Received: 21 July 2018 | Revised: 12 November 2018 | Accepted: 21 November 2018

DOI: 10.1111/ppe.12530

ORIGINAL ARTICLE

WILEY Paediatric and Perinatal Epidemiology

Understanding country-specific determinants of stillbirth using household surveys: The case of Afghanistan

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Funding information
Australian Postgraduate Award funded through the Australian Commonwealth Government; National Health and Medical Research Council Career Development Fellowship, Grant/Award Number: 1087062

An invited commentary of this manuscript appears on pages 45–46

Abstract

Background: Stillbirth rates in Afghanistan have declined little in the past decade with no data available on key risk factors. Health care utilisation and maternal complications are important factors influencing pregnancy outcomes but rarely captured for stillbirth in national surveys from low- and middle-income countries. The 2010 Afghanistan Mortality Survey (AMS) is one of few surveys with this information.

Methods: We used data from the 2010 AMS that included a full pregnancy history and verbal autopsy. Our sample included the most recent live birth or stillbirth of 13 834 women aged 12-49 years in the three years preceding the survey. Multivariable Poisson regression was used to identify sociodemographic, maternal, and health care utilisation risk factors for stillbirth.

Results: The risk of stillbirth was increased among women in the Central Highlands (aRR: 3.01, 95% CI 1.35, 6.70) and of Nuristani ethnicity (aRR: 9.15, 95% CI 2.95, 28.74). Women who did not receive antenatal care had three times increased risk of stillbirth (aRR: 3.03, 95% CI 1.73, 5.30), while high-quality antenatal care was important for reducing the risk of intrapartum stillbirth. Bleeding, infection, headache, and reduced fetal movements were antenatal complications strongly associated with stillbirth. Reduced fetal movements in the delivery period increased stillbirth risk by almost seven (aRR: 6.82, 95% CI 4.20, 11.10). Facility births had a higher risk of stillbirths overall (aRR: 1.55, 95% CI 1.12, 2.16), but not for intrapartum stillbirths.

Conclusions: Targeted interventions are needed to improve access and utilisation of services for high-risk groups. Early detection of complications through improved quality of antenatal and obstetric care is imperative. We demonstrate the potential of household surveys to provide country-specific evidence on stillbirth risk factors for LMICs where data are lacking.

KEYWORDS

Afghanistan, Demographic and Health Survey, fetal death, household surveys, low- and middle-income country, perinatal death, risk factor, stillbirth

1 | INTRODUCTION

A major challenge for stillbirth prevention in low- and middle-income countries (LMIC), where the largest burden lies, is the lack of adequate data to identify and quantify major risk factors at the national level.[1] Existing studies have been predominantly with women who have had contact with the formal health care system,[2] and while prospective, population-based studies such as those from demographic surveillance sites in LMICs are increasing,[3,4] there are no national-level data for many countries.[1] This lack of data on country-specific risk factors makes it challenging to direct attention to stillbirth at a national level and for countries to prioritise programmatic and policy areas for action to reduce stillbirths.

In 2009, Afghanistan was among the top ten nations accounting for almost two-thirds of the global stillbirth burden, and by 2015, little improvement was observed.[5,6] The annual reduction in stillbirths between 2000 and 2015 in Afghanistan was only 1.9%.[6] The stillbirth rate remains high at 27 per 1000 births—six times that of high-income settings, yet there are no published studies to understand stillbirths in this context. Stillbirths have not been a public health priority in Afghanistan partly because of the absence of evidence on the major factors contributing to these deaths. The UN's 2016 Global Strategy for Women's, Children's and Adolescent's Health now includes reduction in the stillbirth rate as a core indicator, and the 2014 Every Newborn Action Plan set the first-ever targets to reduce stillbirths to 12 per 1000 births by 2030 which was endorsed by 190 countries, including Afghanistan.[7] It is therefore both timely and crucial to investigate stillbirths in this high-burden country.

The 2010 Afghanistan Mortality Survey (AMS) was a modified, special Demographic and Health Survey (DHS) and one of a few nationally representative surveys conducted in a LMIC in the last 10 years that collected health service utilisation data for stillbirths and also included a verbal autopsy.[8] The country's unique and diverse socio-cultural, linguistic, and geographical characteristics in addition to the current complex humanitarian situation make the need for context-specific data imperative (Box 1). The objective of this study was to identify key maternal, obstetric, and health care utilisation factors associated with stillbirth in Afghanistan, and to demonstrate the potential of a modified DHS to provide country-specific evidence on risk factors for stillbirth if applied in other LMICs.

2 | METHODS

2.1 | Data sources

Data for this analysis are from the 2010 Afghanistan Mortality Survey.[9] This was the country's first nationally representative household survey and currently the only national, population-based survey that collected women's health service utilisation for stillbirth. The survey adopted a two-stage sampling design based on the 2011 Population and Housing Census preparatory frame from the Central Statistics Organisation. The design produced a sample representative at the country level for rural and urban areas, and for the North, Central, and South geographical domains that are regroupings of eight geographical regions (Figure 1). The rural areas of Kandahar, Helmand, and Zabul provinces in the South were not surveyed for security reasons. Overall, the survey covered 87% of the population; the 13% not surveyed belonged mostly to the South zone.[9]

We used data from three questionnaires in the AMS, the household, women's, and verbal autopsy (VA) questionnaires, based on the DHS model questionnaires developed by the DHS programme and adapted for Afghanistan. The women's questionnaire collected information from ever-married women aged 12-49 years including background characteristics and a complete pregnancy history which captured all pregnancies and their outcomes in a woman's lifetime. Among women who gave birth in the preceding 5 years, the women's questionnaires captured maternal health care utilisation including antenatal, delivery, and postnatal care for the mother's last live birth or stillbirth. The VA questionnaire was completed for each death that occurred in the preceding 3 years.

In total, 22 351 households were interviewed, which included 47 848 women aged 12-49 years, yielding a response of 98%. We limited our analysis to all women's births within the last three years, giving a base of 17 215 births. We merged data from the VA with the women's and household data so that selected variables not available in the pregnancy histories for stillbirths could be included (fetal sex, multiple pregnancy, and timing of the stillbirth). We further restricted our sample to mothers' most recent birth, giving a sample of 13 844 women/births (13 528 live births and 316 stillbirths), and then corrected any misclassification between miscarriages, stillbirths, or early neonatal deaths using the VA data. This gave a final sample of 13 834 births (13 523 live births and 311 stillbirths). Details on this procedure are available in the Appendix S1.

