LIVEWELL HEALTH

RESEARCH ANALYSIS

Force Platform Balance Measures as Predictors of Indoor and Outdoor Falls

LIVEWELL HEALTH

Journal of Gerontology: MEDICAL SCIENCES
2008, Vol. 63A, No. 2, 171–178

Copyright 2008 by The Gerontological Society of America

Force Platform Balance Measures as Predictors of Indoor and Outdoor Falls in Community-Dwelling Women Aged 63–76 Years

Satu Pajala,[1] Pertti Era,[1,2] Markku Koskenvuo,[3] Jaakko Kaprio,[3,4]
Timo Törmäkangas,[1] and Taina Rantanen[1]

[1]Department of Health Sciences, The Finnish Centre for Interdisciplinary Gerontology, University of Jyväskylä, Finland.
[2]Finnish Brain Research and Rehabilitation Center Neuron, Kuopio, Finland.
[3]Department of Public Health, University of Helsinki, Finland.
[4]Department of Mental Health and Alcohol Research, National Public Health Institute, Helsinki, Finland.

Background. Inability to maintain balance while standing increases risk of falls in older people. The present study assessed whether center of pressure (COP) movement measured with force platform technology predicts risk for falls among older people with no manifest deficiency in standing balance.

Methods. Participants were 434 community-dwelling women, aged 63–76 years. COP was measured in six stances on a force platform. Following balance tests, participants reported their falls with 12 monthly calendars. Incidence rate ratios (IRR) with 95% confidence intervals (CI) were computed from negative binomial regression models. For the analysis, those with ≥1 fall indoors were coded "indoor fallers," those with ≥1 fall outdoors, but no indoor falls, were coded "outdoor fallers." Outcome in the models was number of falls. Analyses were repeated including only participants without fall history prior to follow-up.

Results. Among 198 fallers, there were 57 indoor and 132 outdoor fallers. The participants in the highest COP movement tertile, irrespective of the balance test, had a two- to fourfold risk for indoor falls compared to participants in the lowest COP tertile of the test. Inability to complete the tandem stance was also a significant predictor of the fall risk. The trend for increased risk for indoor falls was found also for participants in the highest COP movement tertile and without fall history. The COP movement in balance tests was not associated with outdoor falls.

Conclusion. Force platform balance tests provide valid information of postural control that can be used to predict fall risk even among older people without apparent balance problems or fall history. When the force platform is not available, tandem stance provides a screening tool to show increased fall risk in community-dwelling older people.

Key Words: Postural balance—Falls—Prospective study—Fall prediction—Balance assessment—Fall risk.

FALLS occur commonly among older people, even among those with good health who are living independently in their homes and having no apparent balance problems (1,2). It is important to identify balance problems at an early phase as the first fall can predispose older persons to more falls with possible injury and fear of falling, which further may lead to limited activity and disability. For this purpose, balance measurements sensitive enough to reveal incipient deterioration in balance control are needed.

Functional balance measures usually lack the ability to capture balance impairment at its early phase when no manifest balance problem yet exists. Thus, these tests are prone to a ceiling effect (3,4). Postural control is a product of the central nervous system, the musculoskeletal system, and the sensory system. With force platform–based measures, it is possible to obtain itemized information about integrated functioning of the balance control systems and to identify those individuals who still can successfully perform functional balance tests regardless of the incipient deficiency in balance control (5–8).

Among older people, greater center of pressure (COP) [illegible] typically used to indicate poor balance (7–9). As a recent review (5) revealed, most of the previous information comes from case–control designs. Only a few prospective studies on platform balance measures as predictors of future falls among older people exist. Only some of these existing prospective studies showed that increased COP movement correlates with fall risk (4,7,8,10–12) and, in one of them, the correlation was stronger for indoor than outdoor falls (11).

In case–control studies, a greater deterioration of balance control while dual tasking has been observed among older people with a history of falls than among nonfallers (13–15). Dual tasking refers to a situation where another task (for instance, solving an intellectual problem) is done while standing or walking. It has been suggested that deterioration in the maintenance of an upright posture in a dual-task situation indicates limited central processing capacity and/or difficulty in dividing attention between competing activities and may serve as an early sign of an increased fall risk (13–15). However, only one previous study has found that increased COP while doing a math task predicted increased [illegible]

PUTTING DATA TO THE TEST

AN ARTICLE IN THE JOURNAL OF GERONTOLOGY ANALYZED INDOOR AND OUTDOOR FALLERS UTILIZING FORCE PLATFORM MEASURES

VALD

Journal of Gerontology: MEDICAL SCIENCES
2008, Vol. 63A, No. 2, 171–178

Copyright 2008 by The Gerontological Society of America

Force Platform Balance Measures as Predictors of Indoor and Outdoor Falls in Community-Dwelling Women Aged 63–76 Years

Satu Pajala,[1] Pertti Era,[1,2] Markku Koskenvuo,[3] Jaakko Kaprio,[3,4]
Timo Törmäkangas,[1] and Taina Rantanen[1]

[1]Department of Health Sciences, The Finnish Centre for Interdisciplinary Gerontology, University of Jyväskylä, Finland.
[2]Finnish Brain Research and Rehabilitation Center Neuron, Kuopio, Finland.
[3]Department of Public Health, University of Helsinki, Finland.
[4]Department of Mental Health and Alcohol Research, National Public Health Institute, Helsinki, Finland.

