Uncovering Duplicated Images in Scientific Literature
Systematic Review as a Tool for Detection

(work in progress)

Team

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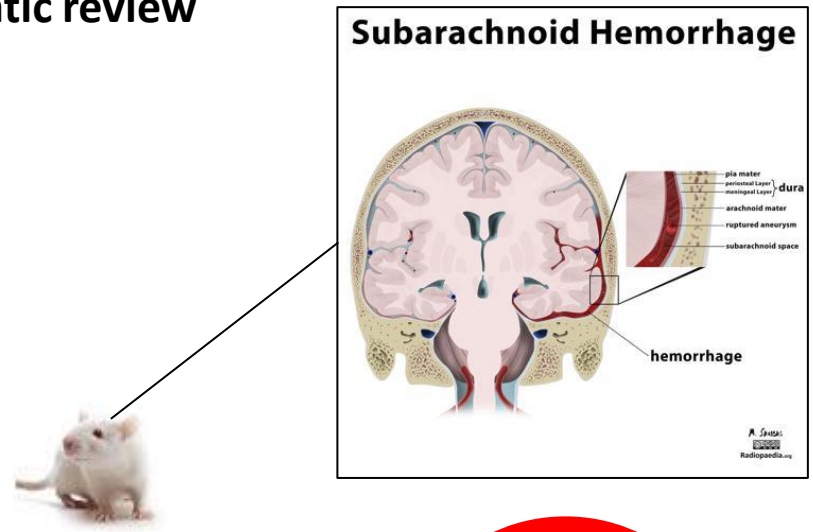
- René Aquarius

Disclosures

- Kim & Rene: admin for Prospero (unpaid)
- Collaboration with ImageTwin
- (partially) Funded by ZonMw

Systematic review



EARLY BRAIN INJURY

Strange inclusions

Total number of full-text inclusions: 612 ← Way more than expected!

After initial inspection: many different interventions

Random Intervention Generator

Obestatin

PACAP38

coenzyme Q10 (CoQ10)

Estrogen-related receptors (ERRs) like ERRgamma agonist DY131, selective inhibitor GSK5182, or SIRT3 selective inhibitor 3-TYP

Ghrelin (and inhibitor LY294002)

Sodium orthovanadate (SOV)

Memantine

Exogenous kisspeptin 54 (KP54)

Astragaloside IV (AS-IV)

ApoE-mimetic peptide COG1410

iNOS inhibitor L-NIL

Hydroxylamine (NO donor)

Trichostatin A

CGRP (calcitonin gene-related peptide)

High-mobility group box 1 (HMGB1)

TREM-1 inhibitor LP17

Topiramate (TPM)

Minocycline

rADAMTS-13

Mangiferin (MF)

eucalyptol

Problematic papers in our set?

Only suspicions. We need hard evidence.

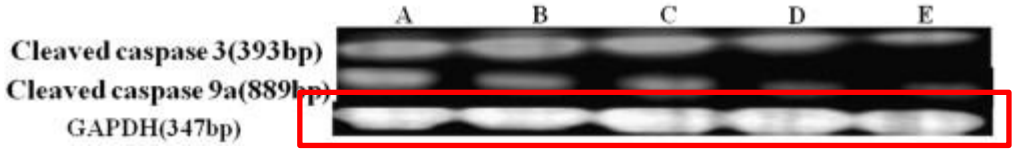
Plan: look at images!

- All images was way too much
  - Therefore: random sample of 80 studies
  - Therefore: only look at images of western blots / agarose gels
  - Look for: image manipulation, duplication, etc.