2.2 | Study variables

2.2.1 | Dependent variable: pregnancy outcome

Our main outcome variable was pregnancy outcome for the mothers' most recent pregnancy and was coded as stillbirth or live birth (see Appendix S1 for detail). We used the definition of stillbirth to be a late fetal death at ≥28 weeks' gestation as recommended by the WHO for international comparisons. The 2010 AMS recorded gestational age in months so we used seven months or more as our cut-off. We defined intrapartum stillbirths as those stillbirths where the mother reported no signs of skin maceration based on the VA data.

2.2.2 | Independent variables and analytical framework

We included individual, household, and community-level explanatory variables based on those identified in the literature as having an important effect on stillbirth, and availability in the 2010 AMS data set[1,10] (see Appendix S1). To guide the analysis, we developed

BOX 1 Afghanistan country context and health situation

Afghanistan is a culturally rich nation located in south-central Asia sharing borders with six different countries, the longest being with Pakistan. The country's 34 provinces comprise a diverse range of ethnicities, languages, and geographical terrains. It is mostly a mountainous landscape with the Hindu Kush mountain range dividing the country from the north-east to the south-west into three distinct regions—the mountainous central highlands, the south-west plateaus characterised by deserts, and the smaller and most fertile northern plains. The current population is estimated to be approximately 30 million. Afghanistan is one of the least developed nations in the world, ranked 169 out of 188 nations on the Human Development Index in 2015. About one-third (37%) of the population lives below the poverty line, and this has remained unchanged since 2007-2008. Afghanistan has a very young population structure with 48% aged under 15 years and an average life expectancy of only 60 years. Fertility rates are high with an average of 5.3 children in 2015—a slight increase from 5.1 in 2010.[9,16] Adult literacy rates remain low at 31%, particularly among females (males 45%; females 17%).

Afghanistan has faced over four decades of ongoing conflict, unstable governance, and population displacement which continues. In 2016, the conflict led to the displacement of over half a million people, more than half of whom were children, and an unexpected influx of over one million Afghan refugees and returnees from Pakistan. It is estimated that over nine million people have limited or no access to essential health services, straining an already weak and recovering health system. The impact of the conflict on access to health services and health education for women and their families is, therefore, particularly challenging.

Since its release from Taliban rule in 2002, immense efforts have been made by the Afghan government and international community to repair and strengthen the health system. Although rates of maternal and child deaths continue to be some of the highest in the world, there have been some encouraging improvements; maternal mortality has declined from 1600 deaths per 100 000 in 2002 to 327 per 100 000 in 2010; however, a 2013 analysis suggests these rates may be inaccurate and could be around 885 per 100 000 live births. Recent estimates for under-five child mortality suggest around 70 deaths per 1000 live births and a neonatal mortality rate of 40 per 1000 live births. In 2015, 18% of women received the recommended four or more ANC visits and 50% reported attendance of a skilled birth attendant at their most recent birth, an increase from 34% in 2010.[9] Despite these improvements, there remains inadequate access to, and utilisation of, ANC and quality obstetric care services,[28] with stark inequities in access between urban and rural areas and across regions.[17] Health system challenges exist around sufficient numbers of female health care providers and the costs of health services and treatment. There are also additional contextual challenges and social and cultural norms surrounding women's low levels of autonomy and education that directly impact on care-seeking delays and child health outcomes.[27]

an analytical framework by adapting existing frameworks.[11,12] This framework mapped explanatory variables according to proximity to the outcome as distal, intermediate, and proximal determinants (Figure S2) and represented three defined time periods—pre-conception, pregnancy, and childbirth.

2.3 | Statistical analysis

All analyses were performed using Stata/SE version 14.2. For the binary outcome, stillbirth, we used Poisson regression models with a log link function to estimate relative risks. All models were weighted using sample weights to account for the complex survey design, and adjusted standard errors were used to obtain Wald test *P*-values and 95% confidence intervals.

We fitted univariable models and built three multivariable regression models to examine the association between stillbirth and the explanatory variables. We applied a sequential approach[13] based on the three stages of pregnancy (Figure S2): model 1 included variables from the pre-conception period (community-level, socioeconomic, environmental, and maternal factors); model 2 included factors related to the pregnancy period (antenatal care and pregnancy complications), having adjusted for the variables from stage 1; and model 3 included factors related to the delivery period (complications during the delivery period and delivery care), having adjusted for the variables from the first two stages. In the first model, no *P*-value criterion was used for including variables, but for subsequent models (model 2 and model 3), only variables with $P \geq 0.20$ from the previous model were included into the next stage. Wealth, maternal age and education, fetal sex, and multiple gestation were considered important factors and were retained in the models regardless of their P-values. All other variables were removed one at time, starting with the highest P-value, until only those who had $P \leq 0.05$ remained. Multi-collinearity was checked using variance inflation factors. Area under the curve (AUC) and calibration plots were used to assess model performance. We used the same model building approach for identifying independent risk factors for intrapartum stillbirth.

3 | RESULTS

We included 13 834 births, of which 311 were stillbirths and 13 523 were live births (23 stillbirths per 1000 total births; Table S2). Most women resided in rural areas (80.9%), were married (99.5%), and

had no formal education (89.4%). First-time mothers comprised 16% of the sample; however, fertility was high with over 40% of women having at least five children prior to the index pregnancy. Approximately 5% had experienced a previous pregnancy loss. Over one-third (36.0%) of women had not received antenatal care (ANC) for their last birth, while 16% had the recommended four or more visits. Quality of ANC was generally low, with most women receiving less than five of the nine recommended services. Only one-third of births took place at a health facility with a skilled birth attendant, and <2% of births were caesarean. Almost two-thirds (60.6%) of stillbirths occurred during the intrapartum period, although the timing was unknown for nearly 20%. The most frequent maternal conditions during pregnancy were headaches, possible hypertension or infection, and bleeding. Common complications in the delivery period were headaches, blurry vision, possible hypertension or infection, excessive bleeding, and prolonged labour/malpresentation. About 1% of women in the pregnancy and delivery periods reported reduced fetal movements (Table S2).

