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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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1 Title

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

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

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26 Abstract

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

29 Design: observational cross-sectional study.

30 Setting: 9 "balance" workshops in France.

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

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

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

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

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

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

49 Introduction

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

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

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

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

75

76 Population and methods

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

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

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

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

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

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

130

131 Results

132 The 1,942 women tested for functional balance and motor skills were on average 79.3 (\pm 2.9) years
133 old, 159 (8,5%) only had no diploma, most of them, 1258 (65.4%), lived alone, their mean BMI was
134 25.9 (\pm 4.4) kg/m², and more than one out of three (39.7%) had fallen during the previous 12 months.
135 It was possible to calculate the ICIQ incontinence score for 1,922 (99.0%) women, with 815 (42.0%) of
136 them reporting urinary incontinence (score \geq 1). Among these women classed as incontinent, the
137 mean ICIQ score was 7.6 (\pm 4.1), UI severity was considered as slight for 305 women (ICIQ score
138 between 1 and 5), moderate for 397 (6-12), severe for 97 (13-18), and very severe for 16 (19-21). Just
139 over half the women (57%) reported leaks of urine every day. In the majority of cases (78%) a small
140 amount of urine was lost. The average score for the degree to which this leakage interfered with
141 everyday life was 3.0 (\pm 2.6) using a scale ranging from 0 to 10. In this group of incontinent women,
142 194 (23.8%) suffered from stress incontinence, 251 (30.8%) from urge incontinence, 302 (37.1%)
143 from mixed incontinence and 45 (5.5%) from urinary incontinence under other circumstances (data
144 about UI type was missing for 23 women).

145 The proportion of incontinent women was a little higher in women aged 80 and over than in younger
146 women (43.8% versus 41.3%), but the difference was not significant. The mean ICIQ-SF score for the
147 incontinent women was higher (8.0 versus 7.2) in the older women. There was a negative correlation
148 between the severity of UI (ICIQ-SF score) and the functional motor skills score (Pearson's coefficient
149 -0.22; $p < 0.0001$), and that for vitality (-0.09; < 0.0001) calculated from the SF36-SF questionnaire.

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

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

160

161 Discussion

162 Main findings

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

167 Strengths

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

175 Weaknesses

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

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

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

206 Interpretation

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

210 (75-79 years) to 40% (80-84 years) of cases.⁴ In another study carried out in 4 other European
211 countries, including France, the prevalence of UI in 578 women aged between 75 and 84 was 46%.²

212 The difference we found during balance and gait tests may appear small. Between slightly (first
213 quartile) and severely incontinent women (last quartile), there is only a one-second difference in
214 mean time on the walking test (Table 1). Such small differences are common in numerous
215 randomized controlled trials designed to prevent falls in older people living at home.^{25,26} As Robinson
216 points out, even a minor difference may be particularly critical in those close to losing their abilities.²⁶

217 Based on results from the EPIDOS study,¹⁶ a one-second increase in time taken to perform the 6-
218 meter walking test increases the risk of hip fracture by 14%. The EPIDOS study also showed that
219 women who are unable to participate in the walking balance test have a 20% higher risk of hip
220 fracture. In our study population, there is a 15% difference in women who are unable to participate
221 in this test when comparing slightly and severely incontinent women.

222 Our results confirm the postulate that women with impaired mobility probably take longer to get to
223 the toilet, which can increase the risk of leakage when the urge to urinate is strong.⁷ Brown showed
224 that urge UI (but not stress UI) was associated with an increase in the risk of falls and fractures.²⁷ This
225 relationship can probably be explained by the fact that women who suffer from urge UI have (to rush
226 to the toilet to avoid leaks. Even in continent women, gait velocity is reduced in case of a strong
227 desire to void.²⁸ Many women limit their activities after a fall due to the fear of falling or because of
228 injuries related with the fall, which will gradually lead to loss of physical condition which in turn will
229 eventually result in deterioration of balance and the ability to walk.^{29,30} There is also another possible
230 explanation for the association observed: that a common cause exists for the onset of urge UI and
231 the gait and balance problems. Functional imaging studies have suggested that abnormalities in the
232 frontal cerebral cortex may be associated with bladder control problems in older adults.^{31,32} Recent
233 clinical and epidemiological studies suggest that deterioration in certain cognitive functions
234 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

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

267

268 Conclusion

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

273

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280 Disclosure of Interests

281 We have no conflicts of interest to report.

282 Contribution to Authorship

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

286 Details of ethics approval

287 The study protocol was approved by the Ile-de-France IV Committee for the Protection of Persons
288 (CPP) in June 2007 (ref 2007/29). It is registered with the CNIL (French Data Authority) under the
289 number 907198. The study is registered with the French Authority for the Safety of Health Products
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291 information about the study. According to French law, written consent was not required for this
292 observational study.

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299

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

Functional tests	Urinary Incontinence Severity {ICIQ-SF score}					p-value*	
	N	{0} n=1107	{1-4} n=215	{5-7} n=259	{8-11} n=164		{12+} n=177
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]