# *Balneotherapy and osteoarthritis: new evidence for an old therapy*


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*President of OMTh (Organisation Mondiale du Thermalisme)*


**THE 73° GENERAL ASSEMBLY**
**AND**
**INTERNATIONAL SCIENTIFIC CONGRESS**
**OF THE WORLD FEDERATION OF HYDROTHERAPY AND CLIMATOTHERAPY**
**(FEMTEC)**

**CASTEL SAN PIETRO TERME (Bologna, ITALIA)**
**3–6 Novembre 2022**

FEMTEC

85 YEARS
FEMTEC JUBILEE
1937-2022

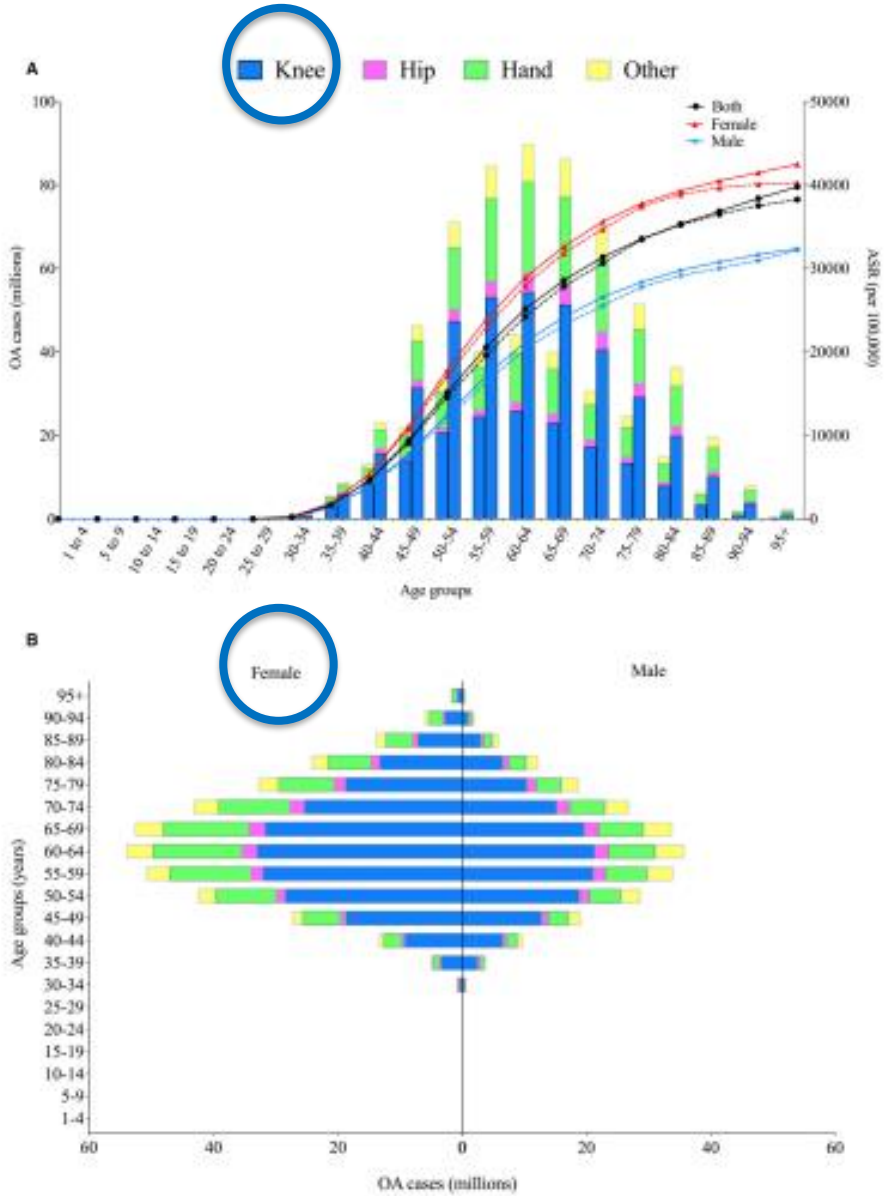
# *Osteoarthritis : an emerging public health problem*

*Globally, prevalent cases of OA increased by 113.25%, from 247.51 million in 1990 to 527.81 million in 2019*

*Globally, of the 369 diseases and injuries in the GBD Study 2019, OA ranked 17th highest in terms of prevalent cases*

*Global trends showed a 114.5% increase in years lived (YLD) with disability due to OA from 1990 to 2019*

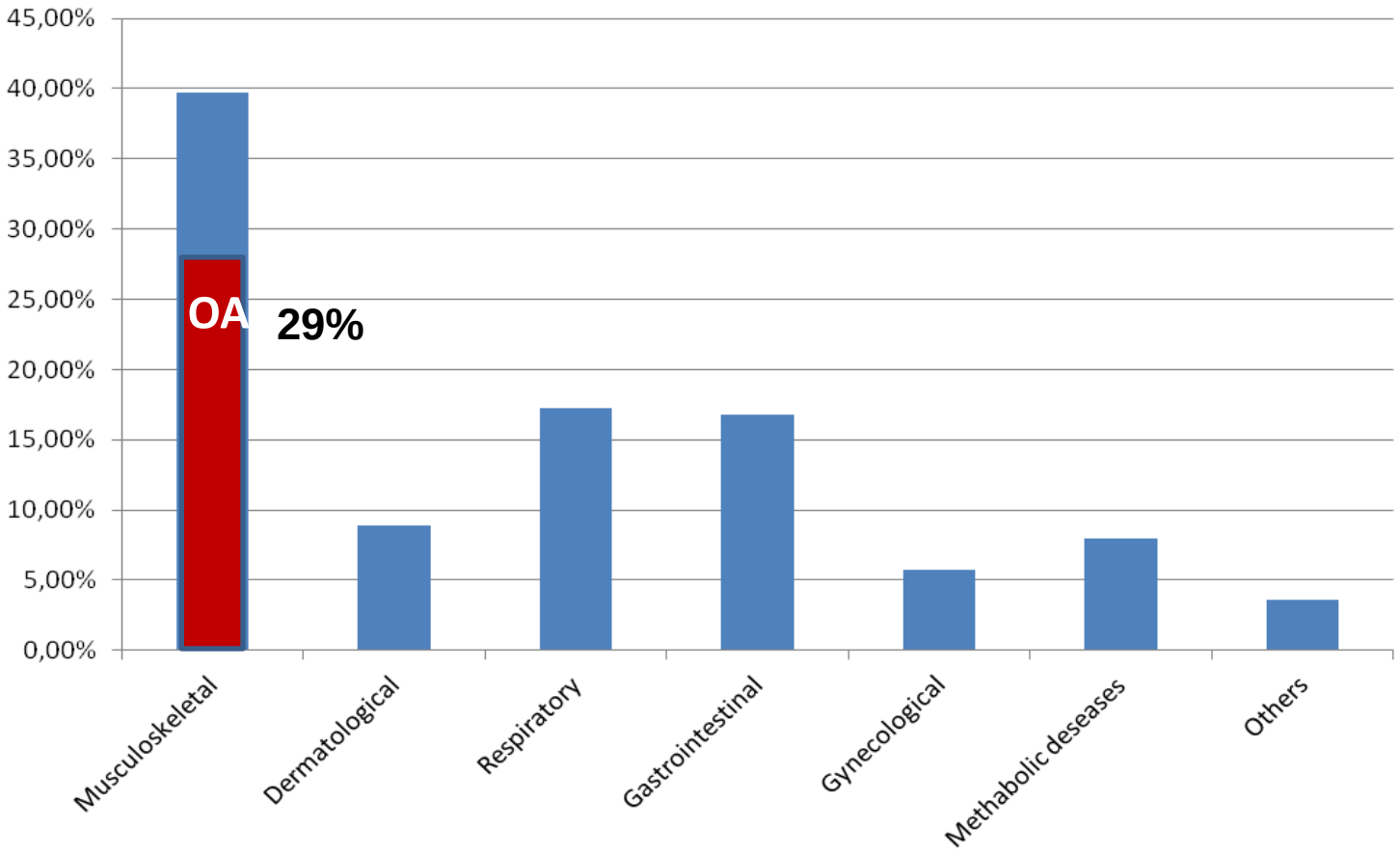
*From Long et al. Arthritis Rheumatol. 2022*




