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# Presence of symptoms after COVID-19 infection may explain the onset of female urinary incontinence: a cross-sectional study

Ana Jéssica dos Santos Sousa[1], Ana Paula Rodrigues Rocha[2], Jordana Barbosa-Silva[2,3], Patricia Driusso[2]

[1]Physiotherapy Department of the State University of Paraíba (UEPB) - Campina Grande (PB), Brazil

[2]Physiotherapy Department, Women's Health Research Laboratory (LAMU), Federal University of São Carlos (UFSCar) – São Carlos (SP), Brazil.

[3]University of Applied Sciences – Hochschule Osnabrück, Osnabrück, Germany

**Corresponding author:** Patricia Driusso - Universidade Federal de São Carlos - Rodovia Washington Luís, km 235 - CEP: 13565-905 - São Carlos (SP), Brazil - E-mail: pdriusso@ufscar.br

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## ABSTRACT

**Introduction:** Coronavirus 2019 (COVID-19) is a multisystem disease that may affect lower urinary tract function. **Objective:** To determine if symptoms after COVID-19 infection may explain the onset of urinary incontinence (UI) in female survivors; to investigate the impacts of symptoms on the quality of life of incontinent women. **Methods:** Cross-sectional study carried out online which included Brazilian women aged 18 years or older who developed UI during or after the COVID-19 infection, and were infected during the last three-months before data collection. Participants answered a semi structured questionnaire with sociodemographic and clinical questions; and validated questionnaires to assess UI symptoms (3-Incontinence Questionnaire; and International Consultation on Incontinence Questionnaire – Short Form). Multiple linear and binary logistic regression analysis were performed. **Results:** 879 women were included. Symptoms after COVID-19 infection had a statistically significant impact on stress UI, urgency UI, and mixed UI, predicting adequately 75.7%, 84.6%, and 73.4% of the cases, respectively. Muscle pain impacted the quality of life of women with UI, explaining 6.3% of UI. Other symptoms (i.e., diarrhea, tingling, and difficulty in breathing) explained 5.2% of of the impact on quality of life in women with UI. The resence of a cough for more than three weeks impacted the quality of life of women with UI, explaining 2.7% of the outcome. **Conclusion:** Post-COVID-19 symptoms can explained the onset of UI. The presence of cough lasting more than 3 weeks impact the women's quality of life.

**Keywords:** urinary incontinence; COVID-19; lower urinary tract symptoms.

## INTRODUCTION

Coronavirus-2019 (COVID-19) is a virus that causes severe acute respiratory syndrome (SARS), a multisystem disease that is associated with a risk of hospitalization and death[1]. It is kown that it has affected around 655,876,036 people worldwide[2] and nowadays, survivors and health professionals are facing the sequels of the infection. Post-COVID-19 syndrome might be present even in patients with mild impairments, and the most common symptoms after infection include cough, difficulty in breathing, fatigue, muscle pain, loss of movement, tingling, and diarrhea[3].

The presence of symptoms after COVID-19 infection may be associated with the development of new health conditions, as an example of the pelvic floor muscles (PFM) dysfunctions. Previous literature suggested that the decrease of muscle strength after COVID-19 infection might affect the lower urinary tract function[4]. One of the most common complains of PFM dysfunctions is the presence of urinary incontinence (UI), described as an involuntary loss of urine[5]. There are previous studies that already hyphothetized that the worsening of urinary symptoms may be related with the chronicity of cough[6], suggesting that it increases the intra-abdominal pressure and trigger the pelvic floor muscle (PFM) fatigue[7], resulting in urinary leakage. However, there is no previous evidence that aimed to investigate the relationship between the new-onset of urinary complains and presence of symptomsafter COVID-19 infection.

Considering that one of the most common symptoms of post-COVID infection (i.e., cough) is highly correlated with the presence of urinary complains[4,6,7], the association between the new-onset of UI should be investigated, as it can adversely influence the quality of life and can reduce women's physical, psychological, and social well-being[8]. Thus, implications about the new-onset of UI might clarify for health professionals which strategies should be taken in order to treat the urinary symptoms, especially because many urogynecological procedures and

appointments were canceled during quarentine, as procedures related to severe cases of COVID-19 infection were prioritized[9].

