Association Between COVID-19 and Activities of Daily Living in Older Adults

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Abstract

Older adults gradually decrease their independence with activities of daily living (ADL) due to aging. The coronavirus disease-19 (COVID-19), the recent pandemic, can accelerate the decline in functions, such as ADL. This study aimed to examine whether there is an association between positive COVID-19 results and decreased independence with ADL in older adults. Data for a total of 3,118 older adults were extracted from the 2020 National Health and Aging Trends Study–COVID-19. A total of 71 (2.29%) participants presented with positive COVID-19 tests. There was a significant association between a positive COVID-19 result and decreased independence with ADL (relative risk [RR] = 1.47, 95% confidence interval [CI] = [1.11, 1.96], p = .0079). The study findings revealed that COVID-19 survivors had a high risk of decreased independence with ADL. These findings indicate that COVID-19 survivors have residual functional deficits and would need comprehensive health care services.

Keywords

aging, activities of daily living, community-based rehabilitation, older adults

Introduction

As of November 1, 2021, the number of people with positive results for coronavirus disease-19 (COVID-19) had surpassed 200 million worldwide. COVID-19 is an infectious and epidemic disease caused by the severe acute respiratory syndrome coronavirus (SARS-CoV-2; Lai et al., 2020). COVID-19 causes a decline in physical function, as well as in pulmonary and immune systems (Méndez et al., 2021). The pulmonary function of COVID-19 survivors rapidly deteriorated, leaving sequela, such as dyspnea and decreased lung capacity (Fumagalli et al., 2021). A gradual decline in physical health functions is a natural part of the aging process for older adults. However, acute pandemic illnesses, such as COVID-19, may accelerate the decline in the physical health of older adults.

Previous studies have reported an association between older adults who test positive for COVID-19 and their demographic characteristics and health outcomes (Carrillo-Garcia et al., 2021). For example, older adults with COVID-19 have a higher mortality risk and a worse prognosis than people of other age groups (Geriatric Medicine Research Collaborative et al., 2021; Wang et al., 2020). Carrillo-Garcia et al. (2021) reported that older adults exhibited a severe functional decline after hospitalization for COVID-19; they reported that 8.5% of the participants died, and 20% of the participants were readmitted during the first month after discharge. In addition, most COVID-19 survivors experienced cognitive impairment, depressive symptoms, and physical functional decline within 3 months after discharge (Carrillo-Garcia et al., 2021). Similarly, Walle-Hansen et al. (2021) reported that 33% of older adults with COVID-19 had decreased mobility (Walle-Hansen et al., 2021). In addition, many studies show that older adults with COVID-19 have a poor quality of life, high anxiety and depression symptoms, and decreased physical function (Mowla et al., 2022; Poletti et al., 2022).

These cognitive and physical changes caused by COVID-19 can deteriorate the functional status of older adults. Independent activities of daily living (ADL) account for a substantial proportion of older adults’ functions (Gill et al., 1995; Reynolds & Silverstein, 2003). The Occupational Therapy Practice Framework: Domain and Process, ADL are defined as activities performed to take care of one’s body, such as showering and dressing (American Occupational Therapy Association, 2020).
Independence in ADL is related to the successful aging of community-dwelling older adults. Indeed, older adults who performed ADL on their own had a higher quality of life and a lower mortality rate than those who did not (Nakazawa et al., 2012). Before COVID-19, various health care professionals assessed ADL function and conducted intervention programs to improve the abilities of older adults to participate in ADL (C. J. Liu et al., 2018). A positive COVID-19 test has become a major determinant of older adults’ ability to participate in ADL; however, the relationship between positive COVID-19 results and the ability to perform ADL in older adults remains unclear.