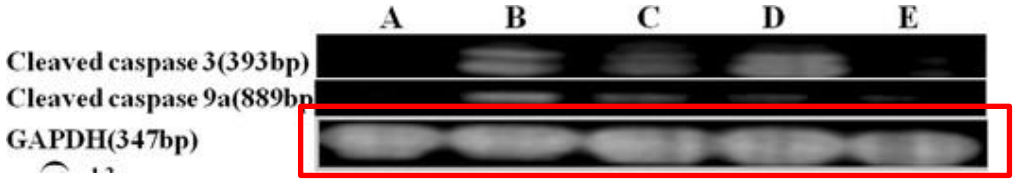
Elisabeth Bik

First findings

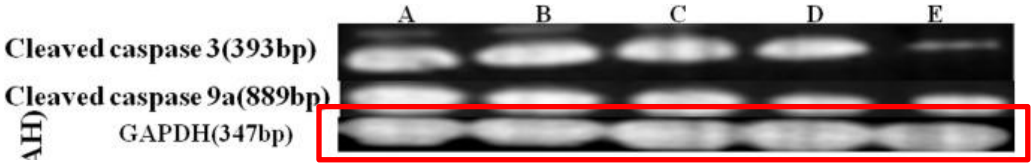
Study 1



Study 2



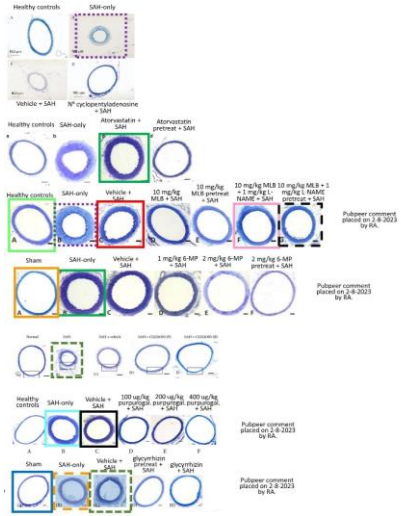
Study 3

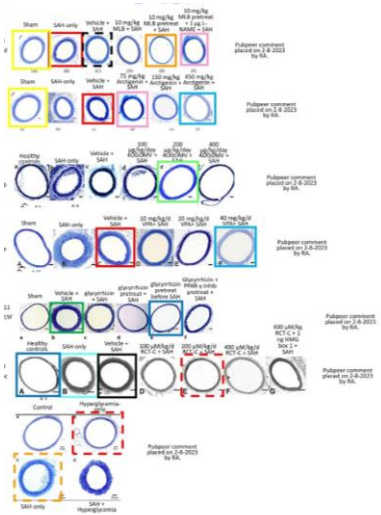


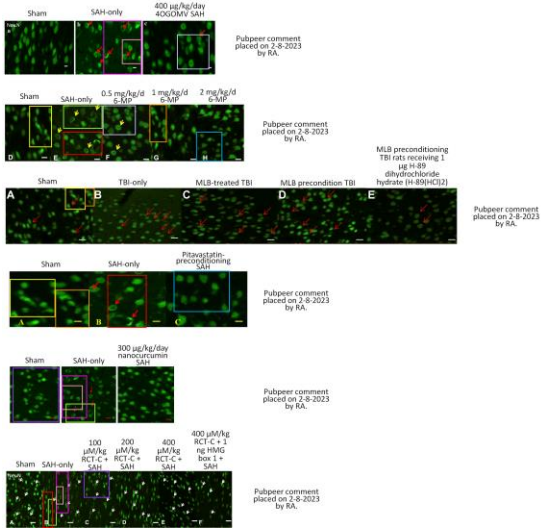
Uh-oh!

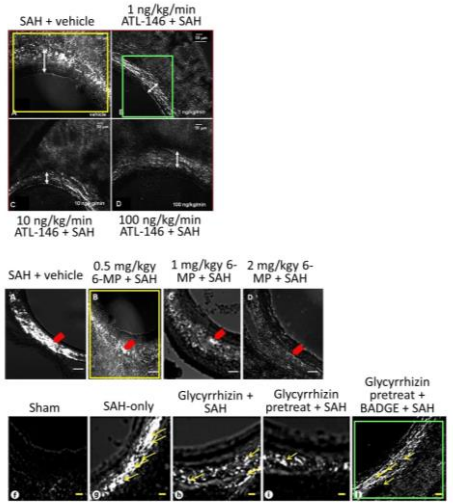
Additional findings

We started looking into other papers of these authors….



