

# Where giving birth is a forecast of death: maternal mortality in four districts of Afghanistan, 1999–2002

*Lancet* 2005; 365: 864–70

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## Summary

**Background** Maternal mortality in Afghanistan is uniformly identified as an issue of primary public-health importance. To guide the implementation of reproductive-health services, we examined the numbers, causes, and preventable factors for maternal deaths among women in four districts.

**Methods** We did a retrospective cohort study of women of reproductive age (15–49 years) who died between March 21, 1999, and March 21, 2002, in four selected districts in four provinces: Kabul city, Kabul province (urban); Alisheng district, Laghman province (semirural); Maywand, Kandahar province (rural); and Ragh, Badakshan province (rural, most remote). Deaths among women of reproductive age were identified through a survey of all households in randomly selected villages and investigated through verbal-autopsy interviews of family members.

**Findings** In a population of 90 816, 357 women of reproductive age died; 154 deaths were related to complications during pregnancy, childbirth, or the puerperal period. Most maternal deaths were caused by ante-partum haemorrhage, except in Ragh, where a greater proportion of women died of obstructed labour. All measures of maternal risk were high, especially in the more remote areas; the maternal mortality ratio (per 100 000 livebirths) was 418 (235–602) in Kabul, 774 (433–1115) in Alisheng, 2182 (1451–2913) in Maywand, and 6507 (5026–7988) in Ragh. In the two rural sites, no woman who died was assisted by a skilled birth attendant.

**Interpretation** Maternal mortality in Afghanistan is high and becomes significantly greater with increasing remoteness. Deaths could be averted if complications were prevented through optimisation of general health status and if complications that occurred were treated to reduce their severity—efforts that require a multisectoral approach to increase availability and accessibility of health care.

## Introduction

For longer than 20 years, the people of Afghanistan have faced international and civil conflicts, drought, famine, and epidemics. Much of the country's infrastructure has been destroyed.<sup>1</sup> In 2002, 60% of Afghans had no access to basic health services.<sup>2</sup> Services for women are particularly scarce; in 2002, two-thirds of Afghanistan's districts lacked maternal and child health services and only 10% of hospitals were adequately equipped for caesarean deliveries.<sup>2</sup> To guide development of reproductive health services in the post-Taliban era, we assessed the numbers of maternal deaths during 1999–2002 in four districts in Afghanistan and identified their causes, risk factors, and preventability, as well as barriers to care.

## Methods

### Study design and setting

We undertook a two-stage, retrospective cohort study of women of reproductive age, defined as 15–49 years, who died between March 21, 1999, and March 21, 2002, in four districts in diverse settings (urban to rural). The first stage, death identification, consisted of finding households (individuals sharing a cooking area) in which a woman of reproductive age had died during the study period. First-stage data were collected between March 22 and April 30, 2002; interviews were carried out at about the same time by separate teams. In the second

stage, death investigation, conducted sequentially in the four districts by a single team in May to July, 2002, we investigated whether deaths among the women of reproductive age were related to maternal complications.

Four provinces in various urban to rural settings were purposely selected after classification of all provinces by remoteness (measured by population, access to urban resources, and distance to the nearest health-care facility with basic and comprehensive essential obstetric care). Basic essential obstetric care includes skilled attendants (midwives or physicians) who can administer parenteral antibiotics, oxytocic drugs, and sedatives and manually remove retained products of conception. Comprehensive essential obstetric care also includes the availability of surgical expertise, including caesarean section, administration of anaesthesia, and blood transfusion.<sup>3</sup> Sample selection was confirmed by examination of population density (people per km<sup>2</sup>) in the Afghan Information Management System as of April, 2002, and data on health resources.<sup>2,4</sup> After accounting for accessibility, security, weather, and geographical constraints, we identified a district in each of the four provinces that represented a degree of remoteness consistent with the larger province. The districts (figure 1) were: Kabul city, Kabul province (urban); Alisheng district, Laghman province (semirural); Maywand, Kandahar province (rural); and

