Gait parameter based fall risk scoring

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Summary

This study explored the connection between subjective self-assessed gait insecurities and objective movement scores. 93 subjects answered detailed fall risk questionnaires and performed functional tests. Significantly different movement patterns between fallers and non-fallers were found.

Introduction

Falls are a serious public health problem and approximately 30% of adults aged 65 years and older fall each year [1], justifying public interest in prevention. Existing research has developed standardised tests for self-assessment of fall risk [2] or correlated movement tests with fall events [3]. However, to our knowledge, no study has investigated the relationship between self-assessment and motion capture recorded functional tests in a large at-risk group. The aim of this study is to investigate the connection between subjective self-reported gait insecurity and objective movement scores.

Methods

A total of 93 subjects were recruited (mean age 77±7 [range 64-94] years), 38 self-reported fallers and 55 non-fallers, 64 females and 29 males.

All participants underwent a series of established functional tests, starting with a 6-metre self-paced walk (normal and fast), followed by the 4-stage balance test, the functional forward reach test, the timed up-and-go test (TUG), the 30-s Chair Stand Test (30-s CST) and the handgrip strength test. In addition, each participant completed a medical questionnaire to assess potential fall risk factors. This questionnaire covered the use of fall-risk increasing drugs (FRIDs), the presence of neurological disorders, physical activity levels using the Global Physical Activity Questionnaire (GPAQ) [4] and sleep habits, any history of falls and associated risk factors from the Stopping Elderly Accidents, Deaths & Injuries (STEADI) toolkit [2], and pain or stiffness in lower extremity joints. All subjects took part in a 6-month telephone follow-up regarding the previously recorded fall risk factors and interim fall events.

All kinematic recordings were performed using the markerless multi-camera-based 3D motion capture system *CapturyStudio* (The Captury GmbH, GER). The test subjects wore flat shoes and tight everyday clothing to ensure uniform movement tracking.

During data preparation, the kinematic data was cycle-segmented or scored according to the standardised movement test. Normal distribution and homogeneity of variance were assessed using the Shapiro-Wilk and Levene's tests, respectively. This was followed by either an independent samples t-test, Welch's t-test or Mann-Whitney U-test ($\alpha = 0.05$). Subjects were categorised as 'fallers' and 'non-fallers' according to the number of falls in the year before and 6 months after data collection.

Results and Discussion

There were significant differences between the two fall groups for the evaluated tests, such as normalised hand strength or 30-s CST (Table 1). The same applied to gait parameters such as step length or speed (Figure 1), as well as the range of motion (RoM) of the lower limb joints during gait.

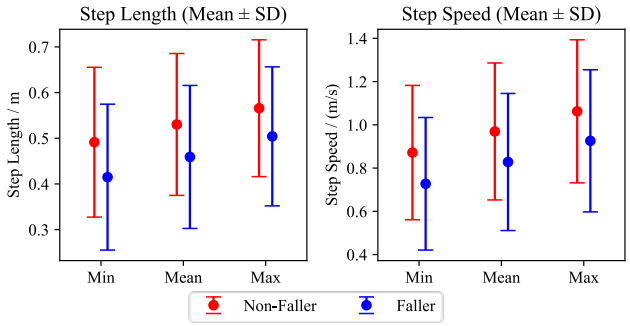

Figure 1: Exemplary results of significant gait parameters for categorisation into 'faller' and 'non-faller' groups.

These results are consistent with existing research [5]. Based on these results, further work should focus on developing a continuous fall risk score rather than the used categorisation to better incorporate less measurable factors such as subjective feeling of stability when walking.

Table 1: Exemplary parameter results. [I]Independent samples t-test.

Parameter	p-Value	Non-Faller Mean ± SD	Faller Mean ± SD
Knee Flexion RoM / °	0.007[I]	64 ± 5	61 ± 6
Hip Flexion RoM / °	0.037[I]	53 ± 7	50 ± 6
30-s CST / Repetitions	0.003[I]	12 ± 2	10 ± 2
Handstrength / %BW	0.004[I]	37 ± 11	30 ± 9

Conclusions

The combination of established self-reported tests and detailed movement analysis allows good categorisation of the falls risk of an individual and should be further investigated.

References

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