Negrini et al. (2021) reported on the COVID-19 Rehabilitation Research Framework (CRRF), which was defined by the Cochrane Rehabilitation and the World Health Organization (WHO) Rehabilitation Program and designed to identify and summarize studies related to rehabilitation in the context of COVID-19 (Negrini et al., 2021). Although there is a growing body of literature emphasizing the need for rehabilitation strategies, evidence for rehabilitation of endurance, mobility, and ADL after COVID-19 is still lacking (Kim et al., 2020; Korupolu et al., 2020). At present, the major rehabilitation intervention for COVID-19 survivors is respiratory recovery (Siddiq et al., 2020). However, although respiratory rehabilitation is a critical healthcare service, some studies have shown that there are unmet needs for physical functions or functional status (e.g., endurance, strength, and balance) in COVID-19 survivors (Kim et al., 2020; Korupolu et al., 2020).

Currently, research related to COVID-19 is actively being conducted, but several limitations exist. First, previous studies on COVID-19 and older adults have mainly reported on the frequency of decline in function or mental health symptoms (Mowla et al., 2022; Walle-Hansen et al., 2021). Second, the association between functional dependency and a positive COVID-19 test in older adults is unclear. Older adults already experience physical and mental dysfunction due to aging, and older adults who survive COVID-19 may experience more functional impairments, such as dependence on ADL, as a result of COVID-19. A study by Pizarro-Pennarolli et al. (2021) reported that there are very limited studies that have examined the ADL independence of those who test positive for COVID-19 among older adults (Pizarro-Pennarolli et al., 2021). As mentioned earlier, older adults experience a functional decline due to aging or infectious diseases (e.g., COVID-19), and those factors may also accelerate the functional decline. ADL are important factors for the independent life of older adults, but its association with COVID-19 is not clear. Therefore, it is necessary to determine whether COVID-19 presents a risk of decreased independence with ADL in older adults. This study aimed to determine whether there is an association between COVID-19 and decreased independence with ADL in older adults.

Method

Study Data

We extracted data of 3,107 older adults who participated in the 2020 National Health and Aging Trends Study–COVID-19 (NHATS-COVID-19) survey. The NHATS has been conducting surveys for adults aged 65 years and older who are a nationally representative sample of Medicare beneficiaries since 2011 (Freedman & Kasper, 2019; Kasper & Freedman, 2014). The NHATS provides a basis for understanding the trends and dynamics of aging, in addition to the functional and social consequences of aging. The survey covers various health-related information, including health conditions, social network, physical capacity, cognition, and rehabilitation. We only utilized de-identified data from the NHATS databases for the data analyses. Since the analytic file was de-identified, our study was exempted by the Institutional Review Board at the Yonsei University Mirae campus.

Study Variables

The independent variable was COVID-19 test positivity (1 = yes, 0 = no). In the survey, the COVID-19 positivity was measured using a self-reported question, “Have you had a positive test for COVID-19?” The dependent variable was independence with ADL: “During the COVID-19 outbreak, has anyone ever helped you with daily activities?” (1 = yes, 0 = no). According to the NHATS-COVID-19, the ADL include the following nine tasks: taking a shower, getting dressed, eating, using the toilet, getting out of bed, getting around inside, going outside, driving, and visiting or communicating with health care providers. We used the total score of the nine ADL as a count variable. The dependent variable’s range was 0 to 9, where a higher score indicated decreased independence with ADL.

The study covariates included demographic characteristics and mental health variables. The demographic characteristics included sex (male or female), age (65-69, 70-74, 75-79, 80-84, 85-89, and ≥90 years), race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and other), marital status, and residence (community, residential care, and nursing home). The mental health variables included were loneliness (1: every day, 2: most day, 3: some days, 4: rarely, and 5: never), poor sleep quality (1: good, 2: fair, and 3: poor), depression and anxiety (1: not at all, 2: mild, 3: moderate, and 4: severe), and post-traumatic stress disorder (PTSD) during the COVID-19 outbreak. The PTSD was assessed using six questions, including those related to recurring (two questions), avoiding (two questions), and feeling (two questions), and the responses of these questions were assessed using a 4-point Likert-type scale (1: not at all, 2: sometimes, 3: rarely, and 4: most of the time).

Statistical Analysis

Poisson regression was used to assess the association between COVID-19 positivity and decreased independence
with ADL by controlling for the demographic and clinical variables listed in Table 1. In this study, we used the total score of the nine ADL as the dependent variable in the Poisson regression analysis.

