EUROPEAN RESPIRATORY *journal*

FLAGSHIP SCIENTIFIC JOURNAL OF ERS

Early View

Research letter

Sleep apnoea management in Europe during the COVID-19 pandemic: data from the European Sleep Apnoea Database (ESADA)

Ludger Grote, Walter T. McNicholas, Jan Hedner

Please cite this article as: Grote L, McNicholas WT, Hedner J. Sleep apnoea management in Europe during the COVID-19 pandemic: data from the European Sleep Apnoea Database (ESADA). *Eur Respir J* 2020; in press (https://doi.org/10.1183/13993003.01323-2020).

Research letter

Sleep apnoea management in Europe during the COVID-19 pandemic – data from the European Sleep Apnoea Database (ESADA)

Short title: OSA management during COVID-19 pandemic

Ludger Grote,[1,2] MD, PhD; Walter T McNicholas,[3] MD; Jan Hedner,[1,2] MD, PhD on behalf of the ESADA collaborators

Affiliations: [1]Centre for Sleep and Wake Disorders, Institute for Internal Medicine, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden and [2]Centre for Sleep Disorders, Department for Pulmonary Medicine, Sahlgrenska University Hospital, Sweden; [3]Department of Respiratory and Sleep Medicine, St. Vincent's Hospital Group, School of Medicine, University College, Dublin, Ireland.

Corresponding Author

Ludger Grote, MD, PhD, Adjunct Professor

Sleep Disorders Centre,

Dept. of Respiratory Medicine,

Sahlgrenska University Hospital

413 45 Gothenburg, Sweden

Email: ludger.grote@lungall.gu.se

Number of tables: 1

Number of figures: 0

Text word count:

Research letter

Sleep disordered breathing (SDB) is highly prevalent with a male to female predominance of two to one, and is more common in middle-aged and elderly subjects (1). Affected patients often present with comorbidities such as obesity, cardiovascular disease (systemic hypertension, heart failure, atrial fibrillation), and diabetes mellitus Type II (2). The strong overlap between the profile for SDB patients and the identified risk factors for adverse outcomes of COVID-19 infection that include age, male gender, and cardio-metabolic comorbidity (3) suggest that SDB patients may benefit from effective therapy if confronted with COVID-19 infection (4).

The COVID-19 pandemic has fundamentally changed the operation of health care systems around the globe. Resources have understandably been shifted from elective care to acute management of severely ill patients with life-threatening COVID-19 infection (5). According to current recommendations, sleep medicine services are advised to reduce in-house services, and to provide medical care by remote contact using phone, video-calls, and telemedicine solutions (6, 7, 8, 9).

In the current study, we assessed the impact of the COVID-19 pandemic on the management of SDB patients in Europe. We approached the centres of the European Sleep Apnoea Database (ESADA) cohort, a well-established network of sleep centres in 19 European countries (2), and a subsample of accredited sleep centres of the German Sleep Society (DGSM). The aim was to analyse how recommendations from expert organisations were applied across various European regions, and whether specific mitigation strategies were already in practice.

A purpose-built questionnaire addressed information about changes in clinical routines imposed during the COVID-19 pandemic compared with routine practices. Specifically, details on the diagnosis of SDB, the procedures for titration of positive airway pressure

(PAP) treatment, and the follow up of PAP treatment were addressed. One question sought the estimated proportion of staff still active in the sleep service during the pandemic compared with beforehand (0-100%, each for “physicians” and “nurses/technicians”). Finally, access to regional or national COVID-19 related guidelines for patients with SDB and for caregivers in sleep medicine services was evaluated. Actual numbers of confirmed COVID-19 infected inhabitants and reported COVID-19 deaths were computed per million inhabitants for each country based on information provided by the Johns Hopkins University COVID-19 statistics website (https://coronavirus.jhu.edu/map.html, April 12, 2020).

Data were provided by 25 of 29 ESADA centres and 15 of 283 DGSM-accredited sleep centres. Most centres were linked to a pulmonary department (**table**) and all bar one were hospital based. In 31 of the total 40 participating centres, patients were unable to physically attend because of sleep centre or travel restrictions.