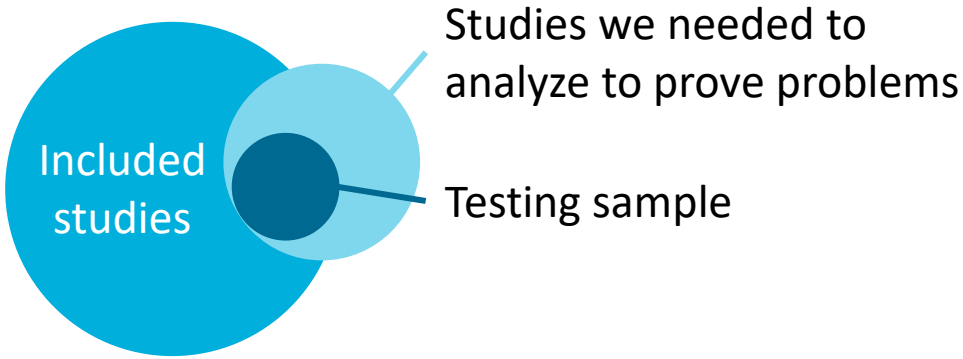






The problem

Important: this is pretty time-consuming



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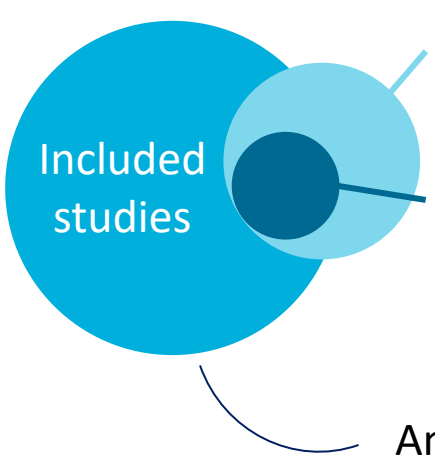


Studies we needed to analyze to prove problems

Testing sample

Analyzing all 612 is our true goal…

…but we need help

A possible solution

First step: collaborate with software developer from Austria

AI-powered software able to compare
any image to a database of 50 million scientific images

