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The Nutrition Society Winter Conference 2023 was held at The Royal Society, London on 5–6 December 2023

Conference on 'Diet and lifestyle strategies for prevention and management of multimorbidity'

Editorial

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Multimorbidity, the existence of two or more concurrent chronic conditions in a single individual, represents a major global health challenge. The Nutrition Society's 2023 Winter Conference at the Royal Society, London focused on the topic of 'Diet and lifestyle strategies for prevention and management of multimorbidity', with symposia designed to explore pathways for prevention of multimorbidity across the lifecourse, the role of ageing, the gut-brain-heart connection and lifestyle strategies for prevention and management of multimorbidity. It also considered machine learning and precision nutrition approaches for addressing research challenges in multimorbidity. The opening plenary lecture discussed advancing diet and lifestyle research to address the increasing burden and complexity of multimorbidity. The two-day programme concluded with a plenary which addressed the key dietary risk factors and policies in multimorbidity prevention.

Keywords: Ageing: Diet quality: Inflammation: Malnutrition: Obesity

Multimorbidity is broadly defined as the co-existence of two or more chronic conditions within the same individual[1,2]. The prevalence of multimorbidity is increasing and represents a major global health challenge, particularly considering that existing healthcare systems are largely structured around treating single diseases or organ systems[3,4]. Patients with multimorbidity experience a reduced quality of life, greater treatment complexity (such as polypharmacy and multiple medical appointments), unplanned healthcare and increased risk of mortality[3]. In England, it is estimated that over one quarter of adults are living with multiple co-occurring long-term conditions[5]. Ageing increases the likelihood of multimorbidity, with projections indicating that two-thirds of the older population in England (aged ≥ 65 years) will be living with multimorbidity by 2035[3]. This poses concern given the substantial transition in population distribution towards older age demographics. Alongside age, socio-economic deprivation is a leading determinant of multimorbidity[4]. A comprehensive study of an adult primary care population in England found that there was a steady increase in multimorbidity prevalence between 2004 and 2019, alongside a marked decrease in the median age of onset[6]. The association between socio-economic inequalities and multimorbidity prevalence was amplified over the 16-year study period, specifically among middle-aged adults (<65 years)[6]. The rising prevalence of multimorbidity, alongside earlier onset age, will exacerbate the strain on already overwhelmed health and social care systems. To alleviate the growing socio-economic impact of multimorbidity, there is an urgent need for diet and lifestyle strategies aimed at preventing its onset and slowing its progression.

The 2023 Nutrition Society Winter conference entitled 'Diet and lifestyle strategies for prevention and management of multimorbidity' was held in hybrid format at the Royal Society, London. Two hundred and thirty-five delegates attended in-person and 57 delegates joined online. The conference welcomed a wide audience, including members of the scientific community, food industry, policymakers, clinicians, health professionals, as well as students and graduates in the field of nutrition and dietetic-related subjects. Delegates from 11 countries worldwide, including Belgium, Canada, Denmark, India, Ireland, Saudi Arabia, Singapore, Spain, Switzerland, Turkey and the UK were in attendance to consider the challenges posed by multimorbidity. Forty-four

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abstracts were accepted for presentation at Original Communication sessions, with 15 and 29 presented in oral and poster format, respectively. The two-day conference was organised into four symposiums, which focused on 'Pathways for prevention of multimorbidity across the lifecourse', 'Ageing and Multimorbidity', 'Diet and the Gut-Brain-Heart Connection' and 'Lifestyle strategies for prevention and management of multimorbidity'. Additionally, there was a sponsored breakfast symposium on 'Using large-scale multi-omics to understand, predict and prevent chronic disease'.

