Mobility impairment is associated with urge but not stress urinary incontinence in community-dwelling older women: results from the Ossébo study.

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Title

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Abstract

Objective: to assess the association between functional limitations related to mobility and urinary incontinence (UI) in elderly women.

Design: observational cross-sectional study.

Setting: 9 "balance" workshops in France.

Population: 1942 community-dwelling women aged 75-85 years, who were invited, based on voter registration lists, to a "balance assessment".

Methods: Mobility and balance test results were compared between incontinent and continent women according to the severity and type of incontinence.

Main Outcome Measures: Data on UI were collected using a self-administered questionnaire (ICIQ-SF). Motor-related physical abilities were assessed using standardised balance and functional gait tests.

Results: 42% of women had involuntary urine leakage, with daily leaks in 57% of cases; 24% had stress UI, 31% urge UI, and 37% mixed UI. Results of each functional test were lower in case of UI and the limitation was more pronounced when the incontinence was severe. Multivariate logistic regression analyses showed that balance and gait impairments were significantly and independently associated with urge UI - walking speed, lower vs. higher quartile, OR= 2.2 (95% CI 1.4-3.5); walking balance, unable vs. able to do 4 tandem steps, OR= 1.6 (1.2-2.2) - but not with stress UI.

Conclusion: In this large population of older women living at home, there was a strong association between limitation of motor and balance skills and UI, which was proportional to the severity of incontinence and related specifically to urge incontinence. These results open new perspectives for prevention and treatment of urge incontinence in elderly women.

Key-words: ageing, urinary incontinence, balance, mobility, impairment

Introduction

Urinary incontinence (UI) is a common pathology in older women and is estimated to affect more than a third of women aged 70 or more.[1,2] Female UI may have an impact on the quality of life close to other chronic pathologies reputed to involve greater morbidity, such as high blood pressure or diabetes.[3] The relative proportion of urge UI increases with age, with the mixed forms associating urge and stress UI found most frequently.[4] The factors that might explain the increase in urge incontinence with advancing age are not yet well understood. Epidemiological studies have shown a link between UI and limitation in functional abilities in elderly women.[5-7] Possible explanations suggested for this association mainly concern urge UI: women who have impaired mobility probably take longer to get to the toilet, which can increase the risk of leakage when the urge to urinate is intense. Conversely, women who experience the urge to urinate frequently may tend to limit their physical activities in order not to find themselves too far from a toilet, which in itself could result in a faster decline in functional motor skills related with age.[8] Another possible explanation could be the presence of a common cause, connected for example with the decline in cognitive functions with age, which could impair both motor skills and the ability to maintain bladder control.

Earlier studies on the subject[7,9,10] used overall physical capacity indicators obtained using a questionnaire (such as the Instrumental Activities of Daily Living score) and did not measure physical abilities related with mobility specifically and directly. Only one study examined the relationship between physical abilities and UI depending on the type of UI.[9] Measuring physical abilities and clarifying the association according to the type of UI would make it easier, however, to gain greater insight into the nature of the relationship between UI and physical limitations, and would perhaps open up new perspectives in the field of UI prevention and management in elderly women.

In this study we analysed the relationship between physical limitations specifically connected with mobility and the various types of UI frequently found in elderly women. The population studied was

drawn from the recruitment phase of the Ossébo study, which is a controlled randomised study of the prevention of serious falls in elderly women based on a programme of physical exercise.

Population and methods

For this investigation we used the data contained in the initial pre-selection report for the Ossébo trial, covering 1,942 women examined in the 9 first study centres opened between January 2008 and June 2009 in several large French cities (Paris, Boulogne-Billancourt, Lille, Reims, Montpellier and Amiens). Electoral rolls were used by each centre to invite all women between the ages of 75 to 85 living close to the places where the "balance" workshops were to be held, to come for a "balance assessment". We mailed 19,360 invitations, but 1,965 women did not receive the invitation because they had moved away. The participation rate was 11% (1942/17761). Almost all participants lived at home, only a few (n = 12) lived in an institution.