We also used multiple imputation techniques to impute the missing observations in the demographic and clinical variables listed in Table 1 (Allison, 2001). Multiple imputation is a statistical method used to predict missing data according to the pattern of known and missing data (de Goeij et al., 2013). We provided point estimates from both the multivariate Poisson regression models and imputation models to determine whether they were robust against the missing observations (Tables 2 and 3).

Finally, for the sensitivity analysis, we examined the association between COVID-19 positivity and each of the nine ADL items. For this analysis, we also utilized multiple imputation techniques to account for the missing observations in the nine ADL items and determined which daily tasks were challenging for COVID-19 survivors (Table 4).

In the regression models, the point estimations were presented using relative risk (RR) with 95% confidence intervals (CI). The SAS software version 9.4 (SAS Institute, Cary, North Carolina, USA) was used for all statistical analyses.

## Results

The demographic and clinical characteristics of the two comparison groups are presented in Table 1. Among the 71 (2.29%) participants who received positive COVID-19 results, 30 were males (42.25%) and 41 were females (57.75%). On average, older adults who have positive COVID-19 needed help with 2.60 daily tasks ($SD = 3.06$). The bivariate analyses showed that the participants with positive COVID-19 results had more decreased independence in the nine individual ADL compared with that of the control group (all $p < .05$).

### Table 1. Demographic and Clinical Characteristics of Older Adults With and Without Positive COVID-19 Tests.

| Variable                  | COVID-19 ($n = 71, 2.29\%$) | Control ($n = 3,036, 97.71\%$) | $p$   |
|---------------------------|-----------------------------|---------------------------------|-------|
| Sex                       |                             |                                 | .9948 |
| Male                      | 30 (42.25)                  | 1,284 (42.29)                   |       |
| Female                    | 41 (57.75)                  | 1,752 (57.71)                   |       |
| Age (years)               |                             |                                 | .6595 |
| 65-69                     | 1 (1.41)                    | 39 (1.28)                       |       |
| 70-74                     | 13 (18.31)                  | 677 (22.30)                     |       |
| 75-79                     | 22 (30.99)                  | 849 (27.96)                     |       |
| 80-84                     | 13 (18.31)                  | 690 (22.73)                     |       |
| 85-89                     | 12 (16.90)                  | 487 (16.04)                     |       |
| 90+                       | 10 (14.08)                  | 294 (9.68)                      |       |
| Race/Ethnicity            |                             |                                 | .0100*|
| Non-Hispanic and White    | 44 (61.97)                  | 2,331 (76.78)                   |       |
| Non-Hispanic and Black    | 17 (23.94)                  | 489 (16.11)                     |       |
| Hispanic                  | 7 (9.86)                    | 117 (3.85)                      |       |
| Other                     | 0 (0.00)                    | 41 (1.35)                       |       |
| Missing                   | 3 (4.23)                    | 58 (1.91)                       |       |
| Marital status            |                             |                                 | .0095**|
| Married                   | 25 (35.21)                  | 1,457 (47.99)                   |       |
| Separated                 | 2 (2.82)                    | 37 (1.22)                       |       |
| Divorced                  | 9 (12.68)                   | 372 (12.25)                     |       |
| Widowed                   | 26 (36.62)                  | 1,014 (33.40)                   |       |
| Not married               | 8 (11.27)                   | 96 (3.16)                       |       |
| Missing                   | 1 (1.41)                    | 60 (1.98)                       |       |
| Residence                 |                             |                                 | <.0001**|
| Community                 | 56 (78.87)                  | 2,855 (94.04)                   |       |
| Residential care          | 9 (12.68)                   | 155 (5.11)                      |       |
| Nursing home              | 6 (8.45)                    | 26 (0.86)                       |       |
| Anxiety                   |                             |                                 | .4670 |
| Not at all                | 17 (23.94)                  | 648 (21.34)                     |       |
| Mild                      | 28 (39.44)                  | 1,486 (48.95)                   |       |
| Moderate                  | 20 (28.17)                  | 688 (22.66)                     |       |
| Severe                    | 4 (5.63)                    | 152 (5.01)                      |       |
| Missing                   | 2 (2.82)                    | 62 (2.04)                       |       |

