



Exposure to aerosolized harmful algal blooms in South Florida poses negative impact on health in a *Drosophila* model of aging

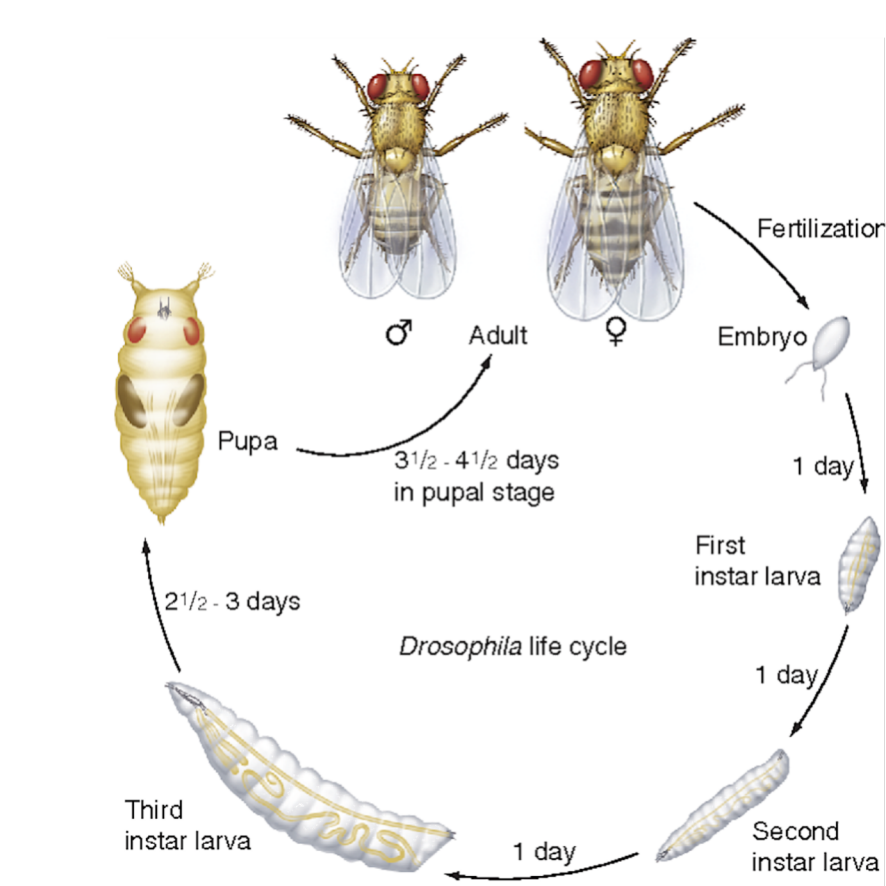
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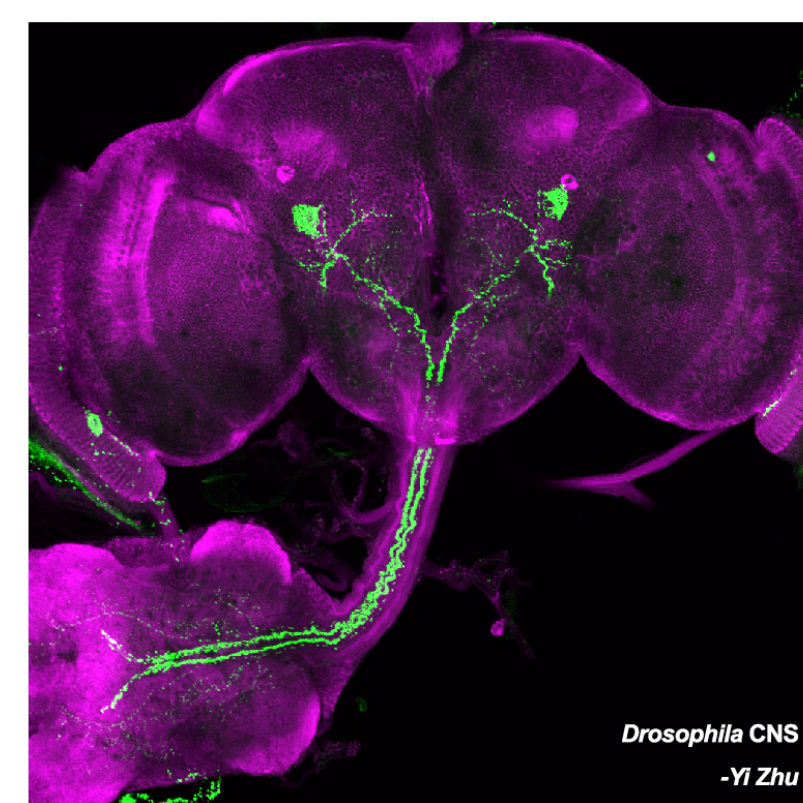
ABSTRACT