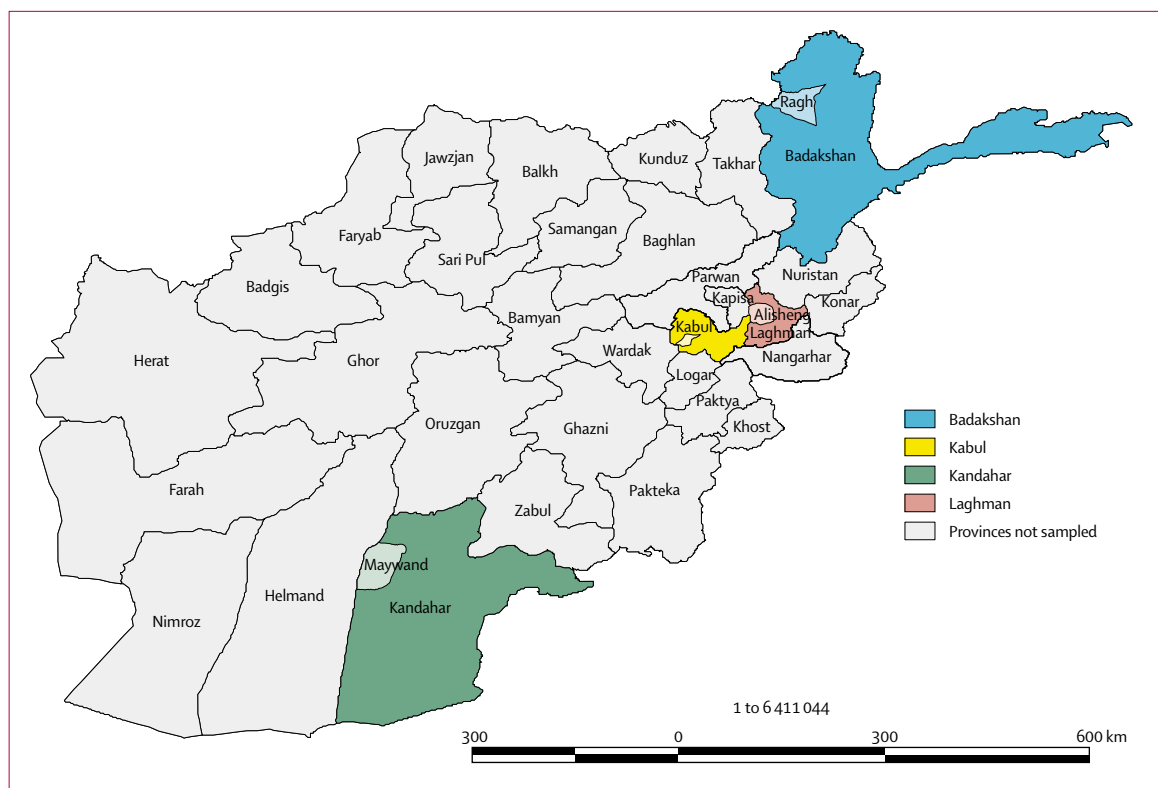


Figure 1: The four study districts in Afghanistan

Ragh, Badakshan province (rural, most remote). Districts differed by population density, geography, availability of care, exposure to conflict, and ethnicity (table 1). We randomly allocated villages stratified by size; equal numbers of villages were sampled from each stratum so that each village in the district had an equal probability of being selected. The sample accounted for roughly 33 000 people from each province type (urban, semiurban, rural). Because of the migration of refugees and others into Kabul, our final sample was more heavily weighted toward that city.

Kabul, the capital and largest city, has experienced conflict since 1979, and large areas were destroyed in

1992–96. During 1997–2001, the city was controlled by the Taliban, who restricted mobility, education, and employment, especially for women.<sup>5</sup> Medical care was available during the study period from two government-run women's hospitals and several clinics run by non-governmental organisations.<sup>2</sup> Alisheng district, Laghman, lies in a predominantly agricultural river valley. The area was affected by the Russian conflict and Taliban rule, and tribal warfare is frequent. Residents have access to a district clinic with basic essential obstetric care and a hospital with comprehensive essential obstetric care in Mehterlam district, several hours' walk from most villages. Maywand district,