Global total number of prevalent OA cases and number of prevalent OA cases according to the affected joint, by sex and age group. A, Global number of prevalent OA cases and age-standardized prevalence rate (ASR) by sex and age group. For each age group, the left column shows data for prevalent cases in 1990 and the right column shows data for prevalent cases in 2019.

# *Balneotherapy for Osteoarthritis*

*Balneotherapy (BT) is one of the most commonly used non-pharmacological approaches for OA in clinical practice in many European and Middle Eastern countries, as well as in Turkey, Japan and Israel*




HydroGlobe

**HydroGlobe**
**Definition of a global framework for hydrotherapy**

A FEMTEC – FoRST joint project
with the cooperation of ISMH and the support of WHO

FEMTEC FoRST

**ESSENTIALS FROM THE FINAL REPORT**

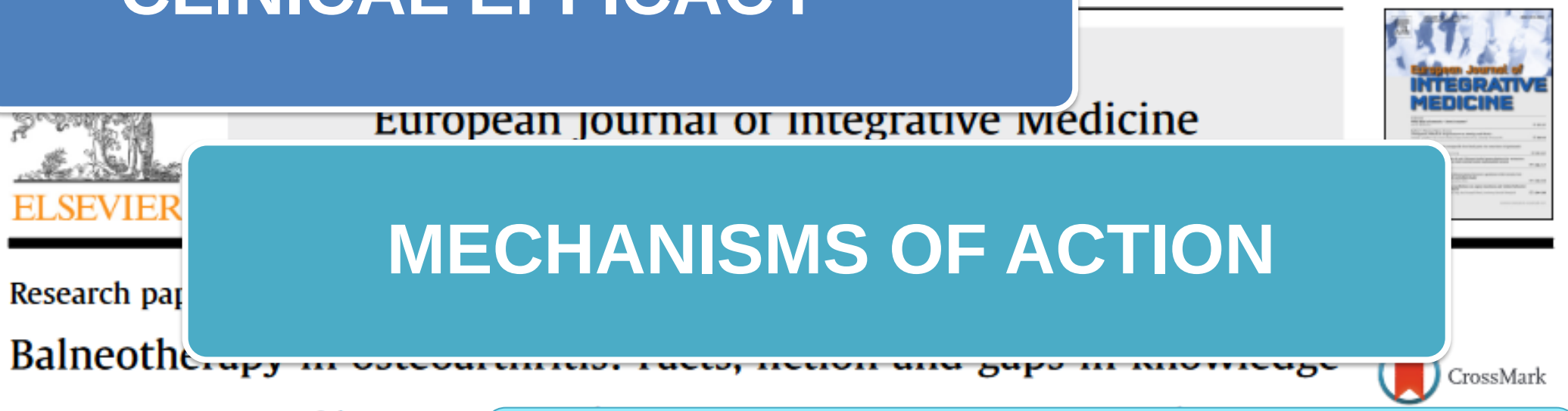
**Edited March 2013**

# *Balneotherapy for Osteoarthritis: Myth or Reality??*

**CLINICAL EFFICACY**

**MECHANISMS OF ACTION**

**COST/EFFECTIVENESS**



# *Balneotherapy for Osteoarthritis: Clinical Efficacy*

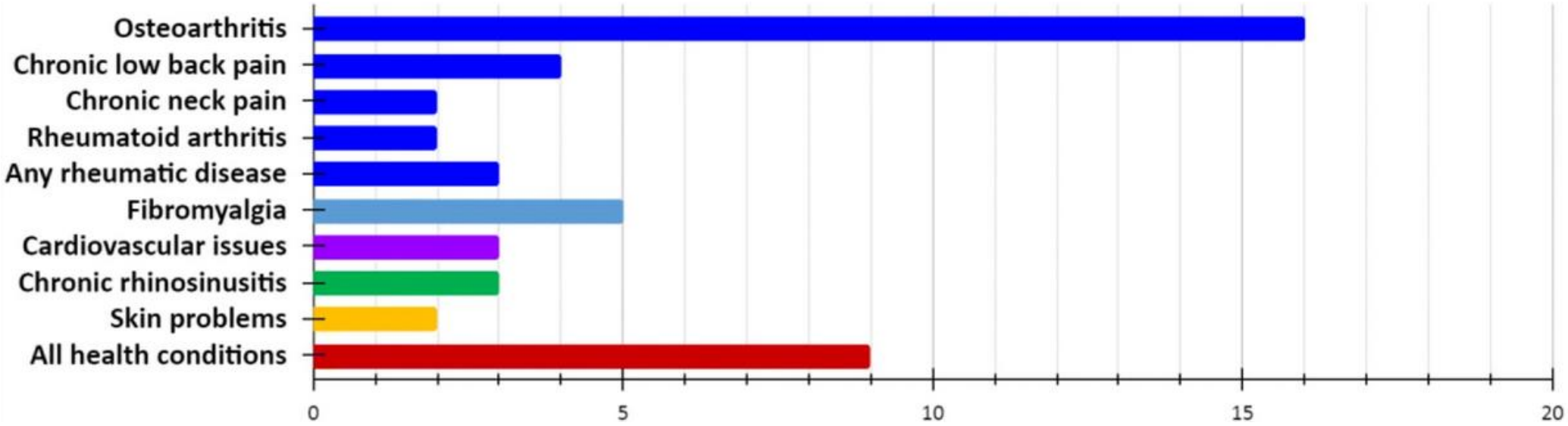
International Journal of Biometeorology (2021) 65:1597–1614
https://doi.org/10.1007/s00484-021-02133-w

REVIEW PAPER

## Clinical efficacy of medical hydrology: an umbrella review

Michele Antonelli[1] · Davide Donelli[1] · Licia Veronesi[2] · Marco Vitale[2,3] · Cesira Pasquarella[2]

Received: 28 December 2020 / Revised: 7 April 2021 / Accepted: 10 April 2021 / Published online: 17 April 2021


