Impact of the COVID-19 pandemic on adults with moderate-to-severe atopic dermatitis in the Dutch general population

To the Editor: The COVID-19 pandemic might disproportionately impact patients with atopic dermatitis (AD), a chronic inflammatory disorder with immune dysregulation. We conducted a large cross-sectional study to investigate the associations between COVID-19-related impact and AD severity among adults in the Dutch general population.

This study was conducted within the Lifelines Cohort Study,1 a multidisciplinary prospective population-based cohort study examining the health and health-related behaviors of 169,729 persons living in the north of the Netherlands in a unique three-generation design. All procedures were approved by the medical ethics committee, and all participants provided written informed consent. AD-related data were collected by sending out a digital questionnaire to all adult participants of the Lifelines Cohort Study (N=135,950) between February and May 2020 (response rate, 42.4%).2 Definitions of AD have been described previously.2 COVID-19-related variables were collected by sending out a series of COVID-19 questionnaires (weekly between March and May 2020, biweekly until July 2020, and then at monthly intervals until July 2021) to the adult participant of the Lifelines Cohort Study (N=139,735),3 of those 76,377 (54.7%) responded to at least one questionnaire. The selection of COVID-19 questionnaires varied across outcome measures of COVID-19-related variables. The COVID-19 infection rate, COVID-19 vaccination coverage, and side effects were based on combined answers from all available questionnaires; lung disease, body mass index, smoking habits, and information regarding precautions taken, were collected from the first COVID-19 questionnaire, which was sent out at the same period of AD questionnaire. Quality of health care was collected from the 15th questionnaire, while COVID-19-related psychological impact was collected from the 2nd questionnaire, because only these 2 questionnaires included all the variables related to health care and psychological impact, respectively. Associations between AD severity and COVID-19-related impact were analyzed using binary logistic regression models.

A total of 53,545 participants, who responded to at least 1 COVID-19 questionnaire and responded to the AD questionnaire, were included (Table I). Nonresponders were younger and more often men (data not shown). In the multivariate analysis (Table II), both mild and moderate-to-severe AD showed a positive association with a higher prevalence of lung disease (mild AD: adjusted odds ratio [aOR], 2.50, 95% CI, 1.89-3.30; moderate-to-severe AD: aOR, 3.19, 95% CI, 2.68-3.80). All groups had similar COVID-19 infection rates. Participants with AD, regardless of disease severity, compared with non-AD participants, were more concerned about the COVID-19 crisis (mild AD: aOR, 1.06, 95% CI, 1.00-1.12; moderate-to-severe AD: aOR, 1.08, 95% CI, 1.04-1.12) and more often chose not to contact a doctor when having health problems (mild AD: aOR, 2.52, 95% CI, 1.35-4.67; moderate-to-severe AD: aOR, 2.43, 95% CI, 1.59-3.71). Participants with mild AD, but not moderate-to-severe AD, compared with non-AD participants, had a higher COVID-19 vaccination rate (aOR, 1.44; 95% CI, 1.01-2.05) and more frequently covered their mouth and nose in public (aOR, 1.93; 95% CI, 1.25-3.00). Moreover, only participants with moderate-to-severe AD compared with non-AD estimated a higher chance of becoming infected (aOR, 1.53, 95% CI, 1.00-2.55) and expected a more serious disease course (aOR, 1.51, 95% CI, 1.19-1.91). Those with moderate-to-severe AD compared with non-AD were more worried about getting sick (aOR, 1.41, 95% CI, 1.09-1.83) and a shortage of medications (aOR, 1.34, 95% CI, 1.09-1.65); and they also tended to take other precautions to prevent the spread of the COVID-19 virus (aOR, 1.23, 95% CI, 1.02-1.48). Participants with moderate-to-severe AD compared with non-AD participants, also more often expected side effects (aOR, 1.50, 95% CI, 1.11-2.01) and were more afraid of side effects of COVID-19 vaccines in the short-term (aOR, 1.42, 95% CI, 1.08-1.86) and long-term (aOR, 1.49, 95% CI, 1.19-1.86), and they reported suffering from side effects more frequently (aOR, 1.39, 95% CI, 1.10-1.75).

