Universiteit Leiden
The Netherlands

Changes in mental health symptoms from pre-COVID-19 to COVID-19 among participants with systemic sclerosis from four countries: a Scleroderma Patient-centered Intervention Network (SPIN) Cohort study

Thombs, B.D.; Kwakkenbos, L.; Henry, R.S.; Carrier, M.E.; Patten, S.; Harb, S.; ... ; Ellis, K.

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Brett D. Thombs[a,b,c,d,e,f,g,*], Linda Kwakkenbos[h], Richard S. Henry[a,b], Marie-Eve Carrier[a], Scott Patten[i,j,k], Sami Harb[a,b], Angelica Bourgeault[a], Lydia Tao[a], Susan J. Bartlett[d,l], Luc Mouthon[m,n], John Varga[o], Andrea Benedetti[c,d,p], for the SPIN Patient Advisors (Catherine Fortuné[q], Amy Gietzen[r], Geneviève Guillot[s], Nancy Lewis[t], Michelle Richard[u], Maureen Sauvé[q], Joep Welling[v], Kim Fligelstone[w], Karen Gottesman[r], Catarina Leite[x], Elisabet Pérez[y]), SPIN Investigators (Murray Baron[z], Vanessa Malcarne[aa], Maureen D. Mayes[ab], Warren R. Nielson[ac], Robert Riggs[aa], Shervin Assassi[ab], Carolyn Ells[z], Cornelia van den Ende[ad], Tracy Frech[ae], Daphna Harel[af], Monique Hinchcliff[ag], Marie Hudson[z], Sindhu R. Johnson[ah,ai], Maggie Larche[aj], Christelle Nguyen[ak,au], Janet Pope[al], François Rannou[ak], Tatiana Sofia Rodriguez Reyna[am], Anne A. Schouffoer[an], Maria E. Suarez-Almazor[ao], Christian Agard[ap], Alexandra Albert[aq], Elana J. Bernstein[ar], Sabine Berthier[ap], Lyne Bissonnette[as], Alessandra Bruns[as], Patricia Carreira[at], Benjamin Chaigne[au], Lorinda Chung[av], Chase Correia[aw], Christopher Denton[ax], Robyn Domsic[ay], James V. Dunne[az], Bertrand Dunogue[au], Dominique Farge-Bancel[au], Paul R. Fortin[ba], Jessica Gordon[bb], Brigitte Granel-Rey[au,bc], Pierre-Yves Hatron[bd], Ariane L. Herrick[be], Sabrina Hoa[bf], Niall Jones[bg], Artur Jose de B. Fernandes[as], Suzanne Kafaja[bh], Nader Khalidi[aj], David Launay[bd], Joanne Manning[bi], Isabelle Marie[bj], Maria Martin[at,bk], Arsene Mekinian[au], Sheila Melchor[at], Mandana Nikpour[bl], Louis Olagne[ap], Susanna Proudman[bm], Alexis Régent[au], Sébastien Rivière[au], David Robinson[bn], Esther Rodriguez[at], Sophie Roux[as], Vincent Sobanski[bd], Virginia Steen[bo], Evelyn Sutton[bp], Carter Thorne[bq], Pearce Wilcox[az], Mara Cañedo Ayala[br], Andrea Carboni-Jiménez[br], Maria Gagarine[br], Julia Nordlund[br], Nora Østbø[br], Danielle B. Rice[br], Kimberly A. Turner[br], Nicole Culos-Reed[bs], Laura Dyas[bt], Ghassan El-Baalbaki[bu], Shannon Hebblethwaite[bv], Laura Bustamante[bv], Delaney Duchek[bs], Kelsey Ellis[bs])

[a] *Lady Davis Institute for Medical Research, Jewish General Hospital, 4333 Chemin de la Côte-Sainte-Catherine, Montreal, Quebec H3T 1E4, Canada*
[b] *Department of Psychiatry, McGill University, 1033 Pine Avenue West, Montreal, Quebec H3A 1A1, Canada*
[c] *Department of Epidemiology, Biostatistics, and Occupational Health, McGill University, 1020 Pine Avenue West, Montreal, Quebec H3A 1A2, Canada*
[d] *Department of Medicine, McGill University, 1001 Decarie Boulevard, Montreal, Quebec H4A 3J1, Canada*
[e] *Department of Psychology, McGill University, 2001 McGill College Avenue, Montreal, Quebec H3A 1G1, Canada*
[f] *Department of Educational and Counselling Psychology, McGill University, 3700 McTavish Street, Montreal, Quebec H3A 1Y2, Canada*
[g] *Biomedical Ethics Unit, McGill University, 3647 Peel Street, Montreal, Quebec H3A 1X1, Canada*
[h] *Department of Clinical Psychology, Behavioural Science Institute, Radboud University, Montessorilaan 3, 6525 HR, Nijmegen, the Netherlands,*
[i] *Department of Community Health Sciences, University of Calgary, 3280 Hospital Drive NW, Calgary, Alberta T2N 4Z6, Canada*
[j] *Hotchkiss Brain Institute, University of Calgary, 3330 Hospital Drive NW, Calgary, Alberta T2N 4N1, Canada*
[k] *O'Brien Institute for Public Health, University of Calgary, 3280 Hospital Drive NW, Calgary, Alberta T2N 4Z6, Canada*
[l] *Research Institute of the McGill University Health Centre, Centre for Outcomes Research and Evaluation, 5252 de Maisonneuve #3D.57, Montreal, Quebec H4A 2S5, Canada*
[m] *Université Paris Descartes, Assistance Publique-Hôpitaux de Paris, 3 Avenue Victoria, 75004 Paris, France*
[n] *Service de Médecine Interne, Centre de Reference Maladies Systémiques Autoimmunes Rares d'Ile de France, Hôpital Cochin, Assistance Publique - Hôpitaux de Paris, 27 Rue du Faubourg Saint-Jacques, 75014 Paris, France*

* Corresponding author at: 4333 Cote Ste Catherine Road, Montreal, Quebec H3T 1E4, Canada.
E-mail address: brett.thombs@mcgill.ca (B.D. Thombs).

[o] *Northwestern Scleroderma Program, Feinberg School of Medicine, Northwestern University, 675 North St. Clair, Chicago, IL 60611, USA*

[p] *Respiratory Epidemiology and Clinical Research Unit, McGill University Health Centre, 5252 boulevard de Maisonneuve, Montreal, Quebec H4A 3S5, Canada*

[q] *Scleroderma Society of Ontario, Hamilton, Ontario, Canada*

[r] *Scleroderma Foundation, Tri-State Chapter, Binghamton, NY, USA*

[s] *Sclérodermie Québec, Longueuil, Quebec, Canada*

[t] *Toronto, Ontario, Canada*

[u] *Scleroderma Atlantic, Halifax, Nova Scotia, Canada*

[v] *NVLE Dutch Patient Organization for Systemic Autoimmune Diseases, Utrecht, the Netherlands*

