Accessibility Research Group

Working Paper

Personal Mobility Scooters: Health differences between mobility scooter users and the unaided pedestrian.

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This paper is part of a work in progress. The findings presented here may change in the future as a result of subsequent work.

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Abstract
This paper presents some initial findings from a PhD project, investigating whether rising mobility scooter usage corresponds with declines in walking levels, cognitive functioning and physical health. Using English Longitudinal Study of Ageing (ELSA) data some analysis has been carried out. This data provides a useful snapshot of the mobility scooter using population.

Introduction

Mobility Scooters are becoming an increasingly common sight on any suburban street. Benefiting from improved design and image as well as a decrease in usage stigma mobility scooters have become an increasingly popular mobility aid. They can be hired in supermarkets and shopping centres and are widely available for purchase including on the high street. Despite their prevalence little is known about their impact upon their users.

Two schools of thought exist regarding of the use of mobility scooters (Hoenig, 2007). The first suggests that scooter use increases participation in social activities outside the home that previously users would have been unable to access (Woods et al, 2003; Miles-Tapping and MacDonald, 1994). This could be expected to increase aspects of quality of life and wellbeing in users. The second suggests that scooter users risk deconditioning the physical functionality that allows them to walk, thus reducing their mobile capability at a greater rate than if they had continued to travel without a scooter. The latter philosophy has had little quantification, either in support or refutation and needs investigation to be able to provide full understanding of the impact which a mobility scooter may have on a person's life.

Scooter usage in the UK is optional. A scooter is a mobility device to enable people to travel further than they chose to on foot and are used by those who are physically able to walk. Unlike in other countries, like the United States, scooters are solely a private purchase in the UK with no provision of usage by the National Health Service or private health insurance. Despite this there are many users and owners of mobility scooters in the UK.

There is compelling evidence to support the health benefits of physical activity for older adults. However, in England the uptake in physical activity is low and declines with age. Only 10% of adults over 65 meet recommended levels of physical activity (Department of Health, 2000). Walking, the most common form of physical activity for older adults, can make a great difference to overall health. For example a brisk walking pace has been linked to a reduced risk of premature death (Manson et al, 2002). However, the percentage of older adults who usually walk at this pace is low, of those over 65; only 16% usually walk at this pace (Department of Health, 2000).

Mobility scooter usage can be seen as a replacement for walking and other forms of physical activity. If this is the case, then using a mobility scooter may hasten physical and functional decline. No literature currently exists detailing

the current scooter usage amongst older people and the characteristics of those users. Among the questions that need addressing are; Does mobility scooter use lead to increased decline in lower strength extremity, mobility functionality and increased levels of frailty? Can mobility scooter usage cause long term harm to those who choose to use them regularly? Can delaying the use of walking aids, particularly those requiring little or no physical exertion, delay the onset of frailty?

Given the wealth of support for increased physical activity participation it is crucial to quantify the impacts using a scooter has on physical health. The purpose of this project was to begin to investigate the impact of scooter use on physical health, using currently available data.

Method
To begin to answer some of the above questions the goal of this paper is to examine the differences in health markers over time of older people who use different forms of walking aids and those who use none. To do this the study uses an existing longitudinal study of older persons in England, the English Longitudinal Study of Ageing (ELSA).

A lode database, ELSA is a longitudinal survey of ageing amongst a representative sample of the over-50 population living in England. The survey explores quality of life, health, social interactions, household makeup and financial security. Waves one (W1) to wave four (W4) of the study surveyed the sample every two years between 2002 and 2009. The survey was carried out by interviewing subjects in their home. On waves two and four a nurse visit was additionally made to collect more specific health data. The study is funded by several UK government departments as well as the National Institute on Aging, in the USA. The study is jointly managed by the National Centre for Social Research and a team at University College London, led by Sir Michael Marmot.

This study used a sample of the full ELSA dataset. Firstly, to correspond with retirement and the inevitable change in lifestyle, this study chose to look at those in the database aged 65 or above. Secondly, given the optional usage of mobility scooters, participants who were completely unable to walk were removed from the dataset. Thirdly, to ensure a full body of information on every participant only those who participated in all waves, including the nurse visits (in the full ELSA sample 12% of all participants did not receive a nurse visit), were included in the subset analyses. Therefore missing variables in tests are due to incapacity (or the interviewer has not deemed participation safe) to complete a test. In summary, the analysis is therefore able to examine how individuals changed their mobility activity over the period 2002-2009.

