

THE ORTHOPAEDIC FORUM



THE BURDEN OF ORTHOPAEDIC DISEASE IN DEVELOPING COUNTRIES

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Abstract: The global burden of musculoskeletal disease in low and middle-income countries is large, growing, and neglected. While there is considerable funding for the control of communicable disease, there has been little attention paid to either the prevention or the treatment of orthopaedic problems in developing countries. “Safe Roads” was the theme for World Health Day 2004, and this paper examines the magnitude of injury in low and middle-income countries, as well as the motors powering its growth, and addresses the balance between the prevention and the treatment of injuries. Finally, it calls upon orthopaedic surgeons in developed countries to build partnerships with their colleagues in less developed countries to improve clinical care, teaching, and research aimed at reducing the global burden of injury.

Public attention, insofar as it concerns itself with the health of people in low and middle-income countries¹, has focused on communicable disease and nutrition, yet there is abundant evidence demonstrating that musculoskeletal trauma constitutes an enormous and steadily increasing proportion of the global burden of disease. There are advanced and well-funded programs to combat the human immunodeficiency virus and malaria², but, as surgeons, we are far behind in developing a comprehensive approach to injuries. “Safe Roads” was the theme for World Health

Day on April 7, 2004³. This is an opportunity for orthopaedic surgeons worldwide to embrace the challenges of reducing the burden of orthopaedic injury in developing countries—to bring their considerable professional weight to bear in support of programs aimed at the training and support of those who treat musculoskeletal injury and to build research and training partnerships with their colleagues in developing countries.

Magnitude of Injury

The estimates upon which the World

Health Organization bases its rates of mortality and burden of disease are flawed in many ways, but they remain the most reliable figures available. In 2001, injuries of all sorts killed 5.1 million people and accounted for 12% of the disability-adjusted life years (DALYs)* lost worldwide, which was more than that lost because of tuberculosis (2.5%), diarrhea (4.3%), and malaria (2.9%) combined and was twice as much as that lost to either the human immunodeficiency virus (6%) or cancer (5.2%)⁴. The leading cause of death in low and middle-income coun-

*The World Health Organization uses disability-adjusted life years to measure and compare the global burden of disease across populations. Disability-adjusted life years are calculated by adding the years of life lost to premature mortality and the years lived with a disability for incident cases of the health condition. The years lived with a disability are weighted according to the severity of the disability, and an age factor is added to the calculation whereby death and disability among children and young adults is weighted more than that among infants and the elderly. Disability-adjusted life years divide the burden of disease according to etiology, and some recent work has looked at the burden of disease in terms of the attributable risk of certain behaviors, such as smoking and drinking alcohol. Another way to look at the global burden of disease is by the skill set required to treat diseases such as injury. Thus, orthopaedic disease includes fractures, congenital abnormalities, and infectious and degenerative diseases of the bones and joints, conditions that are all treatable by manipulation or incision and are preventable by a common group of interventions.

tries among people between the ages of five and forty-five years is injury, and the leading cause of disease burden among children between the ages of five and fourteen years in low and middle-income countries is falls, followed by road-traffic injuries¹. For each person who dies from trauma, three to eight more are permanently disabled^{5,6}.

Predicted Trends

Injury presently accounts for 12% of the global burden of disease and is predicted to increase to 20% by the year 2020. By that time, road-traffic injuries, now ranked the ninth leading cause of disability-adjusted life years lost, will be the third leading cause for the global population⁷. Traffic injury is already the third leading cause of death after malaria and lower respiratory infections for children between the ages of five and fourteen years in low-income countries and is the second leading cause of death after the human immunodeficiency virus for people between the ages of fifteen and forty-four years¹. Population rates of death resulting from traffic accidents are three times higher in low-income countries (thirty per 100,000 children) than in high-income countries (ten per 100,000 children)⁸.

