

# Global Relevance of Literature on Trauma

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**Abstract** The trauma pandemic disproportionately kills and maims citizens of low-income countries although the immediate cause of the trauma is often an industrial export of a high-income country, such as a motor vehicle. Addressing the trauma pandemic in low-income countries requires access to relevant research information regarding prevention and treatment of injuries. Such information is also generally produced in high-income countries. We reviewed two years' worth of articles from leading orthopaedic and general medical journals to determine whether the scientific literature appropriately reflects the global burden of musculoskeletal disease, particularly that due to trauma. General medical journals underrepresented musculoskeletal disease, but within musculoskeletal disease an appropriate majority of papers were regarding trauma, in particular the epidemiology and prevention of injury. Orthopaedic journals, while focusing on musculoskeletal conditions, substantially underrepresented the global burden of disease due to trauma and hardly consider injury epidemiology and prevention. If orthopaedic surgeons

want to maximize their global impact, they should focus on writing about trauma questions relevant to their colleagues in low-income countries and ensuring these same colleagues have access to the literature.

## Introduction

In the new millennium, society faces difficult choices in terms of allocation of scarce resources to medical research. As medical specialists we shoulder the responsibility to ensure research dollars are spent in an equitable manner. As a progressive specialty, we must analyze our research output relative to global mortality and burden of musculoskeletal disease.

Specifically, our orthopaedic colleagues in low-income countries are facing a trauma pandemic that will change the face of musculoskeletal care [1, 5, 7]. They need access to appropriate scientific information to begin to address this.

It is important that orthopaedic research highly relevant to global health be published in widely read orthopaedic and medical journals. Studies published in these journals improve awareness of orthopaedic related global health issues in the general orthopaedic community. Injury and trauma subspecialty journals may be infrequently read by orthopaedic surgeons in general practice or by those in subspecialties other than trauma, which makes the information less accessible to the general orthopaedic community, most of whom are actively involved in treating trauma patients.

We conducted this study to determine whether papers published in leading orthopaedic and general medical journals accurately reflect the morbidity and mortality ascribed to musculoskeletal diseases by the World Health Organization's global burden of disease project. We asked

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Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article. Dr. Howard runs the Ptolemy project described in the accompanying article.

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the following three questions: (1) Does the number of articles published on musculoskeletal conditions reflect the burden of disease attributable to musculoskeletal conditions? (2) Within musculoskeletal disease, does the number of articles published accurately reflect the contribution of injuries, noncommunicable conditions, and infections to global burden of disease? (3) Finally, within articles on injury, are we paying attention to epidemiology and prevention, or only to treatment?

## Materials and Methods

We selected seven medical journals for the purpose of reviewing the subject matter of published papers: (1) four orthopaedic journals: *Journal of Bone and Joint Surgery, American volume*; *Journal of Bone and Joint Surgery, British volume*; *Clinical Orthopaedics and Related Research*; *Journal of Pediatric Orthopaedics*; and (2) three general medical journals: *British Medical Journal*; *Journal of American Medical Association*; and *The Lancet*. These were selected on the basis of the most commonly read/accessed journals by orthopaedic surgeons with high ISI citation indices. They are also widely read internationally by specialist and nonspecialist physicians, and might be expected to accurately reflect the burden of disease in their content. Furthermore, both leading orthopaedic journals and general medical journals may be more accessible to orthopaedic surgeons working in low-income countries than many of the subspecialty journals. We reviewed papers published in all the above-mentioned journals from January 2005 to December 2006. We included original clinical and basic science research papers, editorials, and symposia review articles as well as those in supplement issues, but excluded case reports, book reviews, obituaries, and letters to the editor.

We developed a list of musculoskeletal conditions high on the global priority agenda by adapting information from the WHO global burden of disease project [15]. Mathers and Loncar [7] recently published updated projections of mortality and burden of disease from 2002 to 2030 using methods similar to those of the original Global Burden of Disease (GBD) study [9], based on new input information. Specifically, updated estimates on the spread of HIV/AIDS, tobacco use, body mass index and better statistical data on causes of death in low-income countries have been incorporated into the updated projections that we used. The 2006 projections increase the predicted future impact of noncommunicable diseases, including trauma. The WHO groups diseases into three very broad categories—Group I communicable, Group II noncommunicable, and Group III injuries and violence. Musculoskeletal diseases treated by orthopaedic surgeons are represented in all three broad

categories, although principally come from Groups II and III. Lopez et al. [6] published details of worldwide musculoskeletal disease as part of Group II noncommunicable diseases for cause specific mortality and DALYs. They reported rheumatoid arthritis, osteoarthritis, gout, and low back pain and lumped the remaining conditions as “other musculoskeletal diseases.” Group II also included congenital anomalies, Down syndrome and spina bifida. Group III injuries included those related to road traffic accidents, falls, self-inflicted injuries, various forms of violence, and war.

