
DTU

The indoor environment in Danish classrooms and its associaton with pupil wellbeing and performance

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Schools in Denmark

1.289

Schools

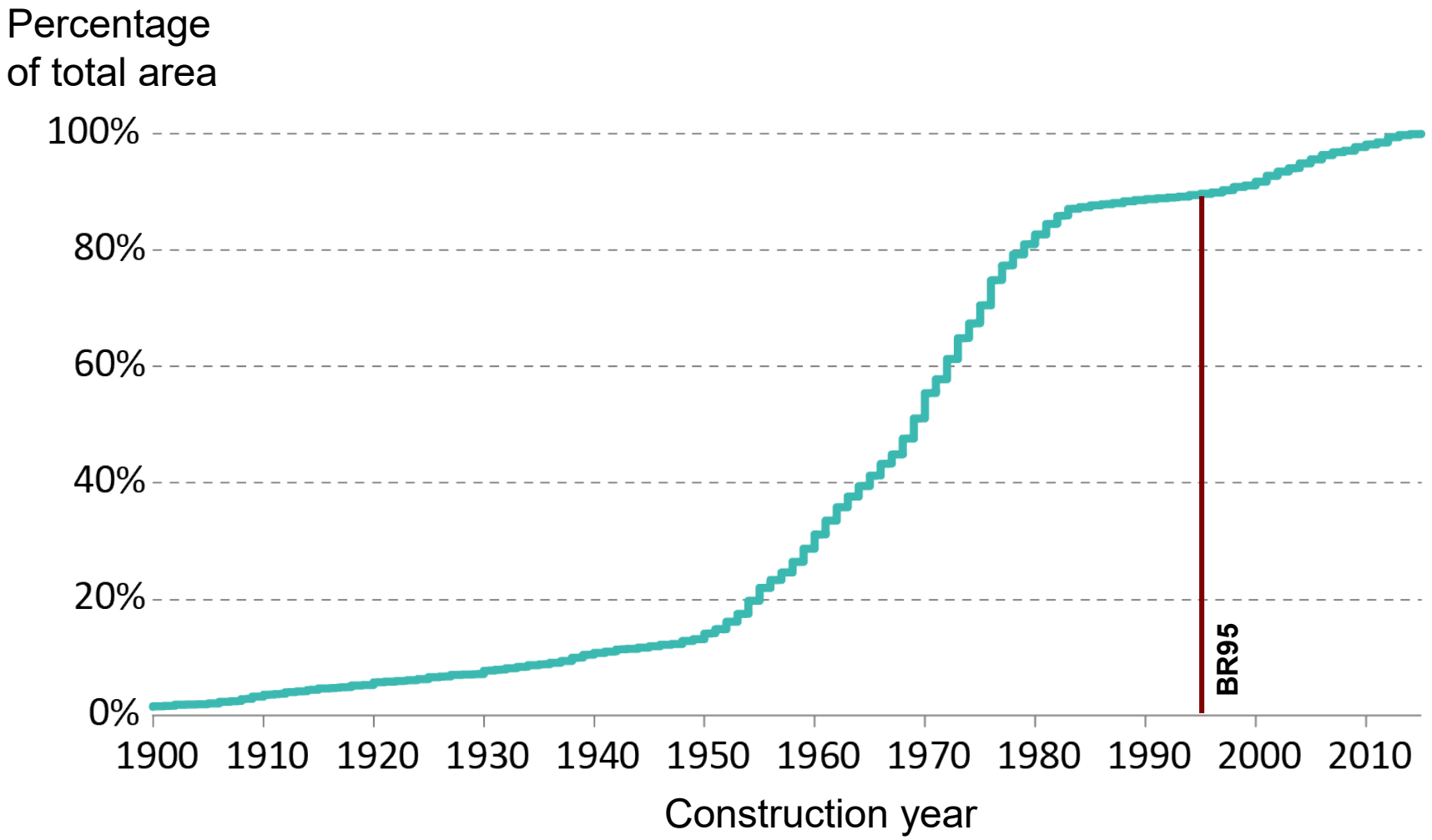
537.097

