

**Title:** Gynecological aspects as a component of comprehensive geriatric assessment: A study of self-rated symptoms of pelvic organ prolapse among community-dwelling elderly women in Japan

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## **Abstract**

**Objectives:** Despite the reported ‘male-female health-survival paradox’, no components of the comprehensive geriatric assessment (CGA) routinely used in the field of geriatrics focus on female-specific symptoms. To investigate the impact of gynecological factors among elderly women, we examined the gynecological history and examined the association between self-rated symptoms of pelvic organ prolapse (POP) and CGA.

**Study design:** This community-based, cross-sectional study in Japan included 164 community-dwelling women aged  $\geq 75$  years.

**Main outcome measures:** Pelvic Organ Prolapse Distress Inventory-6 (POPDI-6), activities of daily living (ADL), and Timed Up and Go (TUG) test were measured mainly. Self-rated symptoms of POP were assessed using POPDI-6, and the participants were dichotomized into POPDI-6  $> 0$  (symptom group) and POPDI-6  $= 0$  (no symptom group). Several components of CGA were compared between the groups with and without symptoms of POP and the association with POPDI-6 was analyzed by multiple logistic regression analysis.

**Results:** Compared to the no-symptom group, the symptom group had significantly longer TUG test time ( $\geq 13.5$  s) ( $P = 0.024$ ) and difficulty in basic ADL (score  $< 21$ ) ( $P = 0.02$ ). In multiple logistic regression analysis, basic ADL  $< 21$  and TUG time  $\geq 13.5$  s were

significantly associated with POPDI-6 >0 (odds ratio [OR] = 2.78; 95% confidence interval [CI] = 1.10–7.06 and OR = 3.45; 95% CI = 1.01–1.24).

**Conclusions:** Self-rated POP symptoms were associated with CGA components among community-dwelling elderly women. Evaluating POP symptoms as part of CGA could be meaningful for improving physical and psychological health in elderly women.

**Keywords:** comprehensive geriatric assessment; male-female health-survival paradox; pelvic organ prolapse; Pelvic Organ Prolapse Distress Inventory-6; Timed

**Up and Go test**

**Abbreviations:**

ADL: activities of daily living

ANOVA: analysis of variance

CGA: comprehensive geriatric assessment

CI: confidence interval

FRI-5: Fall Risk Index-5

GDS-5: five-item version of the Geriatric Depression Scale

MMSE: Mini-Mental State Examination

OR: odds ratio

PFDI-20: Pelvic Floor Distress Inventory-20

POP: pelvic organ prolapse

POPDI-6: Pelvic Organ Prolapse Distress Inventory-6

QOL: quality of life

TLAS: Tosa Longitudinal Aging Study

TMIG-IC: Tokyo Metropolitan Institute of Gerontology Index of Competence

TUG: Timed Up and Go

## 1. Introduction

The aging population is rapidly growing worldwide; thus, health care for elderly people is becoming increasingly important. Comprehensive Geriatric Assessment (CGA) is routinely used in geriatric fields to assess older adults' medical, psychosocial, and functional abilities, as well as their limitations. CGA is important for maintaining the health status of elderly people because non-medical factors such as social and psychological factors greatly affect the health of this population [1]. CGA-based management is reportedly effective in improving survival and function in elderly people [2].

However, studies have reported a discrepancy regarding sex differences in mortality and disability. While women live longer, they tend to have more disabilities and comorbidities than men, a clinical phenomenon known as the 'male-female health-survival paradox' [3][4]. The gap between life expectancy and healthy life expectancy is wider for women than for men in Japan [5]. Therefore, it is important to study female-specific factors that may affect healthy life expectancy, especially among the elderly. However, most previous studies on CGA have not focused on female-specific symptoms and disorders such as pelvic organ prolapse (POP), which is reportedly associated with adverse quality of life (QOL) status [6].

POP is a common condition in elderly women and is characterized by a descent of the female pelvic organs (uterus, bladder, and/or rectum) into the vagina, resulting in symptoms such as a feeling of a vaginal bulge and bladder and bowel control problems [7]. POP greatly affects women's daily activities, QOL, and well-being [7][6]. A major risk factor for POP is advanced age [7]; thus, with the increased population aging worldwide, the number of women with POP is also expected to increase [8].

Although POP is not a life-threatening disease, it greatly affects patient QOL. Hence, POP contributes to healthy life expectancy rather than life expectancy. Therefore, evaluating POP-related symptoms in community-dwelling elderly women as part of the CGA is meaningful. Despite its super-aged society, POP among elderly women in Japan has not been reported.

This study aimed to reveal the impact of gynecological factors as components of CGA. We examined the association between self-rated symptoms of POP and other geriatric items that have been evaluated as components of CGAs in community-dwelling elderly women in a rural town in Japan.