Woolf and Pfleger [18] reported the burden of major musculoskeletal conditions as recognized by the United Nations and WHO, by endorsing the Bone and Joint Decade 2000–2010. They described four major musculoskeletal conditions: osteoarthritis, rheumatoid arthritis, osteoporosis with low trauma fractures and low back pain. Based on these reports, we developed a list of musculoskeletal conditions high on the global priority agenda. We modified the list to represent an orthopaedic surgeon’s point of view, as many of these conditions are primarily treated by colleagues in related subspecialties as primary care and rheumatology. We added categories to more fully describe each paper, for instance whether it dealt with epidemiology, prevention, or treatment. By scanning the tables of contents and the abstracts a single reviewer (SN) categorized all papers in each journal. We compared the proportion of papers within a category to the corresponding proportion of global burden of disease as estimated by the WHO.

To compare musculoskeletal conditions (as classified above) to each other and to other health conditions, we used two measures of burden of disease, disability-adjusted life years (DALYs) [14] and mortality, as used by the WHO [9]. Mortality is based only on the number of deaths, whereas DALY is defined as the sum of life years lost because of premature death and years lived with disability adjusted for severity. One DALY is approximately equivalent to one lost year of healthy life. The construct of a DALY is weighted so that adults in their economically productive years are more highly valued than children and adolescents and therefore undervalues loss of life and potential during childhood; this may underestimate the true burden of diseases such as trauma in low-income countries where half the population is comprised of children and mortality during childhood is common. To calculate the global burden of disease directly related to orthopaedics, we used the data reported by Mathers and Loncar [7]. To calculate the denominator for DALYs attributable to musculoskeletal burden of disease, in Group 1, communicable diseases, we assumed 5% of the total infectious diseases burden to have orthopaedic implications. (This assumption is based on minimum estimates of reported

sites of origin for hospitalized patients with gram positive bacteremias or tuberculosis [12, 13, 17, 19].) In Group 2, noncommunicable diseases, in addition to musculoskeletal diseases (section L), we also included two congenital abnormalities (section M), Down syndrome and spina bifida, conditions which are regularly seen in a pediatric orthopaedic subspecialty practice. In Group 3, injuries section, we included RTA, falls from unintentional injuries, self-inflicted injuries, and injuries from violence and war in the intentional group injury section to calculate our denominators. We used similar groups to calculate the denominator for mortality, with the difference that in Group 1, communicable diseases, we assumed 1% mortality from orthopaedic infections. (This assumption is based on minimum estimates from national data regarding mortality from vertebral osteomyelitis, and hospital data on child mortality from *Staphylococcus aureus* bacteremia [3, 4].)

Finally, we performed a sensitivity analysis to determine the effect that assumptions made in calculating disease burden would have on the answers to the questions posed. Specifically, for those conditions (infections, trauma) which were underrepresented in the literature we determined by what multiple the estimate of disease burden would need to shrink in order to conclude that the burden of disease was appropriately reflected in the literature.

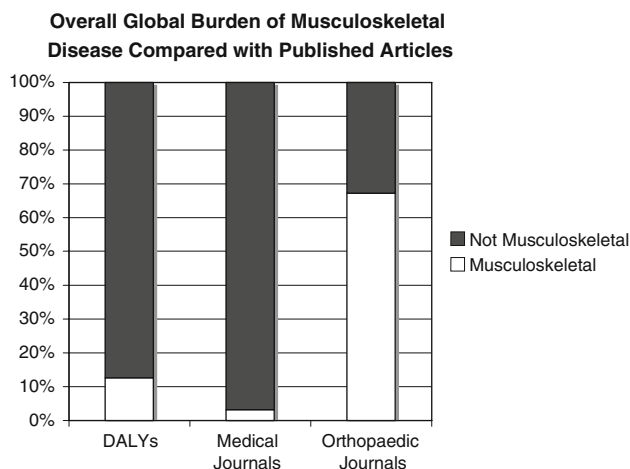
## Results

We reviewed a total of 6614 papers: 2677 papers from the four orthopaedic journals and 3937 papers from the three medical journals. This represents all papers published by the journals of interest during 2005 and 2006. After excluding the miscellaneous group from the orthopaedic papers, we found the most publications were about arthroplasty (30%), followed by trauma management (18.3%) and congenital anomalies (6.6%). During these two years only two papers related to injury epidemiology and prevention. During the same period 66 items in the three general medical journals were published regarding injury epidemiology and prevention. Similarly, during the same period there was only one publication in this orthopaedic literature regarding back pain prevention, whereas the general medical publications contained 11 manuscripts on this topic. Excluding the miscellaneous groups, the highest number of papers according to etiology was trauma (15.5%), followed by arthritis (8.5%), and congenital anomalies (7.4%). Of the total papers, 52.7% exclusively targeted adults whereas 18.4% targeted children.

