The Global Burden of Musculoskeletal Pain— Where to From Here?

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To summarize the current understanding of the global burden of musculoskeletal pain–related conditions, consider the process of evidence generation and the steps to generate global pain estimates, identify key gaps in our understanding, and propose an agenda to address these gaps, we performed a narrative review.

In the 2010 Global Burden of Disease Study (GBD), which broadened the scope of musculoskeletal conditions that were included over previous rounds, low back pain imposed the highest disability burden of all specific conditions assessed, and subsequent GBD reports further reinforce the size of this burden. Over the past decade, the GBD has produced compelling evidence of the leading contribution of musculoskeletal pain conditions to the global burden of disability, but this has not translated into global health policy initiatives. However, system- and service-level responses to the disease burden persist across high-, middle-, and low-income settings.

There is a mismatch between the burden of musculoskeletal pain conditions and appropriate health policy response and planning internationally that can be addressed with an integrated research and policy agenda. (*Am J Public Health.* 2019;109:35–40. doi:10.2105/AJPH.2018.304747)

The burden of disease within and across populations is captured in studies such as the Global Burden of Disease (GBD) study and the World Health Organization's (WHO's) Global Health Estimates. These global studies are critical for informing global, national, and subnational health profiles over time; planning for emerging issues; and informing policy and program responses to health and social care needs. We summarize the current understanding of disease burden measurement in the context of global burden of pain related to musculoskeletal conditions. Although musculoskeletal conditions comprise about 150 discrete conditions, the GBD specifically reports on health estimates for hip and knee osteoarthritis, rheumatoid arthritis, back and neck pain, gout, and a group of other musculoskeletal conditions. The category of "other" refers to a wide range of autoimmune, inflammatory, joint, ligament, tendon, and muscle disorders that vary across epidemiologic studies.[1] The burden of disease has not been measured for osteoporosis as a specific disease but for the burden associated with fractures resulting from falls attributed to low bone mass.[2]

Across all these conditions, pain and its sequelae (e.g., activity limitation, participation restriction) are unifying features. Musculoskeletal conditions included in the GBD, therefore, provide an important, albeit not exhaustive, insight into the global burden of pain, which is otherwise not measured as a condition in its own right. Recent GBD 2016 estimates showed that low back pain was the leading cause of years lived with disability in most countries and territories, and musculoskeletal conditions as a group were a main driver of noncommunicable disease (NCD)–related disability burden.[3]

Two key long-term drivers of contemporary burden of disease estimates are the age structure of populations and their longevity. In simple terms, demographic dynamics related to changes in fertility rates, migration rates, and mortality rates have led to rapid global aging to the extent that soon, for the first time in recorded history, the proportion of the global population 65 years and older will exceed the proportion of those younger than 5 years.[4] Because most painful musculoskeletal conditions increase with age and because there is an increase in multimorbidity, NCDs, and reduced physical activity associated with musculoskeletal pain, the global burden related to pain will also rise substantially.

Current estimates suggest that by 2050, approximately two thirds of the world's population age 65 years and older will reside in Asia.[4] One of the most striking and consequential aspects of global aging is the rapidity with which less-developed countries are aging compared with more-developed countries.

Global life expectancy has been rising, but the extent to which the increase in longevity is matched by gain in healthy life-years is unclear on the basis of current evidence and depends in part on whether healthy aging is defined using a disease-based approach or a functional ability approach.[4] Nevertheless, people are now living longer and experiencing chronic diseases to an extent not seen before, and multimorbidity is the norm rather than the exception; musculoskeletal conditions feature prominently. Musculoskeletal

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conditions contribute to a substantial proportion of global disability, second only to mental health conditions,[5] and commonly occur in multimorbid presentations.[6] Currently, 23% of the global burden of disease occurs in older people, for whom chronic diseases and multimorbidity become more common. Chronic diseases and multimorbidity constitute almost half the burden in high-income countries and about one fifth of the burden in less economically developed countries,[7] where, increasingly, the burden of disease is reflecting a shift from communicable, neonatal, maternal, and nutritional health conditions to NCDs.

As population aging is so fundamental to the global burden of nonfatal conditions, there will be continuing debate about the most appropriate way to measure the morbidity burden in older people and the extent to which increased longevity is lived with or without morbidity burden.[8]

SCOPE OF DISEASE BURDEN

To fully capture the burden of a disease, or the "cost" of an adverse health state, all problems or impacts associated with the disease ought to be measured and monitored. The impact of a health condition can include economic expenditure and loss (both direct and indirect to the patient, carers, and society), mortality, morbidity, and impact on quality of life.

