Portable electromyography: Application for understanding muscle function of daily life in older adults

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O. Theou, S.H. Bruce, K. Roland, G.R. Jones, J.M. Jakobi, Portable electromyography: Application for understanding muscle function of daily life in older adults. Gerontechnology 2011; 10(3):146-156; doi:10.4017/gt.2011.10.3.003.00 **Purpose** To measure arm and thigh muscle activity using electromyography (EMG) for an 8-hour typical day in community-dwelling and retirement-home residents (older women only). **Methods** Twenty-two women (>75 yrs), living either in the community (n=11, 82±6 yrs) or in a retirement facility (n=11, 86±6 yrs) participated. Long term EMG was recorded from the biceps brachii, triceps brachii, vastus lateralis, and biceps femoris using portable surface EMG over a typical 8-hour day. Results of the two groups were compared at a confidence limit of 0.05. **Results** Portable EMG was successfully used to compare muscle activity for a typical day in retirement home residents relative to community-dwelling individuals. Retirement home residents had ~22% greater number of bursts compared to community-dwellers. Conversely, retirement home residents had ~42% lower peak amplitude than community-dwellers. In addition, number of bursts was ~34% greater in the arm muscles than the thigh muscles for both community-dwelling older adults and retirement home residents. Retirement home residents were engaged ~65% less time in instrumental activities of daily living than community-dwellers ($p<0.001$). **Conclusions** The greater number of low amplitude bursts, associated with living in a retirement home, might be sensitive to the types of tasks undertaken during a typical day and indicative of decreased muscle function, likely as a consequence of reductions in mobility and instrumental activities of daily living.

Key words: muscle activity, EMG, mobility, living environment, housing, ADL

The oldest old, those aged 80 years or over, are the fastest growing segment of the older adult population, increasing at 4% per year which is 50% higher than the growth rate of the population aged 60 years or over[1]. Already, 91% of older adults report one or more chronic diseases and 40% report significant disability[2]. Age-related functional decline is often associated with reduced participation in activities of daily living (ADL)[3]. ADL are comprised of both the basic activities of daily living (BADL) required for self-care and daily hygiene[4], and the higher functioning, self-reliance tasks (i.e. shopping, housekeeping, transportation, etc.) referred to as instrumental activities of daily living (IADL)[5]. In general, loss of any IADL often precedes declines in BADL, resulting in functional dependence[6]. Older women live longer and are at greater risk of becoming functionally dependent in later life because they are relatively weaker[7] and are often diagnosed with more chronic disease conditions relative to men[8-11]. This predisposes them to greater functional decline in old age[6] and increased likelihood of transitioning to a care facility in comparison to men who survive to this age[12].

Retirement 'home' facilities provide a variety of services to assist older adults on a pay for service basis that are tailored to the diverse abilities and needs of each resident. Generally, retirement home residents have a higher level of physical functioning than individuals residing in long-term care facilities[13-15]. The functional ability of retirement home residents may range between those who are completely independent, to those requiring assistance with some or all IADL. A decline or progressive inability to perform IADL may signal a transition whereby the older adult may have to move to a facility that provides more comprehensive care. Older adults who move into a retirement facility likely have lower functional abilities and are less physically active than community-dwelling older adults but it is also possible that their new environment would alter their mobility and physical function[16].

Developments in technology and the availability of services makes living easier for those residing in retirement home facilities but may also alter the accumulation of daily physical activity and foster a sense of 'learned dependence' [17,18]. 'Learned dependency' in retirement home residents can result from an overprotecting environment in the retirement facilities where the support from the staff and the assistive living services provided may produce more dependent behaviour from the residents[19]. The limited size of the living space at retirement facilities and the reduced need to undertake all the daily activities a person in the community does due to the available services makes retirement home residents less active during the day[16]. This may eventually hinder their ability to remain functionally independent and increase the risk of mortality[18,20]. For example, over time residents living in a retirement facility may become more accepting of services that support IADL, which might foster reliance or dependency, whereas the community-dwelling older adult is required to complete all IADL in order to remain functionally independent.