Starting with wave one (interviews were held between mid 2002 and mid 2003) of the ELSA study, participants were divided into those who used different mobility devices and those who did not. This analysis used the wave one data as a snapshot to examine characteristics of scooter users and data from all available waves to examine changes in individuals over time. Subsequent analysis looked at how the individuals in the different groups changed across the following waves.

In order to understand what physical differences exist between scooter users, cane users and the unaided mobile older adults. The physical health markers analysed here are Body Mass Index (BMI), chair rises, walking ability, lung function and grip strength.

Results

From this analysis the types of users were broken down to divide users into groups dependent on what type of mobility aid (or unaided if none) they used. A definition of the types of mobility aids is given in Appendix A. Participants were divided into four groups, who used particular aids at the time of the first wave. Those who used a scooter (regardless of whether they additionally used other mobility aids) were included as a scooter user. Those who used a cane and another device (but not a scooter) were included as a cane user. Those who used any other mobility aid (but not a cane or a scooter) were included as "other mobility device users". The remainder of the sample who used no form of mobility aid were categorised as "unaided". The breakdown of people in each group was as follows; (1) Scooter users (n=20); (2) Cane users (n=374); (3) Other mobility device users (n=10); (4) no device users (n=1720). Of the scooter users in this sample, 14 were female and 6 were male.

The W1 data found that scooter usage is low; only 1.4% of the population over 65 uses a scooter. The average age of scooter users over 65 is 76. The scooter is not used in isolation: those who do use scooters often use multiple mobility aids. Of the 77 respondents in the sample who used scooters 60 also used a cane, 13 used a walker, 30 people used a manual wheelchairs and 3 people used an electric wheelchair. It should be noted that the data cannot tell us the frequency of which any of these devices are used or which aid is predominantly used. The ELSA survey also did not ask about when any mobility device was initial taken up so we do not know how long any in the sample have been using scooters or any of the other aids for.

Naturally, mobility device use changed over time. Of those who started out as cane users in W1, only 69% remained as cane users by W4 with 14% becoming scooter users and 7% using no longer using a cane but using other mobility devices. Of those who did not use a mobility aid in W1, 79% were still not using a mobility aid by W4. Of the 363 people who started to use a mobility device, 4% used a scooter, 90% used a cane. The figure below shows how the proportion of the participants using each aid (categorised using our groupings defined above) at each wave point.

Figure 1: Mobility device user over time by percentage of the study population
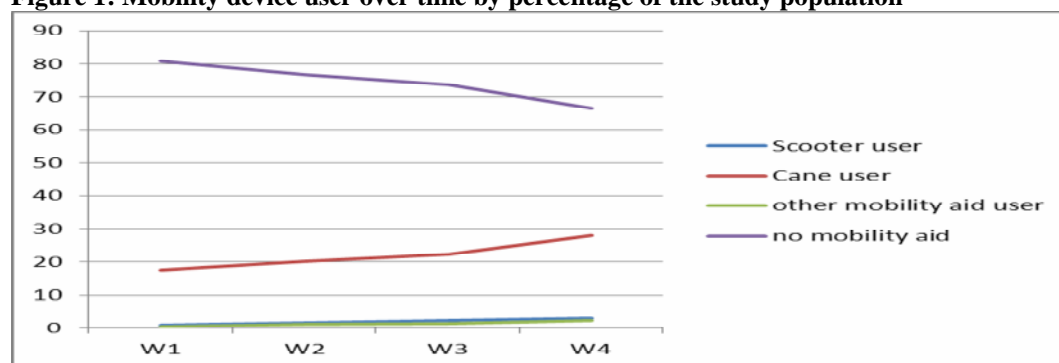
Physical Functioning

Walking Test
The ELSA walking test was designed to measure a participant's normal gait. In this test participants were timed to walk a distance of 2.44 meters (eight feet). At the start of the test, each participant was asked to stand with both feet together. The test started when the participant placed either foot across the start line and finished when the first foot touched the finish line. Participants were asked to walk at their "usual" pace. Given the short distance of the test and the fact that the test takes place in the participant's own home, the incidence of non-completion can be taken as an indication of impairment. The test was carried out twice in each of the two 'nurse waves'. In this analysis the scores of the two tests from each visit have been averaged together and the results shown in table 1 below.