Plenary lecture 1: advancing diet and lifestyle research to address the increasing burden and complexity of multimorbidity

In the opening plenary lecture, Professor Naveed Sattar (University of Glasgow, UK) delivered a compelling overview stressing the importance of tackling adiposity to address the increasing burden and complexity of multimorbidity. Professor Sattar highlighted that excess adiposity, particularly ectopic fat deposition, is increasingly recognised as a casual risk factor for multiple chronic conditions. He presented robust data from a Mendelian randomisation study which demonstrated that the adverse metabolic effect of higher adiposity is contributing causally to conditions, including type 2 diabetes, hypertension, polycystic ovary syndrome and coronary artery disease[7]. The notion of causality was further supported by evidence that remission of type 2 diabetes can be achieved through weight loss induced by a low-energy diet[8]. In the latter part of this talk, and in the context of multimorbidity prevention, Professor Sattar advocated that more emphasis should be placed on addressing excess adiposity earlier in the course of chronic disease management, as this strategy would help to slow the development of subsequent adiposity-related comorbidities in later life, reduce pill burden and improve quality of life[9]. Regarding the treatment and management of obesity, he advised the implementation of evidence-based models of care that incorporate a combination of lifestyle and pharmacological approaches. Professor Sattar concluded by stressing the necessity to upscale policies aimed at preventing obesity.

Symposium 1: pathways for prevention of multimorbidity across the lifecourse

The first symposium was opened by Dr Teresa Marhsall (University of Iowa, US), who delivered a talk on 'Oral health and multimorbidity: Is diet the chicken or the egg?'[10]. Dr Marshall emphasised the need to recognise early childhood caries as a risk marker for chronic disease. She advocated that promotion of healthy dietary patterns during childhood and early dietary intervention represent important opportunities to disrupt oral disease progression and prevent manifestation of diet-related multimorbidity in later life.

Dr Lu Dai's (Karolinska Institute, Sweden) talk on 'Multimorbidity clusters and clinical trajectories: Implications for preventive strategies' provided an impressive overview of the epidemiological evidence and methodological aspects of identifying multimorbidity patterns and its implications for primary, secondary and tertiary prevention strategies across the lifecourse. Dr Dai drew our attention to the ongoing multinational European AFFIRMO Consortium, which aims to implement an integrated patient-centred holistic care approach in elderly multimorbid atrial fibrillation patients. She also presented data on the evolution of multimorbidity clusters and clinical trajectories of older adults with multimorbidity over 12 years and reported how understanding clusters and their transitions may help to identify personalised preventative or therapeutic strategies[11].

Finally, Professor Alex Macgregor (University of East Anglia, UK) provided an overview of 'Multiple long-term conditions: understanding the intersection of diet quality, malnutrition and inflammation'. He explained that inflammation provides a conceptual framework for understanding how diet drives multiple long-term conditions. Professor Macgregor described his recently funded project, 'inflAIM' (Award ID: NIHR205461), which will apply novel artificial intelligence (AI) technologies to longitudinal datasets to address whether interventions can be identified that limit chronic inflammation and improve nutrition to reduce the onset and rate of progression of multimorbidity. His conclusion emphasised that improving suboptimal diets and alleviating malnutrition are expected to be pivotal in managing future risk of multimorbidity. However, Professor Macgregor recommended further research and a comprehensive understanding of mechanisms to facilitate the future adoption of personalised approaches in clinical practice. He also proposed that taking measures to manage exposure to inflammation, such as dietary modification, is likely to yield widespread health benefits throughout the lifecourse.

Symposium 2: ageing and multimorbidity

The second symposium turned attention to ageing and multimorbidity. Dr Antoneta Granic, (Newcastle University, UK) opened the symposium by presenting evidence on 'Diet and lifestyle strategies for prevention of sarcopenia, frailty and multimorbidity'. She recommended 'food first' approaches for older adults, which include myoprotective whole foods. Dr Granic highlighted the existing gaps in evidence concerning the effects of whole foods and high-quality dietary patterns, with or without exercise training, on muscle health outcomes and incident sarcopenia. She advised that more data, especially from randomised controlled trials (RCTs), are necessary to better inform prevention strategies.

