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# Public Transportation and Mobility Enhancement Exercises as Support for the Independent Mobility of Older Family Members

## Abstract:

An independent life for older family members depends on their physical condition as well as on the quality and accessibility of public transport. Together it has a significant impact on social interactions of community-dwelling older adults, their participation in the community and the family. One of the aims of the project was to research the habits, perceptions and satisfaction of older public bus users and to develop and assess an exercise programme for mobility enhancement. The results of the research indicate that older public bus users are satisfied with the bus services on average. Visual impairment, musculoskeletal pain and balance impairment are the most common health problems of the public transportation user and were emphasised in the mobility enhancement programme that was developed for community-dwelling older adults.

**Keywords:** *community-dwelling older adults, mobility, independent life, exercise programme*

## Introduction

Active participation in the community, family and leisure activities well into advanced age are important personal goals for the majority of community-dwelling **older adults**<sup>1</sup>. Leading an independent life is related to and affects the self-perception of the quality of life, as

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<sup>1</sup> Community-dwelling older adults are persons older than 65 years that live in the community.

well as to satisfaction with it. Since most of these activities are related to changing location, the quality and accessibility of **public transport** is expected to have an important impact on social interactions. Access to public transport can thus prevent social exclusion and can add to building social capital. We may well accept the notion that traffic and services have important consequences for **social networks** in advanced age (Boniface, Scantlebury, Watkins & Mindell, 2015). Reports show that due to significant public transport disadvantages, older adults are often limited in their participation in community interactions (Iwarsson & Stahl, 1999). Public transport is, therefore, a necessary condition for the older adults to maintain their **quality of life** by being able to participate in family, social and leisure activities (Boniface et al., 2015). Besides, the independent use of means of transport by the older adults results in great relief for more able family members in terms of the concerns, time and effort for the required support. Therefore, as a part of our project “Helping Families in the Community: Co-Creation of Desired Changes for Reducing Social Exclusion and Strengthening Health”, special attention was given to the **mobility** opportunities and possible disadvantages and improvements for older family members. This was performed on two levels: firstly, the habits, perceptions and satisfaction of older public bus users were determined using a survey in the city of Ljubljana and secondly, a special **exercise programme** for enhancing mobility skills was developed and evaluated.

These activities are very important since it is expected that the need for public transportation for older adults (over 65 years of age) will increase in the near future. It is estimated that by the year 2050 25.1 % of the population in the OECD countries will be of that category, while this estimation is 20 % for Slovenia. And in the metropolitan areas, this increase is expected to be even higher (OECD, 2015). It is suggested that their travel needs will be highly heterogeneous in relation to their **travel habits** and their motor, sensory and cognitive impairments (Hensher, 2007). These facts need to be considered by the transport providers and transport planning authorities. Therefore, the potential of mobility for older adults and the quality, accessibility, usability and affordability of public transportation is an important indicator of the quality of life of the older adults, especially in metropolitan areas.

Age-friendliness is a policy approach to making services and environments more usable for the specific needs of older adults and thus promoting improved opportunities for social participation, active ageing and health (WHO, 2007). Transport providers and transport planning authorities are therefore expected to adjust their policies and action plans in accordance with the needs of the older adults. It has been reported that in USA and Canada, 1-18 % of all trips by older adults are made using public buses (Banister & Bowling, 2004), while a somewhat higher percentage (30%) has been reported for the UK

(Broome, McKenna, Fleming & Worrall, 2009). On the other hand, it has been recognised that ageing is also associated with a decreasing number of trips using public transportation, as well as with shorter distances travelled (Metz, 2000).

Older adults reported that they would be willing to use public transport if it were designed to meet their needs (Broome et al., 2009). **Obstacles to the use of public transportation** were identified as: difficulty getting on and off the vehicles, the distance and height of the kerb, the presence of steps, the speed of driver start-up, the friendliness of the driver and comfort during travelling (Broome, Nalder & Worrall, 2010). Another issue with public transportation use in advanced age is the problem of non-collision accidents resulting in injuries. It has been reported that 64.3 % of all public transport injuries in the UK resulted from non-collision incidents (Kirk, Grant & Bird, 2003). The same study showed that 5.6 % of the incidents on UK buses resulted in serious injuries and that 9.4 % of all incidents occurred while boarding, 17.2 % while alighting, 29.7 % to standing passengers and 43.7% to seated passengers (Kirk et al., 2003).

