Estimates of number of children and adolescents without access to surgical care

Bhargava Mullapudi, David Grabski, Emmanuel Ameh, Doruk Ozgediz, Hariharan Thangarajah, Karen Kling, Blake Alkire, John G Meara & Stephen Bickler

**Objective** To estimate how many children and adolescent worldwide do not have access to surgical care.

**Methods** We estimated the number of children and adolescents younger than 19 years worldwide without access to safe, affordable and timely surgical care, by using population data for 2017 from the United Nations and international data on surgical access in 2015. We categorized countries by World Bank country income group and obtained the proportion of the population with no access to surgical care from a study by the *Lancet* Commission on Global Surgery.

**Findings** An estimated 1.7 billion (95% credible interval: 1.6–1.8) children and adolescents worldwide did not have access to surgical care in 2017. Lack of access occurred overwhelmingly in low- and middle-income countries where children and adolescents make up a disproportionately large fraction of the population. Moreover, 453 million children younger than 5 years did not have access to basic life-saving surgical care. According to *Lancet* Commission on Global Surgery criteria, less than 3% of the paediatric population in low-income countries and less than 8% in lower-middle-income countries had access to surgical care.

**Conclusion** There were substantial gaps in the availability of surgical services for children worldwide, particularly in low- and middle-income countries. Future research should focus on developing specific measures for assessing paediatric surgical access, delivery and outcomes on clarifying how limited surgical access in the poorest parts of the world affects child health, especially mortality in children younger than 5 years.

---

**Introduction**

The Millennium Development Goal period (i.e. 2000 to 2015) was characterized by an unprecedented decrease in child mortality.¹ Even in the poorest areas of the world, mortality in children younger than 5 years fell dramatically, which led to predictions that a grand global convergence in mortality in this age group would be possible by 2035.² However, further progress will depend on continued improvements across the full spectrum of child health services.

Surgical care for children is one area of child health that is often overlooked, yet can play an important role in preventing death and disability.³ Surgery is vital for the repair of correctable congenital anomalies (e.g. congenital heart disease, cleft lip and palate and club foot), the treatment of life-threatening injuries and burns, and the diagnosis and treatment of childhood cancers. Surgery can minimize the acute and long-term suffering of children, protect families from substantial financial loss and increase economic productivity. In addition, surgical care can play a role in achieving health-related sustainable development goals and targets, in particular: (i) ending preventable deaths in newborn babies and children younger than 5 years; (ii) reducing death and disability due to road traffic injuries and noncommunicable diseases; (iii) ensuring universal health coverage; and (iv) increasing the health workforce.⁴

In 2015, the *Lancet* Commission on Global Surgery reported that at least 4.8 billion people worldwide lacked access to surgical care.⁵,⁶ The Commission assessed the availability of surgical services using a chance tree, probability model, in which access was evaluated over four dimensions: (i) timeliness, which was assessed from the proportion of people with serious injuries who were transported by ambulance; (ii) surgical capacity, which was defined as the proportion of surgical procedures needed to meet demand that were actually undertaken; (iii) safety, which was assessed from the proportion of operating theatres with pulse oximetry; and (iv) affordability, which was defined as the proportion of patients undergoing surgery who were protected from catastrophic expenditure due to out-of-pocket payments.⁷ Access to surgical care varied widely across geographical regions, with more than 95% of the population in South Asia and central, eastern and western sub-Saharan Africa having no access. It was not clear, however, how lack of access affects the paediatric population. Consequently, in our analysis, we sought to answer the specific question: “How many children and adolescents worldwide lack access to safe, affordable and timely surgical care?”

**Methods**

To estimate the number of children and adolescents without access to surgical care we used population data for 2017 from the United Nations and previously reported data on access to surgery from the *Lancet* Commission on Global Surgery.⁵,⁷ The proportion of the population without access to surgical...
Poor child surgical care worldwide

Bhargava Mullapudi et al.

Our analysis did not attempt to estimate the number of children and adolescents who required surgical care; instead we estimated the number that did not have access to surgical services had they been needed.

