

PRVIDEMUS ^{alz} PAVING THE WAY TOWARDS A UBIQUITOUS AND PASSIVE SCREENING OF ALZHEIMER'S DISEASE

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RATIONALE

Alzheimer's disease (AD) has been a **known condition for over a century**, but research on it has exploded only in the last 30 years [1]. The **first step** toward dementia due to AD is the **abnormal accumulation of amyloid beta in the brain** [2], **20–25 years before** the clinical onset [3]—**preclinical AD**.

During the preclinical phase, **subtle behavioral and cognitive changes** may precede and **indicate an upcoming decline** toward cognitive impairment and dementia, even before the patient starts feeling any symptoms.

However, the power of these changes relies on **their continuous and longitudinal analysis**. **Machine learning (ML)** possibilitates a **ubiquitous and highly scalable solution** to **assess the first changes** in individuals who will later develop dementia due to AD **years before**.

OBJECTIVES

Apply **ML techniques** to screen individuals for the onset of preclinical AD: analyzing and modeling **data** that is **collected passively and non-intrusively using portable and wearable devices** while always respecting users' privacy.

Explore the power of **globally connected devices** used daily in the natural environment (rather than in a laboratory or controlled environment) and **combine it with the capabilities of ML techniques**.

THE DATA POINTS

CHARACTERISTICS OF THE INDIVIDUAL

PRO **Cognitive reserve***
PRO **Demographics***
PRO **Medical history***

CHARACTERISTICS OF THE ENVIRONMENT

TechRO **Season***
TechRO **Weather***
TechRO **Air quality***
TechRO **Relative location***

SYMPTOM STATUS

PRO **Depression****
PRO **Dysphoria****
PRO **Neuroticism****
PRO **Anxiety****
PRO **Stress****

ClinRO **Clinician-reported outcome**
PerfRO **Performance-reported outcome**
PRO **Patient-reported outcome**
TechRO **Technology-reported outcome**
* **Data for model creation**
** **Data for validation**

BIOLOGICAL, PHYSIOLOGICAL VARIABLES

TechRO **Heart rate variability***
TechRO **Heart rate levels while exercising***
TechRO **Sleep fragmentation***
TechRO **Sleep-wake cycle disturbances***
TechRO **Sleeping and resting heart rate***
ClinRO **Blood based biomarkers for AD****
ClinRO **AB levels and Tau-mediated injury****

FUNCTIONAL STATUS

TechRO **Diurnal napping***
TechRO **Nocturnal sleep duration***
TechRO **Physical activity levels***
TechRO **Social withdrawal***
TechRO **Gait speed, symmetry, variability***
TechRO **Step length, width, height, time***
TechRO **Support time, swing properties***
PRO **Affect****
PerfRO **Attention control****
PerfRO **Activity shifting****
PerfRO **Motor actions****
PerfRO **Processing speed****
PerfRO and PRO **Memory****

Outcomes to be collected, following the Wilson and Cleary [4] model

FEASIBILITY STUDY

Observational study of 2 years with up to **200 cognitively healthy participants** residing in Switzerland or surrounding regions in France.

Individuals are **45 years or older**, fluent in **French, English, or Portuguese**, have basic experience with a **smartphone**, and can wear a **smartwatch** for most of the day.

Collection of **active and passive data** between March 2024 and April 2026.

Patient-reported outcomes on depression, dysphoria, cognitive reserve, demographics, clinical history, and others.

Performance-reported outcomes on memory, motor actions, processing speed, and others.

Technology-reported outcomes on behavioral data and surrounding environment.

