Anabolic Steroids and the Brain

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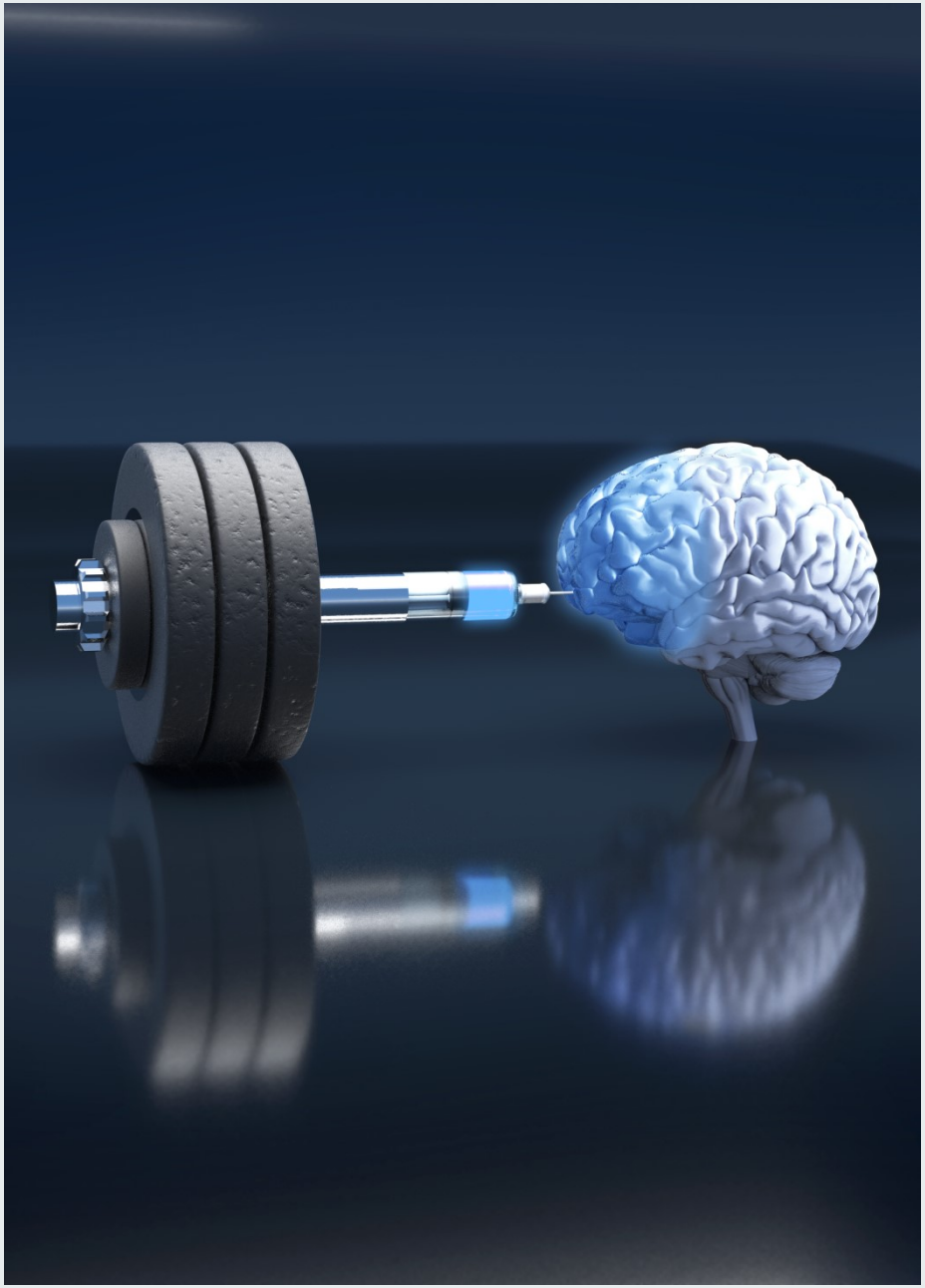


