European Spine Journal (2022) 31:2844–2850
https://doi.org/10.1007/s00586-022-07382-w

ORIGINAL ARTICLE

The effect of COVID-19 lockdown restrictions on oswestry disability index scores: a comparative cross-sectional study

Joshua Filer[1] · Thomas Fleming[1] · Stephen Morris[1] · Neil Upadhyay[1] · Priyan Landham[1] · Michael Katsimihas[1] · Ian Harding[1]

Received: 30 March 2022 / Revised: 31 July 2022 / Accepted: 4 September 2022 / Published online: 20 September 2022

Abstract

Purpose Lockdown measures to combat the COVID-19 pandemic restricted social interactions and travel. This retrospective, observational study was conducted to evaluate the effect of lockdown restrictions on Oswestry Disability Index (ODI) scores in patients with spinal conditions.

Methods Prospectively collected data from the British Spine Registry were retrospectively analysed in two groups. The study group included patients' baseline pre-operative ODI scores collected during the first national lockdown in the UK between March and May 2020. The reference group included ODI scores recorded during the same period in 2019, before the pandemic. Scores were compared between groups using the Mann–Whitney *U* test. We also calculated modified scores that omitted responses to questions related to travel and social life. These were compared using Wilcoxon matched-pairs signed-rank test and Bland–Altman analyses.

Results The median ODI scores for the reference and lockdown groups were 49 and 45, respectively, with no significant differences in the mean ranks ($p = 0.068$). Comparisons of original and modified ODI scores showed different outcomes for each study group. No significant differences were observed in the lockdown group ($p = 0.06$). However, for the pre-COVID-19 reference group, there was a significant difference ($p < 0.01$). Bland–Altman analyses showed reasonable agreement between the methods for calculating ODI in both groups.

Conclusion We found no clinically important differences in ODI scores between the two groups. The findings suggest that the ODI is reliable during lockdown situations and can be used with confidence in the future research using both retrospective and prospective data.

Level of evidence Level 3.

Keywords Oswestry dsability index · ODI · Spine surgery · COVID-19 lockdown · Low back pain

Introduction

Following the outbreak of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) disease (COVID-19), many countries, including the UK, imposed restrictions on the activities of their citizens to reduce the spread of the virus [1–7]. In March 2020, the UK government implemented a nationwide lockdown, whereby people were ordered to stay at home and could leave for essential purposes only [8]. These restrictions were unprecedented and would significantly limit people's social interaction and ability to travel. Although studies are emerging, it is still unknown how patient-reported health questionnaires (including patient-reported outcome measures or PROMs) are affected [9].

For patients with low back pain, the Oswestry Disability Index (ODI) is a well-recognised and widely used patient reported health questionnaire and outcome measure [10, 11]. It is a self-rating questionnaire comprised of a series of ten sections, each with six statements describing functional impairment in a variety of activities of daily living including: personal care, lifting, sitting, standing, walking, sleeping, sex life, social life, and travelling, as well as the intensity of pain and its response to analgesia [10, 12, 13].

✉ Ian Harding
Ian.Harding@nbt.nhs.uk

[1] Musculoskeletal Directorate, North Bristol NHS Trust, Southmead Hospital, Southmead Road, Bristol BS10 5NB, UK

The six statements are scored from 0–5 and responses are added to give a total score out of a maximum possible score of 50 (or 45 if the question on sex life is omitted). The total score is converted to a percentage score to standardise outcomes if the question regarding sexual activity was omitted. This score can subsequently be categorised into five levels of increasing disability [10, 13].

Many of the restrictions imposed during the COVID-19 lockdown significantly restricted both socialising and travelling (Sections "Results" and "Discussion"). However, patients were allowed to attend hospital appointments and undergo surgery for spinal conditions where these were not cancelled because of hospital pressures due to COVID-19. As such, patient-reported outcome data were still collected regarding patients' baseline and post-intervention disabilities, such as the Oswestry Disability Index. Therefore, we questioned how lockdown restrictions may affect the total score, given that people suffering from back pain were not permitted to participate in these activities to the same extent as normal. When these activities are restricted for everyone, how does that impact a patient's perception of their illness or disability? The severity and consequences of the pandemic may cause people to re-evaluate the severity of their pre-existing back pain. This could be in a positive manner such that their condition is perceived to be relatively less severe in comparison with the prevailing respiratory illness caused by COVID-19 infection, or conversely having their usual leisure and social activities restricted may worsen their perception of their illness. In either case, the impact on the ODI scores used in clinical practice and research has the potential to be significant.

