

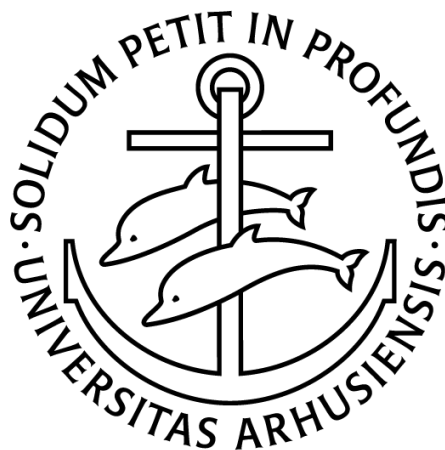
# Physical activity and sequelae after stroke

PhD Midterm Evaluation

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*“Stand up, pick up your mat, and walk!”*  
**- John 5.8 -**

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# 1 State of the art report

Life expectancy and the impact of age-related diseases such as stroke and dementia are increasing. In Denmark, stroke incidence is 12,000 per year, and stroke doubles the risk of dementia. Functional outcome after stroke has improved in recent years with the introduction of new treatment options and increased specialization in the health care systems.<sup>1</sup> Complications other than motor deficits such as depression, cognitive impairment, and physical impairment still pose great challenges and reduce patients' quality of life.<sup>2,3</sup> Vascular causes remain the most significant preventable risk factor of cognitive decline in the elderly.<sup>4</sup> Early identification of pathological changes and risk factors are key to the development of possible intervention strategies.

## 1.1 Physical activity

The idea of beneficial effects of physical activity (PA) on cardio-vascular risk factors was introduced 70 years ago.<sup>5</sup> Since then, PA has been shown to reduce the risk of stroke, and recent studies showed that patients with a higher pre-stroke PA level experienced decreased infarct growth<sup>6</sup>, fewer depressive symptoms<sup>7-9</sup> as well as better cognitive outcome.<sup>10</sup> Also, PA is important in the prevention of recurrent vascular events and neuro-psychiatric disorders.<sup>11</sup> Motor and neuro-psychiatric sequelae may all lead to reduced PA after stroke despite repeated and intensive interventions.<sup>12,13</sup> Identifying predictors of decline in PA after stroke may improve interventions.

After stroke, many different factors influence the long term risk of new cardiovascular event as recurrent stroke, transitory ischaemic attack (TIA), myocardial infarction (MI) or death (vascular or by any cause). The trajectories of PA after stroke has recently been associated to functional outcome suggesting that physical activity is not only an indirect measure of functional impairment.<sup>14</sup>

Despite recent years' spike in the general awareness of the beneficial effects of exercise and active lifestyles, and despite repeated and intensive interventions, preventing low PA or sedentary behaviour after stroke has proven difficult.<sup>12,15,16</sup> Part of the explanation to this paradox may be socio-economic status (SES). Lower socio-economic status has been associated to increased risk of stroke and decreased chance of getting timely stroke treatment.<sup>17,18</sup> In addition, a recent large study found that lower SES is correlated to lower levels of PA.<sup>19</sup> Other explanations may be stroke severity, fear of falling and pre-stroke physical inactivity which were all associated with low post-stroke PA.<sup>20</sup>

The group of patients with a low level of PA both before and after stroke, has not been studied well, but may constitute a group of patients at increased risk and is in need for new interventional strategies. We wish to investigate prediction of which patients increase PA after stroke, and analyse the long-term risk stratification between different PA trajectories after stroke.

## 1.2 Cerebral Small Vessel Disease

Cerebral Small Vessel Disease (cSVD) is a syndrome associated with increased stroke risk and neuropsychiatric disorders including dementia.<sup>21</sup> The prevalence of cSVD increases with age, and different lifestyle factors are thought to be important to the development a progression, including diabetes, hypertension and (low) PA.<sup>22,23</sup>

Among elderly patients, cSVD is the cause of stroke in one of four cases.<sup>24</sup> Recently, rating tools to assist in quantifying cSVD burden from acute magnetic resonance imaging (MRI) scans have been suggested, and cSVD burden have been shown to correlate to development of cognitive impairment among stroke patients.<sup>25,26</sup> We have previously shown that pre-stroke PA is correlated to better cognitive outcome six months after stroke,<sup>10</sup> but it is not clear how PA is correlated to cSVD among stroke patients.

A recently published large long-term follow-up study on PA among patients with cSVD did not find a correlation between to the progression of cSVD<sup>27</sup>, but to our knowledge, the correlation between cSVD burden, PA and lifestyle factors including diabetes and hypertension, in the stroke population has not been well studied.

## 2 PhD status

My PhD project draws on two different data sets. The first data set is from the Efficacy of Citalopram Treatment in Acute Ischemic Stroke (TALOS) trial<sup>28</sup>, a clinical trial conducted between 2013-2016. Within my PhD, I am looking to enrich this clinical data set with data from a number of different registries. The second data set is expected to be and data from a clinical, observational study that is currently including patients. This trial is called Exploring Vascular Contributions to Cognitive Impairment and Dementia (ENIGMA).

As part of my PhD, I have completed courses and other activities corresponding to 28.5 ECTS points (of 30 required) and have performed a total of 129.5 hours of teaching and supervision combined (of 150 hours required).

Below I will go through the three different projects in my PhD.

### 2.1 A: Predicting change in physical activity after stroke

At the clinical setting, when considering rehabilitation need for stroke patients, risk profiling regarding risk of low level of physical activity would be interesting to focus on patients at increased need. We hypothesized that change in physical activity after stroke could be predicted based on baseline factors.

PA reduces the risk of stroke and improves functional outcome. We aimed to investigate predictors for decrease and increase in PA after stroke.

Provisional results have been presented with a poster on European Stroke Organisations Conference (ESOC) 2023.

#### 2.1.1 Methods

We used the Physical Activity Scale for the Elderly (PASE) questionnaire score for pre-stroke PA at inclusion and PA at six months. Main outcomes were decrease in PA to the lowest PASE score quartile from any higher, and increase from the lowest quartile to any higher. We created two cross validated, regularised, predictive models with available clinical variables.