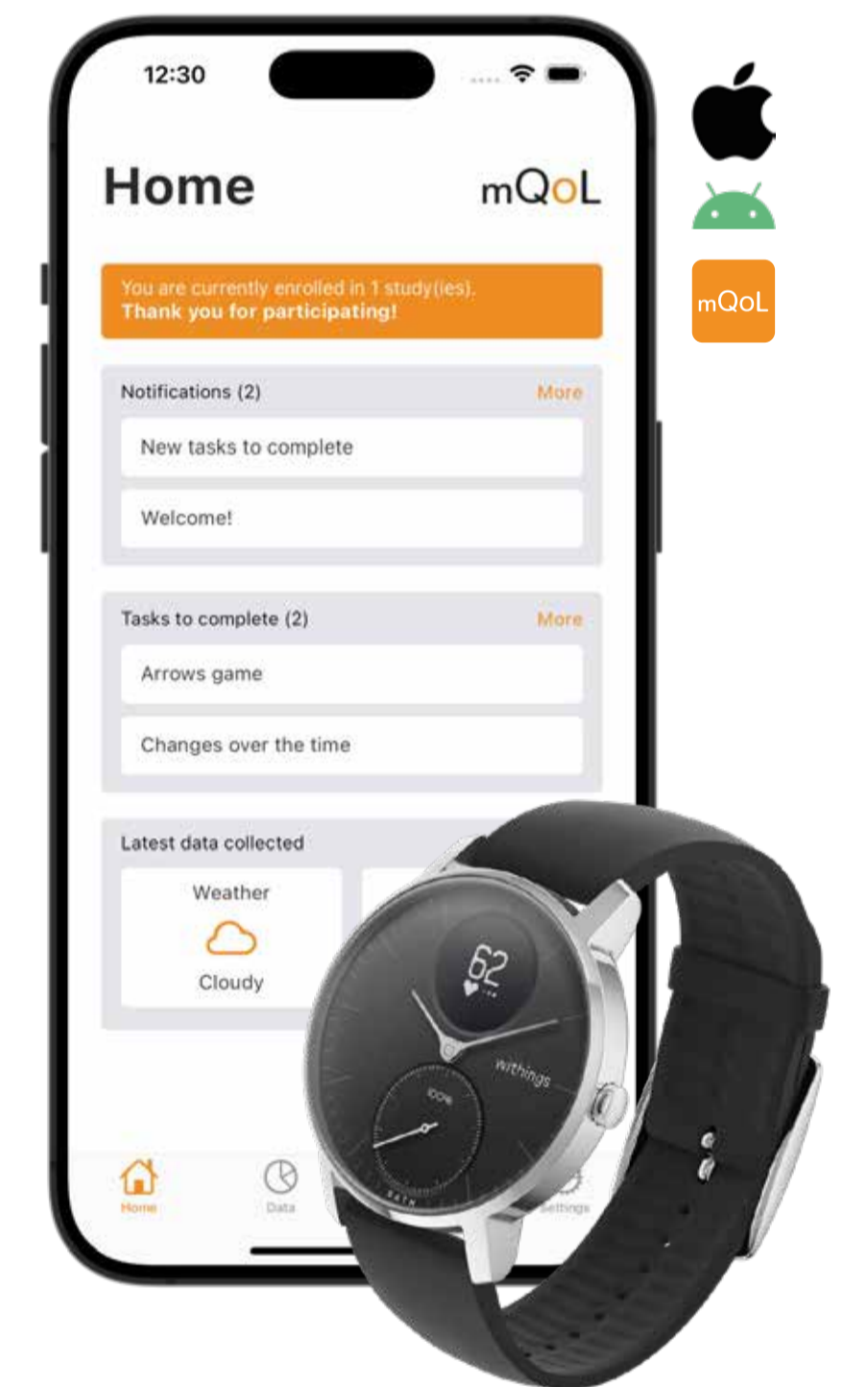
Clinician-reported outcomes will not be collected **during the feasibility study**.



