ISSN 2307-8960 (online)

World Journal of *Clinical Cases*

World J Clin Cases 2024 March 6; 12(7): 1196-1381

Published by Baishideng Publishing Group Inc

World Journal of Clinical Cases

Contents

Thrice Monthly Volume 12 Number 7 March 6, 2024

World Journal of Clinical Cases

Thrice Monthly Volume 12 Number 7 March 6, 2024

Contents

LETTER TO THE EDITOR

ABOUT COVER

Peer Reviewer of *World Journal of Clinical Cases*, Narendra Pamidi, PhD, Assistant Professor, Department of Anatomy, Melaka Manipal Medical College, Karnataka 576104, India. narendra.pamidi@gmail.com

AIMS AND SCOPE

The primary aim of *World Journal of Clinical Cases* (*WJCC*, *World J Clin Cases*) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

INDEXING/ABSTRACTING

The *WJCC* is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Journal Citation Reports/Science Edition, Current Contents®/Clinical Medicine, PubMed, PubMed Central, Reference Citation Analysis, China Science and Technology Journal Database, and Superstar Journals Database. The 2023 Edition of Journal Citation Reports® cites the 2022 impact factor (IF) for *WJCC* as 1.1; IF without journal self cites: 1.1; 5-year IF: 1.3; Journal Citation Indicator: 0.26; Ranking: 133 among 167 journals in medicine, general and internal; and Quartile category: Q4.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Si Zhao*; **Production Department Director:** *Xiang Li*; **Editorial Office Director:** *Jin-Lei Wang*.

NAME OF JOURNAL
World Journal of Clinical Cases

ISSN
ISSN 2307-8960 (online)

LAUNCH DATE
April 16, 2013

FREQUENCY
Thrice Monthly

PUBLICATION DATE
March 6, 2024

INSTRUCTIONS TO AUTHORS
https://www.wjgnet.com/bpg/gerinfo/204

GUIDELINES FOR ETHICS DOCUMENTS
https://www.wjgnet.com/bpg/GerInfo/287

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
https://www.wjgnet.com/bpg/gerinfo/240

PUBLICATION ETHICS
https://www.wjgnet.com/bpg/GerInfo/288

PUBLICATION MISCONDUCT
https://www.wjgnet.com/bpg/gerinfo/208

ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/bpg/gerinfo/242

STEPS FOR SUBMITTING MANUSCRIPTS
https://www.wjgnet.com/bpg/GerInfo/239

ONLINE SUBMISSION
https://www.f6publishing.com

World Journal of Clinical Cases

Submit a Manuscript: https://www.f6publishing.com

World J Clin Cases 2024 March 6; 12(7): 1196-1199

DOI: 10.12998/wjcc.v12.i7.1196

ISSN 2307-8960 (online)

EDITORIAL

Relevance of sleep for wellness: New trends in using artificial intelligence and machine learning

Deb Sanjay Nag, Amlan Swain, Seelora Sahu, Abhishek Chatterjee, Bhanu Pratap Swain

Specialty type: Multidisciplinary sciences

Provenance and peer review: Invited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): 0
Grade C (Good): C
Grade D (Fair): 0
Grade E (Poor): 0

P-Reviewer: Chiu H, Taiwan

Received: December 26, 2023
Peer-review started: December 26, 2023
First decision: January 15, 2024
Revised: January 16, 2024
Accepted: February 5, 2024
Article in press: February 5, 2024
Published online: March 6, 2024

Deb Sanjay Nag, Amlan Swain, Seelora Sahu, Abhishek Chatterjee, Bhanu Pratap Swain, Department of Anaesthesiology, Tata Main Hospital, Jamshedpur 831001, Jharkhand, India

Corresponding author: Deb Sanjay Nag, MBBS, MD, Doctor, Department of Anaesthesiology, Tata Main Hospital, C Road West, Northern Town, Bistupur, Jamshedpur 831001, Jharkhand, India. ds.nag@tatasteel.com

Abstract

Sleep and well-being have been intricately linked, and sleep hygiene is paramount for developing mental well-being and resilience. Although widespread, sleep disorders require elaborate polysomnography laboratory and patient-stay with sleep in unfamiliar environments. Current technologies have allowed various devices to diagnose sleep disorders at home. However, these devices are in various validation stages, with many already receiving approvals from competent authorities. This has captured vast patient-related physiologic data for advanced analytics using artificial intelligence through machine and deep learning applications. This is expected to be integrated with patients' Electronic Health Records and provide individualized prescriptive therapy for sleep disorders in the future.