Not perfect, but helps a lot with detection

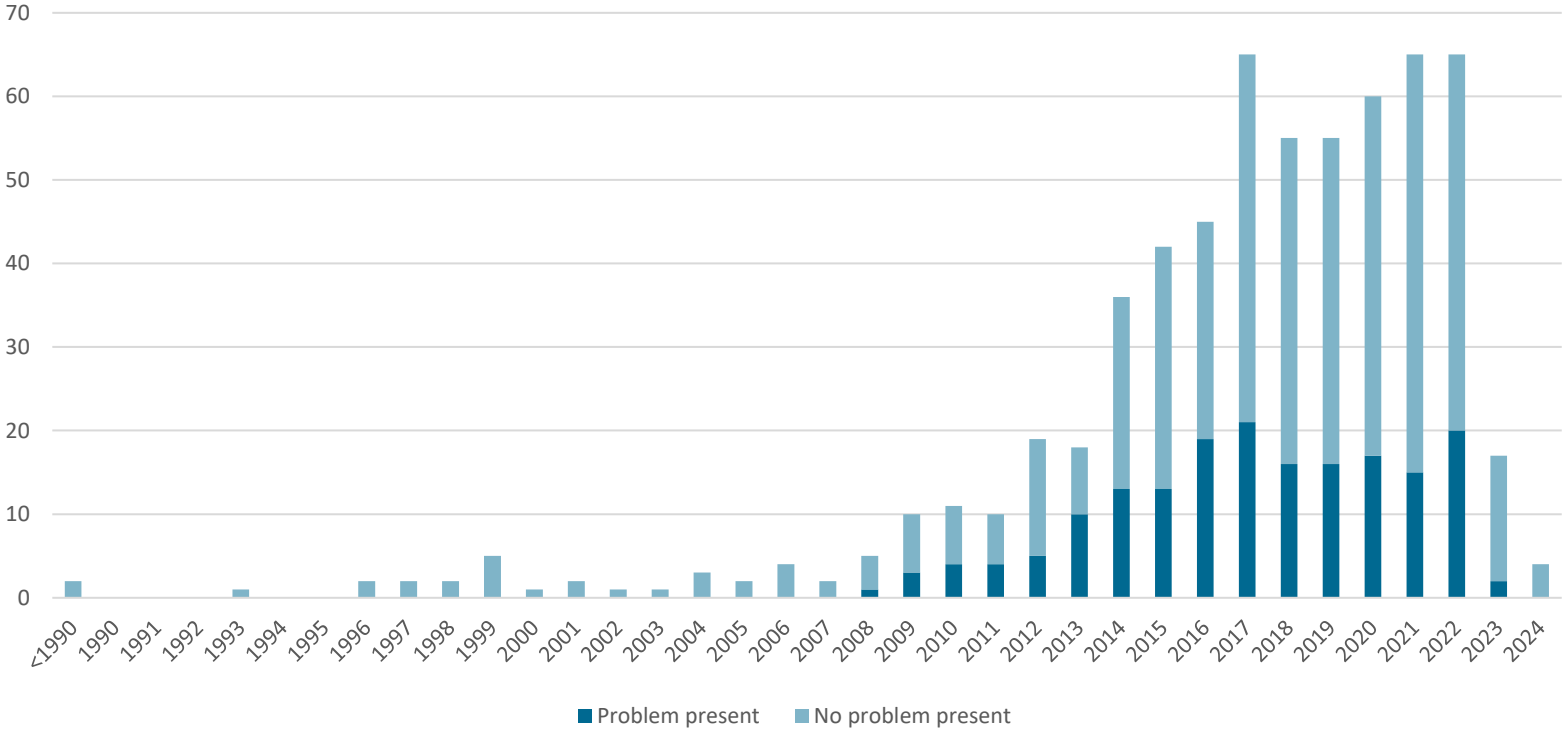
Our plan

- Per study → Any problem present?
  - Any problem found by us with ImageTwin? (Y/N)
  - Any problem found by us with our eyes? (Y/N)
  - Any problem previously reported on Pubpeer? (Y/N)
  - Study has been retracted? (Y/N)