pupils

55.825

teachers

School buildings in Denmark – construction year

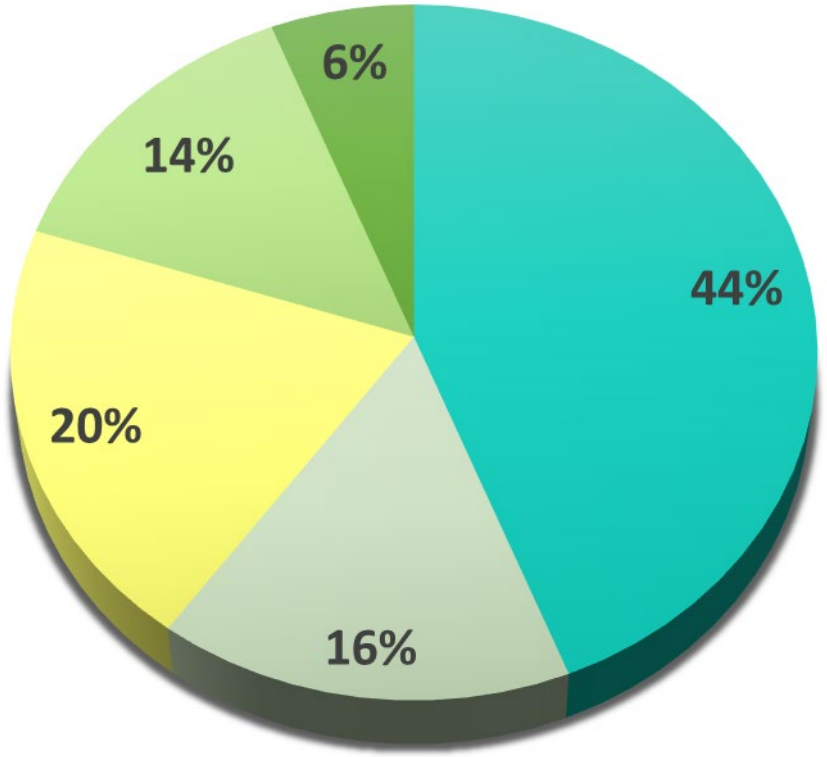


IAQ in Danish schools (2009)

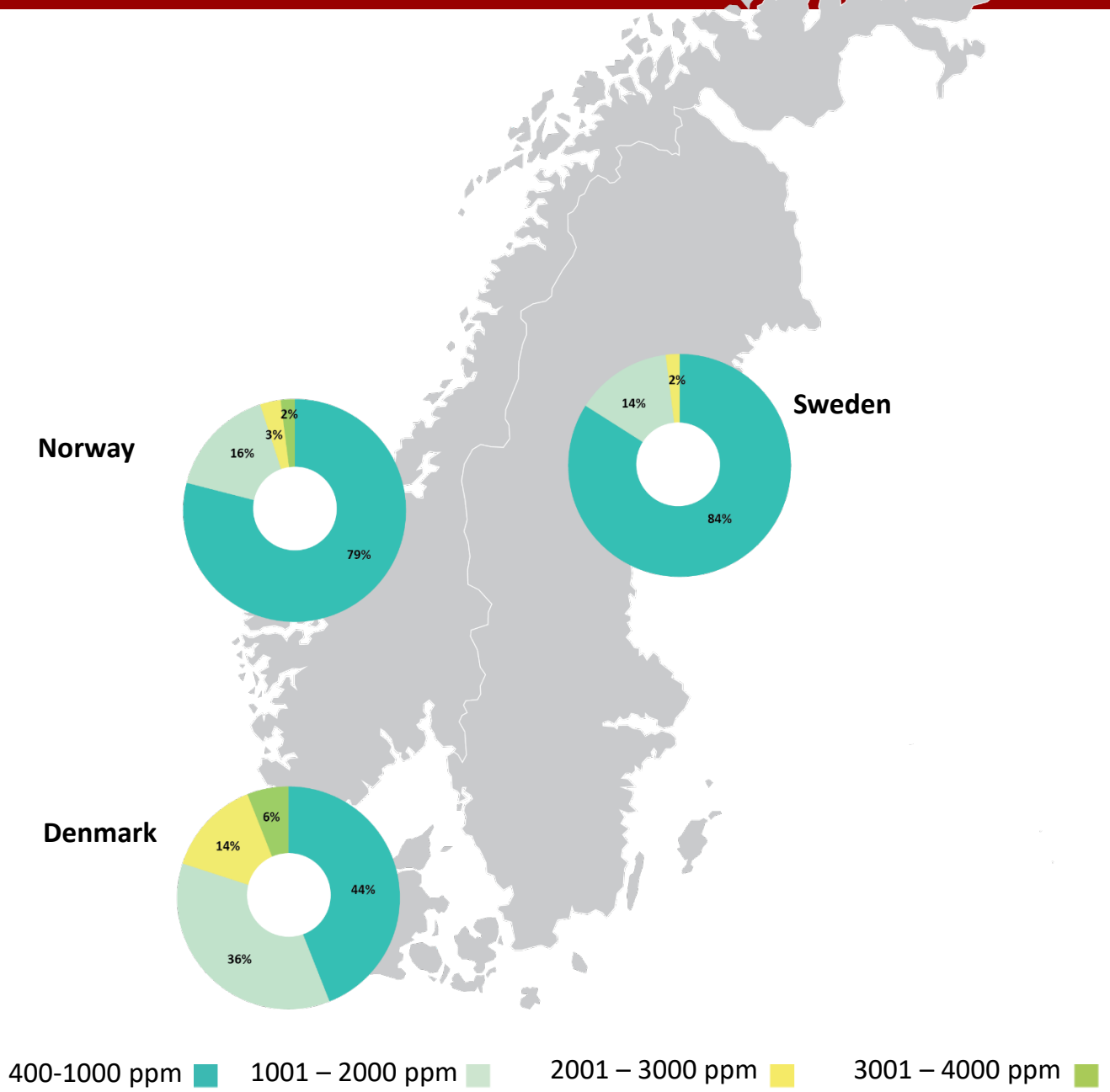
Spot measurements in classrooms in Denmark, Sweden and Norway