Laboratory studies have shown that retirement home residents have reduced muscle strength, balance, and gait compared to community-dwelling older adults[16,21], yet the muscle function of retirement home residents outside the laboratory and during the course of pursuing daily activities is unknown. Measurements that will capture the daily life of the older adults in the home environment are needed. Previous studies have used multiple tools (pedometers, accelerometers, and questionnaires) to demonstrate that retirement home residents are less physically active during daily life than community-dwelling older adults[16,22,23]. These tools do not provide any information about the level of muscle activity that governs movement in older adults during daily activities. To-date there has been no assessment of muscle activity between older adults living independently in the community relative to those in a retirement facility. Understanding muscle activity is important, as declines in physical function are often consequential to alterations in muscle.

Electromyography (EMG) provides a quantifiable measurement of muscle activity. The high pace of technological advances in EMG coupled with the development of portable devices facilitates measurements outside the lab and during typical daily life. Monitoring the daily lives of older adults by measuring long term EMG activity with portable devices to provide an indication of overall muscle activity can be an effective way to identify age-related changes in muscle function and initiate the design of exercise interventions to prevent the further decline in muscle function of older adults. While the development of this device is still in early stages, portable surface EMG devices successfully identified age-related and inter-muscular differences in long term EMG[24-26]. Recent studies found that muscle activity as measured with surface EMG over a typical day (long term) is greater in older women compared with young adults[24,25] and EMG characteristics differ as older women transition through stages of frailty[26]. It is not clear whether the availability of assistive living services and reduced physical activity in retirement home facilities may alter the muscle activity of retirement home residents during daily life. Therefore, the purpose of this investigation was to measure upper and lower limb muscle activity using portable surface EMG for an 8-hour typical day in older women who reside in retirement homes and older women who live in the community. As a consequence of reduced muscle strength, retirement home residents will utilize a higher proportion of their muscle to execute physical movement. Therefore, it was hypothesized that long term EMG recordings, sampled from retirement home residents, would indicate a greater level of muscle activity to execute daily tasks compared with community-dwelling older women.

Methods

Twenty-seven women were recruited to participate. Inclusion criteria included healthy women, older than 75 years of age, who were either living in the community or in a retirement facility. Exclusion criteria included uncontrolled blood pressure and/or diabetes, reliance on a gait aid (i.e. cane, walker), or surgical treatment within the past 6-months. Of the 27 recruited subjects, a complete data set was acquired from four muscles over the 8-hour entire recording period from 22 older women (83.8 ± 6.1 years of age) and only these subjects were included in the analysis. Of the 22 older women eleven resided in a retirement facility and eleven resided in the community. Retirement home residents were recruited from several facilities which provided various services. All subjects who participated in this study were residing in their place of residence for at least 6 months. Of the eleven community-dwelling women six were living in a house and five were living in an apartment/condominium. None of these women were receiving home care. All subjects, regardless of living environment, were single inhabitants. All experimental procedures received approval from the University Human Research Ethics Board and conformed to the Helsinki Declaration. Informed written consent was received prior to participation.

Procedures

Data were collected over a single weekday that was representative of a typical day. The morning of data collection, subjects living in the retirement facility arrived at a designated testing room or common area within the facility approximately one hour after they awoke (~8-10 am). Subjects residing in the community were assessed in their home by the investigator who also arrived at their house approximately one hour after they awoke. The experimental procedure was explained and written informed consent obtained. Thereafter a health history questionnaire, the Paffenbarger Physical Activity Questionnaire, and the Yale Physical Activity Survey for Older Adults were administered. Subsequent to pedometer, Global Positioning System (GPS), and EMG device placement, three Maximal Voluntary Exertions (MVE) were performed for each muscle of interest. All subjects were then asked to proceed with normal daily activities, but avoid any task that might damage the equipment or dislodge the electrodes of the EMG device such as bathing, swimming or strenuous exercise[24,25]. The researcher encouraged the participants to disregard the equipment and undertake a typical day. At the end of the day, approximately 8-9 hours later (between 4-6 pm), the subject was met and MVE were reassessed prior to removal of the testing equipment.