Disparities in stillbirth rates across the eight geographical regions were high, ranging from 13 per 1000 births in the Northern regions to over 40 per 1000 births in the Central Highlands (Table 1). In the univariate analysis, region of residence, ethnicity, and maternal age were strongly associated with stillbirth, but wealth quintile and education were not. First and higher order pregnancies, multiple gestation, previous pregnancy loss, and not receiving ANC were all associated with stillbirth (Table 1).

Table 2 shows the multivariable results of factors associated with stillbirth. Factors associated with stillbirth in the pre-pregnancy period (model 1) were region of residence, ethnicity, previous pregnancy loss, and primiparity. In particular, women in the Central Highlands and South-Eastern regions had twice the risk of stillbirth and women of Nuristani ethnicity were ten times more likely to experience stillbirth. Once pregnant, taking into account utilisation of ANC and pregnancy complications, region of residence was no longer associated with stillbirth, but ethnicity remained, with Nuristani women having over nine times increased risk of stillbirth (model 2). Not receiving any ANC during pregnancy increased the likelihood of stillbirth by almost three times, while women who experienced possible infection, bleeding, and headache during their pregnancy had approximately twice the risk of stillbirth, and women experiencing reduced fetal movements were almost four times more likely to have a stillbirth. Factors independently associated with stillbirth in the delivery period (model 3) were, again, region of residence, ethnicity, previous pregnancy loss, first and multiple pregnancies, not receiving ANC, and giving birth in a health facility. The same pregnancy complications increased

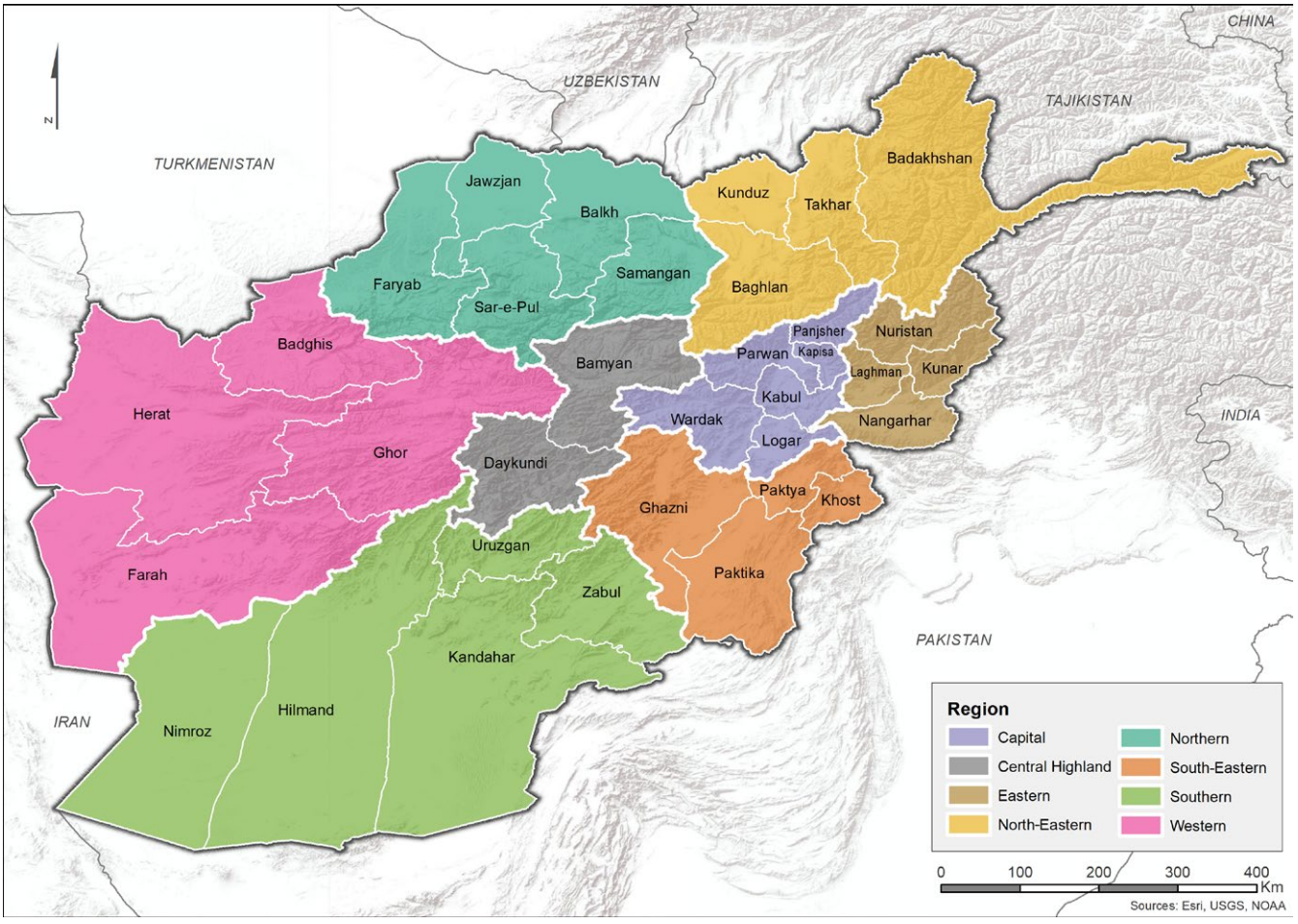

FIGURE 1 Map of Afghanistan showing geographical regions and provinces (Figure courtesy of Mr Rafiqul Haider)

TABLE 1 Univariable results of factors associated with stillbirth for women's most recent birth in the preceding three years, Afghanistan 2010