Harmful algal blooms (HABs) have been a rising health and environmental concern in the United States, particularly in South Florida. Skin contact and ingestion of contaminated water or toxin-accumulated fish had been proved to have severe direct toxicity to human body. However, the impact of aerosolized cyanobacteria HABs is poorly understood if they can form inhalable toxic particles that would constitute a more direct exposure route than ingestion and skin contact. **This project is purposed to** study the toxicity of aerosolized HABs using *Drosophila melanogaster* as an animal model. A water bubbling apparatus was designed and three age groups of flies were exposed to three water sources. After 2 hours of exposure, the negative geotaxis assay and lifespan assay have been performed to analyze impact of HABs on locomotor functions and longevity. Additionally, an immunofluorescence imaging-based brain analysis has been examined to study the impact on *Drosophila* brain morphological change. Young groups were more sensitive in long-term response; whereas mid-age groups and elderly males showed a strong acute response to HAB exposure, suggesting age is an important role in studying impact of aerosol HABs on locomotor functions. Exposure of HABs particularly at young groups significantly reduced their longevity. Juniors and elderly females are more likely to have neurodegenerative diseases after exposure to aerosol HABs. **In conclusion**, results suggest aerosolized particles from HABs cause a significant health risk, both immediately after exposure and in long-term response.