	Kabul city, Kabul	Alisheng, Laghman	Maywand, Kandahar	Ragh, Badakshan	Total
Sampled population	2 197 000	71 725	65 323	89 301	2 423 349
Number of villages selected for data collection/total villages in district	13/180	48/104	36/139	45/240	142/1293
Study households	7904	2666	1617	1661	13 848
Study population (individuals living in household at end of study period)	49 786	17 983	11 807	11 240	90 816
Ethnicity, %					
Tajik	70	4	0	100	
Hazara	16	0	0	0	
Pashtun	14	40	100	0	
Pashai	0	56	0	0	
Number of women of reproductive age	11 064	3635	2180	2548	19 427
Total deaths	742	617	300	901	2560
Deaths among women of reproductive age	122	52	62	121	357
Total livebirths	4994	2583	1604	1214	10 395

Table 1: Population and sample size in the four study sites

Kandahar, is largely desert. Many people are nomadic, herding animals. Kandahar city, 2–6 h drive or 1–2 days' walk from Alisheng, was the Taliban's headquarters. From September, 2001, to March, 2002, fighting with Al Qaeda was concentrated in Kandahar, including Maywand. A clinic with basic essential obstetric care is over a day's walk from some areas, and the nearest hospital with comprehensive essential obstetric care is in Kandahar city. Finally, Ragh, Badakshan, is a remote region in the Hindu-Kush mountains, snowbound at least half the year. The Ragh people practise subsistence farming. Health care is up to 10 days' ride or walk away at the hospital in Faizabad city, which has comprehensive essential obstetric care.

The study protocol was reviewed by the Centers for Disease Control and Prevention's institutional review board and senior stakeholders in the United Nations and the Afghan Ministry of Health. Because of low literacy rates, spoken informed consent was obtained from informants for the deceased.

#### **Death identification, investigation, and classification**

In the first part of the study, respondents reported: the number, sex, and age of individuals in the household at the end of the study period; the number, sex, and age of household members present at any time during the study period; any births and stillbirths during the period; and any deaths during the period and the age and sex of those who died. For these deaths, interviewers asked respondents what they believed was the cause and selected a descriptor from a checklist, which included infectious diseases, other diseases, war-related and land-mine trauma, and unknown. Families of each deceased woman of reproductive age were asked whether the woman died during pregnancy, childbirth, or "chil" (the Afghan term for a 40-day post-partum period).

The interviews were carried out by local literate Afghan women, accompanied by a male relative for cultural reasons, who explained to male household members and community leaders the study's purpose and sought permission for the interviewers to speak to the female household members. Survey team leaders and district coordinators (UNICEF or Ministry of Health staff) had survey experience.

In the second part of the study, households reporting the death of a woman of reproductive age were visited by Afghan and international physicians and midwives trained in verbal-autopsy interviews, accompanied by interpreters when necessary. Neither written nor electronic records (eg, death certificates) were available for the study. For 91% of the households, the primary respondents were women who had lived with the deceased and were present at the time of death. Interviewers used a questionnaire based on questions developed by WHO,<sup>6–8</sup> which was reviewed for cultural appropriateness by Afghan and UNICEF collaborators

and a medical anthropologist. Case histories included medical and reproductive history; pregnancy status; whether death was early in pregnancy (while pregnant or after an induced abortion or spontaneous miscarriage), before or during labour, or in the post-partum period; circumstances surrounding death, including treatment; and barriers to care.

Immediate, underlying, and contributory causes of death were determined to the extent possible by the interviewer and classified by use of the International Statistical Classification of Diseases and Related Problems, 10th Revision.<sup>9</sup> We present only the underlying cause.

We defined, as does WHO, maternal mortality as death from any cause related to pregnancy or its management within 1 year of pregnancy outcome, irrespective of duration or site.<sup>9</sup> Direct deaths arose from complications during pregnancy, labour, or the puerperium as a result of interventions, omissions, or incorrect treatment, and indirect deaths were from previously existing disease or a disease that developed during pregnancy that was not directly related to the obstetric condition but was aggravated by pregnancy.<sup>9</sup>

We determined the potential for prevention of deaths by reviewing the surrounding circumstances, underlying cause, availability and sophistication of medical care, expectation of care in a less developed country, and barriers. We classified barriers<sup>7</sup> as: first, the existence of a problem associated with pregnancy or childbirth was not recognised or care was not sought once the problem was recognised; second, care was sought but could not be obtained because it was too far away or care or transport was unaffordable; third, care was accessed but the woman did not receive appropriate treatment.