Ljubljana is a central European city with 287,000 inhabitants, 24 % of them older than 60 years (MOL, 2013a). Therefore, an initiative was issued in 2013 to make it an **older adults friendly** city. This initiative included also the increased demand for public transportation for the older adults. An action plan called “Age-friendly Ljubljana 2013-2015” (MOL, 2013b) included goals in the field of increased accessibility to public transportation for older inhabitants. As an initial result, the local authorities issued a brochure addressing the older public transportation users emphasising their safety during boarding, transportation and embarking (MOL, 2011).

To assist in developing up-to-date policies for the transportation of older inhabitants, insight is needed into the current habits, frequent difficulties and obstacles that older bus users are confronted with, as well as information on their satisfaction with the current service.

The purpose of the present study was thus to evaluate the habits, perceptions and satisfaction of older bus users with the current Ljubljana public transportation services. This information was used for the preparation of mobility enhancement exercise programmes. Additionally, knowledge of the habits, physical impairments and complaints of older bus service users served as a basis for the preparation of recommendations for older public transportation users and for transportation providers. The results presented in this paper are an important contribution to the project. They can help in improving the environment leading to a more independent lifestyle for older family members, which could result in relief for more able family members in terms of the concerns, time and effort for the required support.

## Methods

A structured **questionnaire** was used to determine the **habits**, perceptions and satisfaction with Ljubljana public transportation services. For this purpose, a Scandinavian questionnaire (Svensson, 2003) was adopted and validated for the Ljubljana situation. The translated and adapted questionnaire was first validated using a small sample of Ljubljana public transport users. The final version was then performed as a structured interview of randomly chosen bus service users. Specially trained undergraduate students of occupational therapy performed on the spot interviews. The questions were of two types, the first part consisted of multiple choice questions while the second was a list of 13 statements related to satisfaction with bus services. Participants were asked to rate these statements on 5 point Licart scale where 1 stands for completely disagree, 2 disagree, 3 neither disagree nor agree, 4 agree, 5 completely agree.

**Satisfaction with the mobility enhancement programme** and its efficacy were assessed with two questionnaires. The Satisfaction questionnaire, aimed at finding the level of satisfaction with the exercise programme, consisted of 15 statements on the programme that were rated on a 5 point Licart scale. The Global Rating of Change scale (hereinafter: GRC) (Kamper, Maher & Mackey, 2009) was used to quantify the **effect of the mobility exercise programme**. The magnitude of the perceived change was scored using a numerical scale where 0 means no change, the maximum score for positive change is +5 and the maximum score for negative change is -5. The GRC scale is known to be valid, reliable and has good reproducibility (Kamper et al., 2009)

## Study Sample

The sample of participants is regarded as a convenient one. Public transportation users in Ljubljana were approached at a bus stop after the completion of their journey or while waiting for the bus. Participants were approached on 6 different bus lines and four different bus stops. All the bus stops were in the city centre and were chosen so that all bus journeys had also begun in the city centre. 195 public transport users were invited to respond to the structured interview. 80 refused to participate while 14 of them were later excluded from the analysis due to their younger age than the required 60 years. Thus 101 structured interviews remained for the final analysis. The average age of respondents was  $74.2 \pm 7.1$  years, 30% males and 70% females. The age structure of the respondents

was 47% in the age group between 60 and 69 years, 38% between 70 and 79 years, 23% between 80 and 89 years and 3% 90 years or more.

A convenient sample of thirty-one older adults aged  $70.1 \pm 6.1$ , 28 females and 3 males, height  $163 \pm 7.5$  cm and weight  $66.5 \pm 11.6$  kg, who participated in the mobility enhancement exercise program twice a week were asked to rate their satisfactions and change in mobility as a result of the participation.

