

Position paper on essential strategies for healthy aging: focus on preventing sarcopenia and cardiovascular diseases from the 38th National Congress of the Italian Society of Geriatrics Hospital and Territory (SIGOT)

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Abstract

Italy's demographic setting is rapidly evolving and is characterized by a substantial increase in the older population segment. This trend, driven by prolonged life expectancy and declining birth rates, positions Italy as a leader in global aging patterns. The 38th National Congress of the *Società Italiana di Geriatria Ospedale e Territorio* (SIGOT), held in Rome, underlined the importance of addressing the health needs of this aging population, particularly focusing on preventing sarcopenia and cardiovascular diseases. Recent data challenge the notion of functional decline as an inevitable consequence of aging, highlighting the interplay of genetic, environmental, and lifestyle factors in modulating health outcomes. Sarcopenia, a prevalent condition and biological substrate of frailty, significantly impacts physical function and mortality rates, necessitating behavioral interventions to mitigate its effects. Physical exercise emerges as a key strategy for maintaining cardiovascular health and reducing the risk of arrhythmias, prevalent in older age groups. However, the complex relationship between physical activity intensity, age, and cardiovascular risk underlines the importance of tailored interventions and preliminary screenings. Looking ahead, proactive measures such as enhanced screening, promoting lifelong healthy habits, research and innovation, robust community support systems, and adaptable policies are essential to address the multifaceted challenges posed by an aging population. With this consensus paper, we aimed to summarize the key messages from the three intensive days of the SIGOT National Congress.

Introduction

Italy has one of the oldest populations in the world, characterized by a significant proportion of older people relative to the overall population. According to demographic data, the country has experienced a substantial increase in the number of residents aged 65 and over, driven by high life expectancy and declining birth rates.¹ This demographic trend places Italy at the forefront of global aging patterns, with the older population expected to continue growing in the coming decades. By 2050, projections suggest that individuals over 65 years old will outnumber those under 15 by a ratio of three to one. This has resulted in an increase in the number of years lived with disabilities and chronic diseases,² among which sarcopenia and cardiovascular diseases (CVDs), the main topics of the conference, have a significant functional impact. Older adults often face a multitude of health issues, medications, impairments, social difficulties, and financial burdens, which result in intricate medical situations that are challenging to manage. This aging population presents unique challenges and opportunities for public health, social services, and economic policies, necessitating targeted strategies to ensure the well-being and active participation of older adults in society.^{3,4} Therefore, the goal of modern geriatrics is to implement measures and skills to minimize the years lived with disability and chronic conditions while promoting successful and healthy aging. This involves adopting comprehensive strategies that focus on prevention, early intervention, and the management of chronic diseases. By doing so, geriatric medicine aims to enhance the quality of life for older adults, enabling them to maintain independence and well-being for as long as possible.⁵ This message emerged from the 38th National Congress of the *Società Italiana di Geriatria Ospedale e Territorio* (SIGOT), held from May 22 to 24, 2024, in Rome. In this article, we aim to summarize the key messages from these intensive days of the Congress.

Functional decline is not an inevitable path

According to ISTAT, between 2004 and 2024, the number of residents in Italy aged 65 and over increased by over 3 million, reaching 14.358 million.⁶⁻⁸ Remarkably, more than half of these individuals are at least 75 years old, underscoring the significant aging within this demographic. This increase is closely tied to a substantial reduction in mortality rates, with 661,000 fewer deaths recorded, which has contributed to a life expectancy at birth of 83.1 years.^{6,7} The trend of an aging population is projected to intensify over the next two decades. By 2050, it is anticipated that the number of people over 65 years old will triple compared to those under 15.⁶ This demographic shift will result in a societal structure where older people significantly outnumber the younger population, posing both challenges and opportunities for healthcare, social services, and economic systems. In this context, recent data support the concept that functional decline is not an inevitable path for everyone but is influenced by three main factors: genetic heritage, the environment we live in, and lifestyle choices, which include behaviors throughout life, including in old age.^{9,10} Genetics plays a crucial role in determining an individual's baseline health and susceptibility to various conditions.⁹ The environment, including factors such as access to healthcare, socio-economic status, and community support, significantly impacts one's ability to maintain functional independence. Lifestyle, which includes diet, physical activity, and engagement in cognitively stimulating activities, is particularly critical.¹¹ In this context, a balanced diet rich in nutrients supports overall health and can prevent or delay the onset of age-related diseases.¹¹⁻¹³ Regular physical activity is essential for