[w] *Scleroderma & Raynaud's UK, London, United Kingdom*

[x] *University of Minho, Braga, Portugal*

[y] *Asociación Española de Esclerodermia, Madrid, Spain*

[z] *McGill University, Montreal, Quebec, Canada*

[aa] *San Diego State University, San Diego, CA, USA*

[ab] *University of Texas McGovern School of Medicine, Houston, TX, USA*

[ac] *St. Joseph's Health Care, London, ON, Canada*

[ad] *Sint Maartenskliniek, Nijmegen, the Netherlands*

[ae] *University of Utah, Salt Lake City, UT, USA*

[af] *New York University, New York, New York, USA*

[ag] *Yale School of Medicine, New Haven, CT, USA*

[ah] *Toronto Scleroderma Program, Mount Sinai Hospital, Toronto Western Hospital, Toronto, Ontario, Canada*

[ai] *University of Toronto, Toronto, Ontario, Canada*

[aj] *McMaster University, Hamilton, Ontario, Canada*

[ak] *Université Paris Descartes, Paris, France*

[al] *University of Western Ontario, London, Ontario, Canada*

[am] *Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, Mexico City, Mexico*

[an] *Leiden University Medical Center, Leiden, the Netherlands*

[ao] *University of Texas MD Anderson Cancer Center, Houston, TX, USA*

[ap] *Centre Hospitalier Universitaire - Hôtel-Dieu de Nantes, Nantes, France*

[aq] *Université Laval, Quebec, Quebec, Canada*

[ar] *Columbia University, New York, NY, USA*

[as] *Université de Sherbrooke, Sherbrooke, Quebec, Canada*

[at] *Servicio de Reumatologia del Hospital, 12 de Octubre, Madrid, Spain*

[au] *Assistance Publique - Hôpitaux de Paris, Hôpital Cochin, Paris, France*

[av] *Stanford University, Stanford, CA, USA*

[aw] *Northwestern University, Chicago, IL, USA*

[ax] *Royal Free London Hospital, London, UK*

[ay] *University of Pittsburgh, Pittsburgh, PA, USA*

[az] *St. Paul's Hospital and University of British Columbia, Vancouver, British Columbia, Canada*

[ba] *CHU de Québec - Université Laval, Quebec, Quebec, Canada*

[bb] *Hospital for Special Surgery, New York City, NY, USA*

[bc] *Aix Marseille Université, Marseille, France*

[bd] *Centre Hospitalier Régional Universitaire de Lille, Hôpital Claude Huriez, Lille, France*

[be] *University of Manchester, Salford Royal NHS Foundation Trust, Manchester, UK*

[bf] *Centre hospitalier de l'université de Montréal – CHUM, Montreal, Quebec, Canada*

[bg] *University of Alberta, Edmonton, Alberta, Canada*

[bh] *University of California, Los Angeles, CA, USA*

[bi] *Salford Royal NHS Foundation Trust, Salford, UK*

[bj] *CHU Rouen, Hôpital de Bois-Guillaume, Rouen, France*

[bk] *François Maurier, Hôpitaux Privés de Metz, Hôpital Belle-Isle, Metz, France*

[bl] *St Vincent's Hospital and University of Melbourne, Melbourne, Victoria, Australia*

[bm] *Royal Adelaide Hospital and University of Adelaide, Adelaide, South Australia, Australia*

[bn] *University of Manitoba, Winnipeg, Manitoba, Canada*

[bo] *Georgetown University, Washington, DC, USA*

[bp] *Dalhousie University, Halifax, Nova Scotia, Canada*

[bq] *Southlake Regional Health Centre, Newmarket, Ontario, Canada*

[br] *Jewish General Hospital, Montreal, Quebec, Canada*

[bs] *University of Calgary, Alberta, Canada*

[bt] *Scleroderma Foundation Michigan Chapter, Southfield, MI, USA*

[bu] *Université du Québec à Montréal, Montreal, Quebec, Canada*

[bv] *Concordia University, Montreal, Quebec, Canada*

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ABSTRACT

Introduction: No studies have reported mental health symptom comparisons prior to and during COVID-19 in vulnerable medical populations.

Objective: To compare anxiety and depression symptoms among people with a pre-existing medical condition and factors associated with changes.

Methods: Pre-COVID-19 Scleroderma Patient-centered Intervention Network Cohort data were linked to COVID-19 data from April 2020. Multiple linear and logistic regression were used to assess factors associated with continuous change and ≥ 1 minimal clinically important difference (MCID) change for anxiety (PROMIS Anxiety 4a v1.0; MCID = 4.0) and depression (Patient Health Questionnaire-8; MCID = 3.0) symptoms, controlling for pre-COVID-19 levels.

Results: Mean anxiety symptoms increased 4.9 points (95% confidence interval [CI] 4.0 to 5.7). Depression symptom change was negligible (0.3 points; 95% CI -0.7 to 0.2). Compared to France (*N* = 159), adjusted anxiety symptom change scores were significantly higher in the United Kingdom (*N* = 50; 3.3 points, 95% CI 0.9 to 5.6), United States (*N* = 128; 2.5 points, 95% CI 0.7 to 4.2), and Canada (*N* = 98; 1.9 points, 95% CI 0.1 to 3.8). Odds of ≥1 MCID increase were 2.6 for the United Kingdom (95% CI 1.2 to 5.7) but not significant for the United States (1.6, 95% CI 0.9 to 2.9) or Canada

(1.4, 95% CI 0.7 to 2.5). Older age and adequate financial resources were associated with less continuous anxiety increase. Employment and shorter time since diagnosis were associated with lower odds of a ≥ 1 MCID increase. *Conclusions:* Anxiety symptoms, but not depression symptoms, increased dramatically during COVID-19 among people with a pre-existing medical condition.

1. Introduction

The SARS-CoV-2 coronavirus disease (COVID-19) pandemic has caused more than 400,000 deaths and has had devastating health, social, political, and economic consequences worldwide. There are expected to be serious mental health implications during and beyond the initial outbreak, but their degree and nature are not well understood [1,2].

Many cross-sectional studies report percentages of participants above cutoff thresholds on mental health symptom questionnaires during COVID-19. Such percentages, however, vary substantially across otherwise similar populations even in normal times [3]. Furthermore, they tend to dramatically overestimate prevalence obtained from validated methods, and there is too much heterogeneity to correct for differences statistically [4,5]. Thus, studies that directly evaluate changes are needed.

Based on a living systematic review [3,6], as of June 22, 2020, only 5 studies had compared mental health prior to and during COVID-19. Four studies of university students suggest small increases in depression but minimal or no increases in anxiety. A United Kingdom general population study found small increases in general mental health symptoms but did not differentiate between anxiety and depression symptoms. No studies had evaluated mental health changes among people at risk of COVID-19 complications due to pre-existing medical conditions. Furthermore, despite important differences in pandemic responses across countries, no studies had compared mental health changes between countries.

People with the autoimmune disease systemic sclerosis (SSc; scleroderma) are representative of patients with pre-existing medical conditions that put them at risk during COVID-19. More than 40% have interstitial lung disease, many are frail, and use of immunosuppressant drugs is common [7,8]. The Scleroderma Patient-centered Intervention Network (SPIN) Cohort routinely collects mental health outcomes at 3- to 6-month intervals [8–10]. The SPIN COVID-19 Cohort was initiated to collect data during COVID-19 and allows comparison of mental health symptoms prior to and during COVID-19 for participants enrolled in both cohorts.