(800 classrooms in Denmark)

CO_2 concentration (2009)

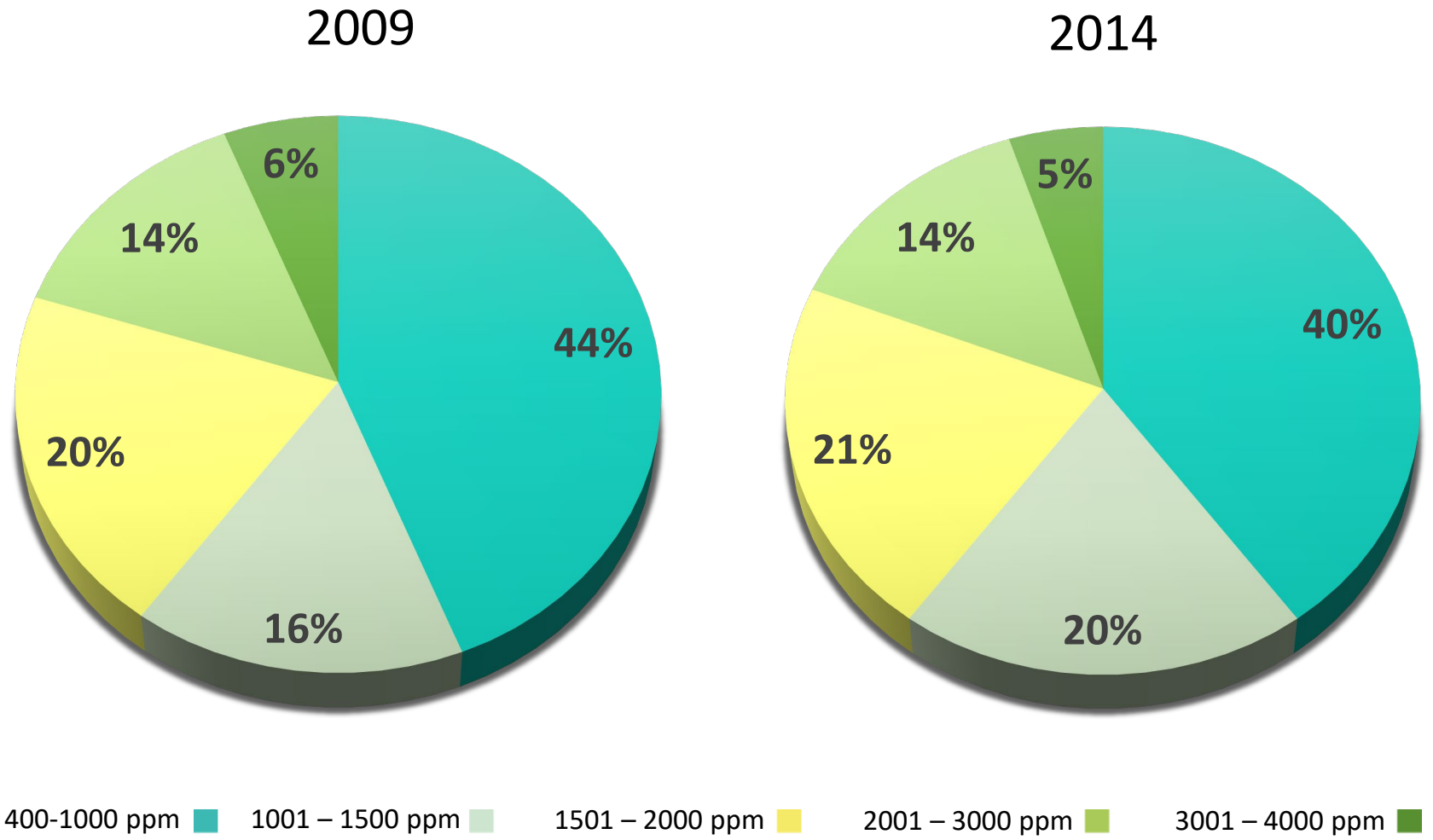


400-1000 ppm 1001 – 1500 ppm 1501 – 2000 ppm 2001 – 3000 ppm 3001 – 4000 ppm


Norway
2%
3%
16%
79%
Sweden
2%
14%
84%
Denmark
6%
14%
44%
36%
400-1000 ppm
1001 – 2000 ppm
2001 – 3000 ppm
3001 – 4000 ppm

IAQ in Danish schools – another round of measurements in 2014….

