



Attributes and definitions of locomotor capacity in older people: a World Health Organisation (WHO) locomotor capacity working group meeting report

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Received: 14 January 2022 / Accepted: 18 January 2022 / Published online: 8 February 2022
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Keywords Locomotor capacity · Older people · Attributes · Conceptual definition

The United Nations (UN) has proclaimed 2021–2030 the Decade of Healthy Ageing, with the World Health Organization (WHO) leading international action to improve the lives of older people, their families, and communities. The Decade brings together a variety of stakeholders for ten years of concerted action to (a) change how we think, feel and act towards age and ageing; (b) develop communities in ways that foster the abilities of older people; (c) deliver person-centred, integrated care and primary health services that are responsive to older people; and (d) provide older people access to long-term care when they need it [1, 2].

Healthy ageing [3] is defined by the World Health Organization (WHO) as “the process of developing and maintaining the functional ability that enables wellbeing in older age” [4, 5]. Functional ability comprises the health-related attributes that enable people to be and to do what they have reason to value. It is made up of the intrinsic capacity of the individual, relevant environmental characteristics, and the interactions between the individual and these characteristics. Intrinsic capacity is the composite of all the physical and mental capacities of an individual. To assess the impact of its actions at the national, regional, and global levels, the WHO proposed intrinsic capacity and functional ability as outcome indicators of healthy ageing. WHO’s integrated care for older people (ICOPE) framework suggests locomotor capacity as one of the domains of intrinsic physical capacity [6].

Locomotor capacity is broadly described as a person’s bodily capacity or physical capacity to move from one place to another [2, 7]. Four main characteristics proposed

Nicola Veronese and Germain Honvo are Joint first authorship.

Jean-Yves Reginster and Anshu Banerjee are Joint last authorship.

The name of the members of the WHO Collaborating Center Working Group on locomotor capacity is mentioned in the Acknowledgements section.

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in a recent publication include a function of joints, bones, reflexes and muscle strength [2]. Other attributes (such as balance, endurance, muscle power) of the musculoskeletal system are also crucial in assessing locomotor capacity in older persons. While there is some clarity on the structure of intrinsic capacity and its subdomains, clear and consensual conceptual and operational definitions of locomotor capacity are still lacking.

To close these gaps, the WHO Collaborating Center for Public Health Aspects of Musculoskeletal Health and Aging (Liège, Belgium), in collaboration with the WHO Ageing and Health Unit, held a virtual Working Group meeting (see Supplementary Material for the participants), convening experts from around the world, to discuss the conceptual and operational definitions of locomotor capacity. The purpose of this Working Group was to provide WHO with clear conceptual and operational definitions of locomotor capacity, to enable the monitoring and evaluation of the impact of public health actions taken at the national, regional, and global levels to improve the lives of older people, their families, and communities, within the framework of the UN's Decade of Healthy Ageing initiative.

Briefly, the most important points discussed by the experts during this initial Working Group were:

- **Potential issues:** locomotor capacity is often described as a person's bodily capacity or physical capacity to move from one place to another. Although this implies the evaluation of mechanisms involved in the movement, there are three main issues with the current description discussed in the meeting: (a) movement of a person from one location to another would imply moving inside the home and from home to different locations in the community (e.g. park); this overlaps with the ability to be mobile, which is the domain of functional ability, (b) the description does not specify all the necessary attributes that should be considered for measurement, and (c) it did not clearly state whether it is a function of the body or a function of a person in the environment as the term bodily capacity was not clearly described.
- **Mobility vs locomotor capacity:** differently, mobility is a domain of functional ability that captures how a potential (locomotor capacity) is actualized in real life when interacting with the environment. Locomotor capacity is a domain of intrinsic capacity and mainly relates to the individual's body function, whereas mobility reflects the interaction between an individual and his environment.
- **Defining mobility:** it is essential to define mobility better before defining the concept of locomotor capacity. Both concepts have some aspects in common. For instance, in some WHO documents, gait speed is a measure of locomotor capacity, but, for example, asking older persons whether they can walk 100 m is considered a measure

of mobility. The WHO representatives emphasize that another Working group on mobility is currently working on the conceptual and operational definitions of the ability to be mobile.