  - Study has received an erratum / corrigendum? (Y/N)

If answered *yes* at least once → study was listed as problematic

Yes: 179 / 612 studies (**29.2%**)

Results – studies per year



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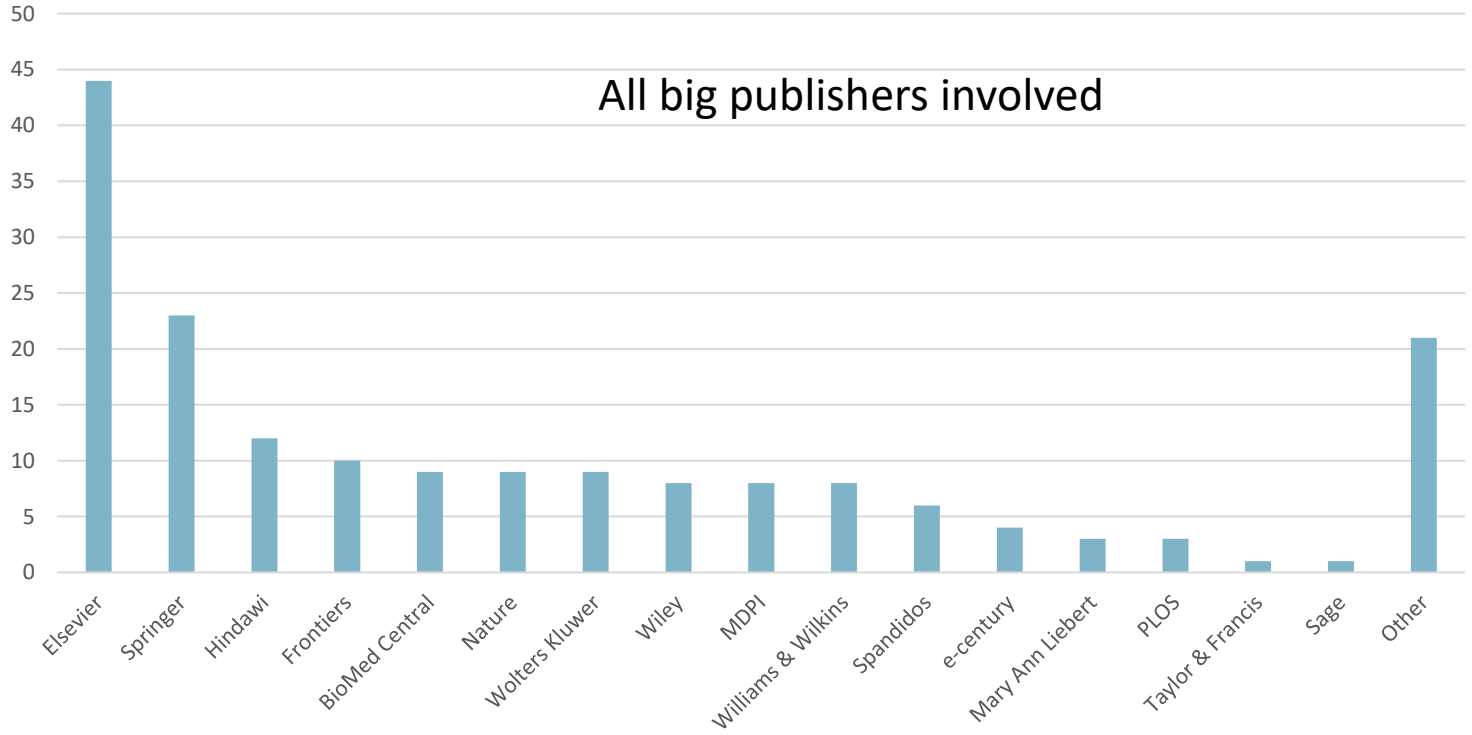
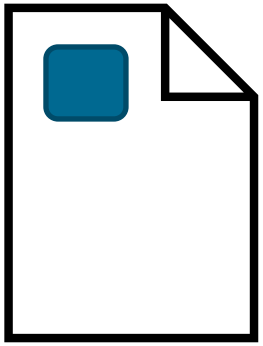
Results – Publishers of problematic papers