## Procedures

The **model** is described in detail elsewhere (Rugelj, 2016). In brief: The mobility enhancement exercise programme developed by our team is based on the system model of motor control (Shumway-Cook & Woollacott, 2012), of balance assessment (Horak, 2006) and on the results of multi-component balance-specific training of the frail (Rugelj, 2010) and community-dwelling older adults (Rugelj, Tomšič & Sevšek, 2012); fallers and non-fallers, as well (Rugelj, Tomšič & Sevšek, 2013a). The reported exercise programme increased balance and resulted in a longer tandem stance, decreased postural sway on a firm and compliant surface with open and closed eyes, significantly increased gait speed of both nursing home residents (Rugelj, 2010) and of community-dwelling older adults (Rugelj et al., 2012). Key components of balance were addressed in a series of balance-specific exercise for the older adults where biomechanical constraints, movement strategies, sensory strategies, orientation in space, control of dynamics and cognitive processing were included. This multi-component programme was organised as circuit training. The components of the modelled balance-specific programme are: 1. changing the centre of gravity position in the vertical direction and its shifting to the border of stability, 2. rotation of the head and body about the vertical and horizontal axis, 3. standing and walking on a soft supporting surface 4. walking over obstacles, on a narrow path and changing direction, 6. multitasking.

## Statistical Methods

The Statistical Package for Social Sciences (SPSS 23, SPSS Inc., Chicago, IL USA) was used for statistical analysis. Descriptive statistics were calculated for the questionnaires and the results of the GRC scale, as well as the graphical presentation.

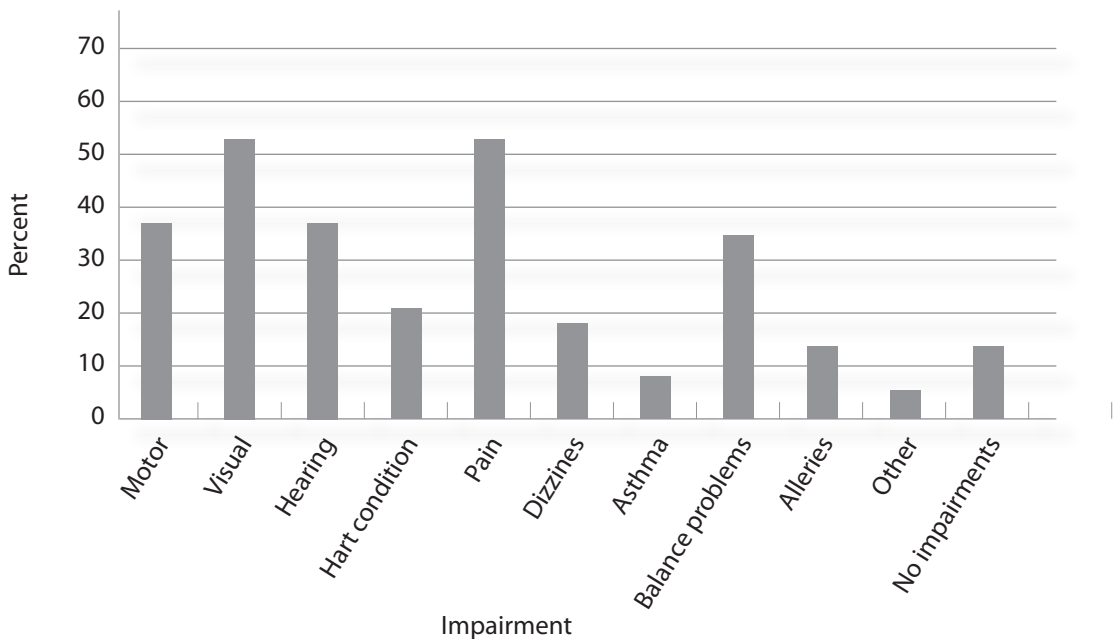
## Results

The results are presented in two parts: firstly the results of the bus users' survey, physical impairments and habits followed by perceptions of the quality of services. The second part presents the results regarding the mobility enhancement exercise programme for community-dwelling older adults: beginning with the satisfaction with it and followed by the perceived efficacy of the programme.

