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Tackling overweight and obesity in the youth with the PAS GRAS project

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t is a startling reality that today, over 245 million children aged 5–14, 249 million adolescents and young adults aged 15–24, and 2.1 billion adults are overweight or all age groups predicted for 2050^{1,2}. The younger cohorts in particular are consigned to a lifetime of obesity-related comorbidities, whose treatment will consume an increasingly larger fraction of healthcare resources, with estimated costs reaching US\$4.32 trillion by 2035³.

The explanation for why youth obesity rates are increasing is complex and involves interactions between biological, economic and societal or environmental factors⁴. There is evidence that both eating behavior and socioeconomic environment amplify the genetic risks for obesity. Contributing factors include the increased availability of energy-dense and sugar-supplemented processed foods and drinks, which are often more affordable and easier to obtain and prepare than more nutritious alternatives. Thus, low-income and time-poor individuals and families become more dependent on highly obesogenic foods for daily sustenance, thereby enhancing the risk for this vulnerable socioeconomic cohort. Other risk factors include lack of sleep, resulting in the disruption of metabolic circadian rhythms, and the use of certain medications such as anti-psychotic drugs. Although much progress has been made in identifying individual metabolic risk factors, their precise roles, and interactions in driving harmful pathways leading to obesity remain undefined (Fig. 1).

Youth obesity is particularly concerning because of the unique vulnerabilities of this age group and requires early intervention and decades of management⁵. Indicators of early onset metabolic complications, such as redox and energy imbalances, DNA methylation and transcriptional alterations, are already present in pre-pubertal children with obesity, resulting in greater adulthood metabolic risks. Many, if not most, of the determinants of lifetime obesity and metabolic sequelae are established during early stages of life. Investment in early childhood, from preconception to adolescence, can yield a 10:1 benefit:cost ratio in health and socioeconomic outcomes during later life⁵.

Non-pharmacological approaches are preferred for a young individual, as the long-term effects of newly available drugs for the treatment of obesity, such as semaglutide or tirzepatide, remain unknown. Meanwhile, most obese adults and children do not meet the clinical criteria for bariatric surgery, according to current guidelines⁶. Health and nutrition knowledge among all ages, but especially younger groups, are unrecognized obesity determinants⁴. Health promotion strategies – in particular advisory campaigns to modify behaviors – may lack the proper messages or approaches towards consistency and efficacy among different ages and sectors⁷.

We argue that to decrease the prevalence of overweight and obesity in children and adolescents, participatory approaches inter-connected with multi/interdisciplinary approaches are needed, with a focus on science and health-based knowledge from a young age together with tailored dietary-active styles interventions.

To implement new solutions to target youth obesity in Europe, the PAS GRAS project, a Horizon Europe Research and Innovation Action (RIA)-funded project (2023-2028), comprising 16 partners across the European Union and the UK, was initiated in May 2023. PAS GRAS is part of the European Cluster of Obesity Research Projects (OBE-Clust), a unique network of nine EU-funded projects focused on obesity prevention and treatment.

In PAS GRAS, multiple datasets such as lifestyle, mental health, family context, socioeconomic factors and environment data are being used to understand the development of obesity, as well as their interaction with the genetic and metabolic characteristics. The project focuses on children, adolescents, young adults and their families, who are overweight or obese, to guide science and health knowledge applied to nutritional and physical activity approaches. PAS GRAS uses integrated analyses from several cohorts, including ongoing intervention studies and large datasets (such as the UK Biobank), to develop a risk-assessment tool (RAT) that will provide users with a personalized and robust evaluation of their risk of obesity and related complications, such as diabetes and cardiovascular disease.

As an example of the dietary patterns intervention studies, we are evaluating the Mediterranean diet (MeD), recognized by UNESCO as an 'intangible cultural heritage of urgent safeguarding'. The MeD involves high consumption of unprocessed cruciferous vegetables, fruits, grains, moderate consumption of fish, seafood, olive oil (the main source of added fat in food), balanced with a low intake of meat products, aligning the production and consumption with natural life cycles. Although the positive effects of MeD on decreasing mortality, cardiometabolic disease and cancer are well established⁸, the underlying biological mechanisms and targets for the bioactivity of components of MeD are not clearly identified. This includes under-explored MeD foods. notably mushrooms⁸ and some traditional aromatic herbs such as the Lebanese herbal mixture Za'atar.