## **2. Materials and Methods**

### **2.1 Study Design and Participants**

Our group conducts an annual health check-up as part of the Tosa Longitudinal Aging Study (TLAS), which is a comprehensive community-based cohort study examining geriatric function in Tosa Town, Kochi Prefecture, Japan [9]. In 2017, the total population of community-dwelling elderly women aged 75 years or older in Tosa Town was 526 (excluding those who were admitted to a hospital or nursing home). Of these, 165 participated in the TLAS annual health check-up, 164 of whom agreed to participate in the present cross-sectional study (participation rate, 31.2%).

## 2.2 CGA

Basic activities of daily living (ADL) were assessed via a seven-item questionnaire on (i) walking, (ii) ascending and descending stairs, (iii) feeding, (iv) dressing, (v) using the toilet, (vi) bathing, and (vii) grooming. These items were scored from 0 (completely dependent) to 3 (completely independent), with a full score of 21 indicating complete independence [1]. In this study, individuals with a basic ADL score of 21 were defined as independent, while those with a score <21 were defined as having difficulty. Advanced ADL was assessed using the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC) questionnaire, which rated participants on a scale of 0 (completely dependent) to 13 (completely independent). The assessment consists of three

components: instrumental self-maintenance (5 items; score range 0–5), intellectual activity (4 items: score range 0–4), and social role (4 items: score range 0–4), with higher scores indicating independence [10]. The Timed Up and Go (TUG) test measures the time a participant takes to stand up from an armchair, walk a distance of 3 m, turn around, return, and sit down on the chair again [11]. A cut-off point of 13.5 s was set because a TUG test time  $\geq 13.5$  s is a reported predictor of falls in community-dwelling elderly people [12]. The walking speed test measures the time taken for a participant to walk 4 m and is reported as the time per meter [13]. The Fall Risk Index-5 (FRI-5) was used to predict the future risk of falls. This score ranged from 0 to 13, with higher scores indicating a higher risk of falls. A cut-off point of 5/6 is useful for detecting fall risk [14]. Cognitive status was assessed by trained staff using the Mini-Mental State Examination (MMSE) [15]. Psychological status was assessed using a five-item version of the Geriatric Depression Scale (GDS-5), which is a self-administered questionnaire. This score has a cut-off point of 1/2 in the range of 0 to 5, with higher scores indicating a higher risk of depression [16]. Subjective QOL was assessed using a 100-mm visual analog scale in which the participants pointed to a place along the scale (lowest QOL on the left; highest on the right) for each of three variables: a subjective sense of health, financial satisfaction, and subjective happiness [17]. This study used the 25<sup>th</sup> percentile

point of each VAS as the cut-off point.

### 2.3 Reproductive history and status

Each participant was interviewed directly by a female gynecologist in a privacy-protected setting regarding their history of POP, hysterectomy, vaginal delivery, place of delivery (home, midwife clinic, hospital), artificial abortion, spontaneous abortion, stillbirth, and knowledge of POP.

### 2.4 Self-rated symptoms of POP assessment

Self-rated POP symptoms were assessed using the Pelvic Organ Prolapse Distress Inventory-6 (POPDI-6) score, which is part of the Pelvic Floor Distress Inventory-20 (PFDI-20) score used to measure condition-specific QOL, especially for women with POP [18]. This study used POPDI-6 to focus on female-specific POP. The six items of the POPDI-6 score included pressure in the lower abdomen, heaviness or dullness in the pelvic area, feeling or seeing a bulge in the vagina, pushing on the vagina to have a bowel movement, feeling of incomplete bladder emptying, or pushing up on the bulge to start or complete urination within the previous 3 months [18]. Each item was first evaluated for the presence or absence of symptoms and then scored regarding the degree of bother

from 1 (not at all) to 4 (quite a bit) only if the symptoms were present. To obtain a final score, the mean score for all six items was calculated and then multiplied by 25 (range, 0–100). Higher scores indicated a low condition-specific QOL. This study defined the “symptom group” as individuals with at least one symptom of POP based on the POPDI-6 items (POPDI-6 >0) and the “no symptom group” as individuals with no symptoms (POPDI-6 = 0).

## 2.5 Statistical analysis

POPDI-6 scores were analyzed using one-way analysis of variance (ANOVA) between the three groups by age (75–80, 80–85, and  $\geq 85$  years of age); all the other categorical variables were analyzed between the three groups using  $\chi^2$ -tests (Table 2). History of vaginal delivery, hysterectomy, artificial abortion and home delivery, present illness, TUG test ( $\geq 13.5$  s), basic ADL ( $< 21$ ), GDS-5 ( $\geq 2$ ), and subjective QOL ( $< 25$ th percentile) were analyzed using  $\chi^2$  or Fisher’s exact probability tests. All other continuous variables were analyzed using Student’s *t*-tests between the two groups (with or without symptoms of POP) (Table 3).