Number of included reviews for each health condition

Clin Ter 2021; 172 (4):372-387 doi: 10.7417/CT.2021.2343

# A meta-analysis of the effectiveness of mud-bath therapy on knee osteoarthritis

G. Mennuni[1], M. Fontana[1], C. Perricone[2], S. Nocchi[1], R. Rosso[1], F. Ceccarelli[3], A. Fraioli[1]

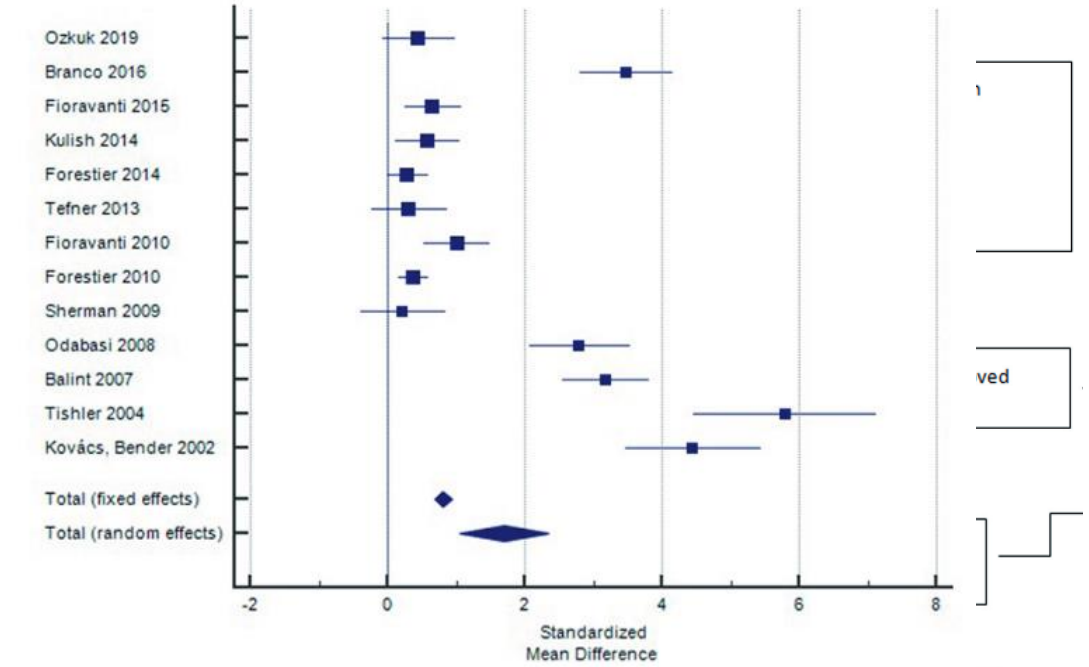



Fig. 3. Improvement of WOMAC scores at T0 and at T last follow-up in different studies




Fig.1 Flow chart of systematic search, screening and selection process

***The improvement for both outcomes was mantained until 9 months into follow-up period***

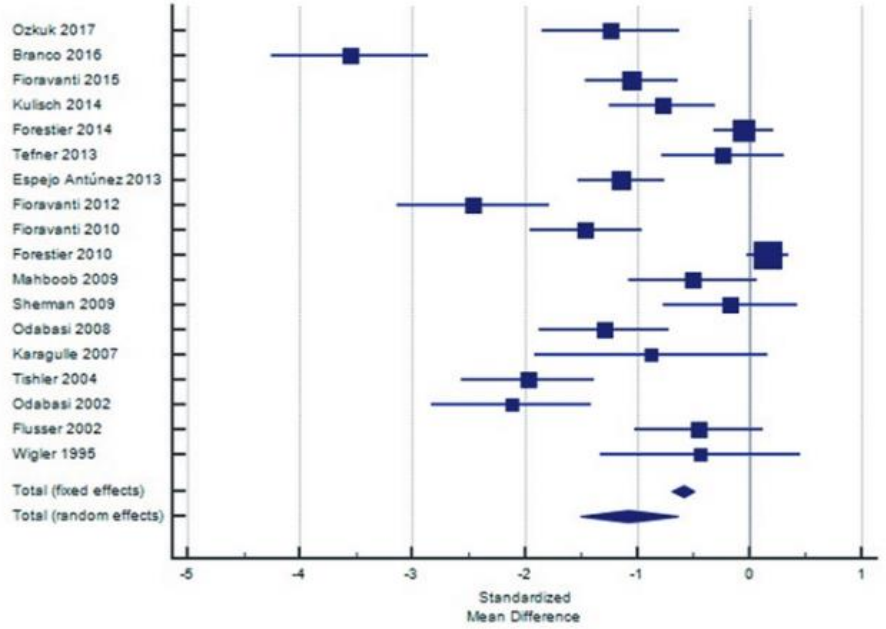



Fig. 4. Improvement of VAS pain at the last end point of the studies compared to controls

# Balneotherapy for Osteoarthritis: Publication Bias of Clinical Studies

## Poor methodological quality

- Inadequate sample size
- High heterogeneity of clinical and demographic characteristics of the population studied
- High heterogeneity of the treatment modalities
- Different outcomes measure
- Different follow-up timing
- Inadequate statistical analysis
- Rarity of double blind studies
- Poor quality of data presentation

Clin Rheumatol (2017) 36:1839–1847
DOI 10.1007/s10067-017-3592-y

ORIGINAL ARTICLE

**The effect of balneotherapy on pain relief, stiffness, and physical function in patients with osteoarthritis of the knee: a meta-analysis**

Hiromi Matsumoto[1] · Hiroshi Hagino[1,2] · Kunihiko Hayashi[3] · Yuki Ideno[4] · Takashi Wada[1] · Toru Ogata[5] · Masami Akai[6] · Atsushi Seichi[7] · Tsutomu Iwaya[8]

Systematic Review and Meta-Analysis 2021 Medicine
OPEN

**The effect of thermal mineral waters on pain relief, physical function and quality of life in patients with osteoarthritis**

**A systematic review and meta-analysis**

Tianwen Ma, PhD[a], Xiaopeng Song, PhD[a], Yuanqiang Ma, PhD[b], Hailong Hu, MS[a], Hui Bai, PhD[a], Yue Li, PhD[a], Li Gao, PhD[a,*]

International Journal of Biometeorology (2021) 65:1255–1271
https://doi.org/10.1007/s00484-021-02102-3

REVIEW PAPER

**The efficacy of balneotherapy, mud therapy and spa therapy in patients with osteoarthritis: an overview of reviews**

Daniela D'Angelo[1] · Daniela Coclite[1] · Antonello Napoletano[1] · Alice Josephine Fauci[1] · Roberto Latina[1] · Silvia Gianola[2] · Greta Castellini[2] · Katia Salomone[1] · Francesca Gambalunga[3] · Francesca Sperati[4] · Laura Iacorossi[1] · Primiano Iannone[1]

Rheumatol Int (2011) 31:1–8
DOI 10.1007/s00296-010-1628-6

REVIEW ARTICLE

# Mechanisms of action of spa therapies in rheumatic diseases: what scientific evidence is there?

Antonella Fioravanti · Luca Cantarini · Giacomo Maria Guidelli · Mauro Galeazzi

Environmental Science and Pollution Research (2022) 29:8054–8073
https://doi.org/10.1007/s11356-021-17780-0

REVIEW ARTICLE

Check for updates

# Balneotherapy year in review 2021: focus on the mechanisms of action of balneotherapy in rheumatic diseases

Sara Cheleschi[1] · Sara Tenti[1] · Iole Seccafico[1] · Isabel Gálvez[2,3] · Antonella Fioravanti[1] · Eduardo Ortega[2,4]

