

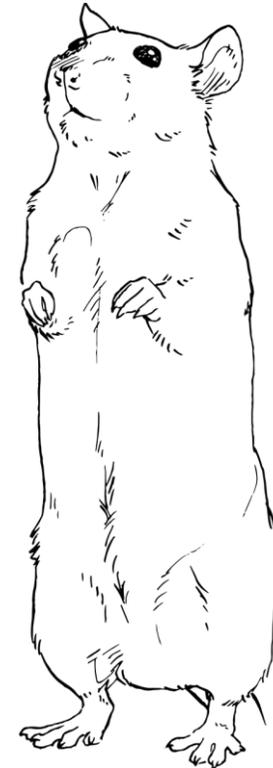
Insights into the impact of vitamin D and physical activity on gene expression in older age

Tamara Stelzer, BSc ; September 20th 2022



Agenda

- Gene expression in the aging organism
- How vitamin D and exercising are influencing gene expression
- Examples from my master's thesis: expression of selected antioxidative enzyme genes



Aging and gene expression

- Expression for several genes is altered [Lopez-Otin et al., 2013 ; Frenk and Houseley, 2018]
- Genes involved in the inflammatory process, in mitochondrial dysfunction, lysosomal degradation and others [Lopez-Otin et al., 2013]
- Increase in transcriptional noise with age lead to expressional changes [Bahar et al., 2006]
- Transcriptional changes do have an impact on the process of aging [Frenk and Houseley,2018]

Vitamin D can alter gene expression

Synthesized in the skin or absorbed with food

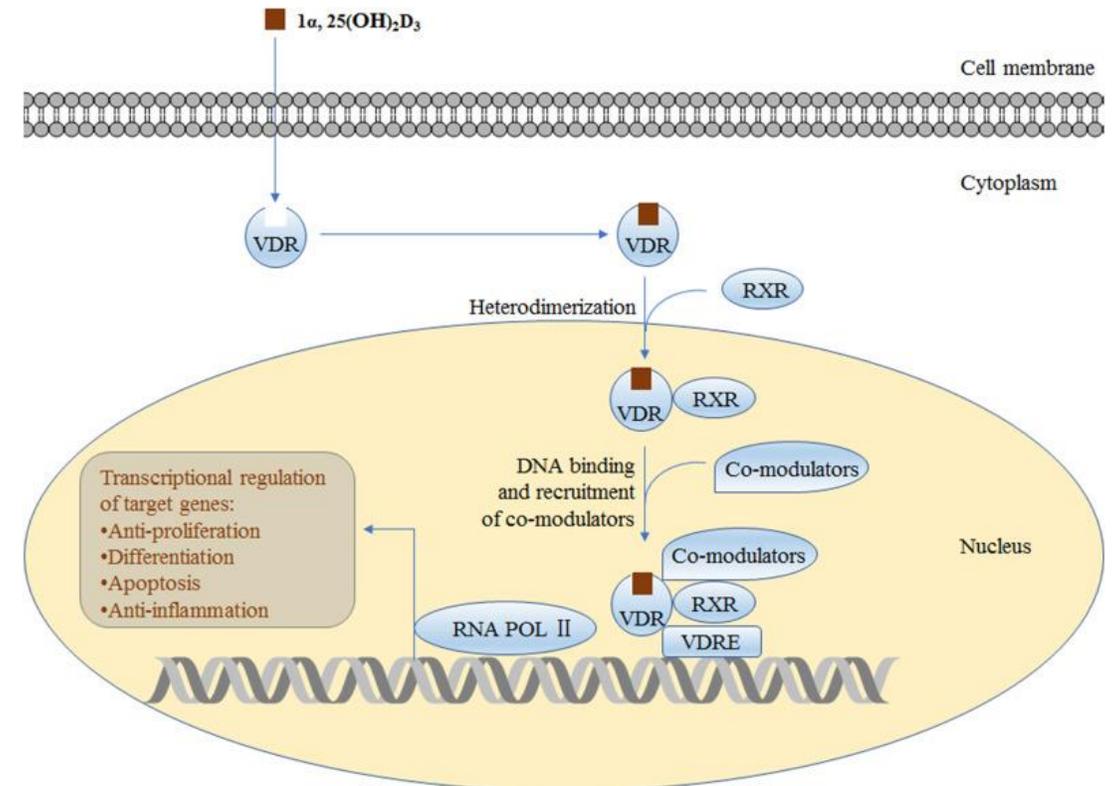
Metabolized in the liver to 25OHD

Metabolized in the kidney to $1,25(\text{OH})_2\text{D}$

$1,25(\text{OH})_2\text{D}$ = active, hormonal form (calcitriol)

