Assessing the Impact of Climate Change on Indoor Fungal Contamination in Lisbon Metropolitan Area Primary Schools: A Comprehensive Study

InChildHealth

Renata Cervantes

PhD Student in Public Health, Environmental and Occupational Health Specialization

Co-funded by the European Union

UK Research and Innovation

Australian Government
National Health and Medical Research Council
NHMRC

Project funded by
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI

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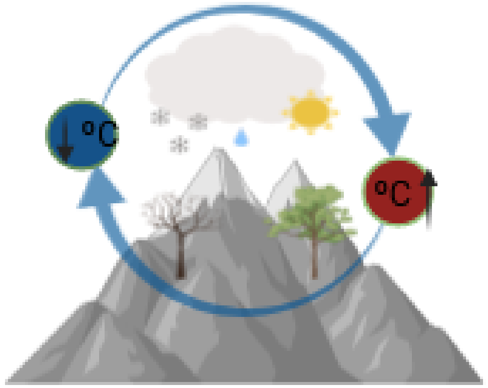
Climate Change & Indoor Air Quality

Climate Change

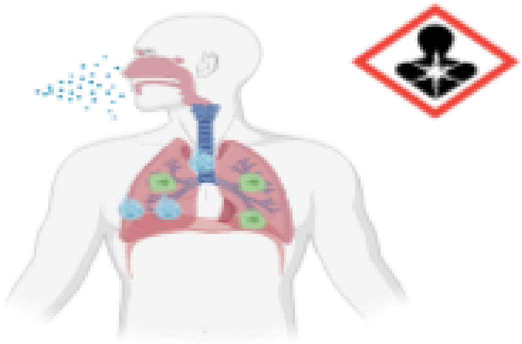


Mycotoxins

Food Safety issues

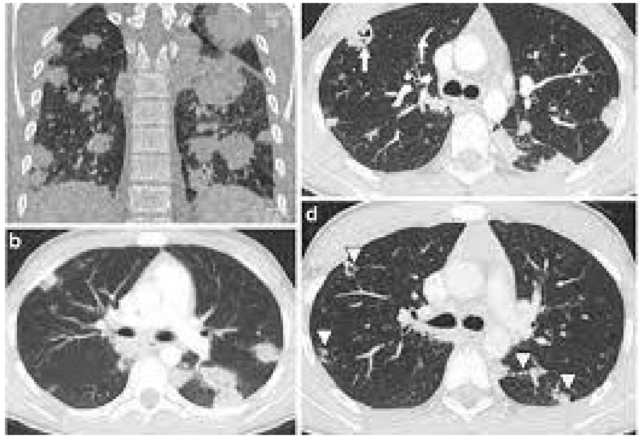
Indor air quality
increased fungal growth and
contamination, impacting health.

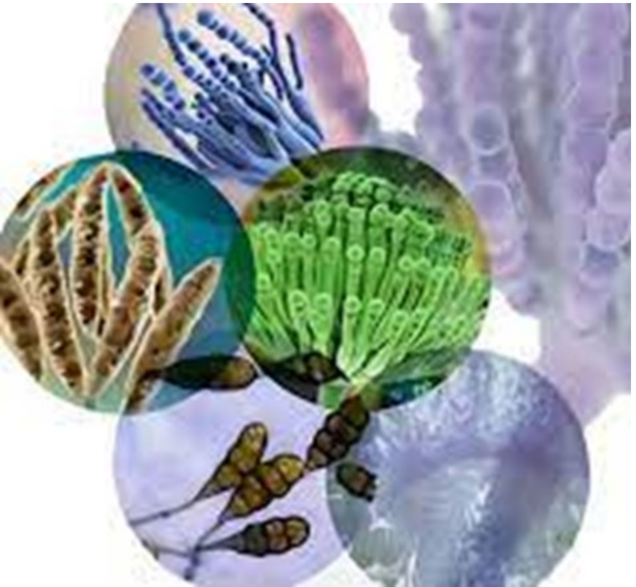
Human Fungal infections
Health risk



- Severe weather events due to global climate change raise concerns about indoor fungi [1].
- Potential alterations in fungal communities and mycotoxin production pose health risks[2,3].
- Educational settings face increased fungal growth and contamination, impacting health[6].


AIR QUALITY
IN OUR SCHOOLS





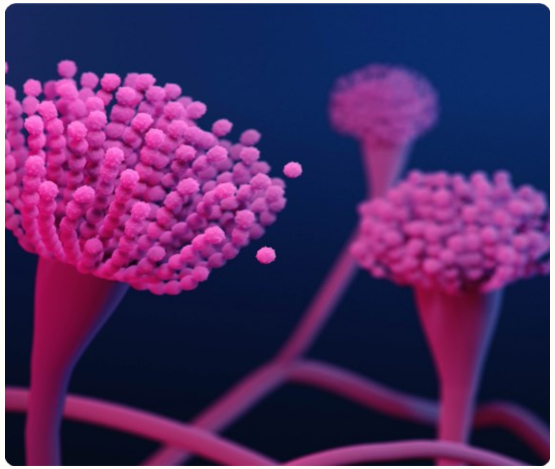
Factors that promote the presence of microorganisms in schools and the Public Health implications