maintaining muscle mass, strength, and cardiovascular health, directly counteracting the effects of sarcopenia and CVDs.¹⁴ Engaging in social and cognitive activities helps preserve mental health and cognitive function, further contributing to overall well-being. Furthermore, interventions aimed at modifying lifestyle factors have shown promising results in delaying or mitigating functional decline.¹⁰ These interventions include tailored exercise programs, nutritional support, and community-based support systems designed to encourage healthy behaviors. By addressing these factors holistically, it is possible to enhance the quality of life for older adults and promote healthy aging, thus demonstrating that functional decline can often be prevented or significantly delayed.

Physical activity and cardiovascular screening: essentials for healthy aging

Among the significant challenges to achieving healthy aging, sarcopenia and CVDs stand out prominently. Sarcopenia, characterized by the progressive loss of muscle mass, strength, and function, has a significant impact on people.¹⁵ Different definitions of sarcopenia generally emphasize aspects such as decreased muscle mass, reduced strength, and functional deterioration. A more recent definition describes sarcopenia as “a progressive and generalized skeletal muscle disorder that is associated with increased likelihood of adverse outcomes including falls, fractures, physical disability, and mortality”.¹⁵ Commonly assessed parameters in these definitions include appendicular lean soft tissue mass (muscle mass), grip strength, and gait speed. Despite this, there is still no consensus on the operational definitions and diagnostic criteria for this condition. As a result, sarcopenia is often excluded from clinical trials to reduce variability and ensure specific efficacy.¹⁶ Most healthcare professionals do not routinely assess the strength or functional capacity of older patients. A simplified definition of sarcopenia could greatly enhance its clinical utility. Thus, recently, Evans *et al.* suggested defining sarcopenia simply as low muscle mass, aligning with the term's literal meaning of “lack of flesh”.¹⁷ Defining sarcopenia in terms of low percentage muscle mass would allow healthcare professionals to identify patients at risk for age-related syndromes linked to low muscle mass and create therapies aimed at maintaining or improving skeletal muscle mass. However, such a decline in muscle health not only increases the risk of physical disability, falls, fractures, and poor quality of life but also complicates health outcomes and elevates mortality rates. According to the World Health Organization, sarcopenia ranks among the primary contributors to the loss of independence in older adults and serves as a significant precursor to various other age-related diseases. Extensive research underlines the prevalence of sarcopenia in old age, with its impact varying across different settings: affecting 5-10% in community settings, 15-30% in long-term care facilities, and 20-25% in hospital environments.^{15,16} The implications for quality of life are significant, with sarcopenic individuals exhibiting a substantially higher mortality rate compared to their non-sarcopenic counterparts, boasting a combined odds ratio of 3.596.¹⁸ Addressing sarcopenia and enhancing the quality of life necessitates multimodal approaches, with behavioral interventions emerging as effective strategies. Literature suggests that even modest interventions, such as incorporating a daily 25-minute walk, can yield tangible improvements in muscle health, particularly during acute hospital stays.¹⁹ By promoting physical activity and adopting lifestyle modifications tailored to individual needs, it is possible to mitigate the progression of sarcopenia and promote overall well-being in aging populations. Interestingly, physical exercise represents a valuable tool in maintaining a regular heart