Our finding of no association between COVID-19 infection rate and the presence of AD in adults is consistent with a recent US study where patients with AD, even those treated with immunomodulatory medications, did not have a significantly elevated risk for COVID-19 infection.3 However, COVID-19-related worries were more often seen in patients with moderate-to-severe AD, which might lead patients to practice more precautions in addition to basic rules (eg, hand hygiene, social

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| Characteristics of the participants from the Lifelines cohort, who answered the questions related to AD and COVID-19, stratified for sex* |
|---------------------------------------------------------------|
| **Total, n (%)** | **Male, n (%)** | **Female, n (%)** | **P value** |
|------------------|----------------|------------------|-------------|
| **Age, y, mean ± SD** | 55.7 ± 12.5 | 57.5 ± 12.4 | 54.6 ± 12.5 | <.001 |
| **Missing, n** | 0 | 0 | 0 | - |
| **Male** | 21,021 (39.3) | 21,021 (100) | 0 (0) | - |
| **Missing, n** | 0 | 0 | 0 | - |
| **AD prevalence, n (% [95% CI])** | | | | |
| Physician-diagnosed AD in lifetime | 4838 (9.1 [8.8-9.3]) | 1345 (6.4 [6.1-6.7]) | 3493 (10.9 [10.4-11.1]) | <.001 |
| **Missing, n** | 489 | 135 | 354 | - |
| **Point prevalence** | 1704 (3.2 [3.0-3.3]) | 534 (2.6 [2.3-2.8]) | 1170 (3.6 [3.4-3.8]) | <.001 |
| **Missing, n** | 455 | 119 | 336 | - |
| **Severity prevalence of AD**, n (% [95% CI]) | | | | |
| Clear or mild | 505 (1.0 [0.9-1.0]) | 191 (0.9 [0.8-1.1]) | 314 (1.0 [0.9-1.1]) | .473 |
| Moderate-to-severe | 1188 (2.2 [2.1-2.4]) | 340 (1.6 [1.5-1.8]) | 848 (2.6 [2.4-2.8]) | <.001 |
| **Missing, n** | 458 | 119 | 339 | - |
| **Lung disease (ie, asthma, COPD, chronic bronchitis)** | 3512 (9.0) | 1181 (7.7) | 2331 (9.8) | <.001 |
| **Missing, n** | 14,438 | 5730 | 8708 | - |
| **BMI, kg/m^2, mean ± SD** | 26.1 ± 4.3 | 26.3 ± 3.6 | 26.0 ± 4.6 | <.001 |
| **Missing, n** | 12,398 | 4992 | 7406 | - |
| **Current smoking** | 3346 (8.1) | 1374 (8.5) | 1972 (7.8) | .006 |
| **Missing, n** | 12,015 | 4893 | 7122 | - |
| **COVID-19 infection and expected disease course** | | | | |
| COVID-19 infection | 2690 (5.1) | 948 (4.6) | 1742 (5.4) | <.001 |
| **Missing, n** | 455 | 205 | 250 | - |
| Imagine that you get corona, you expect the course of the disease would be (serious complaints/very serious complaints/deadly) | 6540 (25.9) | 2606 (26.7) | 3934 (25.5) | .030 |
| **Missing, n** | 28,329 | 11,256 | 17,073 | - |
| **COVID-19 vaccination rate** | 27,131 (77.0) | 10,516 (77.4) | 16,615 (76.7) | .328 |
| **Missing, n** | 18,303 | 7432 | 10,871 | - |
| **Side effects of COVID-19 vaccines** | | | | |
| To what extent the corona vaccine will have serious side effects (often/very often) | 2434 (8.5) | 795 (7.2) | 1639 (9.4) | <.001 |
| **Missing, n** | 24,979 | 9952 | 15,027 | - |
| Afraid of short-term side effects (agree/completely agree) | 3163 (11.0) | 786 (7.1) | 2377 (13.5) | <.001 |
| **Missing, n** | 24,918 | 9937 | 14,981 | - |
| Afraid of long-term side effects (agree/completely agree) | 5627 (19.7) | 1397 (12.6) | 4230 (24.1) | <.001 |
| **Missing, n** | 24,918 | 9937 | 14,981 | - |
| Ever suffered side effects after COVID-19 vaccinations | 9845 (40.9) | 2707 (29.0) | 7138 (48.5) | <.001 |
| **Missing, n** | 3078 | 1172 | 1906 | - |
| **Precaution taken** | | | | |
| Frequent hand washing or use of disinfectant | 38,866 (95.7) | 14,717 (93.2) | 24,149 (97.3) | <.001 |
| Social distancing | 40,115 (98.7) | 15,578 (98.6) | 24,537 (98.8) | .048 |
| Covering mouth and nose in public | 1450 (3.6) | 543 (3.4) | 907 (3.7) | .252 |