	Stillbirths	All births	Stillbirth rate	Unadjusted
	N (%)	N (%)	per 1000 total births	RR (95% CI)
Total pregnancy outcomes (weighted)	311 (2.2)	13 834[a] (100)	22.5	
Community level				
Residence				
Urban	49 (15.7)	2636 (19.1)	18.5	1.00 (Reference)
Rural	262 (84.3)	11 198 (80.9)	23.4	1.26 (0.90, 1.77)
Region				
North-Eastern	34 (10.9)	2081 (15.0)	16.3	1.00 (Reference)
Northern	28 (9.0)	2145 (15.5)	13.0	0.80 (0.45, 1.42)
Western	37 (12.0)	1841 (13.3)	20.3	1.25 (0.72, 2.16)
Central Highland	20 (6.4)	430 (3.1)	46.6	2.86 (1.34, 6.12)
Capital	58 (18.6)	2635 (19.1)	21.9	1.35 (0.82, 2.21)
Eastern	79 (26.5)	2472 (17.8)	32.1	1.97 (0.94, 4.16)
Southern	16 (5.2)	906 (6.6)	17.8	1.09 (0.62, 1.92)
South-Eastern	39 (12.5)	1324 (9.6)	29.3	1.80 (1.12, 2.88)
Ethnicity[1]				
Tajik	76 (24.3)	4386 (31.7)	17.2	1.00 (Reference)
Pashtun	127 (40.9)	5992 (43.4)	21.2	1.23 (0.90, 1.69)
Hazara	30 (9.5)	1125 (8.1)	26.3	1.53 (0.90, 2.60)
Uzbek	24 (7.6)	1218 (8.8)	19.4	1.13 (0.66, 1.94)
Nuristani	35 (11.3)	189 (1.4)	186.0	10.80 (3.67, 31.77)
Pashai	10 (3.1)	318 (2.3)	30.2	1.75 (0.86, 3.57)
Baloch/Turkmen/Other	10 (3.3)	595 (4.3)	17.2	1.00 (0.43, 2.32)
Socio-economic and environmental				
Wealth quintile				
Lowest	58 (18.5)	2828 (20.4)	20.4	1.07 (0.70, 1.762)
Second	76 (24.5)	2817 (20.4)	27.0	1.41 (0.99, 2.03)
Middle	75 (24.0)	2757 (19.9)	27.1	1.47 (1.01, 2.12)
Fourth	51 (16.4)	2736 (19.8)	18.7	0.98 (0.66, 1.45)
Highest	52 (16.6)	2696 (19.5)	19.1	1.00 (Reference)
Marital status				
Currently married	311 (100.0)	13 769 (99.5)	-	-
Previously married	0 (0.7)	65.4 (0.5)	-	-
Maternal education				
No education or madrassa	289 (93.1)	12 372 (89.4)	23.4	1.59 (0.99, 2.55)
Any education[b]	22 (6.9)	1463 (10.6)	14.8	1.00 (Reference)
Source of drinking water[2]				
Improved water source	150 (48.3)	7653 (55.4)	19.6	1.00 (Reference)
Unimproved water source	161 (51.7)	6158 (44.6)	26.1	1.33 (0.95, 1.86)
Sanitation facility[3]				
Improved sanitation facility	117 (37.5)	5043 (36.5)	23.1	1.00 (Reference)
Unimproved sanitation facility/other	194 (62.5)	8781 (63.5)	22.1	0.96 (0.59, 1.56)

(Continues)

TABLE 1 (Continued)

	Stillbirths	All births	Stillbirth rate	Unadjusted
	N (%)	N (%)	per 1000 total births	RR (95% CI)
Fuel used for cooking[4]				
Clean fuel/no food cooked in house	49 (15.8)	2783 (20.2)	17.7	1.00 (Reference)
Solid fuel/other	262 (84.2)	11 024 (79.8)	7.6	1.34 (0.94, 1.91)
Maternal and fetal characteristics				
Sex of baby[5]				
Female	124 (42.0)	6280 (45.4)	19.8	1.00 (Reference)
Male	172 (58.0)	7538 (54.6)	22.8	1.15 (0.88, 1.51)
Pregnancy type[6]				
Singleton	285 (96.8)	13 684 (99.0)	20.9	1.00 (Reference)
Multiple	9 (3.2)	133 (1.0)	70.2	3.37 (1.62, 6.98)
Maternal age (years)				
12-18	22 (7.1)	1209 (8.7)	18.3	0.99 (0.53, 1.87)
19-24	92 (29.6)	5013 (36.2)	18.4	1.00 (Reference)
25-34	134 (43.0)	5666 (41.0)	23.6	1.28 (0.88, 1.87)
≥35	63 (20.2)	1947 (14.1)	32.3	1.76 (1.26, 2.45)
Pregnancy order				
First pregnancy	58 (18.5)	2165 (15.7)	26.6	1.64 (1.10, 2.45)
2nd-4th pregnancy	98 (31.5)	6046 (43.7)	16.2	1.00 (Reference)
≥5th pregnancy	156 (50.0)	5623 (40.6)	27.7	1.71 (1.30, 2.24)
Pregnancy interval[c]				
First pregnancy	58 (18.5)	2165 (15.7)	26.6	1.35 (0.89, 2.04)
<18 months	42 (13.5)	1664 (12.0)	25.2	1.28 (0.81, 2.05)
18-58 months	181 (58.0)	9174 (66.3)	19.7	1.00 (Reference)
≥59 months	31 (10.0)	831 (6.0)	37.3	1.90 (1.25, 2.87)
Previous pregnancy loss				
No[d]	270 (86.8)	13 080 (94.6)	20.6	1.00 (Reference)
Yes	41 (13.2)	754 (5.5)	54.4	2.63 (1.87, 3.71)
Antenatal care				
Number of ANC visits[c, 7]				
None	145 (47.3)	4969 (36.2)	29.1	1.58 (0.98, 2.55)
1	43 (14.2)	1912 (13.9)	22.7	1.23 (0.74, 2.04)
2-3	76 (24.9)	4575 (33.3)	16.7	0.90 (0.60, 1.36)
4 or more	42 (13.7)	2272 (16.6)	18.4	1.00 (Reference)
Timing of first ANC visit[c,8]				
First trimester	47 (15.4)	2569 (18.7)	18.5	1.00 (Reference)
Second trimester	61 (19.9)	3721 (27.1)	16.5	0.89 (0.60, 1.34)
Third trimester	55 (17.8)	2459 (17.9)	22.3	1.21 (0.77, 1.89)
No ANC	145 (46.9)	4969 (36.2)	29.1	1.58 (0.99, 2.52)
ANC provider[c, 9]				
Trained provider [e]	160 (51.5)	8413 (60.9)	19.0	1.00 (Reference)
Untrained provider [f]	6 (2.0)	432 (3.1)	14.1	0.74 (0.29, 1.89)
No ANC	145 (46.5)	4969 (36.0)	29.1	1.53 (1.07, 2.18)
Place of ANC [c]				