Table 1: Time taken to complete walking test in seconds in waves 1 and 4

|	Wave 1	Wave 4
Scooter user	6.02	6.74
Cane user	4.40	5.80
no mobility aid	2.92	3.52

Scooter users were found to have the slowest gait of the groups in all waves. In terms of change in gait between waves, cane users had the greatest decline in their gait speed and scooter users the least, however, these were not statistically significant. No significant differences were found between the four groups.

Crucially the number of scooter users and cane users who were able to complete the walking test was low in both waves. For instance, as shown in Figure 2, only 60% of scooter users were able to complete the test in W1 and this had reduced to 45% by W4. This inability to carry out the test masks a larger decline by scooter users than the completed scores in able to show. Additionally it is interesting to note that whilst by W4 less than half the scooter users were able to complete a short gait test only 1 of the 20 scooter users had a health condition that prevented walking.

Table 2: Proportional change in walking speed between Wave 1 and Wave 4

	Change in walking speed between Wave 1 and Wave 4
Scooter User	12% slower
Cane User	32% slower
Unaided	21% slower

Figure 2: Graph showing the percentage of each user group able to complete the tests at each wave stage.
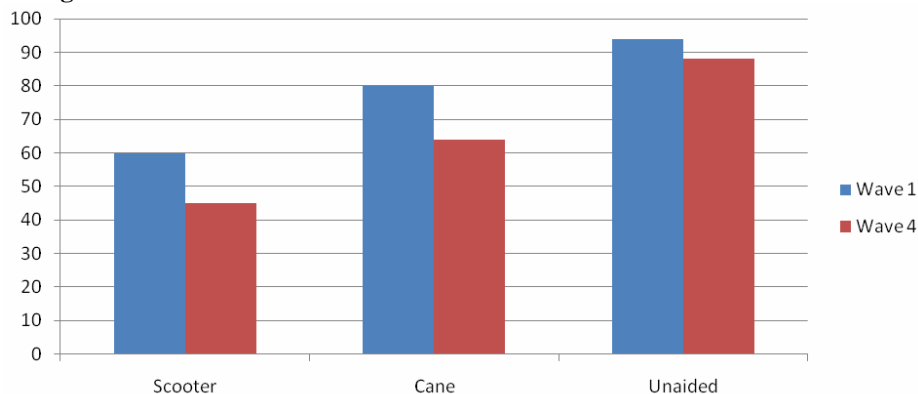
Chair Rise Test

The chair rise test measures the length of time it takes an individual to stand up from a chair without the aid of their arms, an aid or the support of someone else. The test was carried out during the nurse visits of waves two and four. Those over 70 were asked to complete 5 rises and those under 69 were asked to complete 10 rises. In this analysis time taken to perform 5 rises only is used as the sample spans the age breakdown. If participants were not able to rise from a chair without assistance they were not allowed to take part. Additionally, if an individual became breathless, too tired or had not completed the rises after 1 minute the test was stopped.

All groups were found to be slower to complete the chair rise task over time. Scooter users took significantly longer than the other two groups. Scooter users took 28% longer in wave 4 than in wave 2 to complete 5 chair rises, cane users took 3% less time in wave 4 than wave 2 and those with no mobility aids took 5% longer.

The percentage that was unable to complete the test increased in all groups over time. The change in percentage of a user group unable to complete over time is greatest in scooter users. A total of 10% of scooter users were unable to complete in wave 4 who were able to complete in wave 2, higher than the additional 7% of cane users and 4% of no mobility aid users. This indicates that scooter users face steeper declines in capability over time than both cane users and no mobility aid users.