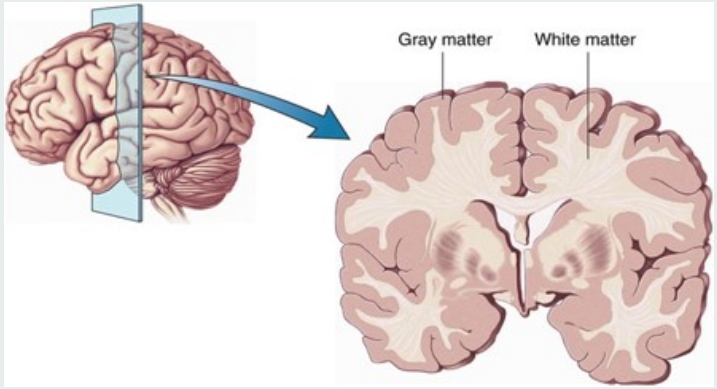
Brain effects

Cognition

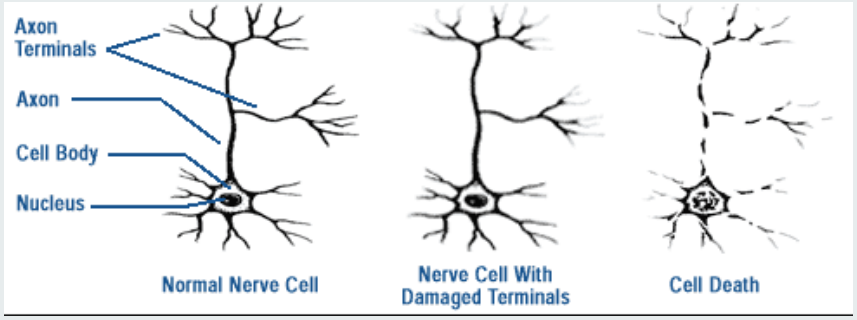
Mental health

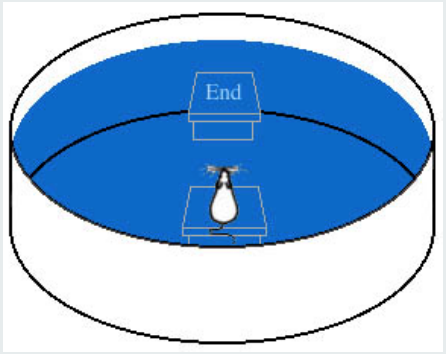
Brain health in old age

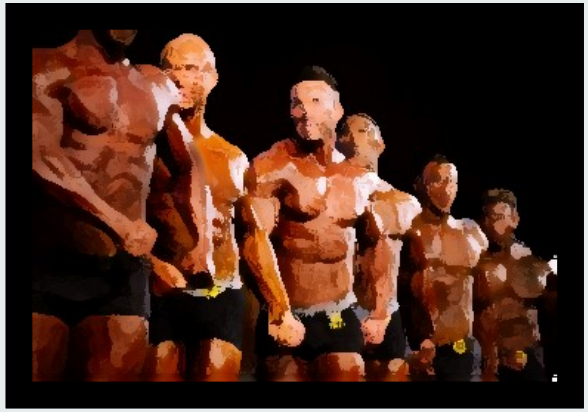
Long-term high dose AAS use



Structural brain changes of AAS – early evidence





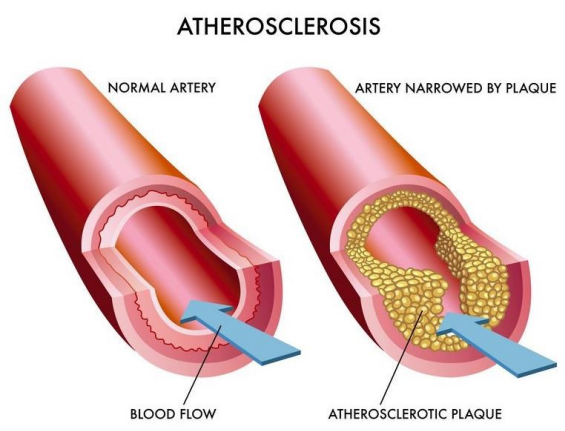


- Neurotoxic effects (in cell cultures)
- Reduced memory in animal models
- Impaired memory and executive function in long-term AAS users

(Kanayama, *et al* 2012; Heffernan *et al* 2015; Bjørnebekk *et al 2019* & Hauger *et al* 2020)

