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## Assessing the Effects of Age and Sex on mTBI Severity

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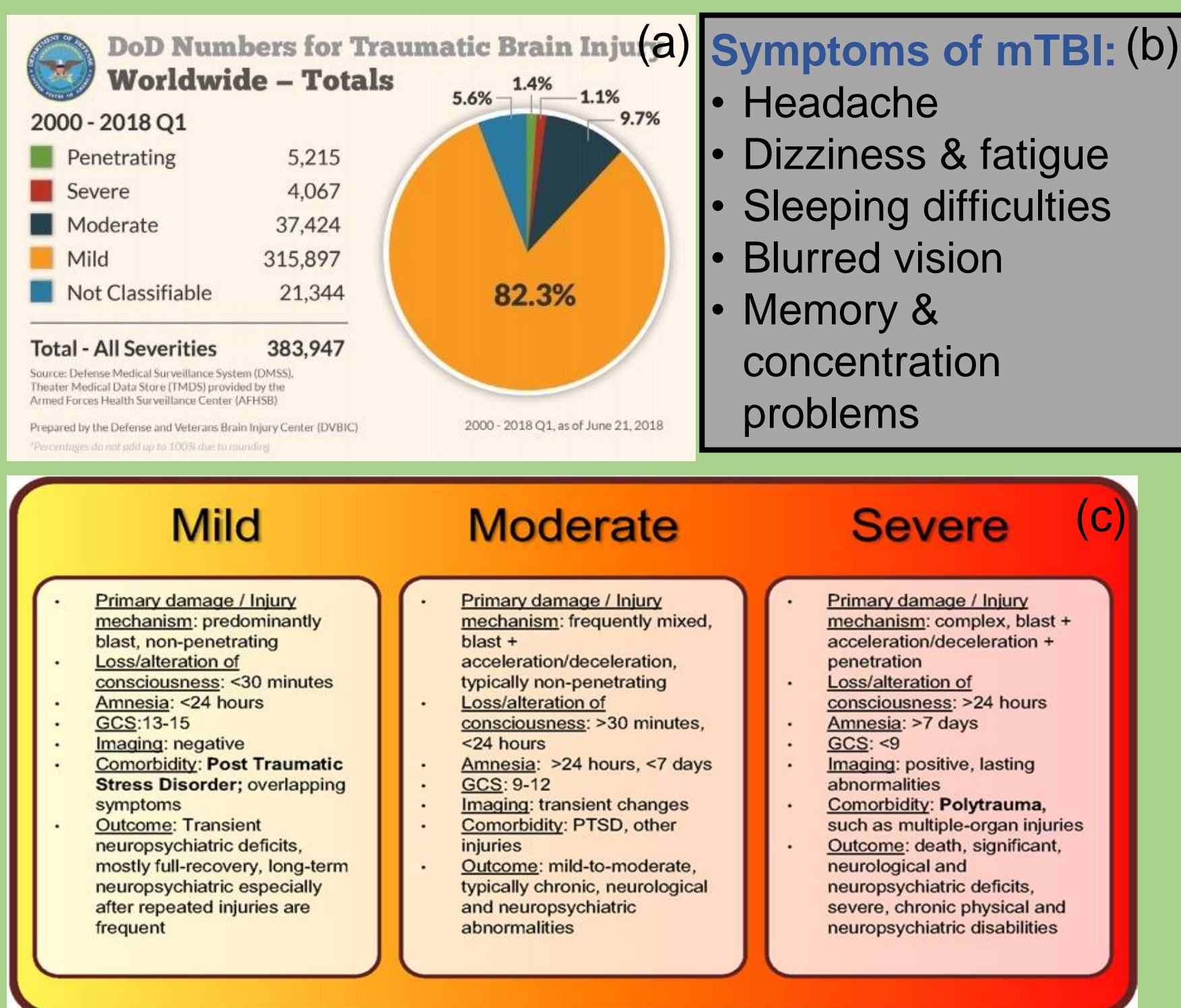
# Assessing the effects of age and sex on mTBI severity

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## Background

- Soldiers experience mTBI primarily as a result of being exposed to blasts during training and deployment.
- According to the DOD, > 80% of all TBI between 2000 -2018 were mTBI
- There is no treatment, but early detection could improve outcome for comorbidities.