Assuming the proxy markers used to assess access to surgical care in the Lancet Commission on Global Surgery’s study apply equally to children and adults, then the number of children and adolescents in a specific age and World Bank income group can be given by:

\[ N_{ij} = P_i \times F_j \]

where \( N_{ij} \) is number of children and adolescents in age group \( i \) and World Bank income group \( j \) without access to surgical care, \( P_i \) is the total population of children and adolescents in age group \( i \) and income group \( j \) and \( F_j \) is the fraction of the total population in income group \( j \) without access to surgery.

The global population of children and adolescents without access to surgical care, \( N_A \), can then be determined by summing the estimated numbers in each age and income group:

\[ N_A = \sum_{ij} N_{ij} \]

We estimated the number of children and adolescents without access to surgical care in the age groups 0 to 1, 1 to 4, 5 to 9, 10 to 14 and 15 to 19 years for each World Bank income category.

Results

Table 1 shows: (i) the number of children and adolescents in different age groups worldwide in 2017, with countries grouped into the World Bank income categories of high, upper-middle, lower-middle and low income; (ii) surgical access rates reported in each income category by the Lancet Commission on Global Surgery study in 2015; and (iii) the estimated number of children and adolescents without access to surgical care worldwide, categorized by age and country income group. We estimated that around 1.7 billion (95% CrI: 1.6–1.8) children and adolescents worldwide did not have access to surgical care in countries in different World Bank income groups and their associated 95% credible intervals (CrIs) were extracted from Table 1 of Alkire et al.’s 2015 paper. Our analysis did not attempt to estimate the number of children and adolescents who required surgical care; instead we estimated the number that did not have access to surgical services had they been needed.
Discussion
The World Health Organization has defined universal health coverage as the opportunity for any individual to have access to needed health services (including disease prevention, health promotion, treatment, rehabilitation and palliative care) of sufficient quality to be effective while also ensuring that use of these services does not result in financial hardship. Surgery and anaesthesia were officially recognized as indispensable components of universal health coverage in 2015 when the World Health Assembly adopted resolution WHA68.15. To facilitate implementation of the resolution, a growing number of countries are developing national surgery, obstetric and anaesthesia plans based on recommendations of the 3rd edition of the World Bank’s Disease Control Priorities and of the Lancet Commission on Global Surgery. These national plans involve an iterative process in which stakeholders use country-level data to develop contextually relevant and sustainable plans to ensure that surgical, obstetrical and anaesthetic services are available for an entire country or region. An appreciation of existing gaps in surgical services for children is important for ensuring that universal health coverage effectively encompasses the health-care needs of paediatric patients.

Although some might consider our estimate of the number of children and adolescents without access to surgical care to be too high, the number is consistent with our experience in many low-income countries, where surgical care for children has been a low priority and has often been excluded from child health programmes. Further, because children develop different surgical problems from adults and often require specialized care, the actual number without access could be even higher. The Lancet Commission used the availability of Caesarean section as a proxy marker for access. However, its availability does not necessarily ensure that the expertise, infrastructure and safety measures are in place to care for children with surgical problems. Indeed, a country could meet its targets for the number of surgical cases, health-care workforce and, even, financial protection without providing any surgical care for children. Specific metrics for paediatric surgical access are needed to help achieve equitable access to surgical and anaesthetic care for children.

It is important to emphasize that our study focused on access to surgical care and not the unmet need for care (i.e. when an individual has an untreated condition that would benefit from surgical care). Access refers simply to the availability of surgical care should it be needed. Unmet need would be a better metric because it could serve to quantify the impact of limited surgical care on child health. Nevertheless, it is difficult to see how the desired child health targets in low- and middle-income countries could be achieved when access to surgical care is so sparse. Surgical conditions are common in paediatric patients, with up to 85% of those younger than 15 years being affected. Consequently, poor access results in substantial morbidity and mortality.

Moreover, the availability of surgical care is critical for infants as birth defects are now the fifth most common cause of death in children younger than 5 years. Without improvements in surgical and anaesthetic paediatric care, it will be impossible to achieve the second target of sustainable development goal 3: to end preventable deaths of newborns and children younger than 5 years by 2030.

Finally, it is important to appreciate that the availability of surgical services does not necessarily ensure that a child or adolescent with a surgical condition will receive high-quality care. However, some elements of effectiveness were inherently considered in our analysis as the Lancet Commission on Global Surgery defined access as the availability of safe, affordable and timely surgical care. In future studies, other aspects of surgical delivery may need to be examined because the quality of care is also dependent upon the care structure (i.e. infrastructure, equipment and human resources for health), the process of care (i.e. the actual care delivered) and outcomes.