This balance assessment consisted of a range of functional balance and motor skills tests carried out by a specially trained investigator, plus an individual interview and a self-assessment questionnaire. The self-assessment questionnaire filled out by the women on the day the tests were carried out included the SF36 quality of life Short Form and the International Consultation on Incontinence Questionnaire - Short Form (ICIQ-SF).[11] The first two questions in the ICIQ-SF concern the frequency and quantity of urine leaks over the past 4 weeks. These questions are similar to those of the Sandvik score which is often used in epidemiological surveys addressing urinary incontinence.[4,12] The third question assesses how much these leaks interfere with everyday life. The ICIQ-SF score is calculated from the answers to these 3 questions; it ranges between 0 and 21 and is correlated with the pad test.[13] For this study we considered that a woman was continent if she had a zero score, and incontinent if she had any positive score. The UI Severity was classified as slight, moderate, severe, and very severe according to the classification suggested by Klovning.[14] The ICIQ-SF includes a series of questions concerning the circumstances when urine leakage occurs. We drew the distinction between stress UI (urine "leaks when you cough or sneeze" or "leaks when you are physically active/exercising"), urge UI (urine "leaks before you can get to the toilet") and mixed UI (presence of both).

A set of simple functional tests, fully standardised and validated for the prediction of falls and fractures, was applied to assess the women's mobility and balance.[15-19] The mobility tests included: a timed six-metre walk test ; the "timed up and go" test which measures the time taken to get up from a chair, walk 3 metres, turn around and return to sit down; and a test measuring the time taken to get up from a chair and sit down again 5 times without using the arms. Tests more specifically concerning balance consisted of the following: a balance test in the semi-tandem position, which measures the woman's ability to remain standing in the semi-tandem position (with the heel of the front foot against the big toe of the rear foot) for at least 10 seconds; the tandem walk test, which consists of assessing the woman's ability to take 4 paces with the two feet in line, placing the heel of the front foot against the toes of the rear foot; and the unipedal stance test which measures the time spent standing on one foot without loss of balance (maximum 30 seconds).

To start with, we compared the mobility and balance test results between incontinent and continent women according to the severity and type of incontinence (urge, stress and mixed UI). We classed the women in 5 groups according to their ICIQ score, with continent women (score = 0) in the first group and the incontinent women in 4 other groups according to the score distribution quartiles. For comparison of the test results for incontinent women relative to the continent women's results we used t-tests and the chi-square test (analysis by type of UI), and linear trend tests and chi-square trend tests (analysis according to the severity of UI).

We then used a logistic regression model to investigate the association between mobility and balance abilities and the different types of UI, after adjusting for age, BMI and the test centre. Each type of UI was modelled separately and the group of continent women (ICIQ score = 0) was used as the comparison group each time. We did not determine whether or not differences between women with stress, urge, or mixed UI for mobility and balances tests were significant. For this part of our study we took into account a general mobility test - the timed 6-metre walk, and a balance test - the tandem walk. These two tests were chosen on the one hand because they were both very strongly related with the degree of urinary incontinence in the previous phases of our analysis, and on the

other hand because it was shown that they were independent risk factors for falls and fractures in a cohort of French women of the same age as the Ossébo cohort, recruited using the same methods.[16] The SAS version 9.1 package was used for all these analyses.

Results

The 1,942 women tested for functional balance and motor skills were on average 79.3 (± 2.9) years old, 159 (8,5%) only had no diploma, most of them, 1258 (65.4%), lived alone, their mean BMI was 25.9 (± 4.4) kg/m^2, and more than one out of three (39.7%) had fallen during the previous 12 months. It was possible to calculate the ICIQ incontinence score for 1,922 (99.0%) women, with 815 (42.0%) of them reporting urinary incontinence (score ≥ 1). Among these women classed as incontinent, the mean ICIQ score was 7.6 (±4.1), UI severity was considered as slight for 305 women (ICIQ score between 1 and 5), moderate for 397 (6-12), severe for 97 (13-18), and very severe for 16 (19-21). Just over half the women (57%) reported leaks of urine every day. In the majority of cases (78%) a small amount of urine was lost. The average score for the degree to which this leakage interfered with everyday life was 3.0 (±2.6) using a scale ranging from 0 to 10. In this group of incontinent women, 194 (23.8%) suffered from stress incontinence, 251 (30.8%) from urge incontinence, 302 (37.1%) from mixed incontinence and 45 (5.5%) from urinary incontinence under other circumstances (data about UI type was missing for 23 women).

The proportion of incontinent women was a little higher in women aged 80 and over than in younger women (43.8% versus 41.3%), but the difference was not significant. The mean ICIQ-SF score for the incontinent women was higher (8.0 versus 7.2) in the older women. There was a negative correlation between the severity of UI (ICIQ-SF score) and the functional motor skills score (Pearson's coefficient -0.22; $p<0.0001$), and that for vitality (-0.09; <0.0001) calculated from the SF36-SF questionnaire.

