URINARY INCONTINENCE AND QUALITY OF LIFE:

A LONGITUDINAL ANALYSIS FROM THE ENGLISH LONGITUDINAL STUDY OF AGEING

Nicola Veronese1, Lee Smith2, Damiano Pizzol3, Pinar Soysal4, Stefania Maggi5, Petre-Cristian Ilie2, Ligia J. Dominguez1, Mario Barbagallo1

1 Geriatric Unit, Department of Internal Medicine and Geriatrics, University of Palermo, Palermo, Italy;

2 Centre for Health, Performance and Wellbeing, Anglia Ruskin University, Cambridge, UK;

3 Italian Agency for Development Cooperation - Khartoum, Sudan.

4 Department of Geriatric Medicine, Faculty of Medicine, Bezmialem Vakif University, Istanbul, Turkey;

5 Aging Branch, Neuroscience Institute, National Research Council, Padua, Italy.

**Corresponding author**: Nicola Veronese. Geriatric Unit, Department of Internal Medicine and Geriatrics, University of Palermo, Via del Vespro, 141, 90127 Palermo, Italy. Email: [nicola.veronese@unipa.it](mailto:nicola.veronese@unipa.it)

# ABSTRACT

**Objectives**: To explore the longitudinal association between UI and QoL in the English Longitudinal Study on Ageing, a large study in older UK adults with ten years of follow-up.

**Study design**: Cohort study.

**Main outcomes interest**: To measure presence of UI participants reported whether they had lost urine beyond their control in last 12 months. Participants also reported whether UI lasted more than one month, indicating a more chronic problem. QoL was measured using the CASP (control, autonomy, self-realisation and pleasure)-19, with higher values indicating a higher QoL.

**Results**: 8,028 participants (mean age: 65.2 years; 56.7% females) were included: 1,172 participants reported UI at baseline. No significant differences in CASP-19 were found at baseline (p=0.24). In people with UI, a significant decline in CASP-19 (from 34.3±14.0 of baseline to 30.9±16.1 of wave 7) (p=0.016) was observed. The results were stronger in men than in women and when a longer duration of UI was present.

**Conclusion**: UI was associated with poor QoL over ten years of follow-up in a large cohort of UK participants. Our findings further suggest the importance of UI as a potential risk factor for poor QoL.

**Key words**: urinary incontinence; quality of life; ELSA; ageing; longitudinal; cohort.

# INTRODUCTION

Urinary incontinence (UI) is a common clinical problem, often defined as a geriatric multifactorial syndrome characterized by any involuntary leakage of urine [1-3].However, it is important to note that UI has also been observed in younger adults.[4] UI affects several million people across the globe, with important and, often, underestimated negative consequences on the quality of life.[5] As widely known, UI affects more frequently women than men, but the prevalence of UI in women is still likely underestimated.[5] Although the precise prevalence rate is not known, at least one in four people are affected by UI in their lifetime.[6, 7]

One of the most important aspects of UI, especially in older non-disabled adults, is that it is seldom reported by the patient to the physician. This is likely owing to UI being considered a natural consequence of ageing and also feelings of of shame in relation to UK.[8, 9] Therefore, often people not only deny, but also hide this problem, that may result in physical and psychosocial limitations to enjoyment in life. [9] The main consequences might include loss of self-confidence and social isolation in addition to other negative outcomes, such as decreases in sexual activity and daily physical activity.[10]

All the potential consequences of UI, including mood disorders, are associated per se with poor quality of life (QoL), a comprehensive term that includes various domains in human life that describes the expectations of an individual or society for a good life.[11] However, despite increasing research indicating the importance of QoL and the high prevalence of UI, only a few studies have reported on the association between UI andQoL. A recent systematic review and meta-analysis including 23 studies and 24,983 participants confirmed that UI is associated with poor QoL.[12] However, these studies were mainly of a cross-sectional or case-control nature that have inherent limitations, such as the presence of a potential reverse causation. On the contrary, longitudinal studies regarding the impact of UI on QoL are still limited.

Given this background, we aimed to investigate whether UI was associated with poorer QoL in the English Longitudinal Study on Ageing, a large study in older adults in the UK with over ten years of follow-up, in order to identify a potential risk factor for poor QoL, often not considered in clinical practice.