Electromyography

EMG instrumentation

Surface recording electrodes were placed on the biceps brachii (BB), triceps brachii (TB), vastus lateralis (VL), and biceps femoris (BF) of the non-dominant side to measure global muscle activity of these muscles with EMG for an 8-hour period of a typical weekday. Only the non-dominant side was tested to lessen the impact of dominance relative to usage which is likely to impart a training effect on neuromuscular function. Electrode placement and attachment on all muscles was similar to prior studies[24-26]. Electrodes were adhered to the mid-belly of the muscle with double sided medical die cut application tape (Biometrics T350) and Hypafix (Hamburg, Germany). Palpation of the muscle and functional testing of movement was used to ensure appropriate placement. The electrodes had an inter-electrode distance of 20 mm, a built in gain (1000x), and band pass filter (20-450 Hz) (Biometrics SX230, Gwent, UK). The common reference electrode (Biometrics Ground Reference R200) was placed on an area of boney prominence on the lateral aspect of the tibia on or near the malleolus and on the same side as the recording electrodes. A high conductivity electrolyte gel (Microlyte, Pennsylvania, USA) was applied to ensure contact between the reference electrode and the skin.

The common reference electrode and all recording electrodes were connected to a portable data logger (Biometrics DataLOG P3X8, Gwent, UK) which stored signals during data collection on a 512 MB MMC flashcard. This unit was attached to the subject's waist by an adjustable belt. The portable data logger had dimensions of 9.5 x 15.8 x 3.3 cm (width x height x depth) and weighed 380 g. The weight of the electrode heads, double sided medical die cut application tape, Hypafix and gel were negligible. Data from the Biometrics unit was downloaded to a computer hard-drive and stored for subsequent analysis.

Maximal voluntary exertions
Isometric maximal voluntary exertions (MVE) were performed for the four muscles (BB, TB, VL, BF) in the morning, following the placement of the EMG electrodes and setup of the recording unit. MVE were also executed in the evening before removal of the equipment. These efforts provided a baseline measure of maximal EMG output for normalization of daily recordings for the 8-hour period. The evening MVE were necessary to ensure the integrity of the recording electrodes and equipment for the duration of the day. The order in which the MVE were executed for each muscle was randomized, and the rest duration between each of the three attempts at an MVE within a muscle was minimally 60s to prevent fatigue.

Maximal EMG activity was recorded against the investigator's manual resistance[24,26]. All four muscle groups were tested with the subject seated. The chair was a standard armless chair with a firm high back and a seat height of 48 cm. The BB and TB of the non-dominant arm were tested, with the arm slightly abducted and the elbow positioned to 90º. This position was maintained while a maximal elbow flexion (push up) or extension (push down) was conducted. The thigh muscles of the same side of the body were evaluated with the hip angle set at ~100º and the knee positioned at 90º. This position was maintained during maximal flexion or extension of the knee. Consistent verbal encouragement was provided.

EMG data analysis
All EMG data recorded on the Biometrics flashcard were downloaded to a computer and imported into the Biometrics program (Gwent, UK) for preliminary visual inspection. The resulting files were exported into Spike 2 version 5.04 (CED, Cambridge, UK) as text files for custom analysis. Manipulation of the data prior to burst analysis included rectifying the data, smoothing at a time constant of 0.01s and down sampling at a factor of 100 (Spike 2, Cambridge, UK). Each file was analyzed for data artefact, and removed by deletion of the area (Spike 2, Cambridge, UK). The four channels of data were mapped on the same time constant, thus removal of data from one channel at a particular time stamp removed the same amount of data on the three other channels simultaneously.