- Potential Consequences of Fungal Infections:
- - Prolonged Hospitalizations,
- - Escalating Healthcare Costs,
- - Increased mortality rates.
- Social and economic Impact
- - Parental Work Absences,
- - Reduced Productivity,
- - Increased School Absenteeism,
- - Learning Disabilities,
- - Potential Long-Term Health Repercussions

Resistance profiles and pathogenic potential of fungi

Resistance profile

Fungi show increasing levels of resistance to antifungal drugs, which creates significant challenges for the control of fungal contamination[3,5].



pathogenic potential

Some types of fungi can cause respiratory or skin infections, while others can produce toxins that are dangerous to health, such as aflatoxin. In school environments, contact with fungi can also trigger allergic reactions in sensitive people, such as rhinitis, asthma, conjunctivitis and hives [3,5 6].



Research Objectives

- Explore the relationship between climate change and fungal diseases.
- Assess indoor contamination and human exposure in Lisbon primary schools.
- Comprehensive microbial characterization through sampling methods.

PROJECT GOALS

”Investigate the potential health impacts of exposure to azole resistant fungi and mycotoxins in school environments and explore how climate and geography might contribute to the overall air quality indoors”.

To characterize fungal contamination and azole resistance profiles.

↓

To characterize mycotoxin contamination

↓

To assess how **climate and geography might contribute to the overall air quality in schools**

↓

To evaluate the impact of these environmental contaminants on children's health...

↓

To provide support for the implementation of risk management measures.

CITY OF LISBON

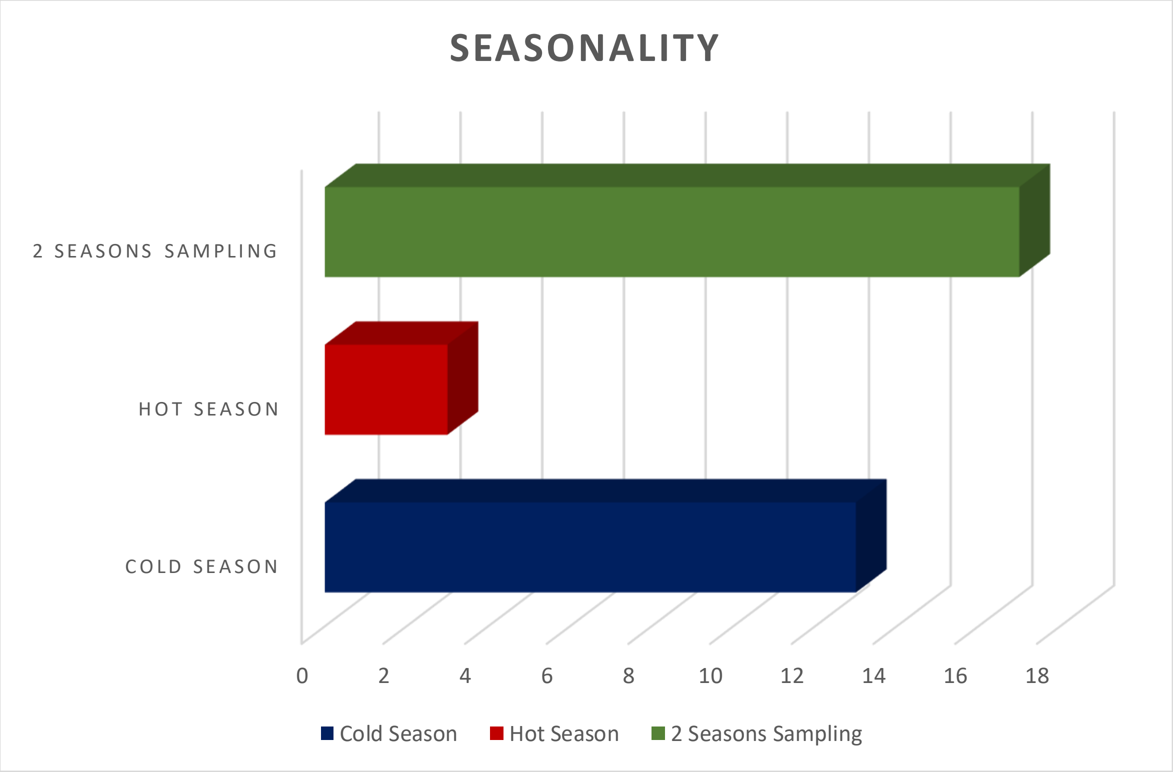
2 seasons:

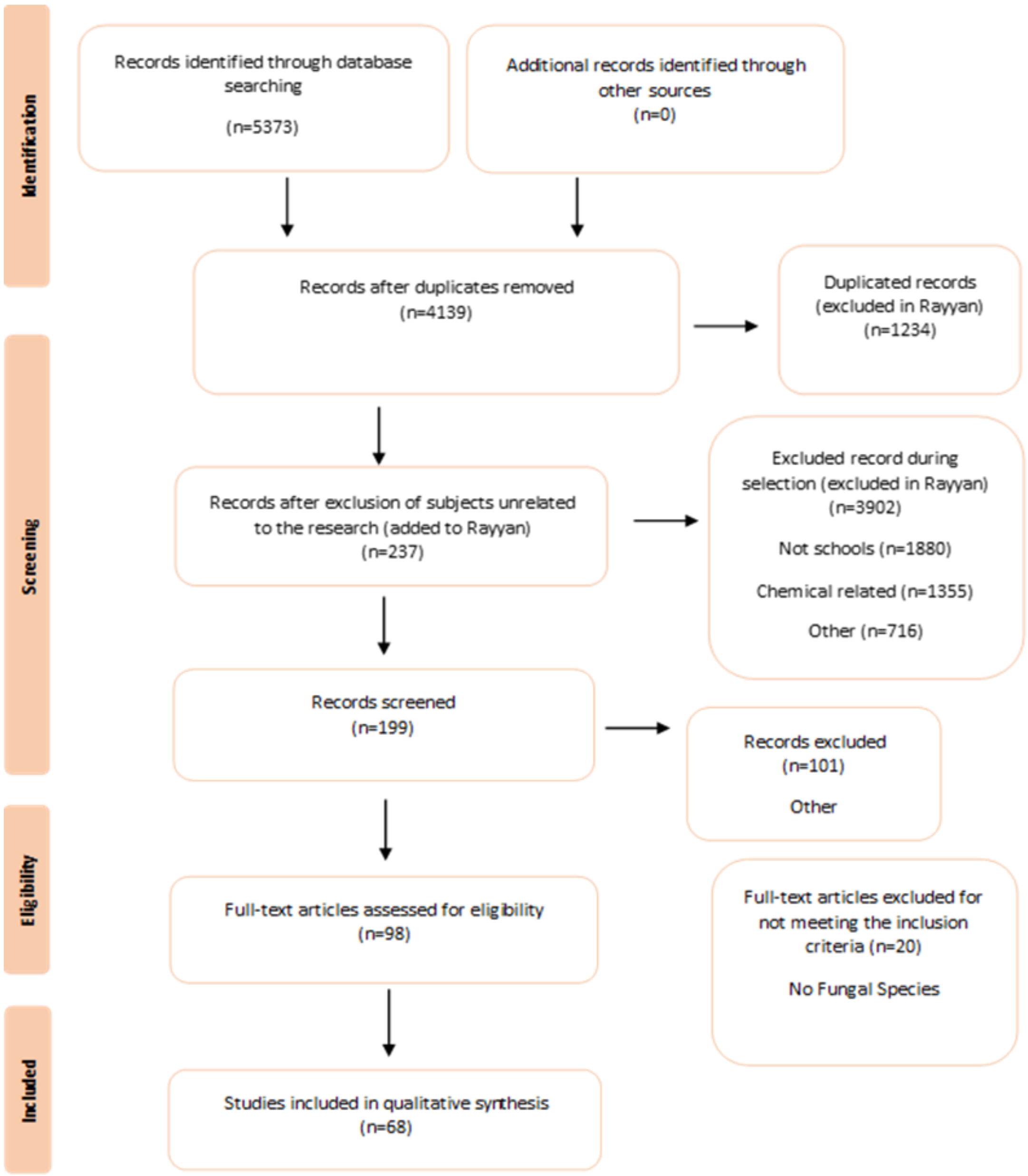
- Cold (autumn & winter)
- Hot (Spring & summer)

11 schools:

- 2 to 4 classrooms
- Average 25 students/classroom
- + Canteen
- + Library
- Gymnasium

Using the review findings, we organized the study and created a protocol for collecting and analysing samples.





Sampling Methods

+

Active sampling using MAS-100 device and Anderson six-stage device

200L at a flow rate of 28.3 L/min

400L at a flow rate of 200 L/min

EDC

Passive sampling of mops, surface swabs, and settled dust.

Monitoring for seasonal Campaign

ONGOING

Sampling strategy

Targeted schools

Rural
- Natural ventilation
- AVAC system

Urban/Suburban
- Natural ventilation
- AVAC system

Locations and sampling sites

2 school/setting (N=10 schools):
- 4 Classrooms
- 1 Outdoor
- 1 School Building
- Library
- Gymnasium
- Canteen
- Toilets/Locker room
- Extracurricular activities room (lab, workshop room, etc.)