In univariate and multiple logistic regression analyses, we considered basic ADL difficulty (score  $< 21$ ) as the dependent variable and symptoms of POP (POPDI-6  $> 0$ ) as

an explanatory variable after adjusting for previously reported basic ADL difficulty risk factors (i.e., age, TUG time, GDS-5 score, and present illness of diabetes mellitus or hypertension) [1][9][19] (Table 4). Univariate and multiple logistic regression analyses were also performed, in which we considered the TUG test ( $\geq 13.5$ s) as the dependent variable and symptoms of POP (POPDI-6  $> 0$ ) as an explanatory variable after adjusting for risk factors related to the TUG test (i.e., age, basic ADL, FRI-5, and presence of diabetes mellitus or hypertension) [20][21] (Table 5). All statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA); the threshold for significance was  $P < 0.05$ .

### 3. Results

Table 1 shows the baseline characteristics of the study participants. The mean age was  $82.8 \pm 4.8$  years). The mean basic ADL score and TUG test time were  $20.4 (\pm 1.0)$  and  $10.1 (\pm 3.3)$  seconds, respectively.

Table 2 shows the reproductive health characteristics of the study participants and comparisons between the three age groups. In this study, 42.7% ( $n = 70$ ) reported a knowledge of POP, 6.1% ( $n = 10$ ) had a history of POP diagnosis, 11.0% ( $n = 18$ ) had a history of hysterectomy, and 38.7% ( $n = 63$ ) had a history of artificial abortion. The mean

POPDI-6 score was  $1.52 \pm 4.6$ . Moreover, 81.7% ( $n = 134$ ) of participants reported no symptoms of POP (POPDI-6 = 0) and there was no significant difference in age between the three groups. The proportions of participants with a history of home delivery, midwife clinic delivery, and hospital delivery differed significantly among the three age groups ( $P < 0.001$ ,  $P = 0.002$ , and  $P = 0.025$ , respectively).

Table 3 shows the result of comparisons of the anthropometric factors, physical functional status, cognitive and psychological status, present illness, and reproductive history and status of the participants with (POPDI-6 >0) and without (POPDI-6 = 0) symptoms of POP. A significantly higher proportion of participants with symptoms of POP had a history of hysterectomy ( $P = 0.025$ ), TUG test time  $\geq 13.5$  s ( $P = 0.024$ ), basic ADL difficulty (basic ADL score <21) ( $P = 0.02$ ), and subjective sense of health score <47 (25th percentile) ( $P = 0.004$ ).

In the univariate analysis, age (OR: 1.18;  $P < 0.001$ ), POPDI-6 >0 (OR: 2.57;  $P = 0.022$ ), TUG test time  $\geq 13.5$  s (OR: 22.05;  $P < 0.001$ ), GDS-5  $\geq 2$  (OR: 4.59;  $P < 0.001$ ), and presence of diabetes mellitus (OR: 3.05;  $P = 0.034$ ) were significantly associated with basic ADL difficulty (Table 4, univariate). In the multiple analysis, age (OR: 1.20;  $P < 0.001$ ), POPDI-6 >0 (OR: 2.78;  $P = 0.031$ ), GDS-5  $\geq 2$  (OR: 4.82;  $P < 0.001$ ), and presence of diabetes mellitus (OR: 3.37;  $P = 0.047$ ) were significantly associated with

basic ADL difficulty after adjusting for all confounding factors except for TUG time (Table 4, Model 1). When TUG time was also adjusted, age (OR: 1.20;  $P < 0.001$ ), TUG time  $\geq 13.5$  s (OR: 11.81;  $P = 0.004$ ), GDS-5  $\geq 2$  (OR: 3.11;  $P = 0.015$ ), and presence of diabetes mellitus (OR: 3.59;  $P = 0.047$ ) were significantly associated with ADL difficulty while POPDI-6  $> 0$  was not (Table 4, Model 2).

In the univariate analysis, POPDI-6  $> 0$  (OR: 3.47;  $P = 0.02$ ), BADL  $< 21$  (OR: 22.05;  $P < 0.001$ ), and FRI-5  $\geq 6$  (OR: 10.6;  $P = 0.002$ ) were significantly associated with TUG test time  $\geq 13.5$  s (Table 5, univariate). In the multiple analysis, POPDI-6  $> 0$  (OR: 3.45;  $P = 0.048$ ) and FRI-5  $\geq 6$  (OR: 8.10;  $P = 0.008$ ) were significantly associated with TUG test time  $\geq 13.5$  s after adjusting for all confounding factors except for basic ADL (Table 5, Model 1). When basic ADL was also adjusted, basic ADL (OR: 8.34;  $P = 0.025$ ) was significantly associated with TUG test time  $\geq 13.5$  s, while POPDI-6  $> 0$  was not (Table 5, Model 2).

