Unravelling Assessment of Musculoskeletal Disorders by Integrating Epidemiology, Neuroscience of Pain and Bio-Psychosocial Model

Dottorato IAMED
Coordinatore: Prof. Domenico Russo

PhD candidate: Paolo Pedersini

Supervisor:

- Prof. Massimiliano Gobbo

UNIVERSITÀ DEGLI STUDI DI BRESCIA

Fondazione Don Carlo Gnocchi Onlus

Introduction

Musculoskeletal disorders: «This aggregate cause incorporates death and, mostly, disability resulting from rheumatoid arthritis, osteoarthritis, low back pain, neck pain, gout, and a large residual category of other musculoskeletal disorders.»

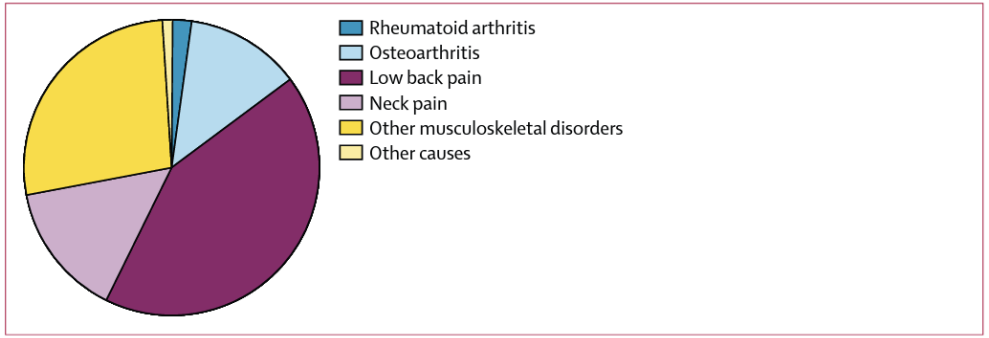


Figure 1: Composition of DALYs by constituent Level 3 causes for both sexes combined, 2019

	Deaths	YLLs	YLDs	DALYs
1990	19th	20th	1st	12th
2010	19th	19th	1st	7th
2019	19th	19th	1st	6th

Table 3: Rank among Level 2 causes for global deaths, YLLs, YLDs, and DALYs in 1990, 2010, and 2019, for both sexes combined

› Lancet. 2021 Dec 19;396(10267):2006-2017. doi: 10.1016/S0140-6736(20)32340-0. Epub 2020 Dec 1.

Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019

Alarcos Cieza [1], Kate Causey [2], Kaloyan Kamenov [3], Sarah Wulf Hanson [2], Somnath Chatterji [4], Theo Vos [2]

Affiliations + expand

PMID: 33275908 PMCID: PMC7811204 DOI: 10.1016/S0140-6736(20)32340-0

WHO is responding to the burden attributed to musculoskeletal conditions through Rehabilitation 2030 initiative

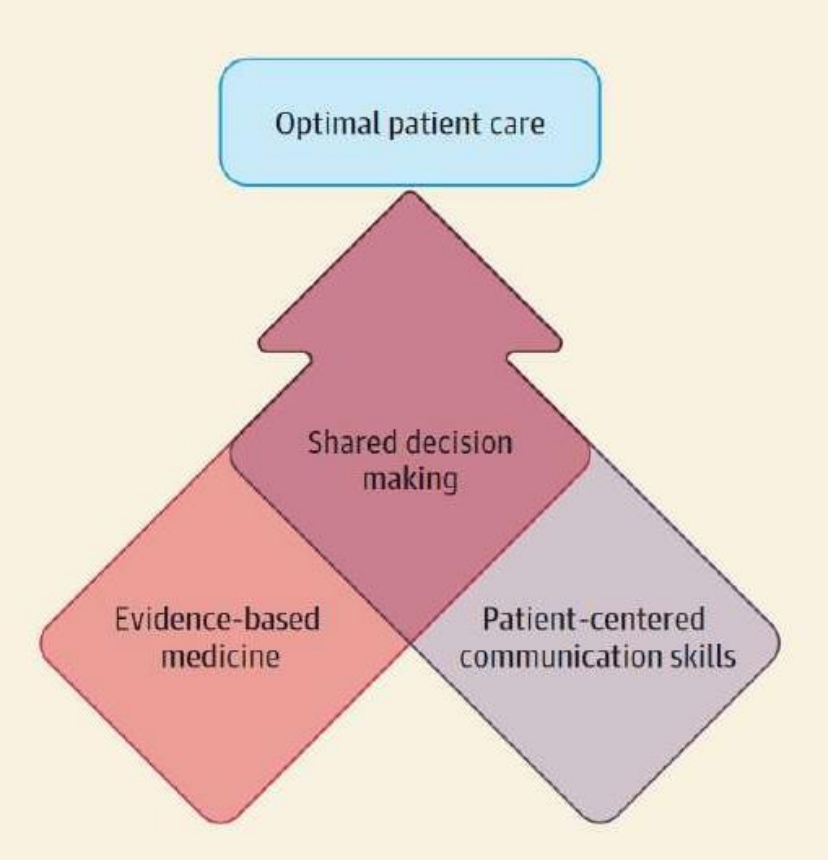
REHABILITATION 2030
a call for action

The Value of good data

To improve global health, researchers and policymakers need a comprehensive picture of what makes people sick and what kills people all over the world.

✅ **Why Good Data Matters:**

- 🔍 **Foundation for Insight**
  High-quality, reliable data are essential to generate valid conclusions about the **burden, causes, and progression** of musculoskeletal disorders.
- 🩻 **Bridging Disciplines**
  Robust data enable true integration across **epidemiology, neuroscience, and psychosocial sciences**, fostering a holistic understanding of pain and function.
- 🧑‍⚕️ **Driving Patient-Centered Care**
  Accurate data enhance clinical decision-making, supporting **tailored interventions** that reflect real patient experiences and needs — leading to **better outcomes**.
- 🏛️ **Informing Policy & Prevention**
  Data-driven evidence underpins effective **public health strategies**, health service planning, and resource allocation for **long-term impact**.
- ✨ **In Short:**
  Good data isn't just numbers — it's the key to delivering smarter, more compassionate, and more effective care.



Hoffmann TC, Montori VM, Del Mar C. The Connection Between Evidence- Based Medicine and Shared Decision Making. *JAMA*. 2014;312(13):1295–1296.doi:10.1001/jama. 2014.10186

Aim of the project

The aim of this PhD project is to study a comprehensive model for the assessment of musculoskeletal disorders that integrates epidemiology, pain neuroscience, and the biopsychosocial model.

Epidemiology:
Burden of Musculoskeletal disorders in italy

Institute for Health Metrics and Evaluation

Pain Neuroscience:
Nociceptive, neuropathic and nociplastic pain

International Association for the Study of Pain
IASP
Working together for pain relief

Bio-psychosocial Model

World Health Organization

Epidemiology:
Burden of Musculoskeletal disorders in Italy

Institute for
Health Metrics
and Evaluation

Burden of Musculoskeletal disorders in Italy

"Burden of Musculoskeletal Disorders in Italy: an analysis of the Global Burden of Disease Study Findings from 1990 to 2023"

Institute for Health Metrics and Evaluation

Categories of MSK Disorders:

B.11.1 Rheumatoid arthritis
B.11.2.1 Osteoarthritis hip
B.11.2.2 Osteoarthritis knee
B.11.2.3 Osteoarthritis hand
B.11.2.4 Osteoarthritis other
B.11.3 Low back pain
B.11.4 Neck pain
B.11.5 Gout
B.11.6 Other musculoskeletal

Measures

What measure(s) will your paper cover?