This study sought to answer the following questions: (1) What is the effect of lockdown restrictions on ODI scores for patients with back pain? (2) Does omitting the scores from Sections "Results" and "Discussion" of the ODI significantly change the overall score?

Materials and methods

Study design

This comparative cross-sectional study included patients with spinal conditions. In this study, a retrospective analysis of prospectively collected observational data was performed. A comparison of the baseline Oswestry Disability Index (ODI) questionnaire responses was made between a group of patients who completed the responses during the first national lockdown between 23 March 2020 and 10 May 2020 and a reference group of patients who completed the questionnaire within the same period in 2019 before the COVID-19 pandemic.

Setting

This analysis was initiated and conducted at a UK major trauma centre with a specialist tertiary referral complex spine surgery service, from October 2021 to January 2022.

Selection of eligible subjects

Patients undergoing spinal procedures in the UK are routinely asked for their consent to record their details, including patient health-related scores such as the ODI, on the British Spine Registry (BSR) [14]. Only patients with complete data including a baseline pre-operative ODI score and a categorised breakdown of the scores to the individual question items that comprise the ODI were eligible for inclusion in the analyses. There were no other exclusion criteria.

Study population

The patients included in the study were anonymous and only demographic data regarding sex and age were available. The sex and age of the study population are shown in Table 1. Although desirable to evaluate for and potentially minimise confounding and bias, further demographic information regarding were not available.

Variables and their measurement

The main outcome measure was the baseline pre-operative ODI score, which is a score based on the responses to a condition-specific questionnaire concerning back pain disability. The questionnaire has ten items with a score from 0 to 5 for each, with higher scores indicating a greater degree of disability. The total score is calculated as a percentage of the total maximum possible score (to account for the fact that some omit question 8 regarding sex life). The ODI questionnaire is usually administered at baseline and at several time points during the follow-up after spinal surgery

Table 1 Study group demographics for each of the study groups (reference sample used for statistical comparisons)

Variable	COVID-19 lockdown cohort ($n=86$)	Pre-COVID Reference cohort ($n=1335$)	Pre-COVID Reference sample ($n=86$)
Gender			
Female (%)	44 (51%)	714 (53%)	46 (53%)
Male (%)	42 (49%)	621 (47%)	40 (46%)
Age			
Mean (±SD)	52 (16)	57 (16)	57 (16)

(6 weeks, 6 months, 12 months, 2 years, 5 years, 7.5 years, and 10 years).

In addition to the overall score, the scores provided for each item were reviewed, particularly the scores for questions 9 and 10 regarding social life and travel. A modified ODI score was calculated by eliminating responses to questions 9 and 10 from the ODI score calculation. This modified score was then compared with the original score to assess the contribution of the impacts on social life and travel to the ODI score both before and during lockdown measures as a result of the COVID-19 pandemic.

Statistical analyses

The anonymised BSR data were exported to spreadsheets for processing and review. Univariate data were subsequently analysed for between-group differences using the Mann–Whitney *U* test. Further analyses, including Wilcoxon matched-pairs signed-rank analyses, were used to compare different modifications of the ODI score, excluding questions relating to social life and travel. The differences in categorical frequency distributions for responses to ODI questions 9 and 10 between each study group were analysed using the chi-square test. Given the vastly different group sizes and the risk of Type I error, a randomly selected, equally sized subsample of the reference group was used for the statistical comparison. Differences were considered statistically significant if $p < 0.05$, but given the previously reported minimal clinically important difference (MCID) for ODI scores of between 10 and 12 points[15, 16], differences were only regarded as important if the average values of the two groups differed by a margin greater than the MCID.

To evaluate the impact of lockdown duration on ODI scores, scatterplots of individual ODI scores were created with time represented as the number of days since the lockdown prior to the determination of the score.

Bland–Altman plots were produced, which visually show the difference between the modified ODI and the full ODI scores for each subject against the mean score of the two assessments. [17, 18] If the assessments are the same, the data points are close to the line of equality (zero line) and 95% of the data points lie between the narrow lower and upper limits of the 95% limits of agreement interval. The plots are also able to illustrate the presence of possible extreme or outlying observations, as well as trends and variability in any differences between methods of measurement [19]. All statistical analyses were performed with GraphPad Prism (version 9.2; GraphPad Software, La Jolla, California, USA).