rhythm, a critical aspect of cardiovascular health, especially as the population ages.²⁰ The aging demographic is associated with a surge in the prevalence and incidence of CVDs, highlighting the significance of interventions like exercise in managing and preventing such conditions. For instance, the prevalence of atrial fibrillation (AF), a common heart rhythm disorder, has doubled within the general population over the past two decades, escalating from just under 1% to nearly 2%.²¹ Projections suggest that this trend will persist, with another doubling anticipated by 2050. Notably, AF currently afflicts over 10% of individuals aged 75 and above, highlighting the pressing need for interventions to mitigate its impact.²¹ AF is the most prevalent serious cardiac arrhythmia in Western nations. It occurs when irregular electrical signals begin firing in the atria, disrupting the heart's natural pacemaker and leading to a loss of rhythm control. This results in irregular and frequently rapid contractions of the atrial cardiomyocytes. Symptoms of AF include an irregular heartbeat, palpitations, dizziness, shortness of breath, and fatigue.²² This condition leads to inefficient blood pumping and compensatory mechanisms, such as increased sympathetic activity, which can further exacerbate the problem. AF can be classified based on its duration: paroxysmal (short episodes), persistent (lasting over 7 days and requiring intervention), and permanent (continuous and resistant to treatment). The longer AF persists, the more likely it is to cause structural heart changes, increasing the risk of stroke, heart failure, and other cardiovascular complications. Moreover, co-morbid conditions like hypertension, diabetes, heart disease, obesity, sleep apnea, and thyroid disorders significantly impact AF management and outcomes, necessitating a holistic treatment approach that addresses both the arrhythmia and these associated conditions to improve patient health and quality of life.²² Older adults also face an increased risk of sudden cardiac death attributed to ventricular arrhythmias, a risk that escalates until the age of 80 before stabilizing.^{23,24} This underlines the importance of proactive measures to maintain heart health and prevent potentially life-threatening arrhythmias in aging populations. Collectively, given these trends, promoting physical activity emerges as a crucial strategy for preserving cardiovascular function and reducing the risk of arrhythmias among older adults. Regular exercise not only enhances heart health and circulation but also helps manage risk factors such as hypertension, obesity, and diabetes, all of which contribute to CVDs. Thus, by integrating exercise into their daily routines, individuals can increase their cardiovascular resilience and enhance their overall well-being, mitigating the impact of age-related cardiovascular conditions, which include arrhythmias and cardiac mortality.²⁵

The complex interplay between arrhythmias and mortality is further complicated by comorbidities such as sarcopenia, a condition characterized by deterioration of muscle mass and metabolic function. By altering muscle fibers and impairing metabolic quality, sarcopenia contributes to an elevated risk of adverse cardiovascular events, underscoring the multifaceted nature of maintaining a healthy lifestyle.^{26,27} Again, emphasizing lifestyle modifications in the context of arrhythmias can significantly reduce the risk of death, with studies suggesting a potential risk reduction of 20-35%. However, it is critical and imperative to recognize that the benefits of physical activity are complex, with the intensity and duration of exercise exerting differential effects on health outcomes.²⁵ While moderate exercise confers numerous health benefits, including cardiovascular protection, vigorous physical activity may reduce these benefits. Interestingly, age plays a pivotal role in the relationship between physical activity and cardiovascular risk. For younger individuals, engaging in vigorous exercise elevates the risk of sudden death from CVDs by 2.5 times.²⁸ Conversely, in older adults, this risk increases substantially to five times, high-

lighting the need for caution when initiating exercise regimens in this population. Moreover, intense physical activity in older adults unfamiliar with exercise can precipitate acute coronary syndrome and sudden death, amplifying the importance of prudent screening measures before starting exercise programs.²⁹ By conducting preliminary cardiovascular screenings, healthcare providers can identify underlying risk factors and tailor exercise prescriptions to maximize the positive effects of physical activity while minimizing potential risks, thereby promoting safe and effective participation in exercise for individuals of all ages.