(Continues)

TABLE 1 (Continued)

	Stillbirths	All births	Stillbirth rate	Unadjusted
	N (%)	N (%)	per 1000 total births	RR (95% CI)
Health facility/clinic	142 (45.5)	7694 (55.6)	18.4	1.00 (Reference)
Home/multiple providers/ other	25 (7.9)	1171 (8.5)	21.1	1.14 (0.63, 2.07)
No ANC	145 (46.5)	4969 (35.9)	29.1	1.58 (1.11, 2.26)
ANC components[c,g]				
Weighed[10]	51 (16.4)	3481 (25.3)	14.6	0.58 (0.42, 0.80)
Blood pressure taken[11]	151 (48.6)	7932 (57.5)	19.0	0.70 (0.50, 0.98)
Urine sample taken[12]	66 (21.2)	2920 (21.2)	22.5	1.00 (0.74, 1.36)
Blood sample taken[13]	72 (23.1)	2742 (19.9)	26.2	1.21 (0.90, 1.63)
Given/bought iron tablets[14]	103 (33.1)	5290 (38.3)	19.4	0.80 (0.56, 1.13)
Took intestinal parasite drugs[15]	11 (3.7)	580 (4.2)	19.7	0.87 (0.41, 1.85)
Told signs of pregnancy complications[16]	56 (18.1)	2888 (20.9)	19.2	0.83 (0.59, 1.17)
Told where to go for complications[17]	47 (15.2)	2416 (17.5)	19.6	0.85 (0.58, 1.24)
Received 2 + tetanus injections[18]	113 (36.4)	6868 (49.8)	16.4	0.58 (0.42, 0.80)
ANC quality score[h]				
Low (0-5)	139 (45.3)	7115 (51.9)	19.5	1.40 (0.86, 2.29)
High (6-9)	23 (7.4)	1636 (11.9)	13.9	1.00 (Reference)
No ANC	145 (47.3)	4969 (36.2)	29.1	2.10 (1.34, 3.29)
Pregnancy complications				
Headache				
No	258 (83.0)	12 102 (87.5)	21.3	1.00 (Reference)
Yes	53 (17.0)	1733 (12.5)	30.6	1.45 (1.00, 2.09)
Blurry vision				
No	279 (89.7)	12 891 (93.2)	21.6	1.00 (Reference)
Yes	32 (10.3)	943 (6.8)	34.1	1.58 (1.05, 2.38)
Bleeding or spotting				
No	285 (91.7)	13 300 (96.1)	21.4	1.00 (Reference)
Yes	26 (8.3)	534 (3.9)	48.4	2.26 (1.41, 3.60)
Probable hypertension[i]				
No	278 (89.5)	12 827 (92.7)	21.7	1.00 (Reference)
Yes	33 (10.5)	1007 (7.3)	32.5	1.50 (0.97, 2.32)
Probable infection[j]				
No	279 (89.7)	13 079 (94.5)	21.3	1.00 (Reference)
Yes	32 (10.3)	755 (5.5)	42.6	2.00 (1.35, 2.96)
Anaemia or thin/weak blood				
No	291 (93.7)	13 152 (4.9)	22.2	1.00 (Reference)
Yes	20 (6.3)	682 (4.9)	28.8	1.30 (0.83, 2.03)
Reduced or no fetal movement				
No	299 (96.1)	13 684 (98.9)	21.8	1.00 (Reference)
Yes	12 (3.9)	150 (1.1)	81.5	3.73 (1.99, 7.94)

(Continues)

TABLE 1 (Continued)

	Stillbirths	All births	Stillbirth rate	Unadjusted
	N (%)	N (%)	per 1000 total births	RR (95% CI)
Too early contractions				
No	294.8 (94.8)	13 424 (97.0)	22.0	1.00 (Reference)
Yes	16.3 (5.2)	410 (3.0)	39.8	1.81 (0.83, 3.95)
Abdominal pain				
No	276 (88.6)	12 275 (88.7)	22.5	1.00 (Reference)
Yes	35 (11.4)	1559 (11.3)	22.7	1.01 (0.64, 1.59)
Fainted/unconsciousness				
No	304 (97.8)	13 595 (98.3)	22.4	1.00 (Reference)
Yes	7 (2.2)	240 (1.7)	28.0	1.25 (0.59, 2.66)
Delivery care				
Birth attendant[19]				
Skilled provider[e]	112 (2.2)	4965 (36.1)	22.5	1.00 (Reference)
Unskilled provider[f]	189 (60.9)	8488 (61.7)	22.3	1.01 (0.70, 1.45)
No one	10 (3.2)	306 (2.2)	32.6	1.47 (0.71, 3.04)
Delivered in health facility[20]				
No	201 (64.8)	9108 (66.0)	22.0	1.00 (Reference)
Yes	109 (35.2)	4702 (34.0)	23.1	1.05 (0.73, 1.51)
Mode of delivery [c,21]				
Vaginal	263 (86.0)	12 867 (94.2)	20.5	1.00 (Reference)
Caesarean section	19 (6.3)	238 (1.7)	80.6	3.95 (2.02, 7.69)
Instrumental (forceps or vacuum)	24 (7.8)	560 (4.1)	42.5	2.12 (1.33, 3.37)
Complications in delivery period				
Headache				
No	192 (61.7)	9023 (65.2)	21.3	1.00 (Reference)
Yes	119 (38.3)	4811 (34.8)	24.8	1.16 (0.82, 1.66)
Blurry vision				
No	238 (76.6)	11 390 (82.3)	20.9	1.00 (Reference)
Yes	73 (23.4)	2444 (17.7)	29.8	1.42 (1.01, 1.99)
Excessive bleeding[c]				
No	217 (69.7)	11 907 (86.1)	18.2	1.00 (Reference)
Yes	94 (30.3)	1927 (13.9)	48.9	2.69 (2.07, 3.50)
Probable hypertension				
No	240 (77.2)	11 594 (83.8)	20.7	1.00 (Reference)
Yes	71 (22.8)	2240 (16.2)	31.6	1.53 (1.05, 2.22)
Probable infection				
No	237 (76.1)	12 039 (87.0)	19.7	1.00 (Reference)
Yes	74 (23.9)	1796 (13.0)	41.5	2.11 (1.59, 2.81)
Prolonged/obstructed labour/malpresentation				
No	271 (87.1)	12 844 (92.8)	21.1	1.00 (Reference)
Yes	40 (12.9)	990 (7.2)	40.5	1.96 (1.33, 2.89)
Water broke too early				
No	280 (90.2)	13 005 (94.0)	21.6	1.00 (Reference)
Yes	31 (9.8)	829 (6.0)	36.9	1.71 (1.03, 2.85)