### 2.1.2 Provisional results

We included 522 patients from The TALOS trial. Median inter quartile range (IQR) age was 68 [59; 76], National Institute of Health Stroke Scale (NIHSS) score 3 [2; 5] and 180 (34%) were females. In total, 77 patients (19.7%) decreased in PA and 63 (48.1%) increased. The decrease model had sensitivity 0.862, specificity 0.290 and area under the receiver operating curve (AUROC) of 0.607. Variables used were increasing age, living alone, daily or occasionally smoking, hypertension, previous myocardial infarction and stroke severity. The increase model performed with sensitivity 0.882, specificity 0.246 and AUC at 0.606. Variables used were increasing age, female sex, living alone, excess alcohol intake, previous atrial fibrillation, hypertension, diabetes, peripheral arterial disease and pre-stroke modified Rankin Scale (mRS) >0.

### 2.1.3 Discussion

We found that change in PA after stroke is highly dynamic, and our prediction models performed only modestly, with baseline factors influencing both PA decrease and increase. These findings highlight the need for a systematic rehabilitation programme to avoid decrease and stimulate increased PA post stroke for all patients.

### 2.1.4 Time frame

A drafted manuscript has already been prepared, but we have chosen to enrich the data set with data on socio-economic status as well educational level. We are currently awaiting access to these data at Statistics Denmark's servers. When these data become available, I hope to be able to finalise analyses fairly quickly and have the manuscript ready for journal submission before spring 2024.

## 2.2 B: Persistent low levels of physical activity and risk of vascular event or death after stroke

PA reduces cardiovascular risk. We aimed to investigate the relation between low PA before and after stroke and long-term risk of vascular events or death.

### 2.2.1 Methods

We assessed pre- and post-stroke PA in patients with first-ever ischemic stroke using the PASE questionnaire at stroke admission and after 6 months, respectively. Covariates includes clinical data, stroke severity and functional status pre-stroke. Main outcome was a composite endpoint of new cardiovascular events (myocardial infarction, stroke or transient ischemic

attack) or any cause of death from 6 months after stroke. Main exposure was PASE-score in the lowest quartile both pre- and post-stroke (low-PA-group). Data was analysed using a multivariate Cox proportional-hazards model.

### **2.2.2 Provisional results**

In total, 490 patients with available PASE-scores were included from the TALOS trial. Median age [IQR] was 68 [58; 76], 170 (35 %) were female, and 48 (9.8 %) patients were in the low-PA-group. In the median follow-up period of 6.9 [5.7; 7.7] years, 11.3 events per 100 patient years occurred in the low-PA-group vs 4.66 among the rest (adjusted hazard ratio: 1.72 (confidence interval (CI): 1.07; 2.77)).

### **2.2.3 Discussion**

Patients with continued low levels of PA before and after stroke were at a higher long-term risk of composite outcome of new cardiovascular events or death compared to patients with changed PA level or continuously higher levels. This low-PA-group may constitute a special group for future interventional trials.

### **2.2.4 Time frame**

At the time of evaluation, the provisional results from this study has been presented at the World Stroke Conference (WSC) 2023 in Toronto (10-12 October).

Final analyses currently awaits availability of data on Statistics Denmark's servers regarding socio-economic status and educational level.

As soon as possible I will begin drafting the manuscript, and perform the final analyses. I plan to have the article ready for submission in spring 2024.

## **2.3 C: Lifestyle factors and small vessel disease in stroke patients**

We aim to investigate the relation between different life style factors and the burden of small vessel disease among stroke patients.

### **2.3.1 Methods**

We plan to combine two clinical cohorts from two randomized trials on stroke patients, totalling around 1000 patients. The main outcome is a MRI bio-marker measure of cSVD burden. The covariates included are pre stroke PA, chronic diseases (diabetes, hypertension, previous myocardial infarction), stroke severity. Pre stroke PA was assessed with a questionnaire on inclusion within a few days after stroke onset. Baseline characteristics were recorded on admission regarding chronic diseases and other clinical features. Small vessel disease burden will be assessed on available MRI from stroke admission, and scored on an ordinal scale. Please refer to Section 5.1 for the scoring system, that we will be using.

### **2.3.2 Perspectives**

New knowledge regarding the impact of different life style factors on small vessel disease burden among stroke patients will enable a prioritized intervention among patients to help prevent accelerated disease.

### **2.3.3 Time frame**

We plan to have all cSVD scoring performed before end of February 2024. The data will then be merged with the clinical data and the data set will be ready for analyses in the spring of 2024. After this comes manuscript writing, which I hope to be able to submit before the end of 2024.

## 3 Publications

As described earlier, my main publications are still pending journal submission. I have, however been involved in a few of other projects. Below, I have highlighted two articles, that I have been closely involved with.

The first article was on depressive symptoms and prePA after stroke within the TALOS-cohort.<sup>29</sup> I performed all the data management and analyses, as well as co-authoring the manuscript.

The second article is on stroke outcome for patients where the clinician abstained from acute treatment and three months outcome.<sup>30</sup> I joined in the work to help on the data analyses and co-authoring the manuscript.

### 3.1 Other publicized work

For the ENIGMA trial, I have been responsible for the data base creation and maintenance in REDCap.<sup>31</sup> All scripts used for data management has been openly shared.<sup>32</sup> I have also improved previous work<sup>33</sup> for handling longitudinal data from REDCap and shared these improvements as an *R* package called **REDCapCAST** with different functions to ease this kind of work.<sup>34</sup> In total, the **REDCapCAST** package has been downloaded 741 times.

Additionally, I have published a collection of useful tools and learning examples as an *R* package called **stRoke**.<sup>35</sup> The **stroke** package has been downloaded a total of 2016 times.

