New metrics for exploring the relationship between mobility and successful ageing

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In Brief

A decline in health is often a major worry as people grow older. People fear not being able to look after themselves and being a burden onto others. Often a cause of this dependence is a decline in mobility. This study aimed to examine mobility patterns in successfully ageing adults and to assess the relationship between mobility, health and lifestyle by examining the predictors and consequences of mobility. The findings will help to determine interventions that could have an impact on maintenance of mobility, so that future generations can be informed of these interventions and encouraged to implement them. The study also examined the utility and acceptability of mobility tracking technologies as healthcare interventions.
Summary of key findings

Study participants who live in the community, are in reasonably good health, have good cognitive acuity and appear to have aged successfully nevertheless do not exhibit very active lifestyles or travel far from home in their daily life.

• A mobility profile of the oldest-old members of the community.

The successfully ageing participants in this study were a moderately active group.

The mobility measures from the accelerometer devices have indicated that the sample comprised of a moderately active group of people and activity profiles are comparable to earlier reports of activity estimates for a slightly younger age group with 70% of the day spent sitting or lying, 22% of the day spent standing and 7% of the day spent walking.

The location monitoring data revealed that older people do not travel far from their home (mean furthest distance travelled away from home = 4.22 miles) and they travel, in total, approximately 23 miles in a week which is spread over 5.63 journeys per week.

Diary accounts of mobility corroborate the accelerometer activity and location monitoring mobility data in that most time is spent doing sedentary activities (63%) and most of the day is spent indoors (78%). In more detail, 55% of time per day was spent doing static indoor activities, 23% of the day spent doing dynamic indoor activities, 8% of the day doing static outdoor activities and 14% of the day doing dynamic outdoor activities.

Recent evidence has suggested that sedentary behaviour is an important characteristic when considering habitual patterns of behaviour, distinct from physical activity. This project allowed the separate quantification of physical and sedentary behaviour in older people. It was found that physical and sedentary behaviour, along with transitory behaviour, are indeed distinct from each other and together explain daily function. Patterns of activity suggest that changes do occur as adults age and initiation of activity may be more challenging for older adults especially later in the day. This suggests that scheduling and timing of exercise programmes for older people will be important.

• Profile of successfully ageing older adults

Lifestyle and health measures give a profile of successful ageing adults with participants exhibiting:

  - Medium to high cognitive functioning
  - Stable cognitive functioning over previous 20 years
  - Few current illness. Participants typically experienced 2 chronic illnesses
  - Taking few medications. Participants typically taking 4 prescribed medications
  - Low levels of depression and anxiety
  - Levels of depression being low over previous 20 years

Predictors of mobility highlight areas for intervention to improve mobility.

• Younger age and a lower body mass index (BMI) were significant predictors of the physical profile of mobility as assessed by accelerometers with BMI also predicting postural transitions assessed by the same device.

• Single leg balance ability predicted number of steps recorded by the accelerometer and the amount of time spent in dynamic activities outdoors suggesting that balance is an important predictor of mobility and especially for outdoor activities.

• Problems with the location monitoring devices resulted in a lower sample size but gave usable data: number of current medications taken, current functional mobility (timed get up and go test) and current gait speed made significant independent predictions of furthest distance travelled.

• Longitudinal measures of cognition and well-being suggest that a measure of anxiety, social network size and health from several years ago are important predictors of current mobility.

Stigma of devices is a problem for product developers to overcome.

• The project examined the utility and acceptability of the location monitoring system and its benefit identifying individuals at risk. The benefits of location monitoring were not immediately identified by our ‘healthy’ older adults and participants expressed fears that such devices would limit their control, portray them as ‘unhealthy’ and they felt they would be stigmatised by the use of such systems.

• Improving the usability and acceptability of such location monitoring systems in the field is required. Not all participants provided a full period of data recording from the location-monitoring devices.

It is possible to reach old age with little change to cognitive abilities, few health problems and good mental health.
Problems in using such devices with this population and the accuracy of such measures provide valuable information about utility and acceptability of new mobility technology in identifying individuals at risk.