Diagnostic routines were changed substantially by the pandemic. Prior to the pandemic, laboratory-based polysomnography was performed “rarely or regularly” in 92.5% of centres but only in 20% during the pandemic ($p<0.001$, **table**). On the other hand, telemedicine-based sleep apnoea diagnosis was used in 30.0% of centres prior to the pandemic and this number was only marginally reduced to 27.5% during the pandemic. From the 10 centres regularly using telemedicine-based diagnosis, three stopped the service during the pandemic, four maintained the level of use, and three increased use from rarely to regularly. Only two centres started this routine during the pandemic.

Prior to the pandemic, laboratory-based CPAP or bi-level PAP titration and initiation were practiced in almost all centres but less than one fifth of centres continued this routine during the pandemic ($p<0.001$, **table**). In the 13 centres already practicing telemedicine-based CPAP titration, four stopped the service, one reduced the use, six maintained the

level of use, and two increased the use from rarely to regularly. Four centres started this routine during the pandemic.

Prior to the pandemic, 39 centres report regular follow-up procedures in patients with SDB. This service continued in 36 centres during the pandemic but the mode of follow up had changed (**table 1)**. Specifically, three centres offered in-laboratory and seven centres performed ambulatory follow-up sleep recordings in selected patients. Thirty centres provided follow-up by phone or video-calls. Out of the nine centres without phone access, two practiced telemedicine follow-up and four centres provided the support via home care providers. The remaining three centres offered no access to follow-up during the pandemic. Telemedicine based follow up was practiced by a minority of centres.

Staffing levels in the sleep medicine service was reduced to 25% (Interquartile range (IQR) 40) for physicians and to 19% (IQR 28) for nurses/technicians compared to pre-pandemic levels. Staffing reductions varied across European regions, being least in Northern and most in the Southern and Central parts of Europe. However, there was no association identified between remaining staff and numbers of infected individuals or numbers of deaths relating to COVID-19 infection in each country. In addition, national recommendations or guidelines for patients with SDB were available in 45% of centres (0% in Eastern, 39% in Central, 60% in Southern and 100% in Northern and Western European centres). Only 28% of centres had guidelines for sleep service personnel.

This descriptive report highlights several important findings. First, sleep medicine services have been reduced by almost 80% during the first 1-2 months of the COVID-19 pandemic in Europe. Second, more comprehensive sleep studies using polysomnography or in-laboratory PAP titrations have been completely interrupted, or practiced only to a very limited extent in highly selected patient groups. Third, commencement of treatment for SDB by various

types of PAP therapy is equally reduced in the vast majority of centres and countries. Fourth, patient follow-up is mainly managed by phone based patient contacts. Fifth, the full potential of mitigation strategies available by telemedicine has not been explored .

The sharp reduction in sleep medicine services in this study was expected and corresponds to the practice in other areas of medicine (3). Prevention of virus spread at the sleep centres such as by PAP-induced aerosol spread (10) as well as quarantine restrictions are plausible explanations for this decline. Nonetheless, we identified sizeable variations within and between countries in the lockdown of sleep medicine services. Rather unexpectedly, the use of telemedicine and other innovative technical solutions including disposable diagnostic tools and non-contact sleep surveillance for sleep apnoea diagnosis, were not reported to any major extent. Uncertainty relating to data protections laws and inadequate practical experience are believed to limit dissemination of such new technology.

There is a medical need for the continued management of SDB patients. Most clinical case series regarding severely affected COVID-19 patients report clinical features including male predominance, obesity, and cardiometabolic disorders (3), all of which are strongly associated with SDB. Furthermore, there are as yet unexplored potential mechanistic links between an imbalance of the Angiotensin II receptor and Angiotensin II Converting Enzyme (ACE2) and severe COVID-19 infections, which may also apply in SDB (11, 12).

In conclusion, our findings suggest that the sleep medicine community needs to collaborate in developing strategies for care of patients with both suspected and established SDB during major events such as the COVID-19 pandemic. Activities need to focus on the recognition of severe cases of SDB and how to initiate treatment in already identified severe cases. The potential of new technologies that enable remote monitoring to optimize treatment may be

more frequently applied during times of restricted health care resources in order to obtain better management of severely affected COVID-19 patients.