Omran coined the term “epidemiologic transition” to describe the historical change in disease patterns⁹. The age of famine and pestilence, which describes most of European history, was characterized by a predominantly young population that died largely of nutritional and communicable disease. The age of receding pandemics describes the situation from the mid-nineteenth century onward when improvements in the standard of living and medical care led to an increase in the number of people who died of noncommunicable, degenerative, and often man-made diseases. Finally, contemporary, wealthy Western nations are in the age of the degenerative and man-made diseases, which include arthritis, diabetes, obesity, vascular disease, and cancer. It is informative to

map this historical pattern onto contemporary geography. Famine and pestilence predominate in the poorest countries of sub-Saharan Africa, where injury accounts for 9% of the disease burden (Fig. 1). But the majority of the world’s population, and the part with the highest growth rate, lives neither in the poorest nor in the richest countries but in the great lands of Asia and South America. It is in these countries where the burden of injury is growing and now approaches 20%. Picture those crowded cities where a helmetless family of four astride a rickety motorcycle negotiates mixed traffic where pedestrians, trucks, handcarts, buses, taxis, and bicycles balancing full-grown pigs all share the same space on the road.

Reducing the Burden

Prevention and treatment have complementary roles that vary with the condition under consideration. As there is no effective treatment for drowning, prevention is the only option; however, as long as mangoes grow at the end of

branches, small boys will fall out of trees and break an arm trying to pick them (Fig. 2). In many developing poor countries, such as pediatric fractures, a relatively normal event of childhood in countries such as Canada, often cause lifelong disability that could be prevented by prompt, simple, inexpensive initial treatment. Injury is amenable to both prevention and treatment, and opportunities to improve both are greatly underexploited.

Injury Prevention

Effective preventive strategies must focus on the vulnerable road user—that is, the pedestrian, cyclist, or motorcyclist—who is at much greater risk than the vehicle occupant. Research into the effectiveness of specific measures to control traffic injury is desperately needed, and it needs to be conducted in developing countries by local researchers who know the right questions to ask in order to discover practicable solutions and who will be present to steer their research findings into action. Primary prevention may include environ-

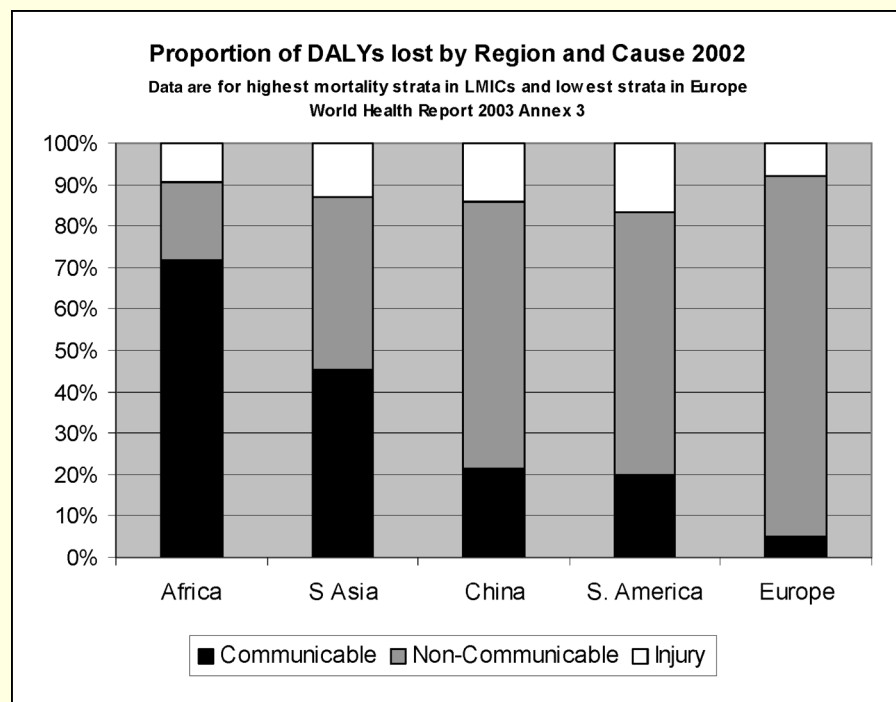


Fig. 1

The epidemiologic transition, according to data from the World Health Organization²⁵. DALYs = disability-adjusted life years, and LMICs = low and middle-income countries.