2 houses/school (N= 20 houses):
- Child room
- Livingroom
- Kitchen

Sampling methods

Active Sampling

Air sampling:

Passive Sampling

Qualitative methods to be applied :
- Walkthrough survey in schools
- Respiratory health survey (children health data to be collected)

Sampling duration

Active sampling: 1 sample per location in each school/seasonally (Autumn/Spring)

Passive sampling: **All matrices:** 1 sample per location in each school/ seasonally (Autumn/Spring)

Assays

Active sampling:

Culture-based methods (fungi and bacteria) :
- Microbial quantification (fungi)
- Fungal identification

Toxigenic fungi species detection through ddPCR

Passive sampling:

Culture-based methods (fungi and bacteria) :
- Microbial quantification (fungi)
- Fungal identification
- Fungal azole resistance screening

Toxigenic fungi species detection through ddPCR

Detection of 38 mycotoxins

Cytotoxicity assessment (lung cells)

Monitoring for longitudinal Campaign

ONGOING

Longitudinal sampling strategy

Targeted schools

Rural
- Natural ventilation
- AVAC system

Urban/Suburban
- Natural ventilation
- AVAC system

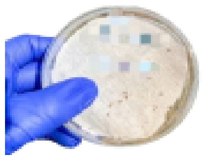
Location and sampling sites

10 school's
4 classrooms/school
(N=40 EDC's):

Sampling methods

Passive Sampling

EDC



Sampling duration

EDC:
1 per classroom in each school/monthly (12 months)

Assays

Culture-based methods (fungi and bacteria):
- Microbial quantification (fungi and bacteria)
- Fungal identification
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Toxigenic fungi species detection through ddPCR

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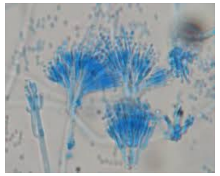
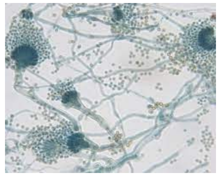
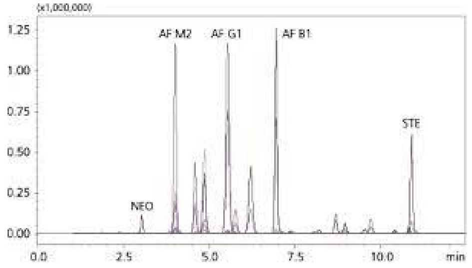
Analysis Techniques







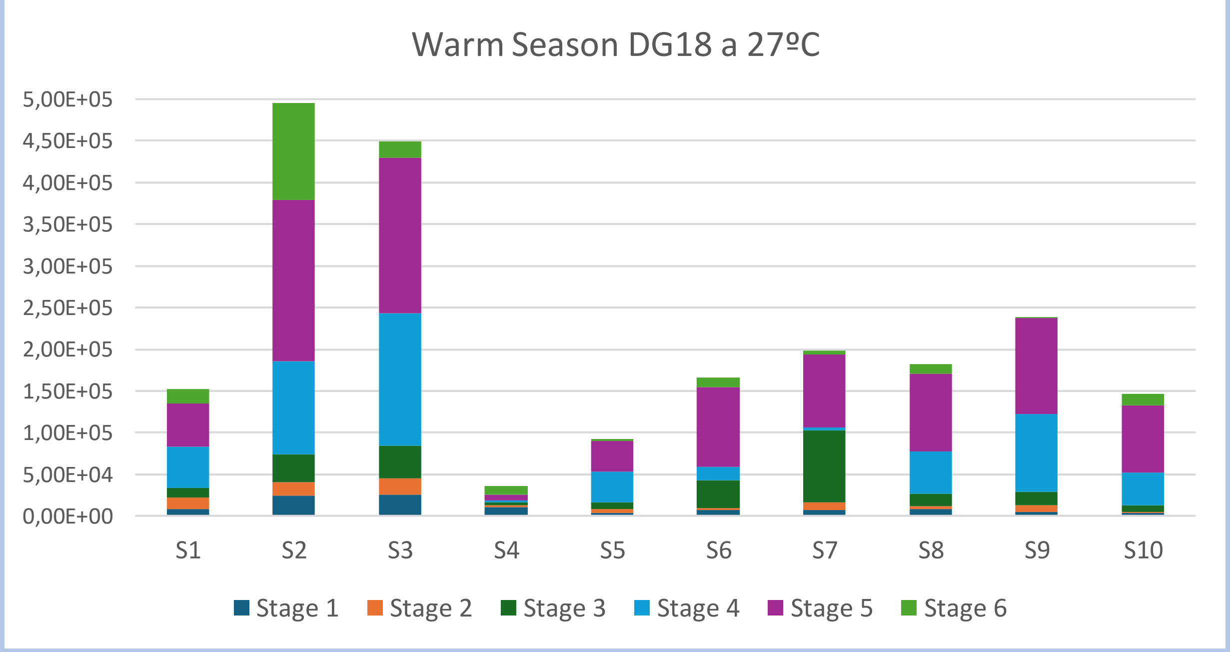
- Culture-based methods on MEA and DG18 culture media.
- Molecular detection of selected fungal sections (*Aspergillus*).
- HPLC for mycotoxin contamination assessment.

