Surgical need & capacity in low and middle income countries
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Chapter 2

Untreated surgical conditions in Sierra Leone: a cluster randomised, cross-sectional, countrywide survey.


Abstract

**Background** Surgical care is increasingly recognised as an important part of global health yet data for the burden of surgical disease are scarce. The Surgeons OverSeas Assessment of Surgical Need (SOSAS) was developed to measure the prevalence of surgical conditions and surgically treatable deaths in low-income and middle-income countries. We administered this survey countrywide in Sierra Leone, which ranks 180 of the 187 nations on the UN Development Index.

**Methods** The study was done between Jan 9 and Feb 3, 2012. 75 of 9671 enumeration areas, the smallest administrative units in Sierra Leone, were randomly selected for the study clusters, with a probability proportional to the population size. In each cluster 25 households were randomly selected to take part in the survey. Data were collected via handheld tablets by trained local medical and nursing students. A household representative was interviewed to establish the number of household members (defined as those who ate from the same pot and slept in the same structure the night before the interview), identify deaths in the household during the previous year, and establish whether any of the deceased household members had a condition needing surgery in the week before death. Two randomly selected household members underwent a head-to-toe verbal examination and need for surgical care was recorded on the basis of the response to whether they had a condition that they believed needed surgical assessment or care.

**Results** Of the 1875 targeted households, data were analysed for 1843 (98%). 896 of 3645 (25%; 95% CI 22.9–26.2) respondents reported a surgical condition needing attention and 179 of 709 (25%; 95% CI 22.5–27.9) deaths of household members in the previous year might have been averted by timely surgical care.

**Discussion** Our results show a large unmet need for surgical consultations in Sierra Leone and provide a baseline against which future surgical programmes can be measured. Additional surveys in other low-income and middle income countries are needed to document and confirm what seems to be a neglected component of global health.
Surgical Need in Sierra Leone

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Interpretation

The actual prevalence of surgical conditions is unknown. In its highest income countries are needed to document and confirm what seems to be a neglected component of global health. Although global health efforts increasingly emphasise health-system strengthening, the surgical needs of populations are frequently neglected. Safe and appropriate interventions. To address these deficiencies, calls to stimulate development of large countrywide surgical estimates have helped to raise awareness of the surgical deformities; diagnose, treat, and palliate cancer; and care for people who are injured. Globally, improvement of surgical care is needed to save substantial numbers of lives and reduce or avoid permanent disabilities.

Findings

In a national sample of households in Sierra Leone, we found that 391 of 744 (53%; 95% CI 49–56) respondents reported a surgical condition needing attention and 179 of 709 (25%; 95% CI 22·5–27·9) deaths of household members had a condition needing surgery in the week before death. Two randomly selected tablets by trained local medical and nursing students. A household representative was interviewed to establish the need for surgical care was recorded on the survey.

Methods

Setting

Sierra Leone is a small west African country (population 6·6 million; area 72 000 km²) and ranks 180 of the 187 nations on the UN Development Index.

In an effort to measure the prevalence of surgical care is needed to decrease maternal mortality; treat congenital anomalies; correct deformities; diagnose, treat, and palliate cancer; and care for people who are injured. Globally, improvement of surgical care is needed to save substantial numbers of lives and reduce or avoid permanent disabilities.

The Surgeons OverSeas Assessment of Surgical Need (SOSAS) was developed for use in low-income and middle-income countries. We administered this survey countrywide in Sierra Leone, which ranks 180 of the 187 nations on the UN Development Index.

We aimed to establish the countrywide prevalence of surgically treatable conditions and to identify deaths potentially preventable and reduce or avoid permanent disabilities.
Untreated surgical conditions in Sierra Leone: a cluster randomised, cross-sectional, countrywide survey

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Summary
Background Surgical care is increasingly recognised as an important part of global health yet data for the burden of surgical disease are scarce. The Surgeons OverSeas Assessment of Surgical Need (SOSAS) was developed to measure the prevalence of surgical conditions and surgically treatable deaths in low-income and middle-income countries. We administered this survey countrywide in Sierra Leone, which ranks 180 of the 187 nations on the UN Development Index.

Methods The study was done between Jan 9 and Feb 3, 2012. 75 of 9671 enumeration areas, the smallest administrative units in Sierra Leone, were randomly selected for the study clusters, with a probability proportional to the population size. In each cluster 25 households were randomly selected to take part in the survey. Data were collected via handheld tablets by trained local medical and nursing students. A household representative was interviewed to establish the number of household members (defined as those who ate from the same pot and slept in the same structure the night before the interview), identify deaths in the household during the previous year, and establish whether any of the deceased household members had a condition needing surgery in the week before death. Two randomly selected household members underwent a head-to-toe verbal examination and need for surgical care was recorded on the basis of the response to whether they had a condition that they believed needed surgical assessment or care.

