Archives of Gerontology and Geriatrics 100 (2022) 104625

Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

Early identification of older individuals at risk of mobility decline with machine learning

Carla Ferreira do Nascimento [a,*], André Filipe de Moraes Batista [a,c], Yeda Aparecida Oliveira Duarte [b], Alexandre Dias Porto Chiavegatto Filho [a]

[a] School of Public Health, University of São Paulo, São Paulo, Brazil Faculdade de Saúde Pública, Av. Dr. Arnaldo, 715, CEP: 01246904, São Paulo-SP, Brasil
[b] School of Nursing, University of São Paulo, São Paulo, Brazil Universidade de São Paulo, Escola de Enfermagem, Departamento de Enfermagem Médico-Cirúrgica. Av. Dr. Enéas de Carvalho Aguiar, 419 - 3o. andar - Sala 318, CEP: 05403000, São Paulo-SP, Brasil
[c] Insper, Instituto de Ensino e Pesquisa, Rua Quatá, 300, CEP: 04546-042, São Paulo-SP, Brasil

ARTICLE INFO

Keywords:
Prediction modeling
Disability
Functional limitation
Decision support tool

ABSTRACT

Background: : The early identification of individuals at risk of mobility decline can improve targeted strategies of prevention.
Aims: : To evaluate the predictive performance of machine learning (ML) algorithms in identifying older individuals at risk of future mobility decline.
Methods: : We used data from the SABE Study (Health, Well-being and Aging Study), a representative sample of people aged 60 years and more, living in the Municipality of São Paulo, Brazil. Mobility decline was assessed 5 years after admission in the study by self-reported difficulty to walk a block, climb steps, being able to stoop, crouch and kneel, or lifting or carrying weights greater than 5 kg. Popular machine learning algorithms were trained in 70% of the sample with 10-fold cross-validation, and predictive performance metrics were obtained from applying the trained algorithms to the other 30% (test set).
Results: : Of the 1,615 individuals, 48% developed difficulty in at least one of the four tasks, 32% in stooping, crouching and kneeling, and 30% in carrying weights. The random forest algorithm had the best predictive performance for most outcomes. The tasks that the algorithm was able to predict with better performance were crouching and kneeling (AUC-ROC: 0.81[0.76–0.85]), and lifting or carrying weights (AUC-ROC: 0.80 [0.75–0.84]). Age was the most important variable for the algorithms, followed by education and back pain, according to the SHAP (SHapley Additive exPlanations) values.
Conclusion: : Applications of ML algorithms are a promising tool to identify older patients at risk of mobility decline, with the potential of improving targeted preventive programs.

1. Introduction

The aging process increases the likelihood of developing mobility limitations, which can arise from the physiological aging of body systems and the presence of chronic diseases, which are directly affected from lifestyle and environmental characteristics (Brach, Rosano & Studenski, 2017; Rantakokko, Mänty & Rantanen, 2013). Functional mobility comprises several functions that include changing body position, carrying, moving or manipulating objects, walking, running, climbing, and even using transportation (World Health Organization (WHO), 2015). To capture these different aspects of mobility, some self-reported measures have been proposed in the literature to evaluate the impact of mobility limitation in older population, such as walking, climbing stairs, carrying weights, and stooping, crouching or kneeling (Bendayan et al., 2016; Cornman, Glei & Weinstein, 2021; Guralnik & Ferrucci, 2003; Nagi, 1976).

The early identification of individuals at risk of mobility decline could help to allocate them in targeted strategies of prevention. Some tests (Guralnik et al., 1994), scales, and simple algorithms (Gomez, Wu, Auais, Vafaei & Zunzunegui, 2017) have been used to classify older

* Corresponding author at: Department of Epidemiology, School of Public Health, University of São Paulo, Avenida Doutor Arnaldo, 715, 1° andar, CEP: 01246-904.
E-mail addresses: nascimento.cfd@gmail.com (C.F. do Nascimento), andrefmb@insper.edu.br (A.F.M. Batista), yedaenf@usp.br (Y.A.O. Duarte), alexdiasporto@usp.br (A.D.P. Chiavegatto Filho).

https://doi.org/10.1016/j.archger.2022.104625
Received 1 November 2021; Received in revised form 9 January 2022; Accepted 19 January 2022
Available online 21 January 2022