

# The Appropriation of Product Design as Solution to Minimise Risk of Exertional Heat Illness among Marathon Runners

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**Abstract** The intensity of environmental heat stress during a marathon race increases the runner's metabolic heat production. Based on series of participatory studies and interview sessions with 100 respondents among runners, the contributing factors to this homeostatic imbalance risk are the excessive amount of body-water deficit from extensive sweating, and the rapid increase of cardiovascular and thermal strain while running. In addition, environmental factors such as humidity, the increase of air temperature, wind speed and solar radiation contribute to the marathon runner's low performance during running with the paucity of cooling strategy that results in the increase of core body temperature with symptoms of exertional heat illness. This paper elucidates the integration of the statistical and theoretical studies of exertional heat illness and the human physiological responses complementing with the product design context. The integration demonstrates the synchronisation of design thinking process within the ergonomics ergosystem framework to develop the appropriate prototype design for marathon runners. As outcome, this research has successfully developed a running suit as its design proposal to minimise exertional heat illness risk and promote the runner's safety, wellbeing and performance in the heat.

**Keywords** Environmental Heat Stress, Exertional Heat Illness, Design Thinking, Prototype Design

## 1. Introduction

This paper is a study about the risk of exertional heat illness among marathon runners within the context of product design research. The main objective of this paper is to demonstrate the possible extension of the statistical and theoretical studies complementary with the design practice that aims to generate further product design innovation coherency to the user need through the development of Vapor X suit prototype design. Furthermore, this study demonstrated de Looze [1] propagation on (1) comfort is affected by factors of a various nature (physical, physiological, psychological) and (2) comfort is a reaction to the environment. The development of this Vapor X suit was based on the ergonomics ergosystem framework. This framework was adopted from the structural ergonomics view of work system by Bridger [2] (Figure 1) and adapted by Mohd Najib [3] (Figure 2). The framework consists of sets of