Table 3: Percentage of users unable to complete single and multiple chair rises

	Percentage unable to complete a single chair rise		Percentage unable to complete 5 rises	
	Wave 2	Wave 4	Wave 2	Wave 4
Scooter user	60	80	70	80
Cane user	38	52	51	58
No aid	8	18	17	21

Grip Strength

The grip strength test measures the strength of each arm and hand. Individuals were required to squeeze the gripometer as strongly as they could manage for a couple of seconds. The test was carried out three times for each hand, alternating between hands.

Grip strength is known to vary by gender and decline with age (Melzer et al. 2006). Additionally the ability to complete the task also declines with age, although not as greatly as with other tests, for instance walking test as shown later in table 5.

Table 4: Grip Strength scores in kilograms

	Wave 2	Wave 4
Scooter user	22.07	17.81
Cane user	21.94	19.20
No aid	27.27	24.69

In ELSA three measurements were taken in each hand at each nurse visit. For the analysis here the three scores were averaged together. The analysis showed that our sample all decrease in strength over time, in dominant and non dominant hands. Scooter users show the greatest declines in strength and those who use no mobility aids the least decline. Of those in each group who completed the test scooter users lost the most grip strength in their dominant hand in terms of proportion, losing 19% of the strength they previously had in wave one by wave four. Cane users lost 12% of their strength, whilst those using no mobility aids lost only 9%.

Ability to complete the tests was different across the mobility groups. Whilst 95% of those without mobility aids and 93% of those who used canes were able to complete the tests on both occasions, only 80% of scooter users were able to complete.

Body Mass Index
Body Mass Index (BMI) is used as a general measure of obesity measures height and weight to have a general indication of body fat. While criticised for not being an accurate measure BMI is a commonly used measure by both the medical profession and the general population and can be an indicator of suitable weight for height. BMI was measured during the nurse visit sessions in waves two and four. The scooter user mean BMI in W2 was 30 and in W4 was 32 (both of which are classed as obese). For cane users the mean BMI in W2 was 30 and in W4 was 29 (classed as obese and overweight respectively). The mean BMI in W2 for non-mobility aided was 27 and in W4 was 27 (classified as overweight). Scooter users gained on average 0.5 of a BMI point. Cane users lost 0.13 of a BMI point. Those who used no mobility aids gained 0.6 of a BMI point. In W2 there were no significant differences in BMI between scooter users and other groups. However by W4 the BMI of non-mobility aid users was significantly lower than scooter users and cane users. However the rate of change in the BMI scores was not found to be significant across the groups.

Lung Function
A general measure of the functionality of the lungs is called Forced Expiratory Volume (FEV). The participant is required to inhale as deeply as possible, and then exhale into the spirometer as hard as they are able, for as long as they are able. The volume of air that can be forcibly exhaled after a full intake of breath is measured. FEV declines over the two visits (a period of six years) were on average minimal. Scooter users show the biggest declines in capacity whilst no mobility aid users the least, however, not significantly. Once more, scooter users were most likely not to be able to complete all tests with

80% completing compared to 83% of cane users and 88% of non mobility aid users.

Discussion

The above results, whilst not all significant, do show differences between scooter users and other participants. The differences show that scooter users have worse health than other participant categories both at specific points in time and steeper declines in health over time.

Few significant differences in decline have been found for the tests on physical capability. However, this masks greater differences between the groups. Whilst the scores on the test themselves don't reveal many statistically significant differences between the groups the completion rates provide evidence towards scooter users capabilities declining at faster rates. In all physical tests scooter users are most likely not to be able to complete the tasks. This shows a much high level of incapacity that the absence in the scores hides.

Comparing completion rates in the W2 Nurse visits with completion rates in the W4 nurse visits show scooter users are the most likely to become incapable of completing physical tests. The table below illustrates this by showing the percentage of the sample which were previously able to complete the tests (in W1 for walking and in W2 nurse visits for the other tests) but by the last measurement taken (in either the wave 4 interview or wave 4 nurse visit) were no longer able to complete the test.

Table 5: Percentage that completed first tests but were unable to complete final tests

	Chair Rise	Walk test	Grip Strength	Lung Function
Scooter users	10	20	20	20
Cane users	7	7	1	17
No aid	4	3	1	12

Limitations

There are a number of limitations to using ELSA data to answer questions regarding the health of scooter users. Despite the limitations, the results above indicate that there is some evidence towards scooter use having negative effects on health and provides a case for further investigation using a larger sample size and distinctly different methodology.