#### 4. Discussion

We investigated the obstetrical and gynecological history and status, as well as the association between self-rated symptoms of POP and components of CGA in community-dwelling elderly women in Japan. We found that 18.3% of participants had at least one

self-rated symptom of POP (symptoms group) and that the symptom group showed longer TUG test time, lower basic ADL score, and lower subjective sense of health compared to those in the group of participants without symptoms. A previous study reported that a history of abortion could be a significant risk factor for pelvic relaxation [22], but we could not find such significant relationships in this study. The average BMI, a well-known risk factor for POP, of this study participants was 22.9, which is relatively low compared to that in other countries. However, based on the official statistics of the Ministry of Health, Labor, and Welfare of Japan, the average BMI of women aged 75 years or more in 2017 was also 22.9 [23].

Previous studies reported prevalences of POP by symptom-based definition of 3–6% for a single question and 28.1% for a 7-item POPSS questionnaire [24][25]. The single question consisted of feeling or seeing a bulge in or outside the vagina, which is a symptom of advanced-stage POP. This questionnaire has been reported to have a high specificity (99%) but low sensitivity (35%) for screening for POP [26]. In contrast, the components of the POPSS questionnaire were relatively similar to those of POPDI-6. The subjects in the previous study of POPSS were aged 27–80 years, which is younger than the present study (75–98 years) [25]. Although the incidence of POP increases with age, women in their 6th and 7th decades of life reportedly show the highest level of

bother regarding prolapse symptoms, irrespective of stage [27]. Therefore, it is possible that the prevalence in the present study was lower than that of the previous study on POPSS. In addition, 83% of participants in the symptom group in this study had a POPDI-6 score of less than 10, suggesting that most had mild symptoms such, as indicated by “symptomatic, but not bothered” responses. The present study adds to previous knowledge by showing that 18% of elderly women in the community aged 75 years or older in a rural town in Japan had some self-rated symptoms of POP; most of which were mild.

The results of this study showed a significant association between TUG test time  $\geq 13.5$  s and self-rated symptoms of POP after adjusting for confounding factors (Table 5). Our findings suggest an association between pelvic floor muscle weakness and time to standing and sitting on a chair (TUG time), especially since we also found no difference in walking speed between participants with and without symptoms of POP. This hypothesis was supported by the results of previous studies, in which pelvic floor muscle weakness was associated with POP [28] and pelvic floor muscles were stimulated by postural changes such as straight leg raise while lying using electromyography [29]. TUG is an objective measure that is often used as a CGA; moreover, it is also a physical predictor of physical functional decline in elderly persons

[12]. Thus, self-rated symptoms of POP may be associated with declines in daily physical function. This study could not prove a causal relationship because of its cross-sectional nature. Further studies are needed to determine whether strengthening the gait function is effective at preventing or improving symptoms of POP, and whether treating POP is effective at improving the gait function.

The results of this study also revealed an association between the basic ADL score and self-rated symptoms of POP after adjusting for confounding factors (Table 4). The basic ADL items that scored particularly low in the POP symptom group included “walking” and “ascending and descending stairs”. Lower limb weakness may cause POP, which is also supported by the association between TUG and POP symptoms in this study. In contrast, the presence of POP symptoms may cause a decrease in basic ADL, and treatment of POP may improve basic ADL. Elderly women with declining ADL, especially due to lower limb weakness, should be investigated for POP symptoms. As the present study was a cross-sectional design, the causal associations should be considered in future longitudinal studies.

The results of this study also revealed an association between the subjective sense of health and self-rated symptoms of POP (Table 2). This result is consistent with those of previous studies reporting an association between POP and adverse psychological status

[6]. In the present study, POPDI-6 was associated with a subjective sense of health but not with GDS-5, suggesting that the POPDI-6 can detect a mild psychological burden below the threshold for GDS detection. As a subjective sense of health is reportedly associated with mental health and functional ability in community-dwelling elderly adults in Japan [30], self-rated symptoms of POP may also be related to these factors.

The present study has several limitations. First, we did not perform a pelvic examination to assess POP. Although we offered a pelvic examination by a female gynecologist to all participants, only two examinations were conducted. A major reason for this reticence to undergo pelvic examination is that talking about sexuality and genitalia remains taboo among many elderly Japanese women [31]. However, this study aimed to examine the subjective symptoms associated with POP rather than its diagnosis. Second, the POPDI-6 is a questionnaire originally designed to assess POP-specific QOL in patients with POP rather than in the general population. However, this study identified the subjective symptoms of POP in the general population. Hence, some of the symptoms extracted by the POPDI-6 may not be due to POP. Third, this was a cross-sectional study with a relatively small population and was conducted in only one rural town in Japan. Furthermore, the study design did not allow the investigation of

causal relationships and generalization. Further longitudinal studies using larger samples from multiple areas are required.