(continued)
Table 1. (continued)

| Variable | COVID-19 (n = 71, 2.29%) | Control (n = 3,036, 97.71%) | p     |
|----------|-------------------------|-----------------------------|-------|
| Depression |                         |                             | .2961 |
| Not at all | 25 (35.21)              | 887 (29.22)                 |       |
| Mild      | 25 (35.21)              | 1,411 (46.48)               |       |
| Moderate  | 16 (22.54)              | 560 (18.45)                 |       |
| Severe    | 4 (5.63)                | 111 (3.66)                  |       |
| Missing   | 1 (1.41)                | 67 (2.21)                   |       |
| Sleep quality |                     |                             | .2210 |
| Good      | 34 (47.89)              | 1,744 (57.44)               |       |
| Fair      | 28 (39.44)              | 1,017 (33.50)               |       |
| Poor      | 8 (11.27)               | 204 (6.72)                  |       |
| Missing   | 1 (1.41)                | 71 (2.34)                   |       |
| Loneliness |                      |                             | .0062** |
| Every day | 3 (4.23)                | 69 (2.27)                   |       |
| Most days | 5 (7.04)                | 158 (5.20)                  |       |
| Some days | 15 (21.13)              | 743 (24.47)                 |       |
| Rarely    | 18 (25.35)              | 946 (31.16)                 |       |
| Never     | 15 (21.13)              | 877 (28.89)                 |       |
| Missing   | 15 (21.13)              | 243 (8.00)                  |       |
| Condition in eating during COVID-19 |                |                             | <.0003** |
| More      | 9 (12.68)               | 477 (15.71)                 |       |
| Less      | 16 (22.54)              | 251 (8.27)                  |       |
| Same amount | 36 (50.70)            | 2,043 (67.29)               |       |
| Missing   | 10 (14.08)              | 265 (8.73)                  |       |
| PTSD      | 11.24 ± 4.65            | 10.86 ± 3.90                | .0376* |
| Number of ADL needed help (yes) |                |                             |       |
| Taking a shower | 21 (29.58)          | 352 (11.59)                 | <.0001** |
| Getting dressed | 19 (26.76)          | 304 (10.01)                 | <.0001** |
| Eating    | 12 (16.90)              | 154 (5.07)                  | <.0001** |
| Using the toilet | 15 (21.13)         | 137 (4.51)                  | <.0001** |
| Getting out of bed | 14 (19.72)        | 163 (5.37)                  | <.0001** |
| Getting around the house | 14 (19.72)       | 195 (6.42)                  | <.0001** |
| Going outside | 16 (22.54)          | 339 (11.17)                 | .0056** |
| Driving   | 33 (46.48)              | 982 (32.35)                 | .0374* |
| Visiting or communicating with healthcare providers | 32 (45.07)        | 725 (23.88)                 | .0002** |

Note. COVID-19 = coronavirus disease-19; PTSD = post-traumatic stress disorder; ADL = activities of daily living. *p < .05. **p < .01.

Table 2. Relative Risk in the Decreased Independence With ADL in Older Adults With COVID-19 Positive Tests.

| Estimation method               | Relative risk | 95% confidence interval | p     |
|---------------------------------|---------------|-------------------------|-------|
| Crude model                     | 1.76          | [1.34, 2.30]            | <.0001* |
| Multivariate Poisson regression model | 1.47          | [1.11, 1.96]            | .0079* |
| Multiple imputation model       | 1.50          | [1.26, 1.77]            | <.0001* |

Note. ADL = activities of daily living; COVID-19 = coronavirus disease-19. *p < .05.