- Disability-adjusted Life Years (DALYs)
- Years lived with disability (YLDs)
- Prevalence
- Incidence

What sexes will your paper cover?

- Both

What age group(s) will your paper cover?

- All ages

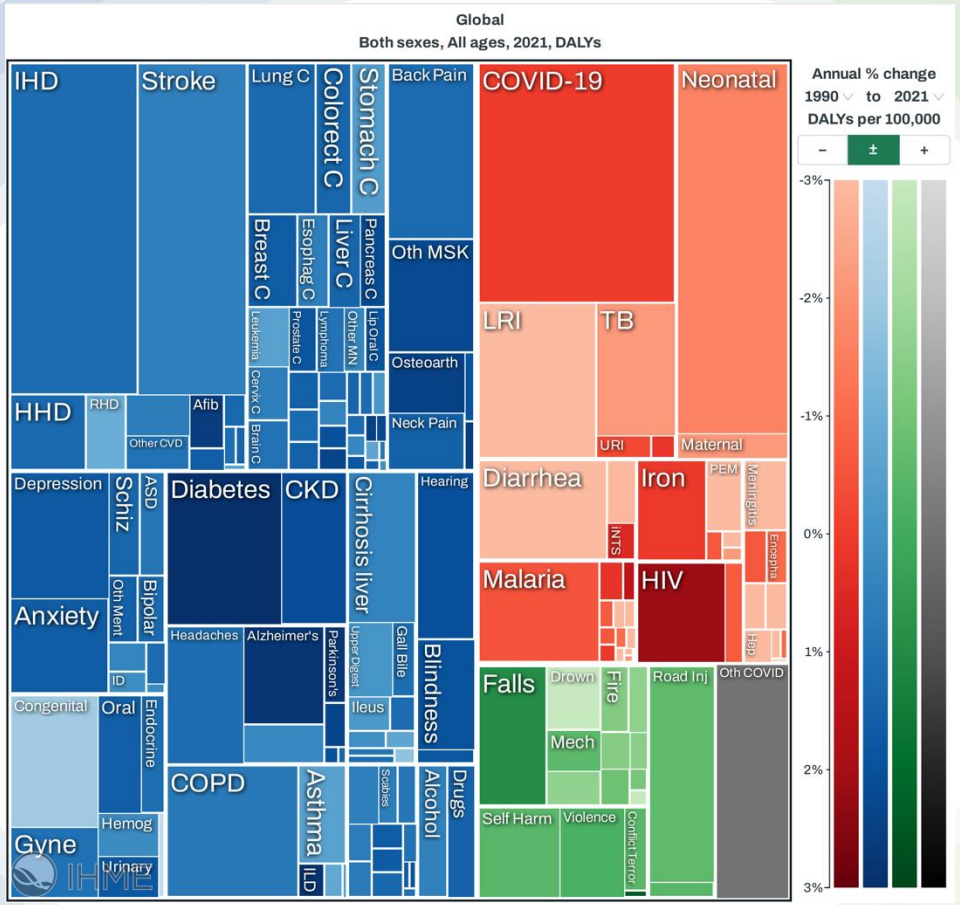
Location

What location set will your paper cover?

- National/multi-national
- Subnational

Global Burden of Disease Potential

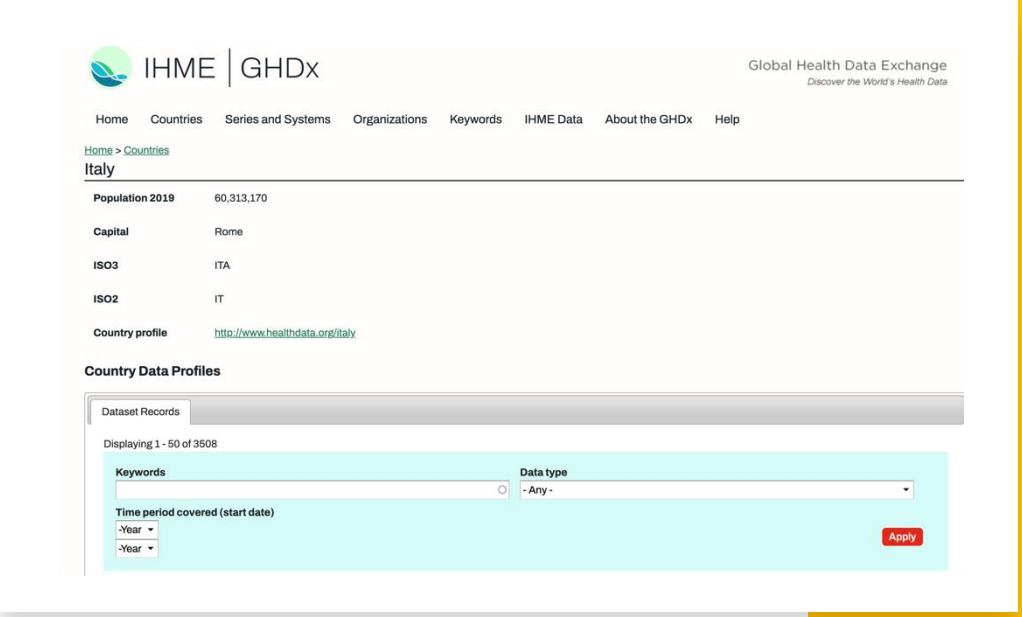
- Enables consistent comparisons across diseases, age groups, countries, and regions
- Combines clinical, epidemiological, and socio-demographic evidence in robust predictive models
- Informs evidence-based decision-making: planning, resource allocation, prevention strategies
- Supports integrated approaches to global health priorities, including Sustainable Development Goals (SDGs)

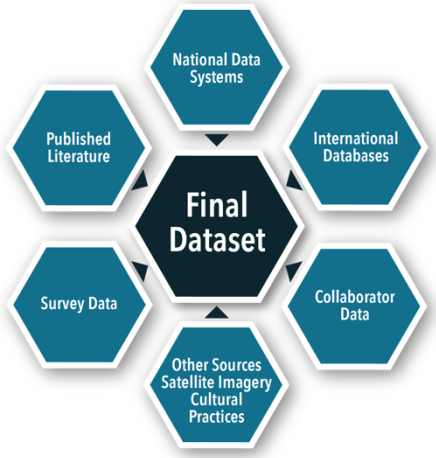


ITALIAN GBD INITIATIVE

Sharing Data, Methods, and Results

- **Global Health Data Exchange (GHDx)** The Global Health Data Exchange is IHME's online public catalog of health and demographic data. The GHDx is a good starting point for conducting data inventories. It contains public entries for nearly 77,000 datasets, including all of the data currently utilized in the GBD study.