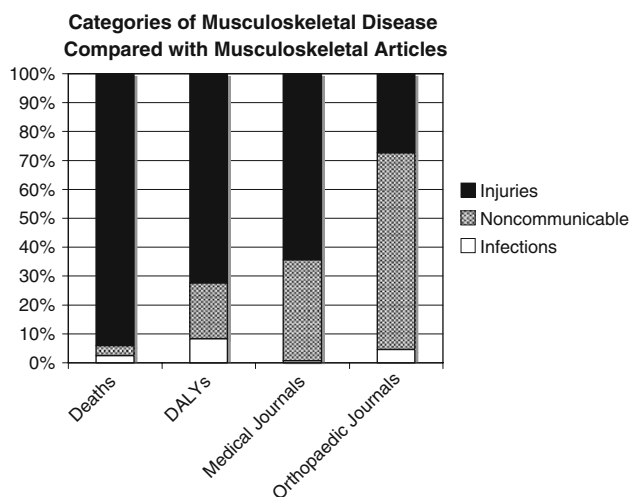
Although we estimate that musculoskeletal conditions account for 12.6% of global DALYs lost, only 3.2% of the articles in general medical journals addressed

musculoskeletal conditions: a substantial underrepresentation (Fig. 1). By comparison, 67.3% of the papers published in orthopaedic journals directly addressed the musculoskeletal conditions in the adapted WHO classification.

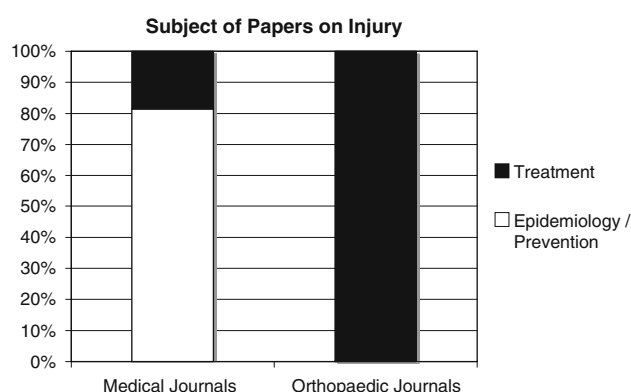
Injuries accounted for 72% of the total DALYs lost to musculoskeletal conditions and for 94% of the deaths, but for only 64% of musculoskeletal publications in general medical journals, and for only 27% of publications in orthopaedic journals (Fig. 2).



**Fig. 1** Musculoskeletal problems contribute 12.6% of the global burden of disease but are dealt with in only 3.2% of the papers in high impact general medical journals. Unsurprisingly, most of the papers in orthopaedic journals address musculoskeletal problems.



**Fig. 2** Among musculoskeletal problems, injuries contribute the highest proportion of global burden of disease; 94% of the mortality and 72% of the morbidity. About 64% of papers on musculoskeletal topics in general medical journals address injury, but only 27% of papers on musculoskeletal topics in widely read orthopaedic journals address injury. Widely read orthopaedic journals therefore underrepresent injury compared with its contribution to musculoskeletal burden of disease.



**Fig. 3** Papers in general medical journals about musculoskeletal injury discuss epidemiology or prevention in 81.5% of cases, and discuss treatment in only 18.5%. Papers in orthopaedic journals about musculoskeletal injury discuss treatment 99.6% of the time, only two papers (.4%) were found in 2005 and 2006 that discussed injury epidemiology or prevention. Orthopaedic journals do not currently reflect a public health approach to injury as a disease.

In general medical journals 81.5% of papers about injury were about epidemiology or prevention, and 18.5% about treatment (Fig. 3). In orthopaedic journals, in contrast, only 2 papers (0.4%) of 498 about injury addressed either epidemiology or prevention, almost all were about treatment.