Vitamin D can alter gene expression

- $1,25(\text{OH})_2\text{D}$ (=active form) binds to VDR
- VDR heterodimerizes with RXR
- Complex binds to VDRE (vitamin D responsive elements)



Chen *et al.*, "Vitamin D and its analogs as anticancer and anti-inflammatory agents," 2020

Exercising can alter gene expression

- Epigenetic mechanisms (DNA-methylation, miRNA, histone modification)
- Activates signaling pathways which than alter gene expression [Widmann, 2019]



Examples from my master's thesis: what was done

- Together with Monika Kolar
- Extraction of mRNA from liver, kidneys and *musculus gastrocnemius*
- Gene expression analysis using RT-qPCR



As an example: Gene expression results for antioxidative enzymes from my Masters thesis

- Oxidative stress theory of aging [Harman,1956]
- Aging leads to progressive dysfunction of mitochondria → accumulation of ROS → oxidative stress → dysfunction of various tissues [Harman,1956]
- Elevation of compounds of the antioxidative defense system could attenuate the aging process [Sohal et al., 1966]
- Glutathione peroxidase (GPx), superoxide dismutase (SOD) and catalase (CAT) are enzymatic compounds of the antioxidative defense system

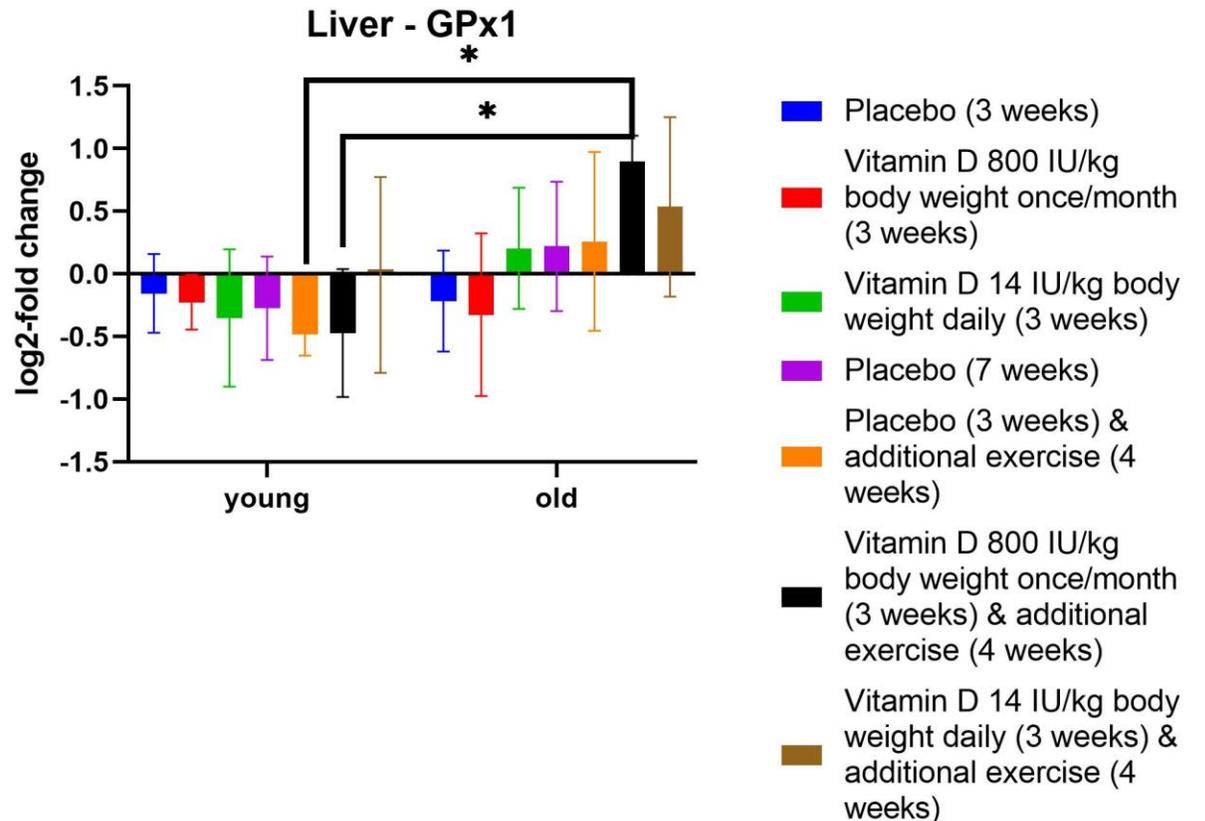
Vitamin D, exercising, aging and oxidative stress

- Vitamin D is known as a major regulator of GPx, SOD, CAT [Yu et al., 2021]
- Vitamin D has been shown to upregulate GPx [Wimalawansa, 2019]
- Exercise has been shown to regulate the expression of GPx, SOD, CAT [Nascimento et al., 2019]

Are Vitamin D and/or exercising influencing the expression of genes encoding for antioxidative enzymes in aging rats?