Our objective was to compare anxiety (PROMIS Anxiety 4a v1.0 scale [11,12]) and depression (Patient Health Questionnaire-8 [PHQ-8] [13]) symptoms before and after onset of COVID-19 among people with SSc, including (1) continuous score changes; (2) proportion with change scores of at least one minimal clinically important difference (MCID); (3) proportion initially under a cutoff threshold who changed by at least 1 MCID and reached the threshold; and (4) factors associated with changes, including country, comparing results from Canada, France, the United Kingdom, and the United States.

2. Methods

This was a longitudinal study that linked pre-COVID-19 data from the SPIN Cohort [8–10] to data collected from a sub-cohort during the baseline assessment of the associated SPIN COVID-19 Cohort between April 9, 2020 and April 27, 2020 using the same measurement scales. Person-level, deterministic linking was used with participant email addresses as the indentifier. The full protocol for the SPIN COVID-19 Cohort and the present study, which provides more detail on the methods and measures, is available online (https://osf.io/kbncx/).

2.1. Participants and procedure

SPIN Cohort participants must be aged ≥18 years and meet 2013 American College of Rheumatology/European League Against Rheumatism criteria for SSc, verified by a SPIN physician [14]. The SPIN Cohort is a convenience sample [8]. Eligible participants are recruited at 47 SPIN sites [10] in Canada, the United States, the United Kingdom, France, Spain, Mexico, and Australia during regular medical visits. Site personnel submit an online medical form to enrol participants, after which participants receive an email with instructions to activate their SPIN account and complete measures via the Cohort online portal in English, French, or Spanish. Assessments are completed at 3-month intervals. SPIN Cohort participants provide informed consent for cohort participation and for contact about additional SPIN studies.

From April 9 to April 27, 2020, SPIN Cohort participants who complete measures in English or French were invited by email and popups during SPIN Cohort online assessments to enrol in the SPIN COVID-19 Cohort. Recruitment announcements were additionally distributed via SPIN's patient organization partners and posted on SPIN's Twitter account and Facebook page. SPIN Cohort participants included in the present study (1) were from Canada, the United States, the United Kingdom, and France; (2) completed the PROMIS Anxiety 4a v1.0 scale [11,12] in English or French between July 1, 2019 and December 31, 2019, when China reported cases of pneumonia later identified as related to COVID-19 to the World Health Organization [15]; and (3) enrolled in the SPIN COVID-19 Cohort and completed baseline measures. SPIN COVID-19 measures were collected using the *Qualtrics* online survey package.

The SPIN (#MP-05-2013-150) and SPIN COVID-19 (#2021–2286) Cohorts were approved by the Research Ethics Committee of the Centre intégré universitaire de santé et de services sociaux du Centre-Ouest-de-l'Île-de-Montréal. The SPIN Cohort was also approved by ethics committees of SPIN sites.

2.2. Measures

Physician-reported SPIN Cohort data included sex, age, body mass index, time since SSc diagnosis, SSc disease subtype (limited, diffuse, sine scleroderma), presence of interstitial lung disease, and presence of overlap syndromes (systemic lupus erythematosus, rheumatoid arthritis, Sjögrens syndrome, idiopathic inflammatory myopathy, primary biliary cirrhosis, autoimmune thyroid disease). Pre-COVID-19 patient-reported data included race or ethnicity, employment status, health professional visit about mental health in previous 3 months, interference of breathing problems in daily activities (single item, past-week, 0–10 severity), the PROMIS Physical Function 4a v1.0 scale (higher scores = better physical function) [11,12], the PROMIS Anxiety 4a v1.0 scale [11,12], and the PHQ-8 [13]. Patient-reported data during COVID-19 included immunosuppressant drug use, COVID-19 positive test status, financial resource adequacy (Consumer Financial Protection Bureau Financial Well-Being Scale [16]), and anxiety and depression symptoms. Details are available in the study protocol.

Anxiety Symptoms. The PROMIS Anxiety 4a v1.0 scale [11,12] includes 4 items asking participants, in the past 7 days, how often: (1) "I felt fearful"; (2) "I found it hard to focus on anything other than my anxiety"; (3) "My worries overwhelmed me"; and (4) "I felt uneasy". Items are scored 1–5 with response options "never" to "always". Higher scores represent more anxiety. Possible raw scores range from 4 to 20. Raw scores are converted into T-scores standardized from the general US population (mean = 50, standard deviation = 10). A change of 4.0 T-score points was selected to represent the MCID [17] and a threshold for identifying people with at least moderate symptoms of T-score ≥ 60 [11]. PROMIS Anxiety 4a v1.0 has been validated in SSc [18,19] and is included in all 3-month SPIN Cohort assessments.

Depressive Symptoms. The eight-item PHQ-8[13] measures depressive symptoms over the last 2 weeks with item scores from 0 (not at all) to 3

(nearly every day) and higher scores representing more depression. Possible total scores range from 0 to 27. The MCID has been estimated to be 3.0 points [20], and a threshold of ≥10 is commonly used to identify people who may have depression [21]. The PHQ-8, which is assessed every 6 months in the SPIN Cohort, performs equivalently to the PHQ-9 [22], which has been shown to be valid in SSc [23].

3. Statistical analyses

Descriptive statistics are presented as mean (standard deviation) for continuous variables and numbers (percentages) for categorical variables. Changes in anxiety and depression symptoms were described: (1) continuously with T-scores or raw scores, in terms of MCIDs, and with a Hedges g standardized mean difference effect size, all with 95% confidence intervals (CIs); (2) as the proportion of participants whose symptoms worsened or improved, separately, by at least 1 MCID, with 95% CIs; and (3) as the proportion initially below a T-score of 60 on the PROMIS Anxiety 4a v1.0[12] or a score of 10 on the PHQ-8[22] who increased by at least 1 MCID and reached the threshold score, with 95% CIs. For proportions, 95% CIs were generated based on Agresti and Coull's approximate method for binomial proportions [24].

We conducted two sets of sensitivity analyses for symptom changes. First, for both anxiety and depressive symptoms, we compared change to scores from assessments done between January 1 and June 30, 2019 in order to determine if seasonal variations may have influenced our main findings. Second, since the PROMIS Anxiety 4a v1.0 is administered in the SPIN Cohort every 3 months and the PHQ-8 every 6 months, to evaluate whether differences in change between anxiety and depression symptoms may have been due to different assessment points between July 1 and December 31, 2019, we evaluated changes only including assessments done at the same timepoint.

We evaluated the association of sociodemographic characteristics, medical characteristics, and COVID-19 variables with continuous changes in anxiety and depression symptoms via multivariable linear regression and with a change of ≥1 MCID with multivariable logistic regression, controlling for pre-COVID-19 anxiety or depression symptoms. Model variables were selected a priori and entered simultaneously. For continuous variables, we assessed linearity via restricted cubic splines. Missing data were dealt with using multiple imputation via chained equations with 20 imputations. Variables entered in models included pre-COVID-19 symptoms of anxiety or depression (continuous), male sex (reference female), age (continuous), non-White race or ethnicity (reference White), education years (continuous), living alone (reference living with others), country (reference France), working part- or full-time (reference not working), time since SSc diagnosis (continuous), diffuse subtype (reference limited or sine scleroderma), interstitial lung disease presence, interference from breathing problems (continuous), overweight or obese (reference normal body mass index or less), overlap syndrome presence, PROMIS Physical Function 4a v1.0 (continuous), immunosuppressant drug use presence, use of mental health services pre-COVID ("In the last 3 months, have you seen any of the following health professionals to address a mental health concern?"), and financial resource adequacy (continuous).