The sensitivity analysis showed that the results were robust across a wide range of assumptions. For trauma, if the mortality burden decreased 51.9 fold and the morbidity burden decreased 6.9 fold, the burden of disease would be appropriately reflected in the literature. For infection, if the mortality burden decreased 3.1 fold and the morbidity burden decreased 9.3 fold, the burden of disease would be appropriately reflected in the literature. If the estimates we have used are accurate to within these large multiples, then the conclusions that trauma and infections are underrepresented would not change.

## Discussion

We wanted to determine whether the topics of papers published in general medical journals and in orthopaedic journals accurately reflect the global burden of musculoskeletal disease. Although we estimate that musculoskeletal conditions accounted for 12.6% of global DALYs lost, only 3.2% of the articles in general medical journals addressed musculoskeletal conditions: a substantial underrepresentation. Unsurprisingly, most papers published in orthopaedic journals directly addressed musculoskeletal conditions. Injury is the major contributor to the global burden of musculoskeletal disease. Injuries account for 72% of the total DALYs lost to musculoskeletal conditions and 94% of

the deaths. Injury was somewhat underrepresented in musculoskeletal papers in general medical journals, and was markedly underrepresented in orthopaedic journals, compared with its contribution to global burden of disease measured by either death or disability. Furthermore, general medical journals addressed injury epidemiology or prevention in over 80% of musculoskeletal injury related articles, but these topics were barely acknowledged (2 papers in 2 years, under 0.5% of the total injury papers) in orthopaedic journals.

There are several limitations to this study. First, the data are based on review of manuscripts published over two years in selected orthopaedic and medical journals based on their circulation and high ISI citation indices and therefore do not reflect articles published in orthopaedic subspecialty journals. The results would certainly look different if we had included subspecialty journals focusing on trauma, but these may not be widely read outside their subspecialty and are unlikely to influence the overall direction of the profession the way the more widely circulated and cited journals do. Second, the musculoskeletal global burden of disease criteria are not mutually exclusive (eg. one could have an infected arthroplasty) and to address this problem we cross-classified the papers and then simplified. Third, we treated trauma as a single disease entity rather than try to subdivide it by system that the data do not allow. Although not all deaths from trauma are orthopaedic deaths, most treatable causes of traumatic death are readily managed in the emergency department by any surgeon with trauma life support training, and trauma resuscitations regularly include orthopaedic surgeons and trainees. Orthopaedic surgeons working in injury prevention can potentially affect injury deaths and disabilities involving many organ systems beyond the musculoskeletal. Furthermore, the sensitivity analysis showed trauma would still be underrepresented in our literature if we attribute only 1/50th of the present mortality and 1/7th of the present morbidity to it so we believe it is fair to say that the orthopaedic literature underrepresents the global burden of trauma.

“The Burden of Musculoskeletal Conditions at the Start of the New Millennium”, a WHO report released in 2003, aims to better prepare nations for the increase in disability brought about by the global rise in musculoskeletal conditions [18]. These musculoskeletal conditions are the most frequent cause of disability and among the most costly illnesses because of the long-term care and support they require, and have been a major reason for development of the Bone and Joint Decade. Total costs of musculoskeletal disease in the US in 2000 have been estimated at US \$254 billion. In developing countries, the figure is estimated at US \$100 billion, nearly twice that of total foreign aid for these nations.

The reasons for the continuing rise in numbers of those affected by musculoskeletal conditions include the epidemiological transition in the developing world, with successful treatment of communicable diseases combined with a rapid increase in road traffic injuries.

Around the world, almost 16,000 people die from injuries every day. For every person who dies of injuries, several thousand injured persons survive, but many of them are left with permanent disabling sequelae [5]. According to Krug et al. [5] the traditional view of injuries as “accidents” or random events has resulted in the historical neglect of this area of public health. However, the most recent estimates document injuries are among the leading causes of death and disability in the world. They affect all populations, regardless of sex, income, or geographic region. Using WHO data, they showed that in high-income countries, road traffic injuries, self-inflicted injuries, and interpersonal violence are the three leading causes of death among people aged 15 through 44 years. Furthermore, they also reported that even in low- and middle-income countries, where infectious diseases are predominant, these three types of injuries are among the leading causes of death. In addition, drowning and war-related injuries were among the leading causes of death in these countries. When disability resulting from injuries is taken into consideration, injuries appear as an even more important health problem. This is because injuries affect many young people, resulting in a large number of years lost because of premature death or a large number of years lived with disability.

