Using supervised learning machine algorithm to identify future fallers based on gait patterns: a two-year longitudinal study

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INTRODUCTION: Given the potential consequences of falls, a major challenge is to identify old people at risk to fall before the first event.

HYPOTHESIS: The use of data mining tools could allow to obtain a classification tree able to detect future fallers and based on the gait parameters recorded in challenging tasks.

METHOD:
A two-year, longitudinal, observational study has included 105 adults older than 65 years, living independently at home, without a recent fall history (<12 month) and without pain or osteoarticular, muscular, neurologic, cognitive or thymic disorder (based on CGA).

At inclusion gait parameters have been recorded in three different walking conditions:
Comfortable (CW), Fast (FW) and Dual Task (DTW), where the cognitive task is an arithmetical task.

Gait parameters have been obtained using both accelerometric and opto electronic methods:
- Gait speed (m/s), Stride length (m), stride frequency (cycle/s), stride regularity and stride symmetry (dimensionless) and Minimal Toe Clearance (MTC) which is the minimal distance between the toe and the ground during the swing phase.
- Gait parameters changes have been calculated between CW and FW or between CW and DTW as (if X = gait parameter):
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  \text{DTW cost} (\%) = \frac{\langle x \rangle_{\text{CW}} - \langle x \rangle_{\text{TOW}}}{\langle x \rangle_{\text{CW}}} \times 100
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  \text{FW improvement} (\%) = \frac{\langle x \rangle_{\text{FW}} - \langle x \rangle_{\text{CW}}}{\langle x \rangle_{\text{FW}}} \times 100
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Results:
A two-year follow-up was available for 96 participants, of whom 35 (36.5%) fell at least once.
Based on fall information from 96 volunteers, a classification tree correctly identifying 80% of future fallers based on gait patterns, gender, and stiffness, was obtained, with an accuracy of 84%, a sensitivity of 80%, a specificity of 87 %, a positive predictive value of 78%, and a negative predictive value of 88%.

Conclusion:
This original longitudinal pilot study using a supervised machine learning algorithm, shows that gait parameters and clinical data can be used to identify future fallers among older adults. Further prospective study including non-fallers old people would allow to confirm our results.

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