Table 2 presents the RR in the decreased independence with ADL in older adults with COVID-19 positive tests. The RR was the ratio of the rates of COVID-19 positive and non-positive participants as differences in the decreased independence with ADL. The crude model had the highest RR (RR = 1.76, 95% CI = [1.34, 2.30]), whereas the imputation model had the lowest RR (RR = 1.50, 95% CI = [1.26, 1.77]). By controlling for the covariates, the adjusted
### Table 3. Relative Risk in the Demographic and Clinical Characteristics on the Decreased Independence With ADL.

| Variables                        | Multivariate Poisson regression model | Multiple imputation model |
|----------------------------------|--------------------------------------|---------------------------|
|                                  | RR        | 95% CI     | p        | RR        | 95% CI     | p        |
| **Sex**                          |           |            |         |           |            |         |
| Male                             |           |            |         |           |            |         |
| Female                           | 1.23      | [1.09, 1.39]| .0006** | 1.25      | [1.15, 1.36]| <.0001** |
| Age (years)                      |           |            |         |           |            |         |
| 65-69                            |           |            |         |           |            |         |
| 70-74                            | 1.01      | [0.61, 1.69]| .9655   | 1.01      | [0.66, 1.56]| .9467   |
| 75-79                            | 1.33      | [0.80, 2.22]| .2676   | 1.34      | [0.87, 2.06]| .1787   |
| 80-84                            | 2.07      | [1.25, 3.44]| .0049** | 2.06      | [1.35, 3.16]| .0009** |
| 85-89                            | 2.49      | [1.49, 4.15]| .0005** | 2.87      | [1.87, 4.40]| <.0001**|
| 90+                              | 4.66      | [2.78, 7.82]| <.0001* | 4.36      | [2.84, 6.70]| <.0001**|
| **Race**                         |           |            |         |           |            |         |
| Non-Hispanic and White           |           |            |         |           |            |         |
| Non-Hispanic and Black           | 1.49      | [1.30, 1.72]| <.0001**| 1.54      | [1.41, 1.69]| <.0001**|
| Hispanic                         | 2.38      | [2.18, 3.28]| <.0001**| 1.93      | [1.67, 2.23]| <.0001**|
| Other                            | 0.78      | [0.46, 1.30]| .3314   | 1.45      | [1.14, 1.86]| .0029** |
| **Marital status**               |           |            |         |           |            |         |
| Married                          |           |            |         |           |            |         |
| Separated                        | 1.11      | [0.63, 1.93]| .7202   | 1.06      | [0.77, 1.45]| .7254   |
| Divorced                         | 0.86      | [0.72, 1.03]| .1047   | 0.88      | [0.78, 0.99]| .0333*  |
| Widowed                          | 0.94      | [0.82, 1.07]| .3276   | 0.92      | [0.84, 1.01]| .0755   |
| Not married                      | 1.26      | [0.97, 1.64]| .0866   | 1.09      | [0.90, 1.31]| .3641   |
| **Residence**                    |           |            |         |           |            |         |
| Community                        |           |            |         |           |            |         |
| Residential care                 | 1.33      | [1.08, 1.64]| .0078** | 1.74      | [1.55, 1.94]| <.0001**|
| Nursing home                     | 3.69      | [2.00, 6.83]| <.0001**| 2.82      | [2.37, 3.36]| <.0001**|
| **Anxiety**                      |           |            |         |           |            |         |
| Not at all                       |           |            |         |           |            |         |
| Mild                             | 0.74      | [0.63, 0.87]| .0003** | 0.79      | [0.71, 0.88]| <.0001**|
| Moderate                         | 0.74      | [0.60, 0.92]| .0061** | 0.78      | [0.67, 0.90]| .0009** |
| Severe                           | 0.91      | [0.66, 1.24]| .5421   | 0.80      | [0.63, 1.01]| .0602   |
| **Depression**                   |           |            |         |           |            |         |
| Not at all                       |           |            |         |           |            |         |
| Mild                             | 1.19      | [1.02, 1.40]| .0311*  | 1.05      | [0.94, 1.18]| .3845   |
| Moderate                         | 1.41      | [1.30, 1.76]| .0024** | 1.17      | [0.99, 1.38]| .0617   |
| Severe                           | 1.16      | [0.81, 1.67]| .4091   | 1.22      | [0.95, 1.57]| .1244   |
| **Sleep quality**                |           |            |         |           |            |         |
| Good                             |           |            |         |           |            |         |
| Fair                             | 1.13      | [1.00, 1.26]| .0421*  | 1.15      | [1.05, 1.26]| .0002** |
| Poor                             | 1.84      | [1.55, 2.18]| <.0001**| 1.67      | [1.47, 1.90]| <.0001**|
| **Loneliness**                   |           |            |         |           |            |         |
| Never                            |           |            |         |           |            |         |
| Rarely                           | 0.91      | [0.78, 1.05]| <.0001**| 0.97      | [0.83, 1.14]| .724    |
| Some days                        | 1.31      | [1.12, 1.52]| .157    | 1.25      | [1.03, 1.52]| .0241*  |
| Most days                        | 1.19      | [0.93, 1.52]| .0006** | 1.25      | [0.89, 1.77]| .195    |
| Every day                        | 1.88      | [1.42, 2.48]| .1807   | 1.67      | [1.26, 2.20]| .0005** |
| **Condition in eating COVID-19** |           |            |         |           |            |         |
| More                             |           |            |         |           |            |         |
| Less                             | 1.20      | [0.98, 1.47]| .079    | 1.48      | [1.24, 1.75]| <.0001**|
| Same amount                      | 1.02      | [0.88, 1.17]| .8157   | 1.24      | [1.08, 1.43]| .0029** |
| PTSD                             | 0.98      | [0.96, 1.00]| .0247*  | 0.96      | [0.95, 0.98]| <.0001**|