Findings Of the 1875 targeted households, data were analysed for 1843 (98%). 896 of 3645 (25%; 95% CI 22.9–26.2) respondents reported a surgical condition needing attention and 179 of 709 (25%; 95% CI 22.5–27.9) deaths of household members in the previous year might have been averted by timely surgical care.

Interpretation Our results show a large unmet need for surgical consultations in Sierra Leone and provide a baseline against which future surgical programmes can be measured. Additional surveys in other low-income and middle-income countries are needed to document and confirm what seems to be a neglected component of global health.

Funding Surgeons OverSeas, Thompson Family Foundation.

Introduction Although global health efforts increasingly emphasise health-system strengthening, the surgical needs of populations are frequently neglected. Safe and appropriate surgical care is needed to decrease maternal mortality; improve the health of women and children; treat congenital deformities; diagnose, treat, and palliate cancer; and care for people who are injured. Globally, improvement of surgical care is needed to save substantial numbers of lives and reduce or avoid permanent disabilities.

The actual prevalence of surgical conditions is unknown. In its place, estimates of the burden of surgically treatable diseases in low-income and middle-income countries rely on rough approximations and extrapolations from short surveys of physicians, data from high-income countries, or hospital registries. These estimates have helped to raise awareness of the surgical need of populations, but have rarely been robust enough to stimulate development of large countrywide surgical programmes. They have also not been sufficient to firmly convince donors of the magnitude of surgically treatable conditions or to provide policy makers and ministries of health with the requisite data needed to plan interventions. To address these deficiencies, calls for community-level research to quantify the surgical need of populations have been repeatedly voiced.

In an effort to measure the prevalence of surgical conditions and to identify deaths potentially preventable with surgical care, the Surgeons OverSeas Assessment of Surgical Need (SOSAS) was developed for use in low-income and middle-income countries. SOSAS is a population-based household survey that was developed collaboratively by an international group of experts and piloted in Sierra Leone. We aimed to establish the countrywide prevalence of surgically treatable conditions and potentially preventable deaths in a low-income country by administering the survey in Sierra Leone.

Methods Setting Sierra Leone is a small west African country (population 6 million; area 72000 km²) and ranks 180 of the 187 nations on the UN Development Index. Health indicators for Sierra Leone are indicative of scarce access to health care: life expectancy at birth is 48 years, an estimated 174 per 1000 children die before their fifth birthday, and maternal mortality rates are among the highest in the world. Sierra Leone was chosen for
the implementation of SOSAS because of the long-standing collaboration between Surgeons OverSeas and surgeons and the Ministry of Health and Sanitation in the country.14

**Study design**

The total sample size was estimated to be 3745 individuals based on $n = \frac{Z^2p(1-p)}{L^2}$, where $L$ is accepted range around the estimated prevalence of the disorder ($1\%$), $Z$ is CI (95%–Z is 1.96), and $p$ is (estimated) prevalence of the condition (7.3%). Estimated prevalence was established in a pilot study of the same survey in Sierra Leone in August, 2011, when 95% of the targeted population were eligible, and the same proportion responded. The calculated sample size was multiplied by a small design-factor of 1.3, assuming that surgical conditions are not very clustered. 75 of 9671 enumeration areas, the smallest administrative units in Sierra Leone, were randomly selected for the study clusters, in two-stages with a probability proportional to population size after stratification for districts and urban and rural population distribution. The sample was self-weighted by randomly selecting 25 households in each cluster.15 Random selection of households and individuals was done on the basis of principles established for countries without full population registries.15,16 This method includes a first structure count (house count) of the enumeration area and thereafter random assignment of the structures. If more than one household was living in a house, an extra listing was done on the basis of male and female response rates. §Approximate values. †Calculated from tables 2.5.1 and 2.5.2 of the 2009 DHS. ‡Calculated on 7284 households and 10 654 individuals, exact numbers for each measure are not available. SOSAS=Surgeons OverSeas

**Procedures**

The study was done from Jan 9 to Feb 3, 2012. Students from the Sierra Leone Faculty of Nursing and Sierra Leone College of Medicine and Allied Health Sciences and staff from Statistics Sierra Leone were trained to be enumerators. The appendix shows the instructions...
The calculated sample size was estimated to be 3745 in Sierra Leone, when 95% of the surgeons and the Ministry of Health and Sanitation in the country. The study was done from January to February 2012. Students and staff from the Sierra Leone College of Medicine and Allied Health Sciences, the Sierra Leone Faculty of Nursing, and the SOSAS were trained to conduct the survey in Sierra Leone in August 2011, when 95% of the population was available. Random assignment of the structures was done in the same way as in a pilot study of the same size. The total sample size was estimated to be 3745 individuals.