Therefore, this study aimed to determine if the most common symptoms after COVID-19 infection (i.e., cough, difficulty in breathing, fatigue, muscle pain, loss of movement, tingling, and diarrhea) may explain the presence of new onset of urinary symptoms in female survivors. Furthermore, it analyzed the impact of COVID-19 symptoms on incontinent women's quality of life.

## METHODS

### Study design

This is a cross-sectional study developed in Brazil and reported according to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines[10]. As determined by Resolution 466/2012 of the Brazilian National Health Council, this study was approved by the Institutional Ethics Committee. All participants agreed to participate by reading the online informed consent form and clicking "I agree to participate in this study" before starting the data collection.

### Participants

Participants were invited to participate through social media (i.e., Facebook, Instagram, and WhatsApp). Participants were included if they were Brazilian women aged 18 or older, that were residing in the national territory, who recovered from COVID-19 infection within three months before the data collection and had developed UI during or after the COVID-19 infection, and those who did not have UI before the COVID-19 infection. Participants who did not complete the questionnaire, pregnant women, and women who treated urinary symptoms after COVID-19 infection were excluded.

**Procedures**

The data collection was carried online by using the Google Forms platform, from January to April 2022 Participants answered a semi-structured and self-administered questionnaire elaborated by the research team to assess the participants' sociodemographic characteristics and information regarding COVID-19 infection. All data collected was self-reported. The questionnaire included questions about personal information (i.e., age, nationality, marital status, and others) and questions about the presence of the most common symptoms after COVID-19 infection (i.e., cough, difficulty in breathing, fatigue, muscle pain, loss of movement, tingling, and diarrhea)[11]. The presence of cough was classified as acute when it was present for a period of up to three weeks, subacute in cases where it persistents between three and eight weeks, and chronic when it last more than eight weeks[12].

To assess the history of UI, the participants answered a question about the onset of the symptom by synalizing if UI have started before COVID-19 infection, during the infection or during the recovery of the infection. To evaluate the presence of UI, women answered the Brazilian Portuguese version of the Three Incontinence Questionnaire (3IQ-Br)[13], a brief and self-administered questionnaire with three questions that distinguishes UI types (stress urinary incontinence, urgency urinary incontinence, and mixed urinary incontinence). This instrument has substantial reliability in the test-retest (kappa=0.66), presented an almost perfect agreement with the King's Health Questionnaire (KHQ) and the Questionnaire for Urinary Incontinence Diagnosis (QUID-Br) to diagnose UI (k>0.8) and it has good accuracy in distinguishing women with UI (AUC 0.83, 95% confidence interval [CI] 0.78 to 0.87)[13].

Participants answered the International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF) questionnaire that measures UI impact on women's quality of life[14]. It consists of four items and total score ranges from 0-21: the higher the score, worst is the impact

of UI severity in quality of life[14]. This instrument is translated, adapted, and validated in Brazil. It has a high internal consistency (Cronbach's alpha 0.88) and moderate to strong test-retest (Kappa index ranged from 0.69 to 0.91, and Pearson's correlation coefficient of 0.89[14].

**Data analysis**

Descriptive data are presented by means, standard deviations (SD), frequencies (%), beta coefficients, and 95% confidence intervals (CI). Analyses were performed using SPSS software Version 22.0 (IBM, Armonk, NY). The Kolmogorov-Smirnov test determined the normality of data distribution, and the Bartlett test assessed the homogeneity of the measured variance.

Binary logistic regression analysis (forward stepwise) was performed to investigate the likelihood of women reporting stress urinary incontinence (SUI), urgency urinary incontinence (UUI) or mixed urinary incontinence (MUI) (assessed by the 3IQ-Br questionnaire), according to the presence of symptoms after COVID-19 infection. The result of "Exp(B)" was used to interpret the odds of changing by one unit of the predictor. When Exp(B) was less than one, the post-COVID-19 symptoms corresponded to a decreasedchance of presenting UI. When Exp(B) is greater than one, post-COVID-19 symptoms corresponded to an increased chance of reporting UI. Log-likelihood analysis was performed to verify unexplained variance, and model quality was verified using the Hosmer-Lemeshow and Nagelkerke tests.