Most validated strategies to prevent sarcopenia and cardiovascular diseases

Sarcopenia and CVDs share common risk factors such as poor diet, physical inactivity, and aging.³⁰ Prevention strategies for both conditions can significantly improve overall health and quality of life, especially among older adults. Protein is essential for maintaining muscle mass. Older adults often consume less protein than needed, exacerbating muscle loss. Recommendations suggest at least 1.0-1.2 g of protein per kg of body weight per day for healthy older adults and 1.2-1.5 g for those who are malnourished or at risk of malnutrition.³¹ High-quality protein sources include lean meats, dairy products, eggs, legumes, and nuts. Ensuring an even distribution of protein intake across meals can maximize muscle protein synthesis. Alongside protein, a balanced intake of carbohydrates and fats is crucial.^{30,32,33} Healthy fats, such as those from fish, avocados, and nuts, support cardiovascular health, while complex carbohydrates from whole grains, fruits, and vegetables provide sustained energy. Avoiding an excessive intake of refined sugars and trans fats can reduce the risk of both sarcopenia and CVD.³³ Vitamins and minerals like vitamin D, calcium, and magnesium are important for muscle function and bone health. Deficiencies can exacerbate sarcopenia and increase the risk of CVDs. Foods rich in these nutrients include dairy products, leafy greens, and fortified foods.³³

Resistance exercises, such as weightlifting, bodyweight exercises, and resistance band workouts, are effective in building and maintaining muscle mass.³⁴ The aim should be 2-3 sessions per week, focusing on major muscle groups. Gradually increasing intensity and load can help sustain muscle growth and strength. Cardiovascular exercises like walking, cycling, swimming, and running improve heart health and endurance. Aim for at least 150 minutes of moderate-intensity aerobic exercise per week or 75 minutes of vigorous-intensity exercise. Integrating both resistance and aerobic exercises provides comprehensive benefits. For instance, a program combining strength training with walking or cycling can enhance both muscle health and cardiovascular fitness.^{34,35} Simple daily activities, such as brisk walking, gardening, and climbing stairs, can also contribute to overall physical activity levels. Maintaining a healthy weight through a balanced diet and regular exercise reduces the risk of sarcopenia and CVD.³⁶ Avoiding extreme diets and focusing on gradual, sustainable weight loss is beneficial. Smoking and excessive alcohol consumption are major risks for both sarcopenia and CVDs. Quitting smoking and limiting alcohol intake can significantly improve health outcomes. Chronic stress can negatively impact both muscle and heart health. Practices like mindfulness, meditation, and yoga can help manage stress levels.^{36,37} Regular check-ups with healthcare providers can help monitor risk factors for sarcopenia and CVD, such as blood pressure, cholesterol levels, and blood glucose levels. Early detection and management of conditions like hypertension, diabetes, and high cholesterol can prevent complications.³⁷

Conclusions and future perspectives

Aging is multifaceted and encompasses many manifestations, meaning that despite any progress, gaps will remain between aging-related diseases and optimal health in old age. Geroscience conceives of moving toward a systems-level approach that slows the aging process.³⁸ Some systemic interventions exist, such as contrasting the shared and modifiable risks of physical inactivity and poor diet.³⁹ Why have we failed thus far to engage populations in adopting a healthy lifestyle? The gaps between healthy aging and the diseases of old age reflect critical conceptual and operational challenges in continuing to address age-related impairments in health. We need a unit measure that is indifferent to which aging mechanism is targeted. The potential to detect the broad effects of existing and future interventions stems from the necessity for integrative measures of age-related health. Frailty, a measure of change in risk, is a widely used and theoretically grounded means of quantifying health in old age. It serves as a system-level measure, a potential “translational measure” that can be applied across levels, from molecular and cellular measures to whole organisms, and can also be used indifferently for animals and humans.⁴⁰ Despite the low certainty of evidence in any setting, several strategies for the management of frailty have shown promise, offering a glimmer of hope for the future. Why do we observe such inconsistent results? Heterogeneous populations are considered as (pre)frail older people as a broad spectrum of frailty screening tools used in research and clinical practice; secondly, the following questions arise: “what is the optimal moment to tackle frailty by an intervention (preventive or in early pre-frailty stage)?”. In this respect, frailty measures rely on disease burden, impairments, and functional limitations. Although these are powerful biomarkers of health and prognosis in older people, such composite scores are much less informative in younger individuals with no clinical evidence of disease due to effective resilience mechanisms that mask the existence and effects of pathology. Some recent evidence provides longitudinal aging metrics to measure accelerated aging and prevention interventions should be proposed early to be beneficial. A robust measure that defines the rate of phenotypic aging independent of