Note. ADL = activities of daily living; RR = relative risk; CI = confidence interval; Ref = reference group; COVID-19 = coronavirus disease-19; PTSD = post-traumatic stress disorder.

*p < .05. **p < .01.
model revealed that people with COVID-19 positive results have 1.47 times higher rates of decreased independence with ADL than those who do not (RR = 1.47, 95% CI = [1.11, 1.96]); this rate was similar to the point estimate from the multiple imputation model (RR = 1.50, 95% CI = [1.26, 1.96]); this rate was similar to the point estimate from the multiple imputation model (RR = 1.50, 95% CI = [1.26, 1.96]).

The results of the multivariate Poisson regression of the associations between the decreased independence with ADL and demographic and clinical characteristics are presented in Table 3. In this adjusted model, factors, such as being older and living in a residential care facility (RR = 1.33, 95% CI = [1.08, 1.64]) or a nursing home (RR = 3.69, 95% CI = [2.00, 6.83]) as well as being female rather than male (RR = 1.23, 95% CI = [1.09, 1.39]), were associated with the decreased independence with ADL. In other words, people living in residential care facilities have 1.33 times higher rates and those living in nursing homes have 3.69 times higher rates of decreased independence with ADL than those who do not. Females have 1.23 times higher rates of decreased independence with ADL than males. In addition, mental health was associated with decreased independence with ADL. For instance, people who felt more lonely on most days showed 1.19 times higher rates of decreased independence with ADL (RR = 1.19, 95% CI = [0.93, 1.52]) compared with those who never did. Then, people who felt more moderate depression presented a 1.41 times higher rate of decreased independence with ADL (RR = 1.41, 95% CI = [1.30, 1.76]). Similarly, people who had a low level of sleep quality showed higher rates of decreased independence with ADL (RR = 1.84, 95% CI = [1.55, 2.18]).

Table 4 shows the RR of decreased independence for nine individual ADL among participants due to being COVID-19 positive. In the multiple imputation model, only the visiting or communicating with a healthcare provider task was significant (RR = 1.50, 95% CI = [1.04, 2.17]). Taking a shower (RR = 1.60, 95% CI = [0.99, 2.57]) and using the toilet (RR = 1.85, 95% CI = [0.99, 3.46]) were not significant, but the p-values were statistically marginal.