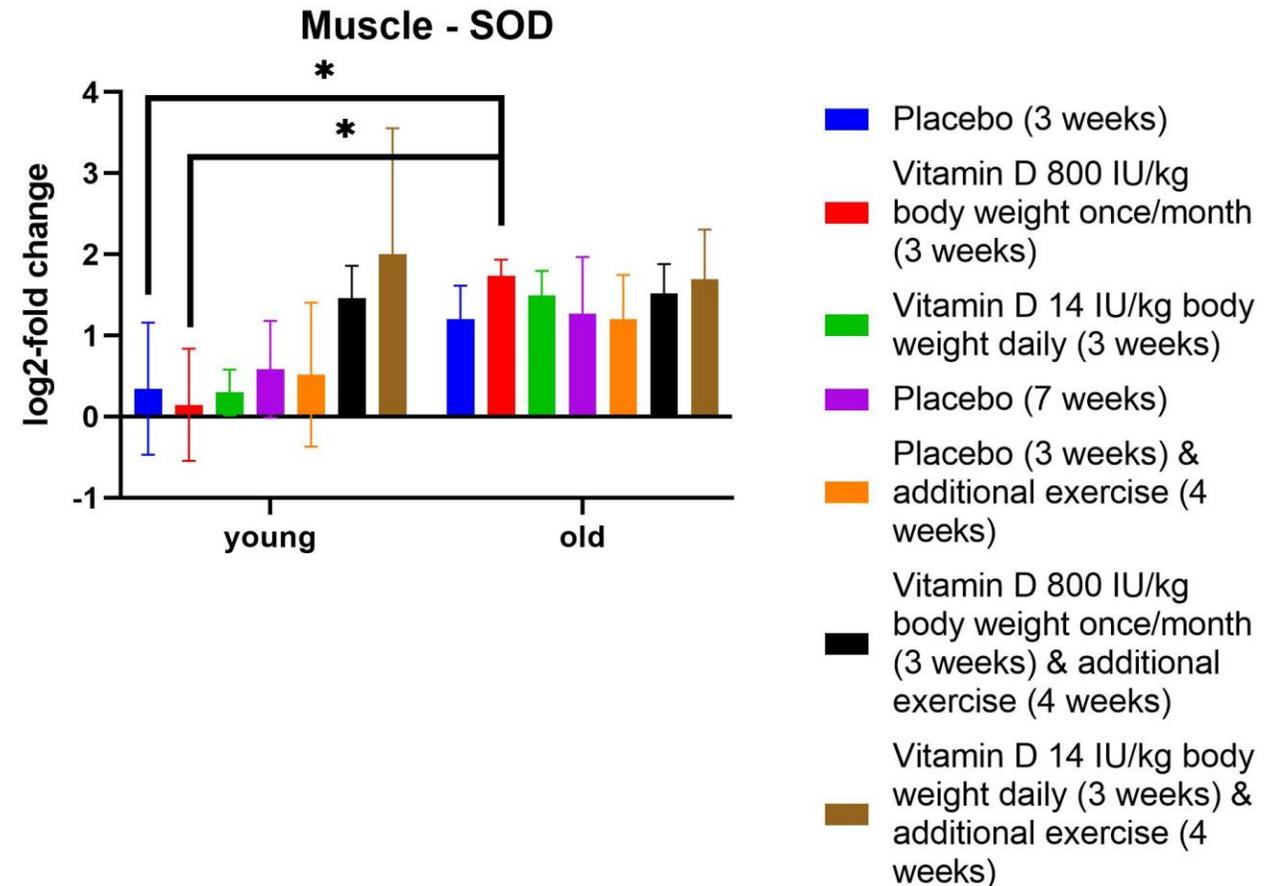
GPx1 - liver

- Especially in **old** rats receiving **vitamin D once a month at 800 IU/kg** body weight and **exercising additionally**
- Elevation of GPx1 expression in the liver might mean an improved response to oxidative stress