REFERENCES

1. Benjafield AV, Ayas NT, Eastwood PR, Heinzer R, Ip MSM, Morrell MJ, Nunez CM, Patel SR, Penzel T, Pépin JL, Peppard PE, Sinha S, Tufik S, Valentine K, Malhotra A. Estimation of the global prevalence and burden of obstructive sleep apnoea: a literature-based analysis. Lancet Respir Med. 2019 Aug;7(8):687-698. doi:10.1016/S2213-2600(19)30198-5.
2. Hedner J, Grote L, Bonsignore M, McNicholas W, Lavie P, Parati G, Sliwinski P,Barbé F, De Backer W, Escourrou P, Fietze I, Kvamme JA, Lombardi C, Marrone O, Masa JF, Montserrat JM, Penzel T, Pretl M, Riha R, Rodenstein D, Saaresranta T, Schulz R, Tkacova R, Varoneckas G, Vitols A, Vrints H, Zielinski J. The European Sleep Apnoea Database (ESADA): report from 22 European sleep laboratories. Eur Respir J. 2011 Sep;38(3):635-42. doi: 10.1183/09031936.00046710.
3. Chen T, Wu D, Chen H, Yan W, Yang D, Chen G, Ma K, Xu D, Yu H, Wang H, Wang T, Guo W, Chen J, Ding C, Zhang X, Huang J, Han M, Li S, Luo X, Zhao J, Ning Q. Clinical characteristics of 113 deceased patients with coronavirus disease 2019: retrospective study. BMJ. 2020 Mar 26;368:m1091. doi: 10.1136/bmj.m1091.
4. Baker JG, Sovani M. Case for continuing community NIV and CPAP during the COVID-19 epidemicThorax Epub ahead of print: [please include Day Month Year]. doi:10.1136/thoraxjnl-2020-214913
5. Swedish perioperative registry SPOR (www.spor.se): Publication at Swedish Broadcast SVT, downloaded April 13 2020; data source https://www.svt.se/datajournalistik/corona-uteblivna-operationer/
6. British Thoracic Society: Advice for those seeing patients with obstructive sleep apnoea. https://www.brit-thoracic.org.uk/about-us/covid-19-information-for-the-respiratory-community/
7. American Academy Sleep Medicine: COVID-19 mitigation strategies for sleep clinics and labs. Updated document at April 8 2020. https://aasm.org/covid-19-resources/
8. Gonzalez J, Maisonobe J, Oranger M, Mendoza-Ruiz A: GAVO2 procedures (French scientific group on chronic ventilation and oxygen) TITLE: Homecare respiratory equipment for patients suspected to be infected with the respiratory virus Covid19

(English version). Version February 2020, French version updated April 2020. Download from: http://splf.fr/gavo2/

9. Grote L, Albrecht D, Franklin K, Granzin P, Harlid R, Lindberg E, Midgren B, Stillberg G, Theorell-Haglow J, Hedner J. Vägledning angående coronavirus (COVID-19) och obstruktiv sömnapné (OSA). Expert group statement March 2020. Download: www.sesar.se
10. Simonds A, Hanak A, Chatwin M, Morrell M, Hall A. Evaluation of droplet dispersion during non-invasive ventilation, oxygen therapy, nebuliser treatment and chest physiotherapy in clinical practice: implications for management of pandemic influenza and other airborne infections. *Health Technol Assess* 2010;14(46 Article 2)
11. Liu PP, Blet A, Smyth D, Li H. The Science Underlying COVID-19: Implications for the Cardiovascular System. Circulation. 2020 Apr 15. doi:10.1161/CIRCULATIONAHA.120.047549
12. Weiss JW, Tamisier R, Liu Y. Sympathoexcitation and arterial hypertension associated with obstructive sleep apnea and cyclic intermittent hypoxia. J Appl Physiol (1985). 2015 Dec 15;119(12):1449-54. doi: 10.1152/japplphysiol.00315.2015

Abbreviations

AASM: American Academy of Sleep Medicine

BTS: British Thoracic Society

CI: Confidence Interval

ESADA: European Sleep Apnoea Database

IQR: Interquartile range

OSA: Obstructive sleep apnoea

PG: Polygraphy

PSG: Polysomnography

SD: Standard Deviation

SPOR: Swedish Perioperative Registry

TABLES

Table 1: Characteristics of the participating sleep centres and change of activities during the COVID-19 pandemic

