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Task Modifications in Walking Postpone Decline in Life-Space Mobility among Community-Dwelling Older People: A Two-year Follow-up Study

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ABSTRACT

BACKGROUND: Task modification refers to performing a task differently than before. While task modification in walking may be a sign of looming walking difficulty, it may also be adaptive in and postpone the decline in life-space mobility. However, this has not been studied. This study examined whether changes in life-space mobility over a two-year period differ between people who at baseline report no walking difficulty and no task modification, those who report no walking difficulty but task modification, and those who report walking difficulty.

METHODS: Community-dwelling people aged 75-90 years were interviewed face-to-face at baseline (N=848), and over phone one (n=816) and two (n=761) years later. Life-space mobility was assessed annually with the Life-Space Assessment (range 0-120, higher scores indicate better life-space mobility). Self-reported ability to walk 2 km was assessed at baseline and categorized into 'no difficulty', 'no difficulty but task modifications' (reduced frequency, given up walking, walking slower or resting during walking) and 'difficulty'. The analyses were adjusted for age, gender, number of chronic conditions, cognitive impairment, lower extremity performance and education.

RESULTS: The life-space mobility score was highest and remained stable over 2-years among those with no walking difficulties at baseline and lowest and showing a steady decline among those with walking difficulties. Those with task modifications formed the middle group. They showed no marked changes in life-space mobility during the first year, but significant decline during the second year.

CONCLUSION: Task modifications in walking may help community-dwelling older people to postpone life-space mobility decline.

KEYWORDS: Aging, Adaptation, Participation, Mobility, Disability

INTRODUCTION

Older people who do not move outside their home are at serious risk for isolation from society, loss of independence and decline in mental health and physical functioning, and even at increased risk of mortality (1-3). Restricted mobility outside the home is the most common form of participation restriction in old age (4). Finding ways to maintain and improve mobility outside the home may help promote active agency and participation in society among older people.

Life-space mobility reflects participation in out-of-home activities by showing where, how often, and with what kind of help people move about, and thus informs us about how effectively people are able to access different community amenities and participate in life situations and society at large (5). It takes into account all forms of mobility from walking to driving and using public transportation. Decline in life-space mobility is associated with adverse health events, such as increased use of health services (6), nursing home admissions (7) and even mortality (8). Such decline is also associated with decline in quality of life in the community-dwelling general population (9). While decline in life-space mobility is common with increasing age, some people are able to maintain their life-space mobility despite chronic diseases or age-related changes in physical functioning (5). However, less is known about the behavioural modifications that older people use to maintain their community mobility when facing declining health and physical capacity.

It has been shown that disability, that is difficulty or inability performing activities (10), is preceded by a phase in which people change their way of performing tasks but do not yet report difficulty. These changes, termed task modifications, are conscious or subconscious

choices such as doing tasks more slowly, resting in the middle or using support. In their physical performance (e.g. muscle power, walking speed), older people reporting task modifications in walking constitute an intermediate group between those reporting no walking difficulty or modification and those reporting walking difficulty (11). Previously, task modifications have mainly been studied as early signs of disability (12-15).

We suggest that task modifications in walking are not only maladaptive signs of declining health and physical functioning, but may also be adaptive. Task modification may enable older people to reduce the physiological demand of the task and thus compensate for their reduced physical capacity. For example, we have previously shown that task modifications help to alleviate the environmental influence on the development of mobility difficulty (16). This is potentially useful as it may help postpone task difficulty and thus preserve participation.

It is not known whether task modifications in walking may help maintain life-space mobility, a measure of community mobility and an indicator of participation. We hypothesize that task modifications in walking may postpone the decline in life-space mobility. This study examined whether changes in life-space mobility over a two-year period differ between people who at baseline report no walking difficulty and no task modification, those who report no walking difficulty but report task modification, and those who report walking difficulty.

METHODS

Study design and participants

This study is part of the "Life-space mobility in old age" (LISPE) project, which is a two-year (2012-2014) prospective cohort study on life-space mobility among community-dwelling older people in Central Finland. The study design, methods and non-response analyses have been reported in detail previously (9, 17). Briefly, a random sample of 2550 community-dwelling- 75- to 90-year-old residents of the municipalities of Jyväskylä and Muurame was drawn from the national population register. Inclusion criteria were: community-dwelling in the study area, and able to communicate and provide an informed consent. In total, 848 eligible persons agreed to participate and were home-interviewed during spring 2012. Of these, 816 participated in the one-year follow-up and 761 participated in the two-year phone follow-up.