#### 3.1.1 Documentation on working with MRI data

During my exchange stay in the Brain Behavior Laboratory (BBL) at University of British Colombia (UBC) led by prof. Lara Boyd, I have worked extensively with colleagues at the BBL on developing a pipeline for translating stroke lesions into a model for studying the “dis-connectome” of lost connections between different functional areas of the brain and linking it to motor function.<sup>36</sup> We have used free and open source tools, and the work on the pipeline has been documented and shared openly and freely as part of the project (<https://agdamsbo.github.io/normalisation-pipeline/>). We are working on a publishing the work in a peer-reviewed journal, and the documentation will be extended to work as reference for others.

## 4 Research plans for the remaining PhD study

I believe that the timeline for my three projects as outlined above is reasonable and leaves room for further delays to data availability as the main limiting factor, that I am not in complete control of. Overall, I plan to have the publications on my three PhD projects ready within the next year.

Regarding my other commitments as a PhD-student I am very satisfied that I have completed my exchange stay and received (almost) all ECTS points from the PhD School at the midterm time point. I will also soon have completed the necessary teaching and supervision, but will be looking forward to continuing supervision, and teaching and dissemination tasks.

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# List of Abbreviations

|               |                                                                       |
|---------------|-----------------------------------------------------------------------|
| <b>AUROC</b>  | area under the receiver operating curve                               |
| <b>BBL</b>    | Brain Behavior Laboratory                                             |
| <b>CI</b>     | confidence interval                                                   |
| <b>cSVD</b>   | Cerebral Small Vessel Disease                                         |
| <b>ENIGMA</b> | Exploring Vascular Contributions to Cognitive Impairment and Dementia |
| <b>ESOC</b>   | European Stroke Organisations Conference                              |
| <b>IQR</b>    | inter quartile range                                                  |
| <b>MI</b>     | myocardial infarction                                                 |
| <b>MR</b>     | magnetic resonance                                                    |
| <b>MRI</b>    | magnetic resonance imaging                                            |
| <b>mRS</b>    | modified Rankin Scale                                                 |
| <b>NIHSS</b>  | National Institute of Health Stroke Scale                             |
| <b>PA</b>     | physical activity                                                     |
| <b>PASE</b>   | Physical Activity Scale for the Elderly                               |
| <b>RESIST</b> | Remote Ischemic Conditioning for Acute Stroke                         |
| <b>SES</b>    | socio-economic status                                                 |
| <b>TALOS</b>  | Efficacy of Citalopram Treatment in Acute Ischemic Stroke             |
| <b>TIA</b>    | transitory ischaemic attack                                           |
| <b>UBC</b>    | University of British Columbia                                        |
| <b>WSC</b>    | World Stroke Conference                                               |

## **5 Appendices**

### **5.1 Ordinal scale for cerebral small vessel disease burden**

During my third study C, we will be using the following ordinal scale of cSVD burden, which we have developed in the group based on previous research.

# Consensus paper

## Purpose

**Primary:** continuous scale for grading SVD burden.

**Secondary:** risk stratification of new stroke, dementia.

## Scoring

| MRI features                                                   | ENIGMA SVD score |
|----------------------------------------------------------------|------------------|
| <b>Number of microbleeds (SWI)</b>                             |                  |
| 0                                                              | 0                |
| 1                                                              | 1                |
| 2-4                                                            | 2                |
| 5-10                                                           | 3                |
| >10                                                            | 4                |
| <b>Location of microbleeds – no points (SWI)</b>               |                  |
| Lobar, deep, or infratentorial (choose one or more)            | L/D/I            |
| <b>Superficial siderose (SWI)</b>                              |                  |
| No siderosis                                                   | 0                |
| 1 sulcus                                                       | 1                |
| >1 sulcus                                                      | 2                |
| <b>Lacunes (3D FLAIR)</b>                                      |                  |
| 0                                                              | 0                |
| 1–2                                                            | 1                |
| 3–5                                                            | 2                |
| >5                                                             | 3                |
| <b>White matter hyperintensities – see Figure 1 (3D FLAIR)</b> |                  |
| Absent                                                         | 0                |
| Punctate foci                                                  | 1                |
| Beginning confluence                                           | 2                |
| Large confluent areas                                          | 3                |
| <b>Atrophy – see Figure 2 (3D T1)</b>                          |                  |
| No                                                             | 0                |
| Mild                                                           | 1                |
| Moderate                                                       | 2                |
| Severe                                                         | 3                |
| <b>Total SVD score</b>                                         | <b>0-15</b>      |

## Setting

Patients were scanned on clinical MR scanners as part of the clinical acute evaluation of stroke patients. Patients were included between 2013-2022 on a variety of scanners with different field forces and scanned with different algorithms.

Scoring is performed independently by a neurologist and a neuroradiologist and consensus as achieved if needed.

## Definitions on biomarkers

Definitions are mainly according to the STRIVE v1 criteria,(Wardlaw et al., 2013) but also with local specifications.

### Microbleeds

Sequence: SWI / T2\*

Small (generally 2–5 mm in diameter, but sometimes up to 10 mm) areas of signal void with associated blooming seen on SWI-weighted MRI.

Different cut-offs are used in different trials. (Akoudad et al., 2016) We try to register in a way, so that our analysis can be made similarly to other studies and to provide enough resolution.

As discussions about the importance of location is ongoing,(Vernooij et al., 2008) we register if microbleeds are located lobar, deep, or infratentorial.

### Superficial siderosis

Sequence: SWI / T2\*

“Investigators should describe the location of siderosis (i.e., the number of sulci involved and in which lobes).”(Wardlaw et al., 2013, p. 828)

### Lacunes

Sequence: 2D / 3D FLAIR

“A round or ovoid, subcortical, fluid-filled cavity (signal similar to CSF) of between 3 mm and about 15 mm in diameter, consistent with a previous acute small subcortical infarct or haemorrhage in the territory of one perforating arteriole.”(Wardlaw et al., 2013, p. 825)

Additionally:

“We identified asymptomatic lacunar infarcts as sharply demarcated hyperintense lesions ~~<20 mm~~ on T2-weighted images with corresponding hypointense lesions with a hyperintense rim on FLAIR. In lacunar stroke patients, the lesion could not be compatible with the clinical stroke.”(Huijts et al., 2013)

### White matter hyperintensities

Sequence: 2D / 3D FLAIR

The Fazekas subscale for deep white matter is used. The scale divides the white matter in periventricular and deep white matter, and each region is given a grade depending on the size and confluence of lesions.(Gaillard, n.d.)