(Continues)

TABLE 1 (Continued)

	Stillbirths	All births	Stillbirth rate	Unadjusted
	N (%)	N (%)	per 1000 total births	RR (95% CI)
Reduced or no fetal movement				
No	283 (91.1)	13 678 (98.9)	20.7	1.00 (Reference)
Yes	28 (8.9)	157 (1.1)	177.2	8.56 (5.51, 13.3)
Lower abdominal pain				
No	182 (58.5)	9568 (69.2)	19.0	1.00 (Reference)
Yes	129 (41.5)	4267 (30.8)	30.3	1.59 (1.24, 2.04)
Fainting/unconsciousness				
No	289 (93.0)	13 202 (95.4)	21.9	1.00 (Reference)
Yes	22 (7.0)	632 (4.6)	34.7	1.58 (0.97, 2.58)

ANC, antenatal care; RR, risk ratio.

Missing values (unweighted observations): [1]n=11; [2]n=24, [3]n=9, [4] n = 23, [5] n = 16, [6]n=49, [7] n = 122, [8] n = 118, [9] n = 22, [10] n = 58, [11] n = 48, [12] n = 65, [13] n = 69, [14] n = 20, [15] n = 133, [16] n = 49, [17] n = 10, [18] n = 133, [19] n = 78, [20] n = 29, [21] n = 230.

[a]N = 13 834 unless otherwise indicated.

[b]Any education refers to any primary, secondary, or higher level of education.

[c]These variables were not included in the multivariable analyses. ANC variables not included due to multi-collinearity with quality of ANC. Delivery assistant was not included due to collinearity with place of delivery. Mode of delivery not included as these are procedures might have occurred after the outcome. Severe bleeding during labour was not included as it was unknown if this was pre- or post-partum haemorrhage and may have occurred after the outcome.

[d]Includes first pregnancies.

[e]Skilled/trained provider refers to doctor, nurse, or midwife.

[f]Unskilled/untrained provider refers to traditional birth attendant (TBA), community health worker (CHW), relative, or friend.

[g]Reference category are those who did not receive the intervention.

[h]ANC quality score calculated by number of components received out of a total of 9 components (1—weight taken, 2—blood pressure taken, 3—blood sample taken, 4—urine sample taken, 5—informed signs of pregnancy complications, 6—informed where to seek care for complications, 7—received 2 + tetanus injections, 8—received iron/folic acid, and 9—received anti-helminths).

[i]Probable hypertension was based on mother's report of convulsions/fits/shaking/eclampsia/pre-eclampsia and/or swelling/oedema.

[j]Probable infection was based on mother's report of high fever and/or foul-smelling vaginal discharge.

the risk of stillbirth, except that the effect of reduced or no fetal movement as a pregnancy complication was reduced. This is likely due to the inclusion of reduced or no fetal movement as a delivery complication in the final model, which was now the factor with the highest relative risk, increasing stillbirth risk by nearly seven times. Across all models, Nuristani women consistently had a higher risk of stillbirth with at least nine times higher risk of stillbirth than the Tajik population. There was no difference in stillbirth across wealth quintiles or levels of maternal education or age after accounting for all other factors. Models were well calibrated (Figures S5) and discrimination improved from model 1 to model 3 (see AUC in Table 2).

The sub-group analysis on intrapartum stillbirth showed that being of Nuristani or Pashai ethnicity, nulliparous women, multiple pregnancies, receiving no or low-quality ANC, or experiencing possible infection or headache during pregnancy increased the risk of stillbirth. Reduced or no fetal movement during the delivery period was also a strong predictor, whereas reduced or no fetal movement as a pregnancy complication and giving birth in health facility were no longer associated with intrapartum stillbirth once other factors were taken into account (Table 3, Figure S6).

We examined health care access disaggregated by ethnicity and region of residence to understand the disparities in stillbirth observed in access between different ethnic groups and geographical regions (Table S3, Figures S3-S4) and found that Nuristani women had the largest proportion of women who did not receive any ANC (89%) and the lowest levels of skilled birth attendance (2.5%) for their last pregnancy. The highest proportion of women receiving low-quality ANC were residents of the Capital and Northern region (Figure S3). The South-Eastern, Western, and Central Highlands regions had the most women who did not receive any ANC. Skilled birth attendance was highest in the Capital and lowest in the Central Highlands, North-Eastern, and Western regions (Figure S4).

4 | COMMENT

4.1 | Principal findings

Our analysis of the 2010 Afghanistan Mortality Survey has highlighted several sociodemographic, health service utilisation, and maternal conditions that increase stillbirth in Afghan women, some of which are modifiable and can inform programmatic focus for future stillbirth prevention in the country. Determinants of stillbirth in Afghanistan included residing in the Central Highlands, being of Nuristan ethnicity, not receiving ANC, and experiencing bleeding, possible infection, or headache during pregnancy. Reduced or no fetal movements during the delivery period and giving birth in a

TABLE 2 Multivariable results of factors associated with stillbirth for women's most recent birth in the preceding three years, Afghanistan 2010