A multiple linear regression analysis (forward method) was performed to investigate the effect of post-COVID-19 symptoms and coughing duration on the quality of life of women with UI. The model, constructed from independent variables, met the criteria for absence of multicollinearity and homoscedasticity. The Durbin-Watson value was used to verify the independence of the residuals. Residual analysis and Mahalanobis and Cook tests were

performed to verify outliers. For all analyses, a p-value of less than 0.05 was considered significant.

A partial correlation was conducted as a supplementary analysis to verify the relationship between the quality of life of women with UI and COVID-19 symptoms, as well as to analyze the relationship between the quality of life of women with UI and cough duration, controlling for confounding factors such as age, BMI, and parturition.

## RESULTS

A total of 879 women were included. Participants had a mean age of 40.4 years (SD 9.4), body mass index (BMI) of 30.1 (SD 6.6) kg/m$^2$, and a mean ICIQ-SF score of 5.3 points (SD: 5.8), which does not represents a severe impact of UI on quality of life. Table 1 shows the sociodemographic characteristics, presence of symptoms after COVID-19 infection, and UI (according to the 3IQ-Br questionnaire).

The presence of cough, muscle pain and loss of movement had a statistically significant impact on SUI, predicting 75.7% of cases in total [$X^2(3)=17.34$, $p<0.001$; Nagelkerke $R^2=0.029$, Hosmer & Lemeshow 0.85]. Regarding UUI, the presence of cough and diarrhea were statistically significant associated with UUI, adequately predicting 84.6% of cases in total [$X^2(2)=8.32$, $p<0.01$; Nagelkerke $R^2=0.02$, Hosmer & Lemeshow 0.98]. Symptoms of MUI were statistically significant associated with difficult in breathing, muscle pain, tingling, and diarrhea, adequately predicting 73.4% of cases in total [$X^2(4)=66.09$, $p<0.001$; Nagelkerke $R^2=0.17$, Hosmer & Lemeshow 0.63].

Table 2 shows the odds ratios for SUI, UUI and MUI [(represented by Exp (B)]) according to the presence of symtpoms after COVID-19 infection. For example, symptoms such as cough, muscle pain, and loss of movement predicted SUI, demonstrating that these symptoms increase the chances of reporting SUI by 1.53, 1.41, and 2.15 times, respectively. Cough and

diarrhea increase the chances of women reporting UUI by 0.58 and 1.75 times, respectively. Difficulty breathing, muscle pain, tingling, and diarrhea were predictive of MUI.

Table 3 demonstrated an effect of post-COVID-19 symptoms on the ICIQ-SF score ($F(4;874)=28.24$, $p<0.001$; $R^2$ adjusted=0.11). It seems that the presence of post-COVID-19 symptoms adversely impacted the quality of life of women with UI. The beta results indicate that muscle pain severely impacted the quality of life of women with UI, explaining 6.3% of the outcome. Other symptoms (i.e., diarrhea, tingling, and difficulty in breathing) accounted for only 5.2% of the explained variance of impact on quality of life in women with UI. The symptoms of cough, fatigue and loss of movement did not have a significant impact and thereforewere not included in the model.

Although the presence of cough was not statically significant considering the impact on the quality of life of women with UI, the duration of the cough was investigated to verify whether it interferes with this outcome. A multiple linear regression analysis was performed to investigate whether the duration of coughaffects the quality of life of women with UI. The results showed a significant effect on the ICIQ-SF score ($F(1;876)=13.0$, $p=0.001$; $R^2$ adjusted=0.027). It was possible to observe that the symptom of cough lasting more than eight weeks impacted the quality of life of women with UI, explaining 2.7% of the outcome. The presence of cough lasting three weeks also decreases the quality of life[15]. Table 4 shows the predictor coefficients.