No regional differences is noted.(de Groot et al., 2000) Scoring is performed with visual reference, see Figure 1 Fazekas score.

### Atrophy

Sequence: 3D T1

We follow definitions for the Global Cerebral Atrophy (GCA) score.(Harper et al., 2015)

A picture sample for reference is used, see Figure 2 Generalised GCA scale.

### ~~Enlarged perivascular space~~

~~Sequence: 3D FLAIR~~

~~Debated whether this measure is clinically important. We register presence or not from 3D FLAIR, and only in the basal ganglia, which is not optimal anyways. (Benjamin et al., 2018; Hilal et al., 2018; MacLulich et al., 2004; Olama et al., 2020)~~

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## Visual guides

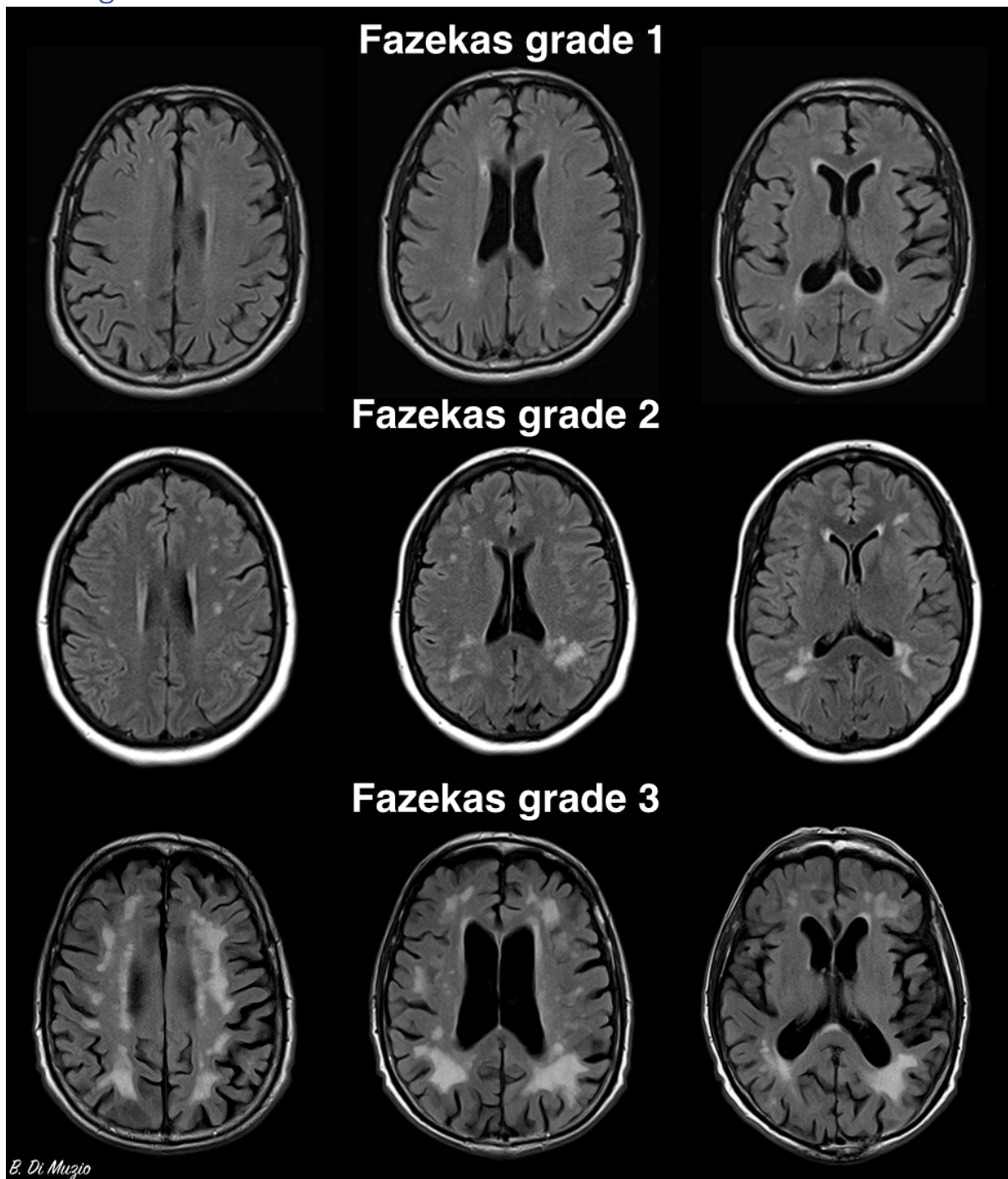


Figure 1 Fazekas score

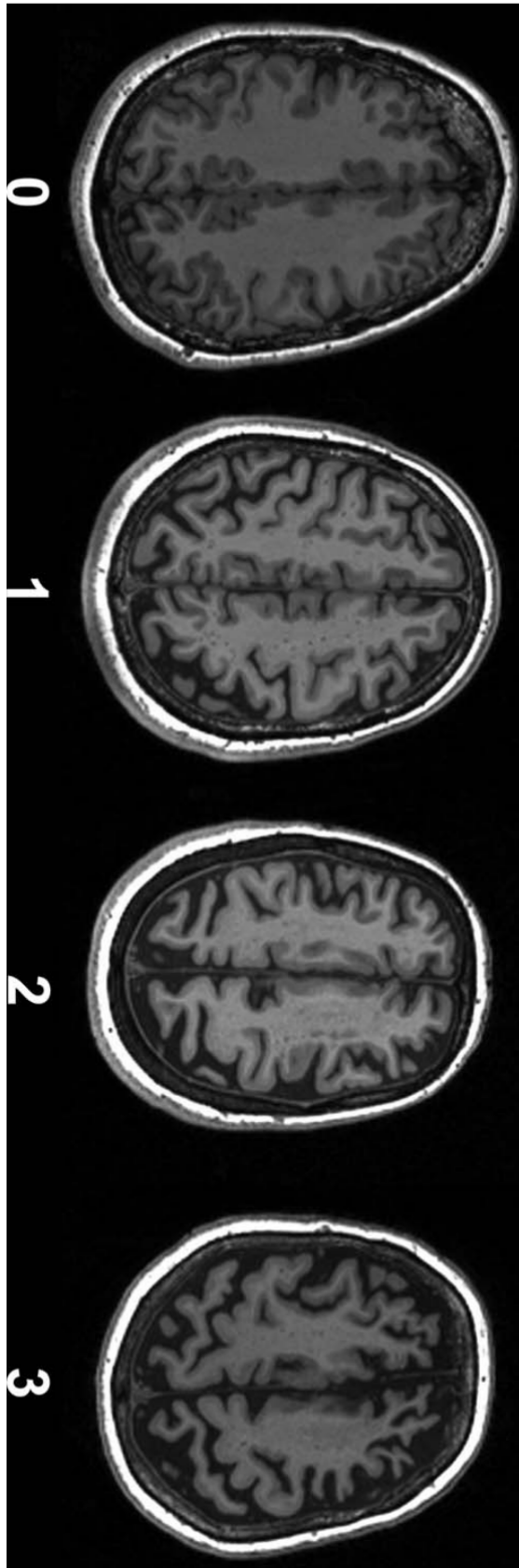


Figure 2 Generalised GCA scale

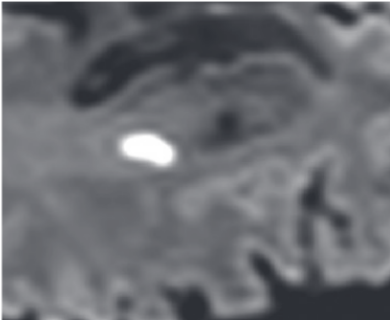
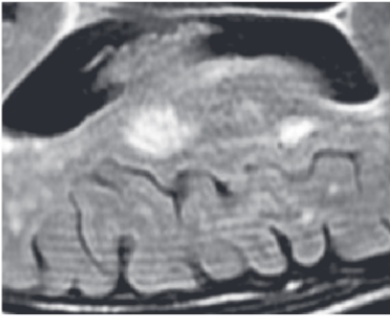
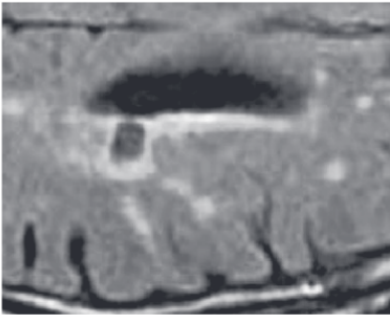
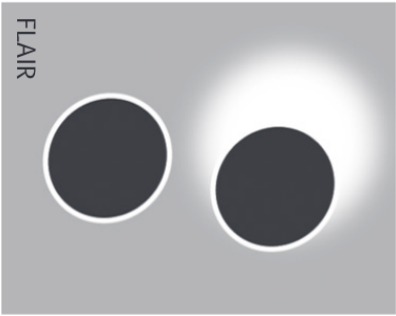
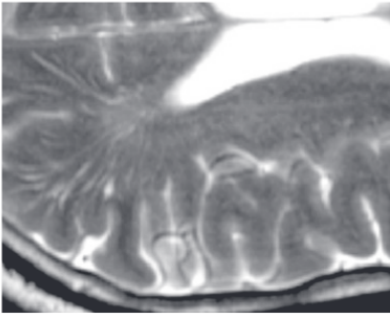
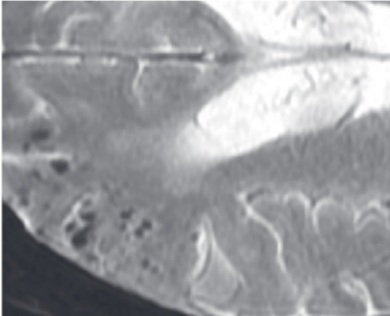
|                                  |                                                                                      |                                                                                     |                                                |
|----------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------|