Key Words: Sleep initiation and maintenance disorders; Sleep apnea; Obstructive; Machine learning; Artificial intelligence; Algorithms

Core Tip: Quality sleep is one of the major determinants of wellness. Insomnia and other sleep disorders are widespread in the society. Increasingly, technology is being used to diagnose sleep disorders through wearable devices and consumer technologies. This has allowed sleep disorders to be diagnosed at home rather than at polysomnography labs. With the advent of artificial intelligence, including machine and deep learning, sleep disorder diagnosis has become highly dynamic based on multiple inputs and complex algorithms analyzing huge quantum of metadata. Similarly, therapy is also becoming highly patient-specific due to available digital tools. However, the ever-expanding knowledge needs further validation to establish patient-centric care.

Citation: Nag DS, Swain A, Sahu S, Chatterjee A, Swain BP. Relevance of sleep for wellness: New trends in using artificial intelligence and machine learning. *World J Clin Cases* 2024; 12(7): 1196-1199
URL: https://www.wjgnet.com/2307-8960/full/v12/i7/1196.htm
DOI: https://dx.doi.org/10.12998/wjcc.v12.i7.1196

INTRODUCTION

The duration and quality of sleep remarkably impact our wellness and health. Quality sleep rejuvenates emotion, body functions, metabolism, memory, and learning[1]. Optimum human functioning has been recently associated with attributes like resilience, an "individual's ability to successfully adapt in life despite social disadvantage or other highly adverse conditions"[2]. Resilience is a complex interplay of environmental, psychosocial, genetic, and biological factors. Quality sleep is important in developing resilience and improves mental health and wellness[2,3].

While insomnia affects one-third of the global population, excessive sleepiness varies from 4% to 26% and obstructive sleep apnea (OSA) prevails in 2%-4%[3]. While impaired mental health leading to poor sleep has been traditionally implied[4,5], subsequent evidence shows that impaired sleep adversely impacts wellness[6].

THE RELEVANCE OF SLEEP FOR WELLNESS

Instead of being a medical concept, wellness is a "holistic and comprehensive multidimensional concept,"[7] representing a continuum of health as defined by the World Health Organization as a "state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity,"[8] to an individual's overall lifestyle and behavior[7] to ensure a balanced and fulfilling life.

While exercise is widely recognized as "medicine" for a healthy life, nutrition and sleep are the other prerequisites[9]. Insomnia or shorter duration of sleep has been associated with reduced happiness levels[10] and weight gain caused by increased food intake due to an imbalance between hunger (ghrelin) and satiety (leptin)[11]. Decreased sleep time and quality have also shown temporal association with various metabolic diseases like diabetes and cardiovascular diseases [11]. Sleep disorders also increase the risk of accidents and hospitalization[12].

Poor sleep health affects the immune system, resulting in long-term impact on infectious and inflammatory disease risks[13]. It also amplifies malignancy development and major depression[14]. Meanwhile, quality sleep restores the immune system, specifically the adaptive and innate immunity. Hence, accurately diagnosing sleep disorders and creating patient-specific management are the keys to sleep hygiene and wellness.

USE OF TECHNOLOGY FOR DIAGNOSIS OF SLEEP DISORDERS

With increasing consumer sleep technology (CST) capabilities, sleep disorder diagnosis and management are enhanced [15]. A continuous feedback loop mechanism is expected to deliver individualized care with enabled wearables and therapeutic devices, like CSTs. Currently, these have been integrated into wearables, sleeping mattresses, clothing, and sleep environments to provide insights into sleep hygiene, quality, and schedule[16]. These devices are at various stages of validation and approval by the United States Food and Drug Administration (FDA), with some even receiving FDA clearance. Although sufficient literature uses actigraph triaxial accelerometers to assess sleep[17,18], data generated through accelerometers and mobile devices needs further reinforcement[16]. Although a study comparing the validity of six wearable devices for assessing sleep validates the "field-based assessment of the timing and duration of sleep," the assessment of specific stages of sleep must still be improved[19].