How Health is Measured in the GBD

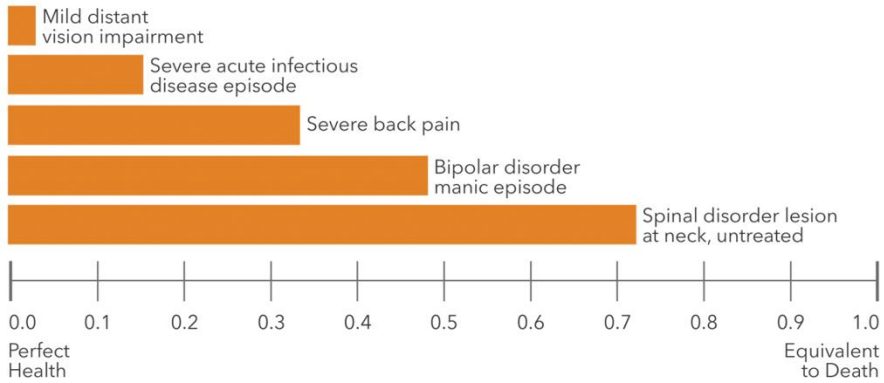
Data the GBD study collects about deaths, YLLs, YLDs, and DALYs continue to sharpen our understanding of local-to-global trends in health as researchers and policymakers work to identify and address concerns

- **What are Years of Life Lost (YLLs)?**

YLLs measure the difference between an individual's age at death and their life expectancy at the time of their death.

- **What are Years Lived with Disability (YLDs)?**

YLDs represent the non-fatal component of the disease burden. They measure the **number of healthy years lost** due to a condition that causes **disability, symptoms, or functional limitations**, but not death.



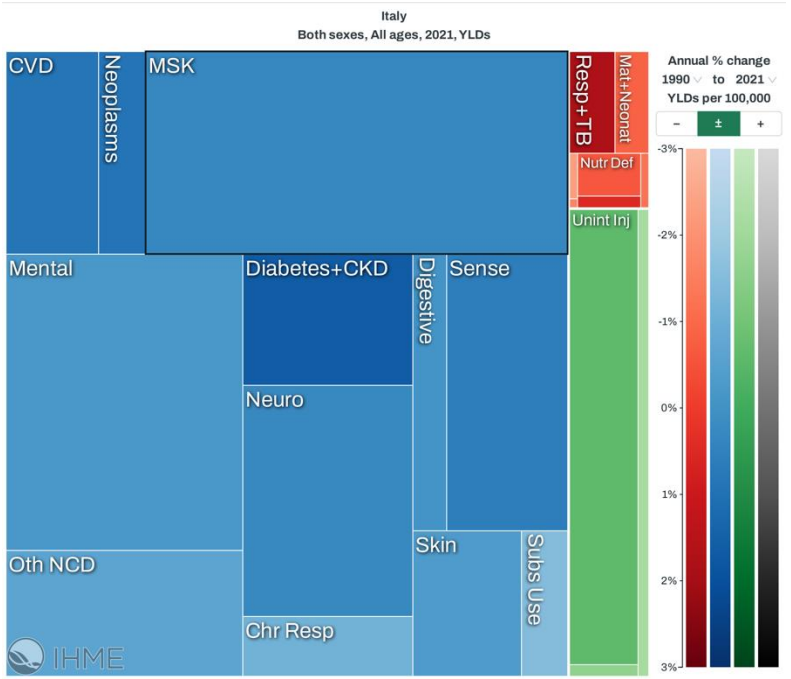
What are DALYs?

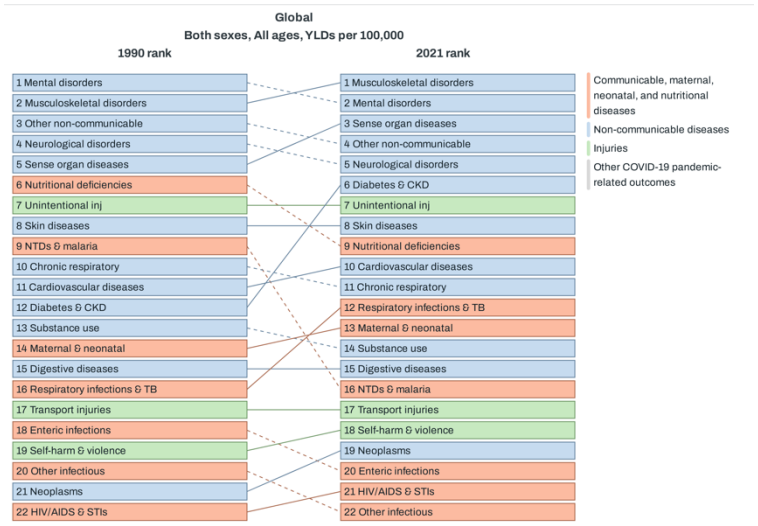
DALYs = disability-adjusted life years
One DALY equals one lost year of healthy life. DALYs are calculated as the sum of years of life lost (YLLs) and years lived with disability (YLDs)