| Recent small subcortical infarct |    |    | Best identified on DWI                         |
| White matter hyperintensity      |    |    | Located in white matter                        |
| Lacune                           |   |   | Usually have hyperintense rim                  |
| Perivascular space               |  |  | Most linear without hyperintense rim           |
| Cerebral microbleed              |  |  | Detected on GRE seq., round or ovoid, blooming |

Figure 3 Overview from Wardlaw et al, 2013

## **5.2 Abstract for ESOC 2023**

This is the abstract submitted for the ESOC 2023 conference held on 23-25 May 2023 in Munich, Germany.

# Predicting change in physical activity after stroke

## **Authors:**

Andreas Gammelgaard Damsbo, MD<sup>1,2</sup>, Rolf Ankerlund Blauenfeldt, MD<sup>1,2</sup>, Søren Paaske

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Abstract word count: 250 (max 250)

## Abstract

### Background and aims

Physical activity (PA) reduces the risk of stroke and improves functional outcome. We aimed to investigate predictors for decrease and increase in PA after stroke.

### Methods

We used the Physical Activity Scale for the Elderly (PASE) questionnaire score for pre-stroke PA at inclusion and PA at six months. Main outcomes were decrease in PA to the lowest PASE score quartile from any higher, and increase from the lowest quartile to any higher. We created two cross validated, regularised, predictive models with available clinical variables.