All these devices are compared against the traditional gold standard of laboratory-based polysomnography (PSG), which integrates data derived from electroencephalography, electrooculography, electromyography for neural activity along with electrocardiographic, blood oxygen saturation, and respiratory patterns[20].

A systematic review showed that the digital clinical tools to screen or diagnose OSA demonstrated an excellent discriminating capability, with the best tools reaching an area under the curve of > 0.99)[21]. Of the 41 studies covered in the systematic review (Table 1), 11 (27%) used bed/mattress sensors, 10 (24%) used wearables, 7 (17%) used smartphones, 5 (12%) used nasal airflow sensors, and 8 (20%) could not be classified into either of these[21].

USE OF TECHNOLOGY TO MANAGE SLEEP DISORDERS: THE ROLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Information and communication technologies aided cognitive-behavioral therapy, Audiovisual Stimulation, Music Video Intervention, and Gight (Innovative Automated Guiding Light) has been used to treat insomnia. It improved sleep-related outcomes and other wellness metrics, such as depression, quality of life, and physical activity[22]. An initial literature proved the efficacy of therapy for sleep disorders through mobile apps. However, its performance and

Table 1 Use of technology for diagnosis of sleep disorders[23]

Type of sensor	Number of studies	Percentage	Sample size	AUC[1]	Evidence
Bed/mattress sensors	11	27%	10-366	AUC: 0.94-1.00	Strong
Wearables	10	24%	20-404	AUC: 0.80-1.00	Strong
Smartphones	7	17%	15-620	AUC: 0.61-0.95	Moderate to strong
Nasal airflow sensors	5	12%	5-288	AUC: 0.77-0.91	Moderate to strong
Other digital tools (could not be classified)	8	20%	10-359	AUC: 0.85-1.00	Strong

[1]Area under curve measures discrimination power of the predictive classification model. AUC: Area under curve.

standardized care delivery must be further validated[23].

Cognitive-behavioral therapy for insomnia remains the first-line treatment for insomnia. However, technology enabling "machine learning (ML)-assisted clinical decision support" can scale and disseminate sustainable care to areas with a scarce supply of skilled physicians[24].

As already discussed, PSG remains the gold standard to detect sleep disorders and physiological records must clinch a diagnosis. Due to the elaborate set-up required and the unnatural environment of a sleep laboratory, research has always tried to analyze physiologic signals from a myriad of devices and use artificial intelligence (AI) to assign meaning to the derived data. Since 2018, using multiple ML and deep learning (DL) algorithms to the metadata acquired from millions of devices, technology has been providing us key insights into simple diagnostic modalities (through complex data analytics) and patient-specific therapy guidelines to drive patient-centric care[25]. DL provides increased resilience to the algorithms derived as it requires several data for testing and training[25]. However, recent interest has been drawn to DL and ML hybrid models for sleep disorder detection through integrated devices.

Future research would also focus on integrating AI with Electronic Health Records to alert caregivers proactively. Integrating data acquired through wearables can allow ML and DL algorithms to provide key insights for driving sleep hygiene and moving from predictive diagnostics to prescriptive therapy[26].

CONCLUSION

Sleep quality is intricately related to an individual's wellness, including productivity and contribution to society. Although widespread, sleep disorders are often underdiagnosed and inappropriately treated. Technologies massively transformed sleep disorder diagnosis and management. With this, wearable devices might soon replace the PSG to detect sleep dysfunction. Voluminous data generated from millions of devices are now using AI, ML, and DL to provide us with deep insights into sleep physiology and suggest targeted therapy.

FOOTNOTES

Author contributions: Nag DS, Swain A, Sahu S, Chatterjee A, Swain BP contributed to this paper; Nag DS and Swain A designed the overall concept and outline of the manuscript; Swain A, Sahu S, Chatterjee A contributed to the discussion and design of the manuscript; Nag DS, Swain A, Sahu S, Chatterjee A and Swain BP contributed to the writing, and editing the manuscript and review of literature.

Conflict-of-interest statement: The authors declare no conflict of interest.