Considering that age, BMI, and parity could act as confounding factors in the model, additional analyses regardging mean, SD and correlations between these variables between quality of life were performed. However, due to the slight variation in means between groups with and without UI, it was determined that those results would be presented in table 5. After controlling for confounding factors, a positive and significant correlation between quality of life and all COVID-19 symptoms analyzed was found (Table 6). Additionally, it seems that

only cough lasting more than 8 weeks remained positive and significant, after confounding factors (Table 6).

## DISCUSSION

The findings of the present study highlight that specific symptoms ocurring after COVID-19 infection are associated with the new onset of SUI, UUI, and MUI and may increase the likelihood of female survivors in reporting urinary complaints. Additionally, post-COVID-19 symptoms might also result in a worsened impact on the quality of life of incontinent women. Specifically, the presence of chronic cough explains 2.7% of the impact on the quality of life of incontinent women.

To the authors' knowledge, this is the first study that aimed to investigate which symptoms present after COVID-19 infection could explain the UI onset. Previous studies only reported the impact of the COVID-19 pandemic on the presence[15,16] or worsening of UI[17], however, authors did not describe any odds or risks in reporting UI after the infection. Therefore, our results may redirect the urogyynecological management of COVID-19 survivors, as it seems that the presence of specific symptoms after the infection may be associated with UI. Moreover, it is known that UI affects the quality of life of women[8], therefore, health professionals should be aware about the likelihood of female survivors in developing urinary symptoms.

The primary clinical symptoms of COVID-19 are related to the respiratory system[18], and the greater the pulmonary impairment, more severe is the patient's infection[19]. The present study identified an association between respiratory symptoms after COVID-19 infection (i.e., cough and difficulty in breathing) and the new onset of UI (i.e., for SUI, UUI, MUI), as well as adverse impacts on the quality of life of incontinent women. There is a hyphothesis that respiratory symptoms may impact urological functionality, as both systems are related[6]. One

possible explanation for this association could be the PFM hypoactivity, which might be linked to either muscle weakness or residual respiratory symptoms from COVID-19[4]. Muscle weakness is a common complaint after COVID-19 infection, and the hyphothesis is that it could potentially affect the voluntary contraction of the PFM. Impairment inPFM activation can affect muscle contraction capacity and the maintenance of urinary continence, leading to involuntary loss of urine. In addition, repetitive trauma to the PFM caused by increased intra-abdominal pressure associated with chronic cough may be related to SUI[20].

Regarding UUI, a previous study indicated that respiratory disorders have a close relationship with urine storage dysfunction[21]. In addition, it has been reported that COVID-19 infection may be associated with viral cystitis[22,23], which could lead to an increased in urinary frequency after recovery from the infection. Therefore, health professionals should also be aware of UUI presence after infection to avoid focusing exclusively on muscle impairment during the care and management of urogynecological patients.

We noticed that a higher risk of reporting SUI was associated with the loss of movement after COVID-19 infection. This could be due to impairment in the musculoskeletal system, which also affects the PFM and continence mechanism. In addition, UI and mobility limitation are associated conditions[24] that may result from the interaction of the functions of the trunk, pelvic floor, and lower limb muscles, which together provide orthostatic balance[25].

Another interesting result highlights the relationship between diarrhea and UI. Women who experienced diarrhea after COVID-19 infection have 1.75 and 2.2. higher likelihood of reporting UUI and MUI, respectively. However, the relationship between urinary symptoms and diarrhea is still unclear. Experimental studies demonstrated a joint innervation between the colon and the bladder that could lead to cross-organ sensitization[26]. Moreover, it is already described the association between symptoms of UUI and irritable bowel syndrome[27]. However,

further investigation about the relationship between bowel and bladder symptoms and their impact on women who have had COVID-19 is required.

Neurological symptoms, such as tingling, have been reported as one of the complications of COVID-19 infection since the beginning of the pandemic[11]. This sensory symptom must be investigated to determine whether there is any sensory deficit that compromises muscle innervation[28], which can affect bladder and sphincter function[29], potentially leading to symptoms of UI.