Subsequently, custom script analysis was employed to calculate the burst composition for each muscle. All channels were normalized to the highest maximal EMG value (% MVE) of each muscle. A burst was defined as having a duration of >0.1s and a threshold amplitude >2 % MVE. Bursts were quantified as; number of bursts, mean burst duration (s/burst), peak burst amplitude (average peak amplitude of all bursts, %MVE), burst activity (average mean amplitude of all bursts, %MVE), and percentage of burst (% of total recording time occupied by bursts).

Physical activity questionnaire

All subjects were administered the Paffenbarger Physical Activity Questionnaire and the Yale Physical Activity Survey for Older Adults. The Paffenbarger Physical Activity Questionnaire quantified the accumulated physical activity and associated caloric expenditure for the subject over an entire week[27]. The Yale Physical Activity Survey provides additional information regarding the types of activities performed during a typical week[28,29] and subsections of this survey focus on IADL, exercise and recreational activities[5].

Pedometer

To record the number of steps taken a pedometer (Yamax Digi-Walker SW-200, Tokyo, Japan) was attached to the same belt as the EMG unit. The pedometer was placed in alignment with the hip of the non-dominant leg. The pedometer was light (21 g) and small (0.5x0.38x0.21 cm). The number of steps was measured in whole unit step counts. The pedometer was sealed shut so that the subject was blinded to the recorded output values.

Global positioning system

To monitor life-space movement within the environment, a GPS (Garmin Forerunner 305, Olathe, USA), was attached to the subject's non-dominant arm at the wrist. The GPS had dimensions of 5.33x6.86x1.78 cm and a weight of 77 g. Data from the GPS was transferred to Garmin Training Center software for further analysis and saved to a computer hard-drive in formats appropriate for Google Earth™ (Google Inc, Mountain View, Canada). The Google Earth™ mapping service was used to define the start and end points of outdoor activities. When the participants were indoors the satellite signal was frequently lost and data may be inaccurate; therefore, only GPS data recorded outdoors were included in the analysis. Each subject's life-space movement was subsequently classified based upon: (i) remaining solely within the principle residence; or (ii) movement outdoors from their principle residence[30]. Data for subjects who moved outdoors included total time travelled outdoors, distance travelled in a vehicle (speed>0 km/hr for>1 min) and walking distance and speed.

Statistical analysis

Analysis was performed using the Statistical Package for the Social Sciences (SPSS v17.0, Chicago, Illinois, USA) at a confidence limit of 0.05. Independent t-tests were utilized to compare the subject and health characteristics (age, height, weight, BMI (Body Mass Index), number of comorbidities, and number of medications) between retirement home residents and community-dwelling older adults. A paired t-test was utilized to compare the morning and evening EMG values for the maximum MVE from each session to ensure the integrity of the testing apparatus. The dependent variables of the burst characteristics (number, mean duration, peak amplitude, activity, percentage) were compared using a 2x4 multivariate analysis of variance (MANOVA). Living environment was the between-subject factor and muscle group (BB, TB, VL, BF) was the within-subject factor. To evaluate physical activity and mobility, between retirement home residents and community-dwellers, independent t-tests were utilized to analyze the Yale Physical Activity Survey and Paffenbarger Physical Activity Questionnaire scores as well as pedometer total step counts and GPS measures. Data are presented as mean values ± standard deviation of the mean (SD).

Results

Subject characteristics (age, height, weight, BMI) were similar between the retirement home residents and community-dwelling

Table 1. Mean and standard deviation of subject and health characteristics of community-dwellers and retirement home residents; BMI=body mass index

Characteristic	Community dwellers (n=11)	Retirement home residents (n=11)
Age, yrs	82±6	86±6
Weight, kg	63±8	65±10
Height, cm	159±5	159±6
BMI	25±3	26±4
Medications	6.4±3.2	4.9±2.7
Comorbidities	5.0±1.9	4.2±1.9

older adults. The community-dwellers reported a similar number of prescription medications and comorbidities relative to the retirement home residents (*Table 1*). All subjects were right hand dominant.

