



**Royal Higher Institute for Defence**

# Defence-related Research Action - DEFRA

**ACRONYM: BREATHFIT**

**Title: Exhaled breath analysis to determine physical and mental readiness of soldiers**

**Duration of the project: 01/12/2022 - 01/12/2025**

**Budget: 1132 k€**

**Key words:** exhaled breath, modular system, biomarkers, monitoring, overtraining

**of which RHID contribution: 1048 k€**

## PROJECT DESCRIPTION

BREATHFIT aims to enable frequent screening of physical and mental health based on exhaled breath by developing a user-friendly and portable system for sampling and analysis. At present, frequent screening is inconvenient and difficult to perform remotely due to the need for expensive and lab-based techniques to gain information on physiology and metabolism.

At this point, medical personnel joining training programs or operations rely on personal surveillance and there is a lack of tools to gain fast oversight of a platoon's physical and mental wellbeing. Due to the great amount of information in exhaled breath samples and the potential to build classifier algorithms based on accurate validation markers, BREATHFIT offers the potential to provide vital tools for the management of a platoon's wellbeing.

Within this project, we will develop

- (1) an exhaled breath sampler that responds to the current challenges by including e.g. inlet air purification and exhaled CO<sub>2</sub> controlled sampling to provide an accurate and standardized sample.
- (2) a portable analysis unit containing a VOC measurement system to identify exhaled biomarker fingerprints

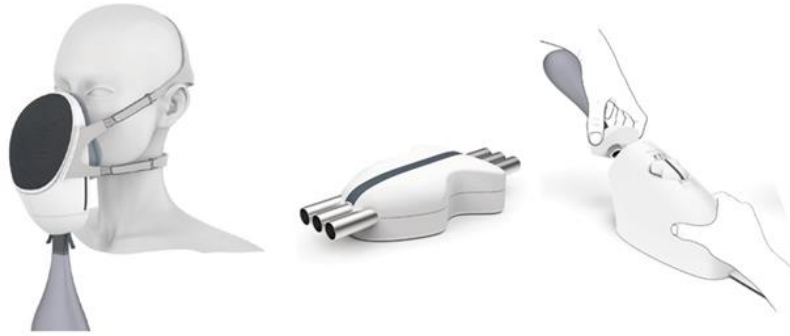


Figure 1 First concept of the breath device

(3) A relational database and classifier algorithm to inform about the physical and mental readiness of soldiers via a data visualization dashboard. The data visualisation dashboard will use easy-to-interpret colour codes on aspects of physical and mental readiness to provide fast oversight of a platoon's wellbeing.

	Soldier 1	Soldier 2	Soldier 3	Soldier 4	Soldier 5	Soldier 6	Soldier 7	Soldier 8	Soldier 9
Performance	●	●	●	●	●	●	●	●	●
Fatigue	●	●	●	●	●	●	●	●	●
Anger	●	●	●	●	●	●	●	●	●
Depression	●	●	●	●	●	●	●	●	●
Calorie intake	●	●	●	●	●	●	●	●	●
Sense of effort	●	●	●	●	●	●	●	●	●
Overall risk	●	●	●	●	●	●	●	●	●
Overtraining	●	●	●	●	●	●	●	●	●

Figure 2 First concept of the data visualisation dashboard

Within this project, the focus will be on identification of reduced physical and mental readiness with overtraining diagnosis as the worst-case scenario. Nevertheless, the sampler/analysis unit will be designed modularly so it can be easily adapted for other exhaled breath biomarker applications.

Based on a literature study, a selection of exhaled breath biomarkers relevant for determining signs of fatigue as well as a selection of gas sensors that are able to detect these exhaled biomarkers will be done. Taking into account the user and application requirements, a few sampler/analysis unit combinations will be built and tested in a lab environment. A few prototype design iterations will probably be needed to end up with a final version that can be used for the validation study to identify early warnings of physical and mental fatigue and overtraining as a first application of exhaled breath VOC fingerprint analysis as generated by the designed device.

For the validation, a group of 20 service members will be tested frequently during a 6-10 weeks training period. Beside the test population, a group of 5 healthy controls and 5 individuals with known signs of overtraining is also included in the validation study. A GDPR compliant relational database including VOC markers from the breath analysis and metadata for validation purposes will be setup. Via a classifier algorithm, reduced physical/mental readiness can be identified.

The potential impact of the research on Defence is that BREATHFIT enables:

- Quick oversight of a platoon's wellbeing to support medical personnel
- More targeted and efficient monitoring of physical and mental health
- Prevention of a heavy burden of disease and non-battle injuries (DNBI)
- Remote monitoring

An important opportunity for a future trajectory is that the BREATHFIT device and system is a valuable vehicle to inform about the impact of the environment on physiology and physical performance. This is of particular interest at shooting ranges and monitoring in chemical, biological, radioactive and nuclear (CBRN) warfare.

Our principal valorisation is a first prototype of the BREATHFIT system: a modular sampler, portable analysis unit and data visualisation dashboard to provide fast oversight of a platoon's wellbeing to soldiers, commanders and health care providers. The potential of the developed system reaches beyond the use case of this project due to the design based on interchangeable sensors for specific applications in e.g. e.g. diagnosis of diseases such as heart failure, lung cancer and asthma, monitoring of environmental effects on health, monitoring of metabolism. Outcomes of the BREATHFIT project will be disseminated through (social) media campaigns, presence at events and conferences and publication in peer-reviewed scientific journals.

## CONTACT INFORMATION

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## LINK(S)

Please mention here the link(s) where the reader can find detailed information on the project (project website, page on social networks, etc.).