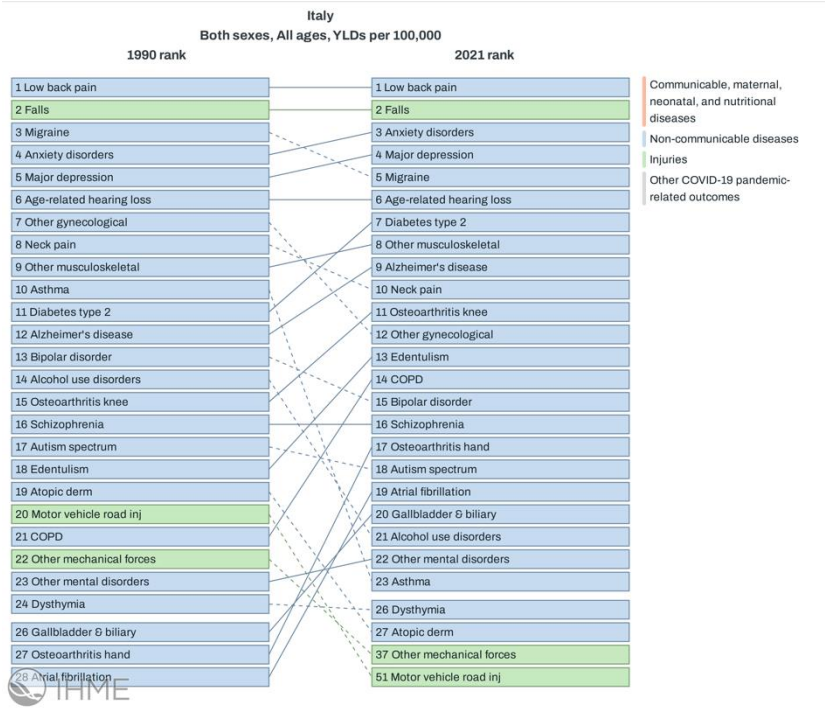
DALYs = YLLs + YLDs

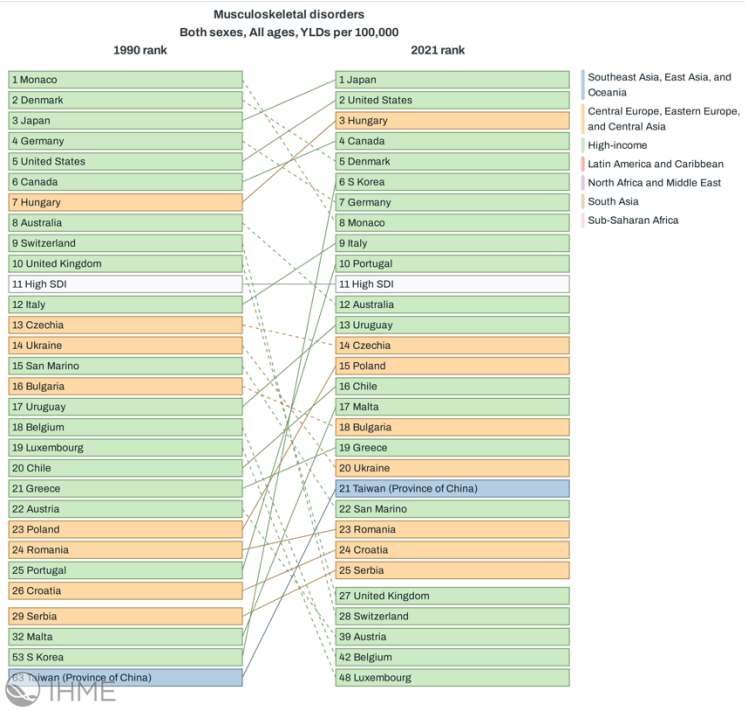
RESULTS

- MSK is ranked as 1st cause of YLDs globally.
- MSK disorders have 27% global increase in YLDs from 1990 to 2021.
- MSK disorders represents in Italy 21.3% of total YLDs.









Risk factors

What is an "Attributable Risk Factor"?

A risk factor that increases the likelihood of disease or injury, and whose elimination would lead to a measurable reduction in disease burden.

Main Categories of GBD Risk Factors

Behavioral

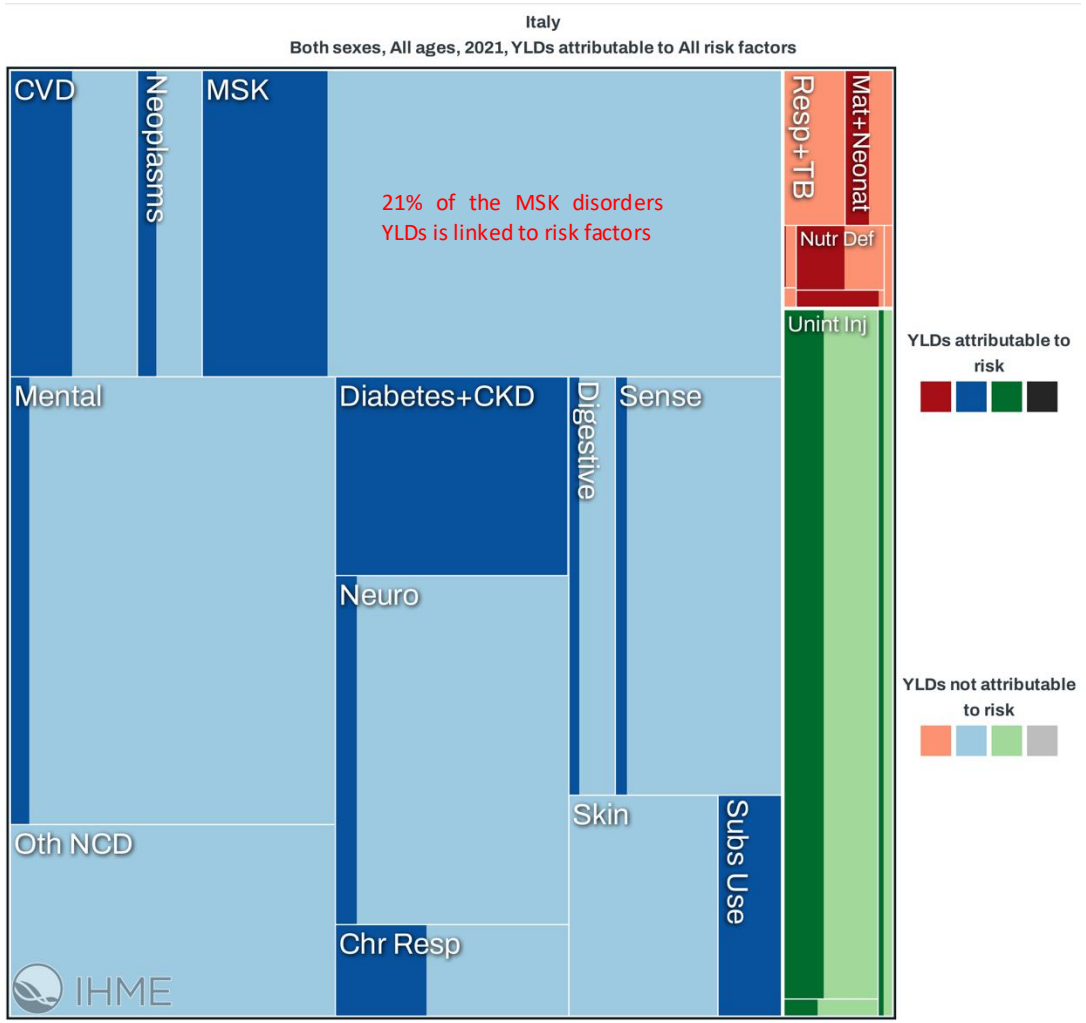
- Unhealthy diet
- Tobacco use
- Alcohol consumption
- Physical inactivity

Metabolic

- High blood pressure
- Elevated blood glucose
- High cholesterol
- High body mass index (BMI)

Environmental and Occupational

- Air pollution
- Exposure to toxic substances
- Hazardous work environments



Prevalence of MSK Disorders by Age and Sex

Sex Differences

•The global prevalence of MSK disorders is **higher in females** than in males.

Age-Related Trends

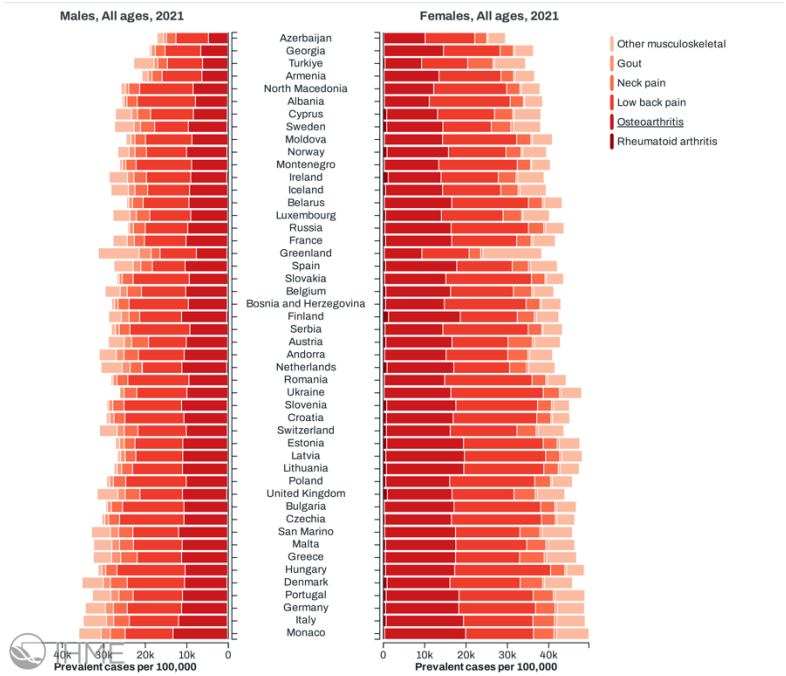
•Prevalence increases steadily with age, **peaking between ages 65–69** in both sexes.