# MATERIALS AND METHODS

## Study population

This research is based on the data of the English Longitudinal Study on Ageing (ELSA) including the waves between wave 2 (2004–2005) and wave 7 (2014–2015). The ELSA is a prospective and nationally representative cohort of participants living in England.[13] The ELSA was approved by the London Multicenter Research Ethics Committee (MREC/01/2/91). Informed consent was obtained from all participants.

## Exposure: urinary incontinence

In the ELSA study, the presence of UI at baseline and during follow-up was confirmed by asking participants whether they lost urine beyond their control in last 12 months. Moreover, it was asked whether UI lasted greater than one month, indicating a chronic problem.

## Outcomes: quality of life

The QoL measure used in the ELSA is CASP (control, autonomy, self-realisation and pleasure)-19. [14] It is a self-completion questionnaire and spans four derived dimensions based on Likert scaled items. CASP-19 has an overall summary measure on a 0–57 scale, with higher scores corresponding to greater well-being.[14]

## Covariates

The following variables were considered as potentially important covariates and included in the ELSA database: educational level, as years of schooling (continuous); marital status, categorized as married vs. other options; body mass index, categorized using the World Health Organization criteria[15]; smoking status (present vs. other status); disability in one or more of five activities of daily living; physical activity level [16], categorized as sedentary, low, moderate or high level; the presence of comorbidities, categorized as >2 vs. less, as commonly used in geriatric medicine [17] (the prevalence of the most important diseases is also reported for descriptive purposes); ethnicity, categorized as whites vs. others.

## Statistical analyses

The data were weighted using the person-level longitudinal weight, core sample, wave 2 (http://www.ifs.org.uk/ELSA). Means and standard deviations (SD) were used to describe quantitative measures, while percentages and counts were used for categorical variables. Normal distributions of continuous variables were tested using the Kolmogorov–Smirnov test. Characteristics of the study participants at the baseline evaluation (wave 2) were compared according to the presence or not of UI, considering the Chi-squared or Fisher exact tests for categorical variables, and generalized linear models after testing for homoscedasticity (Levene test) or Wilcoxon rank sum test for the continuous variables.

The association between UI at the baseline and the changes of CASP-19 during follow-up was evaluated using a generalized linear model with repeated measures. For missing data regarding CASP-19, a multiple imputation method was used, with a maximum of 20 interactions.[18] We also reported sensitivity analyses, including data according to duration of UI (more than one month, less than one month, no UI), sex, and only people having all data regarding CASP-19 during follow-up.

All statistical tests were two-tailed, and a p-value < 0.05 was considered to be statistically significant (the correction proposed by Bonferroni was used for the analyses regarding the duration of UI). All analyses were performed using SPSS 20.0 software.

# RESULTS

Of the 9,432 participants in wave 2 (baseline) of the ELSA study, 139 were removed owing to having no data regarding UI, and 1265 were removed owing to missing data on CASP-19, leaving 8,028 participants eligible for this study.

The mean age of participants was 65.2±10.1 years (range: 17-90) and 56.7% were female. Among the 1,172 participants reporting UI (14.6% of the entire sample), 771 reported a duration of UI more than one month. **Table 1** shows the baseline characteristics according to the presence or not of UI. Compared to 6,856 participants not reporting UI, those with UI were significantly older, more frequently females, and had a lower level of education. Moreover, people with UI were more frequently obese, disabled, and sedentary than those without UI. People with UI reported a significant higher prevalence of comorbidities, except for diabetes and Parkinson’ disease. When stratified by sex, men having UI were less educated, whilst women with UI were more likely to be present smokers that their counterparts (**Supplementary Table 1**). Finally, we did not observe any significant difference in baseline CASP-19 between UI and controls (34.3±14.0 vs. 35.0±12.8; p=0.24) (**Table 1**) or when using the criteria ofUI present for more than one month (p=0.10), or when stratified by sex (p=0.13 in men; p=0.63 in women).

**Figure 1 and Table 2** shows the changes in CASP-19 during the ten years of follow-up. During the ten years of follow-up, among the 6,856 not reporting UI at the baseline, 1,512 (=22.1%) became incontinent. In people with UI, we observed a significant decline in CASP-19 (from 34.3±14.0 of baseline to 30.9±16.1 of wave 7) vs. a change from 35.0±12.8 to 32.0±14.7 in people without UI. Therefore, using a generalized linear model with repeated measures, we identified a significant difference between people with UI and those without at the baseline (p=0.016).