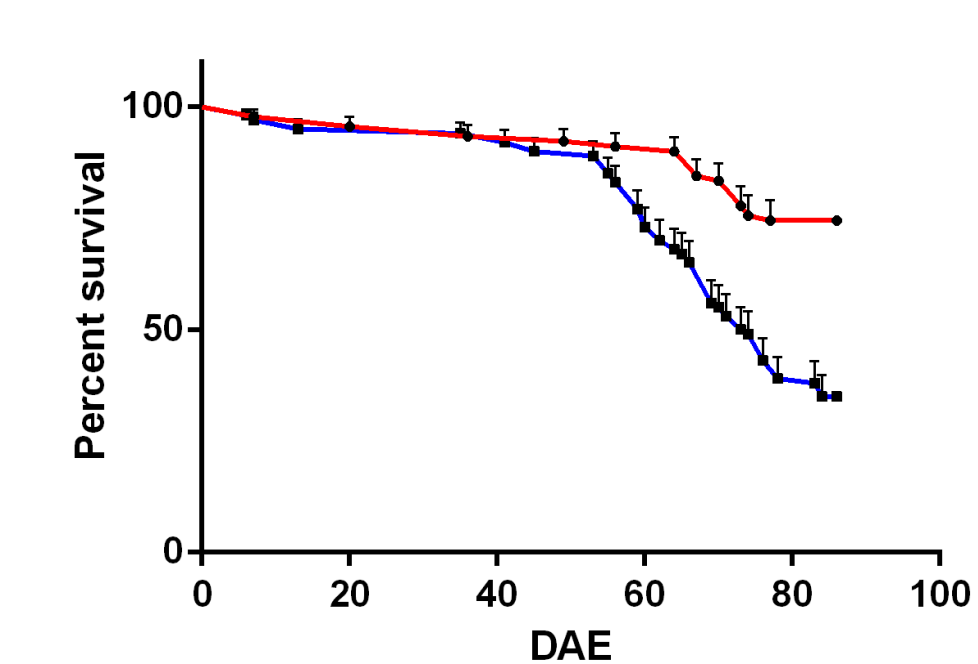
Introduction



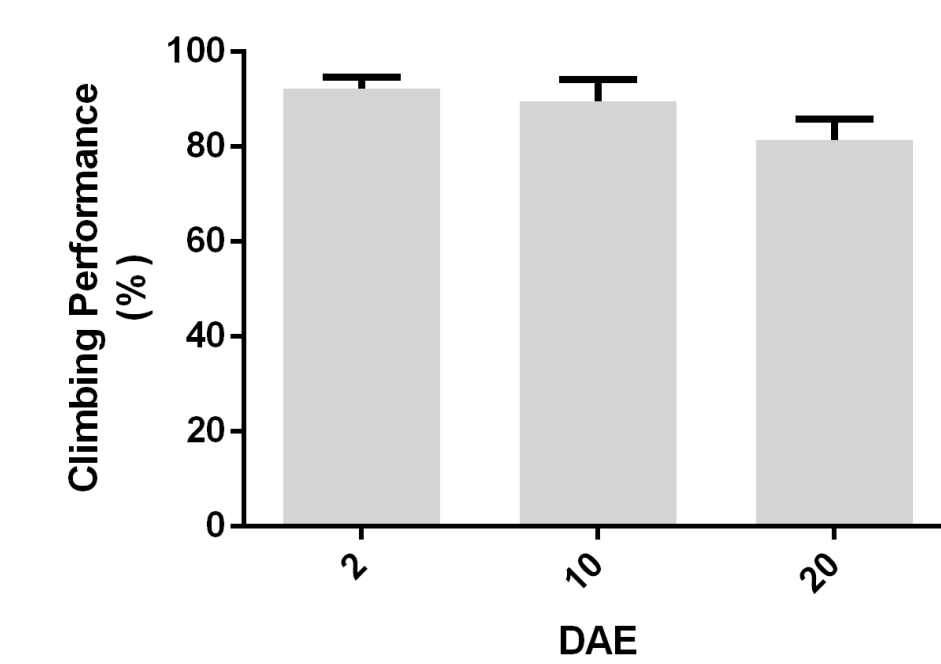
Small & Short Life Cycle



Brain & Central Nervous System



Lifespan of Normal *Drosophila*

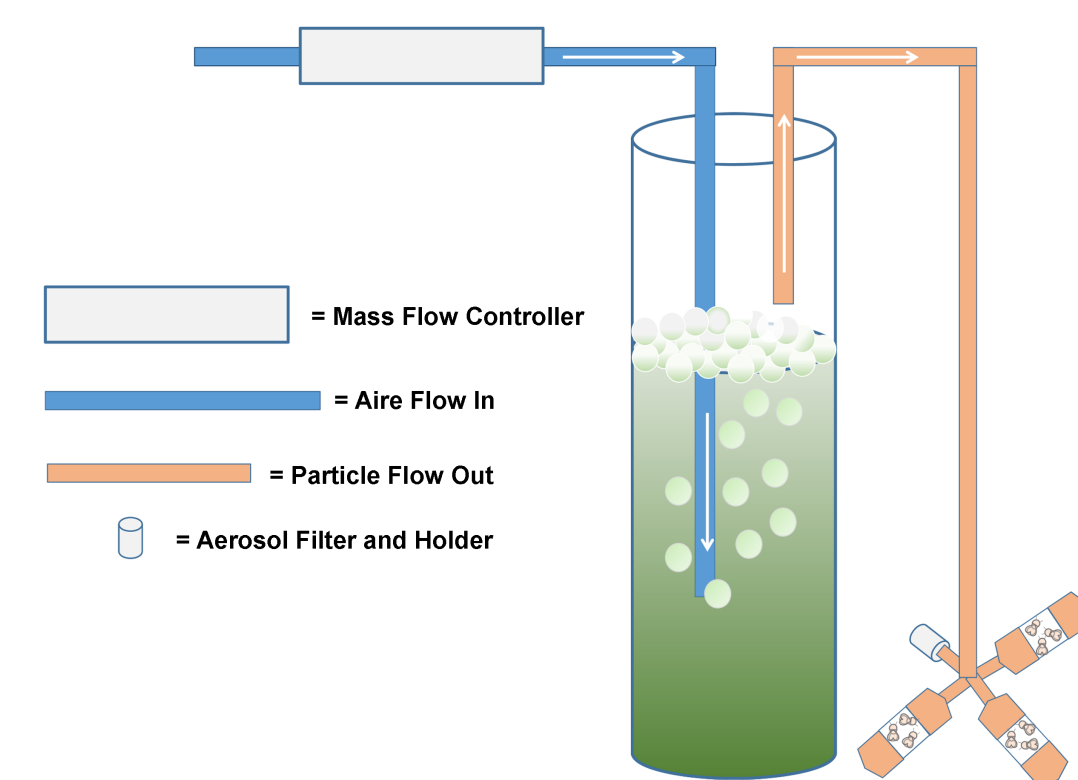


Climbing Performance of Normal *Drosophila*

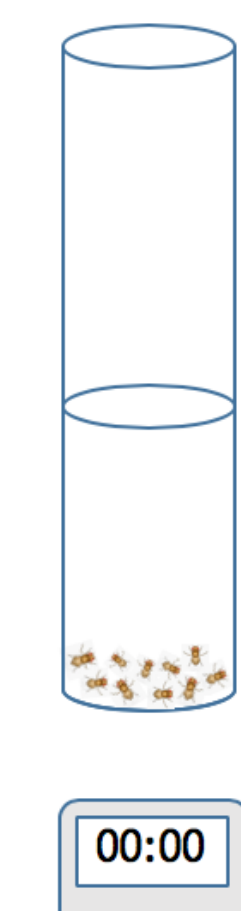
METHOD

	A (2D Young)	B (5-10D Mid-age)	C (20-30D Old)
H ₂ O	Green	Blue	Purple
1635-2 HAB	Light Green	Light Blue	Light Purple
1658-1 HAB	Dark Green	Dark Blue	Dark Purple