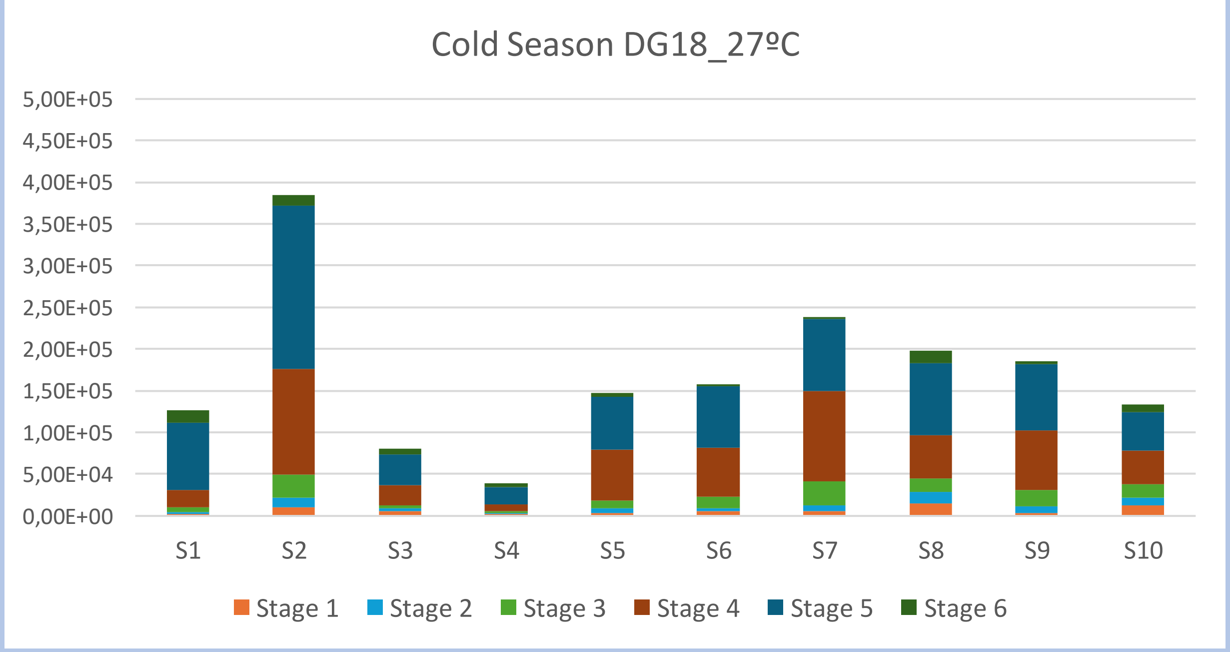
Preliminary Results

Initial insights into fungal contamination levels

- DG18 27ºC:
  - No significant difference in counts from both seasons except for S3
  - Higher counts for S3 school on warm season
  - Higher load in stages 4, 5