The strengths of this study are that it is the first study to 1) assess the subjective symptoms of POP among community-dwelling elderly women in Japan, and 2) focus on obstetrics and gynecology items as part of CGA.

In conclusion, in a rural town in Japan, we found that community-dwelling elderly women with symptoms of POP, as evaluated by the POPDI-6 questionnaire, had a significantly longer TUG test time, a lower capability to perform basic ADL, and a lower subjective sense of health compared with those in participants without symptoms of POP. These results suggest that female-specific symptoms such as POP are associated with decreased physical function (especially in the lower limbs) and adverse mental health in elderly women. Therefore, evaluating POP-related symptoms in community-dwelling elderly women as a component of CGA may contribute to improving the healthy life expectancy of elderly women. More attention should be paid to genital conditions such as POP in the CGA setting.

## **Contributors**

Emiko Kato contributed to the methodology, formal analysis, and writing of the original draft.

Taizo Wada contributed to the investigation and manuscript review and editing.

Mayumi Hirosaki contributed to the investigation and manuscript review and editing.

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Michiko Fujisawa contributed to the investigation and manuscript review and editing.

Yumi Kimura contributed to the investigation and manuscript review and editing.

Yasuko Ishimoto contributed to the investigation and manuscript review and editing.

Mitsuhiro Nose contributed to the investigation and manuscript review and editing.

Kiyohito Okumiya contributed to the investigation and manuscript review and editing.

Kozo Matubayashi contributed to the investigation, manuscript review and editing, and supervision.

Ryota Sakamoto contributed to the study conceptualization and methodology, manuscript reviewing and editing, and project administration.

## **Ethical approval**

This study was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all the participants. This study was approved by the ethical committee of the Faculty of Medicine, Kyoto University, Kyoto, Japan.

### **Provenance and peer review**

This article has undergone peer review.

### **Research data (data sharing and collaboration)**

There are no linked research datasets for this study. The data that support the findings of this study are available from the corresponding author, MK, upon reasonable request.

### **Declaration of Competing Interest**

The authors declare no conflict of interest.

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**Table 1 Baseline characteristics of the study subjects (n = 164)**

| <b><i>Demographic information and anthropometric factors: mean ± SD</i></b> |             |
|-----------------------------------------------------------------------------|-------------|
| Age (years)                                                                 | 82.8 ± 4.8  |
| Height (cm)                                                                 | 144.8 ± 6.6 |
| Body weight (kg)                                                            | 48.2 ± 9.1  |
| Waist (cm)                                                                  | 83.6 ± 11.0 |
| Body mass index (kg/m <sup>2</sup> )                                        | 22.9 ± 3.7  |
| <b><i>Physical function: mean ± SD</i></b>                                  |             |
| Walking speed (s/m)                                                         | 1.09 ± 0.3  |
| TUG test (s)                                                                | 10.1 ± 3.3  |
| TUG test ≥ 13.5 (s), n (%)                                                  | 18 (11.3)   |
| Basic ADL (range 0–21),                                                     | 20.4 ± 1.0  |
| Basic ADL < 21 (%), n (%)                                                   | 56 (35.0)   |
| Instrumental self-maintenance (range 0–5)                                   | 4.7 ± 0.9   |
| Intellectual activity (range 0–4)                                           | 3.3 ± 1.0   |
| Social role (range 0–4)                                                     | 3.3 ± 1.1   |
| TMIG-IC (range 0–13)                                                        | 11.3 ± 2.3  |
| FRI-5 (range 0–13)                                                          | 5.0 ± 3.5   |
| FRI-5 ≥ 6, n (%)                                                            | 76 (47.5)   |
| <b><i>Cognitive and psychological status: mean ± SD</i></b>                 |             |
| MMSE (range 0–30)                                                           | 27.2 ± 3.2  |
| GDS-5 score (range 0–5)                                                     | 0.99 ± 1.2  |
| QOL Subjective sense of health (range 0–100)                                | 57.1 ± 19.6 |
| QOL Subjective sense of health < 47 [25th percentile] (%)                   | 38 (23.3)   |
| QOL Financial satisfaction (range 0–100)                                    | 56.7 ± 21.2 |
| QOL Financial satisfaction < 47 [25th percentile] (%)                       | 39 (23.9)   |
| QOL Subjective happiness (range 0–100)                                      | 64.9 ± 21.1 |
| QOL Subjective happiness < 51 [25th percentile] (%)                         | 49 (29.9)   |
| <b><i>Present illness: n (%)</i></b>                                        |             |
| Diabetes mellitus                                                           | 19 (11.7)   |
| Hypertension                                                                | 122 (74.4)  |

