



**Publicly Stressing the Role of Mitochondria in NAFLD
with(in) a Sports Event**

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Keywords:	NAFLD, Mitochondria, Science Communication, Sports, Health promotion, Partnerships/coalitions

Researcher Letter**Publicly Stressing the Role of Mitochondria in NAFLD with(in) a Sports Event**

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Researcher Letter

Publicly Stressing the Role of Mitochondria in NAFLD with(in) a Sports Event

Non-Alcoholic Fatty Liver Disease (NAFLD) is currently the most prevalent cause of chronic liver disease and constitutes a major risk for the development of end-stage liver disease. NAFLD is led by hypercaloric diets and sedentary lifestyles characteristic of modern societies and with a prevalence of 25% amongst the adult population worldwide, its incidence is rising amongst children and adolescents (1). Alongside basic biomedical research for novel therapeutic tools and the optimization of management strategies, currently based on lifestyle interventions targeting weight loss (2), health promotion initiatives targeting primary prevention through improvement of nutritional quality and physical activity habits are imperative to tackle this and other metabolic diseases.

Offering an interactive environment, informal venues such as music festivals or mass sports events are effective settings to foster community receptiveness for behavior change towards healthier lifestyles (3–5). Sports captivate the attention of countless fans, providing entertainment and joy to both athletes and spectators, and eliciting a contagious wave of emotional connection that gathers and engages the interest and participation of large audiences. As posited by the Social Cognitive Theory's (SCT) concept of modelling (6), passers-by and the spectators of the event, even if not actively engaged in the practice of sports, can experience a self-reflection upon their own health-oriented values and physical activity habits, which in turn, can trigger a behavioral change towards a healthier lifestyle (4,7,8). Furthermore, the receptivity and effectiveness of health-oriented messages seems further increased when perceived as matching with the nature of the event and supported by a wider media campaign (5,9,10). Thus, sports events provide the ideal setting for promoting exercise as an ally for the prevention and treatment of NAFLD and other sedentary-driven contemporary metabolic disorders.

Based on the evidence supporting strategic cross-sectoral partnerships between sports events organizers and health-related specialists in disseminating health valorization ideas and well-being (4,11), we designed and implemented a science communication multimodal approach at the 2018 edition of the European University Games (EUG), the largest university multisport event in Europe. Combining an on-site outreach booth with a wider media campaign targeting the local community at large, we intended to raise awareness on NAFLD and promote lifelong healthy lifestyles, encouraging the practice of physical activity by stressing the role of mitochondria within the context of (energy) homeostasis and the impact of (un)healthy lifestyles on the biological processes that drive health and aging.

Science communication multimodal approach overview

The media campaign involved the collaboration of 52 national and international researchers in the development of science communication materials focused on the biomedical underpinnings driving the health-related benefits of exercise practice in metabolism and metabolic diseases, sleep cycles, memory, reproduction and fertility, articular degeneration and arthritis, menopause, cardiovascular health, neurodevelopment and neurodegenerative disorders. The campaign resulted in 14 illustrated chronicles, radio clips, flyers, videos and a comic strip and had a particular focus on NAFLD and the impact of exercise on mitochondria bioenergetics.

NAFLD is led by a disruption of energy homeostasis and the development of systemic insulin resistance and thus shares an underlying etiopathogenesis with other metabolic diseases such as obesity or type 2 diabetes mellitus (12). The metabolic milieu brought about by this chronic positive energy balance leads to hepatic steatosis that compromises mitochondrial function and triggers an inflammatory state known as Non-Alcoholic Steatohepatitis (NASH), which in turn, can progress to cirrhosis or hepatocellular carcinoma (HCC)(13). Known as the *powerhouse of the cell*, mitochondria mediate the conversion of energy substrates into ATP, and thus represent the ultimate link in the cycle of energy homeostasis and in the conceptual understanding of the relationship between energy intake and energy expenditure; or behaviorally speaking, between nutrition and physical activity (14).

For the illustrations and the comic, the science content was discussed between researchers and an illustrator, to de-construct some scientific jargon and co-create simple and attractive images. Visual imagery is particularly suited to portray and communicate abstract concepts characteristic of macro- and microscopic biological mechanisms or subcellular structures that lie beyond the visual experiential reach of non-experts, as is the case for mitochondria (Figure 1A, B) (15). Besides the 14 illustrations for the chronicles, the co-creation process also resulted in the production of the comic "Exercise, Mitochondria...& Us" (Figure 1D), which combines the power of visual communication and storytelling to elicit learning and attitude shifts. In this case, the narrative of the comic explored the role of mitochondria as the mediators of the metabolic processes that link energy intake with energy expenditure, food consumption and physical activity, closing with age-dependent physical activity recommendations by the World Health Organization. The use of languages such as comics to explore scientific subjects is a creative way to communicate and to involve different audiences.