#### **Data management and analyses**

Data from the death-identification surveys were entered into a Microsoft Access database in Kabul by Afghan staff. Data from verbal-autopsy interviews were entered by means of EpiInfo (version 6.01). Both datasets were converted into SAS (version 8) and SUDAAN (version 8) for statistical analyses. Primary outcomes were measures of maternal mortality, including the maternal mortality ratio, maternal mortality rate, lifetime risk of maternal death, and proportion of deaths among women of reproductive age due to maternal causes. Secondary outcomes included other demographic indicators, the distribution of causes of death, and prevalence of selected risk factors. We assumed a normal distribution when calculating the CI.

All maternal deaths were included in mortality-rate estimates. When the denominator was the population, it was defined by the years each person lived in a household during the study period. When more detailed examination of maternal deaths was done, only deaths investigated by verbal autopsy were included.

### Role of the funding source

The study was funded by UNICEF, the US Centers for Disease Control and Prevention, and the US Agency for International Development. Investigators from the Centers for Disease Control and Prevention directed the project, assisted by UNICEF and Afghanistan Ministry of Health staff. All the authors had full access to all the data for the study and made the final decision to submit for publication.

### Results

Among the 13 848 households in the four districts (total population 90 816), 2560 deaths were reported during the study period (table 1). 357 deaths were among women of reproductive age. 294 (82%) were investigated by verbal autopsy to assess their relation to pregnancy or childbirth; there was no verbal autopsy for 63 women because of insecurity or relocation. Of 154 maternal deaths identified by families, 133 were investigated by verbal autopsy. 109 (82%) were found to be direct maternal deaths, 12 (9%) indirect deaths, and 12 (9%) pregnancy-related complications for which the cause of death was unclear (table 2). Among the 133 women of reproductive age who died of maternal causes and whose deaths were investigated by verbal autopsy, the most common causes were antenatal or post-partum haemorrhage (50 [38%]) and obstructed labour (34 [26%]). Regional differences were noted; in Ragh, obstructed labour was the most common cause of maternal deaths (table 2).

Deaths from maternal causes exceeded those from all other causes among women of reproductive age in our three rural or semirural sites (figure 2). In Alisheng, 20 (38%) deaths were caused by pregnancy or childbirth; pregnancy-related complications caused 35 (56%) deaths among women of reproductive age in rural Maywand and 79 (65%) in Ragh. Only in Kabul was the proportion of deaths due to maternal causes (20 [16%]) similar to proportions from other causes (table 3).

All estimates of mortality, including maternal mortality ratio, maternal mortality rate, lifetime risk of maternal death, and proportion of deaths among women of reproductive age resulting from maternal causes, increased substantially with remoteness (table 3). Infant and perinatal mortality were also very high and increased with remoteness. The highest maternal mortality ratio was in the most remote district, Ragh (6507 per 100 000 livebirths [95% CI 5026–7988]). We applied the maternal mortality ratios from the four sites to all other provinces with similar population densities to calculate a single weighted maternal mortality ratio estimate. Because the maternal mortality ratio in Ragh was higher than ever documented worldwide, for each national estimate, we included the data from that site to calculate a possible upper range and then excluded them to calculate a lower range. Thus, if provinces with similar population densities had maternal mortality