Bivariate analysis revealed a significant deterioration in all the standard mobility and balance tests according to the severity of UI (Table 1). Analysis by type of UI showed that the test results were all lower for women suffering from urge UI or mixed UI when they were compared with continent women (Table 2). For women with stress UI, the mobility test results were also lower but the differences compared with continent women were less marked. There was no difference in the balance test results between women with stress UI and continent women.

Multivariate analysis taking a mobility test (6-metre walk) and a balance test (tandem walk) into account showed simultaneously that the two tests remained significantly and independently associated with urge UI, that the walk test remained significantly associated with mixed UI, but that there was no longer any significant association with stress UI (Table 3).

Discussion

Main findings

In this large study in women aged 79 on average there was a gradient between the degree of deterioration in mobility or balance performance documented by standard physical tests, and the existence or severity of urinary incontinence. The deterioration in performance of physical tests was mainly associated with urge UI, but not with stress UI.

Strengths

The main strength of our study lies in the fact that we used standardised quantitative functional tests that specifically measure walking and balance skills, and also in the fact that we investigated the relationship between physical motor skills and each type of UI separately. Gait and balance impairment as well as UI (and cognitive impairment or depression) are the most serious health problems affecting the quality of life of older people aged 75 years and over and living at home. Unfortunately, up until now, these health problems have received less attention than medical conditions such as high blood pressure, hypercholesterolemia, diabetes mellitus or cancers.[20]

Weaknesses

Due to the way of recruitment, the study subjects were able to reach the workshop places and were urban. Comparing to 1999 census data, they were more likely to live alone, had a higher level of education, and belonged to a higher socio-professional category than the general population of the same age.[21] This leads us to suppose that cognitive functions were unimpaired but unfortunately cognitive status was not assessed in our sample. Our results cannot be taken therefore to apply to the general population of the same age, in particular to women living in institutions. Nevertheless, it can be considered that the women in our study would be similar to the types of women likely to take part in prevention programmes based on physical activities. This response rate, which may seem rather low, is nevertheless typically observed in studies that use large population-based listings (such as electoral rolls) as a basis for the recruitment of elderly subjects.[16] It is likely that the women

invited who did not participate had more severe mobility impairment than those who participated. Severe UI may also have prevented some women from participating. Hence the range of mobility impairment and of incontinence severity is probably smaller in our study population then in the original target population. We do not believe that selection bias could have artificially created the observed positive association between mobility impairment and UI. Our finding of a dose-response type of relationship between the severity of UI and the level of physical impairment argues for the existence of a true relationship.[22] However since our analysis was cross-sectional, it is not possible to establish the sequence of the relationship observed.

We have no information concerning the women's past urological, gynaecological and obstetrical histories. This being said, the association between vaginal birth and UI is limited to stress UI and gradually drops in importance with ageing.[23,24] It is not very likely that these would be confounding factors affecting the association between urge UI and the problems with gait and balance that we have observed. Whether or not medication to control UI was used has not been taken into account in this investigation because the information was not available. Another limitation of this study is that the distinction between stress and urge UI is based on a list of "standard" circumstances concerning leaks, which may not be totally appropriate to the physical activity of elderly people. However, there is no validated questionnaire at present that is able to distinguish between the various forms of UI in elderly women, and it is difficult to predict to what extent a more precise classification would make a difference in the results. It should be noted that the degree of UI reported is based on self-assessment, meaning that it may be underestimated in the event of any cognitive impairment.

Interpretation

Even if our sample was not representative of the general population, the prevalence and type of UI we found are in agreement with other similar studies.[1] In a study of Norwegian women, the prevalence of UI was 34% between 75 and 84 years old (745/2,170 women), with mixed UI in 44%

(75-79 years) to 40% (80-84 years) of cases.[4] In another study carried out in 4 other European countries, including France, the prevalence of UI in 578 women aged between 75 and 84 was 46%.[2]

The difference we found during balance and gait tests may appear small. Between slightly (first quartile) and severely incontinent women (last quartile), there is only a one-second difference in mean time on the walking test (Table 1). Such small differences are common in numerous randomized controlled trials designed to prevent falls in older people living at home.[25,26] As Robinson points out, even a minor difference may be particularly critical in those close to losing their abilities.[26] Based on results from the EPIDOS study,[16] a one-second increase in time taken to perform the 6-meter walking test increases the risk of hip fracture by 14%. The EPIDOS study also showed that women who are unable to participate in the walking balance test have a 20% higher risk of hip fracture. In our study population, there is a 15% difference in women who are unable to participate in this test when comparing slightly and severely incontinent women.