Medical effects of AAS that might impact brain health

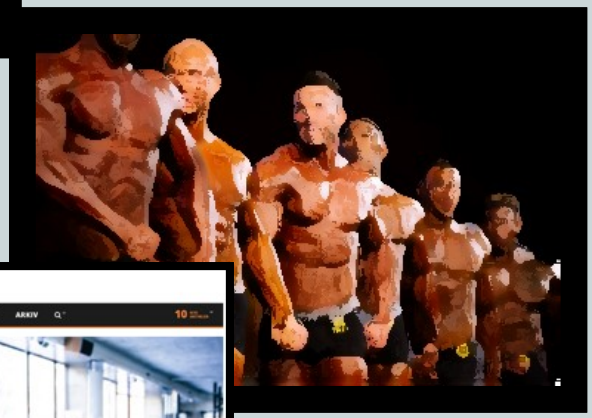
- Hypogonadism
- Cardiovascular risks (Blood pressure, cholesterol, atherosclerosis, cardiac anatomy and function)

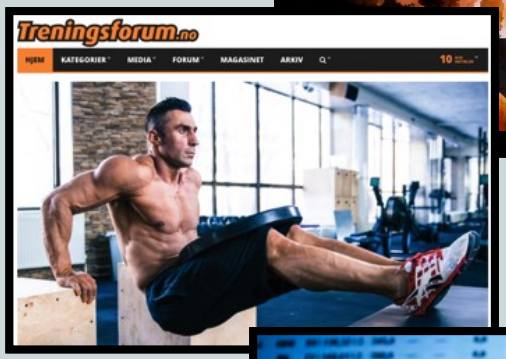


Long-term use of AAS and brain structure

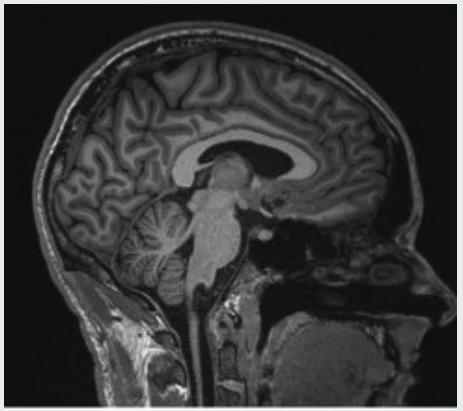
Gray matter volumes and thickness

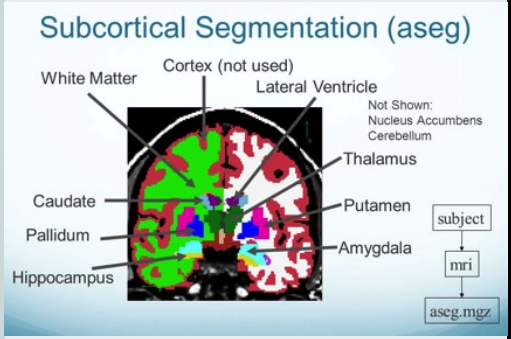
Participants

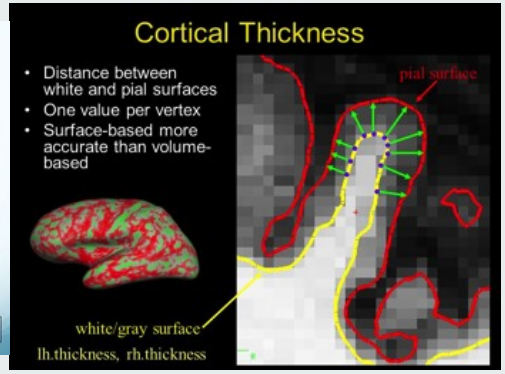