### Discussion

This study showed that positive COVID-19 outcomes were associated with decreased independence with ADL in older adults. In addition, participants with positive COVID-19 results showed a higher RR for decreased independence with ADL than those with negative COVID-19 results. Our findings have two implications. First, patients’ outcomes differ at the activity level depending on whether they test positive for COVID-19, which means that the study could fill the gap in existing research on rehabilitation related to COVID-19. Second, it can affect the types of interventions that COVID-19 survivors will receive.

COVID-19 can increase the functional dependency of older adults. In this study, we found that COVID-19 increased the risk of decreased independence with ADL in older adults. These results could be attributed to a decrease in physical function caused by the disease or by being bedridden for an extended time. Previous studies have reported that COVID-19 reduces physical function in older adults (Carrillo-Garcia et al., 2021; Zampogna et al., 2021). The reduced physical function may have resulted in decreased independence with ADL because, in older adults, physical function is associated with ADL (Marques et al., 2014). Therefore, future studies should be necessary to examine their relationship with the change in physical function due to COVID-19 as a mediator variable to understand the relationship between COVID-19 and changes in physical function due to COVID-19 and ADL in detail.

Previous studies have reported that patients discharged from hospitals with positive COVID-19 results require rehabilitation, and research into the effectiveness of rehabilitation is ongoing (Li, 2020; K. Liu et al., 2020). Our study revealed that COVID-19 is associated with decreased independence with ADL in older adults. These results indicate that ADL should also be included in the scope of rehabilitation for older adult survivors of COVID-19. Since older adults are already experiencing deterioration in their physical and mental functions (Amaya et al., 2018), they are a group that should be addressed for rehabilitation in particular. ADL are included as a part of the activities of daily living; COVID-19 = coronavirus disease-19; RR = relative risk; CI = confidence interval.

*p < .05.*

| Variables                                | RR     | 95% CI       | p      |
|------------------------------------------|--------|--------------|--------|
| Taking a shower                          | 1.60   | [0.99, 2.57] | .0544  |
| Dressing                                 | 1.60   | [0.97, 2.66] | .0663  |
| Eating                                   | 1.62   | [0.83, 3.14] | .1558  |
| Using the toilet                         | 1.85   | [0.99, 3.46] | .0523  |
| Getting out of bed                       | 1.70   | [0.91, 3.18] | .0951  |
| Getting around inside                    | 1.45   | [0.78, 2.70] | .2354  |
| Going outside                            | 1.38   | [0.80, 2.36] | .2461  |
| Driving                                  | 1.35   | [0.94, 1.94] | .1021  |
| Visiting or communicating with healthcare providers | 1.50   | [1.04, 2.17] | .0315* |

Note. ADL = activities of daily living; COVID-19 = coronavirus disease-19; RR = relative risk; CI = confidence interval.
activities and participation in the International Classification of Functioning, Disability and Health model (ÜStÜN et al., 2003). However, previous studies have not provided specialized COVID-19 rehabilitation by considering the age and life cycle (Olezene et al., 2021; Puchner et al., 2021). Moreover, although several studies have highlighted the need for effective rehabilitation of COVID-19 survivors, only a few have focused on patient status or outcomes at the activity and participation level (Malcolm, 2021). Previous studies have only evaluated the ability of COVID-19 survivors to perform functions, such as pulmonary and respiratory rehabilitation (K. Liu et al., 2020; Méndez et al., 2021). Our findings suggest that pulmonary and respiratory rehabilitation along with rehabilitation to enhance the level of activity and engagement of older COVID-19 survivors is necessary. COVID-19, which first appeared in 2020, is still prevalent in 2022. To reduce the long-term impact of COVID-19, each country will need to take appropriate measures, including rehabilitation by considering the characteristics of older adults.

The results of this study present the role of occupational therapists for older adult survivors of COVID-19. Occupational therapists understand that occupation, as in ADL, and leisure is important and how individuals’ quality of life changes depending on the performance of the occupation (American Occupational Therapy Association, 2020; Pizzi & Richards, 2017). The results of this study suggest that COVID-19 can increase older adults’ decreased independence with ADL. Accordingly, occupational therapists should recognize the damage to ADL function of older adults with COVID-19 and plan rehabilitation to improve or maintain ADL function so that secondary negative results do not appear.