Three age groups of flies (2-day “young”, 5-10days “middle age”, and 20-30days “old”) were exposed to three water sources (H₂O, 1635-2 HAB water, and 1658-1 HAB water). The groups exposed to H₂O were used as control.



A water bubbling apparatus was designed where a controlled flow of air was bubbled through water phase and outflowed to a screened cage containing flies.



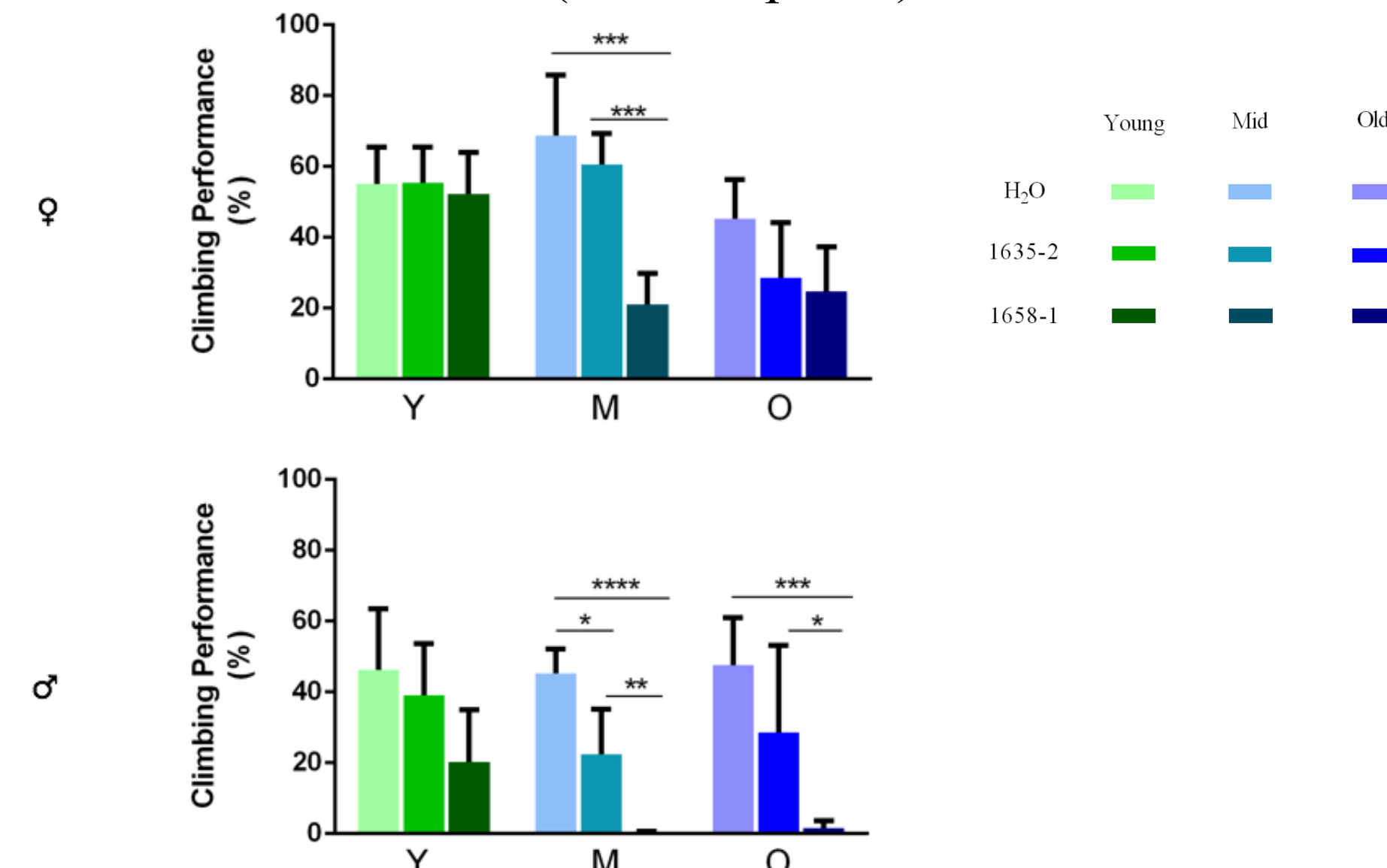
After 2 hours exposure, the vitality of the flies was determined by negative geotaxis assay, where the percent of flies climb above 8 cm height in 10 seconds was measured.