### Procedures

Household members were selected after the household in the year before they died. Random assignment of the households was done after stratification by age, sex, and rural or urban. Since the survey was self-weighted, the respondents were included in the analysis. The response rate was 99% of the households and 93% of the respondents. The survey was closed on December 31, 2011.

### Data collection

Data were collected with a manual for enumerators. Data were collected with handheld tablets. The SOSAS survey (appendix) consists of two parts and has been previously described. The first part is administered to a household representative to establish the number of household members; identify deaths in the household during the previous year; and establish whether any of the deceased household members had any of the following conditions in the week before their death: abdominal distension or pain; bleeding or illness during childbirth; injury; mass, growth, or swelling; acquired deformity; or a wound not due to injury or congenital deformity. The second section consists of structured interviews of two randomly selected household members who undergo a head-to-toe verbal examination covering six anatomical regions: face, head, and neck; chest and breast; abdomen; groin, genitals, and buttocks; back; and arms and hands and legs and feet.

The need for surgical care was recorded on the basis of an individual’s response to whether they had a wound, burn, mass, deformity, or other condition needing surgical assessment or care—ie, the respondent decided whether or not they felt they needed surgical care. A surgical procedure was defined as: wound care, suturing, incision, excision, or other manipulation of tissue, in a safe and painless way. Procedures were deemed major if they required regional or general anaesthesia and minor if they required local anaesthetics or none. Although local enuretists received a stipend, none of the researchers (local and international) received any payment and respondents were not paid.

Collected data were screened every day by the field supervisors and immediate feedback was given to the enumerators; RG gave overall feedback and supervision. Final assessment of the full database was done after data collection to identify inconsistencies and missing items. When clarification by the enumerators was not possible, inconsistent data were coded as missing.

The study was approved by the Sierra Leone Ministry of Health and Sanitation and ethics approval was obtained from the Ethics and Scientific Review Committee of Sierra Leone and the Research Ethics Committee of the Royal Tropical Institute in Amsterdam, Netherlands. Written informed consent was obtained from all respondents, but if the respondent was illiterate, a thumb-print with an additional signature from a literate witness was obtained. For individuals younger than 18 years, a parent or guardian provided written consent.

### Statistical analysis

We analysed data with PROC survey logistic, with SAS (version 9.3). Univariate analyses were done and significant variables were included in a multivariable logistic regression model to predict present surgical need (yes or no). Univariate associations were analysed with $\chi^2$ tests for contingency tables, $t$ tests for normally distributed data, and the Mann-Whitney $U$ test for skewed data. All tests were two-tailed.

### Role of the funding source

All authors had access to the complete data file; RSG, MS, TBK, and ALK made the decision to submit for publication. The Thompson Family Foundation did not have any role in data collection or analysis, or writing of the manuscript. Volunteers from Surgeons OverSeas wrote the study protocol, executed the study, and wrote the report, but did not receive any funds for this work.
Chapter 2

Results

The figure shows the cluster distribution. 74 of the randomly selected clusters were located and confirmed by global positioning system coordinates. One cluster could not be located and was replaced with a village in the same chieftdom (Kenema district). Of the 1875 total targeted households, we analysed data for 1843 (98%). Data from 25 households were excluded because of inconsistencies, five households had too much missing information (ie, surveys that were not completed to the end of the form, or for which essential data for cluster number, age, and sex were missing), and two households refused to give consent.

In each household, we attempted to interview two household members; thus after the exclusions, the total expected number of interviews was 3686. However, in 41 households (1%), only one household member was interviewed, giving a total of 3645 respondents (table 1). Most (1696) household interviews were completed on the initial visit. 132 households needed two visits and 15 households needed three visits. Of selected household members, 149 (4%) were replaced because the individuals initially chosen were not available for interview even after several revisits. Table 1 shows household characteristics and demographic data for respondents.

Of the 3645 respondents, 1352 (37%; 95% CI 34·8–39·4) indicated that they had a wound, burn, mass, growth, deformity, or other surgical condition at the time of the interview and 896 (25%; 22·9–26·2) indicated that they were in need of surgical care. Because respondents could report having more than one surgical condition, a total of 1585 conditions were reported at the time of the interview (table 2). The anatomical regions with the greatest number of reported conditions were abdomen; head, face, and neck; and arms, hands, legs, and feet (table 3). 575 (31%) households reported at least one household member dying in the previous year, with 709 deaths overall. With the total household members (11 870) as denominator, the crude death rate was 59·7 per 1000 population per year.

