The Usefulness of Activity Trackers in Elderly with Reduced Mobility: A Case Study

Jonas Lauritzen
University of Seville, Spain
JonasLauritzen@atc.us.es
Background

- Balance
- Strength
- Flexibility
  - Indoor exercises

- Endurance/Stamina
  - Outdoor exercise
  - Walking

GameUp
Background

• Encourage elderly to walk more and keep walking
  – Provide motivational feedback
  – Provide overview of progress
  – Make recommendations
  → To evaluate their current effort

• A method of accurately quantifying activity
  – Activity trackers/Pedometers
  – GPS (not possible in GameUp)
Goal

• Examine the accuracy of two present activity trackers:
  – Fitbit Ultra (activity tracker)
  – Samsung Galaxy S3 (pedometer application)

• Compare Elderly with normal and reduced mobility and healthy adults
Healthy Adults (HA)

Age: 25 – 45
No gait disabilities
• Global exclusion criteria
  – Cognitive impairment
  – Conditions that hinder gait or correct device placement
Procedure

• Participants instructed to
  – Walk a distance of 20m on a straight outlined path
  – Walk at their own pace
  – Use their own walking aid, if any (not HA)

• Participants always had someone by their side (not for HA)

• Setup
  – Path, Start & finish position marked out clearly
  – Test area closed for other activities/traffic
  – Participants were offered practice “runs”
Instruments

- Wrist
  - Fitbit Ultra

- Hip
  - Fitbit Ultra
  - Samsung Galaxy S3 (*Noom*)

- Feet
  - Video camera

- Time to complete
  - Stopwatch
Results

HA
n = 6
Age: 35.33 ± 6.53

NME
n = 7
Age: 84.14 ± 3.67

RME
n = 5
Age: 87.6 ± 3.91
Results

- POMA gait score
  12 indicates max
  HA = 11.83 ± 0.41
  NME = 9.14 ± 0.9
  RME = 5 ± 1.58
  p < 0.05

- Time to complete 20m/
  avg. walking speed
  p = 0.001
Results

- Wrist placed Fitbit
  - RME performs worse than NME \( (p=0.003) \)
  - RME performs worse than HA \( (p=0.004) \)

- Hip placed Fitbit
  - RME performs worse than HA \( (p=0.009) \)

- Hip placed Smartphone
  - RME performs worse than NME \( (p=0.005) \)
  - RME performs worse than HA \( (p=0.017) \)

- No significant difference between NME and HA

*Independent Kruskal-Wallis & Mann-Whitney U tests*
Results

- POMA, highly negatively correlated with
  - Age
  - Time to Complete  (*avg. speed positively correlated*)
  - Number of Steps Taken
  - Error Percentage in all devices/wear locations

- Time to Complete and Number of Steps Taken correlated with Error Percentage in all devices/wear locations

- Age was not correlated with Error Percentage

- Age highly negatively correlated with avg. speed
Results

- RME data characterized by large undercounting
- RME wrist worn Fitbit failed to detect any steps in 4/5 participants
  - Detected only 1.79% of steps taken when detecting
- RME displayed overall low accuracy (Error percentage > 60%) and poor precision
- Best results obtained in hip worn Fitbit in HA (2.86% ± 2.34%)
Discussion

- Poor device performance in RME
  - Small steps
  - Little/no vertical foot displacement
  - Slow/a abrupt walking pace
  - Static wrist position (Holding on to rollator handles)
  - Sensor not subjected to enough vertical displacement

- Activity trackers usually not targeted at RME (and some NME), but people with faster pace/stride length – HA
Conclusion

- Tested devices not advisable for use in RME, even when placed in accordance to manufacturer recommendations

- Optimum device and placement is Fitbit Ultra at Hip

- Alternative methods required for people with reduced mobility
  - Counting rollator wheel rotations
  - Impact sensor on canes
Recent changes

- Recommended wear updated – wrist no longer recommended
- Fitbit Ultra no longer available in sale
- Fitbit Ultra replaced by Fitbit the One
GAME-BASED MOBILITY TRAINING AND MOTIVATION OF SENIOR CITIZENS

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About POMA


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