Next, sensitivity analyses were run to strengthen results. First, the presence of UI for more than one month was associated with the worse QoL scores: taking people without UI as control group, people with a longer history of UI reported significant lower values of CASP-19 during follow-up (30.4±16.2; p=0.008). Second, we divided the participants by sex. In this case, we observed that UI at the baseline was associated with a significant decline in QoL in men (p=0.002), but not in women (p=0.54), taking people without UI as reference group (full details in **Table 2**). On the contrary, longer presence of UI was not associated with poorer QoL in either sex (p=0.99 in men, p=0.09 in women). Finally, comparing the people with complete data during follow-up (593 with UI vs. 3,585 without UI), the difference in QoL during follow-up remained statistically significant (p=0.03).

# DISCUSSION

In the present study, involving more than 8,000 participants followed-up for ten years, we found that UI was associated with worse QoL estimates compared to those without UI, but no difference was observed between baseline values. Our results were stronger in men than in women and when UI lasts more than one month over the previous year in the sample as whole. We believe that these findings are novel in several ways.

Before this study, studies summarizing the association between UI and QoL were mainly based on cross-sectional or case-control evidence. Approximately ten years prior to the time of writing, one review [19] reported that females affected by UI reported significantly lower QoL than their counterparts; another systematic review found that overactive bladder was associated with lower QoL.[20] More recently a meta-analysis indicates that UI was associated with poor QoL in 23 studies and approximately 25,000 participants.[12] These works clearly advanced knowledge regarding this important topic, however, the nature of these studies is an important limitation, particularly for the possible presence of reverse causation. To the best of our knowledge the present study is the first study assessing longitudinally the potential association between UI and poor QoL in the general population.

Several hypotheses can justify the present findings. First, as reported in this study, people with UI usually exhibit more comorbidities and were more likely to have a disability than those without UI. Many risk factors are reported in the association between UI and poor QoL, but the most important seem to be female sex, age, the presence of comorbidities, and disability.[21] Second, it is possible that people having UI use diapers and the use of diapers may lead to the Incontinence-Associated Dermatitis (IAD).[22] IAD, as other dermatological conditions, is associated with a poor QoL.[23] Unfortunately, in the ELSA study this information is missing and therefore this is a speculation regarding the potential mechanisms justifying the present findings. Third, it is also possible that people with UI can decrease their social contacts due to the shame of having episodes of UI, therefore subsequently decreasing their QoL.[24] Finally, another important point is that shame usually presents in these individuals leading to a negative change in lifestyle and habits[25] (e.g., decrease in physical activity) and to the development of mood disorders, such as depression [25] and anxiety. [26]

Another important finding of the present study is that the association between UI and poor QoL is stronger in men than in women, although UI is more prevalent in women. In a large cross-sectional study, UI was associated with poor QoL in both sexes, however, the design of the study prevents determination of any casual relation hypothesis.[27] Our findings further underline the importance of early detection of UI in men, particularly among those that have important risk factors for UI, such as prostatectomy or prostate problems. It has been demonstrated that in men undergoing radical retropubic prostatectomy QoL is reduced immediately after the surgery, but improves over time and eventually returns to the preoperative level.[28] To the contrary, a recent multicentre study carried out in Italy found that in patients undergoing radical prostatectomy for prostate cancer, the decline in urinary function had a significant impact on QoL 24 months after diagnosis.[29] Therefore, more research is needed to confirm or refute the present findings.

The findings of our study should be interpreted within its limitations. First, the rate of dropout was high. This may introduce a selection bias, but in which direction this bias can modify the findings is unclear, however, to mitigate this risk of bias a multiple imputation method was employed. Moreover, analyses involving only people having completed data did not significantly modify the present findings. Second, the information regarding UI were reported and important data, such as specific exams or the use of diapers were not recorded. Third, types of UI were not evaluated. It is possible that the different types of UI will have differential associations with QoL. Finally, it would be interesting to compare the altered dimensions in men and in women, for example autonomy and pleasure, but this important information is unfortunately not available for CASP-19.