- *The me… / understt…*
- *It is diff… h …*
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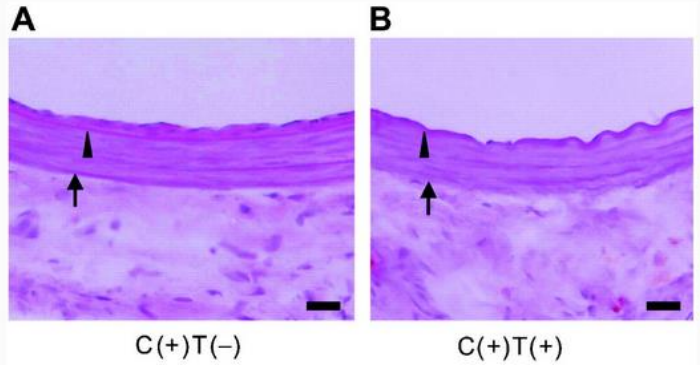
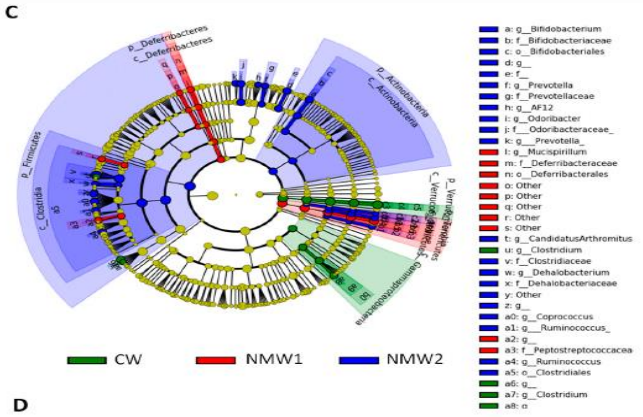
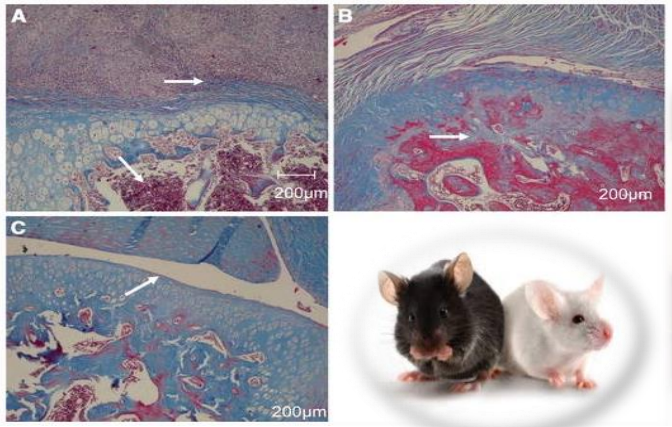
*The … n … bably the resu… en … cal factors*




Journal of Neuroimmunology 348 (2020) 577360

Contents lists available at ScienceDirect

Journal of Neuroimmunology

journal homepage: www.elsevier.com/locate/jneuroim

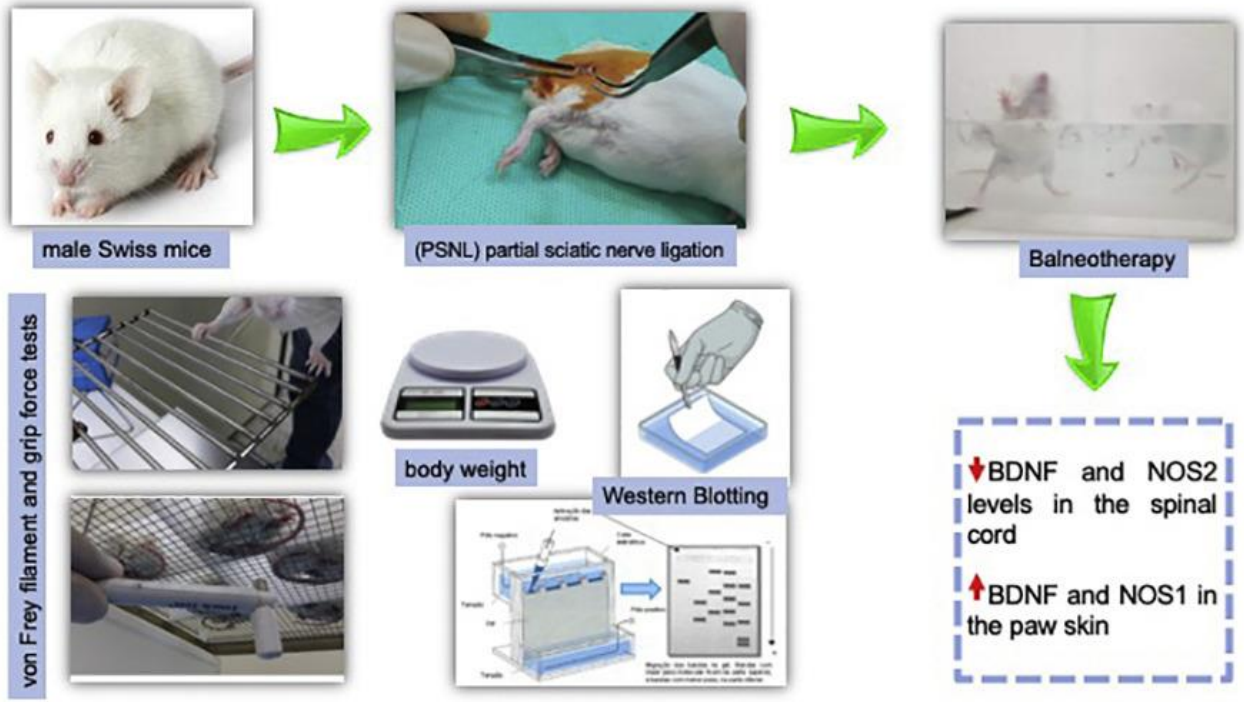
# Balneotherapy decreases mechanical hyperalgesia by reversing BDNF and NOS2 immunocontent in spinal cord of mice with neuropathic pain

Rômulo Nolasco de Brito[a,b], Daniela D. Ludtke[a,b], Bruna Hoffmann de Oliveira[a,b], Taynah de Oliveira Galassi[a,b], Paula Franson Fernandes[a,b], Sarah Van Den Berge[a], Afonso Shiguemi Inoue Salgado[a,b,c], Francisco José Cidral-Filho[a,b], Verônica Vargas Horewicz[a,b], Franciane Bobinski[a,b], Daniel Fernandes Martins[a,b,*]

[a] Experimental Neuroscience Laboratory (LaNEx), Universidade do Sul de Santa Catarina, Palhoça, Santa Catarina, Brazil
[b] Postgraduate Program in Health Sciences, Universidade do Sul de Santa Catarina, Palhoça, Santa Catarina, Brazil
[c] Integrative Physical therapy Residency, Centro Universitário Filadélfia, Londrina, Paraná, Brazil