### Bus service survey

The respondents' perceived **physical impairments** expressed as percentages of the frequencies for all of the reported physical limitations are presented in Figure 1. The most frequent answer was **decreased vision** (53%), followed by motor impairment (37%) and **balance problems** (36%). Only 12.4% of the respondents reported no physical limitations. Of those who reported physical limitations, 33.7% perceived their physical limitations as making their travelling difficult. The number of reported physical limitations per respondent ranged from 1 to 7, averaging  $3 \pm 1.6$ .

Figure 1 *The percentage of individual physical limitations as reported by the respondents*



When asked to estimate their **physical fitness**, the majority of the participants reported being able to walk more than 300 m while 37% of respondents reported using a walking aid during outdoor walking. The most usual type of walking aid reported was a walking cane followed by crutches.

The **frequency of public bus** use by the respondents was 37.6% daily, 41.6% weekly, 8.9% monthly and 11.9% seldom use public transportation. On average, the respondents reported making  $9 \pm 6.7$  one-way journeys per week using the services of Ljubljana public transportation.

The bus users most often have to **walk** between 50 and 150 metres (34.7% of respondents) to the nearest bus stop, followed by 32.7% less than 50 metres, 21.8% between 150 and 300 metres and 10.9% more than 300 metres. The walking time to the nearest service bus stop was  $6.87 \pm 4.2$  minutes on average.

When asked whether they could **sit** during the journey and whether they were offered a seat, 66.3% of the respondents claimed to be offered a seat, of those who were offered a seat, this was done voluntarily in 41.6% cases and upon request in 24.8% cases, while 33.7% of the participants reported that they were not offered a seat. 83.2% of the respondents reported that they had enough time to take a seat before the bus drove off while 16.8% reported that there was not sufficient time to safely sit down.

Perceptions of the **quality of services**, which was the second part of the interview, consisted of 13 statements related to satisfaction with the services, such as “You are treated well on the bus”, and respondents were asked to rate the statements on the five-point Licart scale. The responses indicate the passenger’s satisfaction with the bus service. The majority of the respondents agreed with these statements. The detailed frequencies expressed as percentages are given in Table 1.

**Table 1** *The frequencies of agreement or disagreement with the 13 statements related to satisfaction with the bus services expressed as a percentage*

	Complete-ly disagree	Disagree	Neither disagree Nor agree	Agree	Com-pletely Agree
a. Travel on the bus is fast	2	5	31.7	40.6	20.8
b. Travel on the bus is comfortable	3	10.9	28.7	35.6	21.8
c. Travel on the service lines is cheap	5.9	12.9	23.8	33.7	23.8
d. There are enough bus departures	1	5.9	27.7	44.6	20.8
e. There is a bus stop nearby (your residence)	0	8.9	7.9	30.7	52.5
f. You are treated well on the bus	0	11.9	31.7	26.7	29.7
g. There is no problem finding a seat	4	20.8	27.7	24.8	22.8
h. It is easy to change buses	0	11.9	13.9	30.7	43.6
i. It is easy to enter and exit the bus	0	17.8	22.8	22.8	36.6
j. There is enough time to take a seat	4	29.7	24.8	18.8	22.8
k. Travel on the service bus is pleasant	0	7.9	29.7	30.7	31.7
l. I am satisfied with the bus services	2	4	23.8	41.6	28.7
m. The bus drivers are friendly and helpful	1	13.9	20.8	37.6	26.7

## Mobility enhancement exercise programme

The results of the questionnaire (Table 2) indicate that the participants were satisfied with the exercise programme (4 – I agree, 5 – I absolutely agree). The pace of exercises received the lowest average score and therefore this will be the ground for exercise pace adjustments.