- **Attributes of locomotor capacity:** experts agreed that locomotor capacity could be defined using at least the following attributes: endurance, balance, muscle strength, muscle function, muscle power and joint function of the body.
- **Assessment of locomotor capacity:** experts suggested that the term 'capacity' refers to the highest possible level of functioning in a given domain at a given moment in time. Consequently, an assessment tool would require a test that puts the particular locomotor aspect under stress. In this regard, some discussion emerged regarding whether locomotor capacity could be captured by performance-based tests or reported directly by older people.

In conclusion, based on the discussion above, the Working Group proposed a conceptual working definition that defines *locomotor capacity* as "a state (static or dynamic over time) of the musculoskeletal system that encompasses endurance, balance, muscle strength, muscle function, muscle power and a joint function of the body". A systematic review of measures of locomotor capacity will be undertaken in the coming months to develop operational definitions for monitoring and evaluation of public health actions focusing on older persons. Further meetings and works are planned to elaborate the operational definition of locomotor capacity.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s40520-022-02080-5>.

Acknowledgements The members of the WHO Collaborating Center Working Group on Locomotor Capacity Al-Daghri Nasser, College of Science and Chair for Biomarkers of Chronic Diseases, King Saud University, Riyadh, Saudi Arabia. Andrieu Sandrine, Clinical epidemiology and public health department, Gerontopôle, Toulouse University Hospital, France. Annweiler Cédric, Department of Geriatric Medicine, University of Angers, France. Aubertin-Leheudre Mylène, Exercise sciences department, Université du Québec à Montréal (UQAM), Canada. Bautmans Ivan, Gerontology and Frailty in Ageing research departments, Vrije Universiteit Brussel (VUB), Belgium. Beaudart Charlotte, Department of Health Services Research, Maastricht University, Maastricht, The Netherlands; WHO Collaborating Center for Public Health Aspects of Musculoskeletal Health and Ageing, University of Liège, Belgium. Becker Clemens, Digital Geriatric Medicine, University of Heidelberg, Germany. Bruyère Olivier, WHO Collaborating Center for Public Health Aspects of Musculoskeletal Health and Ageing, University of Liège, Belgium. Buckinx Fanny, WHO Collaborating Center for Public Health Aspects of Musculoskeletal Health and Ageing, University of Liège, Belgium. Campusano Claudia, Universidad de los Andes, Chile. Cesari Matteo, Geriatric Fellowship Program, University of Milan, Italy. Chandran Manju, Osteoporosis and Bone Metabolism Unit, Singapore General Hospital, Singapore. Cherubini Antonio, Geriatria, Accettazione geriatrica e Centro di ricerca per l'invecchiamento, IRCCS INRCA, Ancona, Italy. Clark Patricia, Clinical Epidemiology

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Declarations

Conflict of interest None declared.

Statement of human and animal rights This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study, formal consent is not required

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References

1. Decade of Healthy Ageing (2021) What is the UN Decade of Healthy Ageing? <https://www.decadeofhealthyageing.org/about/about-us/what-is-the-decade>. Accessed 7 Dec 2021
2. World Health Organization (2020) Decade of healthy ageing: Baseline report. World Health Organization, Geneva
3. Woolford SJ, Sohan O, Dennison EM et al (2020) Approaches to the diagnosis and prevention of frailty. *Aging Clin Exp Res* 32:1629–1637
4. World Health Organization (2015) World report on ageing and health. World Health Organization, Geneva
5. Monaco A, Palmer K, Marengoni A et al (2020) Integrated care for the management of ageing-related non-communicable diseases: current gaps and future directions. *Aging Clin Exp Res* 32:1353–1358
6. Cesari M, De Carvalho IA, Thiagarajan JA et al (2018) Evidence for the domains supporting the construct of intrinsic capacity. *J Gerontol Ser A Biol Sci Med Sci* 73:1653–1660
7. World Health Organization (WHO) (2019) Integrated care for older people (ICOPE): guidance for person-centred assessment and pathways in primary care. World Heal Organ Licence: CC BY-NC-SA 3.0 IGO

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