	Kabul city, Kabul (n=20)	Alisheng, Laghman (n=20)	Maywand, Kandahar (n=35)	Ragh, Badakshan (n=79)
<b>Direct causes</b>				
Haemorrhage*	10 (50%)	6 (30%)	14 (40%)	20 (25%)
Obstructed labour	0	3 (15%)	7 (20%)	24 (30%)
Pregnancy-induced hypertension†	3 (15%)	3 (15%)	2 (6%)	5 (6%)
Cardiomyopathy	2 (10%)	0	0	0
Sepsis	1 (5%)	1 (5%)	0	5 (6%)
Obstetric embolism	0	0	1 (3%)	0
Early pregnancy outcome‡	0	0	1 (3%)	1 (1%)
Subtotal	16 (80%)	13 (65%)	25 (71%)	55 (70%)
<b>Indirect causes</b>				
Tuberculosis	0	3 (15%)	1 (3%)	4 (6%)
Malaria	1 (5%)	0	1 (3%)	0
Obstetric tetanus§	0	0	0	2 (3%)
Subtotal	1 (5%)	3 (15%)	2 (6%)	6 (8%)
Unclear causes occurring during pregnancy and delivery¶	2 (10%)	2 (10%)	2 (6%)	6 (8%)
Unknown	1 (5%)	2 (10%)	6 (17%)	12 (15%)
Total	20	20	35	79

\*Includes those related to placental abruption and placenta previa. †Including pre-eclampsia and eclampsia. ‡Unclear whether ectopic or septic abortion. §Deaths due to obstetric tetanus are not counted as maternal deaths in ICD 10, but we chose to count them in this study. ¶Verbal autopsy was done; however, the cause of death was found to be unclear but related to maternal complications. ||Includes cases for which we could not investigate with verbal autopsy to confirm cause of death, but the family had indicated that the cause of death was maternal during the death-identification survey.

**Table 2: Frequency distribution of maternal causes of death among women in the four study sites**

ratios similar to those in the districts where we collected data, the national maternal mortality ratio would be between 1600 and 2200. Similarly, the range for the total combined proportion of women who died from maternal causes would be 48–55%, and the lifetime risk of maternal death one in six to one in nine.

Consistent with demographic data (table 3), women who died in Kabul, Alisheng, and Maywand had had 4.4 livebirths on average, and those in Ragh had fewer (table 4). Women in more rural regions were more likely to die in labour with their infants undelivered. Women in Ragh were younger at death and died either during their first pregnancy, undelivered, or shortly after delivering their first child. Among deliveries in more remote areas, there were more stillbirths and for children born alive, the probability of survival was lower. Overall, three-quarters of infants born alive to mothers

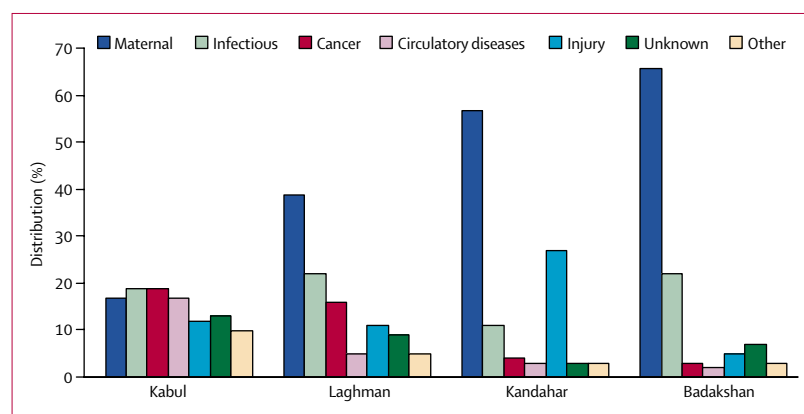


Figure 2: Frequency distribution of causes of death among women of reproductive age in the four study sites