The LISPE project was approved by the Ethical Committee of the University of Jyväskylä, Finland. The study was conducted according to the guidelines for good scientific and clinical practice laid down by the Declaration of Helsinki. Participants were informed about the research and signed a written informed consent prior to the baseline interview.

Measurements

Life-space mobility

Life-space mobility was assessed using the Finnish version of the University of Alabama at Birmingham (UAB) Study of Aging Life-Space Assessment (LSA) (18, 19) at baseline and the one- and two-year follow-ups. The LSA captures mobility based on the distance through

which a person reports moving during the 4 weeks preceding the assessment. The items establish movement patterns in specific life-space areas (home, outside home, neighbourhood, town, beyond town). The life-space mobility score was calculated for each life-space area by multiplying the life-space area (from home to beyond town, scores from 1 to 5 respectively), the frequency of moving in that area (1 = less than once a week, 2=1–3 times a week, 3=4–6 times a week, and 4=daily) and the degree of independence in that area (2 = no assistive devices or help from another person, 1.5 = using assistive devices only, and 1 = need help from another person). Then area-specific values were summed into life-space mobility score (18). Score range from 0 to 120, with higher scores indicating better life-space mobility. The test-retest reliability of the Finnish version of the LSA has been found acceptable (intra-class correlation coefficient 0.72) (19).

Walking difficulty and task modification in walking

Difficulty in walking 2 km was assessed at baseline using a standardized questionnaire. First, the participant was asked whether she/he had difficulties in walking 2 km. Response options were: 1) able to manage without difficulty; 2) able to manage with some difficulty; 3) able to manage with great deal of difficulty; 4) able to manage only with the help of another person; and 5) unable to manage even with help. Second, those who reported being able to manage without difficulty (response option 1) answered a structured questionnaire about their use of four different task modifications in walking (13). The question was: “Have you noticed any of the following changes in walking 2 km?” The response options (yes/no) concerned reduced walking frequency, having given up walking 2 km distances, walking more slowly, and resting during walking the 2 km distance. If the participant reported any of these task modifications, they were classified as using task modification in walking. Three categories were then created; 1) no walking difficulties, 2) no walking difficulty but task modification in

walking, 3) manifest walking difficulties (minor or major difficulties or unable to perform the task). Those with no difficulties and no task modifications in walking (category 1) formed the reference group in the analyses.

Confounding variables

Age and gender were derived from the national registers. Years of education were self-reported. The number of self-reported physician-diagnosed chronic conditions was calculated on the basis of responses to a list of 22 diseases and an additional open-ended question asking about any other physician-diagnosed chronic conditions (20). Cognitive impairment was assessed with the Mini-Mental State Examination (MMSE) (21). Lower extremity performance was objectively assessed with the Short Physical Performance Battery (SPPB)(22), which included assessments of standing balance, walking speed over 2.44 meters, and timed chair rises (five times). Each task was rated from 0 to 4 points and a sum score calculated (range 0-12) when at least two tests were completed. Higher scores indicate better lower extremity performance.

Statistical analyses

Characteristics of the participants were described using means and standard deviations (SD) or percentages according to the walking categories. Differences in baseline characteristics between the categories were tested with the Chi Square test or one-way analyses of variance (ANOVA).

The longitudinal changes in life-space mobility according to the walking categories were studied by constructing Generalized Estimation Equations (GEE) models (23). First, the GEE model was adjusted for gender and age, after which the other confounding variables

(cognitive functioning, number of chronic conditions, lower extremity performance and years of education) were added to the model. The group difference represents the difference in the level of the life-space mobility score and the group by time interaction term represents the difference in time-related change in the life-space mobility score between the three walking categories.

A life-space mobility score was available for 806 participants at the 1-year follow-up and for 757 participants at the 2-year follow-up. Those who died (n=41) or were admitted to institutional care (n=15) during the follow-up were not included in the analyses. In case of missing data on the outcome variable, multivariate imputation by the chained equations procedure (24) in SPSS /GEE (version 20.0) was used in the GEE modelling and sensitivity analyses were performed. Data on life-space mobility were imputed for 35 people, and the unadjusted analyses were based on the data of 792 participants. Information was missing on SPPB for 9 participants and on years of education for 4 participants, and consequently these individuals were not included in the fully adjusted model. Thus the final fully adjusted model comprised 779 participants.

A value of $p<.05$ was taken as the level of statistical significance. Analyses were performed using IBM SPSS version 22.0 (SPSS Inc., Chicago, IL).