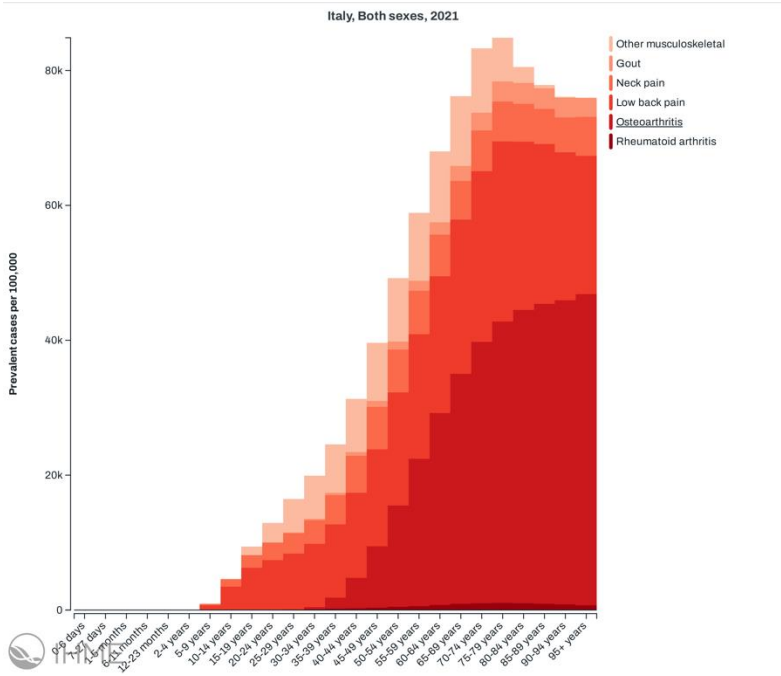
Impact on Older Adults

•The burden of disability (YLDs) due to MSK disorders is **greatest in those aged 70 and older**.

Future Projections

•Global MSK disorder cases are projected to rise from **494 million in 2020** to over **1 billion by 2050**, driven by **population growth and aging**.





ITALIAN GBD INITIATIVE

Lancet Public Health. 2025 Apr;10(4):e309-e320. doi: 10.1016/S2468-2667(25)00045-3.

State of health and inequalities among Italian regions from 2000 to 2021: a systematic analysis based on the Global Burden of Disease Study 2021

Mohsen Naghavi; GBD 2021 Italy Subnational Burden of Disease Collaborators

Collaborators + expand

PMID: 40175012 PMCID: PMC11962357 DOI: 10.1016/S2468-2667(25)00045-3

Findings: Life expectancy at birth in Italy increased from 79·6 years in 2000 to 83·4 years in 2019, dropped to 82·2 years in 2020 due to COVID-19, and recovered slightly to 82·7 years in 2021. HALE was 70·9 years (95% UI 67·4-73·8) in 2021. Substantial regional disparities were observed: in general, despite higher YLD rates, northern regions had better health outcomes, with higher life expectancy and HALE and lower YLL rates compared with southern regions. Overall, the top causes of YLDs were low back pain (1556·5 [1098·5-2080·2]), falls (926·2 [638·8-1253·8]), and headache disorders (858·0 [173·7-1808·2]). Anxiety and depressive disorders both had substantial increases in the period from 2019 to 2021 (19·8% and 17·3%, respectively). YLDs for Alzheimer's disease and diabetes increased substantially from 2000 to 2019 and 2019 to 2021 (70·6% and 3·0% for Alzheimer's disease and 46·8% and 7·9%, respectively for each timepoint). YLL rates declined for ischaemic heart disease from 2000 (-29·9% in 2019), but increased for Alzheimer's disease and other dementias (54·5%). DALY rates decreased overall from 2000 to 2019, but rise again in 2021 due to the COVID-19 pandemic.

Nota Metodologica

- I dati presentati in questa presentazione fanno parte del **ciclo di revisione GBD 2021**.
- È attualmente in corso l'**analisi dei dati GBD 2023**, che rappresentano le informazioni **più aggiornate** disponibili.
- **I dati 2023 sono attualmente sotto embargo** e **non sono stati inclusi** in questa presentazione.
- Il **paper relativo ai disordini muscoloscheletrici (MSK) in Italia** sarà basato sui **dati aggiornati del GBD 2023.**

Italian GBD Initiative

ATTESTATO DI PARTECIPAZIONE

Il presente certificato viene rilasciato a

Paolo Pedersini

per aver frequentato il

Workshop per la valutazione delle stime
Italiane del Global Burden of Disease 2023

tenutosi a Bologna, il 17 e 18 Marzo 2025

organizzato e patrocinato da

Dipartimento di Scienze Mediche e Chirurgiche dell'Università di Bologna
e
IRCCS Materno Infantile – Burlo Garofolo di Trieste

F. Violante

Prof. Francesco S Violante
Dipartimento di Scienze Mediche e Chirurgiche
Università degli Studi di Bologna

Dr. Lorenzo Monasta
SCR Epidemiologia Clinica e Ricerca sui Servizi Sanitari
IRCCS Materno Infantile – Burlo Garofolo, Trieste

Pain Neuroscience: Nociceptive, neuropathic and nociplastic pain

Pain phenotyping in MSK disorders

Review > Lancet Rheumatol. 2024 Mar;6(3):e178-e188.
doi: 10.1016/S2665-9913(23)00324-7. Epub 2024 Feb 1.

Nociceptive, neuropathic, or nociplastic low back pain? The low back pain phenotyping (BACPAP) consortium's international and multidisciplinary consensus recommendations

Review > J Pain. 2015 Apr;16(4):299-305. doi: 10.1016/j.jpain.2015.01.004. Epub 2015 Jan 28.

Quality of pain intensity assessment reporting: ACTTION systematic review and recommendations

Shannon M Smith [1], Matthew Hunsinger [2], Andrew McKeown [3], Melissa Parkhurst [4], Robert Allen [5], Stephen Kopko [6], Yun Lu [7], Hilary D Wilson [8], Laurie B Burke [9], Paul Desjardins [10], Michael P McDermott [11], Bob A Rappaport [12], Dennis C Turk [13], Robert H Dworkin [14]

In the interventional rehabilitation studies involving patients with MSK disorders, is the type of pain phenotyped?