## Sex/Age Differences in mTBI Severity

- Gender and age have been shown to affect outcomes in different neurodegenerative disease
- There are sex & age differences in human TBI population outcomes
- *However, TBI research rarely consider sex or age differences*



**Fix 2. NIH has recently established guidelines to have more studies include sex and age differences.**

## Study Objective

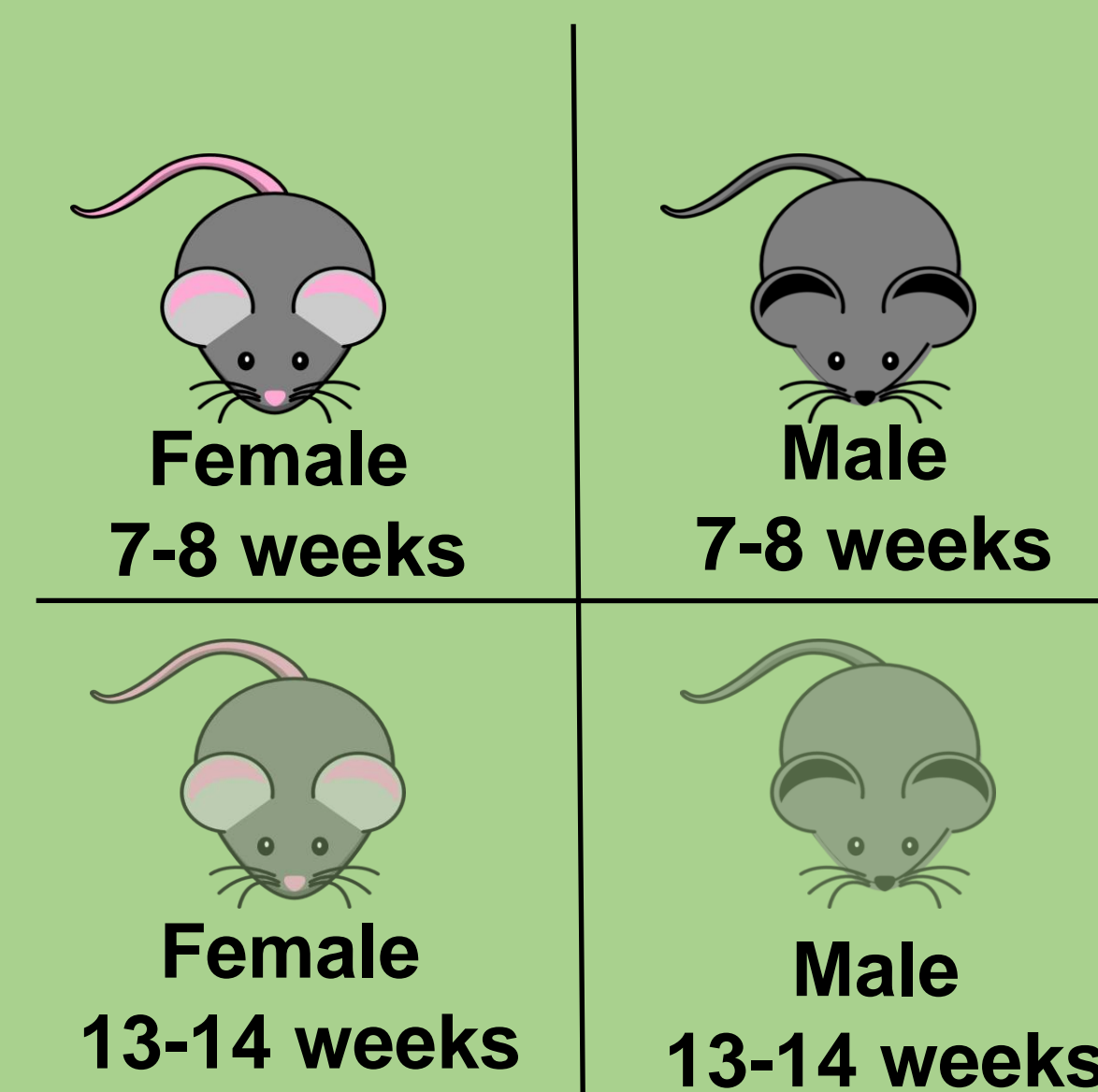
- Evaluate ***sex and age differences*** in outcomes of open air blast model of mTBI
- Investigate an affordable ***high throughput tracking method*** to reproducibly evaluate clinical symptoms of mTBI without bias

## Material & Methods

- Mice were exposed to a single blast of 350g C4 spaced 3 meters from mouse cages
- Mice were evaluated daily for the week following the blast and then once a week for a month.
- Mice were evaluated with traditional behavior testing methods by 3 blinded investigators and also recorded with a GoPro for 5 minutes at each time point and then evaluated with MATLAB.



