Is Balneotherapy a potential answer for sleep disturbances?
A narrative review and personal experience



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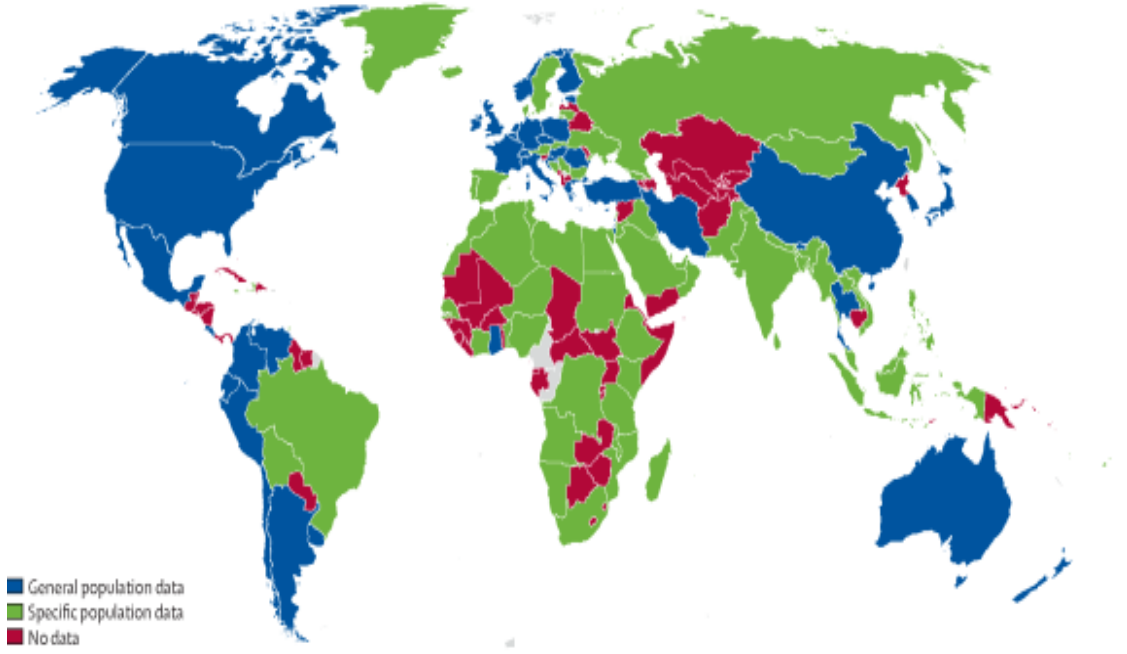
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The Global Burden of Sleep-Wake Disorders

Over the past decade the prevalence of sleep disorders has increased across the world