Electromyography

The maximal EMG from the morning and evening sessions did not differ. As a result, the highest MVE recorded, irrespective of the session, was used to normalise the 8-hour EMG for the burst analysis (Coefficient of Variation ranged 16-30% across muscles). Total time recorded between the community-dwelling subjects (7.8±0.8 hrs) and the retirement home residents (7.9±0.7 hrs) was also not different in the statistical test. The two way interaction between living environment (community-dwellers, retirement home residents) and muscle (BB, TB, VL, BF) was not significant.

Living environment

Main effects for living environment on burst characteristics were observed. Univariate tests on the main effect demonstrated that number of bursts and peak burst amplitude differed between women living in the community compared with women residing in retirement home facilities. The number of bursts was less in the community-dwellers compared to retirement home residents. Peak burst amplitude was greater in the community-dwellers than the retirement home residents. Mean burst duration, burst activity, and burst percentage were similar for both community-dwelling subjects and retirement home residents (*Table 2*).

Muscles

Main effects for muscle group on burst characteristics were observed. Differences were found between muscles for four of the burst characteristics (number of bursts, mean burst duration, peak burst amplitude, and burst activity). Burst percentage was similar across muscles for both the community-dwelling and retirement home older women. Pair-wise comparisons revealed that both of the thigh muscles (VL, BF) had fewer bursts compared with the two arm muscles (BB, TB). However, there were no differences within the arm and thigh functional pairs of muscles; the BB and TB did not differ, nor did the VL and BF differ. Mean burst duration, in both thigh muscles (VL, BF) was longer than the BB, and BF had longer duration than the TB ($p<0.01$). However, there was no statistically significant difference between the VL and the TB. No difference was observed in mean burst duration between the BB and TB or between the VL and BF. Peak burst amplitude was greater in the BB and BF compared with the TB and VL. Burst activity was greater ($p<0.01$) in the BF compared with the other three muscles (BB, TB, VL) (*Table 3*).

*Table 2. Mean and standard deviation of burst characteristics for community-dwellers (n=11) and retirement home residents (n=11); *=parameter differs between the groups at a confidence level of 0.05; MVE=Maximal voluntary exertion*

Burst characteristic	Community dwellers	Retirement home residents
Number*	9983±3362	12205±4081
Mean duration, s	1.0±0.7	1.1±0.9
Peak amplitude, % MVE*	8.1±3.2	6.2±2.9
Activity, % MVE	7.7±4.7	7.0±4.9
% of time active	36±20	42±22

Physical activity and mobility

Physical activity patterns as measured by the Paffenbarger Physical Activity Questionnaire, recreational and exercise activities as measures by the Yale Physical Activity Survey and pedometer step counts were not statistically different be-

Table 3.Mean and standard deviation of burst characteristics for individual muscles; MVE=Maximal voluntary exertion;=parameter differs from BB; #=parameter differs from TB; $=parameter differs from BF*

Muscle	Number	Mean duration s	Peak amplitude % MVE	Activity % MVE	% of time active
Biceps brachii	13163±2973	0.9±0.4	7.3±1.7	5.8±3.3$	39±15
Triceps brachii	12190±3061	0.9±0.5	6.4±1.6*$	6.5±3.2$	36±19
Vastus lateralis	9888±4626*#	1.5±1.4*	6.2±2.1*$	6.9±5.0$	43±30
Biceps femoris	9134±3394*#	1.1±0.4*#	8.8±5.2	10.2±6.0	37±18

tween community-dwellers and retirement home residents. Classification of IADL, with the Yale Physical Activity Survey, suggest that the community-dwellers perform more minutes per week of IADL than the retirement home residents ($p<0.001$). Six of the community-dwelling older women and four of the retirement home women travelled outside of their principle residence whereas five of the community-dwellers and seven of the retirement group remained within principle residence during the testing session. Subsequent analysis of the subjects who moved outdoors based upon GPS indicated no difference between community-dwellers and retirement home residents for total time travelled, distance travelled while walking and/or driving and average walking speed (*Table 4*).