## Abstract

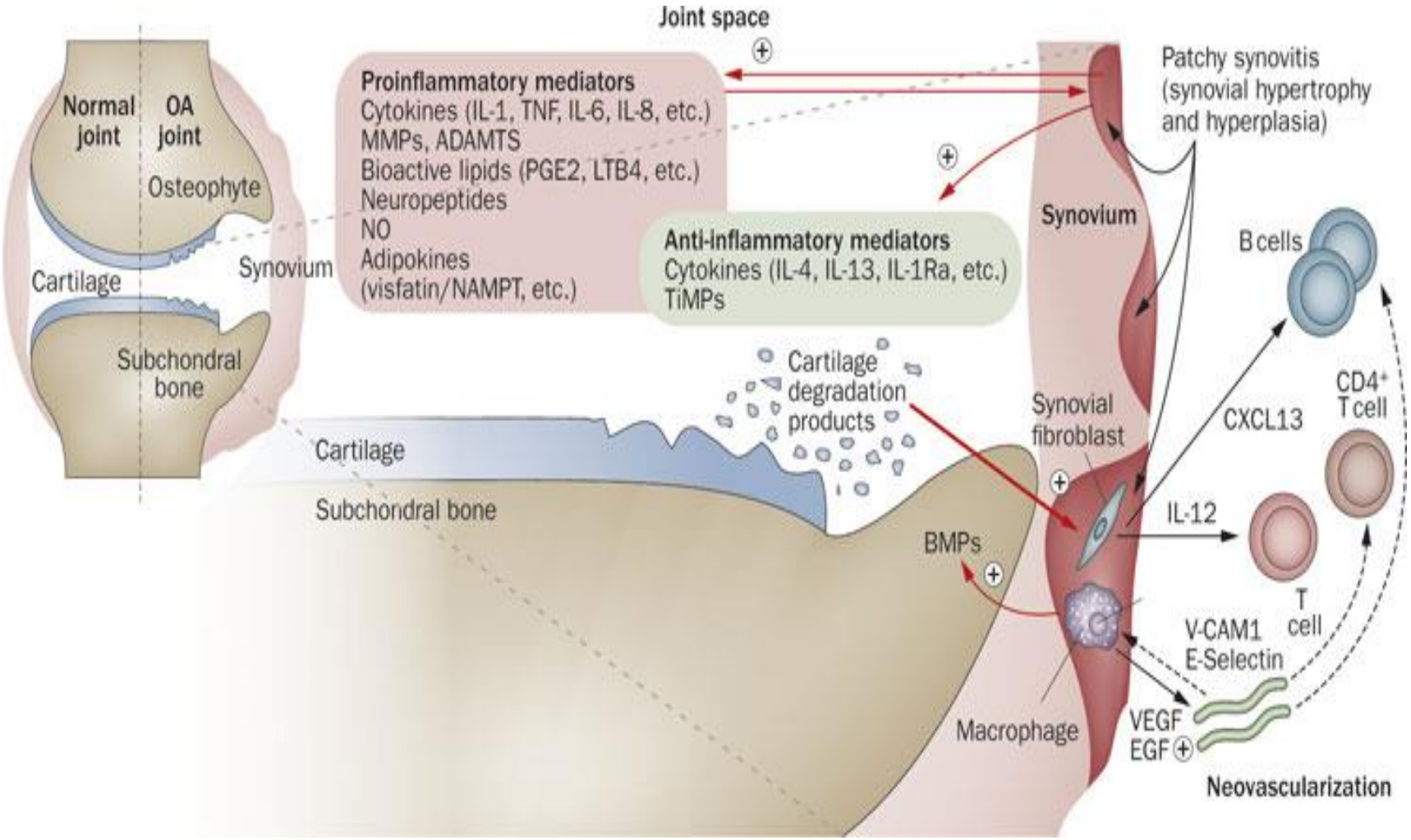
In the last decades, balneotherapy or thermalism has been used for health promotion and in the treatment of inflammatory and chronic processes. We found that balneotherapy reduced mechanical hyperalgesia, as well the increase of BDNF and NOS2 levels in the spinal cord, while increased BDNF and NOS1 in the paw. The data presented herein demonstrated for the first time in a murine model of neuropathic pain, the analgesic effect of balneotherapy with the water from the natural springs of Santo Amaro da Imperatriz-Brazil. Nevertheless, future clinical trials should be conducted to test the effectiveness of balneotherapy in neuropathic pain patients.




Balneotherapy decreases mechanical hyperalgesia by reversing BDNF and NOS2 immunocontent in spinal cord of mice with neuropathic pain

*Brain-derived neurotrophic factor (BDNF)*
*NOS1 (neuronal NOS, nNOS)*
*NOS2 (inducible NOS,iNOS)*

# *Balneotherapy and Mediators of Osteoarthritis Pathogenesis*




*From: Sellam, J. & Berenbaum, F. (2010) Nat. Rev. Rheumatol. doi:10.1038/nrrheum.2010.159*

# *Balneotherapy and Pro-inflammatory Cytokines*

Int J Biometeorol (2017) 61:1777–1785
DOI 10.1007/s00484-017-1361-x

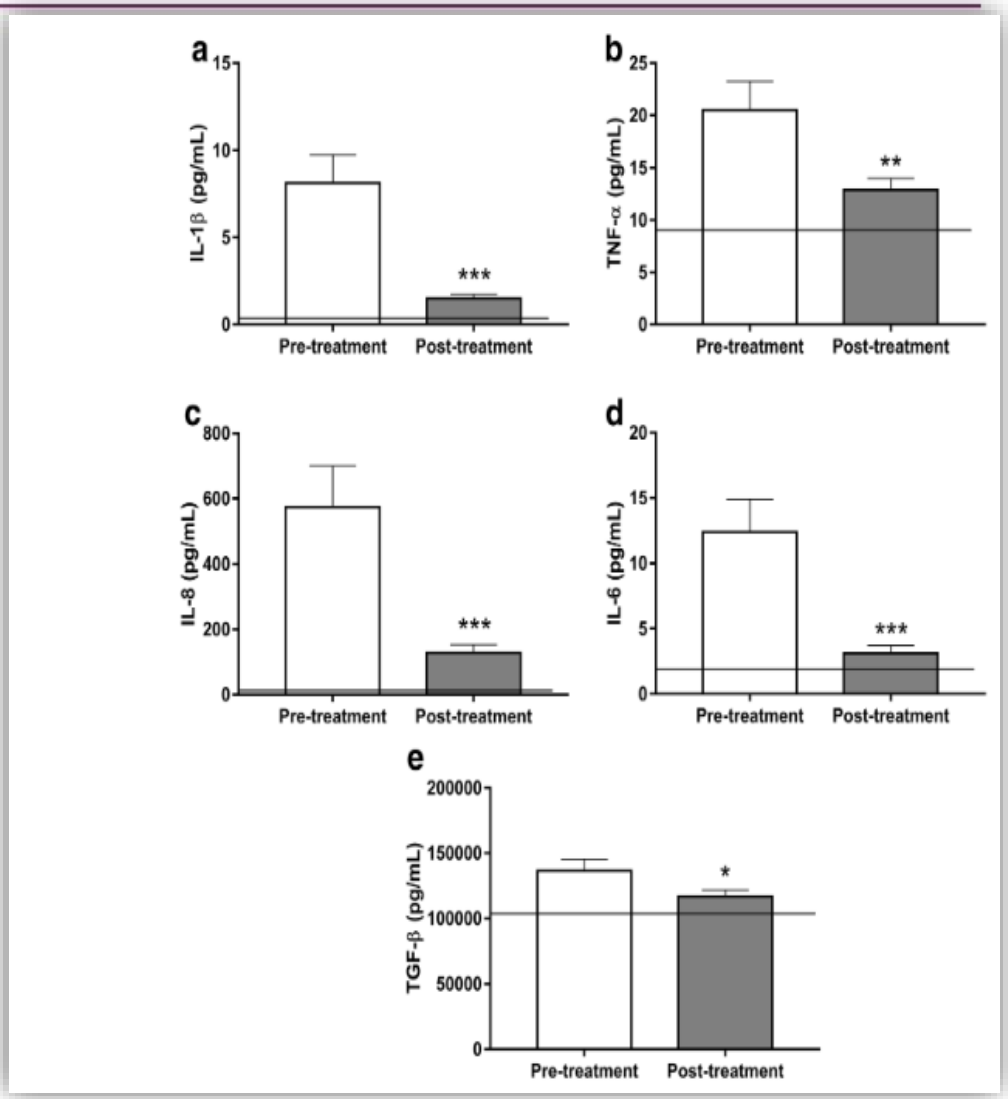
CrossMark

ORIGINAL PAPER

**Anti-inflammatory effect as a mechanism of effectiveness underlying the clinical benefits of pelotherapy in osteoarthritis patients: regulation of the altered inflammatory and stress feedback response**

