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SURGICAL SYMPOSIUM CONTRIBUTION

Surgical Burden of Musculoskeletal Conditions in Low- and Middle-Income Countries

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Abstract

Background The burden of musculoskeletal conditions is growing worldwide. In low- and middle-income countries (LMIC), the burden cannot be fully estimated, due to paucity of credible data. Further, no attempt has been made so far to estimate surgical burden of musculoskeletal conditions. This is a difficult task and accurate estimation of what would constitute surgical burden out of the total musculoskeletal burden in LMIC is not possible, due to number of constraints.

Methods This review looks at current understanding of the musculoskeletal conditions, that can be measured in LMIC and the limitations based on previous studies and past global burden of diseases estimates.

Results An attempt has been made to identify major conditions where a range of surgical burden can be predicted.

Conclusion We conclude that there is huge scope for improvement in the current surveillance mechanism of surgical procedures undertaken for musculoskeletal conditions in LMIC so that the surgical burden can be more accurately predicted. Unless this burden can be highlighted, the attention to these conditions in LMIC will be limited.

Introduction

Musculoskeletal (MSK) disorders encompass a wide range of conditions affecting musculoskeletal system, including injuries. The burden of these conditions is growing worldwide and has an enormous impact on the healthcare systems and the economies across the world. Low- and middle-income countries (LMIC) are not an exception.

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Barely a decade ago, there were almost no reliable data from LMIC on the burden of surgical conditions, met and unmet. Numerous studies have been recently published, using different data collection tools, in particular the Surgeons Overseas Surgical Assessment Survey (SOSAS). This has enabled us to better assess this burden, mainly in sub-Saharan Africa, but also in other LMIC [1]. Unfortunately, almost none of the results are presented in strata that are system specific, to define burden of MSK. Still some significant work has been done to arrive at burden of injuries, of which approximately 75% would involve MSK but for other conditions, including degenerative, inflammatory and congenital diseases, the information for LMIC is sparse, at present.

This review article captures various published estimates around the burden of MSK disorders and for the first time attempts to arrive at surgical burden of these conditions in LMIC. LMIC are identified by the World Bank based on their national income levels. The countries are classified

based on their per capita income using World Bank Atlas method. See Box 1.

It is difficult to accurately estimate the surgical burden of the musculoskeletal conditions in LMIC due to paucity of reliable data and variety of other reasons. The aggregate number of patients globally, with diagnosis of MSK conditions, that may benefit by some surgical procedure either as a definitive treatment, symptomatic relief or palliative care is quite large and undoubtedly increasing. Therefore, the estimation of this burden should be regularly examined [2]. The surgery chapter in the Disease Control Priorities (DCP) 2 book, attempted for the first time to estimate the global burden of surgery. Using a very conservative approach and based on weak data, the estimate was 11% [3]. More recent studies, still based on expert opinion, suggest the global burden of surgery to be in the 28–30% range [4]. No attempt has been made to stratify the estimates by system (MSK, cardiovascular, etc.) or by income (low- and middle-income countries). Weiser et al. tried to estimate the provision of surgical care according to income level: low-income, low-middle-income, high-middle-income and high-income countries [5]. Low- and lower-middle-income countries account for 70% of the world population yet account for only 26% volume of major surgery. Adding upper-middle-income countries now includes 85% of the world population and 41% of the major surgical volume. The remaining 15% of the population in high-income setting receives three out five major surgical procedures [6].

Scope of surgical burden of MSK disorders

The surgically amenable MSK conditions are not distinctly identifiable. Many MSK conditions, appearing as a minor insignificant ailment can gradually lead to surgery, over a period of time and that transition is unpredictable. In LMIC in general, the threshold for surgical interventions is quite high and many diseases and conditions are never surgically treated or surgical options are explored only when the disease is in very advanced stage.