TUG test, Timed Up and Go test; ADL, activities of daily living; TMIG-IC, Tokyo Metropolitan Institute of Gerontology Index of Competence; FRI-5, Fall Risk Index-5; MMSE, Mini-Mental State Examination; GDS-5, 5-item version of the Geriatric Depression Score; QOL, quality of life; SD, standard deviation

**Table 2 Reproductive health characteristics and comparisons among three age groups**

|                                                                        | <b>Total<br/>(n = 164)</b> | <b>75 ≤ age &lt; 80<br/>(n = 42)</b> | <b>80 ≤ age &lt; 85<br/>(n = 71)</b> | <b>85 ≤ age<br/>(n = 51)</b> | <b>P value</b> |
|------------------------------------------------------------------------|----------------------------|--------------------------------------|--------------------------------------|------------------------------|----------------|
| <b><i>Reproductive history and status</i></b>                          |                            |                                      |                                      |                              |                |
| Knowledge of POP, % (n)                                                | 42.7 (70)                  | 28.6 (12)                            | 46.5 (33)                            | 49.0 (25)                    | 0.097          |
| History of POP diagnosis, % (n)                                        | 6.1 (10)                   | 2.4 (1)                              | 7.1 (5)                              | 7.8 (4)                      | 0.494          |
| History of hysterectomy, % (n)                                         | 11.0 (18)                  | 4.8 (2)                              | 9.9 (7)                              | 17.6 (9)                     | 0.13           |
| History of vaginal delivery ≥ 1, % (n)                                 | 93.3 (153)                 | 92.2 (39)                            | 95.8 (68)                            | 90.2 (46)                    | 0.474          |
| History of home delivery ≥ 1, % (n)                                    | 42.7 (70)                  | 7.1 (3)                              | 26.5 (33)                            | 66.7 (34)                    | <0.001         |
| History of midwife clinic delivery ≥ 1, % (n)                          | 46.3 (76)                  | 54.8 (23)                            | 56.3 (40)                            | 25.5 (13)                    | 0.002          |
| History of hospital delivery ≥ 1, % (n)                                | 28.0 (46)                  | 42.9 (18)                            | 26.8 (19)                            | 17.6 (9)                     | 0.025          |
| History of artificial abortion ≥ 1, % (n)                              | 38.7 (63)                  | 35.7 (15)                            | 42.3 (30)                            | 36.0 (18)                    | 0.708          |
| History of spontaneous abortion or stillbirth ≥ 1, % (n)               | 26.4 (43)                  | 26.2 (11)                            | 31.0 (22)                            | 20.0 (10)                    | 0.402          |
| <b><i>Pelvic organ prolapse-related symptoms</i></b>                   |                            |                                      |                                      |                              |                |
| POPDI-6 score (range 0–100), mean ± SD                                 | 1.52 ± 4.6                 | 1.19 ± 3.1                           | 2.00 ± 6.1                           | 1.14 ± 2.8                   | 0.517          |
| POPDI-6 score = 0: without symptoms of POP, % (n)                      | 81.7 (134)                 | 85.7 (36)                            | 78.9 (56)                            | 82.4 (42)                    | 0.655          |
| POPDI-6 score ≥ 1: with symptoms of POP, % (n)                         | 18.3 (30)                  | 14.3 (6)                             | 21.1 (15)                            | 17.6 (9)                     | 0.655          |
| <b><i>POPDI-6 items (range 0–4), (%) with scores of 1 or above</i></b> |                            |                                      |                                      |                              |                |
| Pressure in the lower abdomen, % (n)                                   | 8.5 (14)                   | 9.8 (4)                              | 9.9 (7)                              | 5.9 (3)                      | 0.707          |
| Heaviness or dullness in the pelvic area, % (n)                        | 4.9 (8)                    | 4.9 (2)                              | 4.2 (3)                              | 5.9 (3)                      | 0.916          |
| Feeling or seeing bulge in vagina, % (n)                               | 0.6 (1)                    | 0 (0)                                | 1.4 (1)                              | 0 (0)                        | 0.508          |
| Pushing on the vagina to have bowel movement, % (n)                    | 0.6 (1)                    | 0 (0)                                | 0 (0)                                | 2.0 (1)                      | 0.328          |
| Feeling of incomplete bladder emptying, % (n)                          | 7.9 (13)                   | 4.8 (2)                              | 11.3 (8)                             | 5.9 (3)                      | 0.376          |

|                                                               |         |       |         |       |       |
|---------------------------------------------------------------|---------|-------|---------|-------|-------|
| Pushing up on the bulge to start or complete urination, % (n) | 0.6 (1) | 0 (0) | 1.4 (1) | 0 (0) | 0.517 |
|---------------------------------------------------------------|---------|-------|---------|-------|-------|