Complexities arise when attempting to compare between health conditions and between societies. For example, in musculoskeletal conditions, pain and impaired physical and emotional functioning are important components that should always be measured to assess the impact on the individual living with the condition, regardless of context. However, the cost of medical care, the loss of productivity, and the expected or desired roles in society will vary enormously between low-, middle- and high-income countries and across the life course. Because of this contextual variability, health loss estimates as used in GBD methodology do not include economic or participation impact, which may not give a complete picture of the extent of burden for condition, and this is particularly relevant for musculoskeletal pain conditions for which participation, carer impact, and financial sequelae are key drivers of disease impact.

MEASURING GLOBAL BURDEN OF DISEASE

Addressing the important questions of whether population health is changing over time and why population health varies across countries requires standard methods for summarizing population health. Burden of disease methods are commonly used methods for doing this and build on traditional mortality-based measures in that they take both mortality and morbidity into account.

"Burden of disease" is an umbrella term that includes different conceptual and technical approaches to measuring the impact of poor health on individuals and populations that are used for a range of purposes. How burden is conceptualized (ranging from loss of health to broader effect on functioning and participation) and whether specific or multiple conditions are the focus will determine which methods are used to estimate burden.

An evidence-based approach for setting priorities for population health and social care policy has been advocated by the GBD study and others, including WHO, whereby the health loss related to specific conditions is ranked. Comparing and ranking widely differing conditions thus requires a common summary measure that can be used for all diseases and injuries. These measures aim to decouple estimates of burden from strength of advocacy, as all conditions are measured by the same metric at the same time if sufficient data are available to derive an acceptable level of precision for the estimate.

Summary Health Estimates

Summary health measures include both mortality and morbidity across the life course but traditionally have excluded other components, such as participation and economic impact.[9] Currently, 3 key commonly used metrics that combine mortality and morbidity are health-adjusted life expectancy, quality adjusted life year, and disability adjusted life year (DALY).[10,11]

The health-adjusted life expectancy metric adjusts overall life expectancy by the amount of time lived in less than perfect health with the years of living with a condition weighted to represent the effect of disability. It has not been widely used in the literature or health policy. The quality adjusted life year metric measures years lived in perfect health, with 1 quality adjusted life year equal to 1 year of life in full health. It is often used in health economic decision-making through cost-effectiveness analyses when comparing new or alternate interventions with existing treatments. Judgment is still required on whether the quality adjusted life year metric gains are "value for money." Quality adjusted life-years have been critiqued for a range of reasons, including the challenge of defining perfect health and concerns about who values or rates the health gain.[12] This criticism can be applied to all these types of measures that require a weighting or a choice of different health states.

The DALY was introduced in 1993, when the Harvard School of Public Health, in collaboration with the World Bank, assessed the global burden of disease for the year 1990 in the inaugural GBD study.[13,14] DALYs measure the gap between current health status and an ideal situation in which everyone lives into old age free of disease and disability. The DALY combines in 1 measure the time lived with disability and the time lost because of premature mortality, using a set value for life expectancy to calculate the amount of life lost as a result of premature death or disability. DALYs reflect the impact of disease on populations in terms of death and quality of life but tend to have greater weight on young adults and newborns. DALYs do not directly measure economic value; however, the impact on productivity could potentially be applied to economic loss.

Although these measures have been criticized particularly related to how the weightings are derived, they also have advantages for comparing health conditions and interventions across diverse settings with different diseases in different populations. The DALY is the core measure used in the GBD estimates; thus, we focus on the epidemiologic data needed to derive the DALY estimates.

Epidemiological Data

To calculate DALYs, epidemiologic data on specific conditions are required for each representative population by age group and gender, specifically, population-based estimates of mortality, incidence, prevalence, remission rates, and severity distribution. The GBD estimates required health conditions to have *ICD-10* (*International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*. Geneva, Switzerland: World Health Organization; 2011) codes; thus, estimating the global burden of pain has been limited by poor representation of common pain conditions. Availability of *ICD-11* (*International Statistical Classification of Diseases and Related Health Problems, Eleventh Revision*. Geneva, Switzerland: World Health Organization; 2018) primary pain codes, as discussed subsequently, may rectify this if these codes are included in *ICD-11*.