Discussion

Eight-hours of EMG of two arm (BB, TB) and two thigh (VL, BF) muscles were recorded in women living in two distinct environments. Retirement home residents had approximately 22% greater number of bursts compared to community-dwellers. Conversely, retirement home residents had approximately 42% lower peak amplitude than community-dwelling subjects. In addition, the number of bursts was 34% greater in the arm muscles than the thigh muscles for both community-dwelling and retirement home older women. Thus, portable EMG provides a means to compare muscle activity between older adults. The findings from this study indicate that living in a retirement home is associated with a greater number of low amplitude bursts. Portable EMG may provide a measure to dissociate differences in activation patterns between muscles in older women.

The percentage of time the muscles were active was similar between community-dwelling and retirement home women; however, the characteristics of muscle activity (bursts) were different. The retirement home residents had more bursts of lower amplitude, which suggests muscles are activated more

*Table 4. Physical activity and mobility of the community-dwellers and retirement home residents; *=parameter differs between the groups at a confidence level of 0.05; SD=Standard deviation; PPAQ= Paffenbarger Physical Activity Questionnaire; YPAS=Yale Physical Activity Survey; IADL=Instrumental Activities of Daily Living; GPS=Global Positioning System*

Parameter		Community-dwellers		Retirement home residents	
		n	Mean±SD	n	Mean±SD
PPAQ	Total activity, kcal/wk (x100)	11	35±25	11	19±14
YPAS	Recreational, min/wk	11	453±518	11	230±257
	Exercise, min/wk	11	155±241	11	338±425
	IADL, min/wk*	11	1735±623	11	601±376
Pedometer	Indoors & outdoor steps/day (x 100)	11	25±30	11	9±6
GPS outdoors	Total time, min	6	45±59	4	59±66
	Walking distance, km	3	1.7±1.9	1	1.9
	Walking speed, km/h	3	4.0±1.0	1	3.0
	Driving distance, km	5	11±14	3	14±13

frequently but at a lower intensity relative to community-dwellers. Theou et al.[26] measured long-term EMG activity in community-dwelling older Greek women and found that the burst characteristics (number of bursts 11000, mean burst duration 0.8s, amplitude 8.8% MVE, activity 5.6% MVE, burst percentage 28% time) of these women were similar to the community-dwelling older women in this study. The similarities in burst characteristics between the community-dwelling Canadian and Greek older women suggest that long term EMG might be a reliable tool to measure muscle activity.

Differences in long term EMG might be sensitive to the overall type of tasks undertaken for age-matched groups. Older adults who move to a new living environment experience an increase in ADL and IADL limitations[31]. The retirement-dwelling women in this study performed fewer IADL and were generally less physically active compared with the community-dwelling women. Despite the lack of statistical significance, differences between the two groups for overall physical activity and pedometer scores were great and could be significant with a larger sample or use of accelerometer rather than pedometer.

Subjects in retirement facilities do not perform many IADL, likely because these services are offered by the facility. In general, community-dwelling older adults demonstrate greater involvement in indoor IADL compared with leisure activity participation[32]. Prior studies have indicated that energy expenditure is lower in subjects living in care facilities[33]. Not only are fewer IADL performed in retirement home residents but, Shumway-Cook et al.[34] reported that subjects of a higher mobility status perform more activities per trip into the community (2:1 activities per trip) compared to subjects with lower mobility status (1:1 activities per trip). Thus, retirement-dwelling women may perform different physical activities compared with the community-dwelling women and it might be the type of physical activities that older women are undertaking that contributes to differences in EMG. A previous study[24] has shown that when the same task was performed there were age- and sex- related differences in muscle activities. Future laboratory studies need to examine whether EMG activity differs between community-dwelling and retirement home women when the same task is performed.