All analyses were conducted using Stata (Version 13) with 2-sided statistical tests and $p < 0.05$ significance level.

3.1. Changes to Protocol

Changes included exclusion of participants from Australia, because only 10 would have been eligible; removal of COVID-19 infection from model covariates, since only 4 participants reported a positive test; and addition of sensitivity analyses. Additionally, we controlled for baseline anxiety or depression symptom scores to ensure that factors associated with change were not confounded with initial symptom level differences.

3.2. Patient and Public Involvement

The SPIN Patient Advisory Board (https://spinsclero.com) reviews all SPIN research, including the present study, and advises the SPIN Steering Committee to ensure that SPIN research addresses the needs of people with SSc. Additionally, members of the study-specific SPIN COVID-19 Patient Advisory Team was involved in each stage of the present study, including designing the SPIN COVID-19 Cohort, selecting outcomes for assessment, interpreting results, and providing comments on the present manuscript.

4. Results

4.1. Participants

There were 435 SPIN Cohort participants from Canada ($N = 98$; 11 centres), France ($N = 159$; 11 centres), the United Kingdom ($N = 50$; 2 centres), and the United States ($N = 128$; 11 centres) who enrolled in the SPIN COVID-19 Cohort and were included in the present study. See Fig. 1 for participant flow and Supplementary Table 1 for number of participants from recruitment sites. Table 1 shows participant characteristics. Mean age was 56.9 years, and 88.5% of participants were female. Mean time since SSc diagnosis was 12.1 years; 39.8% had diffuse disease subtype, 35.2% had interstitial lung disease, and 48.1% were using immunosuppressant drugs. Participant characteristics were similar for most variables across countries.

4.2. Comparison of Symptoms of Anxiety and Depression Prior to and During COVID-19

As shown in Table 2, anxiety symptoms increased more than a full MCID (4.9 points, 95% CI 4.0 to 5.7). Increases by country were 3.1 points (95% CI 1.7 to 4.6) for France, 4.4 points for Canada (95% CI 2.7 to 6.0), 6.2 points for the United Kingdom (95% CI 4.0 to 8.3), and 6.9 points for the United States (95% CI 5.4 to 8.5). The percentage of participants with ≥1 MCID increase was 42.8% (95% CI 35.3% to 50.5%) for France, 46.9% for Canada (95% CI 37.4% to 56.7%), 59.4% (95% CI 50.7% to 67.5%) for the United States, and 64.0% (95% CI 50.1% to 75.9%) for the United Kingdom. A similar increase in anxiety was seen compared to pre-COVID-19 anxiety symptoms assessed January 1, 2019 to June 30, 2019 ($N = 392$; see Supplementary Table 2).

As shown in Table 3, among 388 participants who completed the PHQ-8 in the last 6 months of 2019, changes in depressive symptoms were minimal (reduction of 0.3 points, 95% CI -0.7 to 0.2). As shown in Supplementary Table 2, this result was unchanged when including only assessments done on the same day as the included PROMIS Anxiety 4a v1.0 assessments ($N = 223$) and compared to results from assessments done in the first 6 months of 2019 ($N = 352$).

4.3. Multivariable Analysis of Factors Associated with Symptom Changes

As shown in Table 4, in adjusted analyses, compared to France, continuous anxiety symptom change scores for participants from other countries were statistically significantly higher; the United Kingdom was 3.27 points higher (95% CI 0.91 to 5.64), the United States 2.47 points higher (95% CI 0.69 to 4.24), and Canada and 1.93 points higher (95% CI 0.08 to 3.80). Greater increases in continuous anxiety symptom scores were also significantly associated with age (0.07 points lower per year, 95% CI 0.01 to 0.13) and the adequacy of financial resources (0.24 points lower per scale point, 95% CI 0.08 to 0.40).

Results were similar for odds of increasing by ≥1 MCID. As shown in Table 5, odds of anxiety symptom scores increasing by ≥1 MCID were over twice as high for participants from the United Kingdom (odds ratio 2.58, 95% CI 1.18 to 5.67) compared to France. Odds were also elevated for the United States (1.64, 95% CI 0.92 to 2.95) and Canada (1.37, 95% CI 0.74 to 2.54) but were not statistically significant. Longer

time since SSc diagnosis was associated with higher odds (1.05 per year, 95% CI 1.01 to 1.08), and working full- or part-time was associated with lower odds (0.57, 95% CI 0.35 to 0.93).

Although overall, change in depression symptom scores, controlling for pre-COVID-19 scores, was negligible, this depended on country. Compared to participants from France, participants from the United Kingdom scored 2.14 points higher (95% CI 0.78 to 3.51), participants from Canada scored 1.34 points higher (95% CI 0.29 to 2.39), and participants from the United States 1.03 points higher, although this was not statistically significant (95% CI -0.00 to 2.06). Changes in symptoms were also associated with overweight body mass index status (−1.05, 95% CI -1.99 to −0.10), time since diagnosis (0.08 lower per year, 95% CI 0.03 to 0.14), physical function scores (0.07 points lower per scale point, 95% CI 0.01 to 0.13), and adequacy of financial resources (0.20 points lower per scale point, 95% CI 0.11 to 0.29). See Supplementary Table 3.

The odds ratio of an increase of ≥1 MCID was between 1.75 and 2.73 for the three countries, but only statistically significant for the United Kingdom (2.73, 95% CI 1.07 to 6.99). Greater odds of

depression were also associated with continuous interference with breathing ratings (1.19 points per scale point, 95% CI 1.06 to 1.33); lower odds were associated with adequacy of financial resources (0.92, 95% CI 0.86 to 0.98) (Supplementary Table 4).