Box 1 Classification of countries as per their income level (World Bank 2016)

Country classification	Gross per capital income (2015) in US Dollars
Low income	<1025
Lower-middle income	1026–4035
Upper-middle income	4036–12,475
High income	>12476

Further, there is no agreement as to what can be included in "surgically curable diseases" amongst MSK disorders. However, it is obvious that such conditions should include any MSK diagnosis where a surgical intervention may offer temporary relief, definitive cure or just palliative care. Another dilemma is that many of these conditions may not be truly "surgical" and may not need the use of a scalpel or anaesthesia. Airway support in an airway-compromised patient, resuscitation in haemorrhagic shock or immobilization of an extremity following fractures are such examples. In LMICs, many of these interventions are not performed by "surgeons" and neither would they require operation theatres. "Skilful observation" of a conservatively treated fracture by an orthopaedic surgeon might be considered a surgical act, the same way a general surgeon may choose to "observe" a lacerated spleen as a treatment option. However, this situation may gradually change in LMIC for many conditions, as the evolution may dictate the need for an open procedure and the "standard of care" may change in these settings for conditions, for which nonoperative options are considered at present. This is a dynamic situation and the transition is inevitable, as more training and resources are available to the surgeons in LMIC. A more rational approach to account for these dynamics and some consensus amongst the stakeholders will be needed to identify and resolve such complex issues.

The surgical burden of MSK should broadly consider injuries, degenerative, inflammatory, infective, congenital and malignant conditions prevalent in LMIC.

WHO technical report (2003) to estimate global burden of MSK conditions mainly considered rheumatoid arthritis (RA), osteoarthritis (OA), osteoporosis (OP), spinal disorders and severe limb trauma [7]. However, the estimate of surgical burden LMIC would be incomplete if infections and congenital conditions are not included.

Rheumatoid arthritis

The burden of rheumatoid arthritis (RA) in public health studies to ascertain the epidemiology of MSK disorders has changed several times because of the lack of agreement on common diagnostic criteria. The current literature commonly reflects the incidence of RA in Caucasian population. The studies from Africa, Asia and South America are scanty. There is undifferentiated arthritis also grouped as RA. RA is one of the most frequently seen joint conditions across some communities. American College of Rheumatology (ACR) has published diagnostic criteria for its diagnosis, and these are popular amongst the clinicians [8]. The surgery for RA in most LMICs continues to be limited currently to the countries and a few centres, where joint replacement surgeries are available.

Osteoarthritis

OA is a degenerative condition and contributes significantly to the disability burden, especially amongst geriatric population. OA can be diagnosed by symptoms in the affected joints and also on the degenerative changes seen on plain radiographs.

As the onset of OA is gradual and progression is unpredictable, the precise incidence is not easy to estimate. Further, there is no clarity as to at what stage, a "new case" should be considered. Therefore, there is no reliable global epidemiological information for OA. From studies available in high-income countries, it can be assumed that around 10% of population above the age of 60 would have joint symptoms that can be due to OA. It is seen that the OA symptoms start in the fifth decade of life and peak over seventh decade in men and women; however, women outnumber men in OA affecting the knee [9]. There are differences in profile of the patients and the joints affected by OA in several LMIC.

Osteoporosis

OP is defined as "a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk" [10]. A bone densitometry result less than 2.5 standard deviations (−2.5 SD) is diagnostic of OP. Clinically, osteoporosis generally presents with typical fractures around proximal femur, distal radius and in the spine, with minor or no trauma. Osteoporosis and such fractures can be very disabling and are often associated with other comorbidities leading to death in the elderly. As per the literature from developed countries, the incidence of osteoporotic hip fractures continued to rise until 1980 and then stabilized or actually saw some reduction in subsequent decades. A small number of studies from Asia indicate that the number of such fragility fractures may be on the rise in Asia [11]. As people tend to live longer worldwide, the geriatric population, vulnerable to such injuries, is going to rise significantly. By 2050, approximately 6.3 million people globally would sustain hip fractures due to osteoporosis, if we consider the identical rate of incidence, in years to come [11]. It is well known that the incidence of osteoporosis varies by age, gender and race.

Spinal disorders

Spinal disorders constitute a diverse group of specific diagnosis and nonspecific musculoskeletal disorders in and around the spine. These include fractures, repetitive mechanical injuries, injury to the spinal cord, inflammatory and degenerative aetiologies, infection and neoplasms. The affections of the back muscles, nerves, intervertebral discs, joints, cartilage, tendons and ligaments of cervical, thoracic and lumbar region can be clubbed under nonspecific MSK conditions. Regardless of the aetiology, the pain in the lower back or in the neck is the most common presenting symptom. To arrive at a diagnosis amongst these complex aetiologies is not easy even for a specialist and it is documented that an accurate diagnosis can be offered to only 15% of the patients, after full clinical examination and using currently available diagnostic tools and imaging technologies [12].