Country/Territory of origin: India

ORCID number: Deb Sanjay Nag 0000-0003-2200-9324; Amlan Swain 0000-0002-0810-7262; Seelora Sahu 0000-0002-5357-9381.

Corresponding Author's Membership in Professional Societies: Indian Society of Anaesthesiology, S2863.

S-Editor: Gong ZM
L-Editor: A
P-Editor: Zhao S

REFERENCES

1 **Tyagi M**, Shah U, Patel G, Toshniwal V, Bhongade R, Sharma P. The Impact Of Sleep On Physical And Mental Health: Importance Of Healthy Sleep Habits. *Georgian Med News* 2023; 89-94 [PMID: 37522781]

2 **Allan AC**, Gamaldo AA, Gamaldo CE, Gunia BC, Razzak IMAA, Ighodaro E, Salas RME. The promotion of sleep wellness: Resilience as a protective factor. *Front Sleep* 2023; **2** [PMID: 37427086 DOI: 10.3389/frsle.2023.1133347]

3 **Scott AJ**, Webb TL, Martyn-St James M, Rowse G, Weich S. Improving sleep quality leads to better mental health: A meta-analysis of randomised controlled trials. *Sleep Med Rev* 2021; **60**: 101556 [PMID: 34607184 DOI: 10.1016/j.smrv.2021.101556]

4 **Stepanski EJ**, Rybarczyk B. Emerging research on the treatment and etiology of secondary or comorbid insomnia. *Sleep Med Rev* 2006; **10**: 7-18 [PMID: 16376125 DOI: 10.1016/j.smrv.2005.08.002]

5 **McCrae CS**, Lichstein KL. Secondary insomnia: diagnostic challenges and intervention opportunities. *Sleep Med Rev* 2001; **5**: 47-61 [PMID: 12531044 DOI: 10.1053/smrv.2000.0146]

6 **Alvaro PK**, Roberts RM, Harris JK. A Systematic Review Assessing Bidirectionality between Sleep Disturbances, Anxiety, and Depression. *Sleep* 2013; **36**: 1059-1068 [PMID: 23814343 DOI: 10.5665/sleep.2810]

7 **Eriksson M**, Ekström-Bergström A, Arvidsson S, Jormfeldt H, Thorstensson S, Åström U, Lundgren I, Roxberg Å. Meaning of wellness in caring science based on Rodgers's evolutionary concept analysis. *Scand J Caring Sci* 2023 [PMID: 37507842 DOI: 10.1111/scs.13196]

8 **Svalastog AL**, Donev D, Jahren Kristoffersen N, Gajović S. Concepts and definitions of health and health-related values in the knowledge landscapes of the digital society. *Croat Med J* 2017; **58**: 431-435 [PMID: 29308835 DOI: 10.3325/cmj.2017.58.431]

9 **Chow CM**. Sleep and Wellbeing, Now and in the Future. *Int J Environ Res Public Health* 2020; **17** [PMID: 32331237 DOI: 10.3390/ijerph17082883]

10 **Zhao SZ**, Wang MP, Viswanath K, Lai A, Fong DYT, Lin CC, Chan SS, Lam TH. Short Sleep Duration and Insomnia Symptoms were Associated with Lower Happiness Levels in Chinese Adults in Hong Kong. *Int J Environ Res Public Health* 2019; **16** [PMID: 31212815 DOI: 10.3390/ijerph16122079]

11 **Van Cauter E**, Knutson KL. Sleep and the epidemic of obesity in children and adults. *Eur J Endocrinol* 2008; **159** Suppl 1: S59-S66 [PMID: 18719052 DOI: 10.1530/EJE-08-0298]

12 **Zhang J**, Xu Z, Zhao K, Chen T, Ye X, Shen Z, Wu Z, Zhang J, Shen X, Li S. Sleep Habits, Sleep Problems, Sleep Hygiene, and Their Associations With Mental Health Problems Among Adolescents. *J Am Psychiatr Nurses Assoc* 2018; **24**: 223-234 [PMID: 28758527 DOI: 10.1177/1078390317715315]

13 **Buysse DJ**. Sleep health: can we define it? *Sleep* 2014; **37**: 9-17 [PMID: 24470692 DOI: 10.5665/sleep.3298]