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POP, pelvic organ prolapse; POPDI-6, Pelvic Organ Prolapse Distress Inventory-6; SD, standard deviation

**Table 3 Comparisons of geriatric functional and cognitive statuses between participants with and without symptoms of pelvic organ prolapse**

|                                                                             | Without<br>symptoms<br>(POPDI-6 =0)<br>(n = 134) | With<br>symptoms<br>(POPDI-6 >0)<br>(n = 30) | P value |
|-----------------------------------------------------------------------------|--------------------------------------------------|----------------------------------------------|---------|
| <b><i>Demographic information and anthropometric factors: mean ± SD</i></b> |                                                  |                                              |         |
| Age (years)                                                                 | 82.8 ± 5.0                                       | 82.7 ± 3.7                                   | 0.842   |
| Height (cm)                                                                 | 144.6 ± 6.5                                      | 145.8 ± 7.1                                  | 0.356   |
| Body weight (kg)                                                            | 47.5 ± 8.7                                       | 51.0 ± 10.2                                  | 0.061   |
| Waist (cm)                                                                  | 83.0 ± 10.8                                      | 86.5 ± 11.9                                  | 0.124   |
| Body mass index (kg/m <sup>2</sup> )                                        | 22.7 ± 3.6                                       | 23.9 ± 4.1                                   | 0.108   |
| <b><i>Physical functioning</i></b>                                          |                                                  |                                              |         |
| Walking speed (s/m), mean ± SD                                              | 1.10 ± 0.32                                      | 1.03 ± 0.39                                  | 0.277   |
| TUG test (s), mean ± SD                                                     | 9.72 ± 2.45                                      | 11.89 ± 5.61                                 | 0.050   |
| TUG test ≥ 13.5 s (%)                                                       | 8.4                                              | 24.1                                         | 0.024   |
| Basic ADL (range 0–21), mean ± SD                                           | 20.5 ± 1.0                                       | 20.1 ± 1.0                                   | 0.057   |
| Basic ADL < 21 (%)                                                          | 30.8                                             | 53.3                                         | 0.020   |
| Instrumental ADL (range 0–5), mean ± SD                                     | 4.7 ± 1.0                                        | 4.7 ± 0.8                                    | 0.969   |
| Intellectual ADL (range 0–4), mean ± SD                                     | 3.3 ± 0.9                                        | 3.2 ± 1.1                                    | 0.713   |
| Social ADL (range 0–4), mean ± SD                                           | 3.4 ± 1.1                                        | 3.2 ± 1.1                                    | 0.578   |
| TMIG-IC (range 0–13), mean ± SD                                             | 11.4 ± 2.3                                       | 11.1 ± 2.4                                   | 0.584   |
| FRI-5 (range 0–13), mean ± SD                                               | 4.9 ± 3.7                                        | 5.4 ± 3.0                                    | 0.500   |
| FRI-5 ≥ 6 (%)                                                               | 45.5                                             | 57.1                                         | 0.261   |
| <b><i>Cognitive and psychological status</i></b>                            |                                                  |                                              |         |
| MMSE (range 0–30), mean ± SD                                                | 27.0 ± 3.3                                       | 28.2 ± 2.0                                   | 0.075   |
| GDS-5 (range 0–5), mean ± SD                                                | 0.93 ± 1.1                                       | 1.27 ± 1.3                                   | 0.154   |
| GDS-5 ≥ 2 (%)                                                               | 28.0                                             | 36.7                                         | 0.35    |
| QOL Subjective sense of health, mean ± SD                                   | 58.8 ± 18.6                                      | 49.6 ± 22.0                                  | 0.019   |
| QOL Subjective sense of health < 47 [25th percentile] (%)                   | 18.8                                             | 43.3                                         | 0.004   |
| QOL Financial satisfaction, mean ± SD                                       | 57.2 ± 21.4                                      | 54.6 ± 20.4                                  | 0.558   |
| QOL Financial satisfaction < 47 [25th percentile] (%)                       | 23.3                                             | 26.7                                         | 0.697   |
| QOL Subjective happiness, mean ± SD                                         | 65.5 ± 20.2                                      | 62.3 ± 24.6                                  | 0.456   |
| QOL Subjective happiness < 51 [25th percentile] (%)                         | 30.6                                             | 26.7                                         | 0.671   |
| <b><i>Present illness (%)</i></b>                                           |                                                  |                                              |         |
| Diabetes mellitus                                                           | 10.6                                             | 16.7                                         | 0.353   |

|                                                   |      |      |       |
|---------------------------------------------------|------|------|-------|
| Hypertension                                      | 73.1 | 80.0 | 0.436 |
| <b><i>Reproductive history and status (%)</i></b> |      |      |       |
| History of hysterectomy                           | 8.2  | 23.3 | 0.025 |
| History of vaginal delivery $\geq 1$ time         | 93.3 | 93.3 | 1.000 |
| History of artificial abortion $\geq 1$ time      | 40.6 | 30.0 | 0.281 |
| History of home delivery $\geq 1$ time            | 43.3 | 40.0 | 0.742 |