In conclusion, we estimated that around 1.7 billion children and adolescents worldwide did not have access to surgical care in 2017. Most lived in low- and middle-income countries where children and adolescents make up a disproportionately large fraction of the population: less than 8% of the paediatric population in these countries has access to surgical care. Future priorities for research include developing specific metrics for assessing paediatric surgical access, delivery and outcomes, and clarifying how limited access to surgical care in the poorest regions of the world affects child health, especially mortality in children younger than 5 years. Efforts to scale up surgical care in low- and middle-income countries should consider the needs of children and adolescents.

Competing interests: None declared.
The surgical care for children worldwide is severely compromised. The aim of this research is to estimate the number of children and adolescents worldwide who did not receive surgical care. The results of this study are based on the data from the Lancet Global Surgery Commission and the demographic data of the United Nations for 2017. We found that approximately 1.7 billion children and adolescents (95% CI: 1.6–1.8) did not receive surgical care in 2017. This lack of access to surgery is particularly severe in low-income and middle-income countries, where less than 3% of children had access to basic surgical care. In contrast, in high-income countries, 8% of children had access to basic surgical care. The results of this study highlight the need for increased investment in surgical care for children worldwide.
Resumen

Estimaciones del número de niños y adolescentes sin acceso a la atención quirúrgica

Objetivo
Estarim cuántos niños y adolescentes en todo el mundo no tienen acceso a la atención quirúrgica.

Métodos
Estimamos el número de niños y adolescentes menores de 19 años en todo el mundo sin acceso a una atención quirúrgica segura, asequible y oportuna, utilizando datos de población para 2017 de las Naciones Unidas y datos internacionales sobre el acceso quirúrgico en 2015. Clasificamos a los países por grupos de ingresos del Banco Mundial y obtuvimos la proporción de la población sin acceso a la atención quirúrgica de un estudio de la Lancet Commission on Global Surgery.

Resultados
Se estima que 1.700 millones (intervalo creíble del 95 %: 1,6–1,8) de niños y adolescentes en todo el mundo no tenían acceso a la atención quirúrgica en 2017. La falta de acceso se produjo abrumadoramente en los países de ingresos bajos y medios, donde los niños, niñas y adolescentes constituyen una fracción desproporcionadamente grande de la población. Además, 453 millones de niños menores de 5 años no tienen acceso a la atención quirúrgica básica que salva vidas. Según los criterios de la Lancet Commission on Global Surgery, menos del 3 % de la población pediátrica de los países de bajos ingresos y menos del 8 % de los países de ingresos medios-bajos tenían acceso a la atención quirúrgica.

Conclusión
En todo el mundo había considerables diferencias en la disponibilidad de servicios quirúrgicos para los niños, en particular en los países de ingresos bajos y medios. Las investigaciones futuras deben centrarse en el desarrollo de medidas específicas para evaluar el acceso quirúrgico pediátrico, la natalidad y los resultados, y en aclarar cómo el acceso quirúrgico limitado en las partes más pobres del mundo afecta la salud infantil, especialmente la mortalidad en niños menores de 5 años.

