# Summary for the Dr. Edouard Delcroix Incentive Award 2024

## Exploring preventive health strategies:

## The role of coastal environments in the physical and cognitive well-being of older adults

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## Introduction

With **rising life expectancy**, the prevalence of chronic health conditions such as cardiovascular disease and Alzheimer's disease is creating a significant healthcare burden. As healthcare systems face increasing pressures, innovative **preventive strategies** are essential. Exposure to natural environments has shown promise for **reducing stress** and **improving cognitive function**, outcomes that are particularly relevant for **older adults**. While the health benefits of green spaces are well-documented, the effects of **coastal environments**, with their unique sensory and atmospheric qualities, remain underexplored. Moreover, most studies focus on perceived health outcomes, rather than objective **physiological** measures, and older adults—who represent a significant part of Belgium's coastal population—are rarely the primary study group. In addition, research often overlooks the physiological differences between specific coastal components (e.g., beaches, dunes, and dikes), frequently treating coastal areas as a singular entity. Yet, understanding how these diverse components uniquely influence health can provide valuable insights for designing targeted, health-promoting public spaces. **Wearable technology** offers an innovative way to address these knowledge gaps by enabling objective, continuous measurement of physiological signals during everyday activities. Additionally, since research often focuses on passive exposure, wearables provide a unique opportunity to explore the potential amplifying effects of physical activity on health outcomes.

## My work

In my **interdisciplinary** PhD research, conducted at **Ghent University** (Faculty of Bioscience Engineering and Faculty of Medicine and Health Sciences) in collaboration with the **Flanders Marine Institute (VLIZ)**, I examine the health effects of coastal exposure in older adults, focusing on three critical aspects of their well-being: **physiological stress**, **cognitive function**, and the role of **physical activity**. Additionally, I investigate the differential physiological impacts of **various coastal components (e.g., dunes, dikes, beaches)** and examine a **quantitative dose-response relationship**, i.e. whether and how the frequency of exposure influences the intensity of the effects.

As an initial step, I conducted a **pilot study** to **refine the protocol**, exploring the effect of a coastal walk on stress-related physiological parameters. In a randomized cross-over design, **15 participants** (21–56 years, 53% female) completed **two 45-minute walks**: one in a coastal environment (Ostend) and one in an urban environment (Ghent), on separate days. I measured participants' physiological responses using the NeXus-10 MKII wearable device, recording **electrodermal activity (EDA)** as a proxy for sympathetic nervous system (SNS) activity and **high-frequency heart rate variability (HF-HRV)** for parasympathetic nervous system (PNS) activity. I also assessed perceived stress, mental exhaustion, and positive and negative mood before and after exposure, and collected GPS and acceleration data during the walks. Although the sample size was too small to draw definitive conclusions about the (mental) health effects of coastal exposure, this preliminary experiment yielded **four key methodological insights** that informed the design of subsequent studies (see Table 1). Firstly, the urban walk unexpectedly showed a greater stress-reducing effect than the coastal walk, likely influenced by participants' familiarity with the urban environment. Secondly, the interaction between physical activity and environmental type highlighted the need to further explore active versus passive coastal exposure and their distinct health benefits. Thirdly, variations in physiological responses across coastal segments, such as the sea and dunes, underscored the importance of examining specific coastal features rather than treating the coastal environment as a single entity. Lastly, methodological limitations with the NeXus-10 MKII in outdoor settings revealed the need for more robust wearable technology in future studies.