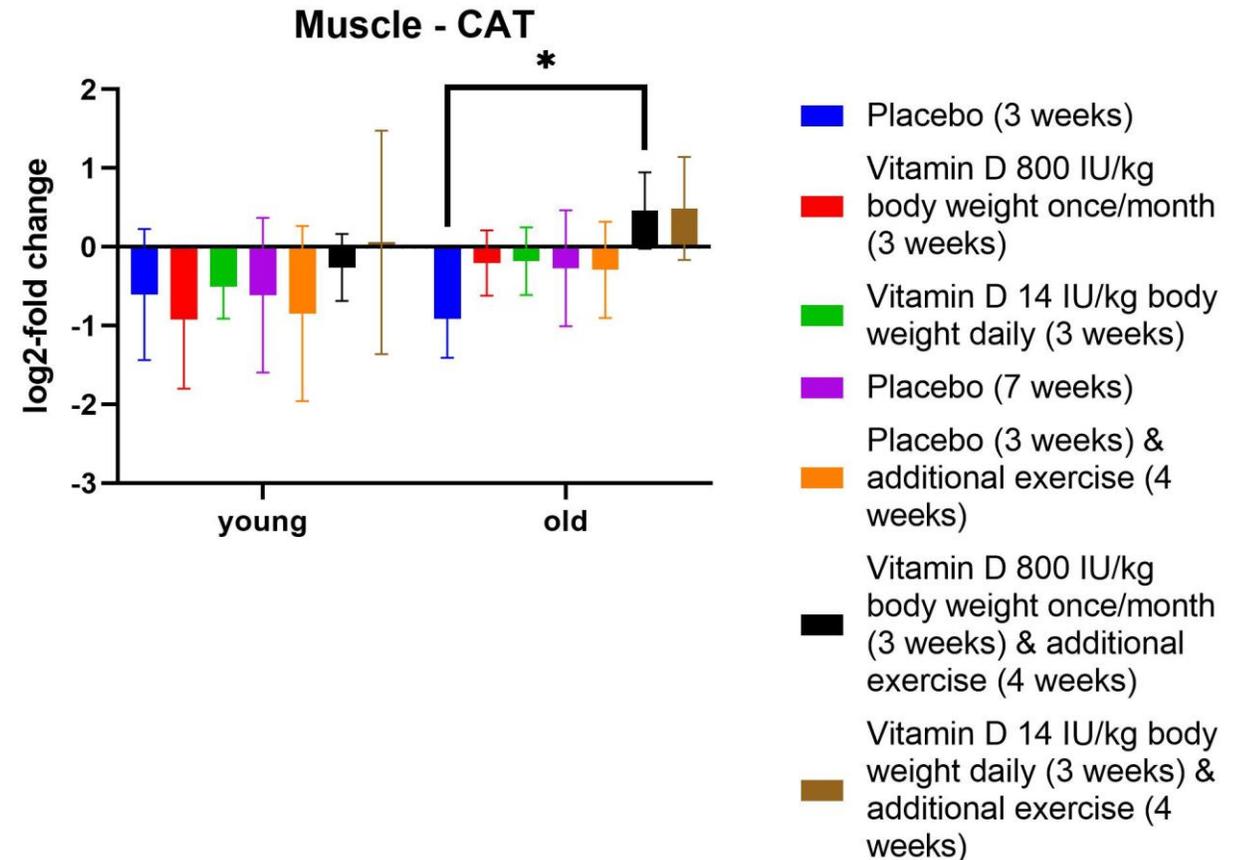
SOD1 - muscle

- Single dose of vitamin D at 800 IU/kg body weight increased SOD1 expression in **old** rats
- Elevation of SOD1 might result in an improvement of the antioxidative defense system



CAT - muscle

- In old animals: vitamin D at 800 IU/kg body weight **once/month together with exercise intervention** increased CAT expression
- high dosage of vitamin D once/month might improve the oxidative stress response in muscle tissue



Summary

- Response to vitamin D and exercise is tissue and age specific
- A **high, dosage of vitamin D once a month** increases the expression of genes encoding for antioxidative enzymes in old animals in the liver (GPx1) and gastrocnemius (SOD1 and CAT), which **might improve the response to oxidative stress in old individuals**
- Changes in gene expression do not necessarily lead to changes in protein levels and/or enzyme activity [Anderson et al, 1997]

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- All pictures were taken from pixabay

Thank you for your attention!