References

1. Countdown to 2030 Collaboration. Countdown to 2030: tracking progress towards universal coverage for reproductive, maternal, newborn, and child health. Lancet. 2018 04 14;391(10129):1538–48. doi: http://dx.doi.org/10.1016/S0140-6736(18)30104-1 PMID: 29395268
2. Jamison DT, Summers LH, Alleyne G, Arow KJ, Berkley S, Binagwaho A, et al. Global health 2035: a world converging within a generation. Lancet. 2013 Dec 7;382(9908):1986–955. doi: http://dx.doi.org/10.1016/S0140-6736(13)62105-4 PMID: 24304975
3. Ozgediz D, Langer M, Kisa P, Poenaru D. Pediatric surgery as an essential component of global child health. Semin Pediatr Surg. 2016 Feb;25(1):3–9. doi: http://dx.doi.org/10.1053/j.sempedsurg.2015.09.002 PMID: 26831131
4. Henry JA, Abdullah F. Global surgical care in the UN post-2015 sustainable development agenda. World J Surg. 2016 Jan;40(1):1–5. doi: http://dx.doi.org/10.1007/s00268-015-3249-4 PMID: 26482361
5. Meera KG, Leather AJ, Hagander L, Alkire BC, Alonso N, Ameh EA, et al. Global surgery 2030 evidence and solutions for achieving health, welfare, and economic development. Lancet. 2015 Aug;8,386(9093):569–624. doi: http://dx.doi.org/10.1016/S0140-6736(15)60160-X PMID: 25924834
6. Alkire BC, Raykar NP, Shrim KG, Weiser TG, Bickler SW, Rose JA, et al. Global access to surgical care: a modelling study. Lancet Glob Health. 2015 Jun;3(6):e316–23. doi: http://dx.doi.org/10.1016/S2214-109X(15)00115-4 PMID: 25926807
7. World population prospects 2017 [Internet]. New York: United Nations Population Division; 2019. Available from: https://population.un.org/wpp/ Download/Standard/Population/ [cited 2019 Jan 10].
8. Universal health coverage. Geneva: World Health Organization; 2019. Available from: http://www.who.int/healthsystems/universal_health_coverage/en/ [cited 2019 Jan 10].
9. Resolution WHA68.15: Strengthening emergency and essential surgical care and anaesthesia as a component of universal health coverage. Agenda item 17.1. In: Sixty-eighth World Health Assembly, Geneva, 26-May 2015. Geneva: World Health Organization; 2015. Available from: http://apps.who.int/gb/ebwha/pdf_files/wha68/a68_r15-en.pdf [cited 2019 Jan 10).
10. Mock CN, Donkor P, Gawande A, Jamison DT, Kruk ME, Debas HT; DCP3 Essential Surgery Author Group. Essential surgery: key messages from Disease Control Priorities, 3rd edition. Lancet. 2015 May 30;385(9983):2209–19. doi: http://dx.doi.org/10.1016/S0140-6736(15)60091-5 PMID: 25662414
11. Surgical care systems strengthening. Developing national surgical, obstetric and anaesthesia plans. Geneva: World Health Organization; 2017. Available from: http://apps.who.int/iris/bitstream/handle/10665/255566/978924151224-4-eng.pdf [cited 2019 Jan 10].
12. Bickler SW, Telfer ML, Sano-Duanda B. Need for paediatric surgical care in an urban area of the Gambia. Trop Doct. 2003 Apr;33(2):91–4. doi: http://dx.doi.org/10.1177/004947550303300212 PMID: 12680542
13. Bickler SW, Rode H. Surgical services for children in developing countries. World J Surg. 2016 Jan;40(1):1–5. doi: http://dx.doi.org/10.1007/s00268-015-31575-6 PMID: 27733285
14. Essential Surgery Author Group. Essential surgery: key messages from Disease Control Priorities, 3rd edition. Lancet. 2015 May 30;385(9983):2209–19. doi: http://dx.doi.org/10.1016/S0140-6736(15)60091-5 PMID: 25662414
15. Wright NJ, Anderson JE, Ozgediz D, Farmer DL, Banu T. Addressing child mortality: global challenges. Lancet. 2018 04 14;391(10129):1898–955. doi: http://dx.doi.org/10.1016/S0140-6736(18)30104-1 PMID: 29395268
16. Bickler SW, Rode H. Surgical services for children in developing countries. World J Surg. 2002;26(10):829–35. PMID: 12471405
17. GBD 2015 Child Mortality Collaborators. Global, regional, national, and selected subnational levels of stillbirths, neonatal, infant, and under-5 mortality, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016 Oct;8,388(10053):1725–74. doi: http://dx.doi.org/10.1016/S0140-6736(16)31575-6 PMID: 27733285
18. Wright NJ, Anderson JE, Ozgediz D, Farmer DL, Banu T. Addressing child mortality: global challenges. Lancet. 2018 04 14;391(10129):1898–955. doi: http://dx.doi.org/10.1016/S0140-6736(18)30501-4 PMID: 29056761
19. Donabedian A. Evaluating the quality of medical care. Milbank Q. 2005;83(4):691–729. doi: http://dx.doi.org/10.1111/j.1468-0009-2005.00397.x PMID: 16279964