Professor Malcom Jackson (University of Liverpool, UK) then shifted the focus to muscle loss from a more basic science perspective, discussing 'Reactive oxygen species in age-related musculoskeletal decline'. Professor Jackson outlined that reactive oxygen species play a key

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role in mediating adaptations to contractile activity in skeletal muscle and these adaptations are attenuated during the ageing process. He presented data from knockout mouse model ($Sod1^{-/-}$) experiments which highlight that motor nerve integrity is vital for maintenance of muscle redox homeostasis. In the context of maintaining muscle mass and function, he recommended that interventions should be targeted to reduce motor nerve loss and addressing the effects of increased muscle mitochondrial peroxide generation.

Associate Professor David Furman (Stanford University, US) then discussed 'Healthy longevity and precision health: the immune system takes the lead'. Systemic chronic inflammation plays a key role in regulating physiological ageing and the well-established nine hallmarks of ageing have all been shown to link to sustained inflammation[12]. He provided a summary of the '1000 Immunomes Project' which has uncovered inflammation-related markers of ageing using state-of-the-art 'omics' platforms and advanced AI methods. Associate Professor Furman went on to discuss their deep-learning-based inflammatory ageing clock (iAge) metric, which tracks multimorbidity, immunosenescence, frailty and cardiovascular ageing and has strong potential for translation medicine[12]. He also outlined current research focused on pharmacological and dietary modulation of the iAge metric.

The first day concluded with the delivery of the Cuthbertson Medal lecture. The award recipient, Dr Eirini Dimidi (King's College London, UK), showcased her series of studies and evidence analysis on the topic of 'Diet and the gut: establishing treatments, improving patient care, and tackling trends'.

Symposium 3: diet and the gut-brain-heart connection

Following a sponsored breakfast symposium at the beginning of day 2 on 'Using large-scale multi-omics to understand, predict, and prevent chronic disease', symposium 3 brought us perspectives on the impact of diet, and its nutrient and bioactive components, on the peripheral and cerebrovascular system, gut microbiota and the brain. Firstly, Professor Anne Marie Minihane (University of East Anglia, UK) summarised the evidence regarding the impact of a Mediterranean-style dietary pattern (MDP) on cardiometabolic and cognitive health. The neurocognitive benefits of a MDP are partly mediated by improvements in systemic cardiometabolic health function. Professor Minihane showed that there is consistent prospective cohort and disease biomarker evidence of cardiometabolic and cognitive benefits of adherence to an MDP. In her concluding remarks, Professor Minihane proposed that more attention be given to achieving consistency in scoring systems for the MDP. She also advised that more evidence from RCTs is needed, particularly within non-Mediterranean populations, and should consider cultural and socio-economic sensitivities.

Professor Jeremy Spencer (University of Reading, UK) delved deeper into dietary components, specifically flavonoids and their metabolic derivatives, which may exert beneficial effects on the vascular system and the brain. Professor Spencer presented evidence on the acute and chronic effects of flavonoids and flavonoid-rich foods on human executive function and episodic memory and how such effects may be underpinned by alterations in peripheral and cerebrovascular blood flow. He also described how these vascular effects could trigger the activation of critical protein and lipid kinase signalling pathways in the brain, thereby suppressing neuroinflammation and promoting synaptic plasticity. He concluded by asserting that consumption of food rich in flavonoids across the lifespan holds the potential to limit neurodegeneration and may prevent, or possibly reverse, age-related cognitive decline.

The final talk of the session by Dr Elizabeth Schneider (APC Microbiome Ireland) centred around the gut-brain axis, a bidirectional communication network that links the enteric and central nervous systems. She outlined how the gut microbiota, the diverse microbial community (bacteria, viruses, fungi, protozoa and archaea) that colonises the host's gastrointestinal tract, profoundly impacts the gut-brain relationship. Dr Schneider presented emerging evidence that gut-microbiota-targeted dietary modulation has a modulatory effect on the interactions between the gut and the brain, with important implications for mood, cognition and mental health. She concluded that further investigation is required to evaluate whether the diet-microbiota-gut brain axis could be applicable to neurological disorders or diseases, including Alzheimer's disease, Parkinson's disease, epilepsy and autism spectrum disorder.