The lifespan was graphed to analyze the impact on longevity.

Additionally, brain dissection was performed. Brain size and BRP fluorescence intensity were analyzed to study the impact of aerosol HABs on brain morphology.

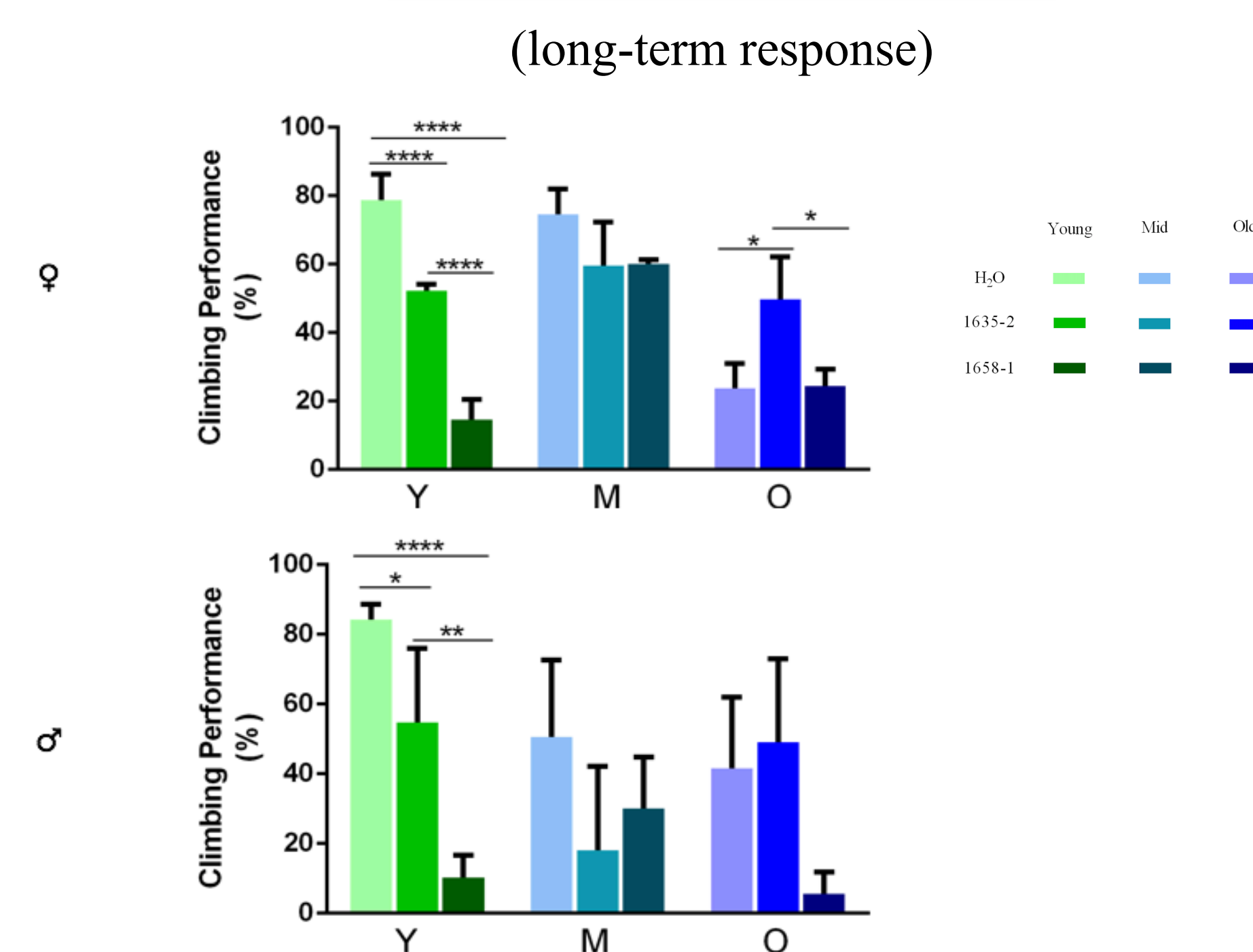
CLIMBING PERFORMANCE

One day after exposure (acute response)



