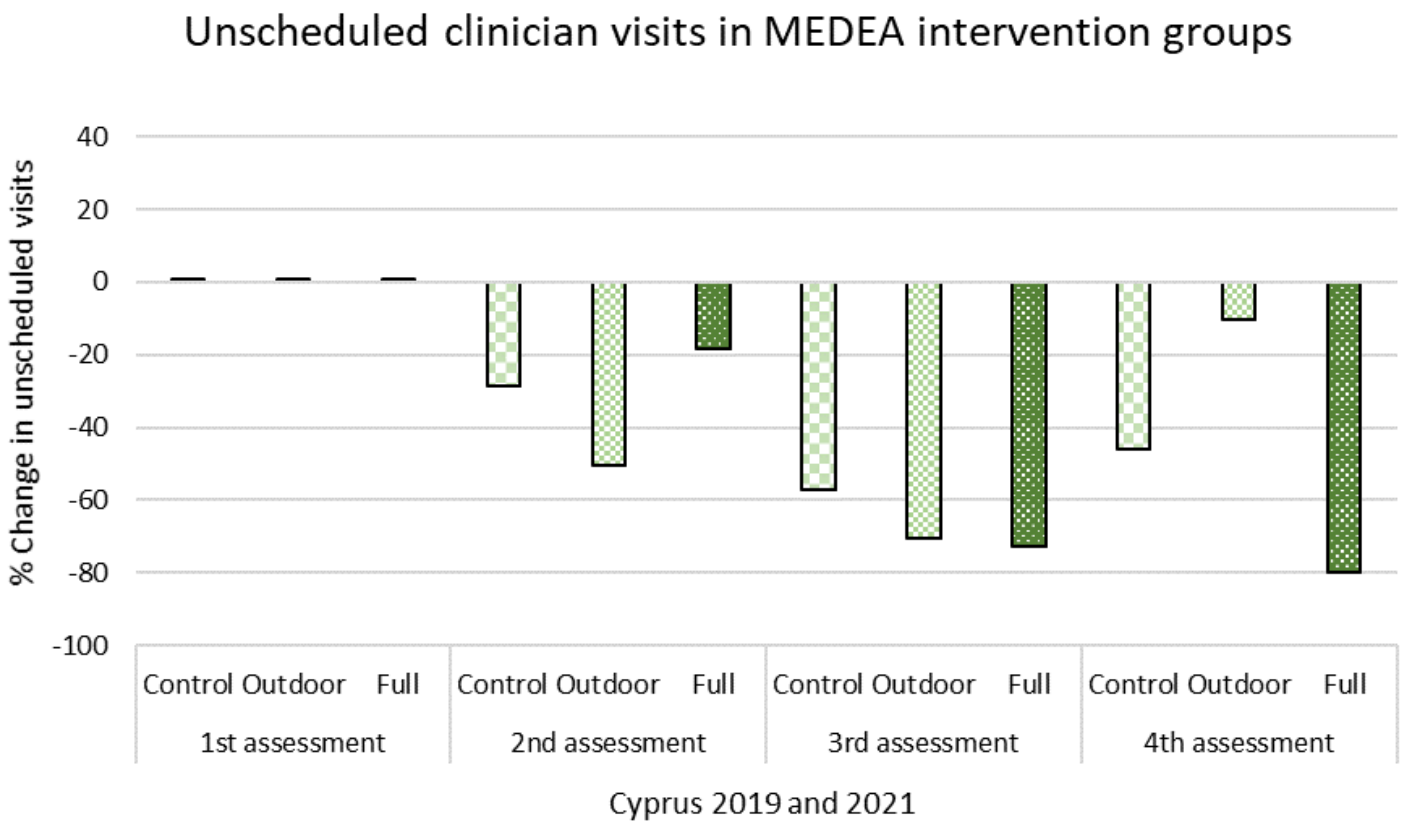
Statistical model (linear mixed model) adjusted for age, gender, BMI, asthma severity and study year)

Impact of MEDEA intervention in asthma symptom control (Asthma Control Test)