14 **Irwin MR**. Why sleep is important for health: a psychoneuroimmunology perspective. *Annu Rev Psychol* 2015; **66**: 143-172 [PMID: 25061767 DOI: 10.1146/annurev-psych-010213-115205]

15 **Penzel T**, Glos M, Fietze I. New Trends and New Technologies in Sleep Medicine: Expanding Accessibility. *Sleep Med Clin* 2021; **16**: 475-483 [PMID: 34325824 DOI: 10.1016/j.jsmc.2021.05.010]

16 **Ko PR**, Kientz JA, Choe EK, Kay M, Landis CA, Watson NF. Consumer Sleep Technologies: A Review of the Landscape. *J Clin Sleep Med* 2015; **11**: 1455-1461 [PMID: 26156958 DOI: 10.5664/jcsm.5288]

17 **Sadeh A**, Acebo C. The role of actigraphy in sleep medicine. *Sleep Med Rev* 2002; **6**: 113-124 [PMID: 12531147 DOI: 10.1053/smrv.2001.0182]

18 **Littner M**, Kushida CA, Anderson WM, Bailey D, Berry RB, Davila DG, Hirshkowitz M, Kapen S, Kramer M, Loube D, Wise M, Johnson SF; Standards of Practice Committee of the American Academy of Sleep Medicine. Practice parameters for the role of actigraphy in the study of sleep and circadian rhythms: an update for 2002. *Sleep* 2003; **26**: 337-341 [PMID: 12749556 DOI: 10.1093/sleep/26.3.337]

19 **Miller DJ**, Sargent C, Roach GD. A Validation of Six Wearable Devices for Estimating Sleep, Heart Rate and Heart Rate Variability in Healthy Adults. *Sensors (Basel)* 2022; **22** [PMID: 36016077 DOI: 10.3390/s22166317]

20 **Rentz LE**, Ulman HK, Galster SM. Deconstructing Commercial Wearable Technology: Contributions toward Accurate and Free-Living Monitoring of Sleep. *Sensors (Basel)* 2021; **21** [PMID: 34372308 DOI: 10.3390/s21155071]

21 **Duarte M**, Pereira-Rodrigues P, Ferreira-Santos D. The Role of Novel Digital Clinical Tools in the Screening or Diagnosis of Obstructive Sleep Apnea: Systematic Review. *J Med Internet Res* 2023; **25**: e47735 [PMID: 37494079 DOI: 10.2196/47735]

22 **Lee S**, Yu S. Effectiveness of Information and Communication Technology (ICT) Interventions in Elderly's Sleep Disturbances: A Systematic Review and Meta-Analysis. *Sensors (Basel)* 2021; **21** [PMID: 34577212 DOI: 10.3390/s21186003]

23 **Al Mahmud A**, Wu J, Mubin O. A scoping review of mobile apps for sleep management: User needs and design considerations. *Front Psychiatry* 2022; **13**: 1037927 [PMID: 36329917 DOI: 10.3389/fpsyt.2022.1037927]

24 **Germain A**, Markwald RR, King E, Bramoweth AD, Wolfson M, Seda G, Han T, Miggantz E, O'Reilly B, Hungerford L, Sitzer T, Mysliwiec V, Hout JJ, Wallace ML. Enhancing behavioral sleep care with digital technology: study protocol for a hybrid type 3 implementation-effectiveness randomized trial. *Trials* 2021; **22**: 46 [PMID: 33430955 DOI: 10.1186/s13063-020-04974-z]

25 **Xu S**, Faust O, Seoni S, Chakraborty S, Barua PD, Loh HW, Elphick H, Molinari F, Acharya UR. A review of automated sleep disorder detection. *Comput Biol Med* 2022; **150**: 106100 [PMID: 36182761 DOI: 10.1016/j.compbiomed.2022.106100]

26 **Verma RK**, Dhillon G, Grewal H, Prasad V, Munjal RS, Sharma P, Buddhavarapu V, Devadoss R, Kashyap R, Surani S. Artificial intelligence in sleep medicine: Present and future. *World J Clin Cases* 2023; **11**: 8106-8110 [PMID: 38130791 DOI: 10.12998/wjcc.v11.i34.8106]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: office@baishideng.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com