Structural brain imaging



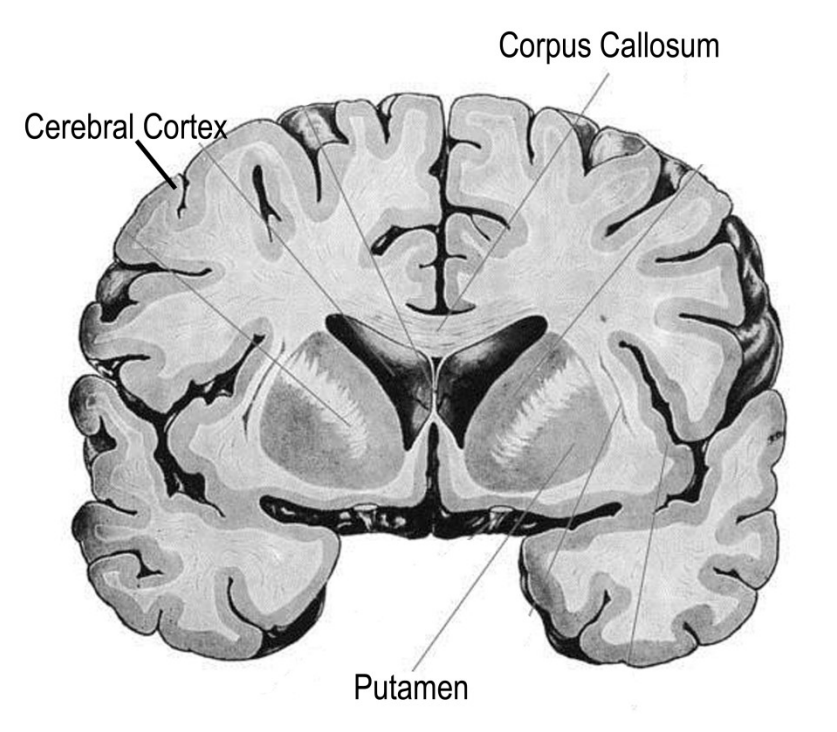




AAS exposed weightlifters

Weightlifting Controls - WLC

MRI-findings: AAS use associated with smaller brain volumes



AAS-exposed users had smaller brain volumes including:

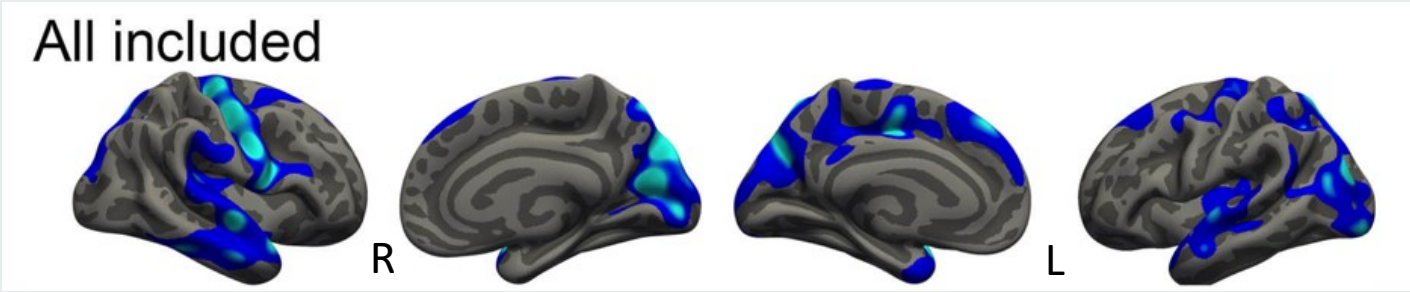
- Total grey matter volume
- Cerebral cortex
- Putamen
- Corpus callosum

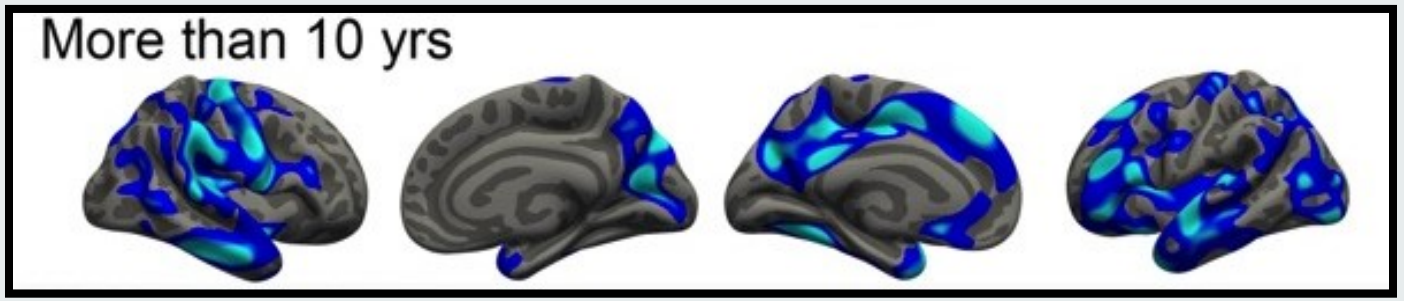
The differences seen in large volumes suggest general rather than regional specific effects