Background. Inability to maintain balance while standing increases risk of falls in older people. The present study assessed whether center of pressure (COP) movement measured with force platform technology predicts risk for falls among older people with no manifest deficiency in standing balance.

Methods. Participants were 434 community-dwelling women, aged 63–76 years. COP was measured in six stances on a force platform. Following balance tests, participants reported their falls with 12 monthly calendars. Incidence rate ratios (IRR) with 95% confidence intervals (CI) were computed from negative binomial regression models. For the analysis, those with ≥1 fall indoors were coded "indoor fallers," those with ≥1 fall outdoors, but no indoor falls, were coded "outdoor fallers." Outcome in the models was number of falls. Analyses were repeated including only participants without fall history prior to follow-up.

Results. Among 198 fallers, there were 57 indoor and 132 outdoor fallers. The participants in the highest COP movement tertile, irrespective of the balance test, had a two- to fourfold risk for indoor falls compared to participants in the lowest COP tertile of the test. Inability to complete the tandem stance was also a significant predictor of the fall risk. The trend for increased risk for indoor falls was found also for participants in the highest COP movement tertile and without fall history. The COP movement in balance tests was not associated with outdoor falls.

Conclusion. Force platform balance tests provide valid information of postural control that can be used to predict fall risk even among older people without apparent balance problems or fall history. When the force platform is not available, tandem stance provides a screening tool to show increased fall risk in community-dwelling older people.

Key Words: Postural balance—Falls—Prospective study—Fall prediction—Balance assessment—Fall risk.

FALLS occur commonly among older people, even among those with good health who are living independently in their homes and having no apparent balance problems (1,2). It is important to identify balance problems at an early phase as the first fall can predispose older persons to more falls with possible injury and fear of falling, which further may lead to limited activity and disability. For this purpose, balance measurements sensitive enough to reveal incipient deterioration in balance control are needed.

Functional balance measures usually lack the ability to capture balance impairment at its early phase when no manifest balance problem yet exists. Thus, these tests are prone to a ceiling effect (3,4). Postural control is a product of the central nervous system, the musculoskeletal system, and the sensory system. With force platform–based measures, it is possible to obtain itemized information about integrated functioning of the balance control systems and to identify those individuals who still can successfully perform functional balance tests regardless of the incipient deficiency in balance control (5–8).

Among older people, greater center of pressure (COP) [illegible] typically used to indicate poor balance (7–9). As a recent review (5) revealed, most of the previous information comes from case–control designs. Only a few prospective studies on platform balance measures as predictors of future falls among older people exist. Only some of these existing prospective studies showed that increased COP movement correlates with fall risk (4,7,8,10–12) and, in one of them, the correlation was stronger for indoor than outdoor falls (11).

In case–control studies, a greater deterioration of balance control while dual tasking has been observed among older people with a history of falls than among nonfallers (13–15). Dual tasking refers to a situation where another task (for instance, solving an intellectual problem) is done while standing or walking. It has been suggested that deterioration in the maintenance of an upright posture in a dual-task situation indicates limited central processing capacity and/or difficulty in dividing attention between competing activities and may serve as an early sign of an increased fall risk (13–15). However, only one previous study has found that increased COP while doing a math task predicted increased [illegible]

PUTTING DATA TO THE TEST

THE MAIN FINDING OF THE STUDY WAS THAT INCREASED COP MOVEMENT IN FORCE PLATFORM BALANCE TESTS IDENTIFIED THOSE OLDER PEOPLE WHO SHOWED NO OBVIOUS BALANCE IMPAIRMENT BUT HAD AN INCREASED RISK FOR INDOOR FALLS REGARDLESS OF WHETHER THEY HAD A HISTORY OF RECENT FALLS