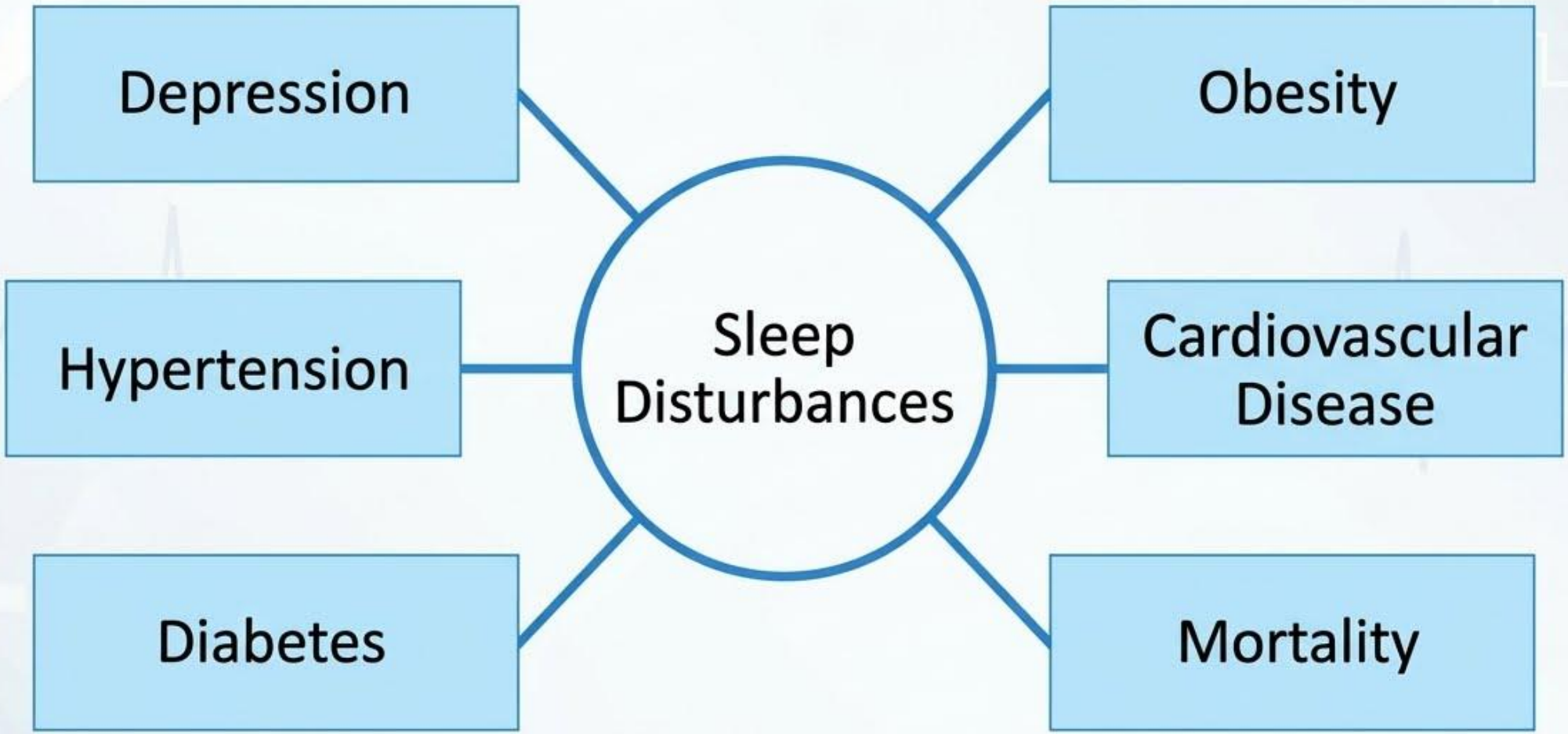
- **Up to 45%** → *Of the global population suffers from at least one sleep disorder*
- **936 Million** → *Adults (30–69 years) affected by Obstructive Sleep Apnea (OSA)*
- **1 in 6 Adults** → *Affected by chronic Insomnia or Sleep-Movement Disorders (like RLS)*

Paucity of sleep duration data across the globe (From: Diane C Lim et al. Lancet 2023)



From: Baranowski M, et al. Eur J Pub Health 2023
Varghese NE, et al. Sci Rep.2020

Clinical Significance of Sleep Disturbances



Fasokun et al., 2026; Li et al., 2024; Diabetes Care, 2024; Alruwaili et al., 2026; Am J Ind Med, 2026

Socio-Economic Burden of Sleep Disorders in Europe

Total Economic Impact

Nearly **€423 Billion** annually across high-income European countries, equating to a 3% taxation on collective Gross Domestic Product (GDP)—the total monetary value of all goods and services produced within a nation.

Cost Distribution

Financed almost equally between **Direct Healthcare Costs** (48%), such as medical visits and treatments, and **Indirect Costs** (52%), heavily driven by lost workplace productivity, absenteism, and accidents.