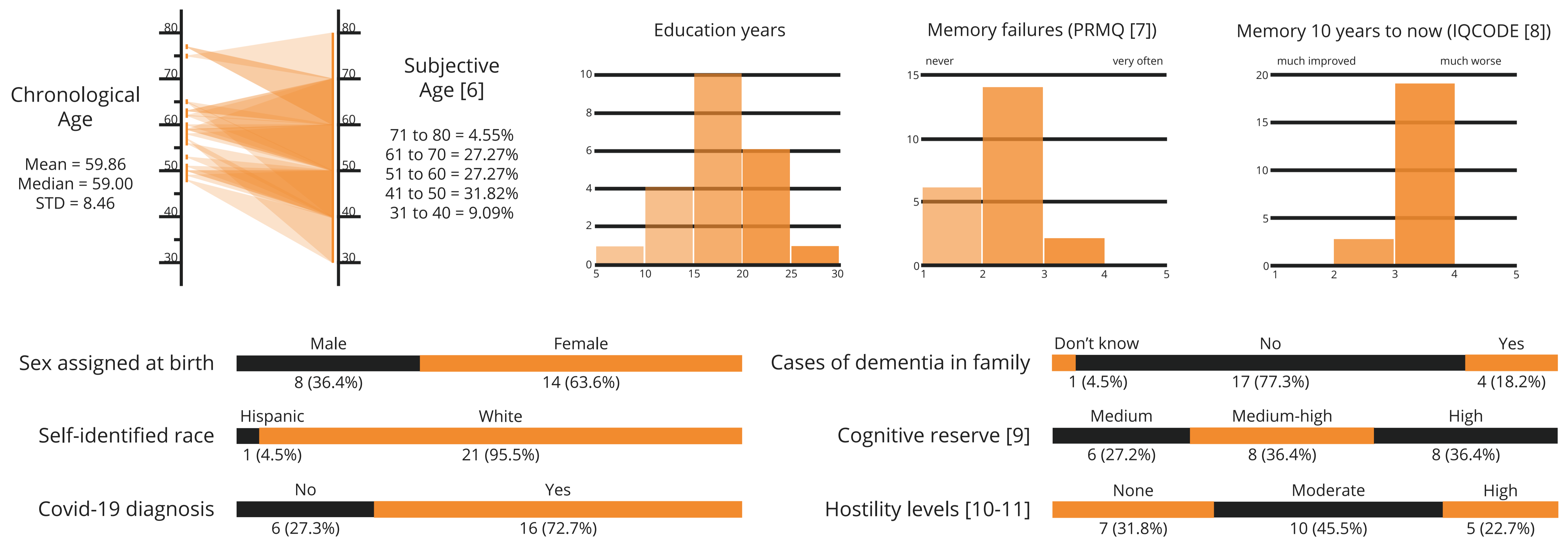
Using a **mobile application** (the mQoL Lab [5]) and a **clinically tested smartwatch** (Withings Steel HR):

Patient and performance-reported outcomes every three months with the mQoL app.

Technology-reported outcomes continuously using the app and the smartwatch.



PRELIMINARY DATA (n=22)



These results reflect part of the data received from the first 22 participants of the Providemus study. As of April 19, 2024, the total number of active participants was 62, but their data has yet to be fully processed and could not be included in this presentation.

More info and call for participants at PROVIDEMUS.UNIGE.CH.



Protocol number 2023-00975 approved by the Commission Cantonale d'Éthique de la Recherche sur l'être humain (CCER) on 25/07/2023.
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READ LATER



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REFERENCES

[1] M. W. Bondi et al., "Alzheimer's disease: Past, present, and future," *Journal of the International Neuropsychological Society*, vol. 23, no. 9-10 Special Issue, pp. 818-831, 2017.
[2] C. R. Jack et al., "Hypothetical model of dynamic biomarkers of the Alzheimer's pathological cascade," *The Lancet Neurology*, vol. 9, no. 1, pp. 119-128, 2010.
[3] C. R. Jack and D. M. Holtzman, "Biomarker modeling of Alzheimer's disease," *Neuron*, vol. 80, no. 6, pp. 1347-1358, 2013.
[4] Wilson, J. S., and Cleary, P. D., "Linking Clinical Variables With Health-Related Quality of Life: A Conceptual Model of Patient Outcomes," *JAMA: The Journal of the American Medical Association*, 273, 1995.
[5] A. Berrocal et al., "MQoL lab: Step-by-step creation of a flexible platform to conduct studies using interactive, mobile, wearable and ubiquitous devices," *Procedia Computer Science*, vol. 175, 2020.

[6] Zhang, W., and Wood, S., "Awareness of age-related change, chronological age, subjective age and proactivity: An empirical study in China," *Frontiers in Psychiatry*, 13, 2022.
[7] G. Smith, S. Della Sala, R. H. Logie, and E. A. Maylor, "Prospective and retrospective memory in normal ageing and dementia: A questionnaire study," *Memory*, vol. 8, no. 5, pp. 311-321, 2000.
[8] A. F. Jorm and P. A. Jacomb, "The Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE): Socio-demographic correlates, reliability, validity and some norms," *Psychol. Med.*, vol. 19, 1989.
[9] M. Nucco, D. Mapelli, and S. Mondini, "Cognitive Reserve Index questionnaire (CRIQ): A new instrument for measuring cognitive reserve," *Aging Clin. Exp. Res.*, vol. 24, no. 3, pp. 218-226, 2012.
[10] A. H. Buss and A. Durkin, "An inventory for assessing different kinds of hostility," *J. Consult. Psychol.*, vol. 21, no. 4, pp. 343-349, 1957.
[11] F. Cyprien et al., "Late-life cynical hostility is associated with white matter alterations and the risk of Alzheimer's disease," *Psychol. Med.*, pp. 1-10, 2021.