- There is support for the use of accelerometry to measure habitual functioning in older adults.

**Background**

The aim of this study was to utilise an innovative method for mapping the mobility of the oldest-old members of an existing 25 year longitudinal study of ageing. The study had four objectives: Firstly, to establish a sophisticated mobility profile of the oldest-old by using methods from accelerometry along with data from new location-based technologies in order to create innovative mobility metrics. These would be used to corroborate self-reports of activity and mobility which will help document older adults’ autonomy and independence in terms of diversity in activity and engagement with public space. Secondly, these new metrics will be used as outcome measures which will be analysed alongside the existing longitudinal dataset in order to establish the predictors and consequences of mobility in the oldest-old. Thirdly, new measures were taken, to include indices of balance, lifestyle and social engagement in order to improve our understanding of successful ageing and its relationship with mobility and pave the way for subsequent investigations of this cohort. Finally, the project allowed us to involve participants and stakeholders in a discussion about utility and acceptability of the new location-based systems in identifying individuals at risk.

**Methodology**

Mobility was assessed by three techniques. Activity monitoring was achieved by participants being asked to wear an accelerometer taped to their thigh for a seven day period (removable for showering, bathing and sleeping). This monitor provided recordings of onset, duration and frequency of physical activity with the outcome measures being number of steps taken, step cadence, time spent seated/lying, standing and walking. Location monitoring was achieved by participants wearing an i-locate device (supplied by Trackaphone) for the same seven days as the accelerometer which recorded geographical movements over space and time via GPS technology. Participants also completed self-report time use diaries pre-testing to achieve baseline measures of activity and during the above monitoring to allow corroboration with the new metrics.

In their first visit to the laboratory, participants completed gait and balance assessments (timed get up and go, single and tandem balance, 10 meter walk using Gaitrite system) and then post- mobility assessment they completed a range of cognitive tasks in the laboratory including tests of fluid and crystallised intelligence. Concurrent with these assessments participants completed a range of questionnaires and measures providing a wealth of health, lifestyle and activity information. These included the Pittsburgh sleep quality index (PSQI); Body Mass Index; Becks depression Inventory; State Trait Anxiety Scale; the Cornell Medical Index; CHAMPS: activities in older populations; FES-I: fear of falling; Life Events; MMSE and NART as well as a newly developed questionnaire on privacy issues with location-based technologies.

Sample

The sample of participants came from the North East Age Research longitudinal study. This study, which began in 1983, had, over time recruited 3384 community dwelling volunteers who took part in various cognitive tasks and completed numerous questionnaires providing information on health status, mood, demographics and socio-economic status. 100 ‘survivors’ of the study were invited to take part of which 86 participants completed all tests. The sample were aged 72 to 92 years (mean: 79.73 years, SD: 4.99); 73% female, 27% male. The majority were in socio-economic status group 2 (intermediate professional occupations such as school teachers, managers) and group 3 non-manual (skilled occupations such as office workers). They were a high cognitive functioning group with a mean MMSE score of 27.8 (SD = 2.14).
Conclusions

• The study has shown that mobility is a key issue for older people. Despite having reasonably good health and good cognitive acuity participants in the study were only moderately active. Much time is spent in sedentary activities and participants did not travel too far from their home base. This has implications for provision of, and access to, local services, shops and leisure facilities as well as being of interest to transport providers.

• It is encouraging to know that old age is not necessarily a time of ill health, cognitive decline and burden. Participants in this study exemplified successful ageing.

• Identification of predictors of mobility highlights areas where interventions could take place to help maintain mobility by future generations.

• Development of novel methods to quantify/explain patterns of habitual physical and sedentary behaviours using accelerometry data is an area of emerging research. Evidence suggests that timing, duration and variability of activity may be relevant to health and successful ageing. These characteristics may identify healthy ageing phenotypes and prompt early intervention where deviations in normal behaviour patterns exist. Such methods may have utility in early diagnosis of neurodegenerative conditions such as Parkinson’s disease.

• Recommendations regarding ease of use, acceptability and privacy issues concerning use of location aware technologies will be of value to product developers.

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