In conclusion, in this study including more than 8,000 participants followed for ten years, UI was associated with poor QoL. This association was stronger in men than in women and when UI was experienced over a long period of time. These findings further underline the importance of UI as a potential risk factor for poor QoL. Early detection and appropriate management of UI is important in order to improve QoL over the time in this at risk population.

# ACKNOWLEDGMENTS

The ELSA was developed by a team of researchers based at University College London, the National Centre for Social Research and the Institute for Fiscal Studies. The data were collected by the National Centre for Social Research. The funding was provided by the National Institute of Aging in the USA, and a consortium of UK government departments coordinated by the Office for National Statistics. The developers and funders of the ELSA and the UK Data Archive do not bear any responsibility for the analyses or interpretations presented here. J. W. is supported by the Centre for the Development and Evaluation of Complex Interventions for Public Health Improvement, a UKCRC Public Health Research: Centre of Excellence. Funding from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council (ESRC RES-590-28-0005), Medical Research Council (MR/KO232331/1), the Welsh Assembly Government and the Wellcome Trust (WT087640MA), under the auspices of the UK Clinical Research Collaboration, and the contribution is gratefully acknowledged. M. K. is supported by the UK Medical Research Council (K013351), the Academy of Finland and the US National Institutes of Health (R01HL036310 and R01AG034454) and by a professorial fellowship from the Economic and Social Research Council. G. D. B. is a member of the University of Edinburgh Centre for Cognitive Ageing and Cognitive Epidemiology, part of the cross-council Lifelong Health and Wellbeing Initiative (G0700704/84698).

**Conflict of interest**: none.

**Funding**: none.

**Data sharing**: The study protocol and statistical analysis plan for this project are available on request from the corresponding author. Data are available from the UK Data Service for researchers who meet the criteria for access to confidential data. Data are from waves 2 to 7 of the ELSA study. Data and contact details may be obtained via the website [**http://www.adls.ac.uk/find-administrative-data/linked-administrative-data/english-longitudinal-study-of-ageing/**](http://www.adls.ac.uk/find-administrative-data/linked-administrative-data/english-longitudinal-study-of-ageing/)

# REFERENCES

[1] L. Aharony, J. De Cock, M. Nuotio, C. Pedone, J. Rifel, N.V. Walle, A. Velghe, A. Vella, C. Verdejo-Bravo, E.U.G.M. Society, Consensus document on the management of urinary incontinence in older people, European geriatric medicine 8(3) (2017) 210-215.

[2] P. Abrams, L. Cardozo, M. Fall, D. Griffiths, P. Rosier, U. Ulmsten, P. van Kerrebroeck, A. Victor, A. Wein, The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society, Am J Obstet Gynecol 187(1) (2002) 116-26.

[3] N. Veronese, P. Soysal, B. Stubbs, A. Marengoni, J. Demurtas, S. Maggi, M. Petrovic, C. Verdejo-Bravo, Association between urinary incontinence and frailty: a systematic review and meta-analysis, European Geriatric Medicine 9(5) (2018) 571-578.

[4] S. Hunskaar, E. Arnold, K. Burgio, A. Diokno, A. Herzog, V. Mallett, Epidemiology and natural history of urinary incontinence, International urogynecology journal 11(5) (2000) 301-319.

[5] Y. Dooley, K. Kenton, G. Cao, A. Luke, R. Durazo-Arvizu, H. Kramer, L. Brubaker, Urinary incontinence prevalence: results from the National Health and Nutrition Examination Survey, J Urol 179(2) (2008) 656-61.

[6] W.F. Stewart, A.G. Hirsh, H.L. Kirchner, D.N. Clarke, M.J. Litchtenfeld, V.A. Minassian, Urinary incontinence incidence: quantitative meta-analysis of factors that explain variation, J Urol 191(4) (2014) 996-1002.

[7] M.H. Ebbesen, S. Hunskaar, G. Rortveit, Y.S. Hannestad, Prevalence, incidence and remission of urinary incontinence in women: longitudinal data from the Norwegian HUNT study (EPINCONT), BMC Urol 13 (2013) 27.