In this study, we found that lower quality of sleep during the COVID-19 outbreak was associated with decreased independence with ADL. Sleep disturbance is one of the most common health issues among older adults, and it is a major concern for many studies (Hanson & Ruthig, 2010). Sleep quality in older adults is associated with ADL. Although many studies have reported a positive association between sleep quality and ADL (Chien & Chen, 2015; Lee et al., 2022; Zhao et al., 2020), the association between sleep quality during the COVID-19 outbreak and ADL remains unclear. The results of the study showed that the lower the quality of sleep during the COVID-19 outbreak, the higher the probability of decreased independence with ADL. These results conform to prior research and indicate the need for psychological rehabilitation to improve sleep quality in older adults during the COVID-19 outbreak.

The independence with ADL was decreased in older adults with moderate depressive symptoms than in older adults without depressive symptoms. Our study investigated the association between depression during the COVID-19 outbreak and decreased independence with ADL in older adults. The association between depression and ADL has already been reported in many previous studies. Previous studies have shown that the more depressive symptoms an older adult has, the worse their ADL performance is (Kondo et al., 2008; Nyunt et al., 2012). Depression impairs cognition and motivation; hence, it can amplify physical symptoms and reduce ADL performance (Ormel et al., 2002). In particular, as lockdown due to COVID-19 limits social activities in older adults, it can further increase depressive symptoms. Many researchers have stated that depressive symptoms in older adults increase during COVID-19, and measures are needed to reduce them (Van Tilburg et al., 2021; Wand et al., 2020). Therefore, it is critical to reemphasize the need to take preventive actions, considering that depression caused by COVID-19 increases the risk of older adults’ decreased independence with ADL.

Based on the recently developed CRRF, Malcolm (2021) reported that occupational therapy researchers could contribute (Malcolm, 2021). Parts 1 and 2 of the CRRF describe occupational therapy’s method, priorities, and scope. Part 1 covers the spectrum of rehabilitation research, which includes a review of intervention and outcome data as well as rehabilitation studies in acute and post-acute settings (Malcolm, 2021). Part 2 is an area of rehabilitation research that analyzes the limitations and determinants of COVID-19-related functions and activities as well as the extensive impact of pandemics on work therapy accessibility and service provision (Malcolm, 2021). Part 2 of our research is in the field of rehabilitation research, and it reveals limitations in function and activity because of COVID-19 infections.

**Study Limitation**

Our study exhibits some limitations. First, this study presents limited adjustable covariates because it uses secondary data. Therefore, it does not include all the covariates that have been found to be associated with the execution of ADL in older adults. Second, the dependent variable was the decreased independence with ADL during the COVID-19 period. Depending on the residence type of the participants, the ability to perform ADL prior to COVID-19 may vary. However, our study did not evaluate the pre-COVID-19 performance. Third, our study relied on NHATS responses and did not identify independent variables (positive COVID-19 results) through clinical evaluation. Moreover, it was not possible to include variables related to COVID-19 care, such as the length of hospitalization and the type of intervention. Due to the nature of the secondary data, it is necessary to rely on the responses to the questionnaire. However, we used three models to analyze the robustness of the results and tried to compensate for the limitations by controlling for covariates.

**Conclusion**

This study aimed to examine the association between positive COVID-19 results and decreased independence with ADL. Our results indicate that in older adults, positive COVID-19 results were associated with compromised independence with ADL. In addition, lower sleep quality and moderate depression
during the COVID-19 outbreak were associated with decreased independence with ADL. We propose some implications based on the research results. First, it can be proposed to provide rehabilitation services related to ADL. Second, it presents the importance of rehabilitation services for COVID-19 patients. Third, it presents problems that may arise when patients surviving COVID-19 return to the community. Based on the above implications, each country should think about possible sequelae other than the primary symptoms of COVID-19 and seek ways to mitigate them.

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