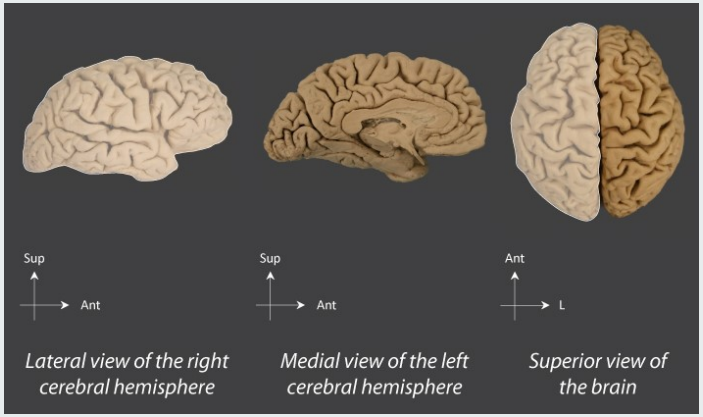
N=151 (82 AAS/69 WLC)

Bjørnebekk *et al.*
Biological Psychiatry, 2017

Thinner cerebral cortex in widespread regions, more extensive with longer exposure







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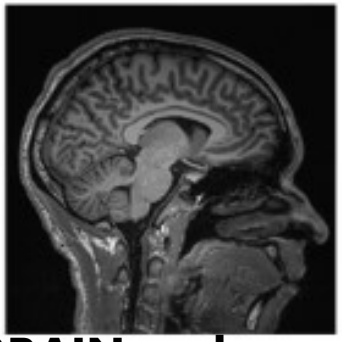