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Table I. Cont’d

|                                | Total, n (%) | Male, n (%) | Female, n (%) | \(P\) value |
|--------------------------------|--------------|-------------|---------------|------------|
|                                | \(N = 53,545\) | \(N = 21,021\) | \(N = 32,524\) |            |
| Avoiding the use of public transport | 28,223 (69.5) | 10,433 (66.0) | 17,790 (71.7) | <.001      |
| Other precautions               | 6072 (14.9)  | 1763 (11.2)  | 4309 (17.4)   | <.001      |
| Missing, n                      | 12,920       | 5223         | 7697          |            |
| Attitudes toward the quality of health care |            |              |               |            |
| It is justified that the capacity for regular health care is reduced in favor of the treatment of corona patients (agree/completely agree) | 7525 (26.1)  | 3406 (30.4)  | 4119 (23.3) | <.001      |
| I am worried that there will be a shortage of medications (agree/completely agree) | 7443 (25.8)  | 2637 (23.5)  | 4806 (27.2)  | <.001      |
| The quality of health care is suffering due to the reduced capacity for regular health care (agree/completely agree) | 22,022 (76.3) | 8678 (77.4) | 13,344 (75.5) | <.001 |
| More people die as a result of the corona crisis (eg, postponing regular medical treatments, stress, depression) than as a result of the corona itself (agree/completely agree) | 15,408 (53.4) | 6037 (53.9)  | 9371 (53.0)  | .155       |
| Missing, n                      | 24,668       | 9815         | 14,853        |            |
| You had health problems that you would normally see the doctor for, but chose not to contact your doctor | 753 (2.6)    | 241 (2.1)    | 512 (2.9)    | <.001      |
| Missing, n                      | 24,618       | 9793         | 14,825        |            |
| Chose not to contact the doctor due to fear of corona | 67 (9.1)    | 24 (10.2)    | 43 (8.6)      | .469       |
| Missing, n                      | 24,634       | 9799         | 14,835        |            |
| Psychological impact            |              |              |               |            |
| Level of concerns about the corona crisis (1-10, mean ± SD) | 5.0 ± 2.2    | 4.6 ± 2.2    | 5.2 ± 2.1    | <.001      |
| Missing, n                      | 17,143       | 6916         | 10,227        |            |
| Quality of life (1-10, mean ± SD) | 7.3 ± 1.3    | 7.4 ± 1.3    | 7.3 ± 1.3    | <.001      |
| Missing, n                      | 13,638       | 5556         | 8082          |            |
| General health (good/very good/ excellent) | 37,977 (93.7) | 14,869 (94.4) | 23,108 (93.2) | <.001      |
| Missing, n                      | 13,014       | 5278         | 7736          |            |
| Worry about getting sick (often/ always or almost always) | 2911 (7.2) | 890 (5.7) | 2021 (8.2) | <.001 |
| Missing, n                      | 13,041       | 5287         | 7754          |            |
| Estimated chances of becoming infected (high/very high) | 865 (3.0)    | 235 (2.2)    | 630 (3.6)    | <.001      |
| Missing, n                      | 25,130       | 10,133       | 14,997        |            |

AD, Atopic dermatitis; COPD, chronic obstructive pulmonary disease; BMI, body mass index.

*All characteristics are self-reported. Significant \(P\) values are in bold.

1 Determined as the proportion of the participants with self-reported physician-diagnosed AD in a lifetime who had current eczema.

2 According to the patient-oriented eczema measure, among the participants with self-reported physician-diagnosed AD in lifetime.