CO_2 concentration



Aim of the experiment in 2021

To explore the effect on the indoor environment, pupil wellbeing and concentration performance of airing the classroom

Experimental design

Two experiment days in two successive weeks in November/December 2021:

Day 1 or 8

Uninstructed behavi… …assroom windows kept closed during the experiment lesson.

"As usual"

Day 8 or 1

Pupils instructed to leave the c… …om in the break prior to carrying out the measurements and carefull… …ut the room during the break. Classroom windows kept closed during the e… …ment lesson.

"With airing"

The order or the two behaviour patterns was randomly balanced between classes

Study components

At classroom level:

- Measurement of indoor environment parameters

- Building checklist

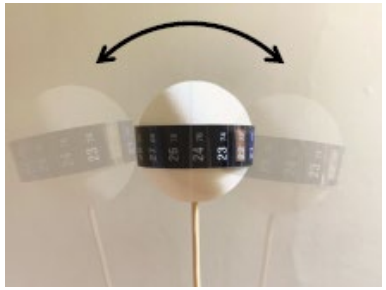
At pupil level:

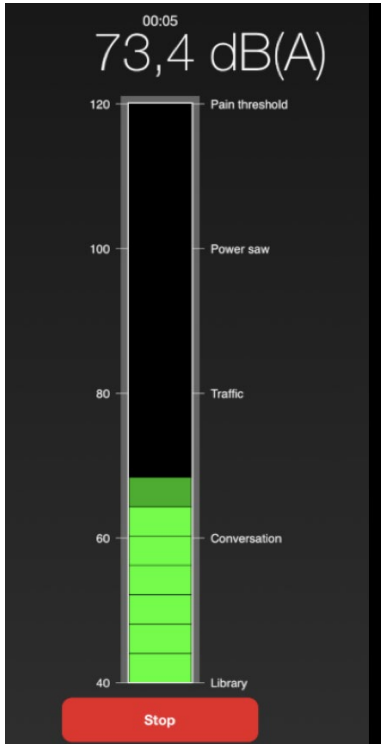
- A here-and-now, online survey of pupil perceptions and symptoms

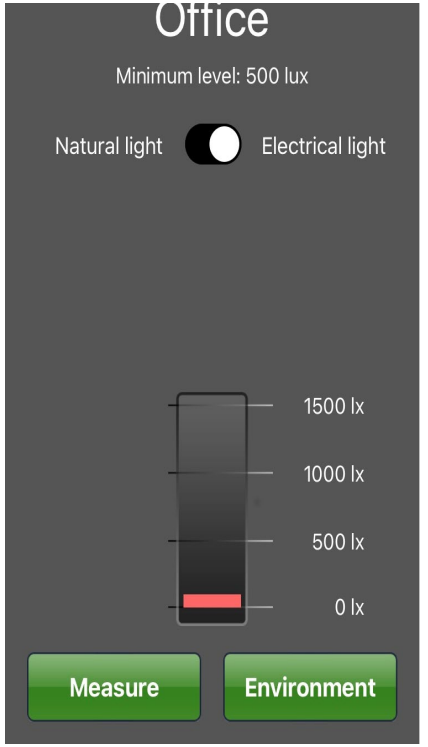
- An online task to measure pupil concentration performance

Measurements

- Air quality (CO_2)
- Temperature (radiant, air)
- Lighting (illumination)
- Noise (SPL, reverberation time)







Pupil perceptions, symptoms and concentration

How do you feel the classroom right now?