RESULTS

The mean baseline age of the participants was 80.6 (SD=4.3), and 62% of them were women. At baseline, 291 (34.3 %) reported no walking difficulty, 201 (23.7%) reported no walking difficulty but task modifications, and 356 (42%) reported walking difficulty. Table 1 shows the participant characteristics according to task modification in walking. Those with 'task modification' in walking formed an intermediate group between those with 'no walking difficulty' and those with 'walking difficulty' in their age, life-space mobility, MMSE score, education, SPPB score and number of chronic conditions (p for trend $\leq$0.004 for all).

At baseline, using those with 'no walking difficulty' as the reference, the life-space mobility difference of those with 'task modification' in walking was not statistically significant (Table 2; p for group difference 0.318). The pattern of change in life-space mobility over the two-year follow-up was, however, significantly different (group x time p=.014). The life-space mobility of those with 'no walking difficulty' at baseline remained unchanged over the entire follow-up. Among the 'task modification' group it showed a curved decline: it remained unchanged over the first year and declined during the second year. The 'walking difficulty' group had statistically significantly lower life-space mobility than the 'no walking difficulty' group at baseline (p for group difference <0.001), and their life-space mobility score declined continuously over the follow-up (group x time p<.001). All models were adjusted for age, gender, lower extremity performance, cognitive functioning, number of chronic conditions, and years of education. The sensitivity analyses indicated no material differences in the associations due to imputation.

DISCUSSION

This study provides evidence to support our hypothesis that task modification in walking may be a form of adaptive behaviour that helps older people to postpone a decline in life-space mobility and thus potentially continue participation in their valued activities. In our study those with task modifications in walking showed no marked changes in life-space mobility during the first year, but a decline during the second year. Those with no walking difficulty showed no change in life-space mobility throughout the follow-up while those reporting difficulty had lower life space mobility at baseline, and subsequently showed steady decline. It is unlikely that the differences observed between the life-space mobility trajectories are explained by underlying differences in physical or psychological capacity, as the models were adjusted for objectively assessed lower extremity performance, memory and number of self-reported chronic conditions.

While task modifications are an indicator of declining health and physical capacity and could be used to identify people for rehabilitation interventions, they may also be viewed as a form of self-directed behavioral change that helps people cope with their declining health and physiological capacity in an adaptive way. We have previously shown that task modifications alleviate the environmental influence on the development of walking difficulties (16), a result which may partly explain our present findings. Life-space mobility reflects a person's mobility in the actual living environment (25). When physical capacity declines to a level that is critical for the successful performance of a given task, people may respond by trying to change the environment or the way they perform the task, e.g. slowing down their performance or resting in the middle of the performance. By changing their way of

accomplishing a task, people seek to optimize the balance between their reduced physical capacity and the environmental and task demands (26). It is possible that there are psychological differences between older people with functional decline who maintain a higher level of life-space mobility and those whose life-space mobility declines. This will form an interesting study question in the future.

Over the two-year follow-up, the decline in the average life-space mobility was approximately five points among those with task modifications and among those with walking difficulties at the baseline. For example, a decrease in frequency of going to beyond town (life-space level 5; unlimited) from daily to 4-6 times a week will lead to a 5-point decline in life-space mobility score. Similarly, the decline in frequency of attaining the neighbourhood from daily to 1-3 times a week results in a 5-point decline. Furthermore, if a person moves independently at the neighbourhood level daily, but starts to use assistive devices, that also results in a five-point decline, even if there are no changes in the frequency. However, among people with task modifications the decline happened later than among those with walking difficulties. This suggests that they were able to maintain their life-space mobility at its previous level for longer and potentially slow down the slope of decline. It is also worth noting that the five-point decrease indicates qualitatively different changes in life-space mobility depending on the starting value (27-29). For people who reach areas beyond their neighborhood independently (life-space mobility score over 60) a five-point decline in life-space mobility score may have rather small implications for their lives. For persons who use assistive devices when leaving their home and who rarely leave the immediate vicinity of home (life-space mobility score around 50), a five-point decline may indicate becoming almost completely home-bound, a situation that seriously threatens autonomy. Based on this we suggest that even though the absolute magnitude of life-space decline was similar among

those with task modifications and walking difficulties, the observed change relative to starting values implied less serious consequences for those with task modifications.