BRAIN and BEHAVIOR

Time Point I

Brain Imaging

Cognition

Mental Health

3.5 yrs

Time Point II

Brain Imaging

Cognition

Mental health

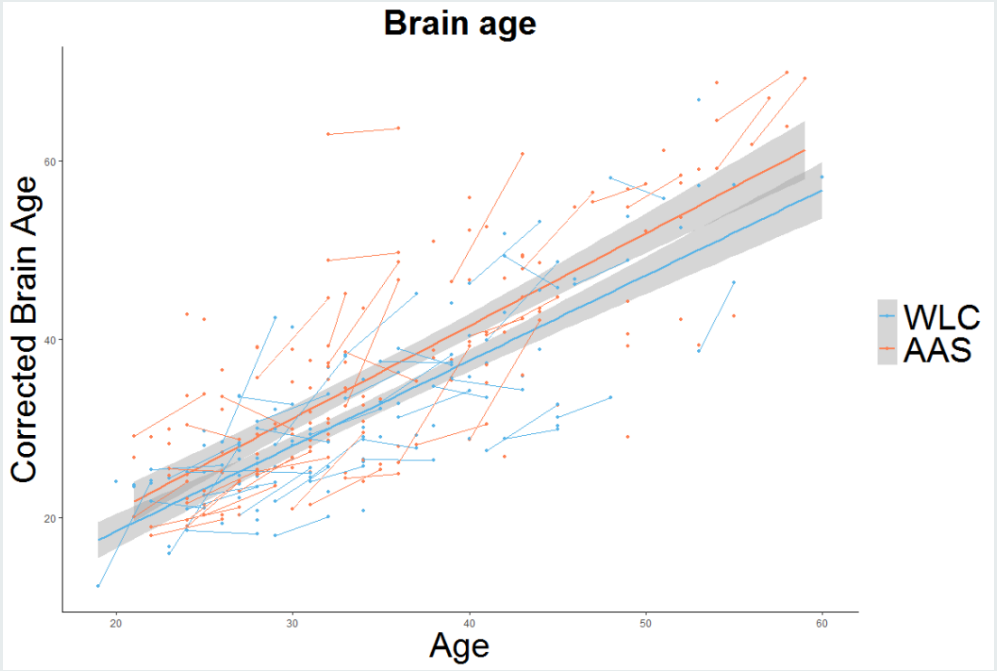
Cardiovascular

Blood Biomarkers

- **140 unique AAS-users and 110 WLC**
- **Longitudinal data**

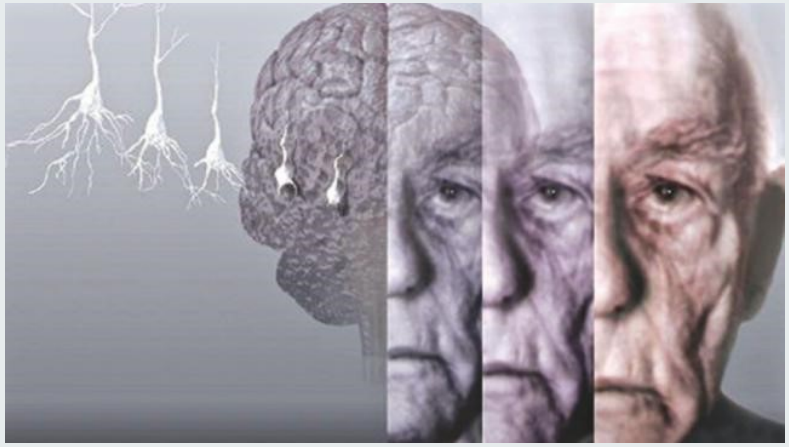
Several collaboration partnerns - Interdisiplinary

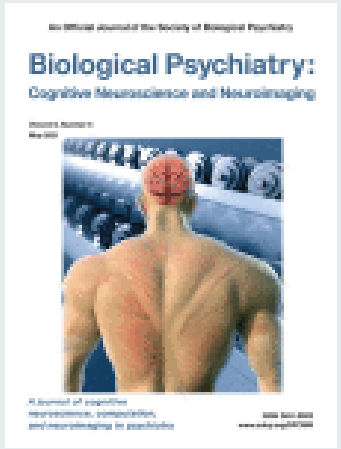
Brain age prediction upon brain imaging data and artificial intelligence



AAS users had older appearing brains (higher *Brain Age Gap)* compared to WLC. Both for full brain volume and regional measures (not shown).