5. Discussion

5.1. Principal findings

We found that anxiety symptoms increased substantially compared to before the COVID-19 pandemic among vulnerable persons with a pre-existing medical condition, SSc, whereas depressive symptom changes were minimal. Overall, mean change on the PROMIS Anxiety 4a v1.0 was 4.9 points, greater than the MCID of 4 points. Approximately 50% of participants experienced an increase of ≥1 MCID. Results differed, however, by country. Anxiety symptoms increased by approximately 3 points among participants from France, 4 points among participants from Canada, 6 points among participants from the United Kingdom, and 7 points among
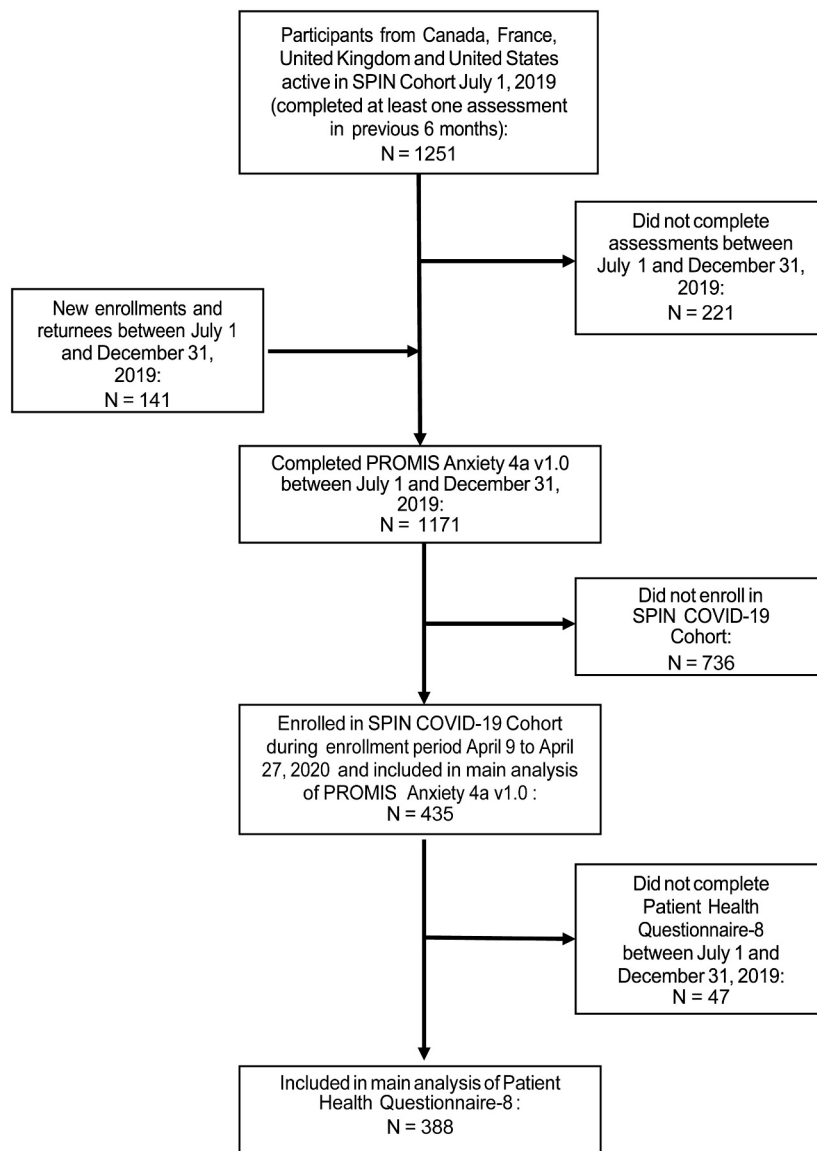

Fig. 1. Flow diagram of participant enrollment and inclusion.

Table 1
Participant Characteristics for the Full Sample and by Country.

	Overall (N = 435)	Canada (N = 98)	France (N = 159)	United Kingdom (N = 50)	United States (N = 128)
Variable	Mean (SD) or N (%)	Mean (SD) or N (%)	Mean (SD) or N (%)	Mean (SD) or N (%)	Mean (SD) or N (%)
Sociodemographics					
Age in years, *mean (SD)*	56.9 (12.6)	57.4 (11.5)	53.8 (14.8)	59.2 (10.5)	59.5 (10.4)
Male sex, *N (%)*	50 (11.5)	11 (11.2)	16 (10.1)	4 (8.0)	19 (14.8)
Education in years, *mean (SD)*	15.6 (3.7)[a]	15.6 (3.2)[b]	15.1 (4.6)[c]	14.8 (3.3)[d]	16.4 (2.8)
Living alone, *N (%)*	80 (18.7)[e]	14 (14.4)[f]	33 (21.6)[g]	11 (22.0)	22 (17.3)[h]
Race/ethnicity, *N (%)*					
White	360 (83.0)[i]	87 (88.8)	122 (77.2)[c]	45 (90.0)	106 (82.8)
Black	38 (8.8)[i]	1 (1.0)	24 (15.2)[c]	4 (8.0)	9 (7.0)
Other	36 (8.3)[i]	10 (10.2)	12 (7.6)[c]	1 (2.0)	13 (10.2)
Working part- or full-time, *N (%)*	197 (45.4)[i]	44 (44.9)	74 (46.8)[c]	21 (42.0)	58 (45.3)
Medical characteristics					
Body Mass Index, *N (%)*					
Underweight or normal (< 25)[j]	254 (58.4)	53 (54.1)	107 (67.3)	26 (52.0)	68 (53.1)
Overweight (25 to < 30)	110 (25.3)	19 (19.4)	36 (22.6)	16 (32.0)	39 (30.5)
Obese (≥ 30.0)	71 (16.3)	26 (26.5)	16 (10.1)	8 (16.0)	21 (16.4)
Time since diagnosis in years, *mean (SD)*	12.1 (7.8)[k]	12.4 (9.7)[b]	11.1 (7.2)[c]	13.3 (7.8)[l]	12.7 (6.6)[m]
Diffuse disease subtype, *N (%)*	173 (39.8)	40 (40.8)	56 (35.2)	17 (34.0)	60 (46.9)
Presence of interstitial lung disease, *N (%)*	148 (35.2)[n]	28 (30.4)[o]	57 (36.3)[p]	14 (28.6)[d]	49 (39.8)[q]
Presence of overlap syndrome, *N (%)*	100 (24.0)[r]	22 (23.9)[o]	28 (17.8)[p]	23 (46.0)	27 (22.9)[s]
Immunosuppressant drug use during COVID-19, *N (%)*	209 (48.1)	44 (44.9)	66 (41.5)	31 (62.0)	68 (53.1)
Pre-COVID-19 use of mental health services, *N (%)*	92 (21.2%)	24 (24.5)	31 (19.5)	9 (18.0)	28 (21.9)
COVID-19 infection confirmed by test, *N (%)*	4 (0.9)	0 (0.0)	4 (2.5)	0 (0.0)	0 (0.0)
Patient-reported outcomes					
Patient-reported interference from breathing problems pre-COVID, *mean (SD)*	2.5 (2.9)[t]	2.9 (3.0)[f]	2.6 (3.0)	2.7 (3.2)[d]	2.1 (2.5)[h]
PROMIS Physical Function 4a v1.0 pre-COVID, *mean (SD)*	43.6 (8.7)	42.4 (8.5)	44.6 (9.2)	43.1 (8.9)	43.4 (8.0)
Adequacy of financial resources score, *mean (SD)*	13.0 (4.8)[u]	13.1 (5.3)[f]	12.7 (5.0)[v]	13.2 (4.1)	13.2 (4.3)
Number of days since completion of pre-COVID measures					
PROMIS Anxiety 4a v1.0, *mean (SD)*	163.1 (37.4)	154.1 (29.3)	163.4 (38.5)	167.2 (37.4)	168.2 (40.6)
Patient Health Questionnaire-8, *mean (SD)*	197.0 (54.0)[w]	189.2 (57.7)[x]	197.4 (52.5)[y]	197.3 (50.8)[z]	203.0 (54.0)[aa]

[a]N = 431, [b]N = 96, [c]N = 158, [d]N = 49, [e]N = 427, [f]N = 97, [g]N = 153, [h]N = 127, [i]N = 434, [j]Because N underweight = 24, underweight and normal were combined, [k]N = 422, [l]N = 44, [m]N = 124, [n]N = 421, [o]N = 92, [p]N = 157, [q]N = 123, [r]N = 417, [s]N = 118, [t]N = 432, [u]N = 430, [v]N = 155, [w]N = 388, [x]N = 91, [y]N = 146, [z]N = 43, [aa]N = 108.

participants from the United States. In multivariable analysis, compared to France, participants from the United Kingdom, United States, and Canada scored 3.3, 2.5, and 1.9 points higher. Participants from the United Kingdom also had odds of over twice as likely to have increased by ≥1 MCID. Overall, depression symptoms changed negligibly, but this was also associated with country with increases higher by approximately 2 points in the United Kingdom and 1 point in Canada and the United States, though this was not statistically significant for the United States. The only other variable that was consistently associated with symptoms of anxiety and depression was adequacy of financial resources, which was significantly associated with better outcomes for continuous anxiety symptoms and both continuous depression symptoms and odds of an increase in depression symptoms of ≥1 MCID.