Indicator	Rate (95% CI)			
	Kabul city, Kabul	Alisheng, Laghman	Maywand, Kandahar	Ragh, Badakshan
Crude mortality rate per 1000 population	5.7 (5.2–6.1)	11.6 (10.7–12.5)	9.0 (8.0–10.0)	27 (25–29)
Maternal mortality ratio per 100 000 livebirths	418 (235–602)	774 (433–1115)	2182 (1451–2913)	6507 (5026–7988)
Maternal mortality rate per 1000 women of reproductive age	0.7 (0.4–1.0)	1.9 (1.1–2.7)	5.8 (3.9–7.7)	10.5 (8.2–12.9)
Lifetime risk of maternal death*	1 in 42 (29–74)	1 in 16 (11–28)	1 in 5 (4–8)	1 in 3 (3–4)
Proportion of deaths among women of reproductive age due to maternal causes	20 (16%)	20 (38%)	35 (56%)	79 (65%)
Mortality rate in children under 5 years per 1000 livebirths†	109 (87–130)	190 (149–230)	Not available	323 (266–378)
Infant mortality rate per 1000 livebirths	78.0 (64.0–91.0)	128.0 (102.9–153.7)	Not available	216.9 (178.0–256.8)
Total stillbirth ratio per 100 births	2.7 (2.3–3.2)	4.2 (3.5–5.0)	9.2 (7.9–10.6)	7.0 (5.6–8.4)
Perinatal mortality rate (stillbirths and deaths in infants ≤7 days of age) per 1000 livebirths	29 (24–34)	60 (50–69)	104 (88–121)	106 (87–126)
Crude birth rate per 1000 population	36 (35–37)	49 (47–51)	48 (45–50)	36 (34–38)
General fertility rate per 1000 women of reproductive age	166 (160–171)	243 (231–255)	265 (248–282)	162 (151–173)
Natural rate of population increase (%)	3.1 (3.0–3.2)	3.7 (3.5–3.7)	3.9 (3.6–4.2)	0.9 (0.7–1.2)

For indicators that use population in the denominator, we used person-years at risk, defined as the years each person lived in a household during the 3-year study period. \*1/(maternal deaths/women aged 15–49 years×35).  
†For these estimates, we used the Brass indirect technique.

**Table 3: Demographic indicators in the four study sites**

who died also died. Of the 70 women who died post partum, 66 (94%) died within 42 days, the standard post-partum period. Of these, 37 (56%) died in the first 24 h. Substantially fewer proportions of women in the rural districts received antenatal care than did in Kabul (table 4). Of rural women receiving care, only 6% were given antenatal vitamins, and none received a clean delivery kit. In Maywand and Ragh, no woman who died was accompanied by a midwife or physician during labour and delivery.

Women who died of maternal causes were significantly more likely than women who died of non-maternal causes to have a first-level barrier (relative risk

2.06;  $p < 0.0001$ ) and to be illiterate (4.35;  $p = 0.002$ ). Health-care knowledge and decision-making to seek care declined with remoteness. Decision-making ability was influenced by perceptions of accessibility. Only 30% of families in Ragh sought care, whereas 72% did so in Kabul. In all sites, lack of transport, distance to services, insecure travelling conditions, and inability to afford transport or care were reported. Most families reported that a female relative recognised there was a problem, but in almost all cases a male relative decided whether or not to seek care. Of families trying to obtain care, three-quarters identified second-level barriers (such as distance, availability of transport, and cost of transport and services) as the most significant obstacles to access. Furthermore, almost 70% reported third-level barriers (did not receive quality and timely care after reaching a facility or provider). Cost was also a barrier, since many families had to buy blood and medications. In all, 120 deaths (78%) were judged preventable.

### Discussion

Maternal mortality among Afghan women was high, and risk increased with greater remoteness. Numbers of deaths from maternal complications exceeded those from all other causes among women in the three semirural or rural sites. As in many other less developed countries, ante-partum haemorrhage was the most common maternal cause in three sites, but in Ragh, where maternal mortality was higher than any rate reported anywhere else in the world, more women died from obstructed labour. Overall, in all four sites, 74% of infants born alive to women who died also died.

The UN's estimated maternal mortality ratio for Afghanistan in 2000 was 1900 (95% CI 470–3500), similar to our estimates for the whole country (1600–2200 per 100 000 livebirths).<sup>10</sup> Another recent study of maternal mortality in Afghanistan found a maternal mortality ratio of 593 (557–630) among women 6 h from an urban centre, which is consistent with our