Mainly due to lack of consensus on classification and nomenclature used for diagnosis of conditions leading to back pain, the prevalence of spinal disorders varies very widely globally [13, 14]. It is commonly acknowledged that this lack of uniform classification is the main impediment to estimate the epidemiological data for spinal disorders [7].

Infections, congenital conditions and others

In LMIC, the incidence and prevalence of infective conditions and their sequelae are quite significant. These conditions include septic arthritis, acute and chronic osteomyelitis, skeletal TB, polio and leprosy. Congenital conditions ranging from club feet and other malformations to scoliosis should be part of the surgical burden. There are numerous chronic conditions such as sickle cell anaemia, haemophilia, other heamoglobinopathies and even diabetes that can also contribute to surgical burden of the MSK conditions.

Injuries

Injury is one of the major public health challenges contributing to deaths and disability worldwide. Injury is just not a problem of high-income countries, as it is commonly perceived. On the contrary, the incidence of injury and its consequences is far higher in LMIC [15]. More patients die due to injuries in LMIC than high-income countries, partly because of the motorization and related automobile injuries in these countries and partly due to lack of efficient trauma care systems [16].

The WHO report on road safety estimates that 1.25 million people died from road traffic injuries (RTIs) in 2010 [17]. Majority of them were young males in their prime years of life and potential breadwinners for their families and societies. Over half of all the injured, who died in LMICs, were vulnerable road users such as pedestrians and cyclists. Total number of the injured could be 20 times more than number of deaths, and many of these injured would end up with a serious disability for the rest of

their lives [17]. LMICs contribute to this burden, which is disproportionate to their populations and rapidly growing countries such as China and India are going to witness further rise in their injury burden [17–19]. Up to about 2 million or little less than 40% injury deaths in LMIC could be avoided if trauma care systems are established in these countries so that the current disparity in the outcomes of injured patients can be eliminated between low- and high-income countries [20].

Major limb injuries are essentially all acute major traumatic conditions of both upper and lower limbs. This group includes all fractures, dislocations, crushing injuries, open lacerations, amputations, burns and neurovascular injuries to the upper and lower extremities. The mechanism of injuries has no bearing in this definition. This, however, does not include minor injuries such as sprains, strains, superficial lacerations and contusions.

According to several estimates, the aggregate rates of limb injuries due to falls and road traffic injuries are two-fold to fivefold higher in LMIC compared to high-income countries [7].

Measuring the burden

Quantifying a disease burden is a complex process. The outcome of progression in majority of MSK conditions may not be fatal, but the condition can significantly limit the mobility of the patients. Further, the overall burden on the communities, health systems and countries can be enormous, as is evident today in many high-income countries.

The main measurement of the burden of disease, the disease adjusted life year (DALY), is defined as "a summary measure of disease related morbidity and mortality and combines in one measure the time lived with disability and the time lost due to premature mortality". One DALY is equivalent to loss of a year of healthy life. DALYs are arrived at as an aggregate of the years of life lost due to early death (YLL) in the population and the years lived with disability (YLD). Obviously, DALYs can be applied to populations and not to individuals. The YLL can be calculated as the number of deaths multiplied by the standard life expectancy at the age at which death occurs [21].

The YLD burden of a disease can be arrived at as "the incidence multiplied by the average time spent with a disease, weighted for the extent of associated disability caused by the disease" [21]. Actually, to measure the societal impact on support and care required, YLDs reflect a better and more realistic picture. DALYs are essentially based on incidence, whereas a lot of MSK conditions, such as OA, are important because of their high prevalence in certain communities and countries.

WHO priority list of leading 10 noncommunicable diseases (NCD) does not include MSK conditions although the incidence and prevalence of these conditions are very high in LMIC. The most plausible reason for noninclusion of MSK in this list seems to be low mortality burden from MSK disorders, when compared to other NCDs such as ischaemic heart diseases, respiratory ailments, diabetes mellitus and cancer. It is well known though that especially OA and RA are amongst common comorbid conditions associated with above more common conditions, with higher mortality burden. There are several studies to suggest that the risk of death could be up to 25% higher within a year, following a hip fracture and such patients also carry a higher risk of mortality for next 4 years [22].