Quality of life is defined as a state of complete physical, mental and social well-being[30]. As a measure of the population's health perception, it is an important aspect to be evaluated in women with UI, specially becasu eeven in mild conditions of urinary symptoms, a decline in quality of life can be significant[31]. This study highlights that symptoms identified after COVID-19 infection, such as muscle pain, diarrhea, tingling, difficulty in breathing, and cough, impair the quality of life of women with UI. This finding suggests that, in addition to the presence of UI, post-COVID-19 symptoms can contribute to worsening of this outcome. Therefore, health professionals focus on the treatment and prevention of these symptoms in survivors of the COVID-19 infection to minimize theirimpact on the quality of life of these women.

The present study has some limitations. The first one is related to the study design. As we decided to conduct a cross-sectional study, we could not investigate the causality of the variables. In addition, we could not measure the severity of UI and post-COVID symptoms, which limited our analysis about the association of symptom severity with the onset of UI. Another limitation is related to the data collection period. When the study began, the vaccination program had already been initiated in Brazil. Therefore, we believe that the immunization level of the participants might be a covariable that should have been included in our analysis, as it could have impacted the severity of COVID-19 symptoms. Moreover, the study was limited in identifying whether participants had a chronic cough or were obese prior

to COVID-19 infection. Future studies should investigate the relationship between the COVID-19 infection and UI to provide a comprehensive understanding of how UI may worsen in women who were already incontinent before the pandemic.Nonetheless, studies should examine the improvement or worsening of UI following infection through a longer cohort study.

## Conclusion

Specific symptoms present after COVID-19 infection can predict SUI, UUI, and MUI. In addition, it seems that muscle pain, diarrhea, tingling, difficulty in breathing and presence of chronic cough can worsening women's quality of life. These findings highlight to the health community the need to provide targeted urogynecological assistance to female survivors of the disease, particularly physiotherapists working with strategies to prevent and treat urinary disorders.

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**Table 1:** Sociodemographic characteristics, presence of urinary incontinence, and post-COVID-19 symptoms.

| Variables | N | % |
|---|---|---|
| Marital status | | |
| Single | 188 | 21.4 |
| Married/stable union | 593 | 67.5 |
| Divorced | 76 | 8.6 |
| Widow | 22 | 2.5 |
| Education | | |
| Primary | 105 | 11.9 |
| High school | 415 | 47.2 |
| College | 359 | 40.8 |
| Post-COVID-19 symptoms | | |
| Coughing | 186 | 21.2 |
| Breathing difficulty | 181 | 20.6 |
| Fatigue | 576 | 65.5 |
| Muscle pain | 488 | 55.5 |
| Loss of movement | 37 | 4.2 |
| Tingling | 237 | 27.0 |
| Diarrhea | 139 | 15.8 |
| Three incontinence questionnaire (3IQ-Br) | | |
| Stress Urinary Incontinence | 213 | 24.2 |
| Urge Urinary Incontinence | 135 | 15.4 |
| Mixed Urinary Incontinence | 192 | 17.4 |
| Onset of UI symptoms | | |
| During COVID-19 infection | 116 | 13.2 |
| Recovery of COVID-19 | 424 | 24.0 |
| Continent women | 339 | 38.6 |
| Chronic cough eight weeks after COVID-19 infection | 264 | 30.0 |