In addition to the media campaign, the outreach booth "Paddle/Pedal Bar" was designed to engage visitors from the local community as well as athletes and passers-by in the practice of physical activity

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2
3 with a static bike and rowing paddle machines. The outreach booth aimed at promoting interactions
4 between the public and science communication materials as well as a questionnaire game enquiring
5 about lifestyle behaviors.
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8 *Outcomes and forefront*

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10 It is difficult to predict the impact of any science communication and outreach campaign, but we
11 estimate that our multimodal approach reached more than 100,000 people (Figure 1C), via the EUG2018
12 newsletter (3,612 subscribers), the Portuguese regional press (*Diário de Coimbra*, with a daily circulation
13 of 10,000 copies), the Portuguese national press (*Público* on-line, 6,814 page-views), the *Healthy Living*
14 *with Exercise* flyer (2,000 printed copies), and the EUG2018 (<https://www.eug2018.com>), EUSA, CNC
15 (http://www.cnc.pt/outreach/outreach00_EUG2018.asp) and FOIE GRAS online social media platforms,
16 beside the coverage in the Portuguese News Agency *Lusa*. Researchers also collaborated in 2-3-minute-
17 long radio pieces (in Portuguese) and in a special interview, produced by the Radio University of
18 Coimbra (RUC, an academic radio with a huge impact in both academic and non-academic local
19 communities).
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28 The Pedal Bar outreach booth (Figure 2) received 1,021 visitors from 33 different nationalities during the
29 ten days of the event. The audience (43% women and 57% men) was composed of athletes (41%),
30 visitors (37%), young volunteers (13%) and staff members (9%). The majority of participants were young
31 adults (74%) but other age groups, going from children to senior citizens also engaged in Pedal Bar
32 activities. The Pedal Bar was also devised as a space for the interaction between scientists and a non-
33 scientific audience. The interaction with people during the questionnaire-game clearly elicited a
34 mutually beneficial dialogue about lifestyle habits and perceptions on and about the importance of
35 exercise practice, and a moment of self-reflection (Figure 2B-F) about individual lifestyle habits from a
36 new and perhaps renewed perspective. Health and well-being are understood and practiced not only in
37 reference to biomedical knowledge, but also shaped by beliefs, perceptions and attitudes that are
38 dependent on cultural, social and environmental factors. The communication of mitochondrial-related
39 concepts rarely occurs outside of the circles of experts, but its appropriation by non-expert audiences
40 can provide a biological framework to understand the process of energy homeostasis and its relation
41 with lifestyle-driven behaviors. Rising awareness on these concepts within the environment of a sports
42 event might be particularly useful for health promotion initiatives focusing on NAFLD and other
43 metabolic diseases, in which sedentary behaviors and the lack of physical activity are etiologically
44 related to the disruption of mitochondrial function and largely to the pathophysiology of the disease. A
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3 multimodal approach such as the one undertaken in EUG seems to engage different publics and
4 broadens the impact of the sports event, reaching not just the spectators visiting the venue but the local
5 community at large.
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10 **Conflict of interest**

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12 None of the authors have potential conflicts of interest to be disclosed.
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23 "A winner's heartbeat!" between July 15 and 28 had over 4 000 participants from 291 Europe's leading
24 sport universities, organized under the umbrella of the European University Sports Association (EUSA),
25 and supported by the International University Sports Federation (FISU), also received funding from the
26 European Erasmus+ Programme and 672 volunteers from Portugal and abroad.
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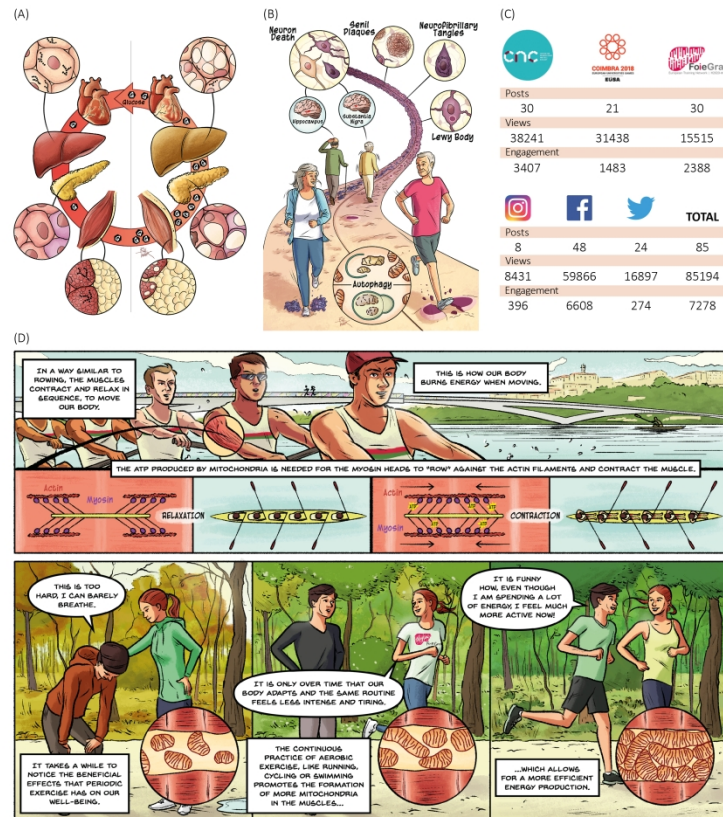