Results

During the lockdown period (23rd March to 10th May 2020), 86 patients had complete data available. In contrast, during the COVID-19 free reference period 1 year earlier (23rd March to 10th May 2019), there were 1335 patients with complete data. A STROBE flow diagram is provided reporting the selection of participants used for the study (Fig. 1).

A comparison of the distribution of ODI scores between the two study groups showed that there was a lower mean rank for the lockdown cohort group scores (79.6) than for the pre-COVID-19 reference group (93.4). This difference

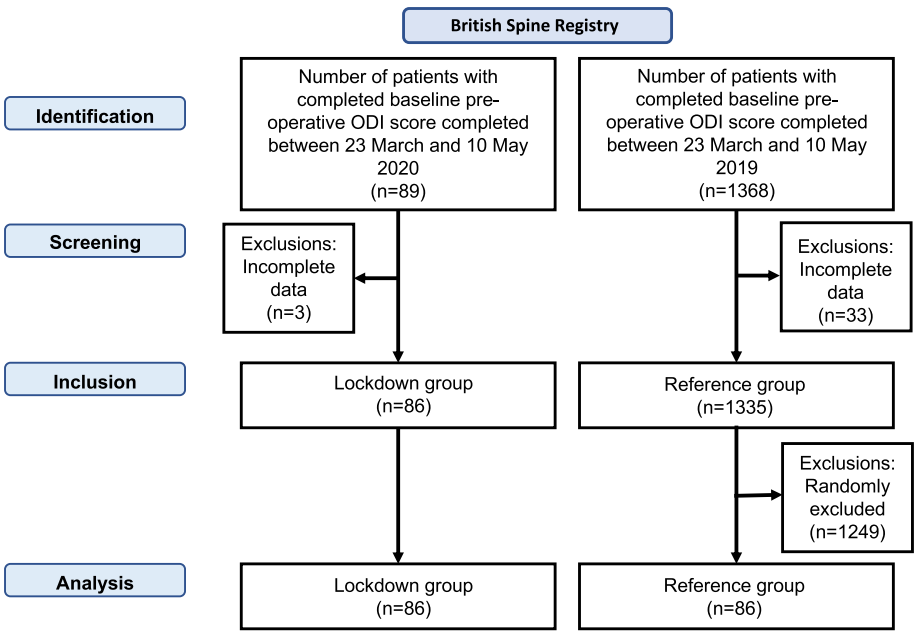

Fig. 1 Flow diagram reporting selection of participants for the study of ODI scores before and during UK national lockdown in response to the COVID-19 pandemic

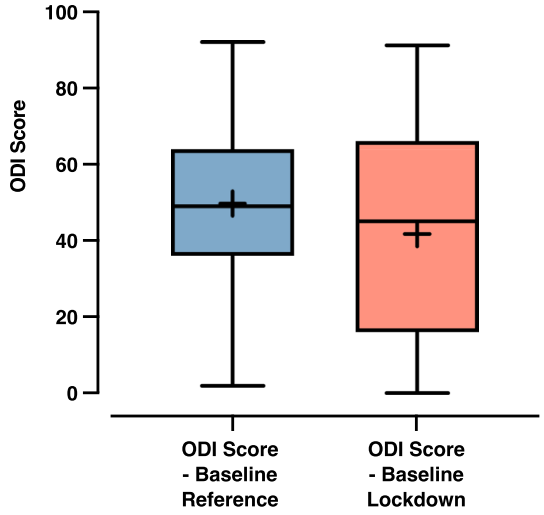

Fig. 2 Tukey boxplot showing median (line) and mean (cross) ODI scores for patients taken during the first UK COVID-19 lockdown and during a reference period 1 year prior in 2019

was not statistically significant ($U = 3104$, $p = 0.068$; Fig. 2). The median scores were 45 and 49, respectively, with a difference of 5 (95% CI = 0 – 12).

ODI scores did not show any clear changes over time with regard to the duration of lockdown before the determination of the score (Fig. 3).

Removing responses to questions 9 and 10 of the ODI and calculating a new modified overall score had different outcomes for each study group. For the lockdown group, there was no significant difference between the two scores (Wilcoxon matched-pairs signed-rank test, $p = 0.06$). However, for the pre-COVID-19 reference group, there was a significant difference (Wilcoxon matched-pairs signed-rank test, $p < 0.01$). Despite this difference, the proportion of scores that led to a change in the patients' disability category was low for both groups (10% in the lockdown group and 12% in the pre-COVID-19 reference group).