***Table 1.*** *An overview of the four most important findings of the pilot study, with their potential explanations and the lessons learned from it for future studies.*

| Finding | Potential explanation | Lesson |
|---|---|---|
| Urban walk reduced stress more than coastal walk | Familiarity with urban environment | Account for environmental familiarity |
| Greater PNS reduction with physical activity in urban environment | Coastal physical activity provides distinct mental health benefits | Investigate active vs. passive exposure |
| Varied physiological responses across coastal walk segments | Coastal stimuli (e.g. sea, dunes) increase arousal | Investigate specific coastal features |
| Wearable device produced noisy data | Wearable not designed for outdoor conditions | Use better-suited wearable devices |

Based on these insights, the **first major study of my PhD** was designed focusing on older adults. Following a randomized cross-over design, a group of **48 participants** (61-86y, 54% male) completed **two 30-minute walks**, one in a coastal environment and one in an urban environment in Ostend, on separate days. Each session included 15 minutes of **seated exposure** prior to walking. I collected continuous heart rate variability (HRV) and electrodermal activity (EDA) data using two wearable devices, the Empatica EmbracePlus wristband and the Polar H10 chest strap, and sampled saliva at four time points to measure **cortisol levels**. I assessed **cognitive function** pre- and post-exposure using validated tests, as well as self-reported mental health. For a complete overview of the experimental protocol, I refer to Figure 1. The data are currently being analysed to assess the potential benefits of coastal walking exposure on the physical and cognitive well-being of this important demographic as well as the differential physiological effects of the various coastal components (e.g. dunes, dikes, beach).

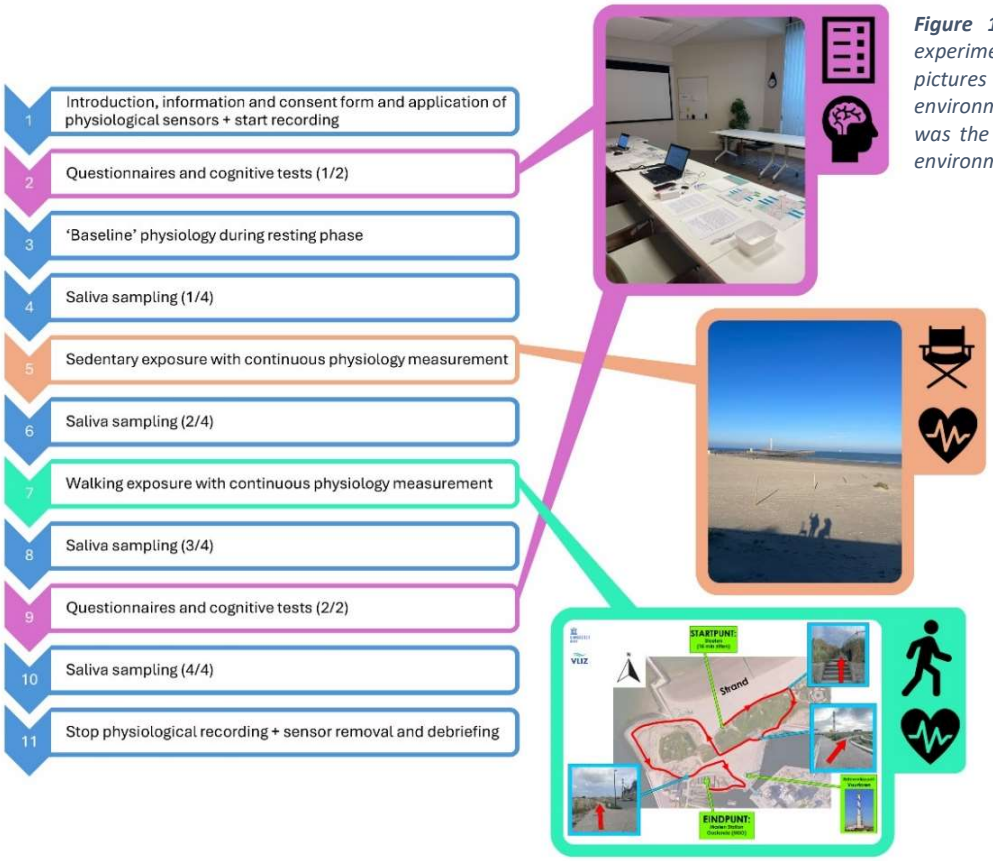


***Figure 1****. Overview of the experimental protocol, with pictures for the coastal environment. The protocol was the same for the urban environment.*