E. Ortega[1] · I. Gálvez[1] · M. D. Hinchado[1] · J. Guerrero[2] · L. Martín-Cordero[3] · S. Torres-Piles[4]

***Significant reduction of serum levels of IL-1β, TNF-α, IL-6, IL-8 and TGF-β after ten days of mud-baths in patients with osteoarthritis***




** p<0.05; ** p<0.01; *** p<0.001*

# Balneotherapy and Adipokines

Rheumatol Int (2011) 31:879–882
DOI 10.1007/s00296-010-1401-x

ORIGINAL ARTICLE

## Effects of Spa therapy on serum leptin and adiponectin levels in patients with knee osteoarthritis

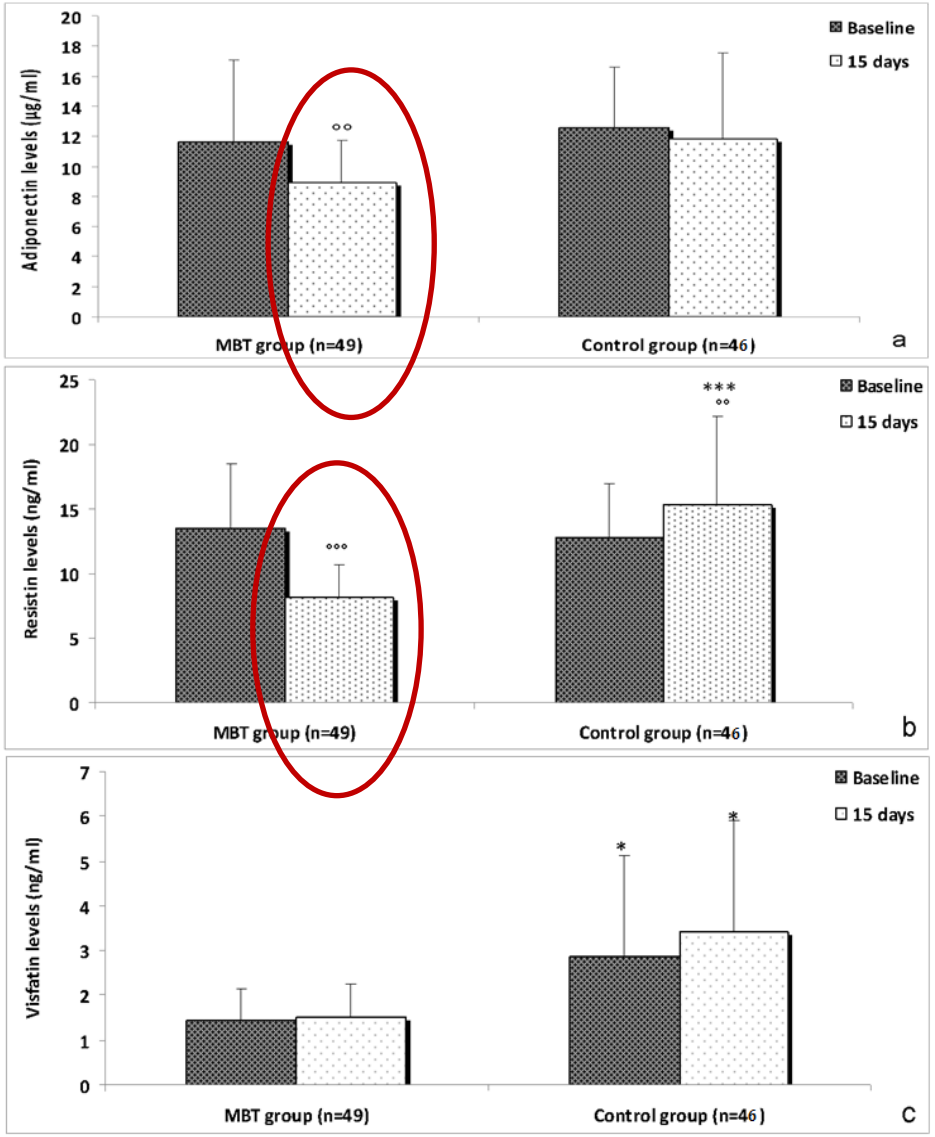
Antonella Fioravanti · Luca Cantarini · Maria Romana Bacarelli · Arianna de Lalla · Linda Ceccatelli · Patrizia Blardi

Int J Biometeorol (2015) 59:1691–1700
DOI 10.1007/s00484-015-0977-y

ORIGINAL PAPER

## Circulating levels of adiponectin, resistin, and visfatin after mud-bath therapy in patients with bilateral knee osteoarthritis

Antonella Fioravanti · Chiara Giannitti · Sara Cheleschi · Antonella Simpatico · Nicola Antonio Pascarelli · Mauro Galeazzi




*Changes in serum adiponectin (a), resistin (b) and visfatin (c) in MBT group and in Control group at basal time and at the end of the study (15 days). Data are expressed as mean ±SD*