VALD

LIVEWELL HEALTH

STRATIFY LIVEWELL HEALTH DATA

- **TOTAL SIZE: 28**
- **MALE: 17 (60%)**
- **FEMALE: 11 (40%)**
- **AVERAGE AGE: 80**
- **COMMUNITY DWELLING: 5 (17%)**

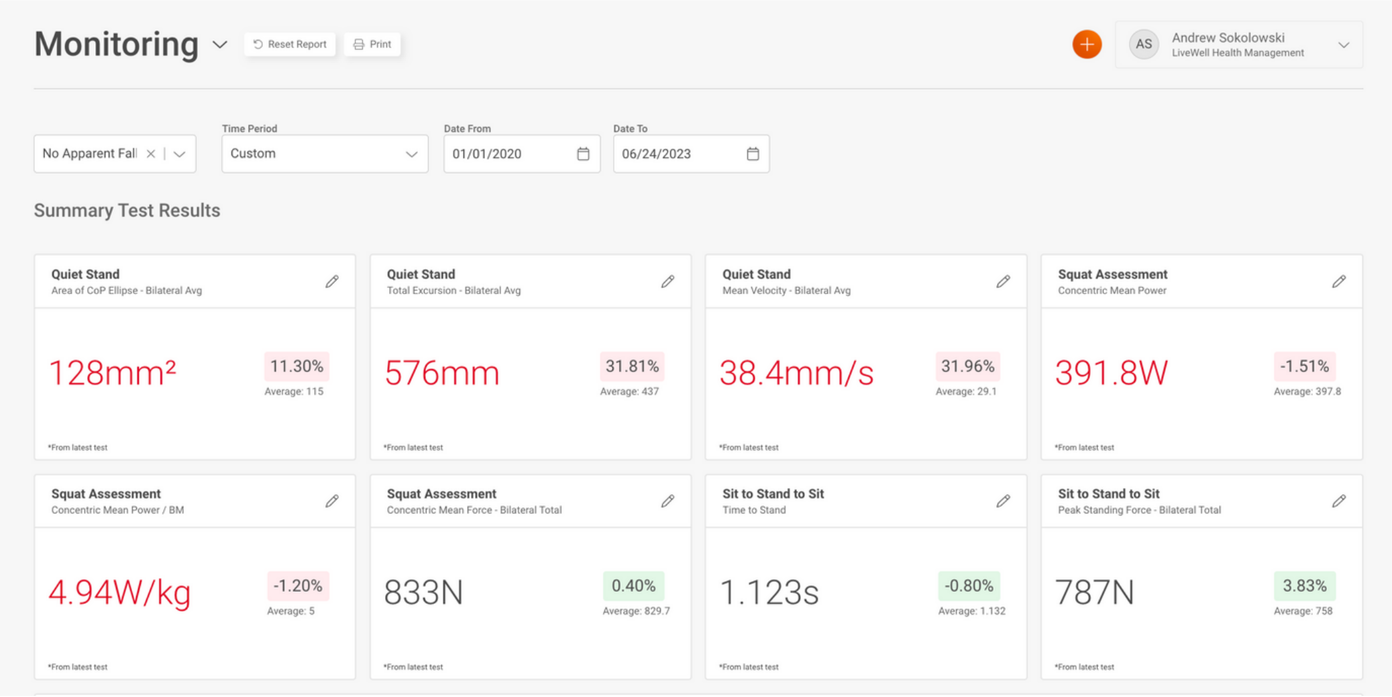
UTILIZING VALD HUB, WE SORTED OUR DATA INTO A GROUP DEEMED 'NON APPARENT FALLERS'

IN THIS CASE, THE SAMPLE SIZE IS SMALL DUE TO THE NATURE OF LIVEWELL HEALTH MEMBERS. MANY HAVE REQUESTED SERVICE DUE TO FALL RELATED ISSUES OR A DECLINE IN PHYSICAL FUNCTIONING IN WHICH FALL RISK IS APPARENT.

VALD

LIVEWELL HEALTH

THE DATA



UTILIZING THE VALD DATA WE WERE EASILY ABLE TO IDENTIFY THE AVERAGE COP VALUE AMONG NON APPARENT FALLERS

VALD

LIVEWELL HEALTH

IDENTIFYING FALLERS

- **TOTAL INDIVIDUALS WHO FELL: 7 (25%)**
- **OUTDOOR FALL: 3**
- **INDOOR FALL: 4**

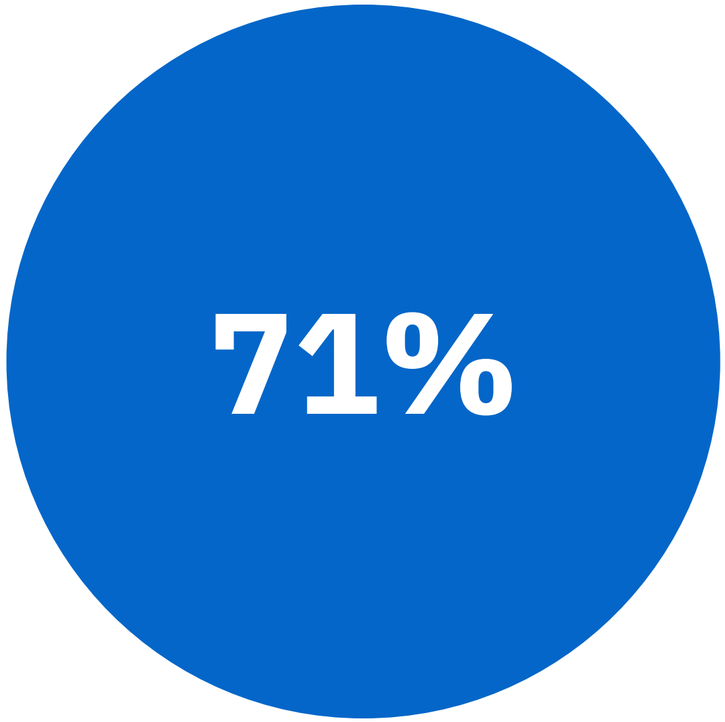
NEXT WE UTILIZED INTERNAL RECORDS TO IDENTIFY THOSE WHO HAD FALLEN IN THE LAST YEAR.