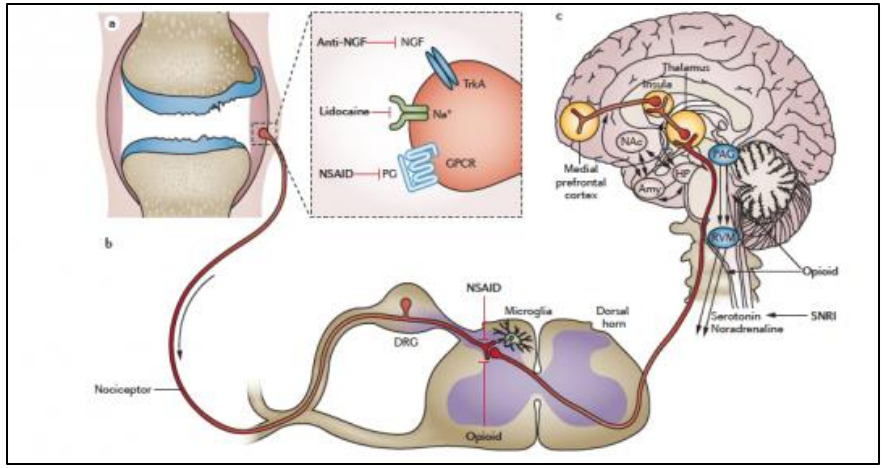
"Assessment of Nociceptive, Neuropathic and Nociplastic pain in MSK disorders: a scoping Review"

Key Concepts in Pain Science

International Association for the Study of Pain
IASP®
Working together for pain relief

1.Pain does not reflect tissue damage
→ The intensity of pain is **not a reliable indicator** of the state of body tissues.
2.Pain is modulated by multiple factors
→ Influenced by **somatic, psychological, and social domains** (biopsychosocial model).
3.Pain-tissue relationship weakens over time
→ As pain persists, the **correlation with tissue state becomes less predictable**.
4.Pain as a protective perception
→ Pain can be understood as the **conscious correlate** of an **implicit perception** that the tissue is under threat.

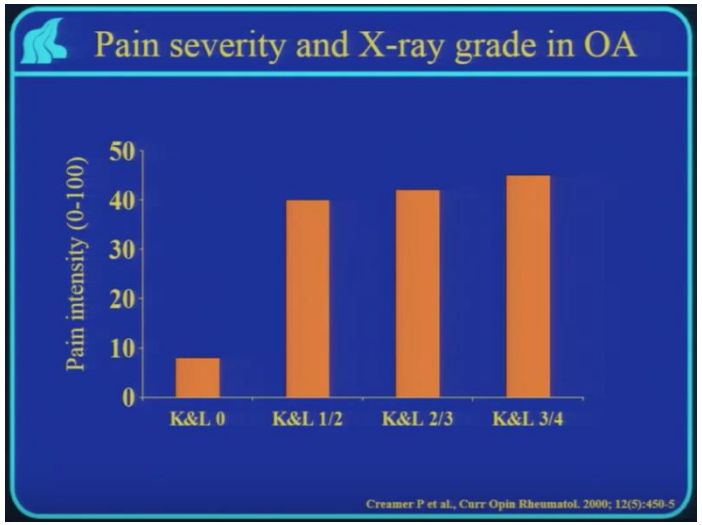
✨ *Understanding these principles is essential for modern, patient-centered pain management.*



Moseley 2007, Reconceptualising pain according to modern pain science. Physical Therapy Reviews. 12. 169-178.

A clinical gap…

Although there is a clear link between structural damage and pain, a large proportion of individuals with high levels of X-ray damage (kellgren &Lawrence scale (K&L)), experience no pain.



> Pain Med. 2022 Mar 2;23(3):488-498. doi: 10.1093/pm/pnab301.

Functional and Structural Neuroplastic Changes Related to Sensitization Proxies in Patients with Osteoarthritis: A Systematic Review

Paolo Pedersini [1], Massimiliano Gobbo [2], Mark D Bishop [3], Lars Arendt-Nielsen [4], Jorge H Villafañe [1]

Altered Central Sensitization and Pain Modulation in the CNS in Chronic Joint Pain, Arendt-Nielsen L et al. 2015, Current Osteoporosis Reports
Quantitative sensory testing in painful osteoarthritis: a systematic review and meta-analysis. Suokas AK et al., 2012, Osteoarthr Cartil.

Phenotyping pain: IASP Classification

1. **Nociceptive Pain**

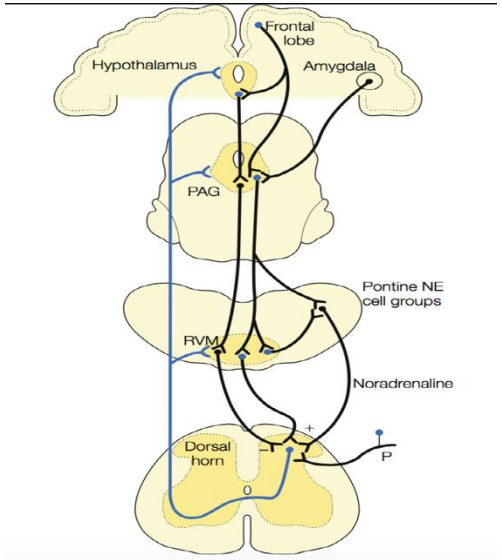
Definition: Pain that arises from actual or threatened damage to non-neural tissue and is due to the activation of nociceptors.