None of these results show that the scooter is the cause of the differences. Are the scooter users performing worse on these health and mobility tests because they use scooters or are they using scooters because they have the worst health and mobility. This question cannot be answered using the analysis possible on the ELSA data. We cannot be sure that the underlying health conditions that have led people to use scooters do not cause the differences shown at any specific wave or over successive waves. Whilst ELSA does include data about underlying conditions, separating the groups by other health conditions would reduce group size to single participants in many cases and would not provide any detailed information. This is a limitation that can be addressed by the larger study of which this paper is a part. The sample of participants in the wider study could have similar health states and none of the participants at the beginning period of the study will be

scooter users. This will make the groups of scooter users and non scooter users evenly matched at the study baseline.

The need for individual participant data from all waves has resulted in a reduction of scooter users in the subset analysed in this paper. The number of scooter users participating in ELSA in wave one was 77, by wave four this has reduced to 20 users. Not only are the number of scooter users low but the number who complete many of the physical tasks is lower still, for example only seven of the 20 scooter users complete the chair rise task in wave two and only four completed it in wave four. Whilst this is a result in itself, showing scooter users have low physical capability, the low number of completions does dilute the reliability of the statistical results.

The low retention of scooter users also raises a potential selective attrition limitation within the ELSA cohort. Those participants who participate in all waves could be healthier and therefore skew the data to a more positive outcome. Physically active people may have more of an interest in the tests and their results than those who are less active. To understand what effect any selective attrition has on the subset there is a need to be able to test whether and how the people who stayed in the ELSA sample differed from the people who dropped out. As we only examined participants who had data in all waves those participants who have died between waves one and waves four are excluded from the subset used. By wave three, almost 60% of the scooter user dropouts were caused by death compared to 33% of non scooter user dropouts. This means that the scooter users in the sample may represent a slightly healthier sample of scooter users than of scooter users in the wider UK population.

This analysis has concentrated on the scooter users who were scooter users in wave one. It has not taken into account the scooter users who were not users in wave one but became scooter users in subsequent waves. To address this limitation participants were further divided into three categories (a) scooter users in wave one (old scooter users) ; (b) non scooter users in wave one but users in one of the subsequent waves (new scooter users) and (c) non scooter users in all waves (non scooter users). Examining walk test time in wave four showed that those who didn't use scooters had significantly faster times than either old scooter users and new scooter users but that no significant difference existed between the two scooter user groups.

Conclusion
Older people who use mobility scooters perform worse than other old people, both in specific instances and over time. Additionally, mobility scooter users have the highest rates of non-completion of physical tasks due to incapacity. The reasons behind the low scores and declines in capability are unclear and cannot be unearthed using the currently available data. However, scooter users poor record shown here indicates the need for it to be investigated, something which the follow up research will achieve.

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Appendix A

Cane

Definition: a stick held in the hand to support the weight and balance of an individual whilst walking. Generally made of light weight metal or wood. The definition here does not include "long cane" as used by a visually impaired person.

Alternative names: stick, cane

Scooter

Definition: A personal transport vehicle constructed similar to a motor scooter (or moped) and used as a mobility aid. A solely battery operated device; it usually has three, four or five wheels. Different scooters can be ridden either on the pavement or the road depending on speed capability.

Alternative names: power-operated vehicle/scooter, electric scooter, mobility scooter

Walker

Definition: a metal structure on wheels or casters with waist high handles usually used by a frail or disabled person to support them while walking. Generally has three or four casters/wheels and sometimes has an inbuilt seat.

Alternative names; Zimmer frame, Walking Frame, Rollator

Wheelchair

Definition: A personal transport device in the form of a chair which is supported on large wheels and casters. Generally used by people who cannot walk at all. The user can be pushed from behind or self propelled.

Electric Wheelchair

Definition: A wheelchair that is driven by an electric motor rather than manual power.
Alternative names: motorized wheelchair, powerchair, or electric-powered wheelchair

Crutches

Definition: Similar to canes but their forearm or under armed weight bearing means they are able to bear a greater load.