On the basis of conditions remembered as being present in the week before death, 237 (33%) deaths were associated with one of the seven conditions that we classified as those that might have benefited from surgical care (table 4). Abdominal distension and pain, problems during childbirth, and injury were the most common conditions recalled as occurring before death (table 4). However, of these 237 deaths, household representatives suggested that for 58 there was no need for a surgical intervention, resulting in 179 (25%; 95% CI 22·5–27·9) deaths for which the deceased individual might have benefited from surgical care.

For the multivariable analysis, urban residency was highly associated with literacy (data not shown), therefore we excluded literacy from the model. Female gender, age older than 45 years, illness in the past year, and urban residency were the reference populations for comparisons. Males were more likely to report a present need for surgical care than were females (appendix; odds ratio [OR] 1·48, 95% CI 1·3–1·7), and respondents in each age group younger than 45 years were significantly less likely to be in need of surgical care than were older respondents (appendix; <5 years OR 0·28, 95% CI 0·21–0·39; 5–15 years 0·38, 0·30–0·48; 15–45 years 0·66, 0·54–0·80). Individuals who reported not being ill in the previous year were also less likely to report a present surgical need than were those who had been ill (appendix; OR 0·37, 95% CI 0·31–0·44). Individuals living in a rural area were more likely to need surgical care than were urban residents (appendix; 2·29, 1·9–2·7).

Discussion

Administration of SOSAS in Sierra Leone shows a high prevalence of untreated surgical conditions. 25% of respondents had a condition possibly needing surgical attention and 25% of deaths in the previous year might have been averted with improved access to surgical services. An extrapolation to the entire population would equate to almost 1·5 million individuals needing—at minimum—a surgical consultation in Sierra Leone today. The major limitation of our study was that it relied solely on a verbal interview of self-reported conditions. Ideally, a physical examination would be done to corroborate responses; however, in view of the substantial ethical and logistical issues, with financial implications, such a survey could not be undertaken at this point. Surveys can be expensive; costs of training, personnel, transportation, and communication are all important considerations and are country-specific. The total cost of our study was less than US$35 000. The use of handheld...
Surgical Need in Sierra Leone

panels: Research in context

Systematic review

We searched PubMed with the terms "surgery" and "household survey", or "burden of surgical disease". We identified no countrywide surveys of the prevalence of surgical conditions or surgical causes of death in low-income countries. Most existing data from low-income countries documenting the burden of surgical conditions are based on hospital assessments or extrapolations from high-income countries. In countries where medical records are often incomplete or absent, these data probably underestimate the true prevalence of surgical disease and surgically related deaths. Extrapolations based on high-income country data might lead to overestimations of need. We selected only reports published in English between 2000 and 2010, although we also included some older reports from the reference lists of these publications.

Interpretation

Our results suggest that a large proportion of the population in Sierra Leone is in need of surgical care. Therefore, when resources are allocated to assist in strengthening health systems, surgical capacity building should not be excluded.
Further investigations into the high prevalence of untreated surgical conditions are needed to confirm unmet need in other low-income and middle-income countries and to identify the causes. However, as Weiser and colleagues’ have estimated, a large discrepancy exists in the number of surgical procedures done in high-income versus low-income and middle-income countries, with far more procedures in high-income countries (panel). The high number of untreated cases in low-income and middle-income countries might merely represent a backlog that could be reduced with the assistance of visiting teams; however, other causes, such as environmental, genetic, cultural, or occupational factors might result in the large number of affected individuals.

Whatever the underlying cause for the high number of cases might be, these data provide valuable insight and provide a baseline for the health needs of the population, which should assist the Ministry of Health and Sanitation and non-governmental organisations wishing to start surgical programmes in Sierra Leone. Projects can be monitored and assessed against the baseline data. Ideally, data for surgically treatable conditions will be collected in future Demographic and Health Surveys in Sierra Leone to limit the necessity of repeating a full-country implementation of SOSAS.

**Contributors**

RSG, ALK, and TPK researched the background of the study; RSG created the figure; SEX, RSG, MS, ALK, and TPK designed the study; MS, RSG, ALK, and K-AS collected the data; LDC and RSG analysed the data; LDC, RSG, ALK, and TPK interpreted the data; RSG, ALK, and LDC wrote the report; and all authors commented on and critically revised the report.

**Conflicts of interest**

We declare that we have no conflicts of interest.

**Acknowledgments**

Funding for logistics was provided by Surgeons Overseas with a donation from the Thompson Family Foundation. The Sierra Leone Ministry of Health and Sanitation, Sierra Leone College of Medicine and Allied Health Sciences, and Connaught Hospital assisted with local transport and administrative issues. We thank personnel from Statistics Sierra Leone for sharing their expertise, the enumerators and field supervisors for their fine work ethic and enthusiasm, and Lucie Blok of the Royal Tropical Institute for her final look through the survey-questionnaire.

**References**