N = 13 683[a]	Model 1: Pre-pregnancy Community + socio-economic + maternal factors	Model 2: Pregnancy Community + socio-economic + maternal + pregnancy complications + ANC + biological	Model 3: Delivery time Community + socio-economic + maternal + pregnancy complications + ANC + delivery care + delivery complications + biological
Independent variables	aRR (95% CI)	aRR (95% CI)	aRR (95% CI)
Region			
North-Eastern	1.00 (Reference)		1.00 (Reference)
Northern	0.70 (0.38, 1.26)		0.68 (0.38, 1.24)
Western	1.52 (0.84, 2.75)		1.20 (0.66, 2.20)
Central Highlands	2.72 (1.16, 6.36)		3.01 (1.35, 6.70)
Capital	1.27 (0.71, 2.27)		1.14 (0.59, 2.29)
Eastern	1.31 (0.69, 2.49)		1.16 (0.51, 2.02)
Southern	1.20 (0.62, 2.34)		1.01 (0.45, 1.91)
South-Eastern	1.97 (1.10, 3.53)		1.59 (0.87, 2.89)
Ethnicity			
Tajik	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Pashtun	1.07 (0.71, 1.60)	1.22 (0.86, 1.74)	1.07 (0.72, 1.60)
Hazara	1.13 (0.63, 2.03)	1.49 (0.88, 2.55)	1.03 (0.61, 1.75)
Uzbek	1.62 (0.85, 3.09)	1.21 (0.70, 2.09)	1.63 (0.86, 3.11)
Nuristani	10.39 (3.39, 31.86)	9.22 (3.49, 24.34)	9.15 (2.95, 28.74)
Pashai	1.65 (0.79, 3.45)	1.95 (0.94, 4.07)	1.78 (0.72, 4.37)
Baloch/Turkmen/Other	1.04 (0.50, 2.16)	0.92 (0.37, 2.27)	1.02 (0.48, 2.15)
Wealth Index			
Poorest	1.05 (0.65, 1.67)	0.96 (0.61, 1.49)	1.08 (0.64, 1.80)
Poorer	1.13 (0.74, 1.74)	1.08 (0.71, 1.64)	1.26 (0.77, 2.07)
Middle	1.10 (0.74, 1.62)	1.02 (0.69, 1.60)	1.16 (0.77, 1.75)
Richer	0.87 (0.58, 1.31)	0.87 (0.58, 1.30)	0.94 (0.62, 1.41)
Richest	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Maternal education			
No education/madrassa	1.59 (0.93, 273)	1.41 (0.83, 2.40)	1.50 (0.87, 2.58)
Any education	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Previous pregnancy loss			
Yes[b]	2.61 (1.74, 3.91)	2.57 (1.77, 3.75)	2.43 (1.65, 3.59)
Maternal age (years)			
12-18	0.79 (0.40, 1.56)	0.80 (0.41, 1.59)	0.82 (0.42, 1.60)
19-24	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
25-34	1.33 (0.90, 1.96)	1.32 (0.86, 2.01)	1.36 (0.89, 2.08)
≥ 35	1.65 (1.02, 2.66)	1.58 (0.96, 2.62)	1.62 (0.99, 2.64)
Pregnancy order			
1st pregnancy	2.18 (1.46, 325)	2.33 (1.56, 3.47)	2.27 (1.52, 3.38)
2nd-4th pregnancy	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
≥ 5th pregnancy	1.32 (0.92, 1.89)	1.35 (0.93, 1.96)	1.37 (0.95, 1.97)
ANC Quality Index			
High (6-9)		1.00 (Reference)	1.00 (Reference)
Low (0-5)		1.50 (0.94, 2.41)	1.56 (0.96, 2.53)

(Continues)

TABLE 2 (Continued)

N = 13 683[a]	Model 1: Pre-pregnancy Community + socio-economic + maternal factors	Model 2: Pregnancy Community + socio-economic + maternal + pregnancy complications + ANC + biological	Model 3: Delivery time Community + socio-economic + maternal + pregnancy complications + ANC + delivery care + delivery complications + biological
No ANC		2.77 (1.67, 4.61)	3.03 (1.73, 5.30)
Antepartum complication: probable infection[c]			
Yes[b]		2.25 (1.36, 3.09)	1.94 (1.29, 2.92)
Antepartum complication: bleeding or spotting			
Yes[b]		2.25 (1.45, 3.49)	1.90 (1.19, 3.04)
Antepartum complication: reduced or no fetal movement			
Yes		3.71 (1.94, 7.12)	2.06 (1.06, 3.97)
Antepartum complication: headache			
Yes[b]		1.70 (1.23, 2.35)	1.67 (1.20, 2.33)
Delivery complication: reduced or no fetal movement			
Yes[b]			6.82 (4.20, 11.10)
Delivered in health facility			
Yes[b]			1.55 (1.12, 2.16)
Sex of the baby			
Female		1.00 (Reference)	1.00 (Reference)
Male		1.17 (0.89, 1.54)	1.16 (0.88, 1.52)
Multiple pregnancy			
Yes[b]		3.01 (1.60, 75.67)	3.19 (1.75, 5.80)
Area under the Curve (AUC)	0.66	0.69	0.73

ANC, antenatal care; aRR, adjusted risk ratio; CI, confidence interval.
[a]N presented is the weighted population and includes all cases with complete data (13 393 live births and 290 stillbirths).
[b]Reference category for variables with yes/no responses is the "No" category
[c]Probable infection: if mother reported having symptoms of high fever and/or foul-smelling vaginal discharge

health facility were also strongly associated with stillbirth. Factors associated with intrapartum stillbirths differed slightly and included being of Nuristani or Pashai ethnicity, utilisation and quality of ANC, possible infection or headache during pregnancy, and reduced fetal movements in the delivery period. Women with first or multiple pregnancies, and previous pregnancy loss also had increased risk of intrapartum stillbirth. These findings offer an evidence base to integrate efforts into health service delivery programmes focused on maternal, perinatal, and newborn survival, as well as future national health policies where until now, no such information was available. We also demonstrate how DHSs can be adapted to generate more data to understand the underlying factors driving stillbirths in other LMIC settings.