Fig. 2
A small boy in a mango tree. (Photograph courtesy of Mychaylo Prystupa.)

mental modifications (i.e., traffic-calming measures, such as signals, traffic separation, and speed bumps), enforcement of speed and alcohol legislation, and public education. Secondary prevention (i.e., the use of helmets, seatbelts, and pedestrian-friendly vehicles) can also play a role. The assumption that general economic development will somehow bring lower injury rates is false. Development brings more kinetic energy and more injury. The traffic-related death rates in East Germany went up dramatically after the Berlin Wall fell and motorized transport grew rapidly¹⁰.

When injury prevention is possible, such measures have clear attractions and have saved hundreds of thousands of lives in developed countries¹¹. Physical interventions closest to the kinetic energy exchange (e.g., seat belts and helmets) are often the most effective measures¹². The enforcement of speed limits, by police or by speed bumps, reduces the available kinetic energy. Alcohol intoxication is a pervasive risk factor for many injury mechanisms. Infrastructure development such as safer road engineering may be effec-

tive but remains expensive. Public education plays a supporting role but may be very expensive per life saved because of the difficulties of changing behavior. Evaluations of the cost-effectiveness of injury control measures in low-income country settings are needed.

Improvement of Surgical Care for the Injured

Much of the death and disability from injury is attributable to absent or inadequate surgical care. Daar et al. estimated that 10% of all deaths in developing countries and 20% of the deaths among young adults can be prevented by simple surgical and obstetrical interventions⁶. The hospitals already exist but are poorly staffed and equipped following twenty years of policy neglect in favor of prevention and primary care. Villagers do not necessarily share the public health perspective—what they want is affordable access to a reasonable standard of acute care when they are sick. Would you rather have a school lunch program or somewhere to take your daughter when she breaks her arm? The cost of treatment varies from place to place, but it is generally low and

certainly more easily quantifiable than the cost of prevention. Beyond the humanitarian imperative of caring for the injured, the cost-effectiveness of providing basic surgical services may be competitive with widely accepted prevention programs, such as vaccination, because surgical services deal only with those who are injured, whereas, to be effective, a vaccination program must reach all individuals. The importance of providing basic surgical services at the district hospital level was acknowledged in the 1993 World Health Report, *Investing in Health*¹³. However, there are currently only 400 surgeons in eight East African countries to serve over 200 million people and only about forty of the surgeons are orthopaedists. Building the orthopaedic skills to improve trauma care will also result in better treatment for other congenital and acquired conditions that cause lifelong morbidity in low-income countries and that respond well to low-technology treatment^{14,15}. Education of frontline health-care workers in the appropriate treatment of orthopaedic patients is important, as is increasing the number of orthopaedists available to provide care and teaching.

However, it is not enough to augment the clinical forces in Africa—research is necessary to paint the big picture, to demonstrate cost-effective treatments and determine the correct balance between prevention and treatment. The Global Forum for Health Research described the 10/90 gap in health research expenditure, whereby 90% of the spending is on diseases affecting 10% of the population; that is, the research is directed largely to medicine to treat chronic disease among the aging population in wealthy countries¹⁶. International research expenditures have trivialized the burden of disease attributable to injury, especially in developing countries^{17,18}.

Future Directions

“Safe Roads” was the theme for World Health Day on April 7, 2004. Organized orthopaedics can use its considerable weight to redress the policy imbalance

that largely ignores the burden of injuries in developing countries^{19,20}. A good start might be to advocate for the inclusion of a burden of disease factor in the health sector and research funding formulae. Academic orthopaedic surgeons have an impressive history of clinical, outcomes, and cost-effectiveness research and could partner effectively with their counterparts in developing countries who have the cases and numbers but neither the time nor the expertise to work them into meaningful research. The Bone and Joint Decade²¹ could play a key role in this matter. Academic journals can dedicate a certain proportion of their publication space to health issues in the developing world. Increasing awareness is the first step to change, but it is also important to make space in respected medical journals more available to researchers in developing countries so that their solutions to large and practical problems can be disseminated throughout the world surgical community. Finally, individual surgeons can build relationships with colleagues in developing countries through organizations such as Orthopaedics Overseas²², World Orthopaedic Concern²³, and the International Center for Orthopaedic Education²⁴, or through bilateral partnerships involving the fair exchange of personnel, ideas, techniques, and research expertise between institutions. Most surgeons who become involved in international health grow to regard it as the most rewarding element of their practice.