5.2. Findings in context

Our study is one of the first to report mental health symptom changes during COVID-19 in a vulnerable population with a pre-existing medical condition and the first to compare symptom changes across countries. Compared to studies of university students, which suggest that depressive symptoms have increased by a small amount and anxiety minimally or not at all [3,6], we found that depressive symptoms changed minimally, but anxiety symptoms, on average, increased substantially. This may relate to the differential effect that COVID-19 is having on different segments of the population. University students may primarily be experiencing consequences of public health interventions, including interruption of academic programs, loss of work to support their studies, and reduced social connectedness. People

with SSc and others with pre-existing medical conditions who are at risk of severe complications or death if infected likely perceive a greater threat from the virus than young adults of university age.

Increases in anxiety and depression symptoms were associated with country with large magnitudes in some cases. Comparing across countries is fraught with complexities. One possible explanation may relate to the coherence of governmental and civil responses in the countries we studied. Indeed, editorials in the Lancet have described the American response as "inconsistent and incoherent" [25] and the UK's national response as "astonishingly haphazard." [26] France undertook some of the most restrictive measures internationally to attempt to reduce the spread of the virus [27], which may have reduced fear, relatively, among people vulnerable due to medical conditions. Canadian provinces were somewhat less restrictive but were generally consistent with a high level of political consensus on measures that have been taken [28].

The consistent finding that symptoms were associated with adequacy of financial resources to meet current needs underlines the financial implications of the pandemic and the role of economics in mental health. All of the countries with participants in our study have provided aid packages [29–32], and findings from our study would seem to emphasize the importance of economic supports for those in need.

5.3. Strengths and limitations

This is the first study to compare mental health outcomes among people vulnerable during COVID-19 due to a pre-existing medical condition. The SPIN Cohort is a well-characterized, ongoing cohort, and

Table 2
Change in Symptoms of PROMIS Anxiety 4a v1.0 Pre-COVID-19 to COVID-19 (Higher Scores = Greater Anxiety).

	Full sample N = 435	Canada N = 98	France N = 159	United Kingdom N = 50	United States N = 128
Change in Score:					
Pre-COVID-19, mean (SD)	52.7 (10.4)	54.3 (10.7)	53.6 (10.8)	53.4 (9.9)	50.0 (9.5)
Post-COVID-19, mean (SD)	57.5 (8.8)	58.6 (8.2)	56.7 (9.6)	59.6 (9.6)	56.9 (8.3)
Mean change (95% CI)	4.9 (4.0 to 5.7)	4.4 (2.7 to 6.0)	3.1 (1.7 to 4.6)	6.2 (4.0 to 8.3)	6.9 (5.4 to 8.5)
Hedges' g (95% CI)	0.51 (0.37 to 0.64)	0.46 (0.17 to 0.74)	0.30 (0.08 to 0.52)	0.67 (0.27 to 1.08)	0.77 (0.51 to 1.02)
Change of ≥ 1 MCID:					
N worsening (%, 95% CI)	222 (51.0%, 46.4% to 55.7%)	46 (46.9%, 37.4% to 56.7%)	68 (42.8%, 35.3% to 50.5%)	32 (64.0%, 50.1% to 75.9%)	76 (59.4%, 50.7% to 67.5%)
N improving (%, 95% CI)	55 (12.6%, 9.8% to 16.1%)	14 (14.3%, 8.7% to 22.6%)	29 (18.2%, 13.0% to 25.0%)	5 (10.0%, 4.4% to 21.4%)	7 (5.5%, 2.7% to 10.9%)
Change of ≥ 1 MCID and reaches cutoff threshold[a]					
N (%) initially < cutoff	324 (74.5%)				
N of N initially < cutoff worsening (%, 95% CI)	81 of 324 (25.0%, 20.6% to 30.0%)	15 of 72 (20.8%, 13.1% to 31.6%)	22 of 108 (20.4%, 13.9% to 28.9%)	15 of 36 (41.7%, 27.1% to 57.8%)	29 of 108 (26.9%, 19.4% to 35.9%)

MCID = minimal clinically important difference. [a] Cutoff threshold = ≥ 60 for PROMIS Anxiety 4a v1.0.

Table 3
Change in Symptoms of Depression Pre-COVID-19 to COVID-19.

	Full sample N = 388	Canada N = 91	France N = 146	United Kingdom N = 43	United States N = 108
Change in Score:					
Pre-COVID-19, mean (SD)	6.7 (5.7)	7.2 (6.1)	7.4 (5.9)	7.2 (5.9)	5.3 (4.9)
Post-COVID-19, mean (SD)	6.4 (5.4)	7.2 (5.9)	6.2 (5.2)	7.5 (5.8)	5.7 (5.2)
Mean change (95% CI)	−0.3 (−0.7 to 0.2)	0.0 (−1.04 to 1.0)	−1.1 (−1.9 to −0.4)	0.3 (−1.1 to 1.7)	0.4 (−0.3 to 1.1)
Hedges' g (95% CI)	−0.05 (−0.19 to 0.09)	0.00 (−0.29 to 0.29)	−0.20 (−0.43 to 0.03)	0.05 (−0.38 to 0.48)	0.08 (−0.19 to 0.35)
Change of ≥ 1 MCID:					
N worsening (%, 95% CI)	82 (21.1%, 17.4% to 25.5%)	23 (25.3%, 17.5% to 35.1%)	24 (16.4%, 11.3% to 23.3%)	11 (25.6%, 14.9% to 40.2%)	24 (22.2%, 15.4% to 30.9%)
N improving (%, 95% CI)	80 (20.6%, 16.9% to 24.9%)	18 (19.8%, 12.9% to 29.1%)	40 (27.4%, 20.8% to 35.1%)	9 (20.9%, 11.4% to 35.2%)	13 (12.0%, 7.2% to 19.5%)
Change of ≥ 1 MCID and reaches cutoff threshold[a]					
N initially < cutoff	284 (73.2%)				
N of N initially < cutoff worsening (%, 95% CI)	27 of 284 (9.5%, 6.6% to 13.5%)	8 of 61 (13.1%, 6.8% to 23.8%)	5 of 103 (4.9%, 2.1% to 10.9%)	6 of 30 (20.0%, 9.5% to 37.3%)	8 of 90 (8.9%, 4.6% to 16.6%)

MCID = minimal clinically important difference. [a]Cutoff threshold ≥10 for Patient Health Questionnaire-8.

Table 4

Multivariable Analysis of Factors Associated with Change in Continuous Anxiety Symptom Scores Pre-COVID-19 to COVID-19.