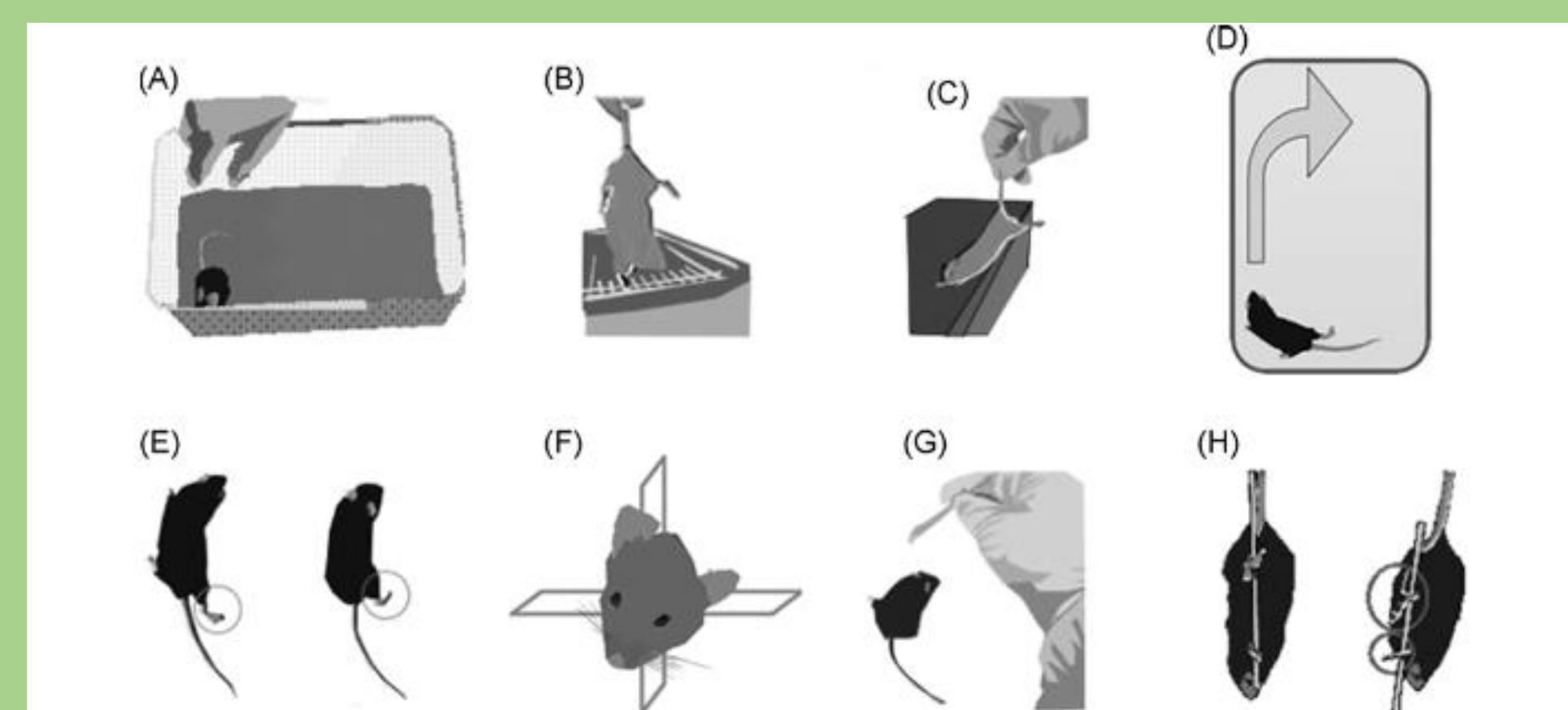
**Fig 3. Missouri Blast Model.** (a) four stands, each with six mice cages, two pencil probe pressure sensors to measure the static pressure of the blast wave, and one flush mount pressure sensor to measure the reflected pressure of the incident wave. All stands are secured 3 meters from the explosive charge and hold the mice 1 meter off the ground. The explosive charge consists of 350g of C4 hanging 1 meter above the ground. (b) mice in cages. (c) Jenn putting mice into cages



