

# CHAPTER I

## INTRODUCTION

According to the trend of world population, the proportion of elderly adults who aged over 60 years is increasing at a faster rate than any other age group, as the results of both longer life expectancy and declining fertility rates (1). Several degenerative changes occur to organs of the body, especially to the neuromuscular system leading to a decline in functional movements (2). One of the most important problems associated with aging is balance impairment (3). Controlling balance is a multifaceted skill requiring the complex integration of vision, vestibular sense, proprioception, muscle strength and reaction time (3). With increasing age, progressive loss of several body systems directly contribute to balance deficits.

It has been reported that to maintain dynamic balance, common age-related changes include reducing speed, taking shorter step and increasing double support time (4). Maintaining stability of the whole body is more challenging when confronted by varying heights of the surface of the physical environment during daily activities such as stepping up and over a door threshold, walking up stairs and stepping down off a walkway curb (5). Previous studies reported that healthy elderly adults exhibited a more conservative strategy while crossing obstacles such as shorter crossing step length, reduced crossing speed, longer pre-obstacle distance and shorter post-obstacle distance and reduced foot-obstacle clearance, which the last two variables may increase risk for tripping compared to young adults (6, 7).

Yack and Berger (8) suggested that measure of trunk acceleration could be an alternative measure of balance during walking. Trunk acceleration could be assessed

by using the tri-axial accelerometer, a device used to measure the acceleration in term of the gravity (g) in vertical, anteroposterior and mediolateral directions. In previous research related to human movement, the accelerometer has been used to quantify the body segment accelerations during activities as it has well potential for explaining the quality control of body movement. For measuring trunk acceleration, accelerometer is placed on the third lumbar vertebral (L3) which produced an acceleration profile comparable to that associated with ground reaction forces typically seen during gait because the accelerometer was positioned close to the center of mass (COM) of the body (9). Recently, there were many studies that used the accelerometers to assess and compare trunk stability during walking on level and irregular surfaces between the young and elderly adults (9-13).

However, there has been no report about using the accelerometer to investigate the trunk stability in elderly women during negotiating an obstacle. It was surmised that elderly adults with balance deficits would show more difficulty in controlling trunk balance during performing the crossing stride compared to elderly with no balance deficits. Elderly women were of interest in this study because rates of balance impairment and fall-related injury in women was higher than men of comparable age (14). Moreover, among the cause of falls in the elderly, tripping during walking over obstacle is one of the most frequent (15). Therefore, we are interest to measure and compare peak trunk acceleration amplitude and gait parameters between elderly with and without balance impairment during walking on level surface and walking and stepping over obstacle.

## **Purposes and hypotheses of the study**

### **Main purpose of the study**

The main purpose of the study was to measure and compare peak trunk acceleration amplitude and gait parameters in elderly women with balance-impaired (BI) and non-balance-impaired (NBI) using a tri-axial accelerometer and the two-dimensional (2D) motion analysis during level walking and walking over obstacle.

### **Specific purposes of the study**

1. To measure and compare peak trunk acceleration amplitude and gait parameters between the BI and the NBI elderly women during walking on level surface.
2. To measure and compare peak trunk acceleration amplitude and gait parameters between the BI and the NBI elderly women during walking over the low and high obstacles.

### **Hypotheses of the study**

1. There would be differences in peak trunk acceleration amplitude and gait parameters between the BI and the NBI groups during walking on level surface.
2. There would be differences in peak trunk acceleration amplitude and gait parameters between the BI and the NBI groups during walking over the low and high obstacles.

## **Independent and dependent variables**

### **Independent variables**

1. A group of elderly women with balance-impaired (the BI group), having BBS score  $\leq 45$
2. A group of elderly women with non-balance-impaired (the NBI group), having BBS score  $> 45$

### **Dependent variables**

1. Peak trunk acceleration amplitude (unit g)
  - Vertical direction
  - Anteroposterior direction
  - Mediolateral direction
2. Gait parameters of level walking
  - Walking speed (m/s)
  - Step length (cm)
  - Toe-floor clearance (cm)
3. Gait parameters of crossing step
  - Crossing speed (m/s)
  - Crossing step length (cm)
  - Leading limb elevation (cm)
  - Trailing limb elevation (cm) } Equivalent to toe-floor clearance
  - Pre-obstacle distance (cm)
  - Post-obstacle distance (cm)