### Results

We included 522 patients from The Efficacy of Citalopram Treatment in Acute Ischemic Stroke (TALOS) trial. Median [IQR] age was 68 [59, 76], NIHSS score 3 [2, 5] and 180 (34%) were females. In total, 77 patients (19.7%) decreased in PA and 63 (48.1%) increased. The decrease model had sensitivity 0.862, specificity 0.290 and AUROC of 0.607. Variables used were increasing age, living alone, daily or occasionally smoking, hypertension, previous myocardial infarction and stroke severity. The increase model performed with sensitivity 0.882, specificity 0.246 and AUC at 0.606. Variables used were increasing age, female sex, living alone, excess alcohol intake, previous atrial fibrillation, hypertension, diabetes, peripheral arterial disease and pre-stroke mRS >0.

### Conclusions

We found that change in PA after stroke is highly dynamic, and our prediction models performed only modestly, with baseline factors influencing both PA decrease and increase. These findings highlight the need for a systematic rehabilitation programme to avoid decrease and stimulate increased PA post stroke for all patients.

### **5.3 Poster from ESOC 2023**

This is the poster presented at the ESOC 2023 conference.

# Predicting change in physical activity after stroke

Andreas Gammelgaard Damsbo, MD<sup>1,2</sup>,  
Rolf Ankerlund Blauenfeldt, MD<sup>1,2</sup>,  
Søren Paaske Johnsen, MD PhD<sup>3</sup>,  
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Disclosures: **No conflicts of interest**

Physical inactivity is an important cardiovascular risk factor, but inactivity is common

A clinical, multi-centre study with 522 first time stroke patients

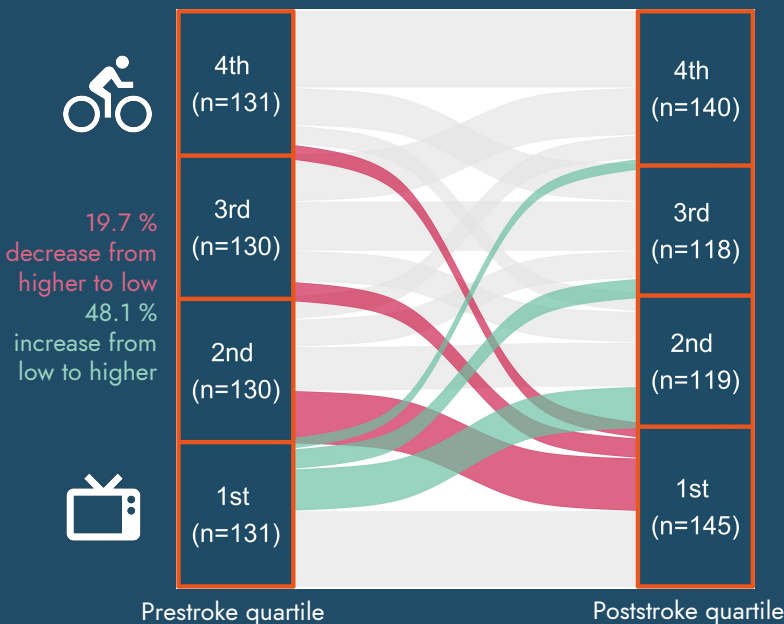
Physical activity 7 days before stroke was recorded on admission, with a follow-up 6 months after stroke

Machine learning prediction model with all baseline covariates included

In total, 180 (34%) women, median age 68 [59, 76], median NIHSS score 3 [2, 5]



## Levels of physical activity



## Conclusion

**Changes in physical activity** after stroke **are highly dynamic** and difficult to predict



## Model performance

Area Under Receiver Operating Curve



**Decrease: 0.607**

**Increase: 0.606**

**All patients need systematic rehabilitation** after stroke **to stimulate physical activity**



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MD, PhD-student

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Read more: [andreas.gdamsbo.dk/academia/predict\\_pa](https://andreas.gdamsbo.dk/academia/predict_pa)



## **5.4 Abstract for WSC 2023**

This is the abstract submitted for the WSC 2023 conference which will be held on 10-12 October 2023 in Toronto, Canada.

# Title: Persistent low physical activity after stroke and risk of new vascular event or death

## Authors:

Andreas Gammelgaard Damsbo, MD<sup>1,2</sup>, Rolf Ankerlund Blauenfeldt, MD<sup>1,2</sup>, Søren Paaske

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University, Denmark

Abstract word count: 248 (max 250)

## **Background and aims**

Physical activity (PA) reduces cardiovascular risk. We aimed to investigate the relation between low PA before and after stroke and long-term risk of vascular events or death.

## **Methods**

We assessed pre- and post-stroke PA in patients with first-ever ischemic stroke using the Physical Activity Scale for the Elderly (PASE) questionnaire at stroke admission and after 6 months, respectively. Covariates includes clinical data, stroke severity and functional status prestroke. Main outcome was a composite endpoint of new cardiovascular events (myocardial infarction, stroke or transient ischemic attack) or any cause of death from 6 months after stroke. Main exposure was PASE-score in the lowest quartile both pre- and post-stroke (low-PA-group). Data was analysed using a multivariate Cox proportional-hazards model.

## **Results**

In total, 490 patients with available PASE-scores were included from The Efficacy of Citalopram Treatment in Acute Ischemic Stroke (TALOS) trial. Median age (interquartile range) was 68 (58; 76), 170 (35 %) were female, and 48 (9.8 %) patients were in the low-PA-group.

In the median follow-up period of 6.9 (5.7; 7.7) years, 11.3 events per 100 patient years occurred in the low-PA-group vs 4.66 among the rest (adjusted hazard ratio: 1.72 (confidence interval: 1.07; 2.77)).

## **Conclusion**

Patients with continued low levels of PA before and after stroke were at a higher long-term risk of composite outcome of new cardiovascular events or death compared to patients with changed PA level or continuously higher levels. This low-PA-group may constitute a special group for future interventional trials.

## **5.5 Drafted slides for WSC 2023**

I will be presenting orally at the WSC 2023 on 11 October.

Below are my drafted slides at the time of finalising this Midterm evaluation.