The program is invested in unravelling key cellular and molecular mechanisms underlying the protective effect of selected MeD components, focusing on the activation of cellular metabolism via AMPK and NRF2 pathways, and regulation of energy balance pathways. With this new evidence-based knowledge, PAS GRAS aims to promote MeD as a tool for precision nutrition. Another uniqueness is the PAS GRAS Campaign for raising awareness through society on the risks of obesity and related comorbidities, such as diabetes and cardiovascular disease. PAS GRAS is performing interdisciplinary collaborative research together with participatory action research involving young people, children, adolescents and families, as well as all relevant actors (Fig. 2). This will help to identify and prioritize key determinants that influence overweight/ obesity prevention and treatment, to design,

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Fig. 1 | Determinants of obesity throughout life. Obesity risk results from the interaction between individual factors, including intrinsic factors like genetics, factors associated with lifestyle, and environmental ones. Obesity also encompasses a strong transgenerational risk acquired during in-utero development and lactation, imprinting a higher obesity risk for the next generation. De-risking obesity throughout the life course requires an integrated strategy from personal choices strongly supported by public policies and institutions, together with changes in environmental factors, urban space design and reduction of processed sugar- and fat-rich diets.

create, implement, evaluate and validate a set of personalized tools and programs for young people together with key players and policymakers. PAS GRAS integrates hardcore science with mixed methods such as systems thinking, focus groups, visual methods and questionnaires, to develop approaches well accepted by young people, including comics⁹, videos, a nutritional guidebook, physical activity programs, including urban green and blue areas. Previous interventions often failed owing to poorly tailored messaging. Success requires cross-disciplinary research within natural and health, social sciences and humanities, and accounting for regional differences¹⁰.

PAS GRAS will address gaps in obesity diagnosis, early interventions, physical activity awareness, and food and nature knowledge, providing an interdisciplinary blueprint and guidelines for a healthier population. Targeting young people in Europe, the UK and beyond, it aims for measurable impact within four years and a long-term goal of reducing obesity in this population by 30% by 2050. This multi/interdisciplinary approach will also help lower future obesity-related co-morbidities.

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Fig. 2 | Conceptual framework of the PAS GRAS campaign. PAS GRAS campaign rooted on groundbreaking interdisciplinary collaborative research and participatory action research resulting in tailored science and health-based

5. Guidelines, recommendations At local, regional, national, EU levels in terms

of food and programs for youth; food insecurity awareness; healthy , sustainable diet awareness; blue and green spaces in neighborhoods; healthy and affordable foods in local markets; digital skills, science and health education aligned with one's/planetary health

4. Awareness, communication, network

Ethnicity or race: built/natural environment in neighborhoods: safe recreation/walkable spaces; healthy and affordable foods in local markets; (un)accessible primary healthcare; engagement in (visual) science and health narratives; accessibility to digital tools and skills.

3. Awareness, communication, network

Science and health education: food, diet/nutrition, mental health, physical activity and sports; (un)accessible primary healthcare; digital tools and skills, sedentry versus physical activity habits; engagement in community event

2. Behavior, beliefs, attitudes

Biology; self-efficacy; psychosocial health/stress: socioeconomic context: weight stigma; diet and feeding practices; sedentary versus active lifestyles; (un)affordable nutritious foods and healthy diets.

1. Behavior, beliefs, attitudes

Biology, e.g.; age, genetics, sex; ethnicity or race; early life events; self-efficacy, mental health; constraints and motivations to gain science/health/food/diet/physical activity-related knowledge.

tools, interventions and programs and hopefully guidelines, recommendations and policies implemented in all countries of the consortium, other countries in Europe and worldwide.

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Competing interests

The authors declare no relevant competing interests.

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