3 Defined as receiving either a positive SARS-CoV-2 polymerase chain reaction test or a positive clinician’s diagnosis.

4 The vaccination rate was calculated based on all COVID-19 questionnaires sent out before the end of July 2021. According to the weekly report from the National Institute for Public Health and the Environment, 70% of people of all ages received at least one vaccine dose until July 27, 2021, in the Netherlands.
|                                | Non-AD in lifetime 1, n (%) | Mild AD, n (%) | Moderate-to-severe AD, n (%) | Mild AD vs non-AD | Moderate-to-severe AD vs non-AD |
|--------------------------------|-----------------------------|---------------|------------------------------|-------------------|--------------------------------|
|                                | N = 48,218                  | N = 505       | N = 1188                     |                   |                                |
| Age, y, mean ± SD              | 56.1 ± 12.5                 | 53.4 ± 12.3   | 50.8 ± 13.0                 | 0.98 (0.98-0.99)  | 0.98 (0.97-0.99)               |
| Missing, n                     | 0                           | 0             | 0                            |                   |                                |
| Sex                            | Male                        | 19,541 (40.5) | 191 (37.8)                  | 1                 | 1                              |
|                                | Female                      | 28,677 (59.5) | 314 (62.2)                  | 1.12 (0.94-1.34)  | 0.98 (0.79-1.21)               |
| Missing, n                     | 0                           | 0             | 0                            |                   |                                |
| Lung disease (ie, asthma, COPD, chronic bronchitis) | No | 32,470 (92.0) | 301 (82.0) | 650 (78.3) | 0.98 (0.96-0.97) | 0.97 (0.96-0.97) |
|                                | Yes                         | 2812 (8.0)    | 66 (18.0)                   | 1.02 (1.00-1.05)  | 1.02 (0.99-1.04)              |
| Missing, n                     | 12,936                      | 138           | 358                          |                   |                                |
| BMI, kg/m², mean ± SD          | 26.1 ± 4.2                  | 26.5 ± 4.8    | 26.5 ± 4.8                  | 1.09 (0.74-1.60)  | 1.12 (0.70-1.50)              |
| Missing, n                     | 11,086                      | 128           | 339                          |                   |                                |
| Current smoking                | No                          | 34,478 (92.0) | 350 (91.1)                  | 1.29 (1.03-1.61)  | 1.29 (1.03-1.61)              |
|                                | Yes                         | 2979 (8.0)    | 34 (8.9)                    | 1.09 (0.74-1.60)  | 1.12 (0.70-1.50)              |
| Missing, n                     | 10,761                      | 121           | 320                          |                   |                                |
| COVID-19 infection and expected disease course | No | 45,433 (95.0) | 473 (94.6) | 1103 (94.2) | 1.09 (0.74-1.60) | 1.12 (0.70-1.50) |
|                                | Yes                         | 2390 (5.0)    | 27 (5.4)                    | 1.09 (0.74-1.60)  | 1.12 (0.70-1.50)              |
| Missing, n                     | 395                         | 5             | 17                           |                   |                                |
| Imagine that you get corona, you expect the course of the disease would be | No or mild complaints | 17,046 (74.6) | 152 (69.7) | 317 (65.0) | 1.09 (0.74-1.60) | 1.12 (0.70-1.50) |
|                                | Serious complaints or very serious complaints or deadly | 5795 (25.4)    | 66 (30.3)                   | 1.28 (0.96-1.71)  | 1.12 (0.79-1.61)              |
| Missing, n                     | 25,377                      | 287           | 700                          |                   |                                |
| COVID-19 vaccination rate      | No                          | 7156 (22.4)   | 65 (21.1)                   | 1.09 (0.83-1.43)  | 1.44 (1.01-2.05)              |
|                                | Yes                         | 24,645 (77.2) | 243 (78.9)                  | 1.09 (0.83-1.43)  | 0.76 (0.64-0.90)              |