The ideal way to measure surgical MSK burden would be to arrive at tables of estimated burden of surgically amenable bellwether MSK conditions, including major injuries. At present, there is no credible information or even agreement on incidence and prevalence of such MSK conditions to justify an effort to compare or analyse the available data. Therefore, tables with limited information on some of these conditions are presented. These tables summarize the data collected from various Global Burden of Disease studies [23, 24]. See Tables 1, 2, 3 and 4.

Surgical burden of MSK conditions

As evident from Table 1, the % of MSK deaths to total deaths have remained almost unchanged over past 25 years. Similarly, there is a little change in % of disability attributed to MSK over similar period (Table 2). Table 3 shows DALYs attributed to various MSK conditions against total DALYs over the years. Table 4 represents estimates of surgical burden of various MSK conditions and DALYs attributable to each MSK group, as defined by the GBD, and based on expert opinion, for years 1990, 2010 and 2016 [23, 24]. The % of surgical burden of MSK conditions is estimated within a range of the highest and the lowest estimates of the conditions amenable to surgery. There is obviously a large uncertainty around these estimates. Therefore to be more realistic, numbers representing a range of the best (lowest) and the worst (highest) case scenarios were also estimated. There were an estimated 2,391,258,000 DALYs worldwide in 2016, down from 2,502,601,000 in 1990 (−4.5%). Our estimates would thus show that in 1990, 10.1% of all DALYs were attributable to surgical MSK conditions, down to 8.1% in 2016 (best/worst: 5–15% for 1990, 4–12% for 2016). If indeed 30% of all DALYs are surgical, then MSK

Table 1 Deaths show a consistent relative decrease over time, of each category of MSK-related deaths, but the ratio MSK deaths: total all causes deaths remains constant

	All ages (×1000)			Age standardized (×100,000)			
	1990	2010	2016	1990	2010	2016	% Difference 1990: 2016
All causes	46,600	53,000	55,000	1000	785	833	−17
MSK	70	154	90	1.7	2.5	1.4	−18
Cong MSK			9			0.1	
Injuries							
Total	4092	5074	4611	83	75	65	−22
Transport	959	1397	1438	20	21	19	−5
Unintentional	2030	2123	1804	40	31	27	−33
Self-arm/violence	1009	1340	1208	22	20	17	−23
Conflict	95	214	162	2	3	2	Same
Total MSK (% total deaths)	4162 (8)	5228 (10)	4701 (9)	85 (8.5)	77.3 (10)	66.4 (8)	−1

Table 2 (All age YLDs) shows an absolute increase in all categories of MSK-related YLDs, as expected with the global population increase, but a 2% decrease in the ratio MSK/ YLDs: total all causes YLDs

	1990	2010	2016	% Difference
All age YLDs (×1000)				
All causes	584,000	778,000	806,000	+39
MSK (total)	115,000	166,000	138,000	+20
Neck/back	82,200	117,000	87,000	+6
Other	32,800	49,000	51,000	+63
Congenital MSK	n/a	n/a	1536	n/a
Injuries (total)	34,100	47,200	55,360	+33
Transport	12,100	16,270	12,345	same
Unintention	19,100	26,700	37,700	+97
Self-harm/violence	1570	1985	3885	+154
Conflict	1400	2300	1433	Same
Total MSK (% Total YLDss)	149,100 (26)	213,200 (28)	193,360 (24)	−2

conditions would account for 33% (16–45%) in 1990 and 24.3% (12–36%) in 2016.

Limitations

There are number of limitations of these estimates of surgical burden of MSK disorders. The overall lack of data, even the adequacy of the vital health statistics, in LMIC continues to remain a big challenge to the global health community, the policy makers and international health agencies.

The number of surgeries performed in LMIC is not reported in official data because in many settings, humanitarian agencies, nongovernmental organizations and individual private surgeons provide surgical services. Their data, the amount of surgical volumes in these situations, are not always compiled in the officially reported statistics.

Hospital-based data fail to give an accurate information for surgical burden of MSK as a section of patients with surgically amenable MSK condition in LMIC never report to a hospital. There is a good evidence to believe that only a minority of injured patients in rural areas in many low-income countries would be seen at the hospitals or within the health systems [25]. The true surgical burden of MSK conditions is the sum of met and unmet needs. The true unmet surgical need for these conditions is almost impossible to measure accurately [26].

