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EVIDENCE FOR ACTION

Magnitude of maternal and neonatal mortality in Tanzania: A systematic review

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ABSTRACT

Background: Maternal and neonatal mortality remains a serious challenge in Tanzania. Progress is tracked through maternal mortality ratios (MMR) and neonatal mortality rates (NMR), yet robust national data on these outcomes is difficult and expensive to ascertain, and mask wide variation. *Search strategy:* We searched EMBASE, MEDLINE, Popline, and EBSCO online databases, basing search terms on ("maternal" OR "neonatal") AND ("mortality" OR "cause of death") AND "Tanzania." *Selection criteria:* Nationally representative or population representative from the subnational context were eligible, providing NMR, MMR, or numbers of maternal deaths or early neonatal deaths or neonatal deaths and live births. *Data collection and analysis:* Data were extracted on study context, time period, number of deaths and live births, definition of maternal and neonatal death, study design, and completeness and representativeness of data. NMR and MMR were extracted or calculated and study quality was assessed. Nationally representative data were compared with modelled national data from international agencies. *Main results:* 2107 records were screened yielding 21 maternal mortality and 15 neonatal mortality datasets. There were high mortality levels with wide subnational MMR and NMR variation. National survey data differed from the modelled estimates, with wide uncertainty ranges. *Conclusion:* Subnational data quality was generally poor with no observable trends and geographical clustering across several regions. Combined MMR and NMR reporting is uncommon. Modelled national estimates lack precision and are complex to interpret. Results suggest that aggregate national data are inadequate for policy generation and progress monitoring. We recommend strengthening of vital registration and Health Management Information Systems with complementary use of process indicators, for improved monitoring of, and accountability for maternal and newborn health.

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1. Introduction

Tanzania has a history of solid national commitments to reduce maternal and neonatal mortality and strong political will for achieving Millennium Development Goals (MDGs) 4 and 5. Multiple national maternal and newborn health policies [1,2] have followed, including integration of maternal, newborn, and child health services, and free access to prenatal care, delivery care, and postnatal care [2]. Despite this, even conservative estimates place Tanzania as one of the worst performing countries globally, with a maternal mortality ratio (MMR) in 2010 of 454 maternal deaths per 100 000 live births [3], and United Nations (UN) modelled estimates projecting a 2013 MMR of 410 [4], with levels not declining at a rate required to achieve the MDG 4 target. Remarkably, Tanzania has reached its MDG target for reducing under-five deaths, yet neonatal mortality has declined at only half the rate, with a 2010 neonatal mortality rate (NMR) of 21 deaths for every 1000 live births [5].

Population-based maternal and neonatal mortality data are needed for monitoring country-level progress in maternal and newborn survival. The Government of Tanzania relies on Demographic and Health Surveys (DHS) for national-level monitoring and decision-making; five surveys have been conducted since 1992 providing MMR and NMR estimates over the last 20 years. At the international level, estimates of NMR and MMR are generally modelled, using different sources and calculation methods [6,7]. Both the UN and Institute for Health Metrics and Evaluation (IHME) MMR estimation models for Tanzania are based on DHS data, but model input data (e.g. gross domestic product, general fertility rate, and skilled birth attendance), and assumptions about the contribution of HIV to maternal mortality vary [8–10]. For neonatal mortality, the UN used DHS and census input data with births estimates from the UN [11,12]. The IHME NMR data were based on DHS data and also used births estimates from the UN [13].

Both the DHS and international estimation models can only provide robust data at national level, masking variation at subnational level. In Tanzania, regions vary substantially in both provision and use of health

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services [5], and sociodemographic factors [3], with some remote rural regions performing much poorer than their urban counterparts. A systematic review of subnational studies reporting NMR or MMR data will present the wealth of additional information available for decision-makers to utilize at central and decentralized level, and may focus attention on the subnational populations with greatest burden of mortality.

Evidence for Action Tanzania endeavors to gather, synthesize, and analyze existing data for more effective decision-making [14]. A qualitative analysis of the use of maternal and newborn health data for decision-making in Tanzania revealed an emerging culture of evidence-based decision-making, yet with much opportunity for improvement in both access to, and use of, maternal and newborn health information [15].