VALD

- FALLER #1
- FALLER #2 ✓
- FALLER #3 ✓
- FALLER #4 ✓
- FALLER #5
- FALLER #6 ✓
- FALLER #7 ✓

DATA SUPPORTED

NEXT, WE COMPARED THE COP MEASURE AMONG FALLERS TO THE AVERAGE AMONG THE ENTIRE GROUP. AMONG THE FALLERS, IF THEIR COP MEASURE WAS GREATER THAN THE AVERAGE, WE CONSIDERED THAT A CONFIRMATION OF DATA. A CHECK MARK NEXT TO EACH FALLER INDICATES A CONFIRMATION.

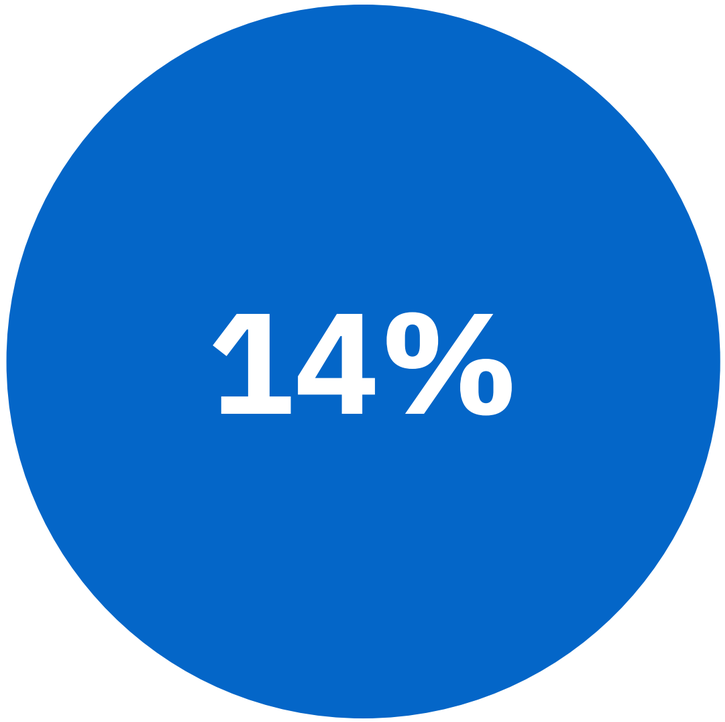


THE FALLERS

OF THE FALLERS, 5 OUT OF 7 (71%) SHOWED COP MEASURE GREATER THAN THE GROUP AVERAGE.

OF THE TWO FALLERS WHO MEASURED BETTER THAN AVERAGE BUT STILL HAD A FALL, ONE OCCURRED INDOOR WHILE THE OTHER OCCURRED OUTDOOR.

LIVEWELL HEALTH



AT RISK

UTILIZING THE DATA, WE WERE ABLE TO IDENTIFY 4 (14%) INDIVIDUALS WHO WERE AT RISK BASED ON THEIR MEASUREMENTS WHEN COMPARED BACK TO OTHER 'NON-APPARENT FALL RISK' INDIVIDUALS.

VALD

LIVEWELL HEALTH

CONCLUSIONS

- THE FINDINGS IN THE RESEARCH STUDY SEEM TO BE IN LINE WITH OUR DATA COLLECTION AT LIVEWELL HEALTH

- WE IDENTIFIED FOUR INDIVIDUALS WHO WERE AT RISK FOR A FALL WHO MAY HAVE BEEN MISSED DUE TO BEING COMPARED TO THE ENTIRE COHORT RATHER THAN THOSE WHO DID NOT HAVE AN APPARENT FALL RISK.

VALD

LIMITATIONS

- OUR SAMPLE SIZE HAD AN AVERAGE AGE GREATER THAN THE STUDY ITSELF.
- ONLY FOUR OF THE INCLUDED INDIVIDUALS WERE CONSIDERED COMMUNITY DWELLING.