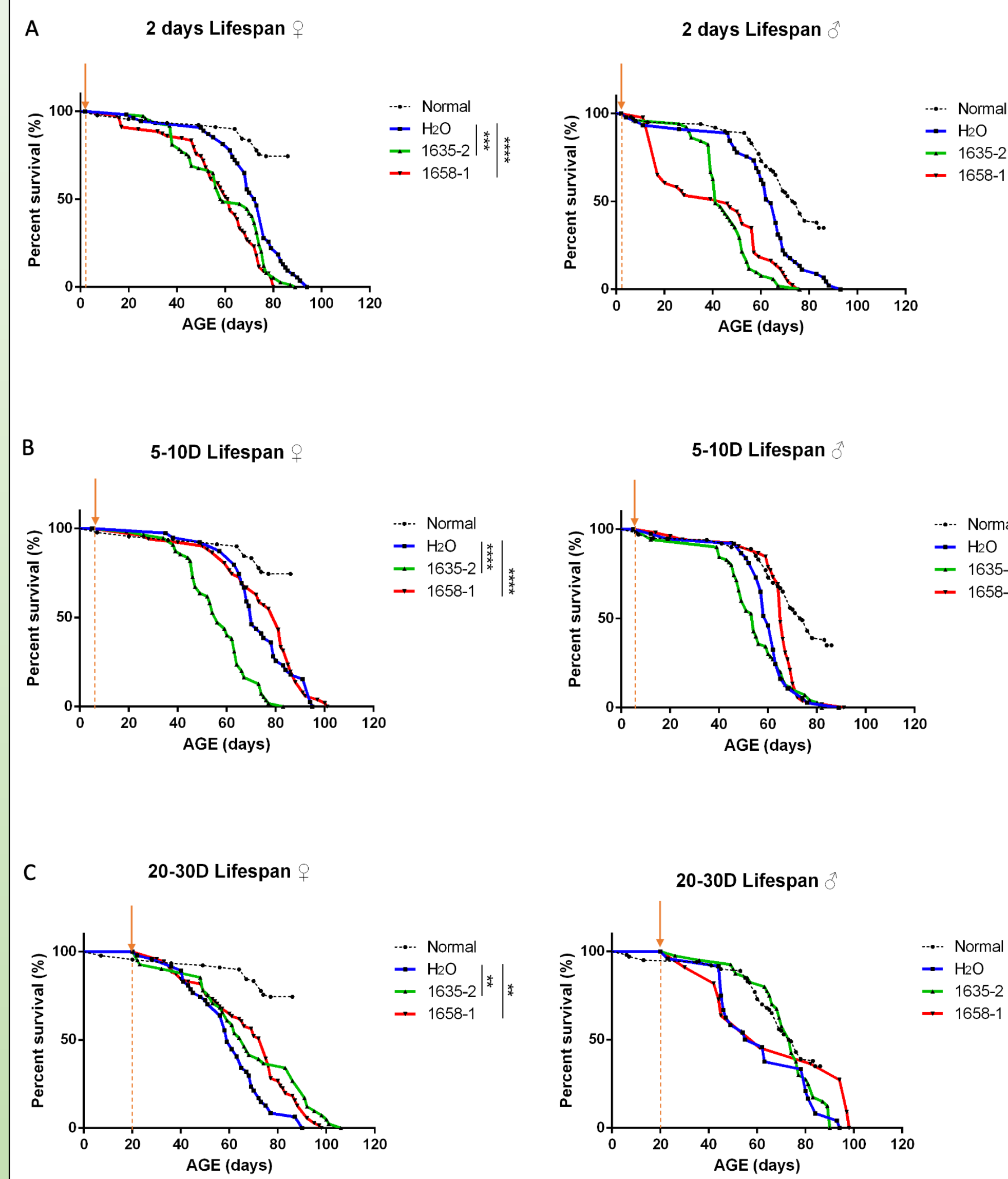
One day after exposure, the climbing performance in middle age and old age groups exposed to 1658-1 was significantly lower than those exposed to 1635-2 and H₂O

Two weeks after exposure (long-term response)