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|                          | Non-AD in lifetime\(^1\), n (%) | Mild AD, n (%) | Moderate-to-severe AD, n (%) | Mild AD vs non-AD | Moderate-to-severe AD vs non-AD |
|--------------------------|---------------------------------|----------------|-----------------------------|------------------|-------------------------------|
|                          | N = 48,218                       | N = 505        | N = 1188                     |                  |                               |
| I prefer not to say      | 111 (0.3)                       | 0 (0)          | <10 (~1.5)                  | -                | -                             |
| Missing, n               | 16,306                          | 197            | 500                         | -                | -                             |
| Side effects of COVID-19 vaccines |                    |                |                             |                  |                               |
| To what extent the corona vaccine will have serious side effects |                    |                |                             |                  |                               |
| Very rarely or rarely or sometimes | 23,762 (91.7) | 225 (88.2) | 468 (86.7) | 1.48 (1.01-2.18) | 1.71 (1.33-2.20) |
| Often or very often      | 2137 (8.3)                      | 30 (11.8)      | 72 (13.3)                   | 1.24 (0.78-1.95) | 1.50 (1.11-2.01) |
| Missing, n               | 22,319                          | 250            | 648                         |                  |                               |
| Afraid of short-term side effects |                    |                |                             |                  |                               |
| Completely disagree or disagree or neutral | 22,631 (87.2) | 211 (~81.2) | 438 (~80.5) | 1.51 (1.07-2.13) | 1.79 (1.43-2.24) |
| Agree or completely agree | 2768 (10.7)                     | 39 (~15.0)     | 96 (~17.6)                  | 1.17 (0.77-1.78) | 1.42 (1.08-1.86) |
| Not applicable           | 549 (2.1)                       | <10 (~3.8)     | <10 (~1.8)                  |                   |                               |
| Missing, n               | 22,270                          | 240            | 640                         |                  |                               |
| Afraid of long-term side effects |                    |                |                             |                  |                               |
| Completely disagree or disagree or neutral | 20,471 (78.9) | 194 (~74.6) | 369 (~67.5) | 1.20 (0.89-1.61) | 1.89 (1.57-2.27) |
| Agree or completely agree | 4938 (19.0)                     | 56 (~21.5)     | 168 (~30.7)                 | 1.01 (0.71-1.44) | 1.49 (1.19-1.86) |
| Not applicable           | 541 (2.1)                       | <10 (~3.8)     | <10 (~1.8)                  |                   |                               |
| Missing, n               | 22,270                          | 240            | 640                         |                  |                               |
| Ever suffered side effects after COVID-19 vaccinations |                    |                |                             |                  |                               |
| No                       | 12,794 (58.5)                   | 113 (~51.1)    | 196 (~44.9)                 | 1.27 (0.97-1.67) | 1.73 (1.43-2.10) |
| Yes                      | 8713 (39.8)                     | 98 (~44.3)     | 231 (~52.9)                 | 1.17 (0.85-1.61) | 1.39 (1.10-1.75) |
| I don’t know or don’t remember | 360 (1.6)                      | <10 (~4.5)     | <10 (~2.3)                  |                   |                               |
| Missing, n               | 2778                            | 20             | 50                          |                  |                               |
| Precaution taken          |                                  |                |                             |                  |                               |
| Frequent hand washing or use of disinfectant |                    |                |                             |                  |                               |
| No                       | 1576 (4.3)                      | 21 (5.6)       | 36 (4.2)                    | 1                 | 1                             |
| Yes                      | 35,057 (95.7)                   | 357 (94.4)     | 813 (95.8)                  | 0.76 (0.49-1.19) | 1.02 (0.72-1.42) |
| Social distancing        |                                  |                |                             |                  |                               |
| No                       | 460 (1.3)                       | <10 (~2.6)     | <10 (~1.2)                  | 1                 | 1                             |
| Yes                      | 36,173 (98.7)                   | 373 (~97.4)    | 842 (~98.8)                 | 0.95 (0.39-2.30) | 1.53 (0.72-3.24) |
| Covering mouth and nose in public |                    |                |                             |                  |                               |
Avoiding use of public transport

|          | No       | Yes       | Adjusted OR (95% CI) |
|----------|----------|-----------|---------------------|
|          | 35,334 (96.5) | 1299 (3.5)   | 1.76 (1.15-2.70)    |
|          | 355 (93.9)     | 23 (6.1)     | 1.93 (1.25-3.00)    |
|          | 822 (96.8)     | 27 (3.2)     | 0.89 (0.61-1.32)    |
|          | 1111         |             | 0.92 (0.61-1.40)    |

Other precautions

|          | No       | Yes       | Adjusted OR (95% CI) |
|----------|----------|-----------|---------------------|
|          | 11,232 (30.7) | 25,401 (69.3)   | 1.10 (0.83-1.45)    |
|          | 113 (29.9)     | 265 (70.1)     | 1.06 (0.84-1.34)    |
|          | 246 (29.0)     | 603 (71.0)     | 1.08 (0.93-1.26)    |
|          | 1111         |             | 1.14 (0.97-1.33)    |