The Bland–Altman analyses showed similar results (Table 2). The plots show an overall good agreement between the two different versions of the ODI scores for each cohort (i.e. narrow LOA, low variability, and no overall trend; Fig. 4). Upon inspection of the plots for both the pre-COVID-19 cohort (Fig. 4A) and the lockdown cohort (Fig. 4B), the bias (mean difference) lies above the line of equality, but the confidence intervals include the line of equality.

Histogram plots for the responses to questions 9 and 10 for each of the study groups showed that during the lockdown, there was a significantly greater proportion of respondents who scored these categories as 0 than in the pre-COVID-19 reference group ($\chi^2 = 21.9$, df 5, $p < 0.001$ and $\chi^2 = 23.4$, df 5, $p < 0.001$, respectively; Fig. 5).

Discussion

The findings of this study show that there are no meaningful differences between baseline ODI scores taken from patients with low back pain during lockdown restrictions and those

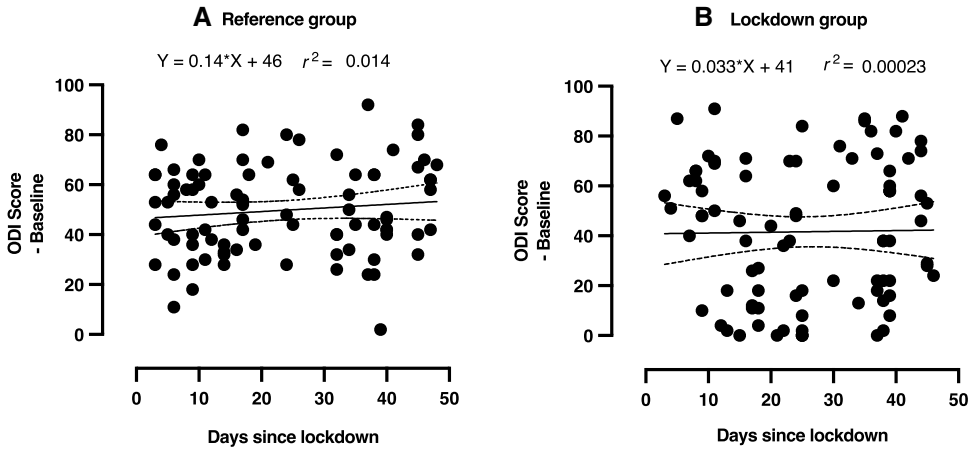

Fig. 3 Scatter plots and simple linear regression analyses with regression lines and 95% confidence intervals for individual ODI scores as a function of the number of days since 23 March 2019 for the reference group **A** and since lockdown on 23 March 2020 for the lockdown group **B**

Table 2 Bland–Altman analyses for each study group

Study group	ODI score	Modified ODI score	Diff (SD)	95% Limits of agreement (LOA)	% of values outside of LOA
Pre-COVID-19 reference group	49.7	48.7	1.06 (3.3)	− 5.5,7.6	5.8%
Lockdown group	41.6	40.9	0.69 (3.4)	− 6.0,7.4	5.8%