[8] C. Shaw, S. Rajabali, C. Tannenbaum, A. Wagg, Is the belief that urinary incontinence is normal for ageing related to older Canadian women’s experience of urinary incontinence?, International urogynecology journal 30(12) (2019) 2157-2160.

[9] K. Elenskaia, K. Haidvogel, C. Heidinger, D. Doerfler, W. Umek, E. Hanzal, The greatest taboo: urinary incontinence as a source of shame and embarrassment, Wiener Klinische Wochenschrift 123(19-20) (2011) 607-610.

[10] M.A. Farage, K.W. Miller, E. Berardesca, H.I. Maibach, Psychosocial and societal burden of incontinence in the aged population: a review, Arch Gynecol Obstet 277(4) (2008) 285-90.

[11] G.H. Guyatt, D.H. Feeny, D.L. Patrick, Measuring health-related quality of life, Annals of internal medicine 118(8) (1993) 622-629.

[12] D. Pizzol, J. Demurtas, S. Celotto, S. Maggi, L. Smith, G. Angiolelli, M. Trott, L. Yang, N. Veronese, Urinary incontinence and quality of life: a systematic review and meta-analysis, Aging Clinical and Experimental Research (2020) 1-11.

[13] C. Cao, L. Yang, T. Xu, P.A. Cavazos-Rehg, Q. Liu, D. McDermott, N. Veronese, T. Waldhoer, P.C. Ilie, S.F. Shariat, L. Smith, Trends in Sexual Activity and Associations With All-Cause and Cause-Specific Mortality Among US Adults, J Sex Med 17(10) (2020) 1903-1913.

[14] D. Howel, Interpreting and evaluating the CASP-19 quality of life measure in older people, Age and ageing 41(5) (2012) 612-617.

[15] W.H. Organization, Obesity: preventing and managing the global epidemic, (2000).

[16] N. Veronese, M. Solmi, S. Maggi, M. Noale, G. Sergi, E. Manzato, A.M. Prina, M. Fornaro, A.F. Carvalho, B. Stubbs, Frailty and incident depression in community‐dwelling older people: results from the ELSA study, International journal of geriatric psychiatry 32(12) (2017) e141-e149.

[17] M.E. Salive, Multimorbidity in older adults, Epidemiologic reviews 35(1) (2013) 75-83.

[18] P. Royston, Multiple imputation of missing values, The Stata Journal 4(3) (2004) 227-241.

[19] B.E. Kwon, G.Y. Kim, Y.J. Son, Y.S. Roh, M.A. You, Quality of life of women with urinary incontinence: a systematic literature review, International neurourology journal 14(3) (2010) 133.

[20] S. Bartoli, G. Aguzzi, R. Tarricone, Impact on quality of life of urinary incontinence and overactive bladder: a systematic literature review, Urology 75(3) (2010) 491-500.

[21] M.P. Offermans, M.F. Du Moulin, J.P. Hamers, T. Dassen, R.J. Halfens, Prevalence of urinary incontinence and associated risk factors in nursing home residents: a systematic review, Neurourol Urodyn 28(4) (2009) 288-94.

[22] H. Beele, S. Smet, N. Van Damme, D. Beeckman, Incontinence-associated dermatitis: pathogenesis, contributing factors, prevention and management options, Drugs & aging 35(1) (2018) 1-10.

[23] D. Beeckman, J. Campbell, K. Campbell, D. Denise Chimentão, R. Domansky, M. Gray, H. Hevia, J. Junkin, A. Karada, J. Kottner, Incontinence-associated dermatitis: moving prevention forward, Wounds International (2015).

[24] H. Van Oyen, P. Van Oyen, Urinary incontinence in Belgium; prevalence, correlates and psychosocial consequences, Acta Clinica Belgica 57(4) (2002) 207-218.

[25] I. Nygaard, J. DeLancey, L. Arnsdorf, E. Murphy, Exercise and incontinence, Obstetrics and Gynecology 75(5) (1990) 848-851.

[26] H.R. Bogner, J.J. Gallo, K.L. Swartz, D.E. Ford, Anxiety disorders and disability secondary to urinary incontinence among adults over age 50, The International Journal of Psychiatry in Medicine 32(2) (2002) 141-154.