Several studies have demonstrated that mobility patterns vary between seasons. Merchant et al.[35] reported that between July 1st to September 30th, Canadians are 31-48 % more likely to be physically active compared to January 1st through to March 31st. In older adults activity is also influenced by weather conditions, with reduced physical activity during extreme temperatures[36]. Data collection in this study was restricted to one season (winter) thus, seasonal variation was not a factor evaluated.

Although the two groups of older women examined in the current study had similar age, anthropometric and health characteristics, their long term EMG activity was different. Services offered in a retirement facility (e.g. full meal services plan) reduce the amount of ADL performed and subsequently mobility, specifically IADL (e.g. shopping for groceries, meal preparation)[16,22,23,37]. These reductions may be reflected in the observed differences in EMG between groups. Women residing in retirement facilities had lower amplitude of muscle activity and this might be attributed to lower physical activity and mobility levels since they engaged in fewer daily activities that would require the production of high forces. Reduction in functional ability and an increase in services provided to retirement home residents likely culminate in decreased mobility and engagement in IADL and further the decline in functional ability. These factors lessen the everyday load placed upon muscle and are detectable through EMG differences. Changes in muscle characteristics (e.g. muscle strength and mass, muscle fiber-type proportion, motor unit firing rate, nerve conduction velocity, muscle fatigue) may be related to differences in EMG between community-dwelling and retirement home women, but this remains to be evaluated. For example, muscle of women residing in retirement facilities may need to be activated more frequently to complete daily tasks due to reduced muscle function[16,21] and this will result in greater number of bursts compared with the 'healthier' muscles of community-dwelling women. Future longitudinal studies should examine underlying mechanisms that contribute to changes in EMG across older adults residing in different living environments.

Differences were also indicated between arm (BB, TB) and thigh muscles (VL, BF). The non-significant interaction of living environment by muscle indicated that the muscle differences in EMG activity were similar in the two groups of older women. The arm muscles had 34% greater burst numbers than thigh muscles. Previous studies in young[38] and older adults[26] have also demonstrated that arm muscles are more frequently active relative to thigh muscles likely because they are needed extensively to execute ADL[39]. The occurrence of bursts which was similar between the BB and TB and between the VL and BF is likely reflective of IADL participation which involves co-activation of these muscles. The greater peak amplitude of the knee and elbow flexor muscles (BB, BF) compared with the knee and elbow extensor muscles (TB, VL) may be related to the greater age-related decline in the flexor muscles compared with the extensor muscles[40-42]. Thus, the flexor muscles are required to work at a greater percentage of their maximum to complete the daily tasks.

The observed differences in long term EMG between these groups of older adults might relate to lower functional abilities in the retirement home residents that preceded the move into a retirement facility. However, EMG differences are also likely to arise from the reduction in mobility and participation in IADL due to 'learned dependence' as a consequence of the availability of assistive living services. The relationship between physical function, mobility and IADL participation and long term EMG during daily activities requires further study. Moreover, whether increased physical activity through recreation or exercise may lessen the effects of decreased mobility and IADL and alter muscle activity during daily tasks remains to be elucidated. Ultimately, factors relating to both ADL and exercise need to be considered when evaluating changes that precipitate declines in muscle activity that inevitably lead to loss of functional independence in older adults.

In conclusion, women of similar age, but living in the community compared with retirement home residents have different patterns of muscle activity as detected with portable EMG, recorded from the upper and lower limb muscles for an 8-hour typical day. Older women residing in retirement home facilities had more bursts of lower amplitude compared with community-dwelling older women. Retirement home residents accomplished less IADL relative to community-dwellers. The observed changes in long term EMG may be indicative of alterations in mobility and IADL participation due to the availability of assistive living services in retirement home facilities that predispose functional decline. Portable EMG can be readily used in community-dwelling and retirement home residents to gain an earlier indication of changes in muscle prior to further physical function decline.

Acknowledgments
The authors acknowledge the contributions of Dr's Kenji Kenno and Patricia Weir, at the University of Windsor, for reviewing prior versions of this manuscript. This research was funded with a University of British Columbia Internal Health Research Grant

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