# Persistent low physical activity after stroke and risk of new vascular event or death

**Andreas Gammelgaard Damsbo**, MD<sup>1,2</sup>, Rolf Ankerlund Blauenfeldt, MD<sup>1,2</sup>, Søren Paaske Johnsen, MD PhD<sup>3</sup>, Grethe Andersen, MD DMSc<sup>1,2</sup>, Janne Kaergaard Mortensen, MD PhD<sup>1,2</sup>

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Danish Stroke Centre

# Faculty Disclosure

|   |                                                                                                 |
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|--------------|-------------------------------------|----------------------------------------------------|----------------------------------|--------------------------------------|----------------------------------------|
|              |                                     |                                                    |                                  |                                      |                                        |
|              |                                     |                                                    |                                  |                                      |                                        |
|              |                                     |                                                    |                                  |                                      |                                        |
|              |                                     |                                                    |                                  |                                      |                                        |
|              |                                     |                                                    |                                  |                                      |                                        |
|              |                                     |                                                    |                                  |                                      |                                        |





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# Background

## Aim



Physical activity  
(PA) reduces  
cardio-vascular  
risk



Risk of **new cardio-vascular events or death** in **persistent low PA** after **stroke**



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# Design

**Danish cohort of**  
first ever stroke in  
adults with **registry-**  
**based, long-term**  
**follow-up**



**Personal civil**  
**registration**  
**number linked to**  
**hospital data and**  
**death registrations**



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# Data

**Clinical and PA  
data** at inclusion  
and 6 months after  
stroke



Walking, light to  
intense exercise,  
household work and  
hours at work  
converted to score<sup>1</sup>



1: PASE: Physical Activity Scale in the Elderly



# Analysis

Multivariate Cox  
proportional  
hazards model



Composite outcome  
of **new cardio-  
vascular events**  
(stroke, TIA, MI) or  
**death of any cause**

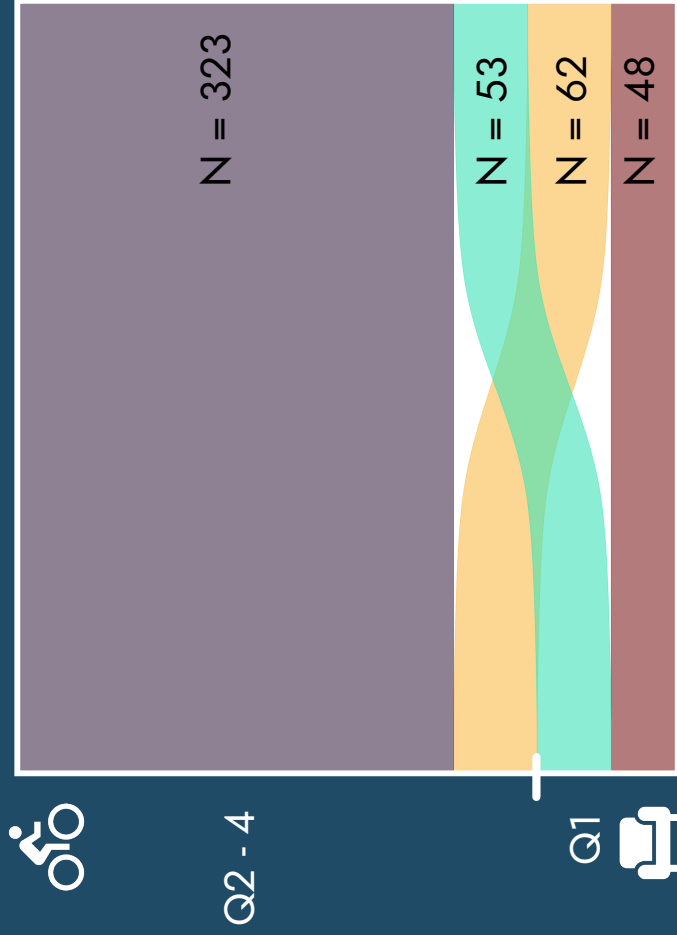


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# Patients

*Changes in level of PA*



Inclusion  
(N=522)

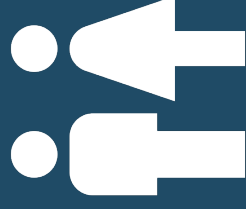
6 months  
(N=488)



Up to 8 years

Mean age **67** (13),  
mean **NIHSS 4.5** (4.5),  
**35 %** (169) female

**Pre-stroke PA** assessment  
within median **2.0 [1–3]**  
**days** after onset



**Best standard care**

**7.4 %** (36) had **mRS**  
**>2** at 6 months



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# Group characteristics



Low PA were **older**, more **female**, lived **alone**, more **smokers**, **hypertension**, more **disabled**



No difference in **stroke severity** or **study allocation**

Mean 6.27 (2.1) years follow-up

Inclusion  
(N=522)

6 months  
(N=488)