Our results confirm the postulate that women with impaired mobility probably take longer to get to the toilet, which can increase the risk of leakage when the urge to urinate is strong.[7] Brown showed that urge UI (but not stress UI) was associated with an increase in the risk of falls and fractures.[27] This relationship can probably be explained by the fact that women who suffer from urge UI have (to rush to the toilet to avoid leaks. Even in continent women, gait velocity is reduced in case of a strong desire to void.[28] Many women limit their activities after a fall due to the fear of falling or because of injuries related with the fall, which will gradually lead to loss of physical condition which in turn will eventually result in deterioration of balance and the ability to walk.[29,30] There is also another possible explanation for the association observed: that a common cause exists for the onset of urge UI and the gait and balance problems. Functional imaging studies have suggested that abnormalities in the frontal cerebral cortex may be associated with bladder control problems in older adults .[31,32] Recent clinical and epidemiological studies suggest that deterioration in certain cognitive functions implicated in problems with gait and the risk of falling may also be involved in the onset of UI,[33-35] but

235 the relationship between the causes is still not sure and the analyses carried out did not always take
236 the type of UI into account. The study by Huang et al. of a cohort of over 6,000 women over the age
237 of 65 and living at home suggests that deterioration in cognitive functions may not be associated
238 with an increased risk of UI, but would more likely mean that it is more difficult to adapt everyday life
239 to the constraints caused by UI.[33] The various possibilities considered above are not mutually
240 exclusive and it is likely that they each contribute to any explanation of the association observed.[7,36]

241 Balance tests were not different for women with stress-UI and no-UI (Table 2) and the difference
242 observed for the 6-metre walk test during bivariate analysis disappeared during multivariate analysis
243 taking into account age, BMI and study centre (Table 3) while there was still a difference between
244 women with urge-UI and women with no-UI.

245 Our results are important because they provide new prospects for assessment and management of
246 urge UI, which is particularly frequent in elderly women. Indeed, they are all the more important
247 given that the usual treatments are less effective or counter-indicated in elderly women because of
248 their side effects (e.g. anti-cholinergic drugs which may adversely affect cognitive functions).[37] Our
249 results provide hope that improvements in walking ability and balance could help to improve urge UI
250 symptoms (by reducing the number of leaks, even though the urgent need to pass urine remains just
251 as frequent as before). A longitudinal study showed a link between reduced physical activity and the
252 incidence of overactive bladder.[38] Another observational study showed that improvement in
253 activities of daily living was associated with a remission of urge symptoms.[9] Recent randomised
254 controlled trials have shown that it is possible to reduce the risk of falls in the elderly by appropriate
255 programmes of physical exercise.[25] Another randomized trial showed that improving mobility and
256 toileting skills reduces incontinence.[39] Physical activity is regarded as one of the most important
257 factors influencing the functional ability of the older people. Our study showed an association
258 between functional mobility and UI suggesting that the two entities should not be considered
259 separately.[30] Patients should be encouraged to remain physically active in order to prevent falls and
260 UI. But the nature and intensity of suitable physical activities are being debated.[40] The Ossébo

randomised controlled trial which comprises 2 groups, one with intervention (balance improvement sessions) and a "control" group with no intervention, should provide some answers since it is planned to use the ICIQ-SF questionnaire again at the end of the observation period. The results of this trial will provide a means of checking not only if there are fewer leaks due to urge UI in the group with intervention than in the control group, but also that the intervention does not increase stress UI.

Conclusion

Our results show that a strong relationship exists between motor functional problems and UI, this relationship is proportional to the severity of the UI, and concerns urge UI but not stress UI. These results open up new perspectives for the prevention and treatment of urge UI or mixed UI in elderly women.

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Disclosure of Interests

We have no conflicts of interest to report.

Contribution to Authorship

PDM and BC led the Ossébo study. XF and AF had suggested focusing on urinary incontinence in this population. LL performed the analysis conducted as part of her Master dissertation, directed by Patricia PDM and XF. XF wrote the manuscript that has been revised and approved by each author.