Strengths and limitations

Strengths of the study include the longitudinal study design with a two-year follow-up of a large population-based sample of community-dwelling older people. We were able to study annual changes in life-space mobility. The baseline age-range of 75-90 years was chosen as many people start to experience a progressive decline in mobility at around that time of life. Walking longer distances, such as the 2 km examined here, forms a measure of advanced mobility in which task modifications indicate early signs of functional decline, which may not be detected by traditional disability assessments.

The study has some limitations. The first is the use of self-reported modifications in walking instead of focusing on objectively evaluated modifications in physical functions, such as gait (30). However, self-reported modifications in walking reflect changes that people have noticed themselves and that they use in their actual living environment. It should also be noted that for some people task modification and walking difficulty may overlap. In fact, we observed in our previous study that practically all persons reporting walking difficulty had also changed their way of walking given distances (unpublished results). In this study, however, these categories do not overlap. Only people who reported no difficulty walking 2 km were asked about possible modifications. We do not believe that participants confused walking difficulty with the idea of being completely unable to walk 2 km, as the response options included ‘minor difficulty’, ‘major difficulty’ and ‘not able’, as a separate category (31).

Using assistive technology such as mobility devices is a common way to try to re-establish a balance between reduced physical capacity (e.g. reduced strength and balance) and task demands (walking). The use of mobility devices is incorporated in the calculation of life-space mobility. To avoid tautology, the use of mobility devices was not included in the categorization of task modifications in walking. Thus the difference in life-space mobility between the 'no difficulties' and 'task modifications' groups may be slightly underestimated.

Conclusions

The findings of this study lay a foundation for investigating task modifications in walking not only as an indicator of declining health, but as strategies that older people use to maintain their participation in the community. These results may serve as a justification for a more comprehensive research approach to modifications in different mobility tasks. Knowledge on the task modifications applied by people as they age has the potential to nurture the development of interventions to prevent restrictions on participation and so support older people to continue independent living in their own homes.

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Table 1. Participant characteristics by walking difficulty and task modification at the baseline (N=848).

Characteristics	No Difficulties n=291	Task Modifications n=201	Difficulties n=356	P-value
	% (n)	% (n)	% (n)	
Women	54.0 (157)	58.7 (118)	70.5 (251)	<.001
	Mean (SD)	Mean (SD)	Mean (SD)	
Age, years	78.4 (3.7)	79.8 (4.3)	81.7 (4.1)	<.001
Life-space mobility, score (range 0-120)	77.2 (15.6)	66.9±16.7	51.4±18.6	<.001
Cognitive functioning (MMSE score)	26.6 (2.5)	26.1 (2.8)	25.8 (3.0)	.004
Education, years	10.4 (4.5)	9.8 (3.7)	8.8 (4.0)	<.001
Lower extremity performance (SPPB score)	10.9 (1.4)	10.0 (1.9)	8.4 (3.0)	<.001
No. of chronic conditions	3.3 (2.0)	4.1 (2.2)	5.4 (2.4)	<.001

'No Difficulties', no difficulties walking 2 km and no task modifications

'Task Modifications', no difficulties walking 2 km but reporting reduced frequency, given up walking, walking slower or resting during the performance

'Difficulties', reporting at least minor difficulties walking 2 km

SPPB, Short Physical Performance Battery

MMSE, Mini-Mental State Examination

Table 2. Changes in life-space mobility over a 2-year period by walking category among community-dwelling people aged 75-90 years at baseline.

Category	Life-space mobility score						
	Baseline n=848	1-year Follow-up n=806	2-year Follow-up n=757			Group difference	Group*time interaction
	Mean ± SD	Mean ± SD	Mean ± SD	β	s.e.	p-value‡	p-value‡
No Difficulty	77.2±15.6	76.7±15.2	76.0±17.9	ref		ref.	ref.
Task Modification	66.9±16.7	66.9±18.1	62.5±18.0	-2.0	2.0	.318	.014
Difficulties	51.4±18.6	47.8±20.1	45.8±19.5	-9.7	1.7	<.001	<.001

‘No Difficulties’, no difficulties walking 2 km and no task modifications

‘Task Modifications’, no difficulties walking 2 km but reporting reduced frequency, given up walking, walking slower or resting during the performance

‘Difficulties’, reporting at least minor difficulties walking 2 km

ǂ GEE analyses.

Group*time interaction for time-related change in life-space mobility score in the walking categories, adjusted for age, gender, education, number of chronic conditions, lower extremity performance (SPPB) and cognitive functioning (MMSE).

Note: Life-space mobility score range 0-120; higher scores indicate better life-space mobility.

1