**Fig 4. Experimental set-up. Four groups were evaluated: juvenile females, adult females, juvenile males, and adult males. Each group consisted of 3 control mice that were not blasted and 5 blasted mice.**



**Fig 5. Custom built chambers using GoPro mounts on top for video recording mice. Insert: GoPro camera set-up looking into chambers.**

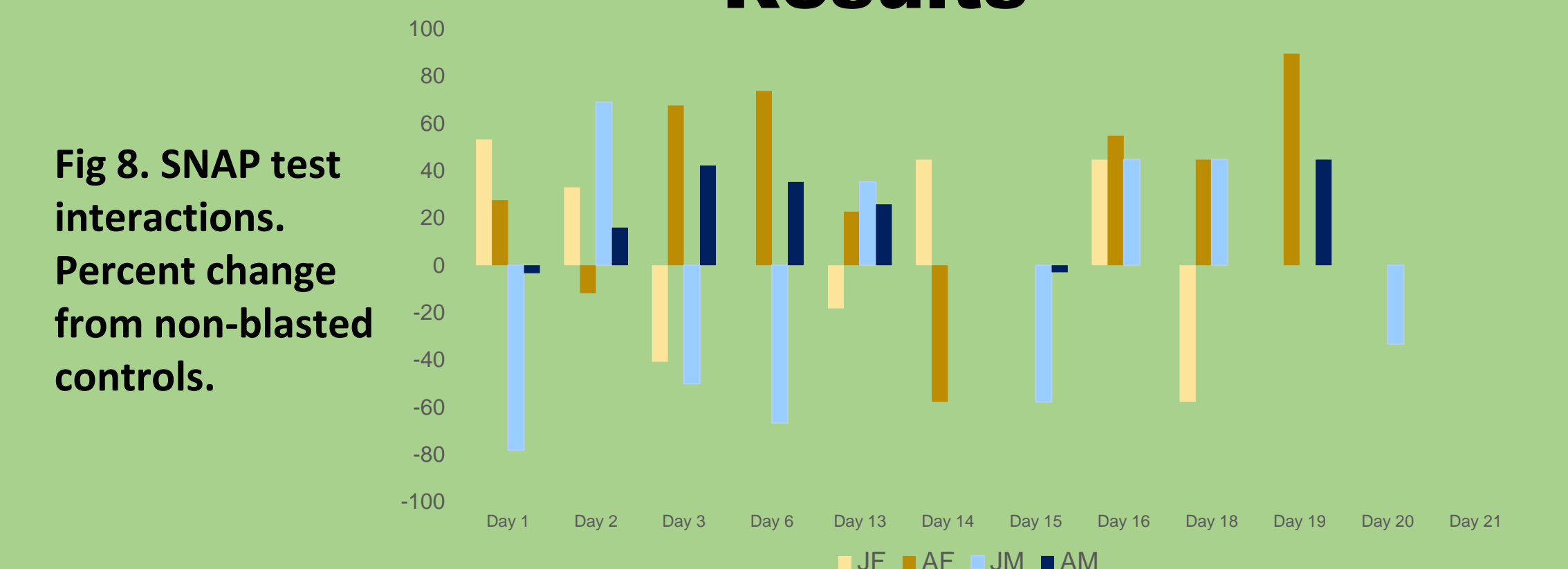


**Fig 6. Traditional methods to clinically evaluate mTBI in mice. (a) foot fault test. (b) balance bar. (c) visual placing. (d) pacing or circling. (e) gait and posture. (f) head tilt. (g) visual field. (h) baton.**