Bassetti et al., Eur J Neurol, 2026; European Sleep Foundation Report, 2026

Balneotherapy and Sleep: What Does the Scientific Literature Say?

healthcare 2026 MDPI

Article

Short-Term Sulfurous Balneotherapy and Self-Reported Sleep Quality: An Exploratory Retrospective Real-World Pre–Post Observational Study at Terme di Saturnia (Italy)

Elisabetta Ferrara [1,*], Manela Scaramuzzino [2], Giuseppe Balice [3], Giovanna Murmura [3,†] and Bruna Sinjari [3,†]

Journal of *Clinical Medicine* 2026 MDPI

Article

Digital Cognitive Behavioural Therapy for Insomnia Delivered Within a Crenotherapy Setting: Results from a Multicentre Proof-of-Concept Randomised Controlled Trial

Julie Lenoir [1,2,*], Marie Mengarduque [1], Julien Coelho [1,2,3], Pierre-Alexis Geoffroy [4,5], Émilie Denéchère [1],

International Journal of Biometeorology (2026) 70:211
https://doi.org/10.1007/s00484-026-03273-7

ORIGINAL PAPER

Short-term hot spring balneotherapy ameliorates sleep disorders: wrist-worn wearable-assessed sleep improvement associated with neuroimmune, tryptophan metabolic and gut microbiome alterations

Xiao Zhang[1] · Yue Zou[2] · Xiao-qin He[1] · Yi-hang Xu[1] · Hong-xia Li[3] · Fen Yang[1] · Bao-chao Zhang[1] · Lin-xuan Liao[1] · Meng-xi Cao[1] · Rui-xue Wang[1] · Si-fan Hao[1] · Meng-meng Wang[1] · Jing Zhang[1] · Xiao-fang Pei[1]

•A Valuable & Efficient Tool: Balneotherapy may be considered an effective tool in sleep management on the basis of recent clinical trials.

•Synergistic Approaches: Balneotherapy alone, or associated with other non-pharmacological interventions such as physical exercise, significantly improves the quality of sleep.

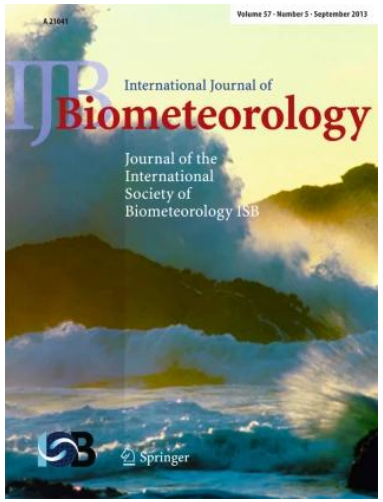
International Journal of Biometeorology
https://doi.org/10.1007/s00484-024-02626-4

SHORT COMMUNICATION

Efficacy of balneotherapy on pain, function, and sleep quality in patients with chronic low-back pain: a prospective observational study

Patrizia Manica[1] · Justina Claudatus[1] · Riccardo Pertile[2] · Alarico Ariani[3] · Antonella Fioravanti[4]

Received: 15 December 2023 / Revised: 15 December 2023 / Accepted: 15 January 2024
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OUR EXPERIENCE



Study Design: **Prospective observational**
[From May to October 2022 at Levico Terme Spa Center (Trento, Italy)]

Subjects: **Pts of both sexes, aged between 20 and 80 years with CLBP (AAPT criteria 2020)**

Treatments: **12 daily local mud packs and generalized thermal baths** ***(sulfate-arsenical ferruginous water)***

Aim: **To explore the possible effects on pain, function and sleep quality**

Outcomes

- ***Pain intensity and stiffness****: VAS score (0 to 10 cm)*
- ***Function*****:** *Schober test and Roland-Morris Disability Questionnaire (RMDQ)*
- ***Sleep Quality****:* Pittsburgh Sleep Quality Index (PSQI)