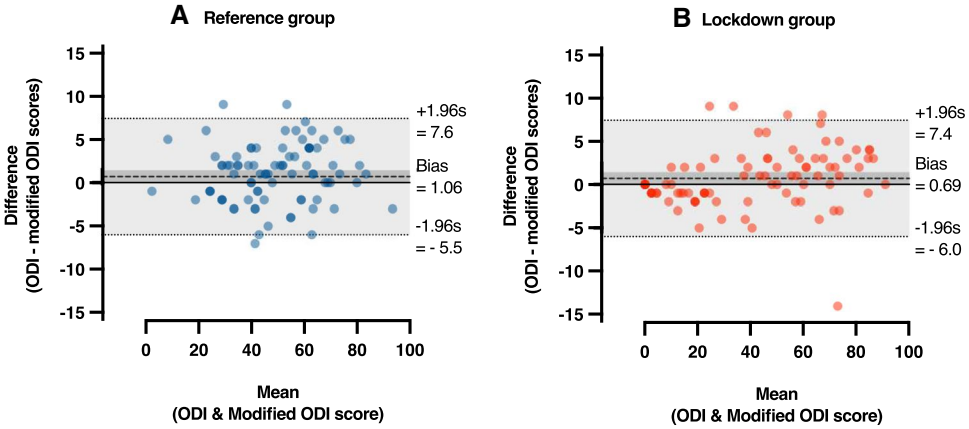

Fig. 4 Bland–Altman plots showing the difference between the original ODI score and the modified ODI score with responses to Sections "Results" and "Discussion" omitted for ODI scores taken from patients during the first UK COVID-19 lockdown and a reference group taken during a reference period 1 year before the lockdown. The shaded light grey area represents 95% limits of agreement, dark shaded areas represent the confidence interval of the mean difference

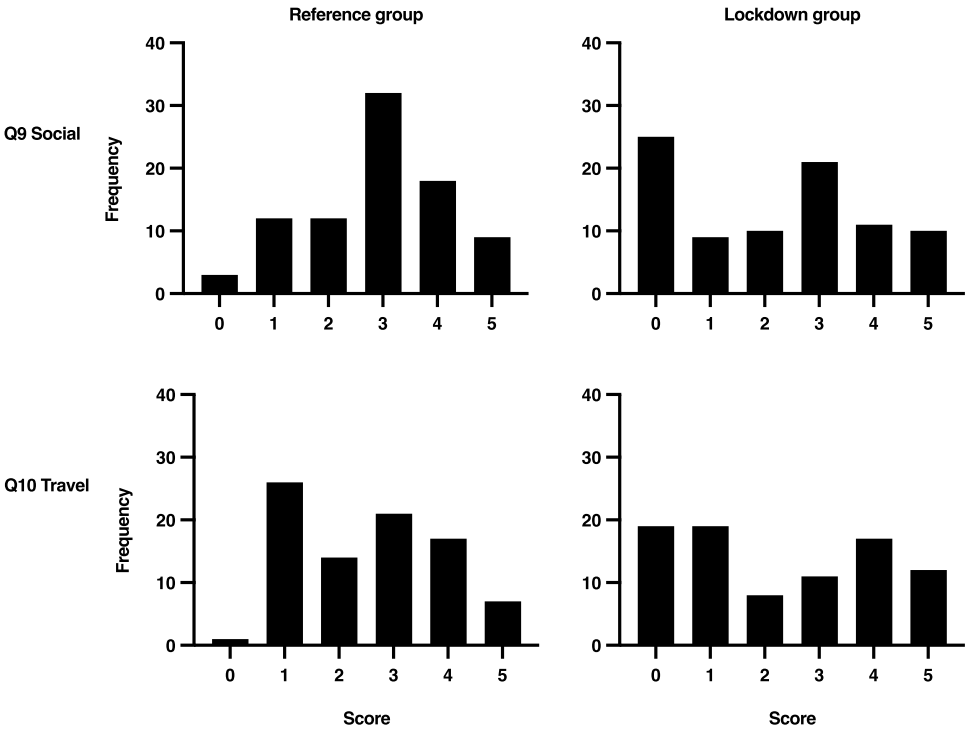

Fig. 5 Histograms showing responses to questions 9 and 10 of the ODI instrument from patients collected during the first UK COVID-19 lockdown and a reference group taken 1 year before the lockdown

taken before the COVID-19 pandemic. The small difference in median ODI scores between our study groups was not statistically different and was well below the established MCID for the ODI [15, 16]. We also showed that when scores for questions 9 and 10 were removed, there was a difference in the pre-lockdown reference group, but not in the lockdown group. This suggests that in a normally functioning society, one cannot exclude these scores and that during lockdown, patients somehow modify their perception of pain overall to provide equivalent scores to those taken when not in lockdown. It may be that patients' perceptions of their illness changed in light of the comparatively more severe prevailing respiratory illness in the general population, or that they felt their social and travelling activities were restricted for reasons other than back pain and subsequently gave lower scores for these questions. Thus, when they are omitted, they have a smaller impact on the overall score. Previous studies have already evaluated the effect of patients not answering the question on sexual function on the total ODI and found that these omissions still provide a reliable score. [20] Our study shows that this is also the case when you remove questions 9 and 10 in lockdown when socialising and travel is not possible, but is not normally true when there are no restrictions on socialising and travelling.