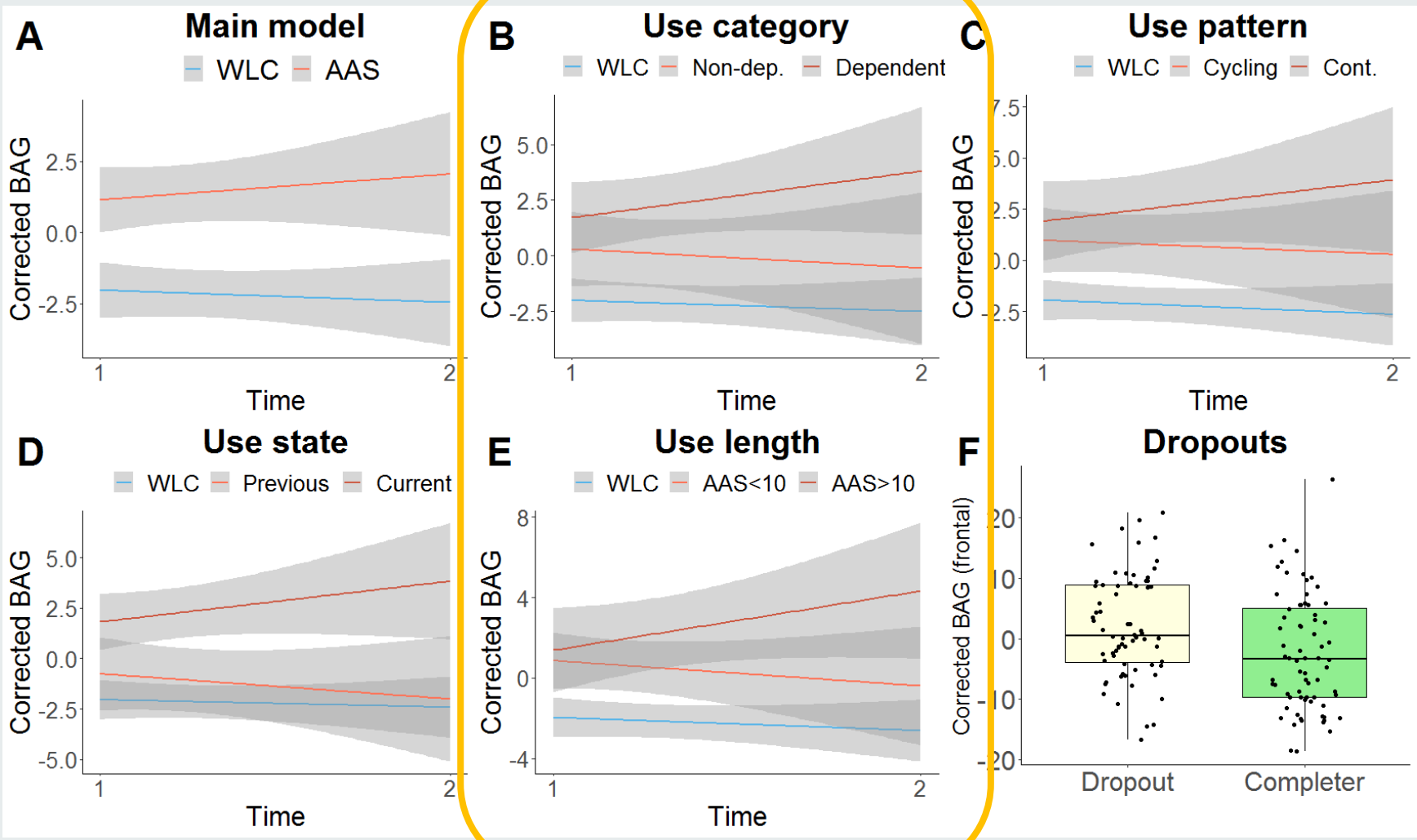
Scans from 133 AAS users and 99 WLC





Bjørnebekk et al, Biological Psych – CNNI, 2021

Accelerated brain-aging upon long term use and dependence



Trying to disentangle the brain age findings

1. Neurotoxicity
2. **Cardiovascular effects**
3. Neuro-inflammation & Oxidative stress
4. Hypogonadism

Cardiac structure and function are associated with *brain age* findings

Data is removed as findings are not published yet..

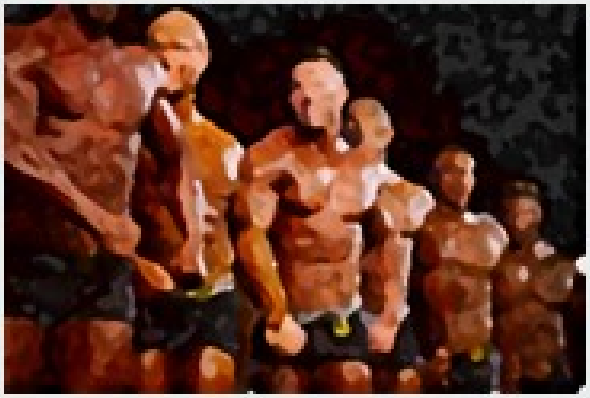
Work in progress

- Summary -

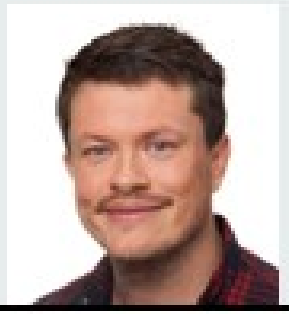
Long-term AAS use is associated with:

- Apparant brain aging compared to WLC
- Long-term AAS & dependence is associated with accelerated brain aging
- Cardiac structure and function is partly linked to brain aging in AAS users

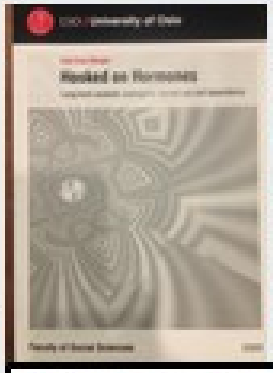
... and thanks for your attention and to all contributing muscles and brains



Cardiologist Almaas & Abdullah



Brain age prediction; Westlye & Kaufmann



Alumni; Hauger

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