In the larger scheme of things, the important question is how orthopaedic surgeons as a specialty can positively influence this global trend. Stanitski, reflecting on the evolution of orthopaedics, noted it is embarrassing to admit we are no closer to understanding the etiologies and pathophysiologies for a number of pediatric orthopaedic conditions than we were 30 years ago [11]; they remain “idiopathic”. While our joint arthroplasty colleagues continue to modify implants to provide the most dramatic orthopaedic quality-of-life improvement in the past 3 decades, the etiologies of primary degenerative joint disease and rheumatoid arthritis remain elusive. The leadership of the AOA has cautioned that focusing only on surgical procedures will ensure orthopaedic surgeons are considered as “technicians” available for the ever-shrinking list of invasive “salvage” operations [2]. Certainly operations for trauma will be on this list for a long time—but do we lack the curiosity and the humanity to go after the etiology of injury, and to prevent injuries rather than merely improving their treatment?

Among the important lessons learned during the past decades is injuries are preventable. A public health approach is required in orthopaedics, and public health training to target priority areas is necessary. This is even more important today because left alone, things are getting

worse rather than better. The approach to injury prevention must be multidisciplinary and intersectoral. In many cases it is only through effective collaboration between orthopaedic surgeons, sociologists, psychologists, lawyers, politicians, engineers, designers, human rights experts, journalists and other professionals from the public and private sectors that the right injury prevention strategy can be developed and promoted. Providing secondary and tertiary prevention through appropriate prehospital and hospital care and rehabilitation are classic areas of intervention for the health sector. Less classic is primary prevention. Using seat belts in cars is but one example that has contributed to a decrease in injuries.

A good start might be to advocate for the inclusion of a burden of disease factor in the health sector and research funding formulae [1]. Academic journals can dedicate a certain proportion of their publication space to musculoskeletal global burden of disease issues. Increasing awareness is the first step to change. It is also important to make space in respected medical journals available to researchers in low-income countries so that their solutions to large and practical problems can be disseminated throughout the world surgical community. Although some injury prevention strategies developed in high-income countries will be appropriate for low- and middle-income countries, others will not [20]. For example, the patterns of traffic and road traffic injuries in low- and middle-income countries are very different from those in high-income countries, since there are a much larger proportion of vulnerable road users in the lower- and middle-income group. Road and vehicle designs that eliminate risk of serious injuries to vulnerable road users are not available at present [8]. Individual surgeons can therefore build relationships with colleagues in other countries through organizations such as Orthopaedics Overseas, World Orthopaedic Concern, and the International Center for Orthopaedic Education, or through bilateral partnerships involving fair exchange of personnel, ideas, techniques and research expertise between institutions.

Our future is dictated in part by how we respond to the present. At present, the promise of the internet as a means of providing the information to respond to the trauma pandemic is only partially fulfilled. Even if the medical literature were freely available to all, it does not accurately reflect the global burden of musculoskeletal trauma. General medical journals underrepresent musculoskeletal conditions, although they accurately reflect trauma as the major contributor to musculoskeletal morbidity and they appropriately focus on epidemiology and prevention. Orthopaedic journals, on the other hand, allocate 27% of articles to the 72% of morbidity and 94% of mortality which trauma represents among the global burden of musculoskeletal disease. More worryingly, orthopaedic journals almost exclusively discuss treatment of injuries and do not



venture into epidemiology or prevention. The orthopaedic community decides what we will read and write about and influences how far our writings are disseminated. Addressing the global burden of disease due to injury requires us to focus more on prevention, epidemiology, and treatment applicable to low-income country settings.

Governments who pay for health care will likely find that effective injury prevention programs are actually cost saving. Effective interventions to prevent road injuries include those aimed at speed, alcohol use, seat belts and child restraints for motor vehicle occupants, helmets for cyclists and motorcyclists, and visibility for pedestrians. Guidelines summarizing what works and how to implement and evaluate road safety programs were published by the WHO in 2004 [10], with an updated manual on implementing speed reductions published in 2008 [16]. Hospitals and health care providers can plan a system response to injury, including prehospital care and transportation, primary and referral level management of injuries, and rehabilitation. Orthopaedic leaders, educators, and researchers can teach and write about injury at a systems level. In particular, we need to approach injury with a public health mindset and train the next generation of surgeons to participate fully in research, prevention, and treatment of injuries. Our journals may want to prioritize or highlight important public health aspects of injury (the current issue is an example) but as our mindset changes to consider injury an important, single, preventable disease so will our literature change. The brunt of the injury pandemic will be felt by patients and our colleagues in low- and middle-income countries. Each of us can take practical steps outlined above to extend the reach of academic orthopaedics to include a public health approach to injury in low and middle income countries. This will diminish the human costs of the coming injury pandemic.

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