The findings presented here are similar to a growing body of work on the impact of COVID-19 and lockdown restrictions on PROMs. For example, Cohen et al. recently reported a large cohort study looking at the quality of life,

pain and function concerning hand and wrist conditions [9]. Their study found no meaningful differences in routinely collected PROMs from people during the Netherlands' less restrictive "intelligent lockdown" compared to PROMs collected from people before the COVID-19 pandemic. Furthermore, a recent study of oncology patients in Australia also found that PROMs and patients' experiences of their illness remained fairly stable despite the COVID-19 pandemic [21]. Our study provides further evidence that using outcome scores such as the ODI to monitor clinical outcomes and for research purposes remains reliable and valid in the event of further lockdowns or restrictions being utilised in the management of this ongoing COVID-19 and future pandemics.

There are significant impacts of the COVID-19 pandemic and lockdown measures on psychological wellbeing including anxiety and depression, [22, 23] and psychological wellbeing is known to influence patients' quality of life and perceptions of their pain and function [24–26]. However, despite this, our study has shown no overall differences in ODI scores between patients during lockdown and those taken from patients before lockdown. Therefore, our findings suggest that using all components of an ODI score is valid in a full lockdown situation. Furthermore, given that the ODI is widely used in registries and databases worldwide to evaluate spinal interventions, it is important that total score data acquired during lockdown periods should still be considered useful when looking at data retrospectively as well as in the future prospective analyses.

This study has limitations. We used anonymised data with limited demographic or other related health data (e.g. spinal condition and comorbidities) available, and it is possible that only the more severe cases (with presumably higher ODI scores) were being treated during lockdown due to hospital pressures. This may also explain the difference in number of patients with ODI scores available on the BSR for the two study periods. This is a potential source of bias as the two compared groups could have been unintentionally, but systematically, different. The scores used were from a cohort of UK-based patients, and different countries have been variably affected, utilising a range of different strategies to tackle the COVID-19 pandemic; therefore, the results from this study may not be generalisable to all populations. Despite this, many countries did impose some form of lockdown with restrictions on social activities and travel. The data presented do reflect a total lockdown scenario which would put the ODI item scores related to social activity and travel under the most scrutiny. Despite these limitations, there are also strengths of this study: the data used comprised a national registry dataset and was prospectively collected, with patients included from many centres. The broad dataset and limited exclusion criteria give us confidence that the results are robust and generalisable.

Conclusions

In conclusion, we found no clinically important differences in the ODI scores between the two study groups. The findings suggest that the use of ODI to monitor the outcomes of patients with spinal conditions is reliable during lockdown situations and can be used with confidence in the future research using both retrospective and prospective data if future lockdowns occur.

Funding No funds were received in support of this work.

Declarations

Conflict of interest IH receives royalties for spinal instrumentation and honoraria for lectures and educational events from Medtronic. IH sits on the executive committee of the British Scoliosis Society. SM receives honoraria from Medtronic for consultations, lectures and educational events. NU receives honoraria from Medtronic and Globus for presentations, lectures and educational events. For the remaining authors none were declared.

Ethics approval Consent was obtained from all participants during the collection of ODI scores for the British Spine Registry. Only anonymised data were used. Our institutional review board approved the study and formal ethical approval to conduct this study was not required.

References

1. Cauchemez S, Kiem CT, Paireau J, Rolland P, Fontanet A (2020) Lockdown impact on COVID-19 epidemics in regions across metropolitan France. Lancet 396:1068–1069. https://doi.org/10.1016/S0140-6736(20)32034-1
2. Davies NG et al (2021) Association of tiered restrictions and a second lockdown with COVID-19 deaths and hospital admissions in England: a modelling study. Lancet Infect Dis 21:482–492. https://doi.org/10.1016/S1473-3099(20)30984-1
3. Dickens BL et al (2020) Modelling lockdown and exit strategies for COVID-19 in Singapore. Lancet Reg Health West Pac 1:100004. https://doi.org/10.1016/j.lanwpc.2020.100004
4. Jefferies S et al (2020) COVID-19 in New Zealand and the impact of the national response: a descriptive epidemiological study. Lancet Public Health 5:e612–e623. https://doi.org/10.1016/S2468-2667(20)30225-5
5. Lancet T (2020) India under COVID-19 lockdown. Lancet 395:1315. https://doi.org/10.1016/S0140-6736(20)30938-7
6. Mitjà O et al (2020) Experts' request to the Spanish Government: move Spain towards complete lockdown. Lancet 395:1193–1194. https://doi.org/10.1016/S0140-6736(20)30753-4
7. Peto J et al (2020) Universal weekly testing as the UK COVID-19 lockdown exit strategy. Lancet 395:1420–1421. https://doi.org/10.1016/S0140-6736(20)30936-3
8. J. Brown and E. Kirk-Wade, (2021) "House of commons library briefing paper - coronavirus: a history of English lockdown laws," House of Commons Library, London, No. 9068. https://