Anderson six-stage findings



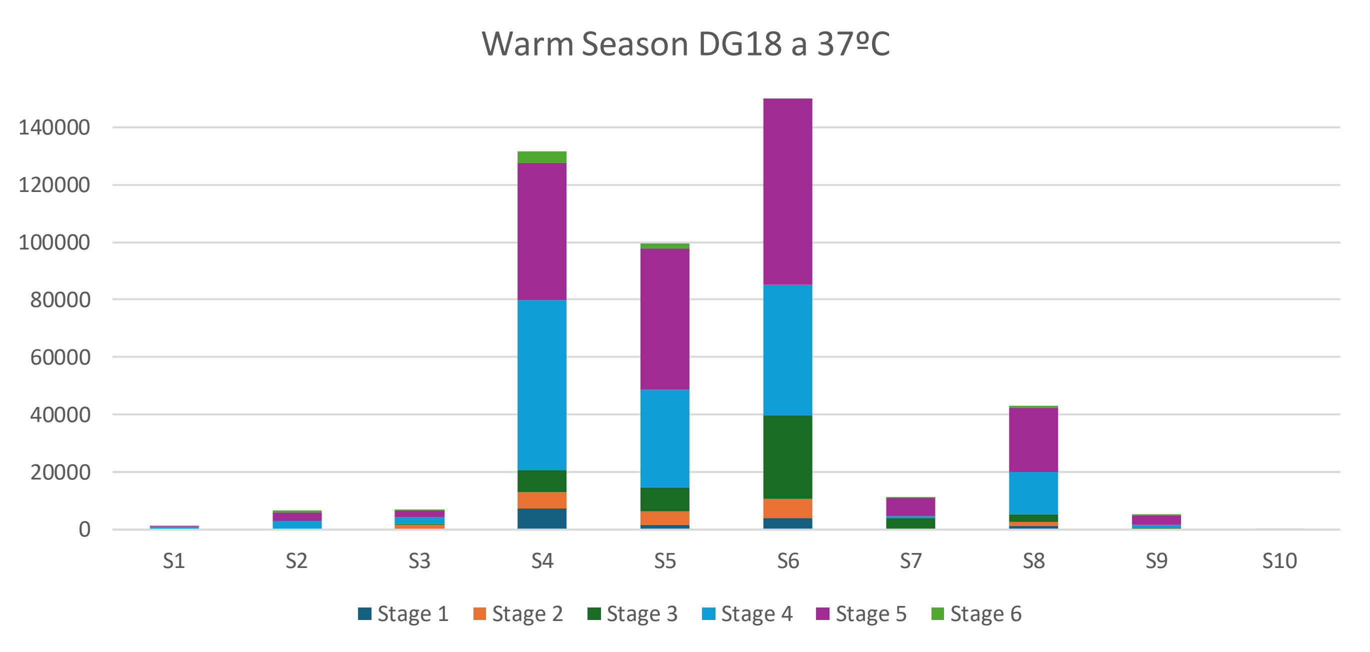


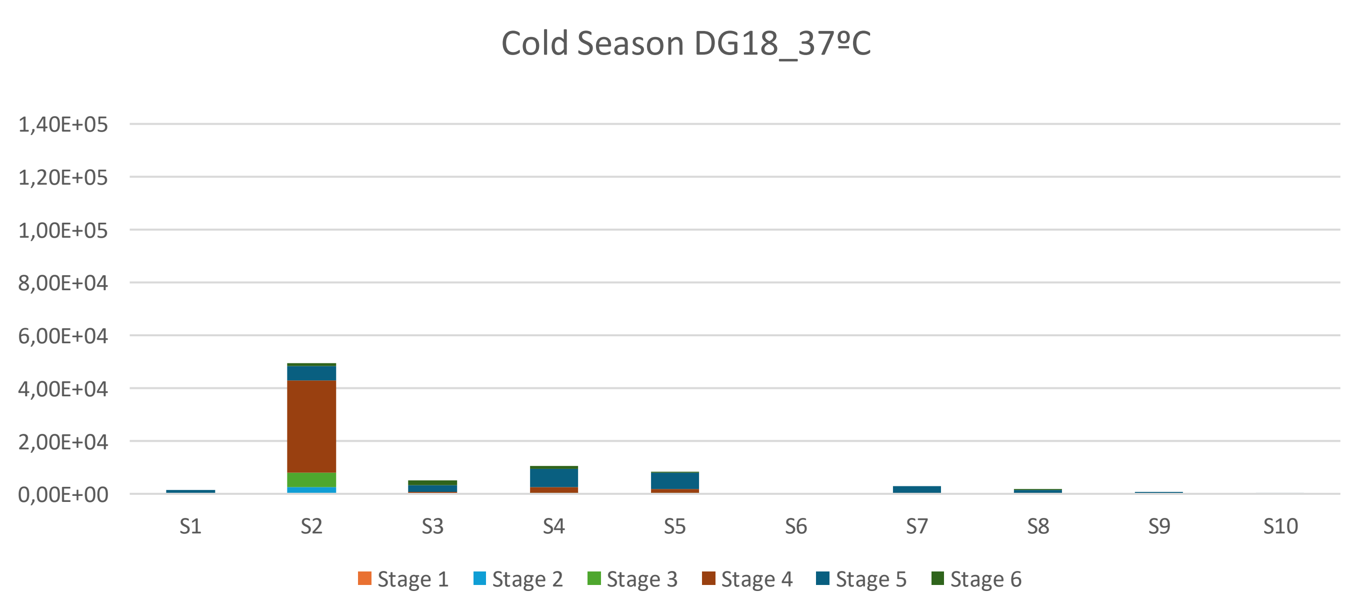
Preliminary Results

Initial insights into fungal contamination levels

- DG18 37ºC:
  - Higher load in stages 6
  - Lower counts on cold season except for S2
  - Significative difference from warm to cold season in particular S4, S5 and S6