It is too cold

It is not too cold

Back Next

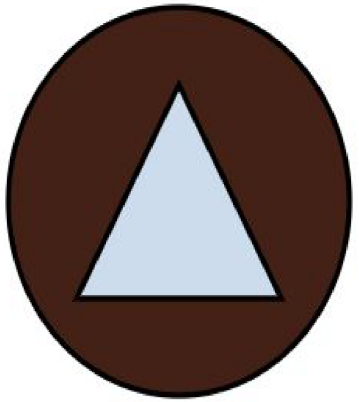
Right now, do you feel you have

Headache

No headache

Back Next

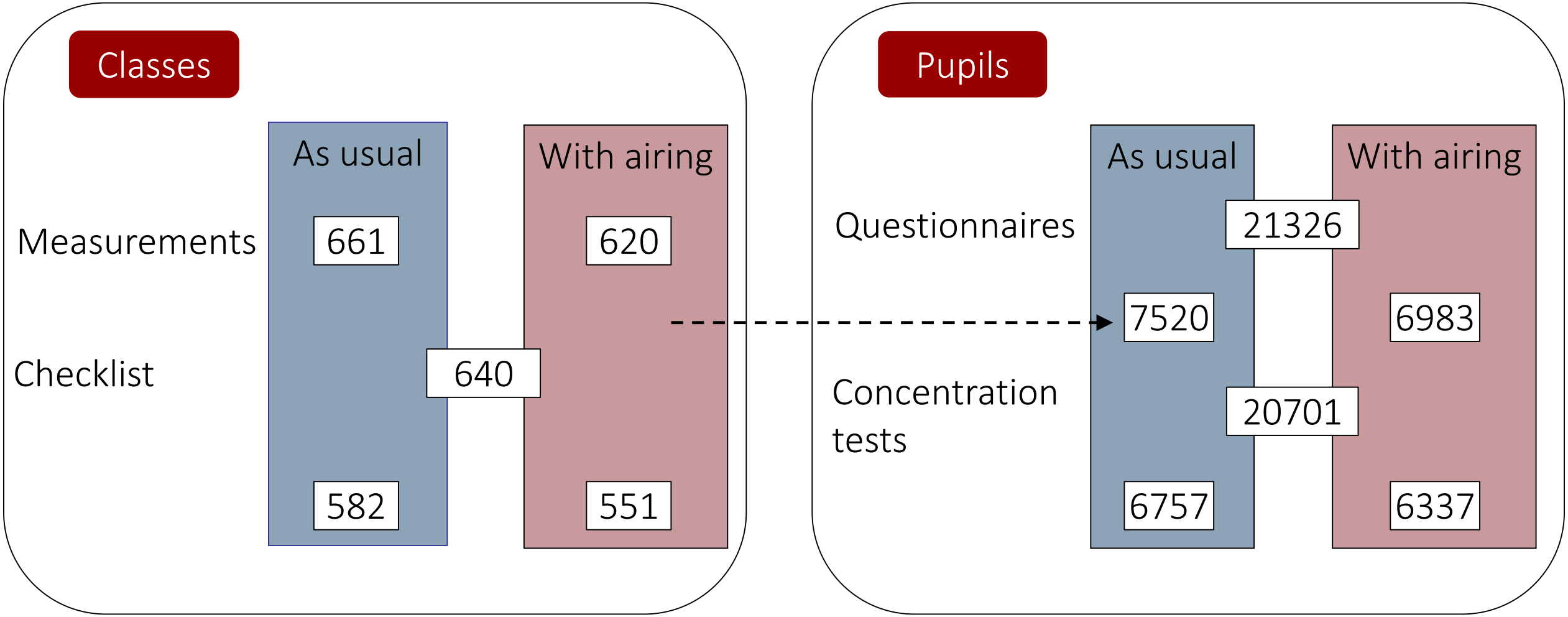