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References

- Krug E, editor.** *Injury: a leading cause of the global burden of disease.* Geneva: World Health Organization; 1999 (document WHO/HSC/PVI/99.11; available from the Department of Injuries and Violence Prevention, World Health Organization, 1211 Geneva 27, Switzerland).
- The Global Fund to Fight AIDS, Tuberculosis and Malaria.** *Global fund grants—progress summary (rounds 1-3).* www.theglobalfund.org/en/files/grantsstatusreport.xls.
- World Health Organization.** *World Health Day 2004: road safety.* www.who.int/world-health-day/2004/en.
- World Health Organization.** *World health report 2002. Statistical annex 3: burden of disease in DALYs by cause, sex and mortality stratum in WHO regions, estimates for 2001.* www.who.int/whr/2002/en/
- Kobusingye O, Guwatudde D, Lett R.** Injury patterns in rural and urban Uganda. *Inj Prev.* 2001;7:46-50.
- Daar AS, Rizvi SA, Naqvi SA.** Surgery with limited resources. In: Morris PJ, Wood WC, editors. *Oxford textbook of surgery.* 2nd ed. New York: Oxford University Press; 2000. p 3386.
- Murray CJL, Lopez AD, editors.** *The global burden of disease. A comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020.* Cambridge, MA: The Harvard School of Public Health, on behalf of The World Health Organization and The World Bank; 1996.
- Barss P, Smith G, Baker S, Mohan D.** *Injury prevention: an international perspective. Epidemiology, surveillance, and policy.* New York: Oxford University Press; 1998.
- Omran AR.** The epidemiologic transition. A theory of the epidemiology of population change. *Milbank Mem Fund Q.* 1971;49: 509-38.
- Clark DE, Wildner M, Bergmann KE.** Injury mortality in East Germany. *Am J Public Health.* 2000;90:1761-4.
- World Health Organization.** *World report on road traffic injury prevention.* Geneva, World Health Organization; 2004. p 158. www.who.int/world-health-day/2004/infomaterials/world_report/en.
- Miller TR, Levy DT.** Cost-outcome analysis in injury prevention and control: eighty-four recent estimates for the United States. *Med Care.* 2000;38:562-82.
- World Bank.** *World health report: investing in health.* New York: Oxford University Press; 1993. p 112.
- Ponseti IV.** Treatment of congenital club foot. *J Bone Joint Surg Am.* 1992;74:448-54.
- Ramsey PL, Lasser S, MacEwen GD.** Congenital dislocation of the hip: use of the Pavlik harness in the child during the first six months of life. 1976. *J Bone Joint Surg Am.* 2002;84:1478.
- Global Forum for Health Research.** *Helping correct the 10/90 gap.* www.globalforumhealth.org/pages/index.asp.
- Roberts I, Hoford T, Edwards P.** The World Health Organization and the prevention of road injuries: phone book analysis. *BMJ.* 2001;323:1485.
- Isaakidis P, Swingler GH, Pienaar E, Volmink J, Ioannidis JP.** Relation between burden of disease and randomised evidence in sub-Saharan Africa: survey of research. *BMJ.* 2002;324:702.
- Dormans JP, Fisher RC, Pili SG.** Orthopaedics in the developing world: present and future concerns. *J Am Acad Orthop Surg.* 2001;9:289-96.
- Dormans JP.** Orthopaedic surgery in the developing world—can orthopaedic residents help? *J Bone Joint Surg Am.* 2002;84:1086-94.
- Bone and joint decade. www.boneandjointdecade.org/background/default.html.
- Health volunteers overseas: improving global health through education. www.hvoua.org.
- World Orthopaedic Concern. www.worldorthopedicconcern.org.
- International Center for Orthopaedic Education. www.icoe.aoassn.org.
- World Health Organization.** The world health report 2003—shaping the future. Statistical annex 3: burden of disease in DALYs by cause, sex and mortality stratum in WHO regions, estimates for 2002. www.who.int/whr/2003/en.