Participants in the mobility enhancement exercise programme rated their **perceived efficacy** using a GRC scale and 52 % of the participants reported the perceived improvement as +3 (out of max. +5) and 17% as +2. The perceived improvement in confidence in mobility was rated by 43% of participants as +3 and 26% as +2.



Table 2 *Responses to the satisfaction questionnaire*

	Question	Average score
1	The variety of exercises is appropriate	4.6
2	The exercises are appropriately challenging	4.5
3	The exercises are performed at appropriate pace	4.3
4	I like the music during exercise	4.4
5	There is enough rest between exercises	4.9
6	I feel safe during the exercise	4.9
7	The instructor appropriately leads the exercise	4.9
8	I like the involvement of students in the programme	5
9	I feel good in the group	4.9
10	After the exercises, I am pleasantly tired	4.9
11	In addition to exercise, I like socializing with the group	4.7
11	I feel better since I started attending the exercise	4.6
12	My family and friends support me for exercise attendance	4.6
13	Participation in measurements is interesting	4.8
14	I am looking forward to being informed about the results	4.9
15	I would like to continue attending the exercise program organised by Faculty of Health Sciences	5

## Discussion

Living in a community with good **public transportation** is a “building block” of the quality of life (Banister & Bowling, 2004). In order to provide a comprehensive understanding of public transportation usability, one should not just consider the physical and sensory environment, but also social, cultural and institutional factors need to be taken into account. One of the purposes of our research was thus to assess the **habits, perceptions and satisfaction** of older public transportation users in the Ljubljana metropolitan area. The results indicate that they are satisfied with the bus services in Ljubljana on average.

The age distribution of the respondents indicates a high proportion of the **younger older adults**<sup>2</sup> public transportation users. The majority of the participants in our on the spot street survey were female and aged between 60 and 70 years. The overall gender distribution of the participants was 70% in favour of female participants. These results do not reflect the gender distribution of the inhabitants of Ljubljana (MOL, 2013). However, this

<sup>2</sup> The diversity of old age is recognised by defining sub-groups: young-old (65 to 74), middle-old (75–84), and oldest-old (85+).

gender distribution of bus users corresponds to those previously reported: Banister and Bowling (2004) reported 60% female bus users while Kirk, Grant and Bird (2003) claimed that there were three times more female bus users than male ones.

The reported frequency of bus use indicates that 80% of the respondents were **regular users** of bus services. Those who rarely use the bus service were predominantly in the oldest age group. The lower number of very old public transportation users was also reported by Banister and Bowling (2004). While the distances travelled using other means of transportation decrease with age, presumably due to the reduced use of other means of transport such as car, plane and walking, the distances travelled by bus increase with age (Banister & Bowling, 2004).

In general, older adults users of public transportation in Ljubljana are satisfied with the service provided. With 12 out of 13 statements that positively evaluated the bus services, more than 56% of respondents either agreed or completely agreed and between 20 to 30% of respondents neither agreed nor disagreed with the statements. The highest percentage of disagreement was with the statement on sitting and boarding the bus: 25% of respondents reported problems **finding a seat** and 34% of respondents reported not having **enough time** to sit down before the bus started to move. Finding a seat and having enough time to sit down are two areas where Ljubljana public transportation services could improve. Another area with unsatisfied users is entering and exiting the bus since 18% of the respondents reported having difficulties entering and exiting. Difficulty getting on and off the vehicles and the speed of driver start-up are commonly reported in other studies as a major obstacle to the use of public transportation by older service users (Broome, 2010). It has been reported that 9.4% of injuries happen during boarding, 17.2% during alighting and 29.7% to standing passengers (Kirk et al., 2003). The major weakness of our study is the choice of participants - it was a convenient sample of participants travelling through the city centre. Of those approached, only those who were willing to participate could be analysed. It seems reasonable to assume that those who were willing to participate in the study belonged to the more satisfied end of the distribution. A randomised sample of all adult public transportation users would probably be needed to decrease the potential bias.