The triangle is smaller than the circle



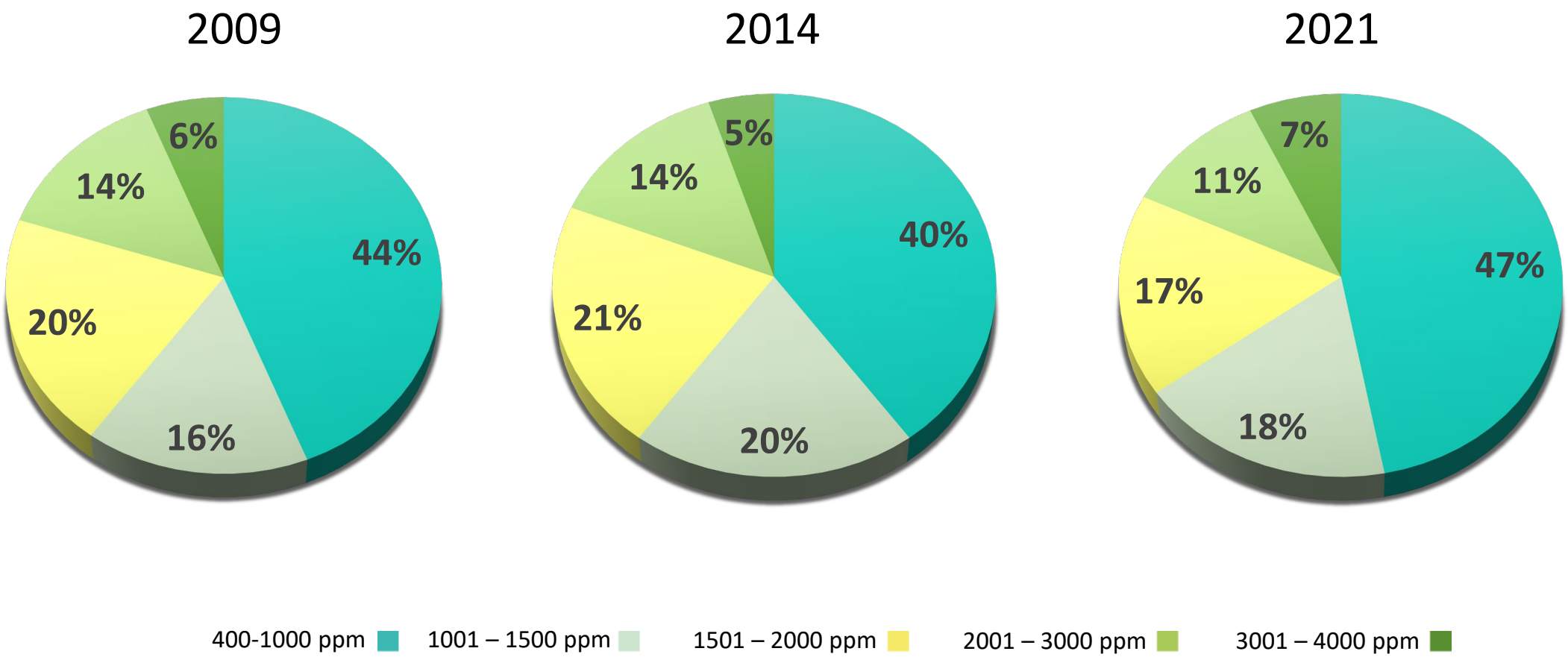
True False

Back Next

Data processing



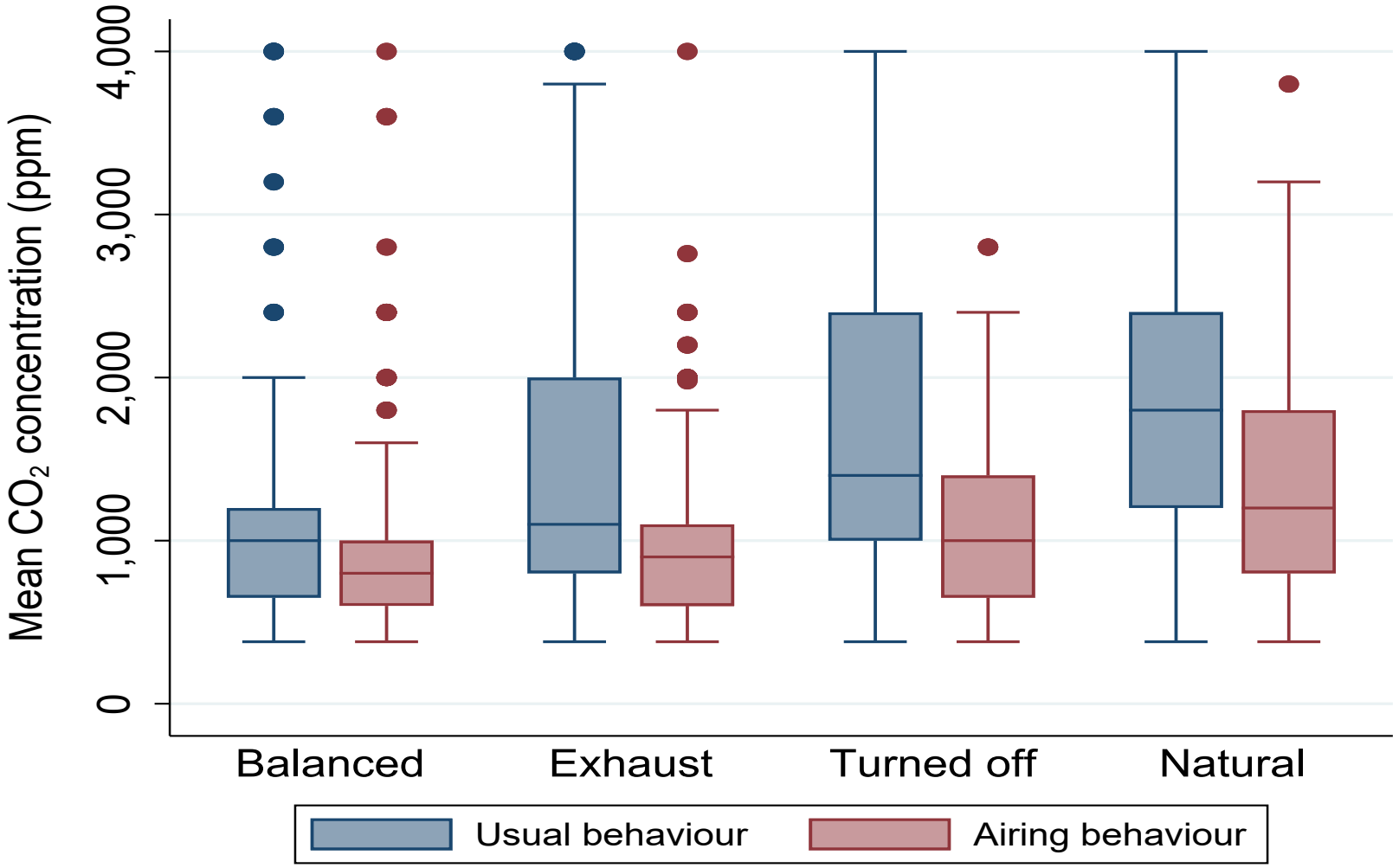
CO_2 concentration