Details of ethics approval

The study protocol was approved by the Ile-de-France IV Committee for the Protection of Persons (CPP) in June 2007 (ref 2007/29). It is registered with the CNIL (French Data Authority) under the number 907198. The study is registered with the French Authority for the Safety of Health Products (AFSSAPS) and on ClinicalTrials.gov under the number NCT00545350. Each woman received written information about the study. According to French law, written consent was not required for this observational study.

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Table 1. Urinary incontinence severity and motor and balance performance.

Functional tests	N	Urinary Incontinence Severity {ICIQ-SF score} {0} n=1107	{1-4} n=215	{5-7} n=259	{8-11} n=164	{12+} n=177	p-value*
Walking 6 metres (mean in seconds ± standard deviation)		6.4 ±1.8	6.7 ±1.7	7.0 ±2.4	7.5 ±2.7	7.7 ±2.6	<0.0001
Timed up and go (mean in seconds ± standard deviation)		10.6 ±2.8	11.1 ±3.3	11.7 ±4.5	12.3 ±4.4	12.6 ±4.4	<0.0001
Chair rising without using hands (mean in seconds ± standard deviation)		14.8 ±4.5	15.8 ±6.0	16.2 ±4.8	17.1 ±6.0	17.0 ±5.7	<0.0001
Standing balance: 10 seconds in semi-tandem (% success)		72.4%	69.3%	69.1%	63.4%	55.4%	<0.0001
Walking balance : 4 tandem steps in line (% success)		68.2%	63.3%	58.3%	55.5%	48.0%	<0.0001
Unipedal stance test (mean in seconds ± standard deviation)		10.6 ±9.2	9.8 ±8.6	9.5 ±9.1	8.6 ±8.8	6.9 ±7.7	<0.0001

* linear trend tests for continuous variable and chi-square trend tests for nominal variables

Table 2. Urinary incontinence type and motor and balance performances. Stress urinary incontinence is defined by "leaks when you cough or sneeze" or "leaks when you are physically active/exercising", urge urinary incontinence by "leaks before you can get to the toilet" and mixed urinary incontinence by the presence of both. Bivariate analysis, each UI type was compared to no-UI.

Functional tests	N	No UI n=1107	Stress UI n=194	p-value	Urge UI n=251	p-value	Mixed UI n=302	p-value
Walking 6 metres (mean in seconds ± standard deviation)		6.4 ±1.8	6.8 ±2.3	0.021	7.3 ±2.6	<0.0001	7.2±2.3	<0.0001
Timed get up and go test (mean in seconds ± standard deviation)		10.6 ±2.8	11.3 ±3.4	0.0076	12.2 ±4.9	<0.0001	11.9±4.0	<0.0001
Chair rising 5 times without using hands (mean in seconds ± standard deviation)		14.9 ±4.4	15.9 ±4.7	0.0033	16.8 ±5.7	<0.0001	16.4±5.9	<0.0001
Standing balance: 10s in semi-tandem (% success)		72.4%	71.1%	0.73	65.0%	0.019	63.6%	0.003
Walking balance : 4 tandem steps in line(% success)		68.2%	64.4%	0.30	50.6%	<0.0001	58.3%	0.0012
Unipedal stance test (mean in seconds ± standard deviation)		10.6 ±9.2	9.6 ±8.7	0.17	9.1 ±8.9	0.018	8.2±8.4	<0.0001

t-tests for continuous variables and chi-square tests for nominal variables

Table 3. Urinary incontinence type and motor and balance performances. Stress urinary incontinence is defined by "leaks when you cough or sneeze" or "leaks when you are physically active/exercising", urge urinary incontinence by "leaks before you can get to the toilet" and mixed urinary incontinence by the presence of both. Logistic regression adjusted for age, BMI and study centre.

		Stress UI ORa [95% CI]	Urge UI ORa [95% CI]	Mixed UI ORa [95% CI]
Walking 6 metres (sec)	Quartile 1	1	1	1
	Quartile 2	1.08 [0.69-1.69]	1.26 [0.81-1.96]	1.53 [1.02-2.31]
	Quartile 3	1.30 [0.82-2.07]	1.84 [1.19-2.85]	1.78 [1.17-2.72]
	Quartile 4	1.38 [0.82-2.31]	2.17 [1.36-3.45]	2.61 [1.69-4.03]
Walking balance (able to take 4 tandem steps in line)	Yes	1	1	1
	No	1.04 [0.72-1.49]	1.58 [1.16-2.17]	1.10 [0.82-1.47]