Anderson six-stage findings



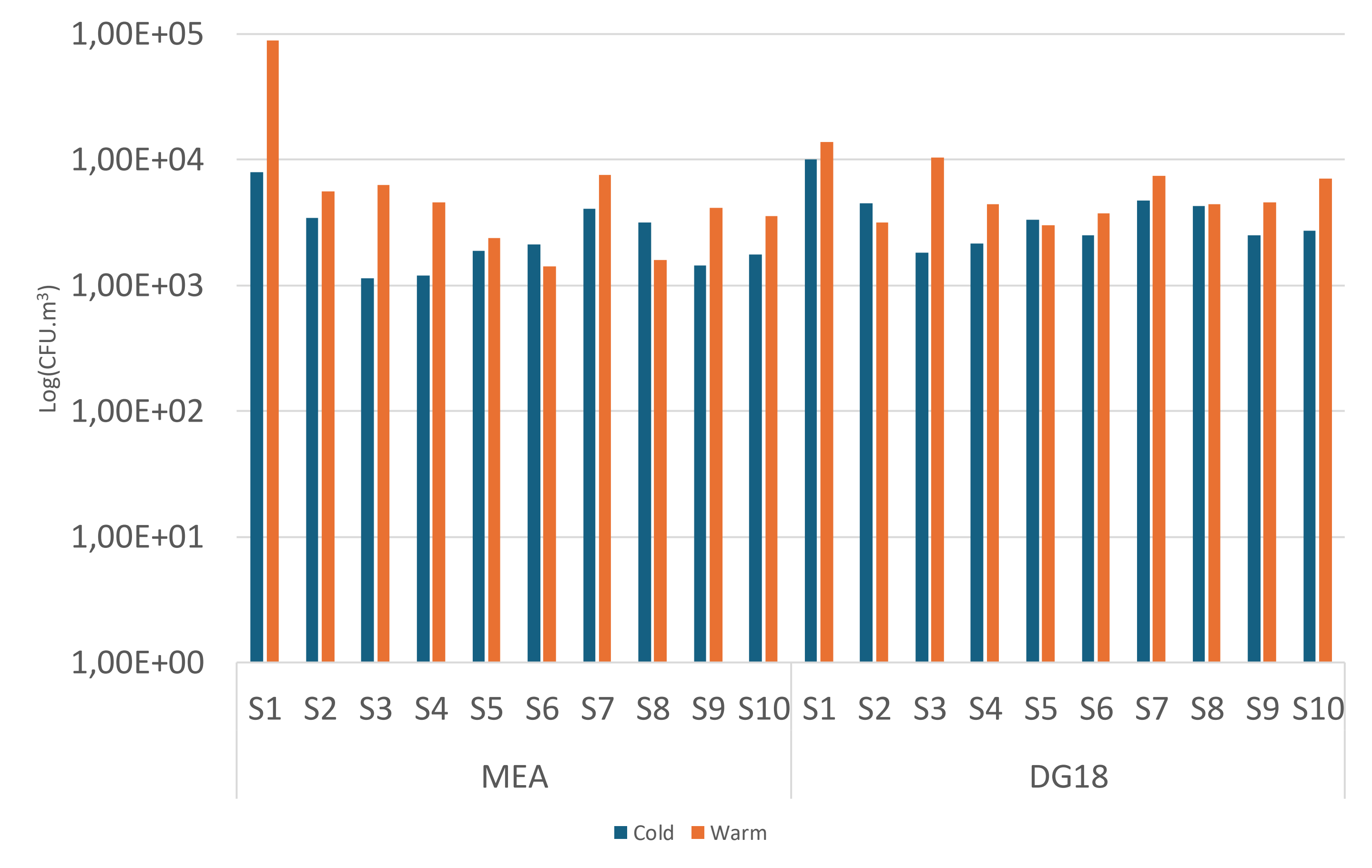


Preliminary Results

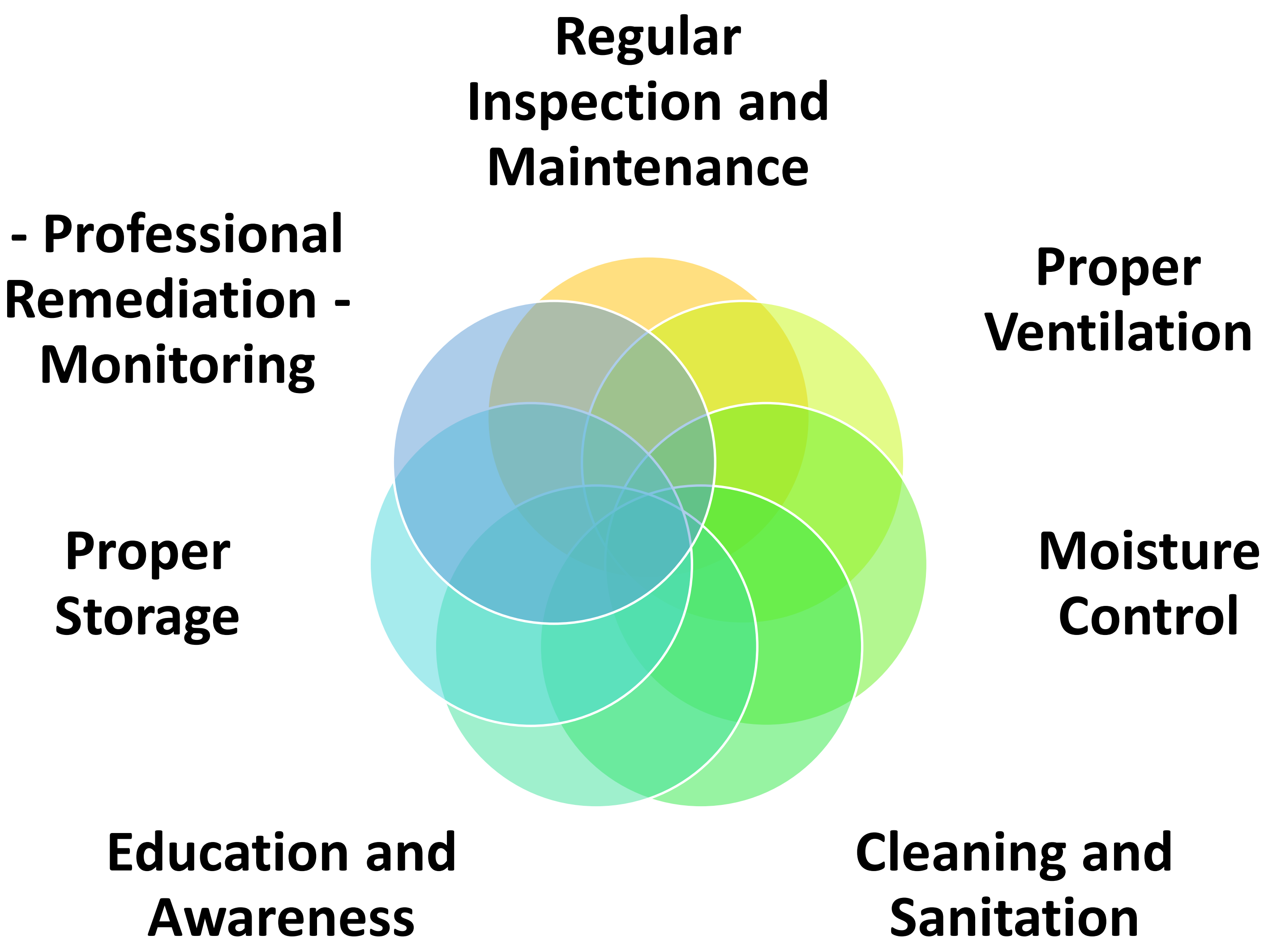
MAS 100 findings

Initial insights into fungal contamination levels

- higher counts on Warm season except for S6 and S8 on MEA, and S2 and S5 on DG18
- Significative difference from warm to cold season in most schools on both media



Development of effective risk management strategies



Innovative character
and
Next steps?

Acknowledgments

H&TRC authors gratefully acknowledge FCT/MCTES national support through the IPL/2022/InChildhealth/BI/12M; 2023.01366.BD; UI/BD/151431/2021, also supported by national funds through FCT/MCTES/FSE/UE, UI/BD/153746/2022 and CE3C unit UIDB/00329/2020 (https://doi.org/10.54499/UIDB/00329/2020), and the ESTeSL- Escola Superior de Tecnologia e Saúde de Lisboa, Instituto Politécnico de Lisboa,national support through IPL/IDI&CA2023/FoodAlleEU; IPL/IDI&CA2023/ASPRisk and IPL/IDI&CA2023/ARAFSawmil.

Partly funded by the European Union's Horizon 2021 research and innovation program under grant agreement no. 101056883 and received co-funding from the author's organizations and/or Ministries. This work has received funding from the Swiss State Secretariat for Education, Research and Innovation (SERI) grant number 22.00324, from the United Kingdom Research and Innovation (UKRI) grant number 10040524, and the Australian National Health & Medical Research Council (NMHRC) grant numbers APP2017786 and APP2008813. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Swiss State Secretariat for Education, Research and Innovation (SERI), or the United Kingdom Research and Innovation (UKRI), or the Australian National Health & Medical Research Council (NHMRC). Neither the European Union nor the granting authorities can be held responsible for them