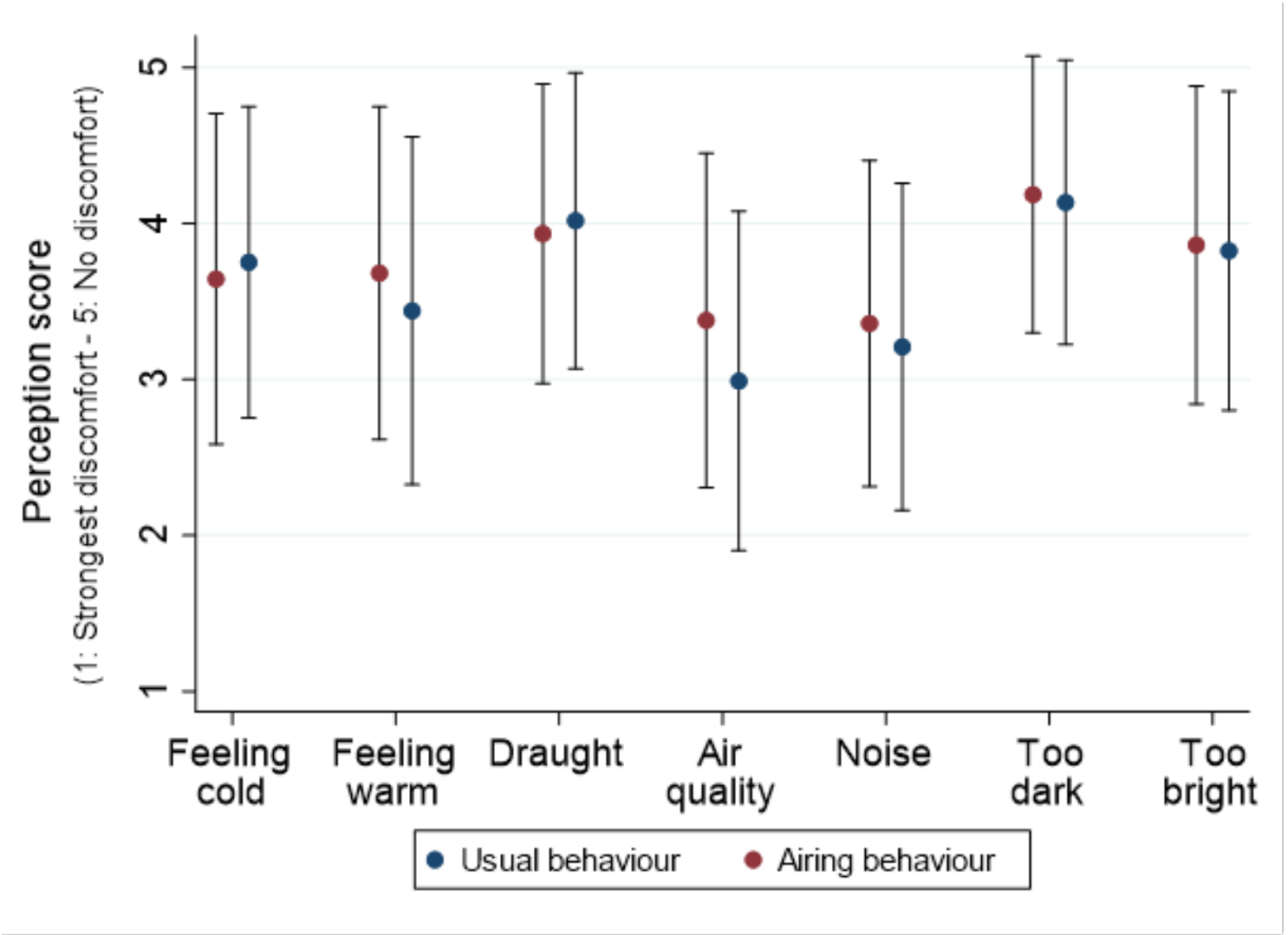
Type of ventilation

	2021	2014	2009
No mechanical ventilation	27%	42%	52%
Mech vent installed, not running	14%		
Exhaust	21%	22%	18%
Balanced	38%	36%	30%