To derive the disability weighting or value of the burden related to a condition, the common scenarios or sequelae need to be determined and the impact on daily activity and loss of physical and mental function need to be described. For example, the range of sequelae for low back pain includes acute and chronic pain states with and without leg pain and a range of pain severity (mild, moderate, and severe). Historically, this has been problematic, as diagnoses have been reported independent of functional impact. However, population-based measures of function are now being more explicitly linked with disease coding with some harmonization planned between the *ICD-11* and the *ICF* (*International Classification of Functioning, Disability and Health*. Geneva, Switzerland: World Health Organization; 2001) frameworks.[15]

Valuing Health States and Disability Weights

Estimation of nonfatal burden (using the measure of years lived with disability) is fundamentally influenced by disability weighting.[16] The weights are derived by pairwise comparison techniques in which participants are asked to judge who is in better health on the basis of randomly selected pairs of simply described health states.

Successive rounds of the GBD have substantially improved the conceptual basis for deriving disability weights and the process of estimating weights by conducting large-scale population surveys in developing and developed countries for pairwise comparison estimation of disability weights.

UNDERESTIMATION OF BURDEN OF DISEASE

Despite evidence for the very significant burden of musculoskeletal conditions associated with pain, current estimates are likely to be an underestimate of both true prevalence and burden. Specifically, the calculation of DALYs related to musculoskeletal pain likely underestimates both the mortality (years of life lost) as well as the morbidity (years lived with disability) components. The main contributors to this underestimation include the following:

1. Case definitions for most musculoskeletal conditions have not been universally standardized or applied consistently in population-based studies, and in particular with inconsistency between low–, middle- and high-income settings. There are no standardized *ICD* codes for pain as a disease entity. *ICD-11* modifications may address this.

2. Reliable and validated self-report measures are not available for each of the 150 or more painful musculoskeletal conditions, making large-scale population-based studies logistically difficult and costly, rendering impact data limited in volume and scope.

3. Because of the discordance between clinical features that help define a case (e.g., rheumatoid factor for rheumatoid arthritis, x-ray change for osteoarthritis, hyperuricemia for gout) and the clinical manifestations of the diseases (e.g., levels of pain and loss of function or activity limitation), simple biomarkers of musculoskeletal pain are not available for routine use in disease surveillance, nor are they appropriate for capturing the multidimensional impact of a pain experience.

4. Reporting pain and the resulting impact of musculoskeletal conditions can fluctuate widely, and there can be transition between many health states for the 1 condition throughout a person's life (e.g., osteoarthritis of the knee typically has a fluctuating pain profile over a protracted timeframe; in estimating the global burden of low back pain, the nature of episodes of low back pain such as episode duration, severity distribution, and the modifying effect of treatment are not well considered).

5. Harms associated with treatment, including medication-based interventions (notably long-term opioids, corticosteroids, and nonsteroidal and immunosuppressive therapies) and surgical interventions, are not captured in the estimation of burden.

6. Many musculoskeletal conditions are nonspecific with no defined tissue-based cause and, although they may have a low level of associated disability, they are extremely common and the associated pain burden has previously been underestimated or not measured (e.g., the pain and loss of function associated with arthritis in hands and feet was not measured in GBD).

7. Even the wider range of musculoskeletal conditions (e.g., such as other musculoskeletal, rheumatoid arthritis, osteoarthritis, and gout) that have pain as a key feature in the lay health state descriptors but not in the title are not immediately recognized as contributing to global pain burden, limiting the awareness of the magnitude of this burden.

8. Numerous other health conditions have musculoskeletal pain as a key factor contributing to overall morbidity and mortality that will not always be acknowledged or attributed to pain or musculoskeletal burden. On scanning the 235 unique health states in GBD 2015 publications,[3] musculoskeletal-related pain would likely be present in as many as 50 (e.g., all of the acute fracture health states, the majority of other injury states, and most end-stage cancer health states), whereas other types of bodily pain would likely be present for a significant amount of time in an additional 17 (e.g., migraine, diabetic neuropathy, abdominal, and pelvic conditions). It is also likely that a considerable proportion of both the years of life lost and

years lived with disability burden that is attributed to injury, mental health, and substance abuse and neurologic disorders is related to musculoskeletal and other acute and chronic pain conditions.

9. Although the chronic nature of the majority of musculoskeletal pain conditions means that most people do not die from their condition, the condition may contribute to premature mortality through the effect of associated comorbidities related to the disease and treatments. Frequently the associated musculoskeletal conditions (e.g., the increased cardiovascular mortality associated with chronic inflammatory arthritis) are usually poorly documented in cause of death reporting).