Variable	Unadjusted Regression Coefficient[a] (95% Confidence Interval)	Adjusted Regression Coefficient[a] (95% Confidence Interval)
Baseline Anxiety Symptoms		
PROMIS Anxiety pre-COVID (continuous)	−0.50 (−0.56 to −0.44)	−0.56 (−0.64 to −0.48)
Sociodemographic		
Age in years (continuous)	0.02 (−0.05 to 0.08)	−0.07 (−0.13 to −0.01)
Male sex (reference = female)	−0.58 (−3.20 to 2.03)	−1.52 (−3.75 to 2.33)
Education in years (continuous)	0.09 (−0.14 to 0.31)	−0.03 (−0.22 to 0.16)
Living alone (reference = living with others)	1.18 (−0.98 to 3.35)	0.93 (−0.81 to 2.68)
"Other" Race or ethnicity (reference = White)	−1.15 (−3.37 to 1.07)	0.47 (−1.40 to 2.33)
Working part- or full-time (reference = not working)	0.50 (−1.17 to 2.18)	−1.09 (−2.54 to 0.36)
Country (reference = France)		
Canada	1.22 (−0.98 to 3.43)	1.93 (0.08 to 3.80)
United Kingdom	3.05 (0.27 to 5.84)	3.27 (0.91 to 5.64)
United States	3.81 (1.78 to 5.85)	2.47 (0.69 to 4.24)
Medical characteristics		
Body mass index (reference = underweight or normal)		
Overweight	0.96 (−1.03 to 2.95)	−0.72 (−2.39 to 0.94)
Obese	0.81 (−1.52 to 3.15)	1.09 (−0.90 to 3.08)
Time since diagnosis of SSc (continuous)	0.11 (0.01 to 0.22)	0.03 (−0.07 to 0.13)
Diffuse disease subtype (reference = limited or sine)	−0.65 (−2.36 to 1.06)	−0.53 (−2.03 to 0.97)
Presence of interstitial lung disease (reference = no)	0.04 (−1.72 to 1.80)	0.49 (−1.07 to 2.06)
Presence of any overlap syndrome (reference = no)	−0.18 (−2.17 to 1.80)	0.23 (−1.45 to 1.91)
Immunosuppressant drug use (reference = no)	−0.34 (−2.01 to 1.33)	0.20 (−1.35 to 1.75)
Pre-COVID-19 use of mental health services (reference = no)	−4.18 (−6.19 to −2.18)	−0.18 (−1.93 to 1.58)
Interference from breathing problems (continuous)	−0.54 (−0.83 to −0.26)	−0.00 (−0.29 to 0.29)
PROMIS Physical Function pre-COVID (continuous)	0.19 (0.10 to 0.29)	0.02 (−0.08 to 0.12)
COVID-19 variables:		
Adequacy of financial resources = continuous	0.23 (0.06 to 0.40)	−0.24 (−0.40 to −0.08)

[a] Results based on imputed datasets. Based on assessment using via restricted cubic splines, there was no appreciable non-linearity.

people with SSc are representative of other patient groups who are vulnerable during COVID-19. There are also limitations to consider. First, the SPIN Cohort is a convenience sample, although participant characteristics are similar to other large SSc cohorts [8]. Second, participants complete questionnaires online, which may reduce generalizability. Third, it was not possible to capture and include local variables, such as the degree participants' communities were affected or whether public health interventions were consistently followed in those communities. Nonetheless, data were collected at a time when social isolations were generally at their most conservative. Finally, different MCID values may be chosen. The 4-point MCID we used for anxiety symptoms was conservative; others have recommended MCIDs of 2 to 3

Table 5

Multivariable Analysis of Factors Associated with Change in of at least 1 MCID in Anxiety Symptom Scores Pre-COVID-19 to COVID-19.

Variable	Unadjusted Odds Ratio[a] (95% Confidence Interval)	Adjusted Odds Ratio[a] (95% Confidence Interval)
Baseline Anxiety Symptoms		
PROMIS Anxiety pre-COVID (continuous)	0.90 (0.88 to 0.92)	0.89 (0.86 to 0.91)
Sociodemographic		
Age in years (continuous)	1.01 (0.99 to 1.02)	0.98 (0.96 to 1.00)
Male sex (reference = female)	0.95 (0.53 to 1.72)	0.74 (0.35 to 1.54)
Education in years (continuous)	0.99 (0.94 to 1.04)	0.97 (0.91 to 1.03)
Living alone (reference = living with others)	1.12 (0.69 to 1.83)	1.16 (0.65 to 2.09)
"Other" Race or ethnicity (reference = White)	0.72 (0.44 to 1.20)	0.97 (0.52 to 1.78)
Working part- or full-time (reference = not working)	0.84 (0.57 to 1.22)	0.57 (0.35 to 0.93)
Country (reference = France)		
Canada	1.18 (0.71 to 1.96)	1.37 (0.74 to 2.54)
United Kingdom	2.38 (1.23 to 4.59)	2.58 (1.18 to 5.67)
United States	1.96 (1.22 to 3.14)	1.64 (0.92 to 2.95)
Medical characteristics		
Body mass index (reference = underweight or normal)		
Overweight	1.59 (1.01 to 2.50)	1.36 (0.79 to 2.37)
Obese	1.13 (0.67 to 1.91)	1.33 (0.68 to 2.60)
Time since diagnosis of SSc (continuous)	1.05 (1.02 to 1.08)	1.05 (1.01 to 1.08)
Diffuse disease subtype (reference = limited or sine)	0.85 (0.58 to 1.25)	0.82 (0.49 to 1.35)
Presence of interstitial lung disease (reference = no)	1.07 (0.71 to 1.59)	1.10 (0.65 to 1.85)
Presence of any overlap syndrome (reference = no)	0.98 (0.62 to 1.53)	0.96 (0.54 to 1.69)
Immunosuppressant drug use (reference = no)	1.13 (0.78 to 1.65)	1.50 (0.89 to 2.52)
Pre-COVID-19 use of mental health services (reference = no)	0.51 (0.32 to 0.82)	1.09 (0.60 to 1.95)
Interference from breathing problems (continuous)	0.94 (0.88 to 1.00)	1.03 (0.94 to 1.14)
PROMIS Physical Function pre-COVID (continuous)	1.02 (1.00 to 1.05)	1.00 (0.97 to 1.04)
COVID-19 variables:		
Adequacy of financial resources = continuous	1.05 (1.01 to 1.10)	0.97 (0.92 to 1.02)

[a] Results based on imputed datasets.

points [33], and it is possible that we may have underestimated the degree of patient-important change.

5.4. Conclusions and policy implications

In sum, we compared mental health symptoms prior to and during the COVID-19 outbreak among people vulnerable due to a pre-existing medical condition. We found that anxiety symptoms increased substantially and that the magnitude was associated with country; increases were highest in the United States and United Kingdom and more moderate in France and Canada. There were minimal differences in depressive symptoms during COVID-19 compared to pre-COVID-19. These findings, which differ from early reports of results from younger adults, for instance, and suggest that the nature of mental health implications for different populations may reflect specific concerns in COVID-19; however, more research is needed on this topic.

Authors contributions

BDT, LK, RSH, SP, SJB, JV, and ABenedetti were responsible for study concept and design. BDT, LK, RSH, SP, SH, ABourgeault, LT, SJB, JV, and ABenedetti were responsible for acquisition, analysis, or interpretation of data. LK, RSH, and ABenedetti were responsible for statistical analysis. BDT and RSH drafted the manuscript. All authors provided critical revision of the manuscript for important intellectual content, approved the final version, and agree to be accountable for all aspects of the work.