*Significance within groups: °°°p<0.0001 °°p<0.001*

*Significance between groups: ***p<0.0001; *P<0.05*

Int J Biometeorol (2017) 61:2153–2158
DOI 10.1007/s00484-017-1420-3

ORIGINAL PAPER

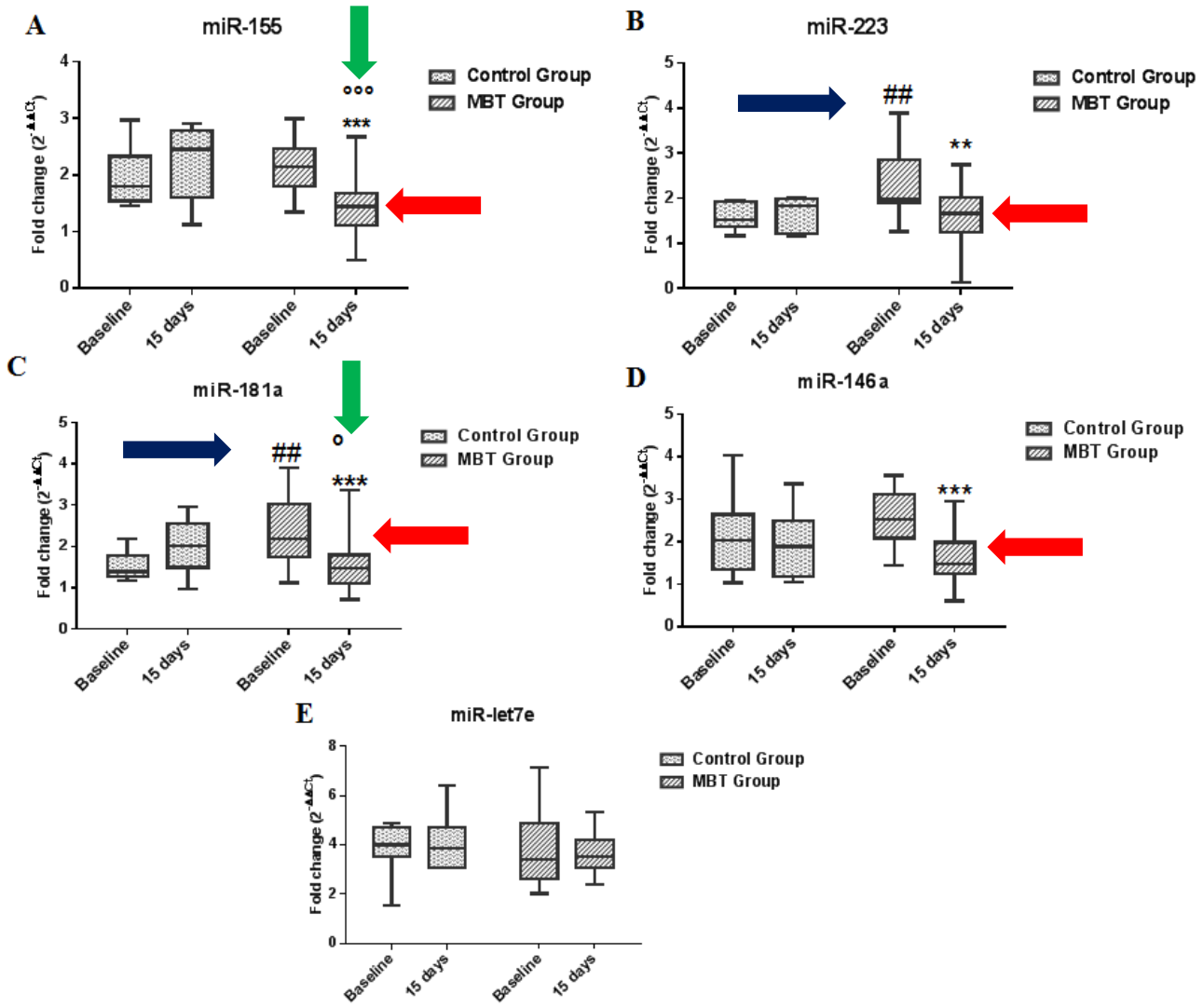
# Can balneotherapy modify microRNA expression levels in osteoarthritis? A comparative study in patients with knee osteoarthritis

C. Giannitti[1] · A. De Palma[1,2] · N. A. Pascarelli[1] · S. Cheleschi[1,2] · N. Giordano[3] · M. Galeazzi[1] · Antonella Fioravanti[1,4]

## *RESULTS:*

*Significant reduction of a pattern of microRNA, mainly involved in the pathogenesis of OA involved in the pathogenesis of osteoarthritis in the mud bath group at the end of the therapy (red arrow)*

## *Expression levels of microRNA evaluated by real time PCR*




*** p< 0.01, *** p< 0.001 MBT Group 15 days vs MBT Group baseline*
*° p< 0.05, °°° p< 0.001 MBT 15 days vs Control Group 15 days*
*## p< 0.01 MBT Group Baseline vs Control Group Baseline*

# *Balneotherapy: Effects on Cartilage, Bone and Synovial cells*

Received: 24 June 2020 | Revised: 26 September 2020 | Accepted: 29 October 2020
DOI: 10.1002/jcp.30154

ORIGINAL RESEARCH ARTICLE

Journal of Cellular Physiology WILEY

## Hydrogen sulfide protects against IL-1β-induced inflammation and mitochondrial dysfunction-related apoptosis in chondrocytes and ameliorates osteoarthritis

Ben Wang[1,2,3] | Zhenxuan Shao[1,2] | Mingbao Gu[1,2] | Libin Ni[1,2] | Yifeng Shi[1,2] | Yingzhao Yan[4] | Aimin Wu[1,2] | Haiming Jin[1,2] | Jiaoxiang Chen[1,2] | Xiaoyun Pan[1,2] | Daoliang Xu[1,2]

Nitric Oxide 70 (2017) 42–50

Contents lists available at ScienceDirect

Nitric Oxide

journal homepage: www.elsevier.com/locate/yniox

## Long-term effects of hydrogen sulfide on the anabolic-catabolic balance of articular cartilage *in vitro*

Á. Vela-Anero [a, b], T. Hermida-Gómez [b, c], L. Gato-Calvo [c], C. Vaamonde-García [a], S. Díaz-Prado [a, b], R. Meijide-Faílde [a], F.J. Blanco [c], E.F. Burguera [b, c, *]

Biomedicine & Pharmacotherapy 129 (2020) 110344

Contents lists available at ScienceDirect

Biomedicine & Pharmacotherapy

journal homepage: www.elsevier.com/locate/biopha

## Sulfurous thermal waters stimulate the osteogenic differentiation of human mesenchymal stromal cells – An *in vitro* study

Laura Gambari[a], Brunella Grigolo[a], Giuseppe Filardo[b], Francesco Grassi[a,*]

Cell Biology International

Cell Biol. Int. (2010) 34, 477–484 (Printed in Great Britain)

Research Article

## $H_2S$ transiently blocks IL-6 expression in rheumatoid arthritic fibroblast-like synoviocytes and deactivates p44/42 mitogen-activated protein kinase

**Burkhard Kloesch[1], Melissa Liszt and Johann Broell**
Ludwig Boltzmann Institute for Rheumatology and Balneology, Kurbadstrasse 14, 1100 Vienna, Austria