Up to 8 years



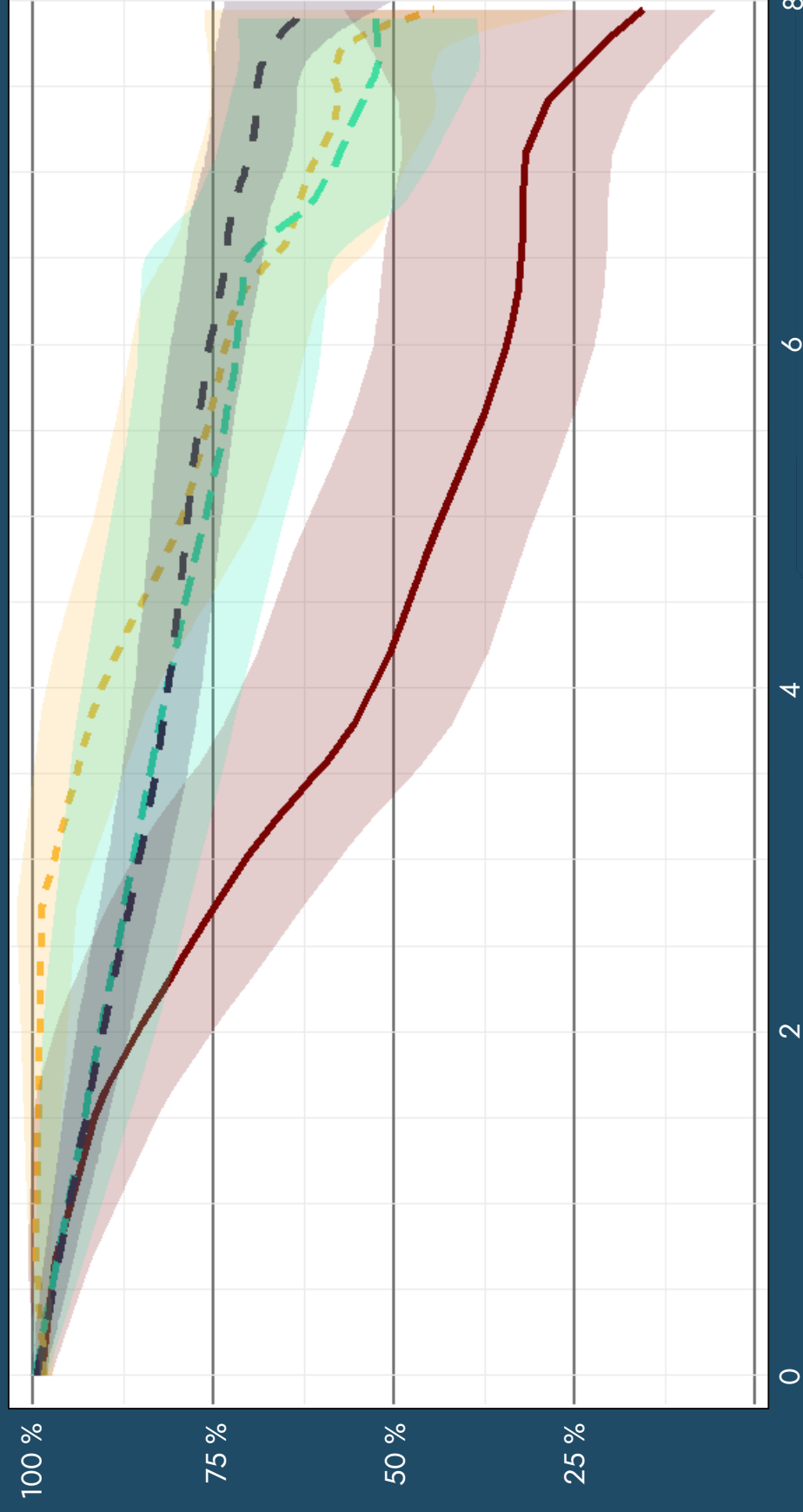
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| Patient years (PY) | Events | Events pr 100 PY |
|--------------------|--------|------------------|
| 1581               | 79     | 5.00             |
| 286                | 20     | 7.00             |
| 318                | 20     | 6.29             |
| 177                | 29     | 16.4             |
| 2362               | 148    | 6.27             |



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# Smoothed survival plot



*Years of follow-up*

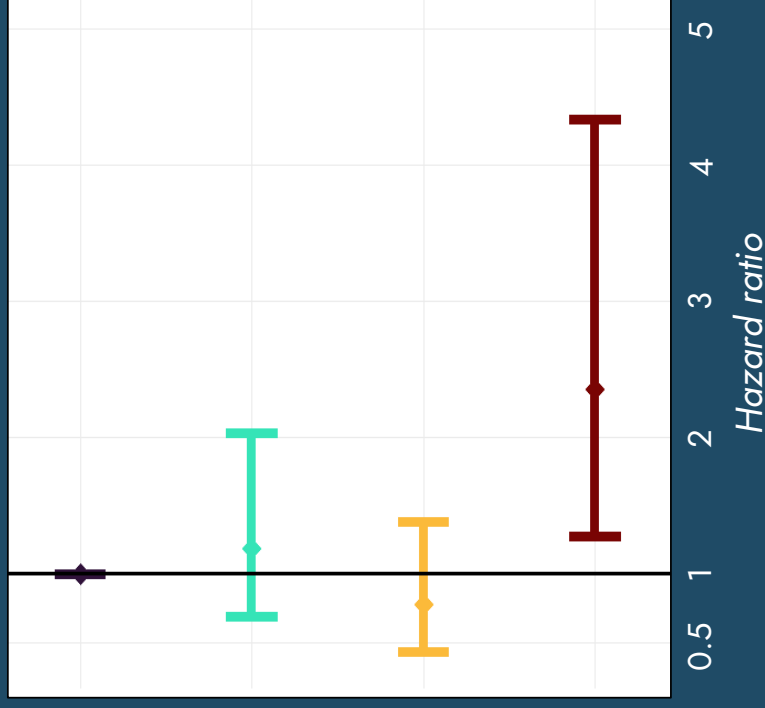
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# Cox Proportional Hazards

Multivariate regression model

| Hazard Ratio | Confidence Interval |
|--------------|---------------------|
| REF          | REF                 |
| 1.19         | [0.69;2.04]         |
| 0.78         | [0.44;1.39]         |
| 2.36         | [1.28;4.34]         |



*Included covariates are age, sex, cohabitation, smoking, alcohol, stroke severity, acute treatment, diabetes, hypertension, AFIB, previous TIA, previous MI, mRS at inclusion and at 6 months.*



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# Conclusion

Patients with  
**persistent low level**  
of physical activity  
have an **increased**  
**hazards ratio**



Patients **increasing**  
**physical activity**  
level have **lower**  
**hazards ratio**



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# Co-authors and supervisors



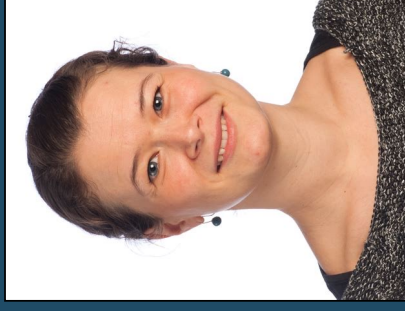
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# THANK YOU



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