The aims of the present review are to collate all available evidence from population-based studies to expand on the national-level data on the levels of maternal and neonatal mortality, to describe the subnational mortality levels, and to compare with national estimates. This review will ascertain the methodological quality of national and subnational studies to better inform comparison across such estimates, and to potentially illuminate regional variation and trends over time.

2. Materials and methods

2.1. Search strategy

We adhered to the guidelines for Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). We searched EMBASE, MEDLINE, Popline, and EBSCO online databases and hand searched the reference lists of eligible articles. Search terms were based on ("maternal" OR "neonatal") AND ("mortality" OR "cause of death") AND "Tanzania" (Supplementary material S1). The search was carried out on February 5, 2014. Duplicates were deleted.

2.2. Study selection and eligibility criteria

Title and abstract screening and data extraction were completed by one author (CA). Citations of eligible articles were screened to identify relevant titles and abstracts. Where there were insufficient data in the titles or abstracts the full text article was sourced and evaluated.

We included studies that were published in English, with no restrictions on date of publication. Eligible data were either nationally representative, or population representative from any subnational context in Tanzania. Studies were included if they provided numbers of maternal death (occurring during pregnancy, childbirth, or within 42 days after the birth or termination of a pregnancy or similar definition), early neonatal deaths (a live-born infant within the first seven days), or neonatal deaths (a live-born infant within the first 28 days or similar definition), and live births. Conference abstracts were excluded.

Eligible data were examined to identify duplication. Where one set of mortality data was captured in multiple journal articles or with different main authors, the publication with the most detailed information was included.

We further excluded datasets that had fewer than 25 maternal deaths for generating an MMR, following the methods of previous systematic reviews of maternal mortality [16,17]. There was no similar pre-existing protocol to follow for neonatal mortality so no eligible studies were excluded.

2.3. Data extraction and analysis

Data were extracted on study place, time period of deaths, number of deaths, definition of maternal death, definition of neonatal death, study design, completeness of records, and number of live births. NMR and MMR were extracted or calculated. Where possible, 95% confidence intervals of the NMR or MMR were extracted, or calculated.

Studies were assessed against two quality criteria: definition of maternal or neonatal death and completeness of ascertainment of deaths and live births (Table 1). An overall rating of "low risk of bias" was assigned to the studies that were in low risk categories for both criteria. Studies with one or two high risk criteria were rated "high risk of bias."

MMR and NMR were plotted over time in scatter graphs and mapped to show regional spread. Data collected within a period of years were assigned a mid-point single year estimate. Unless otherwise reported in the publication, estimates from the indirect sisterhood method were assumed to refer to 12 years prior to the survey [18]. The interquartile range (IQR) was calculated for the NMR and MMR data points. National estimates were compared with modeled data reported by the UN [4,19–22] and IHME [8,12,23,24] on scatter graphs.

3. Results

The search generated 3278 publications of which 2107 were screened for inclusion (Fig. 1). One PhD thesis [25] was provided by an author (C.R.). Two studies could not be found. A total of 205 full text articles were reviewed with an additional study identified through hand-searching of reference lists [26]. Thirty-six relevant studies were

Table 1
Methodological quality assessment criteria.

Criteria	Low risk of bias	High risk of bias
1. Definition of maternal or neonatal mortality	• ICD-10 definition of maternal death or similar	• No definition provided • Definition unclear
	• Neonatal death defined as death of a live-born infant under 28 days, or similar • Early neonatal mortality defined as death of a live-born infant within first 7 days	• No definition provided • Definition unclear
2. Completeness of ascertainment of maternal or neonatal deaths and live births	• Prospective recording of mortality data • Mixed methods data review cross-referencing facility records and community-based DSS with frequent (≤6 months) rounds. • Demographic surveillance system with frequent (≤6 months) rounds	• Direct or indirect sisterhood survey • Demographic surveillance system with infrequent (>6 months) rounds
	• Cross-sectional study design based on recall of maternal or neonatal deaths ≤ 6 months previously • Key informant reporting from sufficiently broad pool of informants	• Cross-sectional study design based on recall of maternal or neonatal deaths > 6 months previously • Key informant reporting details unclear/likely to miss deaths and births
	• Prospective recording of births data • Use of census data <5 years old for live births	• Use of national TFR as proxy for regional live births • Use of census data ≥5 years old for live births • Live births data source not stated/unclear
	• <10% loss to follow-up or participation	• Completeness not stated • >10% loss to follow-up or participation

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