

# Identify future fallers based on gait symmetry dual task changes : a two-year longitudinal study



Sophie Gillain<sup>1</sup>, Mohamed Boutayamou<sup>2</sup>, Cedric Schwartz<sup>3</sup>, Nadia Dardenne<sup>3</sup>, Olivier Bruyère<sup>4</sup>, Olivier Brûls<sup>3</sup>, Jean-Louis Croisier<sup>3,5</sup>, Eric Salmon<sup>6</sup>, Jean-Yves Reginster<sup>7</sup>, Gaëtan Garraux<sup>3,6</sup>, Jean Petermans<sup>1</sup>

1. Geriatric Department, Liège University Hospital, 2. INTELISIG Laboratory, Department of Electrical Engineering and Computer Science, University of Liège, 3. Laboratory of Human Motion Analysis - LAMH, University of Liège, 4. Research Unit in Public Health, Epidemiology and Health Economics, University of Liège, 5. Science of Motricity Department, University of Liège, 6. Neurology Department and GIGA Cyclotron Research Centre, University of Liège, 7. WHO Collaborating Centre for Public Health Aspects of Musculoskeletal Health and Ageing.

## INTRODUCTION :

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

## HYPOTHESIS :

Gait parameters recorded during challenging tasks could help to detect future fallers among older adults initially not known to be at risk

## 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 walking conditions: Comfortable (CW), Fast (FW) and Dual Task (DTW), where the cognitive task is an arithmetical task

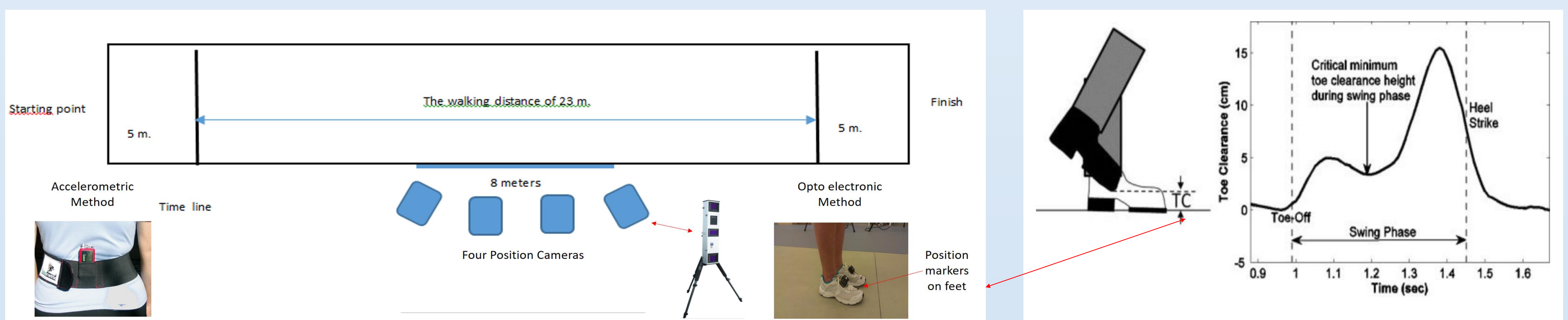
Gait parameters obtained using both accelerometric and opto electronic methods

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 calculated between CW and FW or between CW and DTW (if X = gait parameter)

$$DTW \text{ cost } (\%) = [(X)_{conf} - (x)_{td}] / (X)_{conf} \times 100$$

$$FW \text{ improvement } (\%) = [(x)_{rap} - (X)_{conf}] / (X)_{conf} \times 100$$



During the two-year follow-up, fall events were recorded using fall diaries.

## Statistical analyses:

Comparisons according to fall occurrence were performed by means of univariate analysis and multivariate binary logistic regression analysis. For independent variable significantly ( $p < 0.05$ ) associated with fall(s), a cutoff value has been calculated using the Youden method ( $= [(Se+Sp) - 1]$ )

## Results :

A two-year follow-up was available for 96 participants, of whom 35 (36.5%) fell at least once.

Comparative analysis showed that future fallers had shorter FW stride length and higher symmetry DTW cost than non-fallers ( $p < 0.05$ ).

Binary logistic regression analysis showed that each additional percent of stride symmetry cost was associated with an increase in future fall risk (odds ratio 1.018, 95 % Confidence Interval (CI) 1.002-1.033;  $p = 0.027$ ).

According the Youden method, the cutoff value of symmetry DTW cost allowing to differentiate the futures fallers is a cost between  $+\infty$  and  $-18\%$  (with Sensitivity = 83% ; Specificity = 43% and  $p$ -value = 0.0092)

Meaning the old people who were not able to increase enough symmetry in DT (more than 18%) were at risk to fall

In opposite, people able to increase their gait symmetry in dual task more than 18% have less risk to fall into the next two years.

## Conclusion :

The stride symmetry changes between CW and DTW are significantly and independently associated with future fall(s) among older adults having none known fall risk. According the results obtained in this study, old people who are not able to enough increase their symmetry in DTW compared in CW have to be considered as at risk to fall into the next two years.

## Perspective :

In order to confirm our results, the cut off value of gait symmetry would be used in a further clinical study involving non-fallers old people. The detection of people at risk to fall should be systematically followed by clinical interventions aiming to reduce the occurrence and the consequence(s) of potential fall(s).