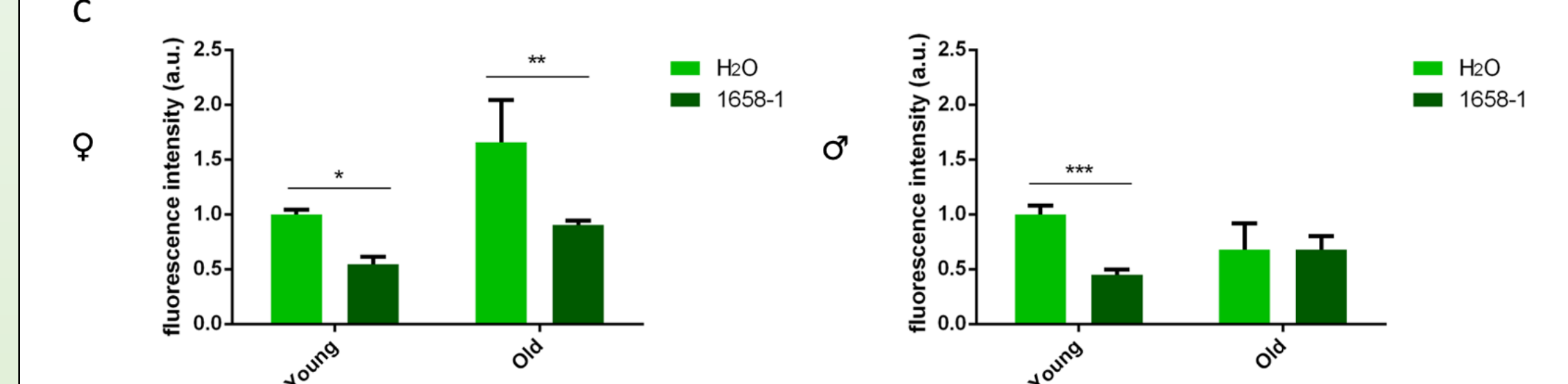
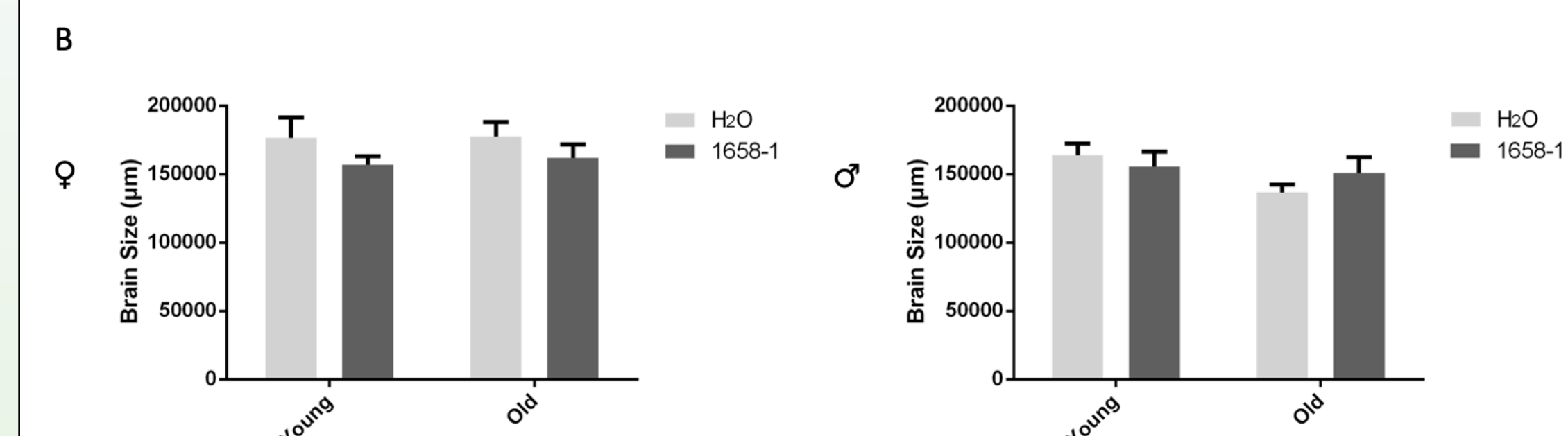
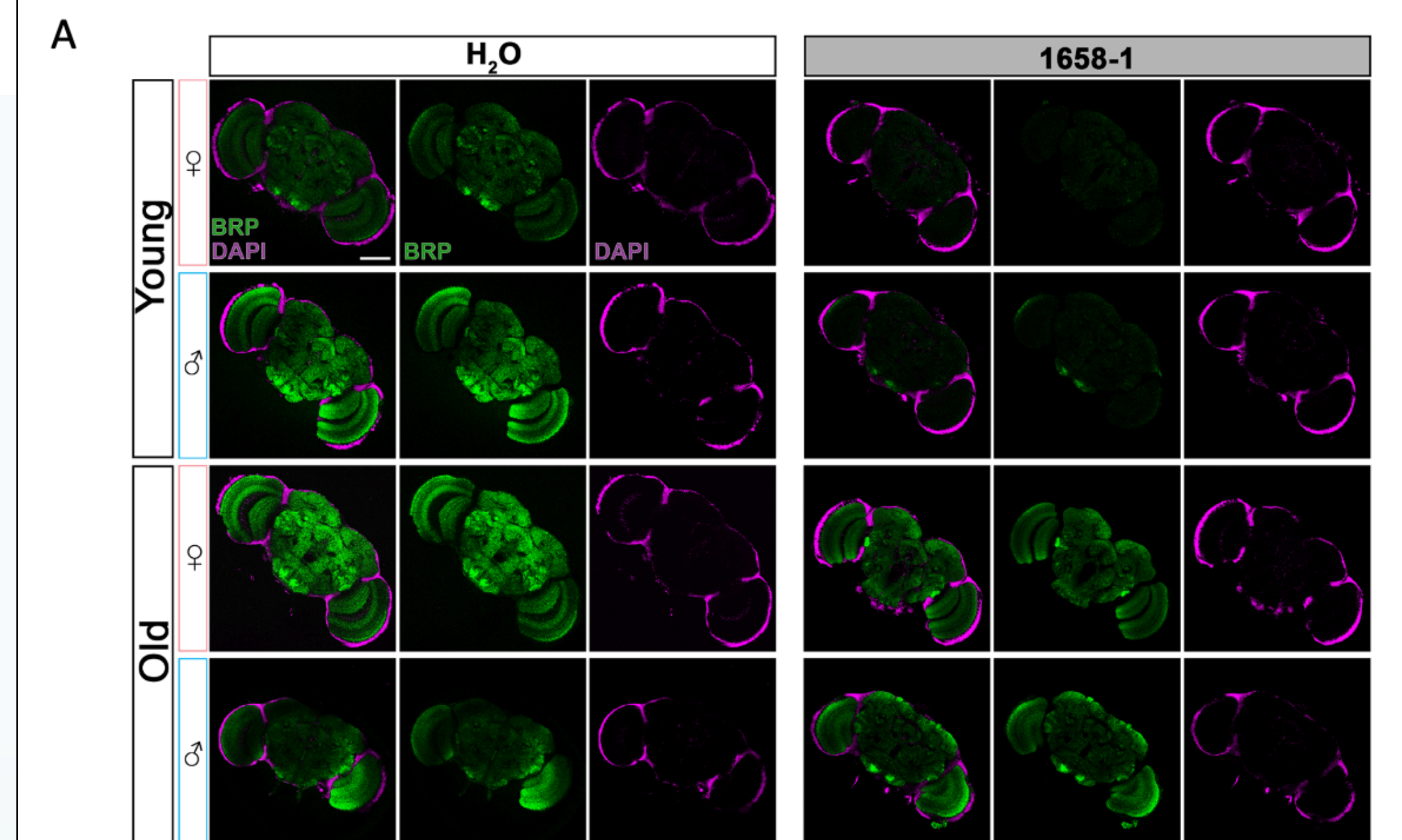
Young groups were more sensitive in long-term HAB exposure impact compare with their performance in acute response. The mid-age and old groups recovered some climbing abilities from HAB exposure 14 days later.

LIFESPAN



Aerosolized 1658-1 HAB water exposure particularly and significantly shortened lifespan of the young groups for both sexes. Exposure of HABs at an early age has the most impact on their longevity.

BRAIN MORPHOLOGY



Exposure to inhalable HABs at an early age may lead to an increased risk of neurodegenerative diseases. Elderly females are more likely to have neurodegenerative diseases than elderly males.

CONCLUSION

- Exposure to harmful algal blooms impairs locomotor functions, shortens the life span, and causes *Drosophila* synapse dysfunction.
- Aerosolized particles from harmful algal blooms pose significant health risk, both immediately after exposure and long-term.
- The fruit fly *Drosophila melanogaster* is an ideal *in vivo* animal model to analyze acute and chronic impact on health.

ACKNOWLEDGEMENT

This work was supported and funded by ULINK. I sincerely thank all the members of the HAB team for their technical supports and efforts throughout the project.