	Kabul city, Kabul (n=20)	Alisheng, Laghman (n=20)	Maywand, Kandahar (n=35)	Ragh, Badakshan (n=79)
<b>Demographics and indicators of socioeconomic status</b>				
Mean (SD) age, years	31.1 (2.0)	30.8 (2.0)	26.1 (1.4)	26.1 (0.7)
Currently married	18/19 (95%)	18/18 (100%)	29/29 (100%)	66/67 (99%)
Number living in household	6.3	6.7	7.3	6.7
Literate	5/19 (26%)	0/18	1/29 (3%)	0/66
Husband literate	10/18 (56%)	8/18 (44%)	8/29 (28%)	17/66 (26%)
Own radio	10/18 (56%)	8/18 (44%)	21/28 (75%)	9/67 (13%)
Enough to eat always	4/19 (21%)	10/18 (56%)	16/29 (55%)	14/67 (21%)
<b>Obstetric history</b>				
Mean (SE) number of livebirths	4.3 (0.5)	4.4 (0.7)	4.6 (0.6)	3.4 (0.3)
Mean (SE) number of living children	3.3 (0.5)	3.2 (0.5)	3.7 (0.5)	1.8 (0.2)
History of stillbirth	5/18 (28%)	6/18 (33%)	6/29 (21%)	5/67 (7%)
<b>Outcome of last pregnancy before death</b>				
Livebirth	13/19 (68%)	9/18 (50%)	11/29 (38%)	29/67 (43%)
Child survived	6/13 (45%)	2/9 (22%)	4/11 (36%)	4/29 (14%)
Stillbirth	3/19 (16%)	4/18 (22%)	3/29 (10%)	3/67 (5%)
Undelivered, in labour	2/19 (11%)	4/18 (22%)	12/29 (41%)	30/67 (45%)
Pregnant, before onset of labour	1/19 (5%)*	1/18 (6%)	3/29 (10%)	5/67 (8%)
<b>Health-care access during last pregnancy before death</b>				
Antenatal care	10/18 (56%)	1/18 (6%)	4/28 (14%)	2/68 (3%)
Took antenatal vitamins during pregnancy	4/16 (25%)	1/18 (6%)	1/27 (4%)	0/67
Given clean delivery kit	0	0	0	0
Skilled attendant at birth immediately preceding death	6/18 (40%)	2/17 (12%)	0/29	0/68
Ever used contraception	2/18 (11%)	1/18 (6%)	2/29 (7%)	0

Denominators vary owing to missing data. \*Ectopic.

**Table 4: Characteristics of women who died of maternal causes in the four study sites**

maternal mortality ratio of 774 (433–1115) among women in Alisheng, a similarly rural site.<sup>11</sup> These maternal mortality estimates exceed UN estimates for all neighbouring countries and those recorded among Afghan refugees in Pakistan.<sup>10,12</sup>

The high maternal mortality of Afghan women could have many causes, including limited availability and accessibility of health services,<sup>13</sup> high fertility,<sup>14</sup> poor health, including anaemia from chronic under-nutrition<sup>15,16</sup> and infectious diseases,<sup>17</sup> poverty,<sup>18</sup> low rates of literacy,<sup>19</sup> lack of knowledge about maternal health and safe delivery, and cultural practices. Widespread restrictions on education and employment limit the number of trained female health providers and reduce women's resources to access care. Inability to leave the home without the permission or escort of a male relative is a constraint. These factors are exacerbated in rural areas. Direct effects of conflict include delay in seeking care because of insecure travel. Even for areas like Ragh, which did not directly experience conflict, the risk of maternal death was likely increased through indirect effects, including the destruction or decay of the health-care, education, and transport systems; emigration of health professionals; and decreased opportunity for employment increasing poverty and hindering development.

To overcome these substantial challenges will require well-informed planning within and beyond the health sector. The Afghan Ministry of Health has developed a comprehensive National Reproductive Health Strategy for lowering maternal mortality, guided partly by this study's preliminary findings and other research.<sup>20,21</sup> The strategy seeks effective antenatal care for all by focusing on improved availability of skilled attendants (community-based midwives) at birth and the coverage, use, and quality of emergency obstetric care, particularly in rural areas. Training of providers has been initiated, standards of care adopted and distributed, five centres of obstetric excellence developed, and the number and quality of health facilities improved.<sup>21</sup> Improvement of ante-partum care should prevent most deaths. In addition, complications can be prevented by optimisation of general health (primary prevention) or treated to reduce their severity (secondary and tertiary prevention). Primary prevention during preconceptional and prenatal care could: decrease the number of pregnancies and increase birth spacing in higher-risk women; improve nutritional status; reduce infectious diseases through access to immunisation, education on hygiene, safe water, and programmes to prevent malaria and tuberculosis; educate women and their families about warning signs during pregnancy and delivery; and ensure preparedness for birth. Secondary prevention services (eg, screening) and tertiary prevention (eg, treatment of life-threatening childbirth complications) can be provided during antenatal, peri-partum, or post-partum care.