Symposium 4: lifestyle strategies for prevention and management of multimorbidity

The fourth and final symposium addressed diet and lifestyle factors for prevention and management of multimorbidity. In the opening talk, Dr Rebecca Stratton (University of Southampton, UK) presented on 'Managing malnutrition and multimorbidity in primary care: dietary approaches to reduce treatment burden' and discussed the challenge of malnutrition in those with multimorbidity[13]. In the context of multimorbidity, Dr Stratton emphasised the importance of personalised dietary approaches and nutritional support to enhance compliance and improve functional and clinical outcomes. She highlighted the requirement for additional evidence to strengthen guidelines concerning nutritional management of multimorbidity, particularly within community settings. She concluded by stressing the importance of empowering patients, as well as their caregivers, to be actively involved in their own nutritional care.

Subsequently, Dr Heinz Freisling (International Agency for Research on Cancer, France) considered 'Lifestyle factors and risk of multimorbidity of cancer and cardiometabolic diseases'. During his presentation, Dr Freisling showcased multinational data from The European Prospective Investigation into Cancer and Nutrition

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(EPIC) cohort study, indicating that pre-diagnostic healthy lifestyle behaviours (namely body mass index, smoking status, alcohol intake, physical activity and adherence to an MDP) were strongly inversely associated with incident multimorbidity of cancer and cardiometabolic diseases[14]. Moreover, each additional health behaviour, as assessed by a healthy lifestyle index, was associated with further reduction in these risks[14]. In his concluding remarks, Dr Freisling pointed out that these findings can expand the scope of public health recommendations encompassing patients affected by chronic conditions and could inform the development of integrated lifestyle interventions to prevent multimorbidity.

The concluding symposium talk, delivered by Professor Lorraine Brennan (University College Dublin, Ireland), summarised advancements in precision nutrition and outlined how the use of omics technologies can support our understanding of variability in response to diet and enable prediction of these responses. Professor Brennan described the concept of metabotyping, which entails tailoring diets for groups of individuals according to their metabolic phenotypes[15], and presented evidence which suggests that metabotyping could help to deliver precision nutrition at a group level. She recommended that future work is needed to understand the mechanistic basis of metabotypes and to demonstrate the utility of metabotype-based nutritional advice approach in larger population groups.

Plenary lecture 2: addressing the key dietary risk factors and policies in multimorbidity prevention

The scientific programme culminated with a plenary by Dr Adrienne Cullum (Head of Nutrition Science for The Office for Health Improvement and Disparities, UK) which addressed the key dietary risk factors and policies in multimorbidity prevention. Dr Cullum presented UK data which illustrated that a large proportion of 16–24-year-olds are living with at least one long-term condition[16] and stressed the importance of taking a lifecourse approach to multimorbidity prevention. She described the Department of Health and Social Care's intention to release a Major Conditions Strategy[17]. This strategic framework recognises the importance of addressing the issue of multimorbidity and will focus effort on key lifestyle drivers of ill health and disease, including obesity and dietary factors[17]. Dr Cullum highlighted that we are living in an obesogenic food environment that promotes excess energy intake, adiposity and multimorbidity, and stressed the need for policies to adapt to address this challenge.

Conclusions

Over the course of this two-day conference on 'Diet and Multimorbidity', we considered various perspectives surrounding one of the most significant public health challenges of our time. To address the escalating socio-economic challenges posed by multimorbidity, it is essential to foster synergistic, multidisciplinary collaborations that encourage new perspectives on this complex issue. The importance of adopting a lifecourse approach to healthy ageing and multimorbidity was highlighted. In his opening address, Professor Naveed Sattar presented convincing evidence that treating chronic diseases without tackling excess adiposity promotes multimorbidity[9], yet highlighted that obesity currently belongs to no clinician and is undertreated. Tackling obesity and key lifestyle drivers, including poor diet and physical inactivity, could serve as a significant focus for preventing prevalent patterns of multimorbidity. In agreement with recommendations outlined in The Academy of Medical Sciences policy report[2], it was acknowledged that further evidence is required to better understand multimorbidity from a broad spectrum of viewpoints extending from biological mechanisms to the complexities of how to structure healthcare systems to provide personalised integrated care for multimorbid patients.

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Competing interests

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