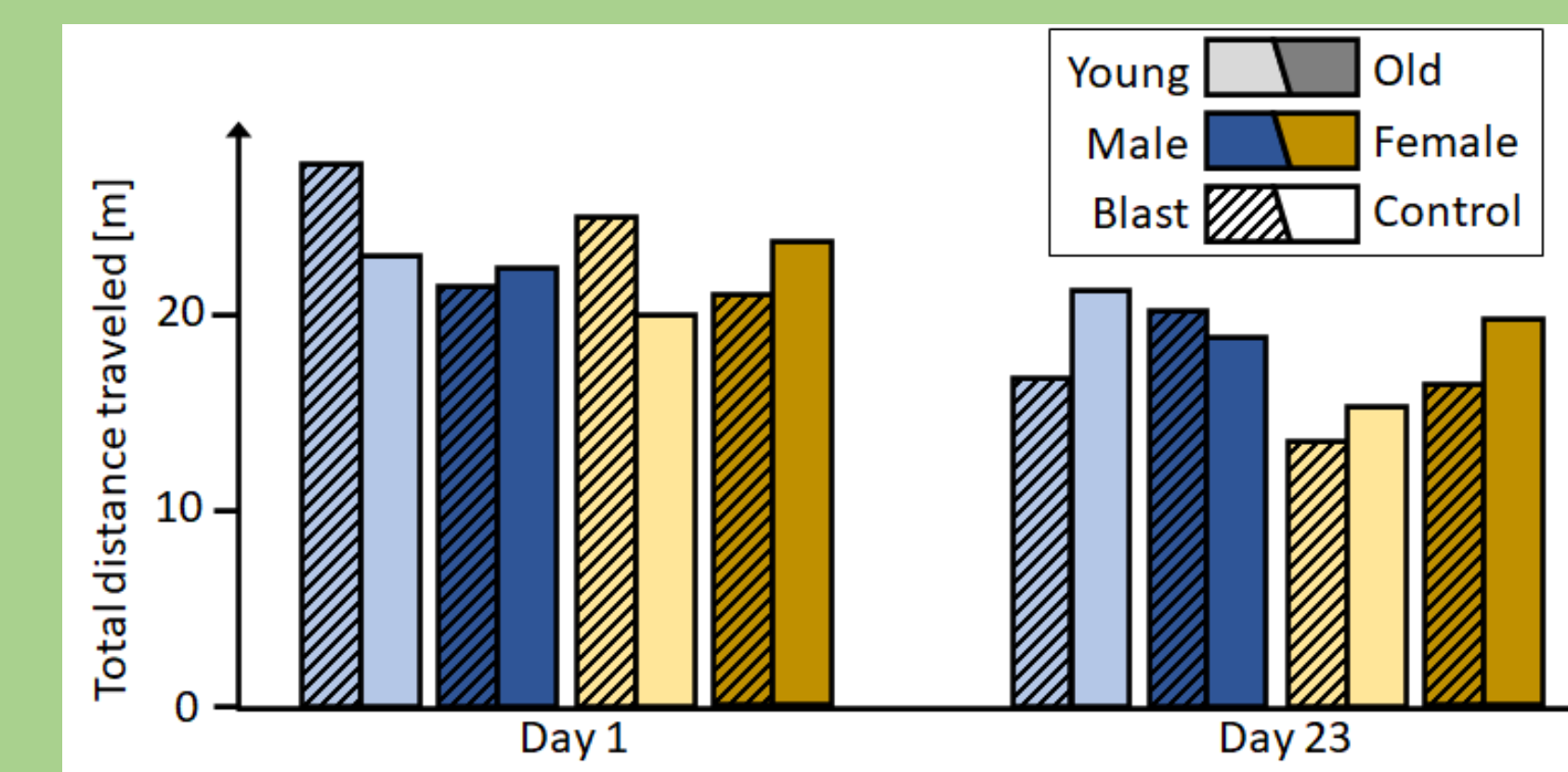


**Fig 7. Protocol to video record and analyze mouse movement with MATLAB. (a) still frame of a mouse in the recoding cage. (b) computer adaptation (c) data points for the mouse movement during 5-minute video**