In 33.7%, the respondents reported that they perceived the use of public transportation as limited by their various physical conditions. In community-dwelling older adults, various health conditions can lead to less frequent trips and additional health conditions are strongly correlated with the incidence of traffic injuries (Hong, Lee & Jang, 2015), with the legs, back and chest being the most frequent sites of injuries (Hong et al., 2015).

Perceived **balance problems** were reported by 38% of respondents. Impaired balance alone is an important risk factor for accidental falls of older adults. Added to this is the inherently unstable supporting surface of the moving, accelerating and decelerating bus. Unfortunately, the accessibility of public transportation may also increase the possibility of incidents, especially for the more fragile travellers. Older adults are less resilient and more vulnerable to stress, and stressful events could lead to a reduction in concentration, physical balance and gait velocity (Hong et al., 2015). Therefore the mobility enhancement exercise programme is a possibility for community-dwelling older adults to increase their resilience to the stress of travelling by bus. Boarding, finding a vacant seat and preparing for getting off the bus are typical activities that require divided attention where a person needs to combine one or two motor tasks with a cognitive one. Additionally, carrying bags can add to a person's instability and may also occupy their attention. Studies of divided attention and multitasking have clearly shown that the balance performance of older adults while multitasking is reduced (Borel & Alescio-Lautier, 2014) and their gait speed is significantly lower while multitasking (Rugelj et al., 2013b). With appropriate training, the costs of multitasking can be decreased even at advanced age (Agmon, Belza, Ngujan, Logsdon & Kelly, 2014), although the training should be as specific as possible (Taube, 2011). Within the mobility enhancement exercise programme, we created situations similar to those encountered in public transportation and provide a close relationship between the training and functional situations.

The **impaired balance** that was reported by 36% of bus users is an important risk factor for accidental falls of older adults. Therefore, we tailored the mobility enhancement exercise programme accordingly. The creation of the programme, together with the survey of public transportation use and perceptions of older community-dwelling adults, was an inherent part and one of the aims of our project. Since awareness of the benefits of balance maintenance exercises is increasing among the older adults, more and more decide to participate in the programme before serious mobility problems occur. These **balance-specific programmes** are reported to be effective in various components of balance, given a sufficient frequency and number of repetitions (Shubert, 2011). Therefore, we assessed the perceptual domain of the exercise programme with the assessment of satisfaction and the GRC scale. With an average of 4.6 on the five-point Licart scale, the mobility exercise programme is liked by the participants. And when assessing the perceived impact of the programme on their mobility, the majority of participants rated the change as +2 and +3 (of maximum +5). The global aspect of the measure allows the participants to rate the aspect of mobility they consider important and most relevant to them. It is reasonable to

believe that such high ratings of the impact of the programme may also reflect when the participants are bus service users.

The programme was organised as **circuit training** and therefore we additionally assessed the time needed for the efficient performance of each station in the circuit. The results indicate that 7 minutes per station is optimal. Satisfaction with the balance-specific programme was very high and its adherence rate was 70%. The results indicate that the safety during exercises received the highest and the pace of the exercises the lowest average score. Based on the assessment of the feasibility of the programme, the improvement of balance and satisfaction with the programme, we can conclude that the mobility enhancement exercise programme is **feasible, effective, well-liked by the participants and perceived as efficient**.

## Conclusion

In conclusion, older inhabitants of Ljubljana metropolitan area **frequently** use the public transportation services despite their physical weaknesses, they perceive travelling on buses as **pleasant** and in general the respondents are **satisfied** with the services. There is still an opportunity for improvement in the promotion of voluntarily offering seats to older fellow passengers. Our specially developed mobility enhancement exercise programme proved to be efficient and well-liked by the participants. It would thus be desirable to consider the means of including a much larger number of the older adults in it in an effort to enhance their independent participation in the community and to enable them to participate in family and social life as long as possible. Keeping older family members **independent** provides relief for other family members in terms of the concerns, time and effort required for support.

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# CO-CREATING PROCESSES OF HELP: COLLABORATION WITH FAMILIES IN THE COMMUNITY

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