[27] D. Bedretdinova, X. Fritel, M. Zins, V. Ringa, The effect of urinary incontinence on health-related quality of life: is it similar in men and women?, Urology 91 (2016) 83-89.

[28] M. Jønler, F.A. Madsen, P.R. Rhodes, M. Sall, E.M. Messing, R.C. Bruskewitz, A prospective study of quantification of urinary incontinence and quality of life in patients undergoing radical retropubic prostatectomy, Urology 48(3) (1996) 433-440.

[29] C. Palumbo, A. Bruni, A. Antonelli, W. Artibani, P.F. Bassi, F. Bertoni, P. Borghetti, S. Bracarda, A. Cicchetti, R. Corvò, Health-related quality of life 24-month after prostate cancer diagnosis: an update from the Pros-IT CNR prospective observational study, Minerva Urologica e Nefrologica= The Italian Journal of Urology and Nephrology (2021).

# Tables and Figures

**Table 1. Participants’ characteristics at the baseline according to the presence of urinary incontinence (weighted data)**

|  | **Urinary incontinence** | | |
| --- | --- | --- | --- |
|  | **Yes**  **(n=1172)** | **No**  **(n=6856)** | **p-value** |
| Age, y, mean (SD) | 68.4 (10.4) | 65.8 (9.7) | <0.0001 |
| Sex, male, n (%) | 252 (23.2) | 3162 (49.6) | <0.0001 |
| Whites, n (%) | 1060 (97.5) | 6203 (97.3) | 0.76 |
| Years of education (SD) | 6.4 (6.9) | 7.0 (6.9) | 0.006 |
| Married, n(%) | 654 (60.2) | 4269 (67.0) | <0.0001 |
| Present smokers, n(%) | 899 (82.9) | 5400 (84.8) | 0.09 |
| BMI, n (%)  <18.5 kg/m2  18.5-24.9 kg/m2  25.0-29.9 kg/m2  ≥30 kg/m2 | 11 (1.1)  222 (22.3)  356 (35.7)  334 (40.9) | 39 (0.7)  1485 (25.9)  2418 (42.1)  1510 (31.3) | <0.0001 |
| Disability in 1 or more ADL, n (%) | 391 (36.0) | 1076 (16.9) | <0.0001 |
| Physical activity level, n (%)  Sedentary  Low  Moderate  High | 103 (9.5)  358 (32.9)  479 (44.0)  147 (13.5) | 305 (4.8)  1482 (23.3)  3311 (52.0)  1272 (20.0) | <0.0001 |
| Comorbidities (>2 comorbidities), n (%) | 758 (69.8) | 3176 (49.8) | <0.0001 |
| Cardiovascular diseases, n(%) | 382 (35.5) | 1803 (28.2) | <0.0001 |
| Diabetes, n(%) | 98 (9.0) | 493 (7.7) | 0.23 |
| Hypertension, n(%) | 533 (49.1) | 2717 (42.6) | <0.0001 |
| Lung disease, ever diagnosed, n (%) | 100 (9.3) | 433 (6.8) | 0.006 |
| Asthma, ever diagnosed, n (%) | 204 (18.8) | 742 (11.6) | <0.0001 |
| Arthritis, ever diagnosed, n (%) | 595 (54.8) | 2204 (34.6) | <0.0001 |
| Osteoporosis, ever diagnosed, n (%) | 119 (11.0) | 385 (6.0) | <0.0001 |
| Cancer, ever diagnosed, n (%) | 113 (10.4) | 416 (6.5) | <0.0001 |
| Parkinson’s Disease, ever diagnosed, n (%) | 9 (0.83) | 30 (0.47) | 0.31 |
| Psychiatric disorder, ever diagnosed, n (%) | 184 (16.9) | 542 (8.5) | <0.0001 |
| Alzheimer’s Disease, ever diagnosed, n (%) | 2 (0.18) | 4 (0.06) | 0.03 |
| Dementia or memory impairment, ever diagnosed, n (%) | 9 (0.83) | 36 (0.56) | 0.55 |
| CASP-19 baseline value (mean SD) | 34.3 (14.0) | 35.0 (12.8) | 0.24 |