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References

1. Nnadi, N. E., & Carter, D. A. (2021). Climate change and the emergence of fungal pathogens. PLoS pathogens, 17(4), e1009503. https://doi.org/10.1371/journal.ppat.1009503

2. Mannaa, M., & Kim, K. D. (2017). Influence of Temperature and Water Activity on Deleterious Fungi and Mycotoxin Production during Grain Storage. Mycobiology, 45(4), 240–254. https://doi.org/10.5941/MYCO.2017.45.4.240

3. Zingales V, Taroncher M, Martino PA, Ruiz M-J, Caloni F. Climate Change and Effects on Molds and Mycotoxins. Toxins. 2022; 14(7):445. https://doi.org/10.3390/toxins14070445

4. Perrone, G., Ferrara, M., Medina, A., Pascale, M., & Magan, N. (2020). Toxigenic Fungi and Mycotoxins in a Climate Change Scenario: Ecology, Genomics, Distribution, Prediction and Prevention of the Risk. Microorganisms, 8(10), 1496. https://doi.org/10.3390/microorganisms8101496

5. Mendell, M. J., Mirer, A. G., Cheung, K., Tong, M., & Douwes, J. (2011). Respiratory and allergic health effects of dampness, mold, and dampness-related agents: a review of the epidemiologic evidence. Environmental health perspectives, 119(6), 748–756. https://doi.org/10.1289/ehp.1002410

6. Norbäck, D., Hashim, J. H., Cai, G. H., Hashim, Z., Ali, F., Bloom, E., & Larsson, L. (2016). Rhinitis, Ocular, Throat and Dermal Symptoms, Headache and Tiredness among Students in Schools from Johor Bahru, Malaysia: Associations with Fungal DNA and Mycotoxins in Classroom Dust. PloS one, 11(2), e0147996. https://doi.org/10.1371/journal.pone.0147996

Thank you