chronological age would serve as a valuable benchmark to identify the intrinsic mechanisms of biological aging. This measure could include scores, biomarkers, and other indicators. In the absence of suitable treatments for age-related dysfunction, exercise is currently the only intervention that has shown remarkable efficacy in reducing the incidence of age-related disease,⁴¹ improving the quality of life,⁴² and even increasing mean and maximum lifespan in humans.⁴³ We must learn to tailor physical exercise based on the individual’s functional level, focusing on strength, balance, and cardio fitness. The objective is to preserve a function that maintains the highest degree of autonomy possible in each case. The health of older people should be measured in terms of its function and not as a disease.

The 38th National Congress of SIGOT, held in Rome, focused on preventing sarcopenia and CVDs through a multifaceted approach that includes a balanced diet, regular physical activity, and healthy lifestyle choices. By addressing these factors, older adults can improve their muscle and cardiovascular health, enhancing their overall well-being and reducing the risk of chronic diseases. Collectively, promoting healthy aging is crucial in geriatrics, as it significantly enhances the quality of life for older adults, extending their years of active and independent living. Table 1 shows our proposed decalogue for successful aging. Encouraging healthy habits such as balanced nutrition, regular exercise, and routine health screenings helps prevent and manage chronic diseases like diabetes, hypertension, and heart disease, thus reducing the burden of illness. These practices contribute to increased longevity, allowing older adults to live more productive lives. Additionally, activities that stimulate the brain, such as reading and social interactions, can delay or prevent cognitive decline, including dementia and Alzheimer’s disease. By promoting health and preventing diseases, overall healthcare costs can be reduced, benefiting both individuals and healthcare systems. Healthy aging supports older adults in maintaining independence, reducing the need for long-term care, and enabling them to stay in their homes longer (the aging in place). Furthermore, promoting social connections and mental health care helps prevent loneliness, depression, and anxiety, contributing to a sense of purpose and community. Regular physical activity maintains muscle strength, balance, and flexibility, which are essential for

Table 1. Decalogue for successful aging: the ten “S”. By integrating these ten strategies into daily life, older adults can enhance their physical and mental health, promoting a more independent aging process.

	Description
Stay active	Engage in regular physical activity, such as walking, swimming, or exercising, to improve mobility and cardiovascular health.
Sufficient nutrition	Follow a diet rich in fruits, vegetables, lean proteins, and whole grains. Avoid processed foods, sugars, and saturated fats.
Schedule screening and monitoring	Schedule regular medical visits and preventive screenings to detect any potential conditions early.
Safety measures	Implement safety measures at home and in daily activities to prevent falls and injuries. This includes using assistive devices if needed and ensuring living spaces are well-lit and free of hazards.
Sleep well	Ensure adequate and restorative sleep, aiming for 7 to 9 hours per night.
Smart hydration	Drink water regularly to maintain hydration balance and proper bodily functions.
Substance moderation	Avoid smoking and limit alcohol consumption to reduce the risk of respiratory diseases, cardiovascular issues, and other health problems.
Stimulate cognition	Keep the brain active with reading, logic games, learning new skills, and participating in social activities. Foster mental well-being through meditation, yoga, and relaxation techniques.
Stress management	Practice stress management techniques to improve the quality of life and prevent mental health issues.
Social relationship	Cultivate positive relationships with friends and family, participating in groups and communities to maintain a support network and combat isolation.