After the completion of this first study**, two follow-up studies** are on the agenda: one examining the effects of **virtual coastal exposure** on older adults, and another exploring the **dose-response relationship** of coastal exposure. In the former study, the aim will be to compare virtual and real-life exposure, addressing whether the benefits of coastal environments can be replicated indoors—a particularly valuable option for **older adults with reduced mobility**. This study will take place in the **immersive room "The Cave"**, located at the Ostend Science Park, where videos of the coastal and urban environments will be displayed. This setup provides a controlled yet realistic setting, facilitating both passive and active engagement with the environment, while maintaining **sensory experiences comparable to real-life exposures**. In the latter study, I will investigate the **ideal exposure frequency** to maximize health benefits, which is essential for public health recommendations. For this study, I will repeat the protocol of the real-life exposure study five times, in a within subject design, only in the coastal environment. The exposures will take place with a week between sessions. The aim is to investigate how health outcomes change as the frequency of exposures varies from 1 to 5. In Figure 2, a schematic overview of the past, present and future studies is given.

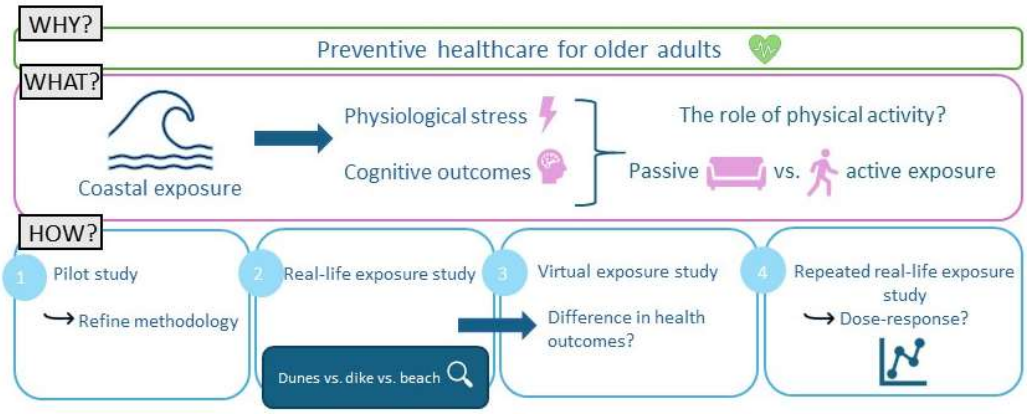


***Figure 2.*** *Schematic overview of the past, present and future studies of my PhD research. The pilot study and data collection of the real-life exposure study are finished. The latter is currently in the analysis phase. The virtual exposure study and repeated real-life study are planned.*

## Conclusion

I firmly believe that receiving the **Dr. Delcroix Incentive Award would greatly advance my ongoing research** on this important topic. The award would provide **critical resources** to support the implementation of my current research plans. For instance, the funding could be used to acquire essential equipment, such as wearable devices or a walking pad, or to attend (international) conferences and trainings where I can both deepen my understanding and share my findings. More importantly, winning the award would **give the research topic the recognition it deserves**.

With the dual challenges of rising life expectancy and climate change, incorporating nature into health strategies for older adults is more crucial than ever. This research directly **supports preventive health interventions** by providing evidence-based insights into how coastal environments can enhance the well-being of **ageing populations**. The findings could guide **urban planners** and **policymakers** in designing **health-promoting public spaces** that encourage physical activity, improve stress reduction and benefit cognitive functioning. Furthermore, by highlighting these environments as valuable public health resources, it also underscores the importance of **protecting marine environments** for future generations.

Finally, I would like to **thank my supervisors: Prof. Asselman, Prof. Everaert, Prof. Petrovic, and Prof. Cardon**, for their invaluable support and guidance during this first phase of my PhD research. I am truly grateful for the opportunity to spend the next four years working on such an innovative and meaningful topic. I would also like to thank the Special Research Fund of Ghent University (BOF-UGent) for supporting this research with a BOF Blue Growth scholarship.