International Journal of
*Molecular Sciences*

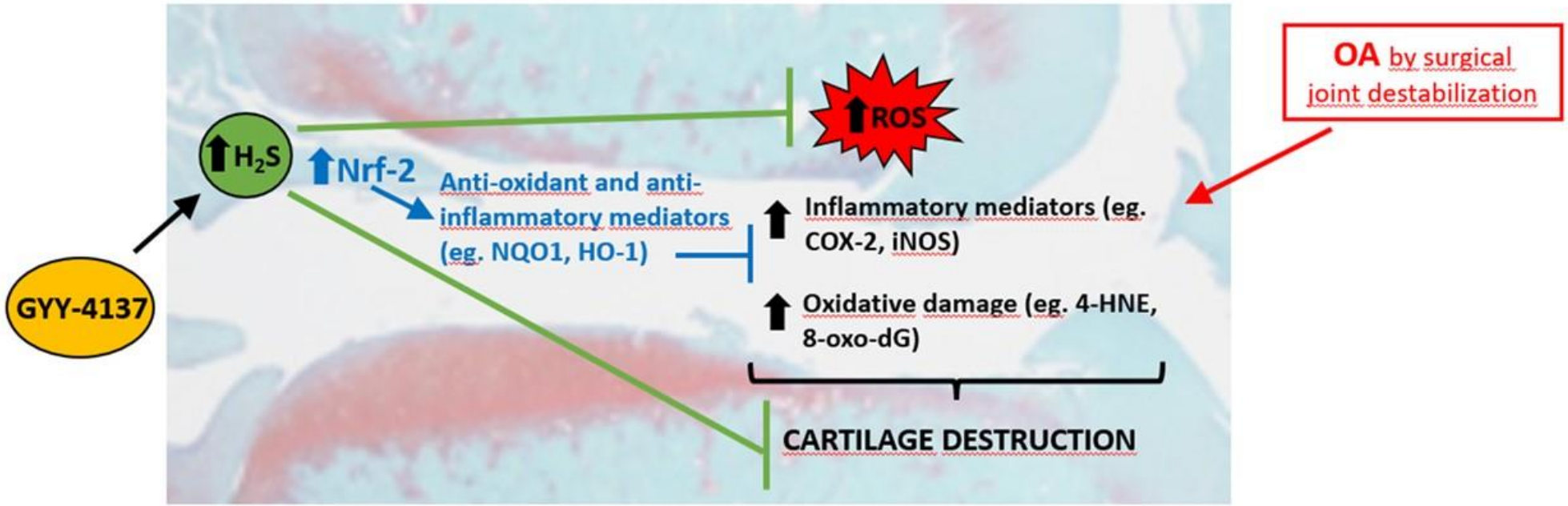
MDPI

2020

*Article*

# Intraarticular Administration Effect of Hydrogen Sulfide on an In Vivo Rat Model of Osteoarthritis

Carlos Vaamonde-García [1,2,†], Elena F. Burguera [2,3,†], Ángela Vela-Anero [1], Tamara Hermida-Gómez [2,3], Purificación Filgueira-Fernández [2,3], Jennifer A. Fernández-Rodríguez [4], Rosa Meijide-Faílde [1,*] and Francisco J. Blanco [2,5,*]



Arthritis Care & Research
Vol. 69, No. 7, July 2017, pp 966–972
DOI 10.1002/acr.23116


ORIGINAL ARTICLE

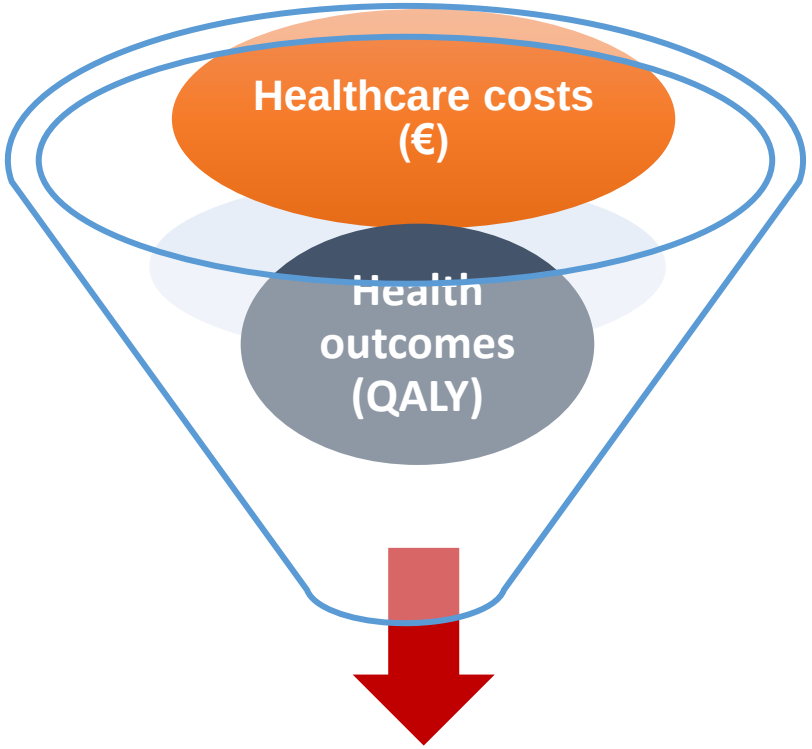
# Mud-Bath Therapy in Addition to Usual Care in Bilateral Knee Osteoarthritis: An Economic Evaluation Alongside a Randomized Controlled Trial

ORIANA CIANI,[1] NICOLA ANTONIO PASCARELLI,[2] CHIARA GIANNITTI,[2] MAURO GALEAZZI,[3] MICHELA MEREGAGLIA,[4] GIOVANNI FATTORE,[4] AND ANTONELLA FIORAVANTI[2]

Bocconi
Università Commerciale
Luigi Bocconi

## Objectives

*To evaluate **direct healthcare costs for patients and** to perform a **cost-effectiveness analysis** of mud-bath therapy (MBT) in addition to usual treatment compared to usual treatment alone in patients with bilateral knee osteoarthritis (OA)* **at 12 months follow-up**



# *Average Cost per Patient (€)*

| Assessment | V1 | V3 | V6 | V9 | V12 | V13 | V14 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Time | Baseline | 1 m | 4 m | 7 m | 10 m | 11 m | 12 m | |
| MBT [53] (m ± SD) | 8.3 (7.20) | 17.6 (62.42) | 12.3 (40.13) | 8.1 (20.05) | 10.1 (29.56) | 17.7 (55.06) | 12.3 (38.49) | 168.4 (223.14) |
| MBT | | | | | | | | 134.4 |
| Total | 8.3 | 17.6 | 12.3 | 8.1 | 10.1 | 17.7 | 12.3 | 302.8 |
| Control [50] (m ± SD) | 5.8 (7.86) | 88.1 (133.1) | 57.6 (79.39) | 74.0 (113.88) | 32.6 (34.87) | 70.7 (251.41) | 75.6 (109.55) | 975.0 (740.10) |

*Difference in MEAN COST per patient between the two groups was* ***€ 672*** *!!!!!*

# *Balneotherapy for Osteoarthritis: Key Points*

*Recent pre-clinical and clinical studies investigating the mechanism*

***OPEN QUESTION***

***What is the position of the International Guidelines for the management of OA about Balneotherapy?***

*d*

*The rare studies on cost/effectiveness analysis shows a favorable economic profile*

# *Recommendations taken from ACR, EULAR, AAOS and OARSI Guidelines for the Management of OA*

| Recommendation | ACR | | EULAR | | AAOS | | OARSI | |
|---|---|---|---|---|---|---|---|---|
| | Knee | Hip | Knee | Hip | Knee | Hip | Knee | Hip |
| **Non-Pharmacological Treatments** | | | | | | | | |
| **Weight Loss** recommended for individuals who are overweight or obese | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | | 🟢 | 🟡 |
| **Self-Management/Education Programs** which may include goal setting, skill building, education about exercise and medication | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | | 🟢 | 🟢 |
| **Physical exercise** Can include aerobic exercise, strengthening, neuromuscular training, isometric exercises; a combination of these exercises is advised. | 🟢 | 🟢 | 🟢 | 🟢 | 🟢 | | 🟢 | 🟢 |
| **Balance Training** | 🟡 | 🟡 | | | | | 🟢 | 🟢 |
| **Yoga** | 🟡 | | | | | | 🟢 | 🟢 |
| **Tai Chi** | 🟢 | 🟢 | | | | | 🟢 | 🟢 |
| **Cognitive Behavioral Therapy** | 🟡 | 🟡 | | | | | | 🔴 |
| **Acupuncture** | 🟡 | 🟡 | | | 🔴 | | 🔴 | 🔴 |
| **Transcutaneous Electrical Nerve Stimulation (TENS)** | 🔴 | 🔴 | | | 🟣 | | | |

| LEGEND | |
|---|---|
| 🟢 | Strongly recommended |
| 🟡 | Conditionally recommended |
| 🔴 | Conditionally recommended against |
| 🔴 | Strongly recommended against |
| 🟣 | Inconclusive |

*From Katz JN et al. JAMA 2021*

*Now….*

*It’s the time to work hard and TOGETHER!!!!!*

***Thank you for your time***

***and***

***Your attention !!!***