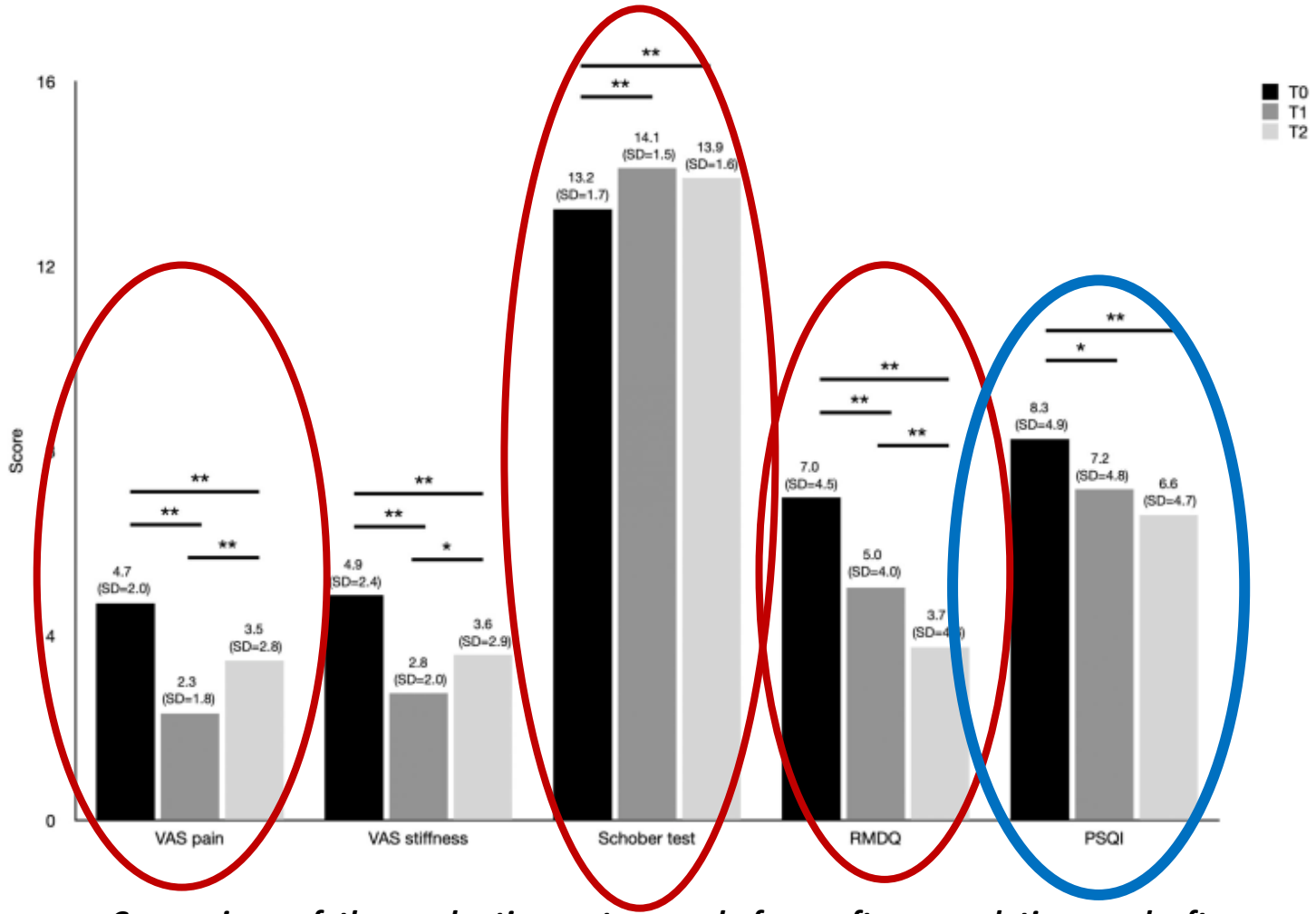
All participants were evaluated at baseline, at the end of the treatment and at 3-month follow-up