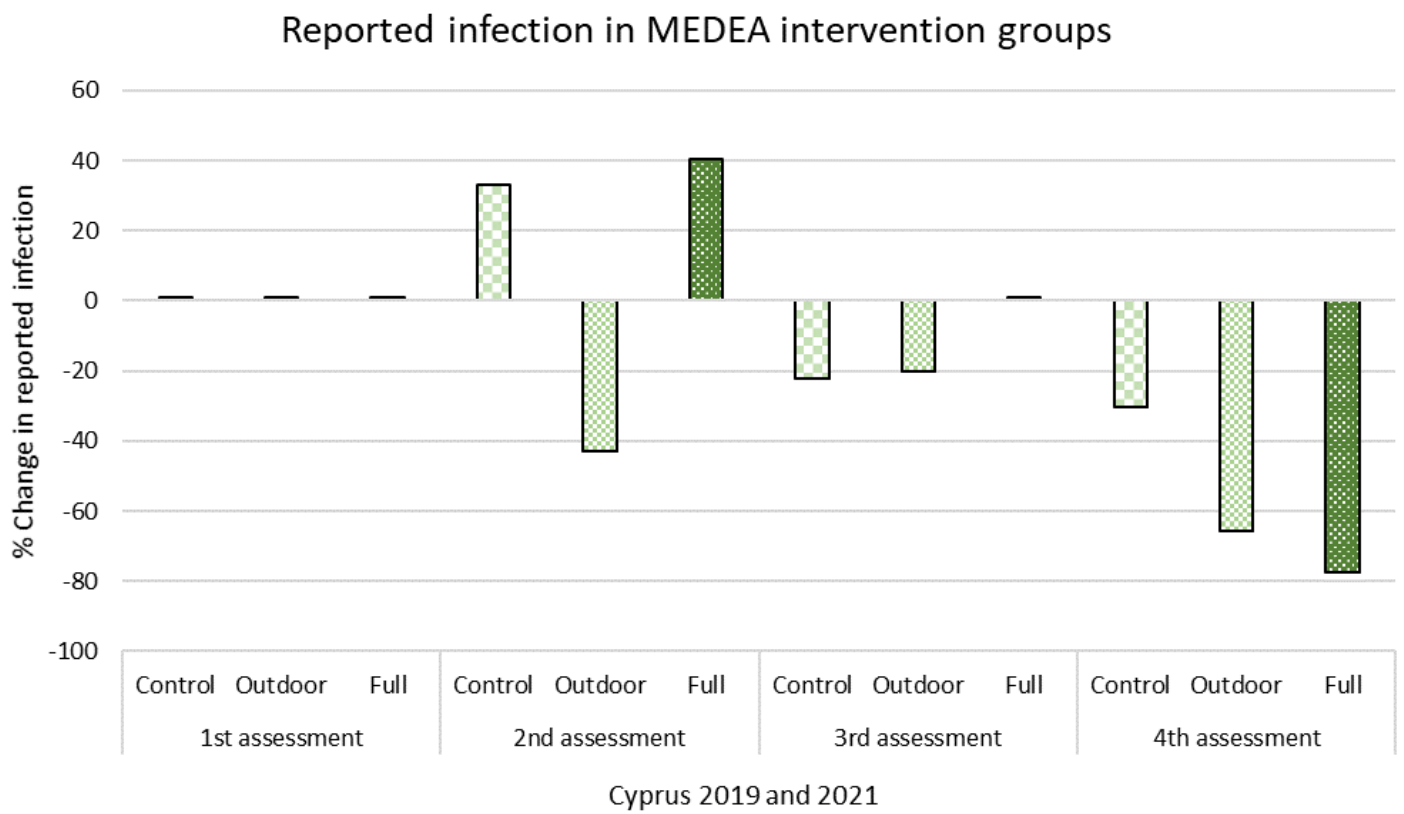
Statistical model (linear mixed model) adjusted for age, gender, BMI, asthma severity and study year)

Parameter	Intervention	Intercept	Statistical significance	Coefficient	Statistical significance
ACT Score	Controls	24.4 (21.7 -27.0)	-	-0.18	-
	Outdoor intervention	25.1 (20.7-27.0)	0.397	0.35	0.274
	Combined intervention	24.2 (18.9-27.0)	0.744	0.84	0.005

Impact of MEDEA intervention on likelihood on likelihood of unscheduled clinician visits for asthma



Impact of MEDEA intervention on likelihood of reported respiratory infection



Take home messages

- Asthma panel study completed in Cyprus
  - In Crete, completion is expected in December 2021.

- Partial compliance of asthmatic children to exposure reduction guidelines.

- Compared to controls, children participating in intervention groups demonstrated:
  - Clinically and statistically significant improvement in asthma symptom control (ACT test).
  - Improvement, primarily observed in children with atopy and in children undergoing in the combined intervention group (guidelines and air cleaner)
  - Evidence of reduction in respiratory infections
  - Evidence of reduction in the likelihood of unscheduled clinician visits.

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LIFE MEDEA literature:

- https://doi.org/10.1186/s12887-020-02472-4
- https://doi.org/10.1038/s41598-021-85358-4
- https://doi.org/10.1016/j.scitotenv.2020.136693

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