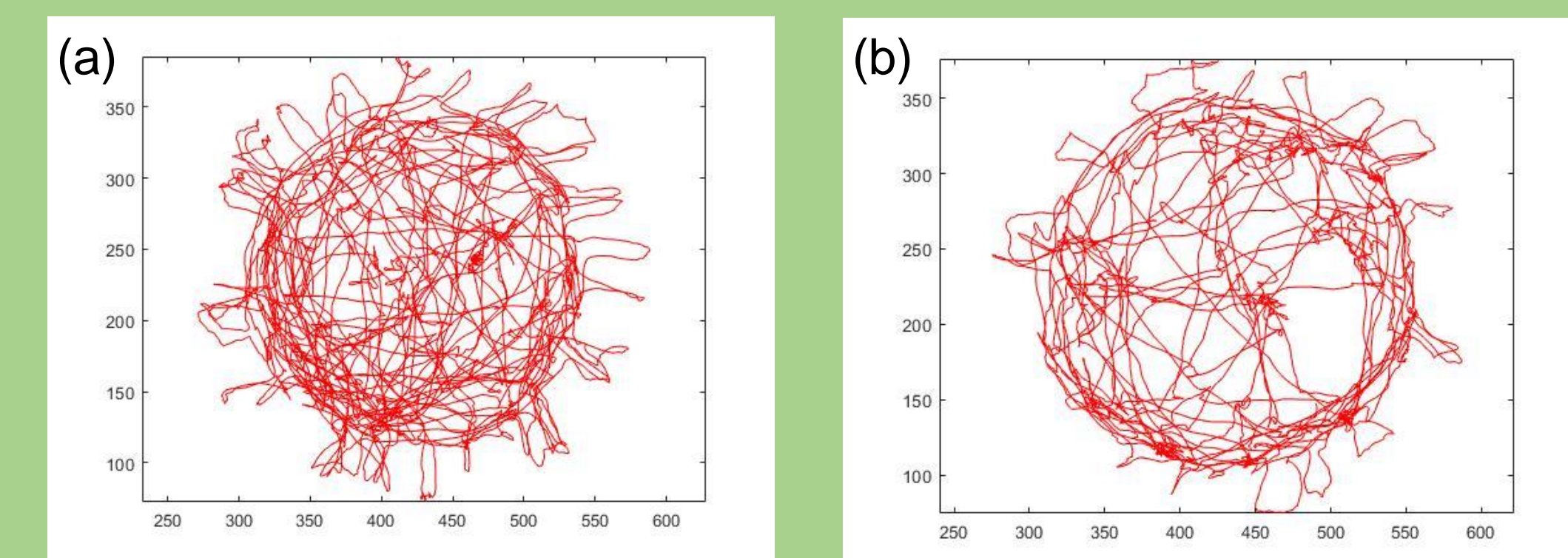
## Results



**Fig 8. SNAP test interactions.**  
Percent change from non-blasted controls.



**Fig 9. Total distanced traveled as quantified by MATLAB.**



**Fig 10. MATLAB output showing travel patterns of JM controls (a) and blasted (b) mice on Day 1 after blast.**

## Conclusion

- Age had a bigger difference on outcomes than gender
- Differences between blasted mice and controls, genders, and age groups were identified in both traditional and tracking methods
- Tracking methods were able to detect differences after 20 days when traditional methods were not.

## Acknowledgements

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## References

1. Lazarus R, Helmick K, Malik S, Gregory E, Agimi Y, Marion D. Continuum of the United States military's traumatic brain injury care: adjusting to the changing battlefield. *Neurosurgical Focus* [Internet]. 2018 Dec 1 [cited 2022 Feb 24];45(6):E15. Available from: <https://thejns.org/focus/view/journals/neurosurg-focus/45/6/article-pE15.xml>
2. Elsayed M, Agoston D. Serum-Based Protein Biomarkers in Blast-Induced Traumatic Brain Injury Spectrum Disorder. *Frontiers in Neurology* [Internet]. 2012 [cited 2022 Feb 24];3. Available from: <https://www.frontiersin.org/article/10.3389/fneur.2012.00107>
3. NIH. Guidelines for the Review of Inclusion on the Basis of Sex/Gender, Race, Ethnicity, and Age in Clinical Research [Internet]. 2019. Available from: [https://grants.nih.gov/grants/peer/guidelines\\_general/Review\\_Human\\_subjects\\_Inclusion.pdf](https://grants.nih.gov/grants/peer/guidelines_general/Review_Human_subjects_Inclusion.pdf)
4. Shelton SB, Pettigrew DB, Hermann AD, Zhou W, Sullivan PM, Crutcher KA, et al. A simple, efficient tool for assessment of mice after unilateral cortical injury. *J Neurosci Methods* [Internet]. 2008 Mar 15 [cited 2022 Feb 17];168(2):431–42. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2702871/>