Missing, n

|          | 11,585 | 120  | 330  |
|----------|--------|------|------|

Attitudes toward quality of health care

It is justified that the capacity for regular health care is reduced in favor of the treatment of corona patients

|          | No       | Yes       | Adjusted OR (95% CI) |
|----------|----------|-----------|---------------------|
|          | 19,338 (73.9) | 19,513 (74.6)   | 1.23 (0.94-1.61)    |
|          | 173 (69.8)     | 176 (71.0)     | 1.15 (0.84-1.57)    |
|          | 408 (72.7)     | 383 (68.4)     | 1.06 (0.88-1.28)    |
|          | 1111         |             | 0.97 (0.78-1.21)    |

I am worried that there will be a shortage of medications

|          | No       | Yes       | Adjusted OR (95% CI) |
|----------|----------|-----------|---------------------|
|          | 6287 (24.0) | 19,877 (76.0)   | 1.20 (0.91-1.58)    |
|          | 58 (23.4)     | 190 (76.6)     | 1.13 (0.83-1.56)    |
|          | 120 (21.4)     | 441 (78.6)     | 1.36 (1.13-1.62)    |
|          | 1111         |             | 1.34 (1.09-1.65)    |

The quality of health care is suffering due to the reduced capacity for regular health care

|          | No       | Yes       | Adjusted OR (95% CI) |
|----------|----------|-----------|---------------------|
|          | 6287 (24.0) | 19,877 (76.0)   | 1.04 (0.77-1.39)    |
|          | 58 (23.4)     | 190 (76.6)     | 0.98 (0.70-1.37)    |
|          | 120 (21.4)     | 441 (78.6)     | 1.16 (0.95-1.43)    |
|          | 1111         |             | 1.13 (0.89-1.44)    |

More people die as a result of the corona crisis (eg, postponing regular medical treatments, stress, depression) than as a result of corona itself

|          | No       | Yes       | Adjusted OR (95% CI) |
|----------|----------|-----------|---------------------|
|          | 12,250 (46.8) | 13,910 (53.2)   | 0.96 (0.75-1.24)    |
|          | 118 (47.8)     | 129 (52.2)     | 0.87 (0.65-1.16)    |
|          | 265 (47.2)     | 297 (52.8)     | 0.99 (0.84-1.17)    |
|          | 1111         |             | 0.87 (0.72-1.06)    |

You had health problems that you would normally see the doctor for, but chose not to contact your doctor

|          | No       | Yes       | Adjusted OR (95% CI) |
|----------|----------|-----------|---------------------|
|          | 25,581 (97.6) | 22,054 | 257  | 627  |
|          | 236 (95.2)     | 531 (94.5)     | 1     | 1     |
|          | 531 (94.5)     | 1     | 1     |
|          | 1111         |         | 1     |

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Table II. Cont’d

|                                      | Non-AD in lifetime¹, n (%) | Mild AD, n (%) | Moderate-to-severe AD, n (%) | Mild AD vs non-AD | Moderate-to-severe AD vs non-AD |
|-------------------------------------|----------------------------|----------------|-------------------------------|-------------------|--------------------------------|
|                                     | N = 48,218                 | N = 505        | N = 1188                      |                   |                                |
| Yes                                 | 631 (2.4)                  | 12 (4.8)       | 31 (5.5)                      | **2.06 (1.15-3.70)** | **2.37 (1.63-3.43)** |
| Missing, n                          | 22,006                     | 257            | 626                           | **2.52 (1.35-4.67)** | **2.43 (1.59-3.71)** |
| Chose not to contact the doctor due to fear of corona |                      |                |                               |                   |                                |
| No                                  | 568 (91.8)                 | 11 (~52.4)     | 27 (~73.0)                    | 1                 | 1                             |
| Yes                                 | 51 (8.2)                   | <10 (~47.6)    | <10 (~27.0)                   | 1.01 (0.13-8.00)  | 1.16 (0.13-10.69) |
| Missing, n                          | 22,018                     | 250            | 620                           | 1.65 (0.56-4.90)  | 1.59 (0.49-5.22) |