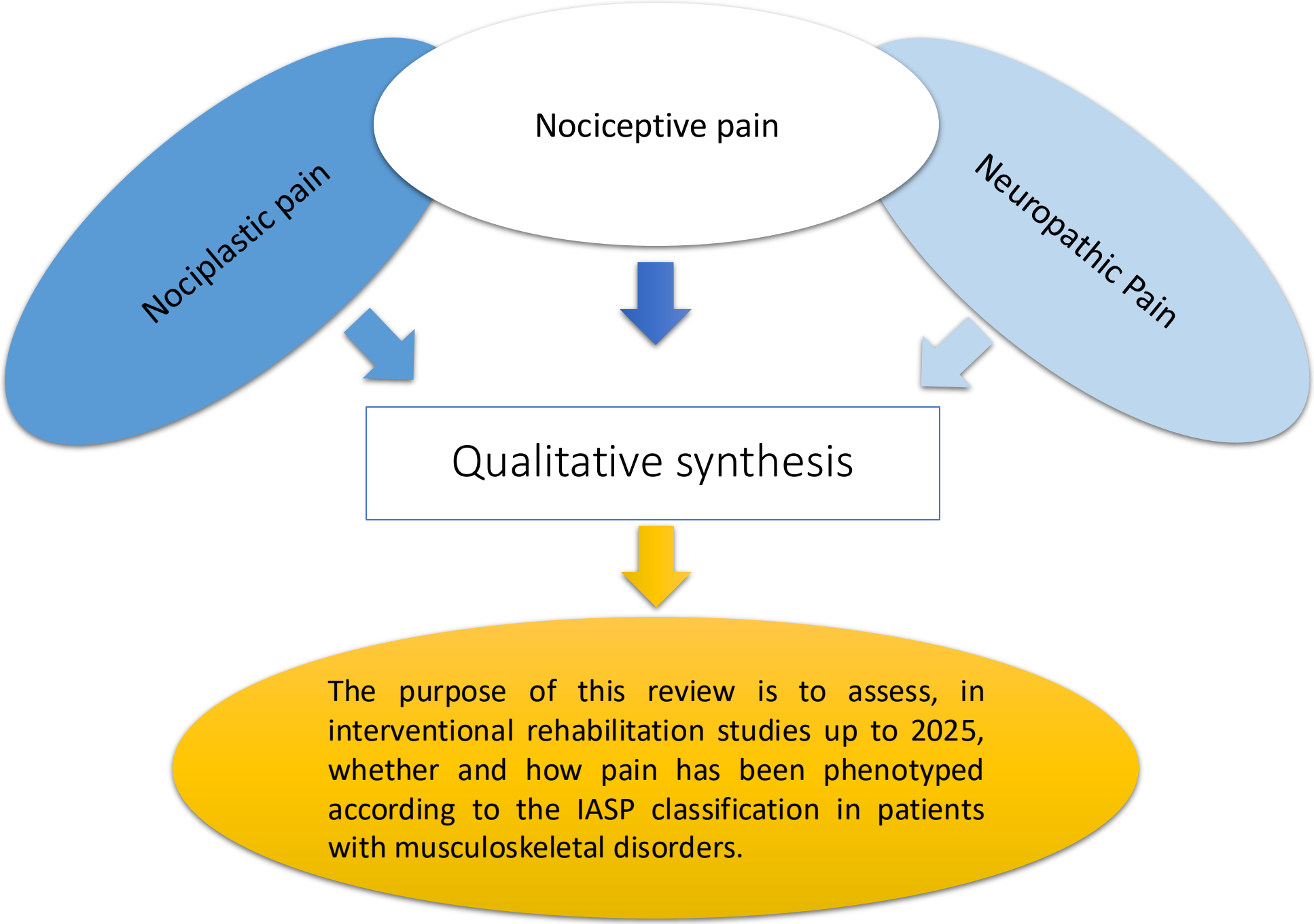
2. **Neuropathic Pain**

Definition: Pain caused by a lesion or disease of the somatosensory nervous system.

3. **Nociplastic Pain**

Definition: Pain that arises from altered nociception despite no clear evidence of actual or threatened tissue damage causing the activation of peripheral nociceptors or evidence for disease or lesion of the somatosensory system causing the pain.




Nociceptive pain
Nociplastic pain
Neuropathic Pain
Qualitative synthesis
The purpose of this review is to assess, in interventional rehabilitation studies up to 2025, whether and how pain has been phenotyped according to the IASP classification in patients with musculoskeletal disorders.

Methods: “Assessment of Nociceptive, Neuropathic and Nociplastic pain in MSK disorders: a scoping Review”

🔍 **Review Objective**

To assess, in interventional rehabilitation studies, **whether and how pain has been phenotyped** according to the **IASP classification** in patients with **musculoskeletal conditions**.

🧩 **Inclusion Criteria**

- **Interventional studies** (RCTs, quasi-RCTs)
- Population: patients with **musculoskeletal disorders (GBD classification)**
- Interventions: **rehabilitative approaches** (physical therapy, multimodal, exercise, manual therapy etc.)
- Outcome: **pain assessment** based on IASP criteria
- Published **up to december 2024**
- Articles published in **Q1-ranked journals** (based on Scimago Journal Rank or equivalent)

📚 **Search Strategy**

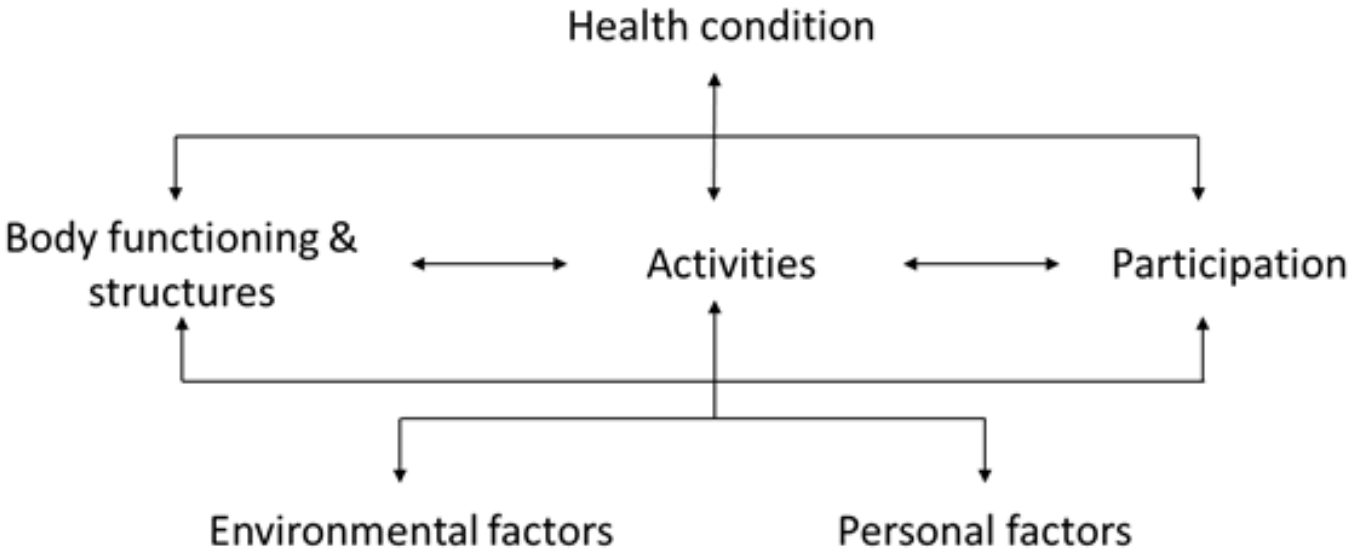
- Databases: **PubMed**, **Scopus**, **PEDro**, **CINAHL**
- Timeframe: from inception to **December 2024**
- Keywords: combinations of “musculoskeletal disorders”, “rehabilitation”, “pain”, “Nociceptive Pain”, “Neuropathic pain”, “nociplastic pain” “intervention studies”

STUDY ONGOING…

Bio-Psychosocial Model in MSK disorders

3. Biopsychosocial model approach

How is the biopsychosocial model applied in studies concerning the rehabilitation of musculoskeletal disorders?



› Pain. 2021 Aug 1;162(8):2154-2185. doi: 10.1097/j.pain.0000000000002217.

Barriers and enablers influencing healthcare professionals' adoption of a biopsychosocial approach to musculoskeletal pain: a systematic review and qualitative evidence synthesis

Wendy Ng [1], Helen Slater [1], Cobie Starcevich [1], Anthony Wright [1], Tim Mitchell [1 2], Darren Beales [1 2]

Clinical biopsychosocial assesment: type of pain, psychological aspect, socio-environmental factors, beliefs, and contextual factors.