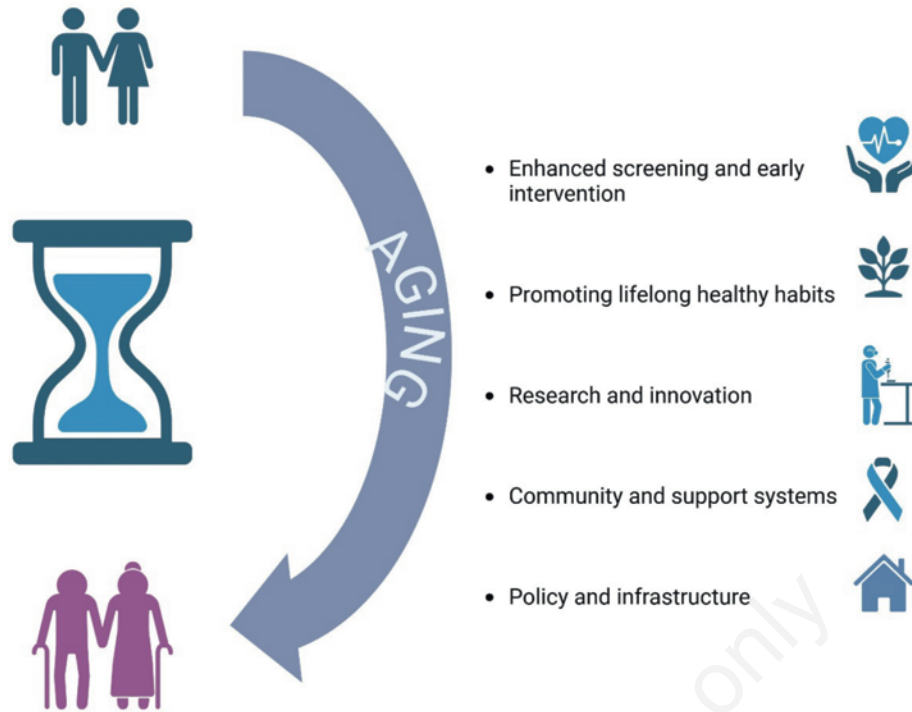


Figure 1. Potential strategies for the promotion of preventive geriatric medicine.

preventing falls and ensuring safe movement. Geriatric care that emphasizes healthy aging adopts a holistic approach, considering physical, mental, and social aspects of health and empowering older adults through education to make proactive and informed decisions about their well-being. In summary, promoting healthy aging in geriatrics is fundamental for enhancing the overall health and well-being of older adults, ensuring they can enjoy their later years with vitality and independence. In conclusion, Figure 1 shows the potential and suggested strategies for the promotion of preventive geriatric medicine. Firstly, “enhanced screening and early intervention”: future strategies should focus on enhanced screening and early intervention programs to identify at-risk individuals for sarcopenia and CVDs. Incorporating regular assessments and personalized health plans can mitigate the progression of these conditions. Secondly, “promoting lifelong healthy habits”: public health campaigns should emphasize the importance of maintaining a healthy lifestyle from an early age, including regular physical activity and a balanced diet. Education on the benefits of these habits can lead to a significant reduction in the incidence of age-related health issues. Then, “research and innovation”: investing in research to better understand the mechanisms of aging and the development of sarcopenia and CVDs is crucial. Innovative treatments and preventive measures can emerge from such research, improving the quality of life for older adults. Another strategy is “community and support systems”: developing robust community support systems that provide resources and assistance to older people can enhance their ability to live independently. This includes access to fitness programs, nutritional guidance, and social activities that promote overall well-being. Finally, “policy and infrastructure”: governments and healthcare institutions must adapt their policies and infrastructure to address the needs of an aging population. This includes funding for geriatric care, accessible healthcare facilities, and programs that support healthy aging.