Variable	Result	Commentary
Number of centres	40	European Sleep Apnoea Database (ESADA) (25), German Sleep Society (15)
Distribution across Europe	5 regions, 15 countries	North (3), West (2), Central (22), South (10), East (3)
Clinical affiliation of the sleep centre	Pulmonary Department (22), any other department (18)	Other departments (18): Neurology (1), ENT (3), Cardiology (1), Independent unit at hospital (12), Independent unit outside a hospital (1)
Patient spectrum of the sleep centre	Entire spectrum of sleep/wake disorders (32), with focus on sleep disordered breathing (8)	
Sleep apnea diagnostic procedures used prior to Covid-19 pandemic (Answer: Rarely or regularly)		
Polysomnography in lab 92.5%	Polygraphy at home 87.5%	Telemedicine based 30.0%
Sleep apnea diagnostic procedures during Covid-19 pandemic		
Polysomnography in Lab 20.0%	Polygraphy at home 32.5%	Telemedicine based 27.5%
CPAP treatment start procedures used prior to Covid-19 pandemic (Answer: Rarely or regularly)		
In lab titration – 90.0%	Ambulatory titration – 55.0%	Telemedicine based APAP titration – 32.5% (Regularly 6 centres)
CPAP treatment start procedures used during the Covid-19 pandemic (Answer: Rarely or regularly)		
In lab titration – 17.5%	Ambulatory titration – 22.5% (all rarely)	Telemedicine based APAP titration – 32.5% (Regularly 4 centres)
BiLevel-PAP treatment start procedures used prior to the Covid-19 pandemic (Answer: Rarely or regularly)		
In lab titration – 87.5%	Ambulatory titration – 40.0%	Telemedicine based BiLevel-PAP titration – 20.0% (Regularly 4 centres)
BiLevel-PAP treatment start procedures used during the Covid-19 pandemic (Answer: Rarely or regularly)		
In lab titration – 17.5%	Ambulatory titration – 17.5%	Telemedicine based BiLevel-PAP titration 12.5% (Regularly 3 centres)
Follow up routines for PAP treatment prior to the Covid-19 pandemic (Answer: Rarely or regularly)		
In lab follow up – 82.5%	Ambulatory titration -	Distance follow up:

	92.5%	Base on phone calls: 70% Based on telemonitoring – 50.0% (“Regularly use” at 7 centers)
Follow up routines for PAP treatment during the Covid-19 pandemic (Answer: Rarely or regularly)		
In lab Follow up – 7.5%	Ambulatory titration – 17.5% (all rarely)	Distance follow up: Base on phone calls: 75.0% Based on telemonitoring – 57.5% (“Regularly use at 12 centers, 8 centers started, 4 centers stopped telemonitoring for PAP follow up)

ESADA Collaborators

1. Ulla Anttalainen and Tarja Saaresranta (Turku University Hospital, Division of Medicine, Department of Pulmonary Diseases and Sleep Research Centre, Department of Pulmonary Diseases and Clinical Allergology, University of Turku, Turku, Finland)*
2. Ozen K. Basoglu, Canan Gunduz, and Sezai Tasbakan (Dept of Chest Diseases, Ege University School of Medicine, Izmir, Turkey)*
3. Izolde Bouloukaki and Sophia E. Schiza (Sleep Disorders Centre, University of Crete, Heraklion, Greece)*
4. Maria R. Bonsignore and Oreste Marrone (DiBiMIS, University of Palermo and CNR, Istituto per la Ricerca e l'Innovazione Biomedica, Palermo, and Italy)*
5. Michel Petitjean and Gabriel Roisman (Service d'Explorations Fonctionnelles Multidisciplinaires, and Unité de Médecine du Sommeil, Hôpital Antoine Béclère, Clamart, France);
6. Ingo Fietze, Naima Laharnar, and Thomas Penzel (Centre of Sleep Medicine, Charité Universitätsmedizin Berlin, Berlin, Germany)*
7. Jan Hedner, Ding Zou, and Ludger Grote (Sleep Medicine, Sahlgrenska University Hospital and Sahlgrenska Academy, Gothenburg, Sweden)*
8. Brian D. Kent, Walter T. McNicholas and Silke Ryan (School of Medicine and Medical Science, University College Dublin, and Department of Respiratory and Sleep Medicine, St. Vincent's Hospital Group, Dublin, Ireland)*
9. John A. Kvamme (ENT Dept., Førde Central Hospital, Førde, Norway);
10. Sebastien Bailly, Jean-Louis Pépin and Renaud Tamisier (Université Joseph Fourier and Université Grenoble Alpes, Grenoble, France)*
11. Carolina Lombardi and Gianfranco Parati (Sleep Disorders Centre, Department of Cardiovascular Neural and Metabolic Sciences, IRCCS Istituto Auxologico Italiano, Milano-Bicocca University, Milan, Italy)*
12. Athanasia Pataka (Respiratory Failure Unit, G. Papanikolau Hospital, Thessaloniki, Greece)*
13. Robert Plywaczewski and Pawel Sliwinski (Institute of Tuberculosis and Lung Diseases, Warsaw, Poland);
14. Martin Pretl (Sleep Disorders Centre, Department of Neurology, Charles University, Prague, Czech Republic);
15. Renata Riha (Dept of Sleep Medicine, Edinburgh Royal Infirmary, Edinburgh, UK)*
16. Richard Staats (Dept. of Pneumology, University Hospital de Santa Maria, Lisbon, Portugal)*
17. Paschalis Steiropoulos (Sleep Unit, Dept of Pneumonology, Democritus University of Thrace, Alexandroupolis, Greece)*
18. Pavol Joppa (Dept of Respiratory Medicine, P.J. Safarik University, Kosice, and L. Pasteur University Hospital, Kosice, Slovakia)*
19. Johan Verbraecken and E. Petiet (Multidisciplinary Sleep Disorders Centre, Antwerp University Hospital and University of Antwerp)*
20. Georgia Trakada (Pulmonary Medicine, National and Kapodistrian University of Athens, Athens, Greece)*
21. Ondrej Ludka (Department of Cardiology, University Hospital Brno and International Clinical Research Centre, St. Ann´s University Hospital, Brno, Czech Republic) and