Only major MSK conditions—such as OA, RA, back pain and neck pain are considered measurable and their

Table 3 (Age-standardized DALYs) shows that when standardized for age, every category of MSK-related DALYS decreases over time except other MSK and conflict, but they all decrease less than the decrease in all causes DALYs, except for unintentional injuries

	1990	2010	2016	% Difference
Age-standardized DALYs (×100,000)				
All causes	48,000	37,000	34,000	−30
MSK (total)	2200	2500	2000	−10
Neck/Back	1550	1700	1200	−23
Other	650	800	800	+25
Congenital MSK	37	n/a	32	−13
Injuries (total)	4700	4100	3500	−25
Transport	1150	1200	1050	−9
Unintention	2450	1750	1500	−39
Self-harm/viol	930	900	780	−16
Conflict	120	210	150	+25
Total MSK (% Total DALYs)	6937 (15)	6600 (18)	5532 (17)	

Here, the ratio MSK-related DALYs: total all causes DALYs increase by 2%

Table 4 Estimates of % of each MSK conditions requiring surgery

	1990	2010	2016
MSK-back	5% (1–10%)	5% (1–10%)	5% (1–10%)
	77.5 (15.5–155)	85 (17–170)	60 (6–600)
MSK-other	15% (5–25%)	15% (5–25%)	15% (5–25%)
	97.5 (32.5–162.5)	120 (40–200)	120 (40–200)
Congenital	20% (10–30%)	20% (10–30)	20% (10–30)
	7.4 (3.7–11.1)	N/A	6.4 (3.2–9.6)
Injuries	50% (25–75%)	50% (25–75%)	50% (25–75%)
	2350 (1175–3525)	2050 (1025–3075)	1750 (875–2625)
Total	2532.4	2070.5	1936.4
Best/worst	1226.7–3869.1	1082–3445	924.2–3434.6

Estimates of surgical burden of MSK conditions in % (lower/upper % range) and in DALYs (×100,000)

data are available in some countries for review. Obviously, there are many more conditions that are surgically amenable and should have been considered.

In the absence of clear and consistent definitions across the world, the certain conditions such as burns, snake bites and animal bites which can involve MSK surgeons for the purpose of treatment and reconstruction should also be added to the estimate to build the full picture of the burden.

The estimation of surgical burden concept in LMIC will be dynamic for two reasons. With advances in access to diagnostic and therapeutic resources in LMIC, more and more surgical procedures would be available to the patients of MSK conditions and this burden would continue to rise. Further, many of these countries will also continue to graduate to achieve high-income status over a period of time and the actual estimate of surgical burden of MSK in LMIC would need to take this fact into account.

Way forward

Estimating surgical burden of MSK conditions in LMIC continues to remain a challenge for most experts. Most studies around global burden of diseases are not granular enough to extract the required data from LMIC. This situation is unlikely to change unless the MSK disorders and surgery are prioritized, as a part of global health agenda. DCP 3 project exposed the paucity of relevant evidence on epidemiology and economic burden of injuries from the LMIC [27]. There appears to be increasing attention to essential surgery in the last decade or so; however, the

advocates for MSK disorders would need to compete within noncommunicable conditions with other major disorders, such as cardiovascular, diabetes and cancer, to gain better visibility and attention. At this juncture, it remains unclear if efforts for more accurate estimation of surgical burden of MSK disorders would yield any better quality data than the current estimates. Perhaps as a pilot study, a low- or middle-income country, with better health data, can be selected as a test case in each region, for estimation of surgical burden of MSK conditions. The lessons learned from this pilot can be extended to a larger study. However, the surgical community and advocacy groups for better MSK services could continue to work together to refine the estimates for surgical burden of MSK conditions in LMIC, in particular by adding layers of sophistication to existing tools or developing better data collection tools, to stratify results according to system-specific conditions. This would add some additional complexity, but provide more useful specific data. The statistical community should also be encouraged to explore if more powerful statistical tools could improve the robustness of conclusions based on such data. Estimating more accurately, the met and unmet burden of MSK conditions will invite global attention to strengthen the health systems in LMIC to better equip themselves to address this challenge.

Compliance with ethical standards

Conflicts of interest None.

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