



**University
of Victoria**

Graduate Studies

Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

DREW COMMANDEUR

BSc (Hons) (University of Victoria, 2013)

**“Targeted Use of Technology to Assist With Fall Risk Classification in
Older Adults”**

School of Exercise Science, Physical and Health Education

Friday, September 14th, 2018

3:00 p.m.

McKinnon Building

Room 0025

Supervisory Committee:

Dr. Mark Klimstra, School of Exercise Science, Physical and Health Education, University of Victoria
(Co-Supervisor)

Dr. Sandra Hundza, School of Exercise Science, Physical and Health Education, UVic (Co-
Supervisor)

Dr. Stuart MacDonald, Department of Psychology, UVic (Outside Member)

External Examiner:

Dr. Courtney Pollock, Department of Physiotherapy, University of British Columbia

Chair of Oral Examination:

Dr. Debra Sheets, School of Nursing, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Falling is a significant risk for older adults in Canada. Suffering a fall can result in injury and reduced quality of life which may include loss of autonomy. Additionally, injuries and rehabilitation from falls are a significant resource burden on the healthcare system. With the increasing proportion of older adults in Canada, there will be an increase in incidence of falls. Early identification of fall-risk is an essential step for the prevention of falls, and will provide the opportunity for fall-prevention interventions for at-risk older adults. This research is comprised of four projects that investigate and enhance current methods of fall risk detection which has potential to improve the quality of life of older adults.

The first study was a scoping review that identified tools for self-assessment of fall-risk. Seven distinct fall-risk self-assessments were identified; of which most were survey based. The most effective self-assessment tools were those that included physical assessments, with interactive technology-based assessments showing exceptional promise in preliminary studies. While self-assessment is an important first-line defense for fall-risk identification and monitoring, more sensitive measures that require administration by trained professionals are likely required for accurate prediction of fall risk.

The second project concurrently investigated a battery of clinical, physiological, and biomechanical assessments, to determine which measures, alone or in combination, best retrospectively classified fall risk. Ten clinical balance and mobility tests, comprising 40 unique measures, 5 physiological assessments, and 45 gait measures were included. From this extensive battery, only 5 measures were required to classify fallers with 92% sensitivity and consisted only of gait measures.

A practical clinical fall risk detection tool must be both time efficient and accurate. Thus it is essential to determine the minimum amount of reliable data that is required to maintain accuracy. To this end, based on the value of walking gait assessment for fall risk detection, it is essential to determine the minimum number of strides required to accurately classify fallers. To determine the number of strides required to identify fallers, subsets of a large sample of gait data measured with a GAITRite™ pressure sensing walkway were created and compared for internal consistency and variance between the reduced and complete data sets. For measures of mean values for dual task and difference scores of walking gait it was determined that a minimum of 10 strides are required, while for measures of variability between 30-50 strides, are required. It is encouraged to acquire as much gait data as possible, however, reasonable limits may be set to reduce the strain on older adults. This will allow for studies to include additional measures, such as clinical tests which prolong the experiment duration, to produce a clinically viable tool.

Emerging technologies allow research to remain at the cutting edge and provide opportunities to expand into new markets. The use of Microsoft Kinect V2 for measurement of walking gait will allow for long term monitoring of fall status in the homes of older adults. To this end, we developed a walking stride detection algorithm that can be utilized for measurement of gait. The proven measurement accuracy of the Microsoft Kinect depth sensing capability coupled with an accurate and reliable stride detection algorithm provides the opportunity for affordable and portable gait analysis. This algorithm can be utilized with any 3D depth sensing technology, and future investigations will assess the accuracy across devices and clinical populations.