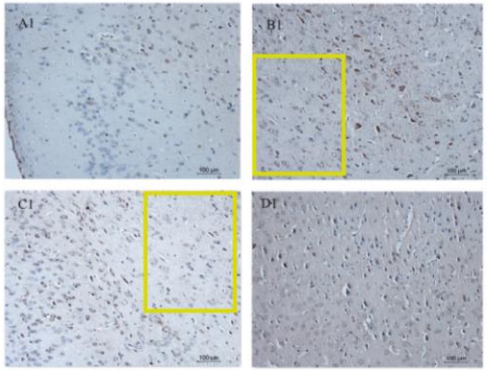


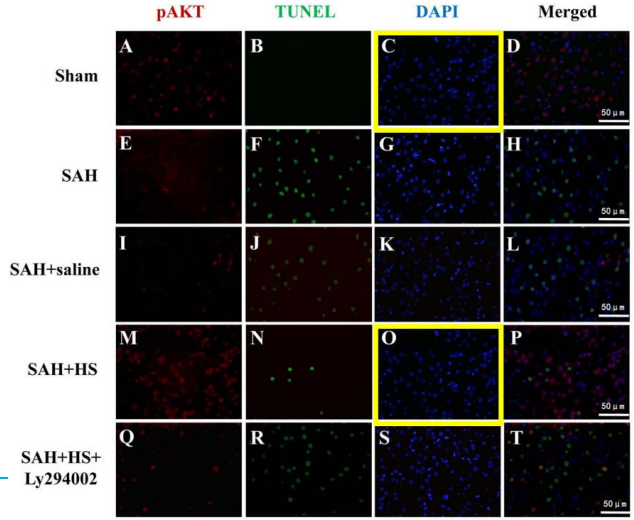
Results

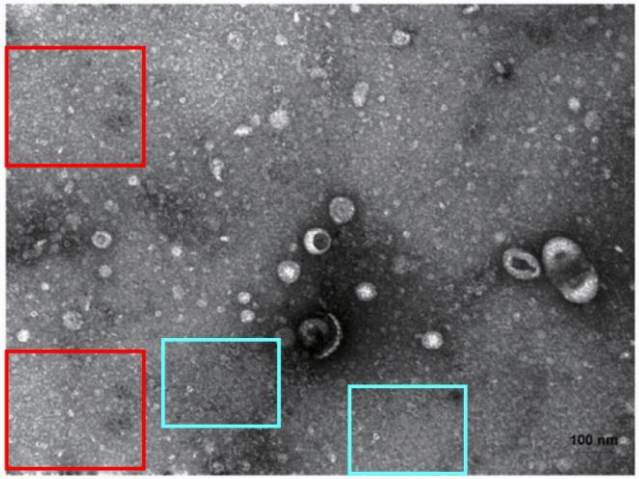


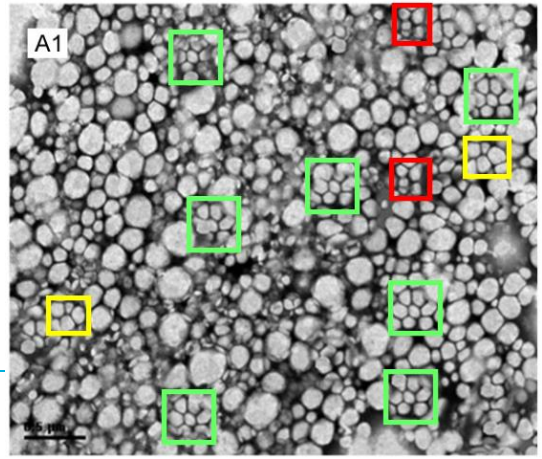
Within a figure

- 95 papers
- 107 figures

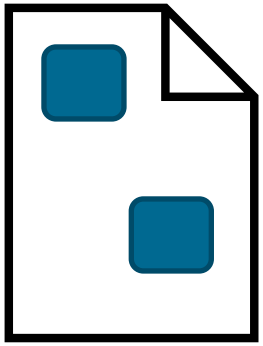






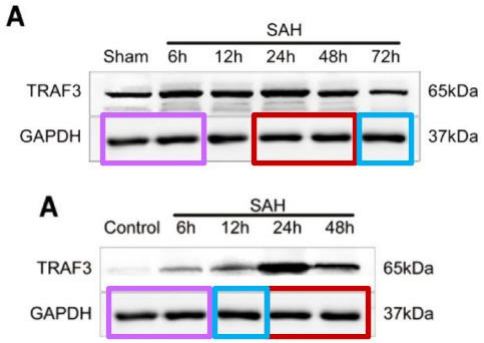


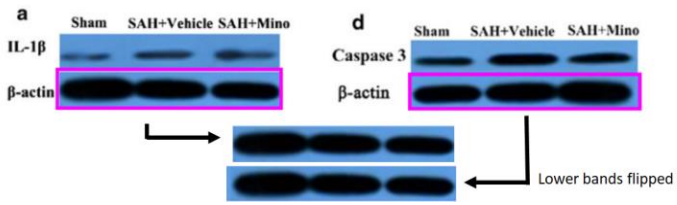
Results

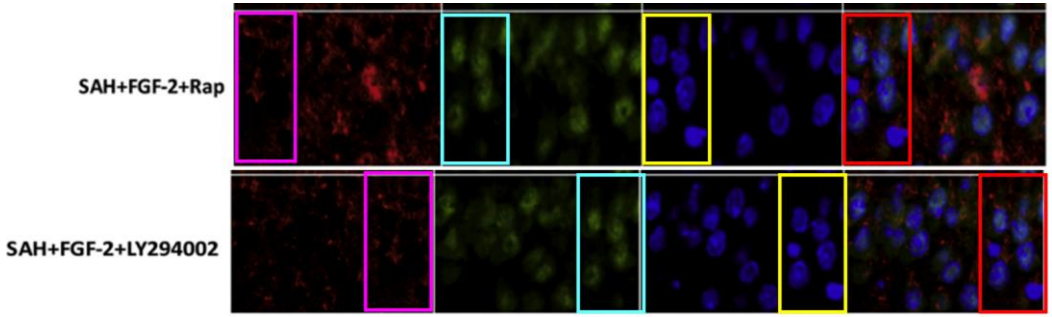


Between figures

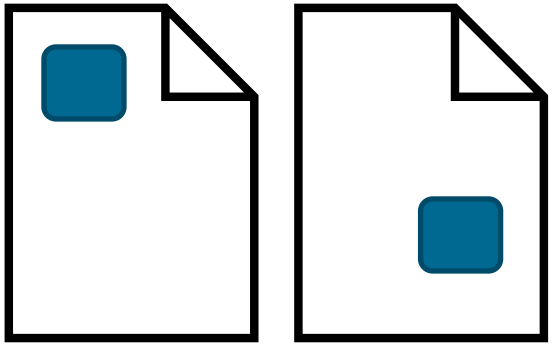
- 34 papers
- 70 figures

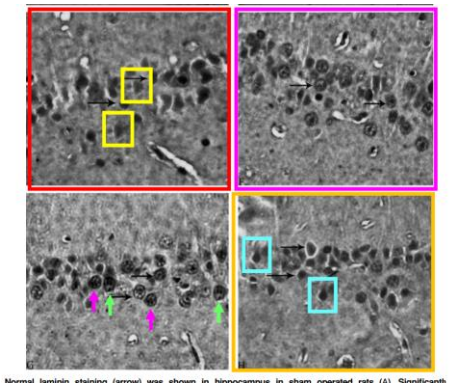


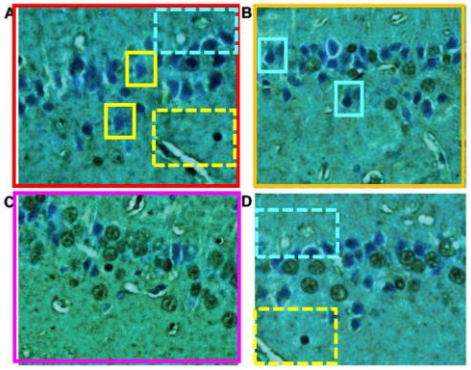




Results

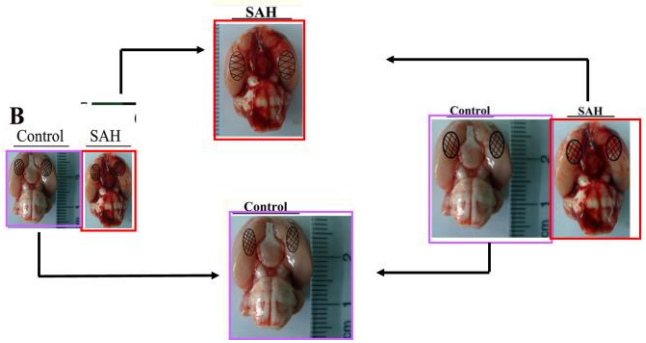






Between papers

- 65 papers
- 77 figures



Publisher actions up to now?

- **Erratum / Corrigendum: 22**
  - Before our investigation started: 11
  - Due to our investigation: 10
    - Stealth erratum: 1
  - Authors triggered due to our investigation: 1
    - Author contacted me

- **Retraction: 6**
  - Before our investigation: 2
  - Due to our investigation: 4

What now?

- **Additional actions**
  - ImageTwin check of supplementary files
  - Batch analysis ImageTwin
  - Bik-Scale analysis of problems found
  - Other analyses: text (plagiarism)? Graphs? References?
  - Collaboration with publishers (80 papers already sent for review)

Final thoughts

Intervention
Fancy verb
The problem
The animal model
Optional: pathway