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POPDI-6, Pelvic Organ Prolapse Distress Inventory-6; TUG test, Timed Up and Go test; ADL, activities of daily living; TMIG-IC, Tokyo Metropolitan Institute of Gerontology Index of Competence; FRI-5, Fall Risk Index-5; MMSE, Mini-Mental State Examination; GDS-5, 5-item version of the Geriatric Depression Score; QOL, quality of life; SD, standard deviation

**Table 4 Results of univariate and multiple logistic regression analyses examining the associations between difficulty in performing basic ADL (score < 21) and POPDI-6 > 0 after adjusting for risk factors related to difficulty in basic ADL**

| Independent variable | Univariate |               |         | Multiple (Model 1) |              |         | Multiple (Model 2) |              |         |
|----------------------|------------|---------------|---------|--------------------|--------------|---------|--------------------|--------------|---------|
|                      | OR         | 95%CI         | P value | OR                 | 95%CI        | P value | OR                 | 95%CI        | P value |
| Age                  | 1.18       | 1.09 - 1.27   | <0.001  | 1.20               | 1.10 - 1.31  | <0.001  | 1.20               | 1.09 - 1.32  | <0.001  |
| POPDI-6 > 0          | 2.57       | 1.15 - 5.77   | 0.022   | 2.78               | 1.10 - 7.06  | 0.031   | 2.01               | 0.74 - 5.48  | 0.171   |
| TUG $\geq$ 13.5 s    | 22.05      | 4.84 - 100.57 | <0.001  | -                  | -            | -       | 11.81              | 2.19 - 63.55 | 0.004   |
| GDS-5 $\geq$ 2       | 4.59       | 2.22 - 9.48   | <0.001  | 4.82               | 2.05 - 11.30 | <0.001  | 3.11               | 1.25 - 7.76  | 0.015   |
| Diabetes mellitus    | 3.05       | 1.09 - 8.53   | 0.034   | 3.37               | 1.02 - 11.13 | 0.047   | 3.59               | 1.02 - 12.71 | 0.047   |
| Hypertension         | 1.74       | 0.80 - 3.80   | 0.166   | 1.69               | 0.67 - 4.29  | 0.270   | 1.76               | 0.64 - 4.83  | 0.274   |

ADL, activities of daily living; OR, odds ratio; CI, confidence interval; POPDI-6, Pelvic Organ Prolapse Distress Inventory-6; TUG, Timed Up and Go test; GDS-5, 5-item version of the Geriatric Depression Score

**Table 5 Results of univariate and multiple logistic regression analyses examining the associations between Timed Up and Go test ( > 13.5 ) and POPDI-6 ( > 0), after adjusting for risk factors related to Timed Up and Go test**

| Independent variable | Univariate |               |         | Multiple (Model 1) |              |         | Multiple (Model 2) |              |         |
|----------------------|------------|---------------|---------|--------------------|--------------|---------|--------------------|--------------|---------|
|                      | OR         | 95%CI         | P value | OR                 | 95%CI        | P value | OR                 | 95%CI        | P value |
| Age                  | 1.10       | 0.99 - 1.21   | 0.067   | 1.09               | 0.97 - 1.24  | 0.165   | 1.04               | 0.91 - 1.19  | 0.588   |
| POPDI-6 > 0          | 3.47       | 1.21 - 9.93   | 0.02    | 3.45               | 1.01 - 1.24  | 0.048   | 2.57               | 0.72 - 9.18  | 0.146   |
| BADL < 21            | 22.05      | 4.84 - 100.57 | <0.001  | -                  | -            | -       | 8.34               | 1.30 - 53.49 | 0.025   |
| FRI-5 $\geq$ 6       | 10.60      | 2.34 - 48.16  | 0.002   | 8.10               | 1.71 - 38.41 | 0.008   | 2.62               | 0.41 - 16.92 | 0.312   |
| Diabetes mellitus    | 2.59       | 0.75 - 8.95   | 0.134   | 2.24               | 0.48 - 10.37 | 0.304   | 1.40               | 0.29 - 6.80  | 0.680   |
| Hypertension         | 1.23       | 0.38 - 3.98   | 0.726   | 1.04               | 0.26 - 4.27  | 0.953   | 0.99               | 0.23 - 4.34  | 0.990   |

POPDI-6, Pelvic Organ Prolapse Distress Inventory-6; OR, odds ratio; CI, confidence interval; BADL, basic activities of daily living; FRI-5, Fall Risk Index-5