Murray and Lopez have described ongoing challenges in estimating global burden of disease that are also relevant to musculoskeletal pain conditions.[17] Lack of empirical data, particularly from developing countries and for some conditions, remains an ongoing challenge, as do the methods related to disability estimation.[16] There is an ongoing debate about the extent to which the relative importance of physical versus cognitive function in health state valuations vary by culture, age, education, and socioeconomic status. Cultural heterogeneity related to pain is an important consideration in this context.

The problems related to underestimation of musculoskeletal pain burden should also be seen in the broader context of pain burden. Chronic pain of neuropathic or mixed origin is a common and enduring consequence of other diseases and injuries, for example, painful diabetic neuropathy, spinal cord injury-related neuropathic pain, HIV-related painful neuropathies, and persistent postsurgical pain.

RESEARCH AGENDA

Blyth has recently proposed a research agenda focused on better characterization of the global burden of neuropathic pain conditions; the components of this agenda are relevant for musculoskeletal pain conditions more generally.[18] This agenda covers the appropriate definition of major pain conditions at a population level; more comprehensive mapping of pain conditions within the existing GBD framework as risk factors or consequences of other conditions (e.g., pain as a risk factor for falls or a consequence of falls); an expanded condition set of pain conditions overall; specific consideration of fatal versus nonfatal burden; more consistent and comprehensive description of relevant characteristics of common pain conditions at a population level (including duration, severity distribution across mild, moderate and severe, trends by major demographic factors including age and gender); and differences between developed and developing countries.

At the level of measurement, 1 key barrier is the wide range of definitions used, if at all, in national health and burden of disease surveys. This limits the derivation of precise estimates of a health state from data pooling and the absence of data may be inappropriately used as evidence to infer the absence of prevalence and impact. We expand on approaches and initiatives to address some of these for musculoskeletal pain.

1. Standardized case definitions and data capture—"no data, no disease." Many regions, particularly the low- and middle-income countries, did not have specific population-based estimates of musculoskeletal pain conditions. The Global Alliance for Musculoskeletal Health has developed and recommend a standardized module of questions to be included in all national health or disease burden studies. These have been piloted in both developing and developed countries, and the authors welcome ongoing collaboration and incorporation in the field.[19]

2. Pain-specific disease coding. The revision to *ICD-11* is expected to address this limitation in part through classification of chronic primary pain and chronic musculoskeletal pain.[20] The proposed classification will also include an option for coding severity in relation to each diagnostic code; importantly, severity will be able to be coded according to pain intensity, distress, and functional impairment.

3. Standardized definition for pain and pain impact. As mentioned, the Global Alliance for Musculoskeletal Health has developed a musculoskeletal survey module for describing site specific pain, whereas other groups (e.g., Outcome Measures in Rheumatology; Analgesic, Anesthetic, and Addiction Clinical Trial Translations, Innovations, Opportunities, and Networks; Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials) are collaborating to standardize definition and instruments for measurement of levels of severity and impact of pain in clinical trials. Ongoing intersectoral collaborations of this nature are highly recommended to minimize heterogeneity in measurement approaches to pain and to deliver a unified message about the importance of measuring pain.

4. Improved methods for identifying attributable impact of musculoskeletal pain on morbidity and mortality from the multiple health states currently not identified as having a musculoskeletal component. Collaboration with other condition groups—particularly those focused on other NCDs, such as mental health and alcohol and substance abuse disorders—is critical for ensuring that integrated measures of health (disease and function) are possible in national and multinational health surveys. One example is the inclusion of musculoskeletal (or locomotor) health as a key component in the WHO concept of intrinsic capacity across the life course.[4] Without explicit collaboration and integration across conditions, health surveillance and performance indicators for NCDs are likely to remain focused on diabetes, cancer, lung disease, and heart disease—at the exclusion of musculoskeletal pain and health. A further example is the integration of the Global Alliance for Musculoskeletal Health survey module in the International Demographic and Health Survey in the Solomon Islands.[19] Integration of musculoskeletal conditions with other health conditions at the data collection phase is likely to enable the integration of musculoskeletal policy with broader health policy.