Biopsychosocial Model – Key Components

Biological

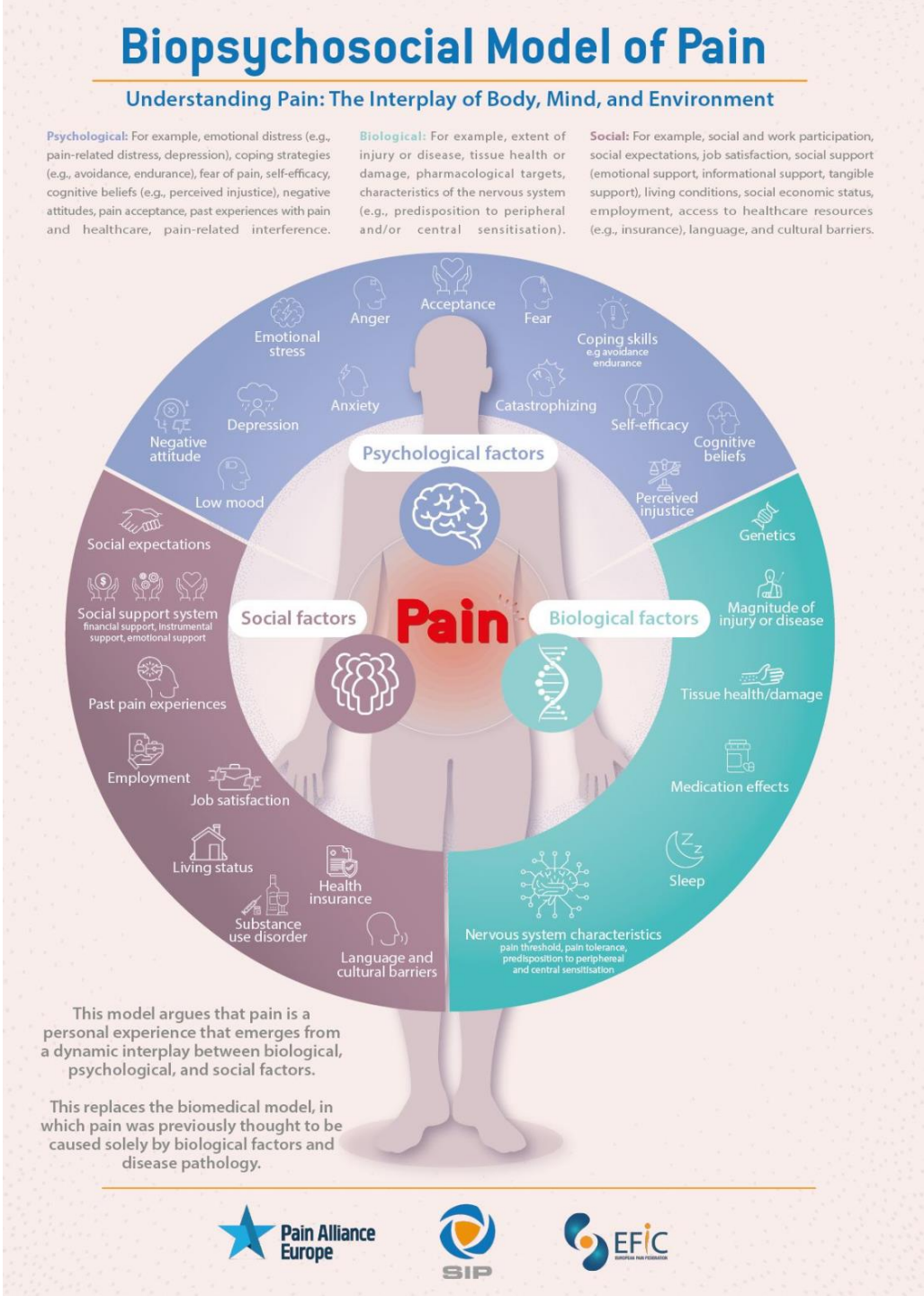
- Structural alterations (e.g., osteoarthritis, injuries, inflammation)
- Physical comorbidities and genetic factors
- Neurophysiological pain responses

Psychological

- Emotions, anxiety, depression
- Catastrophizing, fear of movement (kinesiophobia)
- Previous pain experiences and coping strategies

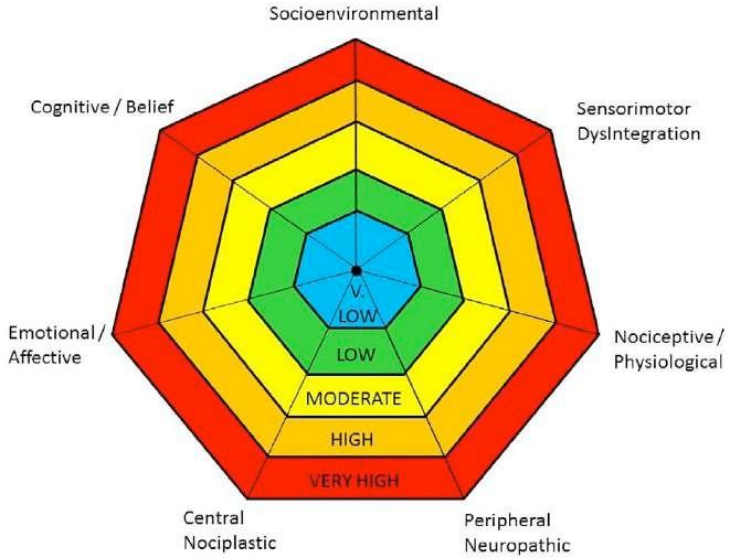
Social

- Work, family, social roles
- Access to care, social support
- Culture, stigma, and traditional expectations



”Pain assessment through a biopsychosocial model in patients with osteoarthritis: a literature review”

CONCLUSION: The influence of prevalent pain mechanisms on clinical outcomes in rehabilitation is still being studied. Future studies should also consider incorporating a comprehensive pain assessment which may provide better insight into the role of factors affecting nociception and pain perception. The biopsychosocial model should be implemented not only in clinical practice but translational be applied to scientific research to assess all aspects that may characterize the patient's pain experience. Providing the best available care according to scientific evidence turns out to be the primary goal towards the patient, so the study of an assessment that considers all domains of pain aims as the ultimate goal to improve patient-targeted interventions.



STUDY IN SUBMISSION…

Future perspective: Clinical Trial!

Objective: To apply an assesment model integrating epidemiology, pain neuoroscience and biopsychosocial model in patients with MSK disorders

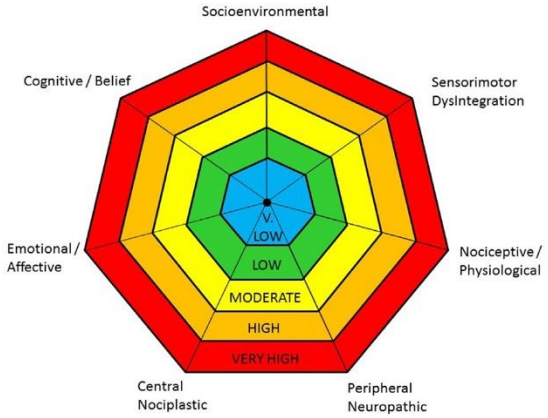
Study Design: Prospective cohort study

Methods: All domains of assessment considered relevant to musculoskeletal disorders will be investigated. This study seeks to integrate epidemiological data, pain neuroscience, and the biopsychosocial model to better understand and address the rehabilitation needs of patients with musculoskeletal disorders.

› Musculoskelet Sci Pract. 2018 Aug;36:17-24. doi: 10.1016/j.msksp.2018.03.006.
Epub 2018 Apr 9.

A new clinical model for facilitating the development of pattern recognition skills in clinical pain assessment

David M Walton [1], James M Elliott [2]



Domain	Level
Nociceptive (Physiological) input	V. Low / Low / Moderate / High / V. High
Peripheral neuropathy	V. Low / Low / Moderate / High / V. High
Central nociplastic mechanisms	V. Low / Low / Moderate / High / V. High
Emotional Dysregulation	V. Low / Low / Moderate / High / V. High
Maladaptive Cognitions or Beliefs	V. Low / Low / Moderate / High / V. High
Socioenvironmental Context	V. Low / Low / Moderate / High / V. High
Sensorimotor Dys-integration	V. Low / Low / Moderate / High / V. High

Grazie per l’attenzione

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