Jitka Bušková (Department of Sleep Medicine, National Institute of Mental Health, Klecany, CZ)*

22. Hein H (Sleep Disorders Centre, Johanniter-Krankenhaus Geesthacht, Germany)*
23. Marta Drummond and Mafalda van Zeller (Pulmonology Department Hospital São João, Medicine Faculty of Porto University, Porto, Portugal)*
24. Zoran Dogas and Tea Galic (Sleep Medicine Centre, Department of Neuroscience, University of Split School of Medicine, Split, Croatia);
25. Haralampos Gouveris (ENT department at Mainz University Hospital, Mainz, Germany)*
26. Stefan Mihaicuta (Timisoara Victor Babes University Hospital)*
27. Winfried Randerath and Simon Herkenrath (Bethanien Hospital, Solingen, Germany)*
28. Francesco Fanfulla (Unità Operativa di Medicina del Sonno (Sleep Medicine Unit) – Istituti Clinici Scientifici Maugeri, Padua, Italy)*
29. Dries Testelmans (Sleep Disorders Centre, University Hospital Gasthuisberg, Leuven, Belgium)

*= center provided data for the study

Accredited sleep centres of the German Sleep Society (DGSM) participating in the study

City	Name	Centre
Aachen	J Schiefer	Sleep Centre, Neurological Department, University Hospital
Arolsen	W Knüppel	Sleep Centre, Krankenhaus Bad Arolsen
Berlin	H Danker-Hopfe	Competence Centre for Sleep Medicine, Charité Universitätsmedizin Berlin, Campus Benjamin Franklin
Düsseldorf	M Minuth	Florence-Nightingale Krankenhaus, Kaiserswerther Diakonie
Essen	G Nilius	Sleep Centre, Pulmonary Medicine, Kliniken Essen Mitte
Frankfurt	H Schneider	Zentrum für Schlafmedizin Frankfurt
Garmisch	R Püschel	Klinikum Garmisch-Partenkirchen
Halle	S Schädlich	Krankenhaus Martha-Maria Halle
Hannover	K Meyer	Sleep Centre, Medizinischen Hochschule
Heidelberg	A Benz	Thoraxklinik Heidelberg, University Hospital
Landshut	B Schneider	Sleep Centre, Pediatric Hospital St. Marien
Nordhausen	J Büntzel	Sleep Centre, Suedharz Klinikum
Oldenburg	I Koper	Sleep Centre at Sana Klinik Oldenburg
Trostberg	R Koch	Sleep Centre, Kreisklinik Trostberg
Ulm	J Lindemann	Sleep Centre, ENT department, University Hospital