CONCLUSIONS

Current estimates of the global burden of musculoskeletal pain, although they underestimate the burden, are grounded on a systematic, rigorously evaluated evidence base that was defined for the GBD 2010. Despite the underestimation of total burden, the data remain essential to our understanding and the urgency to address musculoskeletal pain at a global level. In particular, the burden from musculoskeletal pain is likely to rise greatly in low- and middle-income countries because of population growth, aging, and the rise of other risk factors for the burden of musculoskeletal conditions, such as obesity, injury, and a sedentary lifestyle. Although demographic change in developed countries occurred relatively gradually following steady socioeconomic growth over several decades, in many developing countries, this change is being compressed into 2 or 3 decades, and health systems and national economies are ill equipped to deal with this.[21]

The size of the problem clearly requires a significantly accelerated and globally elevated policy response commensurate with the magnitude of the musculoskeletal pain burden. The ambitious United Nations Sustainable Development Agenda and upcoming Decade of Healthy Aging 2020–2030 offer a renewed opportunity for global and national action to reduce global disability through appropriate action on musculoskeletal pain.[22]

There are multiple barriers to the accurate estimation of the health burden of musculoskeletal pain globally; these occur at the measurement level; the professional, organizational, and health services level (meso); and the health systems level (macro). These barriers, however, present opportunities to improve health surveillance processes across the health system, including the provision of more compelling, tangible, and accurate data for decision-makers. This can ultimately lead to improved integration of care across health and social care systems.[23]

System-level reform initiatives, such as changes or enhancements to policy, governance, and health financing, are likely to have the most impactful and sustainable effect on improving population-level musculoskeletal health and system efficiencies.[24] At a systems level, pain and musculoskeletal health are inadequately integrated with other NCDs in the context of health policy and system financing.[25] This issue is observed at a global level (e.g., at the level of WHO) and at national levels across all economies.[21,22,25] Health systems have traditionally been oriented toward prevention and measurement of mortality, rather than the long-term health and social care for people with disabilities.[26]

Current global health surveillance initiatives, action plans, and strategies and performance measures for NCDs (e.g., the Sustainable Development Goals and Global Action Plan for the Prevention and Control of Non-Communicable Diseases 2013–2020)[27] focus on the NCDs that are most strongly associated with premature mortality—cancer, diabetes, heart disease, and lung disease—with interventions aimed to reduce premature mortality, consistent with SDG target 3.4. Until musculoskeletal health and pain are explicitly recognized in policy in an integrated manner with other NCDs and until performance metrics include outcomes beyond mortality, health reform, resourcing, and surveillance activities will likely remain disproportionally focused on cancer, cardiovascular disease, diabetes, lung disease, and mental health. Further, inclusion of musculoskeletal pain into NCD policy and practice provides major opportunities for improving health system efficiencies, integration, and harmonization.

Many nations have demonstrated leadership in tackling the national burden of musculoskeletal pain through the development of policy and models of care to drive system reform, such as the Australian National Pain Strategy[28] and the Relieving Pain in America National Blueprint.[29] Desirable characteristics of national pain strategies have also been described as guidance for other nations, whereby prioritization of improving population-level pain outcomes has not yet occurred (https://www.iasp-pain.org/Advocacy/Content.aspx?ItemNumber=1473). In particular, models of care are important in orienting systems and services toward high-value care options for musculoskeletal pain and away from low-value care.[30] A framework to develop such models of care that aligns with a participatory governance approach and the WHO Framework on Integrated People-Centred Health Services[31] has been developed for low-, middle- and high-income settings[32]; examples in innovation in implementation across settings have been reported.[33,34]

At a service delivery level, the lack of recognition that musculoskeletal pain may be affecting other health conditions is also problematic. For example, musculoskeletal pain limits mobility in older people, culminating in increased cognitive decline, sarcopenia, frailty, loss of independence,[4,6,25] and risk of other NCDs. Until musculoskeletal pain is recognized as a major reason for lack of adherence to, or uptake of, healthy behaviors and rehabilitation,[35] suboptimal health states will prevail. Such a shift requires a transformation in the way health services are delivered to a more integrated care model underpinned by a biopsychosocial approach to care.[23] The impact of pain and musculoskeletal diseases on functional ability should be more explicitly assessed and documented in planning health resources and delivering care interventions aimed at improving functional outcomes.

It is in this important context that we have proposed the steps be taken to better estimate musculoskeletal pain burden—and to do so in a way that works with a broader policy agenda for global health. In essence, what is needed is a dual strategy to strengthen the evidence base (as is the case for all conditions included in the GBD) and a policy response that includes integration of musculoskeletal pain into health surveillance systems for NCDs and injury, sending both hortatory signals and steering system drivers to increased attention and action for musculoskeletal pain. AJPH

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