References

1. De Tommaso CV. Ageing, longevity and sustainability. Available from: <https://www.secondowelfare.it/primo-welfare/aging-longevity-and-sustainability/>. Accessed on: 27/05/2024.
2. Monasta L, Abbafati C, Logroscino G, et al. Italy’s health performance, 1990-2017: findings from the Global Burden of Disease Study 2017. *Lancet Public Health* 2019;4:e645-57.
3. Gusmano MK, Okma KGH. Population aging and the sustainability of the welfare state. *Hastings Cent Rep* 2018;48:S57-S61.
4. Cristea M, Noja GG, Stefea P, Sala AL. The impact of population aging and public health support on EU labor markets. *Intl J Environ Res Public Health* 2020;17:1439.
5. Ayoubi-Mahani S, Eghbali-Babadi M, Farajzadegan Z, et al. Active aging needs from the perspectives of older adults and geriatric experts: a qualitative study. *Front Public Health* 2023;11:1121761.
6. STATISTA. Aging index in Italy from 2010 to 2024. Available from: <https://www.statista.com/statistics/657628/ageing-index-italy/>. Accessed on: 27/05/2024.
7. ISTAT. Households and population projections. Fewer residents, more elderly, smaller families. Available from: <https://www.istat.it/en/press-release/households-and-population-projections-base-112021/>.
8. ISTAT. Demographic Indicators - Year 2023. Nearly stable population thanks to immigration. Available from: <https://www.istat.it/en/press-release/demographic-indicators-year-2023/#:~:text=Nearly%20stable%20population%20thanks%20to,2022%20to%20%2B274thousand%20in%202023.>
9. The Lancet Healthy Longevity. The decade of healthy ageing: progress and challenges ahead. *Lancet Healthy Longev* 2024;5:e1.