researchbriefings.files.parliament.uk/documents/CBP-9068/CBP-9068.pdf Accessed: 15 Nov 2021.
9. Cohen A et al (2021) What is the impact of the COVID-19 pandemic on quality of life and other patient-reported outcomes? An analysis of the hand-wrist study cohort. Clin Orthop Relat Res 479:335–345. https://doi.org/10.1097/CORR.0000000000001514
10. J. C. Fairbank and P. B. Pynsent, (2000) "The Oswestry Disability Index," Spine (Phila Pa 1976), 25:2940–52; discussion 2952, doi: https://doi.org/10.1097/00007632-200011150-00017.
11. Yates M, Shastri-Hurst N (2017) The Oswestry Disability Index. Occup Med 67:241–242. https://doi.org/10.1093/occmed/kqw051
12. Haegg O (2007) Oswestry Disability Index. In: Schmidt RF, Willis WD (eds) Encyclopedia of Pain. Springer, Berlin Heidelberg, pp 1627–1630
13. Fairbank J, Couper J, DaviesO'brien JJ (1980) The Oswestry low back pain disability questionnaire. Physiotherapy 66:271–273
14. British Spine Registry (BSR), (2020) "The BSR Annual Report 2020," BSR, United Kingdom. https://www.britishspineregistry.com/app/download/33055544/BSR+Annual+Report++2020.pdf Accessed: 15 Nov 2021.
15. Copay AG, Glassman SD, Subach BR, Berven S, Schuler TC, Carreon LY (2008) Minimum clinically important difference in lumbar spine surgery patients: a choice of methods using the oswestry disability index, medical outcomes study questionnaire short form 36, and pain scales. Spine J 8:968–974. https://doi.org/10.1016/j.spinee.2007.11.006
16. Ostelo RW, de Vet HC (2005) Clinically important outcomes in low back pain. Best Pract Res Clin Rheumatol 19:593–607. https://doi.org/10.1016/j.berh.2005.03.003
17. Bland JM, Altman DG (1999) Measuring agreement in method comparison studies. Stat Methods Med Res 8:135–160. https://doi.org/10.1177/096228029900800204
18. Bland JM, Altman DG (1986) Statistical methods for assessing agreement between two methods of clinical measurement. Lancet 1:307–310
19. Giavarina D (2015) Understanding bland altman analysis. Biochem Med (Zagreb) 25:141–151. https://doi.org/10.11613/BM.2015.015
20. Costa M, Marshman LA (2015) Sex life and the oswestry disability index. Spine J 15:1225–1232. https://doi.org/10.1016/j.spinee.2015.02.022
21. Webber K, Cook O, White M, Kwok A, Segelov E (2021) The impact of the COVID-19 pandemic on patient-reported outcome measures (PROMs) and patient-reported experience measures (PREMs) in an Australian outpatient oncology setting. J Clin Oncol 39:195–195. https://doi.org/10.1200/JCO.2020.39.28_suppl.195
22. Brooks SK et al (2020) The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet 395:912–920. https://doi.org/10.1016/S0140-6736(20)30460-8
23. Fairlamb S (2021) The relationship between COVID-19-induced death thoughts and depression during a national lockdown. J Health Psychol. https://doi.org/10.1177/13591053211067102
24. Linton SJ, Shaw WS (2011) Impact of psychological factors in the experience of pain. Phys Ther 91:700–711. https://doi.org/10.2522/ptj.20100330
25. Lieb R, Meinlschmidt G, Araya R (2007) Epidemiology of the association between somatoform disorders and anxiety and depressive disorders: an update. Psychosom Med 69:860–863
26. Hallegraeff JM, van Trijffel E, Kan RW, Stenneberg MS, Reneman MF (2021) Illness perceptions as an independent predictor of chronic low back pain and pain-related disability: a prospective cohort study. Physiotherapy 112:72–77. https://doi.org/10.1016/j.physio.2020.12.001