Psychological impact

| Level of concerns about the corona crisis (1-10, mean ± SD) | Non-AD in lifetime¹, n (%) | Mild AD, n (%) | Moderate-to-severe AD, n (%) | Mild AD vs non-AD | Moderate-to-severe AD vs non-AD |
|------------------------------------------------------------|----------------------------|----------------|-------------------------------|-------------------|--------------------------------|
| N = 48,218                                                 |                            |                |                               |                   |                                |
| Yes                                                        | 4.9 ± 2.2                  | 5.1 ± 2.1      | 5.2 ± 2.2                     | 1.03 (0.98-1.08)  | **1.06 (1.00-1.12)** |
| No                                                         | 568 (91.8)                 | 11 (~52.4)     | 27 (~73.0)                    | **0.93 (0.86-1.00)** | **0.88 (0.84-0.92)** |
| Missing, n                                                 | 22,018                     | 250            | 620                           | **1.06 (1.02-1.09)** | **1.08 (1.04-1.12)** |

Quality of life (1-10, mean ± SD)

| N = 48,218                                                 |                            |                |                               |                   |                                |
| Poor or mediocre                                          | 7.3 ± 1.3                  | 7.2 ± 1.3      | 7.1 ± 1.4                     | **0.63 (0.44-0.90)** | **0.42 (0.34-0.52)** |
| Good or very good or excellent                            | 34,364 (94.0)              | 339 (90.9)     | 742 (86.9)                    | 0.82 (0.53-1.27)  | **0.50 (0.39-0.64)** |
| Missing, n                                                 | 12,285                     | 132            | 332                           |                   |                                |

General health

| N = 48,218                                                 |                            |                |                               |                   |                                |
| Worry about getting sick                                  |                            |                |                               |                   |                                |
| Never or rarely or sometimes                              | 33,963 (93.1)              | 343 (91.2)     | 765 (88.3)                    | 1                 | 1                             |
| Often or always or almost always                          | 2534 (6.9)                 | 33 (8.8)       | 101 (11.7)                    | 1.29 (0.90-1.85)  | 1.77 (1.43-2.19) |
| Missing, n                                                 | 11,721                     | 129            | 322                           |                   |                                |

Estimated chances of becoming infected

| N = 48,218                                                 |                            |                |                               |                   |                                |
| Very low or low or neutral                                 | 24,971 (97.0)              | 242 (~96.0)    | 521 (94.0)                    | 1                 | 1                             |
| High or very high                                          | 764 (3.0)                  | <10 (~4.0)     | 33 (6.0)                      | 0.54 (0.20-1.46)  | **2.07 (1.45-2.97)** |
| Missing, n                                                 | 22,483                     | 250            | 634                           |                   |                                |

*AD, Atopic dermatitis; OR, odds ratio; COPD, chronic obstructive pulmonary disease; BMI, body mass index.
§All characteristics are self-reported. Statistical significance is in bold. If a group size was below 10, we took the following three performances to prevent traceability to participants: 1) n <10 rather than exact number, was displayed; 2) n <10 was treated as n = 10 when calculating the percentage; and 3) the corresponding number of missing was rounded.
*Based on self-reported physician-diagnosed AD in a lifetime.
*Adjusted for age, sex, lung disease, smoking, and BMI.
*Defined as receiving either a positive SARS-CoV-2 polymerase chain reaction test or a positive clinician’s diagnosis.
Furthermore, patients with moderate-to-severe AD tend to encounter dilemmas when comparing the benefit and the potential side effects of COVID-19 vaccines, which may explain why they had comparable vaccination rates to healthy controls. Notably, patients with AD were less likely to search for medical help, reflecting that they did not want to further burden the health care system. Nonetheless, this might also lead to situations where patients miss safety assessments and/or discontinue their treatment, resulting in disease exacerbation, which has been reported in a Danish surveyed-based study.\(^5\)

To summarize, the COVID-19 pandemic has a considerable impact on patients with moderate-to-severe AD, highlighting the need for more attention for their overall wellbeing in daily practice.

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Key words: atopic dermatitis; atopic eczema; COVID-19; disease severity; epidemiology; general population.

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Conflicts of interest

Dr Schuttelaar received consultancy fees from Sanofi Genzyme and Regeneron Pharmaceuticals; and is advisory board member for Sanofi, Regeneron, Pfizer, LEO Pharma, Lilly. Authors Zhang, Loman, and Kamphuis have no conflicts of interest to declare.

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