- **We think our findings offer a VERY conservative estimate**
  - The problem of ~1 intervention per study is still present
  - Suspicious graphs often encountered
  - Many titles are extremely similar

Rosiglitazone attenuates early brain injury after experimental subarachnoid hemorrhage in rats

Quercetin alleviates subarachnoid hemorrhage-induced early brain injury via inhibiting ferroptosis in the rat model

Fucoxanthin Mitigates Subarachnoid Hemorrhage-Induced Oxidative Damage via Sirtuin 1-Dependent Pathway

Metformin attenuates early brain injury after subarachnoid hemorrhage in rats via AMPK-dependent mitophagy

Salvinorin A attenuates early brain injury through PI3K/Akt pathway after subarachnoid hemorrhage in rat

Pituitary adenylate cyclase-activating polypeptide attenuates mitochondria-mediated oxidative stress and neuronal apoptosis after subarachnoid hemorrhage in rats

Kisspeptin-54 attenuates oxidative stress and neuronal apoptosis in early brain injury after subarachnoid hemorrhage in rats via GPR54/ARRB2/AKT/GSK3β signaling pathway

Final thoughts

- **Systematic review can serve as a framework for identifying problems in studies**
  - Clearly defined number of publications to check
  - Can give an idea on how ‘problematic’ the field is
  - Can give insight in certain labs publishing multiple problematic papers

Thank you!

Rene Aquarius