10. Leung AYM, Molassiotis A, Carino DA. A challenge to healthy aging: limited social participation in old age. *Aging Dis* 2021; 12:1536-8.
11. Morgan PT, Witard OC, Højfeldt G, et al. Dietary protein recommendations to support healthy muscle ageing in the 21st century and beyond: considerations and future directions. *Proc Nutr Soc* 2023;11:1-14.
12. Townsend JR, Kirby TO, Marshall TM, et al. Foundational nutrition: implications for human health. *Nutrients* 2023; 15:2837.
13. Ekmekcioglu C. Nutrition and longevity – from mechanisms to uncertainties. *Crit Rev Food Sci Nutr* 2020;60:3063-82.
14. Lee DC, Lee IM. Optimum dose of resistance exercise for cardiovascular health and longevity: is more better? *Curr Cardiol Rep* 2023;25:1573-80.
15. Boccardi V. Sarcopenia: a dive into metabolism to promote a multimodal, preventive, and regenerative approach. *Mech Ageing Dev* 2024;219:111941.
16. Evans WJ, Guralnik J, Cawthon P, et al. Sarcopenia: no consensus, no diagnostic criteria, and no approved indication - how did we get here?. *Geroscience* 2024;46:183-90.
17. Evans WJ, Ferrucci L. A simplified definition of sarcopenia: muscle mass/body weight. *J Nutr Health Aging* 2024;28:100302.
18. Beaudart C, Zaaria M, Pasleau F, et al. Health outcomes of sarcopenia: a systematic review and meta-analysis. *PLoS One* 2017;12:e0169548.
19. Gallardo-Gómez D, del Pozo-Cruz J, Pedder H, et al. Optimal dose and type of physical activity to improve functional capacity and minimise adverse events in acutely hospitalised older adults: a systematic review with dose-response network meta-analysis of randomised controlled trials. *Br J Sports Med* 2023;57:1272-8.
20. Warburton DER, Nicol CW, Bredin SSD. Health benefits of physical activity: the evidence. *CMAJ* 2006;174:801-9.
21. Hindricks G, Potpara T, Dagres N, et al. 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS): The Task Force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC. *Eur Heart J* 2021;42:373-498.
22. Brundel BJM, Ai X, Hills MT, et al. Atrial fibrillation. *Nat Rev Dis Primers* 2022;8:21.
23. Curtis AB, Karki R, Hattoum A, Sharma UC. Arrhythmias in patients ≥ 80 years of age: pathophysiology, management, and outcomes. *J Am Coll Cardiol* 2018;71:2041-57.
24. Rodgers JL, Jones J, Bolleddu SI, et al. Cardiovascular risks associated with gender and aging. *J Cardiovasc Dev Dis* 2019;6:19.
25. Franklin BA, Eijsvogels TMH, Pandey A, et al. Physical activity, cardiorespiratory fitness, and cardiovascular health: a clinical practice statement of the ASPC part I: bioenergetics, contemporary physical activity recommendations, benefits, risks, extreme exercise regimens, potential maladaptations. *Am J Prev Cardiol* 2022;12:100424.
26. Bilski J, Pierzchalski P, Szczepanik M, et al. Multifactorial mechanism of sarcopenia and sarcopenic obesity. Role of physical exercise, microbiota and myokines. *Cells* 2022; 11:160.
27. Hunter GR, Singh H, Carter SJ, et al. Sarcopenia and its implications for metabolic health. *J Obes* 2019;2019:8031705.
28. Thompson PD, Franklin BA, Balady GJ, et al. Exercise and acute cardiovascular events. *Circulation* 2007;115:2358-68.
29. Izquierdo M, Merchant RA, Morley JE, et al. International exercise recommendations in older adults (ICFSR): expert consensus guidelines. *J Nutr Health Aging* 2021;25:824-53.
30. He N, Zhang Y, Zhang L, et al. Relationship between sarcopenia and cardiovascular diseases in the elderly: an overview. *Front Cardiovasc Med* 2021;8:743710.
31. ESPEN. ESPEN guidelines and consensus papers. Available from: <https://www.espen.org/guidelines-home/espen-guidelines>. Accessed on: 28/05/2024.
32. Wang M, Tan Y, Shi Y, et al. Diabetes and sarcopenic obesity: pathogenesis, diagnosis, and treatments. *Front Endocrinol (Lausanne)* 2020;11:568.
33. Schoufour JD, Tieland M, Barazzoni R, et al. The relevance of diet, physical activity, exercise, and persuasive technology in the prevention and treatment of sarcopenic obesity in older adults. *Front Nutr* 2021;8:661449.
34. Liu CJ, Latham NK. Progressive resistance strength training for improving physical function in older adults. *Cochrane Database Syst Rev* 2009;2009:CD002759.
35. Voulgaridou G, Papadopoulou SD, Spanoudaki M, et al. Increasing muscle mass in elders through diet and exercise: a literature review of recent RCTs. *Foods* 2023;12:1218.
36. Isath A, Koziol KJ, Martinez MW, et al. Exercise and cardiovascular health: a state-of-the-art review. *Prog Cardiovasc Dis* 2023;79:44-52.
37. Lv H, Zhang T, Li B, Wang R. The influence of control beliefs on the cardiovascular fitness of college students: the chain mediating effect of subjective exercise experience and exercise adherence. *BMC Public Health* 2024;24:2.
38. Kennedy BK, Berger SL, Brunet A, et al. Geroscience: linking aging to chronic disease. *Cell* 2014;159:709-13.
39. Campisi J, Kapahi P, Lithgow GJ, et al. From discoveries in ageing research to therapeutics for healthy ageing. *Nature* 2019;571:183-92.
40. Rutenberg AD, Mitnitski AB, Farrell SG, Rockwood K. Unifying aging and frailty through complex dynamical networks. *Exp Gerontol* 2018;107:126-9.
41. Duggal NA, Pollock RD, Lazarus NR, et al. Major features of immunosenescence, including reduced thymic output, are ameliorated by high levels of physical activity in adulthood. *Aging Cell* 2018;17:e12750.
42. Chakravarty EF, Hubert HB, Lingala VB, Fries JF. Reduced disability and mortality among aging runners: a 21-year longitudinal study. *Arch Intern Med* 2008;168:1638-46.
43. Lee D chul, Brellenthin AG, Thompson PD, et al. Running as a key lifestyle medicine for longevity. *Prog Cardiovasc Dis* 2017;60:45-55.