Demographic and clinical characteristics of the study population (n = 123)

Age (years) (Mean ± SD)	**62.86 ± 11.21**
Gender: Male n (%)	82 (66.7%)
Gender: Female n (%)	41 (33.3%)
BMI (kg/m^2) (Mean ± SD)	25.54 ± 4.10
Disease duration (months) (Mean ± SD)	36 ± 6.4
Employment status n (%)	
Employed	69 (56.09%)
Unemployed	7 (5.69%)
Retired	47 (38.22%)
Clinical Parameters	
VAS pain (0-10 cm) (Mean ± SD)	4.7 ± 2.0
VAS stiffness (0-10 cm) (Mean ± SD)	4.9 ± 2.4
Schober test (cm) (Mean ± SD)	13.2 ± 1.7
RMDQ (0-24) (Mean ± SD)	7.0 ± 4.5
PSQI (0-21) (Mean ± SD)	8.3 ± 4.9
Concomitant treatments n (%)	
Paracetamol	16 (13.0%)
NSAIDs	47 (38.2%)
Corticosteroids	4 (3.25%)
Opioid analgesics	1 (0.81%)
Exercise	3 (2.43%)
Massotherapy	6 (4.87%)
Myofascial massage	17 (13.82%)

Results

- Decrease of Pain
- Increase of Function
- Reduction of Pittsburgh Sleep Quality Index (PSQI)
- A significant improvement persisting up to 3 months of follow-up



*Comparison of the evaluation outcomes before, after completion, and after 3 months of balneotherapy in patients with CLBP (data are expressed as mean ± SD). RMDQ, Roland-Morris Disability Questionnaire; PSQI, Pittsburgh Sleep Quality Index. ***p < 0.0001; **p < 0.001*

Spearman correlation coefficients (p-value)

	VAS Pain	VAS stiffness	Schober test	RMDQ	PSQI
VAS Pain	1	0.598 (<0.0001)	-0.275 (<0.0001)	0.480 (<0.0001)	0.306 (<0.0001)
VAS Stiffness		1	-0.249 (<0.0001)	0.423 (<0.0001)	0.296 (<0.0001)
Schober test			1	-0.289 (<0.0001)	-0.050 (0.227)
RMDQ				1	0.374 (<0.0001)
PSQI					1

RMDQ Roland-Morris Disability Questionnaire, PSQI Pittsburgh Sleep Quality Index

Concluding Remarks

Novel Insights: Our findings provide new evidence on the clinical utility of balneotherapy for CLBP management

Sustained Efficacy: They confirm significant improvements in pain and function, both immediately post-treatment and at 3 months follow-up

Sleep Quality: For the first time, a positive effect on sleep quality was also demonstrated

Study Limitations

- ***Study Design:*** *Observational nature and lack of a control group*
- ***Confounding Factors:*** *Missing clinical and demographic data that could influence sleep quality assessment in CLBP*
- ***Outcome Gaps:*** *No evaluations on QoL or symptomatic medication consumption*

How can Balneotherapy work?

Thermoregulation & Analgesia

- Thermoregulation
- Analgesic and antispastic effects
- Blockade of peripheral pain inputs

Neuroendocrine Factors

- Cortisol and serotonin modulation
- Beta-endorphin regulation
- Tryptophan pathway

Systemic Cross-Talk

- Gut microbiota modulation
- Reduction of pro-inflammatory IL-6
- Increase of anti-inflammatory IL-10

Heffner et al. 2011; Cheleschi et al. 2022; Castelli et al. 2022; Silva et al. 2023; Gálvez et al. 2024; Zhang 2026

Take-Home Messages

- Sleep disorders represent an enormous burden for both individuals and society.
- BT represents a valid therapeutic option, especially when combined with other pharmacological and non-pharmacological treatments.
- Focusing on sleep is a novel challenge for researchers and a unique opportunity for spa managers.


Thank you for your time
and
your attention