Optimisation of maternal survival also requires that barriers to care are addressed. Crucial strategies are to render care more affordable, to increase security and education, to promote the value of girls and women, and to improve roads and transport. Informing both men and women about the time to seek care is necessary. Employment of husband-and-wife teams to work as health educators, pregnancy monitors, and providers might be effective for rural communities.

Reduction of maternal mortality is a human rights issue for women and their children.<sup>22</sup> Lower educational attainment and higher mortality among children, especially girls, and lowered socioeconomic status are effects of maternal death documented elsewhere.<sup>23</sup> Safe motherhood benefits not only women but clearly also their families, community, and society and is an essential component of development.

Our study has limitations. Because we had no reliable routine sources of data to identify births or deaths, we used a survey, with its possibilities for error. Our mortality and fertility estimates are consistent with those expected for other countries of similar development, however.<sup>7</sup> Although over-reporting of deaths and under-reporting of births might have affected results from Ragh, we believe that similar rates of maternal mortality have not been recorded because few studies have been carried out in equally remote, conflict-affected populations. To assess the effect of potential undercounting of births on the maternal mortality ratio in Ragh, we adjusted it using the birth rate in our second rural site, Maywand, as the standard and calculated a birth-rate-adjusted maternal mortality ratio for Ragh of 4900 (95% CI 3800–6000); this range overlaps that of the unadjusted maternal mortality ratio. Furthermore, all other measures of mortality in Ragh were consistently higher than reported in other study sites. Although in other south Asian countries, the estimated proportion of maternal deaths due to complications of illegal abortion is almost 15%, we identified only one such possible death,<sup>24</sup> possibly because induced abortion is rare in Afghanistan. Although specific causes of maternal death are difficult to classify without the benefit of pathology or medical records, in the only validation study of verbal-autopsy determination, the interview was sensitive (84%) and specific (97%).<sup>25</sup> Verbal autopsy is particularly effective for direct causes, such as those found in 109 (84%) of our women who died of maternal causes. Finally, our estimates of possible maternal mortality ratios for Afghanistan were based on only four districts.

The unprecedented magnitude of maternal mortality in Ragh suggests the need for additional research in similarly remote, resource-poor, crisis settings. Further information is also needed about the services that lower the risk of maternal death when high-quality care is limited.<sup>26</sup> Because much of Afghanistan has virtually no services, a crucial opportunity exists to assess the acceptability, feasibility, and effectiveness of the

programmes implemented, which could not only guide services in Afghanistan but also inform prevention efforts worldwide. The response from the international humanitarian community to Afghanistan has been commendable; long-term commitment of substantial resources, particularly for rural areas, is needed to reduce the extreme risk of maternal mortality among Afghan women.

#### Afghan Maternal Mortality Study Team: other members

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#### Contributors

L Bartlett (principal investigator), S Mawji, S Whitehead, C Crouse, S Dalil, D Ionete, and P Salama participated in the conception and design of this study, acquisition and interpretation of data, and drafting and review of the report. S Siddiqi, N Qani, R Wilson, M Chen, P Stupp, T Johnson, and H Goldberg made important contributions to one or more of: study design; acquisition, analysis, or interpretation of data; or review of the study report.

#### Conflict of interest statement

We declare that we have no conflict of interest.

#### Acknowledgments

We thank the women and men in Afghanistan without whose help this study would not have been accomplished, including all those who were supervisors, interviewers, trainers, drivers, and data-entry staff; the staff of the UNICEF offices in Badakshan, Kabul, Jalalabad, and Kandahar; from CDC, Hoyt Wilson, Sonya Bowens, Anita McLees, and Sharon Daves; Patricia Omidian, formerly of Ceres Tech, Kabul; and Peter Taylor, Palladian Partners, USA.

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