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Declaration of Competing Interest

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Appendix A. Supplementary data

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References

[1] G.J. Rubin, S. Wessely, The psychological effects of quarantining a city, BMJ. 368 (2020) m313.

[2] E.A. Holmes, R.C. O'Connor, V.H. Perry, et al., Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science, Lancet Psychiatry 7 (2020) 547–560.

[3] B.D. Thombs, O. Bonardi, D.B. Rice, et al., Curating evidence on mental health during COVID-19: a living systematic review, J. Psychosom. Res. (2020), https://doi.org/10.1016/j.jpsychores.2020.110113 (Epub ahead of print).

[4] B.D. Thombs, L. Kwakkenbos, A.W. Levis, A. Benedetti, Addressing overestimation of the prevalence of depression based on self-report screening questionnaires, CMAJ. 190 (2018) E44–E49.

[5] B. Levis, A. Benedetti, J.P.A. Ioannidis, et al., Patient health Questionnaire-9 scores do not accurately estimate depression prevalence: an individual participant data meta-analysis, J. Clin. Epidemiol. 122 (2020) 115–128.

[6] Living Systematic Review of Mental Health in COVID-19, https://www.depressd.ca/covid-19-mental-health, (2020) Accessed June 22, 2020.

[7] Y. Allanore, R. Simms, O. Distler, et al., Systemic sclerosis, Nat. Rev. Dis. Primers. 1 (2015) 15002.

[8] D.H. Dougherty, L. Kwakkenbos, M.E. Carrier, et al., The scleroderma patient-Centered intervention network cohort: baseline clinical features and comparison with other large scleroderma cohorts, Rheumatology. 57 (2018) 1623–1631.

[9] L. Kwakkenbos, L.R. Jewett, M. Baron, et al., The scleroderma patient-centered intervention network (SPIN) cohort: protocol for a cohort multiple randomised controlled trial (cmRCT) design to support trials of psychosocial and rehabilitation interventions in a rare disease context, BMJ Open 3 (2013) e003563.

[10] Scleroderma Patient-centered Intervention Network, https://www.spinsclero.com/en/cohort, (2020) (Accessed June 22, 2020).

[11] PROMIS measure development and research, http://www.healthmeasures.net/explore-measurement-systems/promis/measure-development-research, (2020) (Accessed June 22, 2020).

[12] D. Cella, W. Riley, A. Stone, et al., The patient-reported outcomes measurement information system (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008, J. Clin. Epidemiol. 63 (2010) 1179–1194.

[13] K. Kroenke, T.W. Strine, R.L. Spitzer, J.B.W. Williams, J.T. Berry, A.H. Mokdad, The PHQ-8 as a measure of current depression in the general population, J. Affect. Disord. 114 (2009) 163–173.

[14] F. van den Hoogen, D. Khanna, J. Fransen, et al., Classification criteria for systemic sclerosis: an American College of Rheumatology/European league against rheumatism collaborative initiative, Arthritis Rheum. 65 (2013) 2737–2747.

[15] WHO Timeline - COVID-19, World Health Organization, https://www.who.int/news-room/detail/08-04-2020-who-timeline---covid-19, (2020) (Accessed June 22, 2020).

[16] Consumer Financial Protection Bureau, CFPB Financial Well-Being Scale: Scale Development Technical Report, May 26, 2017 https://www.consumerfinance.gov/data-research/research-reports/financial-well-being-technical-report/, (2020) (Accessed June 22, 2020).

[17] K. Kroenke, F. Baye, S.G. Lourens, Comparative responsiveness and minimally important difference of common anxiety measures, Med. Care 57 (11) (2019) 890–897.

[18] M. Hinchcliff, J.L. Beaumont, K. Thavarajah, et al., Validity of two new patient-reported outcome measures in systemic sclerosis: patient-reported outcomes measurement information system 29-item health profile and functional assessment of chronic illness therapy-Dyspnea short form, Arthritis Care Res. 63 (11) (2011) 1620–1628.

[19] L. Kwakkenbos, B.D. Thombs, D. Khanna, et al., Performance of the patient-reported outcomes measurement information System-29 in scleroderma: a scleroderma patient-centered intervention network cohort study, Rheumatology. 56 (8) (2017) 1302–1311.

[20] K. Kroenke, J. Wu, Z. Yu, et al., The patient health questionnaire anxiety and depression scale (PHQ-ADS): initial validation in three clinical trials, Psychosom. Med. 78 (2016) 716–727.

[21] B. Levis, A. Benedetti, B.D. Thombs, DEPRESSion screening data (DEPRESSD) collaboration. Accuracy of patient health Questionnaire-9 (PHQ-9) for screening to detect major depression: individual participant data meta-analysis, BMJ. 365 (2019) l1476.

[22] Y. Wu, B. Levis, K.E. Riehm, et al., Equivalency of the diagnostic accuracy of the PHQ-8 and PHQ-9: a systematic review and individual participant data meta-analysis, Psychol. Med. (2020), https://doi.org/10.1017/S0033291719001314 (Epub ahead of print).

[23] K. Milette, M. Hudson, M. Baron, B.D. Thombs, Canadian scleroderma research group. Comparison of the PHQ-9 and CES-D depression scales in systemic sclerosis: internal consistency reliability, convergent validity and clinical correlates, Rheumatology. 49 (2010) 789–796.

[24] A. Agresti, B.A. Coull, Approximate is better than "exact" for interval estimation of binomial proportions, Am. Stat. 52 (1998) 119–126.

[25] Reviving the US CDC, Lancet. 395 (2020) 1521.

[26] R. Horton, Offline: COVID-19 – what countries must do now, Lancet. 395 (2020) 1100.

[27] Oxford COVID-19 Government Response Tracker, https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker, (2020) (Accessed June 22, 2020).

[28] E. Merkley, A. Bridgman, P.J. Loewen, T. Owen, D. Ruths, O. Zhilin, A rare moment

of cross-partisan consensus: elite and public response to the COVID-19 pandemic in Canada, Can J Political Sci. (2020), https://doi.org/10.1017/S0008423920000311 (Epub ahead of print).

[29] Canada Emergency Response Benefit (CERB), https://www.canada.ca/en/services/benefits/ei/cerb-application.html, (2020) (Accessed September 14, 2020).

[30] Economic Impact Payments, https://www.irs.gov/coronavirus/economic-impact-payments, (2020) (Accessed September 14, 2020).

[31] A. Morales, L. Meakin, A.U.K. Atkinson, Virus aid Package Beats Financial Crisis Stimulus, March 26. Available at, 2020. https://www.bloomberg.com/news/articles/2020-03-26/u-k-s-sunak-pledges-coronavirus-support-for-self-employed.

[32] AS English, Which Countries Have Applied Measures Like Stimulus Checks and How Much? April 17. Available at: https://en.as.com/en/2020/04/16/other_sports/1587074127_029119.html, (2020) (Accessed September 14, 2020).

[33] B.D. Thombs, L. Kwakkenbos, M.E. Carrier, et al., Protocol for a partially nested randomised controlled trial to evaluate the effectiveness of the scleroderma patient-Centered intervention network COVID-19 home-isolation activities together (SPIN-CHAT) program to reduce anxiety among at-risk scleroderma patients, J. Psychosom. Res. 135 (2020) 110132.