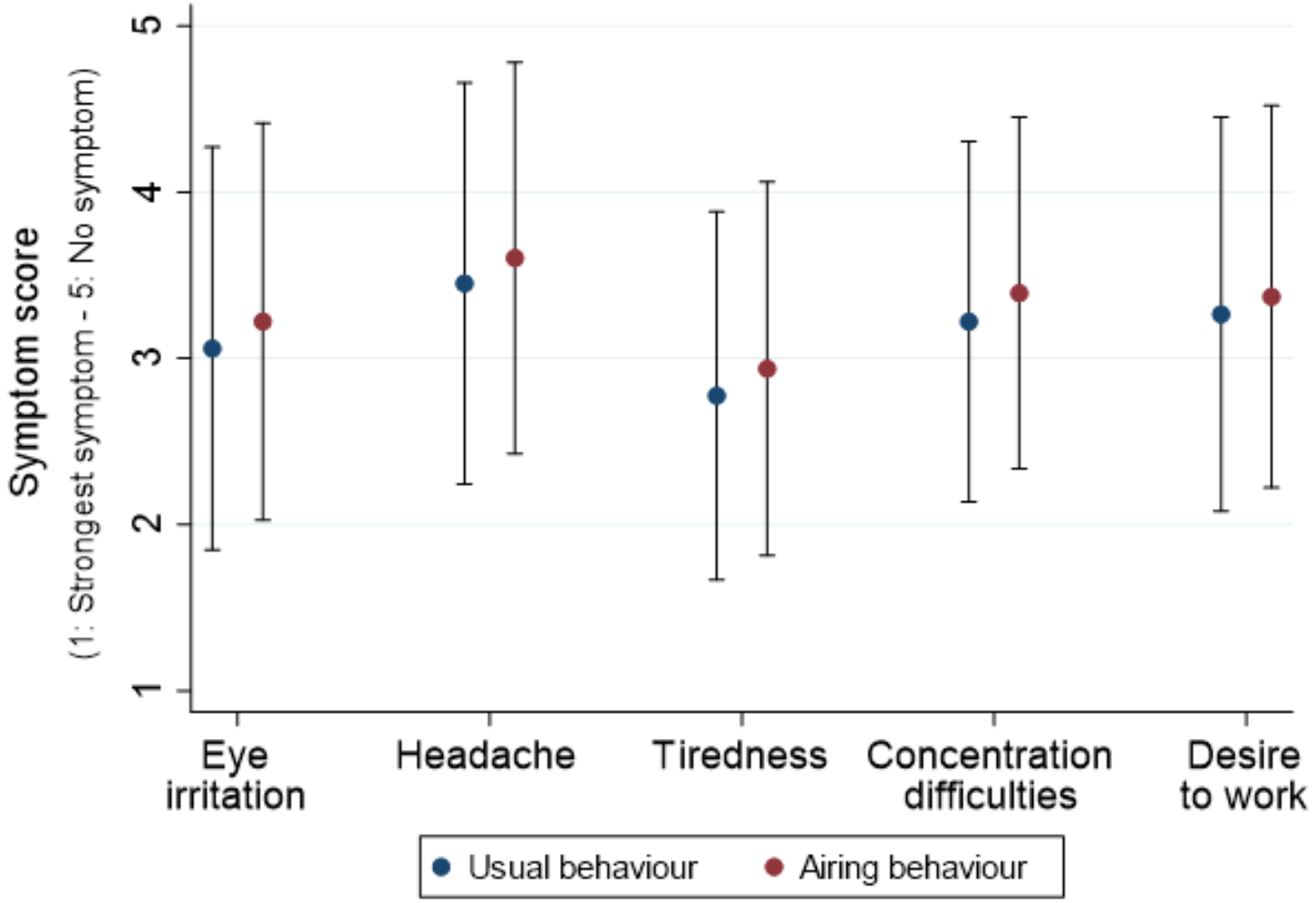
Classroom CO_2-concentration



Pupils' perception of their classroom environment



Pupils' symptoms



Concentration test error count

Airing vs usual behavior

- 6% fewer errors

High vs lower elementary school

- 42% fewer errors

Girls vs boys

- 20% fewer errors

The end……

Airing and leaving the classroom during a break…

- Improved the air quality as quantified by the CO_2-concentration
- Improved pupils' perception of the classroom environment
- Improved pupils' building related symptoms
- Reduced the number of errors in a concentration test by 6%