**Table 2:** Variables that were prognostic of urinary symptoms.

| Post-COVID-19 symptoms | Wald | df | *p*-value | Exp(B) | 95% CI to Exp(B) | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| SUI | | | | | | |
| (Constant) | 124.99 | 1 | 0.01 | 0.23 | | |
| Cough | 5.28 | 1 | 0.02 | 1.53 | 1.06 | 2.19 |
| Muscle pain | 4.40 | 1 | 0.04 | 1.41 | 1.02 | 1.95 |
| Loss of movement | 4.85 | 1 | 0.03 | 2.15 | 1.09 | 4.25 |
| UUI | | | | | | |
| (Constant) | 239.70 | 1 | 0.01 | 0.18 | | |
| Cough | 4.34 | 1 | 0.04 | 0.58 | 0.35 | 0.97 |
| Diarrhea | 5.45 | 1 | 0.02 | 1.75 | 1.09 | 2.79 |
| MUI | | | | | | |
| (Constant) | 105.33 | 1 | 0.01 | 0.16 | | |
| Breathing difficulty | 5.70 | 1 | 0.02 | 1.81 | 1.11 | 2.96 |
| Muscle pain | 9.58 | 1 | 0.01 | 2.00 | 1.29 | 3.11 |
| Tingling | 13.12 | 1 | 0.01 | 2.36 | 1.48 | 3.75 |
| Diarrhea | 8.83 | 1 | 0.01 | 2.20 | 1.31 | 3.70 |

The binary logistic regression model included all factors which were significant in the univariate analysis using the forward stepwise method.
MUI: mixed urinary incontinence, SUI: stress urinary incontinence, UUI: urgency urinary incontinence.

**Table 3:** Effect of post-COVID-19 symptoms on the quality of life of women with UI.

| Post-COVID-19 symptoms | Standardized coefficients | *p*-value | 95% CI | | $R^2$ | Difference $R^2$ |
|---|---|---|---|---|---|---|
| | *Beta* | | Lower limit | Upper limit | | |
| (Constant) | - | | 2.60 | 3.72 | - | - |
| Muscle pain | 0.17 | 0.01 | 1.14 | 2.71 | 0.06 | - |
| Diarrhea | 0.15 | 0.01 | 1.27 | 3.31 | 0.09 | 0.03 |
| Tingling | 0.12 | 0.01 | 0.62 | 2.39 | 0.10 | 0.02 |
| Breathing difficulty | 0.1 | 0.01 | 0.49 | 2.33 | 0.11 | 0.01 |

**Table 4:** Effect of coughing duration on the quality of life of women with UI.

| Coughing time | Standardized coefficients | t | *p*-value | 95% CI | | *R Adjusted* $^2$ |
|---|---|---|---|---|---|---|
| | *Beta* | | | Lower limit | Upper limit | |
| (Constant) | - | 11.654 | 0.01 | 3.45 | 4.83 | - |
| > eight weeks | 0.200 | 5.042 | 0.01 | 1.53 | 3.49 | 0.02 |
| three weeks | 0.084 | 2.114 | 0.03 | 0.07 | 1.89 | 0.03 |

**Table 5:** Characteristics of confounding factors according to the presence of urinary incontinence.

| 3IQ | | SUI | | UUI | | MUI | |
|---|---|---|---|---|---|---|---|
| | | Mean | Standard deviation | Mean | Standard deviation | Mean | Standard deviation |
| Age | Without UI | 40.049 | 9.61 | 40.46 | 9.49 | 38.69 | 9.39 |
| | With UI | 41.932 | 8.45 | 40.68 | 8.73 | 42.83 | 10.19 |
| BMI | Without UI | 29.9222 | 6.71 | 29.87 | 6.40 | 28.92 | 6.13 |
| | With UI | 30.4494 | 6.168 | 31.00 | 7.45 | 31.58 | 7.01 |
| Parturition | Without UI | 1.65 | 1.18 | 1.74 | 1.18 | 1.53 | 1.17 |
| | With UI | 1.94 | 1.14 | 1.64 | 1.16 | 1.97 | 1.20 |

BMI: body mass index

**Table 6:** Correlation between the quality of life of women with UI and symptoms of COVID-19.

| ICIQ score | Age & BMI & Parturition |
|---|---|
| Cough | 0.09* |
| > eight weeks | 0.13* |
| three weeks | -0.02 |
| Breathing difficulty | 0.14* |
| Fatigue | 0.17* |
| Muscle pain | 0.22* |
| Loss of moviment | 0.12* |
| Tingling | 0.19* |
| Diarrhea | 0.20* |

**BMI:** body mass index; * p-value<0.01