Figure 1. (A) Illustration of the chronicle "A Tale of a (Too Much) Sugar and How to Fight it" about the impact of excess of sugar and sedentary lifestyle / physical activity on the development of cardiometabolic diseases, including Non-Alcoholic Fatty Liver Disease. (B) Illustration of the chronicle "Sports and Neurodegenerative Diseases" about the role of exercise practice in the regulation of autophagy, involved in the degradation of toxic protein aggregates such as senile plaques in Alzheimer's Disease and Lewy Bodies in Parkinson's Disease. (C) Social Media Coverage in the online platforms of CNC, EUG2018 and FOIE GRAS. (D) Comic "Exercise, Mitochondria...& Us" introduces the concept of body adaptation to exercise practice and the fact that endurance training promotes mitochondrial biogenesis, closing with age-dependent physical activity recommendations by the World Health Organization.

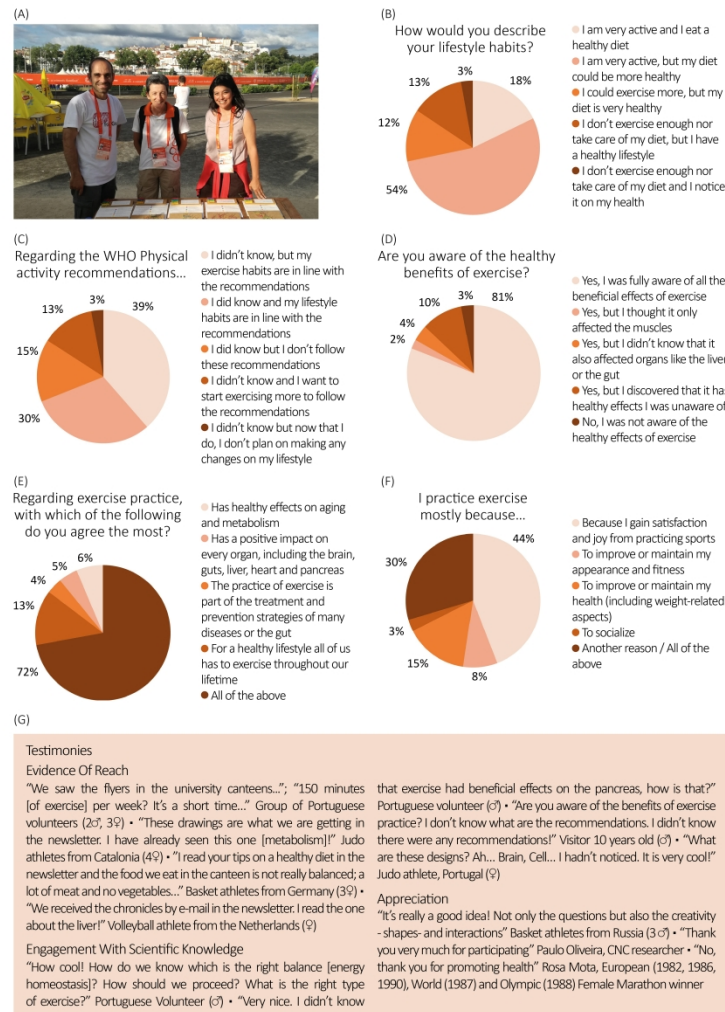


Figure 2. (A) Pedal Bar outreach booth at the EUG2018 with Paulo Oliveira, Rosa Mota (Portuguese former marathon runner, Olympic gold in 1988) and Marisa Azul. (B-F) The outreach booth promoted a self-reflection on lifestyle behaviors, especially through the interactive questionnaire and sprout conversations on the biological underpinnings of exercise practice as well as nutrition and physical activity habits (N=1,021).

(G) Testimonies given by passersby, reflecting the reach, engagement with scientific knowledge and appreciation of the multimodal approach.