**Table 2. Association between urinary incontinence and quality of life changes during follow-up, in the sample as whole and by sex.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Wave 2** | | **Wave 3** | | | **Wave 4** | | **Wave 5** | | **Wave 6** | | **Wave 7** | | **p-value** |
| **Urinary incontinence** | **Yes** | **No** | **Yes** | | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** |  |
| **All sample** | 34.3  (14.0) | 35.0  (12.8) | 33.4  (14.9) | 33.5  (13.8) | | 32.7  (15.5) | 32.9  (14.3) | 32.9  (15.2) | 33.8  (13.2) | 31.9  (15.4) | 33.0  (13.8) | 30.9  (16.1) | 32.0  (14.7) | 0.016 |
| **Men** | 33.6  (15.5) | 35.2  (12.9) | 31.9  (16.0) | 33.7  (13.7) | | 31.2  (16.4) | 32.9  (14.3) | 31.6  (16.5) | 33.9  (13.2) | 30.5  (16.8) | 33.3  (13.8) | 31.0  (16.8) | 32.3  (14.8) | 0.002 |
| **Women** | 34.5  (13.6) | 34.8  (12.8) | 33.5  (14.8) | 33.1  (14.1) | | 33.0  (15.3) | 32.5  (14.6) | 32.0  (15.1) | 32.6  (14.0) | 30.9  (15.9) | 31.8  (14.6) | 30.9  (15.9) | 31.8  (14.6) | 0.54 |

Data are reported, for each wave, as mean with correspondent standard deviations in people with or without urinary incontinence. P-values are reported as result of the generalized linear model, repeated measures.

**Figure 1. Changes of CASP-19 during follow-up, by the presence of urinary incontinence at the baseline**

*The data are reported as mean with their standard errors.*

**Supplementary Table 1. Characteristics at the baseline according to the presence of urinary incontinence, by sex (weighted data)**

|  | **Men** | | | **Women** | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Yes**  **(n=260)** | **No**  **(n=3213)** | **p-value** | **Yes**  **(n=912)** | **No**  **(n=3643)** | **p-value** |
| Age, y, mean (SD) | 70.9 (9.6) | 64.9 (9.1) | <0.0001 | 67.6 (10.5) | 66.8 (10.1) | 0.04 |
| Whites, n (%) | 243 (96.4) | 3064 (96.9) | 0.71 | 817 (97.8) | 3139 (97.7) | 0.99 |
| Years of education (SD) | 6.7 (6.9) | 8.1 (6.8) | 0.001 | 6.3 (6.9) | 5.9 (6.8) | 0.16 |
| Married, n(%) | 191 (75.8) | 2387 (75.5) | 0.50 | 463 (55.5) | 1882 (58.6) | 0.64 |
| Present smokers, n(%) | 40 (15.9) | 510 (16.1) | 0.99 | 147 (17.6) | 458 (14.3) | 0.01 |
| BMI, n (%)  <18.5 kg/m2  18.5-24.9 kg/m2  25.0-29.9 kg/m2  ≥30 kg/m2 | 1 (0.4)  51 (21.4)  100 (42.0)  108 (41.5) | 16 (0.6)  621 (22.1)  1345 (47.9)  1231 (38.3) | 0.003 | 10 (1.2)  178 (22.2)  274 (34.2)  450 (49.3) | 24 (0.8)  884 (29.6)  1105 (37.0)  1630 (44.7) | <0.0001 |
| Disability in 1 or more ADL, n (%) | 109 (41.9) | 492 (15.3) | <0.0001 | 297 (32.6) | 600 (16.5) | <0.0001 |
| Physical activity level, n (%)  Sedentary  Low  Moderate  High | 32 (12.6)  72 (28.5)  116 (45.8)  33 (13.0) | 132 (4.2)  619 (19.6)  1646 (52.1)  762 (24.1) | <0.0001 | 71 (8.5)  286 (34.3)  363 (43.5)  114 (13.7) | 174 (5.4)  862 (26.8)  1665 (51.8)  510 (15.9) | <0.0001 |
| Comorbidities (>2 comorbidities), n (%) | 176 (67.7) | 1475 (45.9) | <0.0001 | 632 (69.3) | 1865 (51.2) | <0.0001 |
| CASP-19 baseline value (mean SD) | 33.5 (15.7) | 35.0 (13.2) | 0.13 | 34.4 (13.8) | 34.7 (13.0) | 0.63 |