The overall stillbirth rate of 22.5 per 1000 total births is lower than adjusted rates reported for Afghanistan in 2009 (29.3 per 1000) and in 2015 (26.7 per 1000) from the Lancet series which accounted for under-reporting.[1] Intrapartum stillbirths constituted almost two-thirds of stillbirths in our study and is consistent with findings from other LMICs.[3] Within-country variations in stillbirth risk have been observed in many countries, as have ethnic differences.[14,15] Nuristani people are a minority group that reside predominantly in the Eastern part of Afghanistan (Nuristan province), and the low levels of health care utilisation may explain the extremely high rates of stillbirth. The 2015 Afghanistan DHS also found only 1% of births in Nuristan province were in a health facility, and this province had the lowest levels of ANC utilisation across the country (11%). Exacerbating the situation is that the East is a high-intensity conflict zone and one of the poorest regions in the country. For intrapartum stillbirths, both Nuristani and Pashai women had higher risk of stillbirth. Pashai women also reside in the East, where high levels of conflict could have compromised access and quality of health services. The 2010 AMS did not report mortality rates according to province or ethnicity; however, the 2015 DHS reported provincial-level mortality rates which showed that Nuristan province had the highest infant and under-five child mortality rates nation-wide (123 and 170 per 1000 live births, respectively, compared to 45 and 55 per 1000 live births nationally).[16] The high stillbirth rates in this group appear to reflect the pattern in regional disparities in other mortality rates.

Geographical disparities underlie maternal and child mortality, morbidity, and health care–seeking in Afghanistan.[17] The high rates

TABLE 3 Multivariable results of factors associated with intrapartum stillbirths for women's most recent birth in the preceding three years, Afghanistan 2010

	Model 1: Pre-pregnancy	Model 2: Pregnancy	Model 3: Delivery time
N = 13 577[a]	Community + socio-economic + environmental + maternal	Community + socio-economic + maternal + pregnancy complications + ANC + biological	Community + socio-economic + maternal + pregnancy complications + ANC + delivery care + delivery complications + biological
Independent variables	aRR (95% CI)	aRR (95% CI)	aRR (95% CI)
Ethnicity			
Tajik	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Pashtun	1.25 (0.82, 1.90)	1.21 (0.80 ,1.84)	1.17 (0.77, 1.78)
Hazara	1.21 (0.62, 2.38)	1.19 (0.61, 2.35)	1.17 (0.61, 2.27)
Uzbek	1.48 (0.83, 2.66)	1.59 (0.89, 2.86)	1.52 (0.82, 2.87)
Nuristani	12.55 (4.08, 38.66)	11.32 (3.71, 34.52)	11.13 (3.56, 34.80)
Pashai	2.81 (1.42, 5.56)	3.11 (1.50, 6.47)	2.92 (1.28, 6.64)
Baloch/Turkmen/Other	0.55 (0.20, 1.50)	0.57 (0.21, 1.57)	0.57 (0.21, 1.59)
Wealth index			
Poorest	0.99 (0.57, 1.70)	0.90 (0.53, 1.55)	0.89 (0.51, 1.53)
Poorer	1.08 (0.65, 1.79)	1.06 (0.64, 1.78)	1.04 (0.62, 1.77)
Middle	1.22 (0.72, 2.06)	1.19 (0.71, 1.98)	1.22 (0.73, 2.05)
Richer	0.84 (0.50, 1.42)	0.84 (0.52, 1.39)	0.85 (0.51, 1.53)
Richest	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Maternal education			
No education/madrassa	1.89 (0.98, 3.66)	1.67 (0.86, 3.24)	1.70 (0.87, 3.32)
Any education	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Maternal age years			
12-18	0.80 (0.31, 2.06)	0.80 (0.31, 2.03)	0.83 (0.33, 2.12)
19-24	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
25-34	1.37 (0.86, 2.22)	1.34 (0.84, 2.15)	1.37 (0.86, 2.18)
≥ 35	1.65 (0.94, 2.92)	1.56 (0.87, 2.80)	1.61 (0.91, 2.87)
Pregnancy order			
1st pregnancy	2.10 (1.20, 3.70)	2.19 (1.25, 3.86)	2.19 (1.24, 3.88)
2nd-4th pregnancy	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
≥ 5th pregnancy	1.29 (0.84, 1.99)	1.33 (0.86, 206)	1.34 (0.86, 2.07)
Previous pregnancy loss			
Yes[b]	2.91 (1.79, 4.72)	2.98 (1.87, 4.75)	2.91 (1.82, 4.65)
Quality of ANC			
High (6-9)		1.00 (Reference)	1.00 (Reference)
Low (0-5)		2.18 (1.04, 4.60)	2.17 (1.03, 4.57)
No ANC		3.55 (1.60, 7.88)	3.33 (1.56, 7.32)
Antepartum complication: probable infection[c]			
Yes[b]		2.02 (1.13, 3.62)	1.96 (1.09, 352)
Antepartum complication: bleeding or spotting			
Yes		2.04 (1.06, 3.92)	
Antepartum complication: headache			
Yes[b]		1.63 (1.05, 2.52)	1.63 (1.05, 2.52)
Delivery complication: reduced or no fetal movement			

(Continues)

TABLE 3 (Continued)

N = 13 577[a]	Model 1: Pre-pregnancy Community + socio-economic + environmental + maternal	Model 2: Pregnancy Community + socio-economic + maternal + pregnancy complications + ANC + biological	Model 3: Delivery time Community + socio-economic + maternal + pregnancy complications + ANC + delivery care + delivery complications + biological
Yes[b]			8.15 (4.68, 14.18)
Sex of the baby			
Female		1.00 (Reference)	1.00 (Reference)
Male		1.50 (1.02, 2.22)	1.51 (1.02, 2.22)
Multiple pregnancy			
Yes[b]		4.89 (2.12, 11.30)	4.96 (2.19, 1124)
Area under the curve (AUC)	0.65	0.70	0.72

ANC, antenatal care; aRR, adjusted risk ratio; CI, confidence interval.
[a]N presented is the weighted population and includes all cases with complete data (13 393 live births and 184 stillbirths).
[b]Reference category for variables with yes/no responses is the "No" category
[c]Probable infection: if mother reported having symptoms of high fever and/or foul-smelling vaginal discharge

of stillbirth among women in the Central Highlands are likely due to lack of access and availability of health services, as these areas are characterised by mountainous terrain often isolated by snow. This region experiences scarcities in medical supplies due to poor transport infrastructure and security concerns, and a shortage of medical doctors willing to work there. Women from the South-Eastern region had higher risk of stillbirth in the initial multivariable model until adjustment with antenatal and delivery care variables, indicating the importance of health service utilisation in this area. High levels of conflict would likely limit access and availability of services in this area.

The diverse geographical terrain with concentrated ethnic groups in specific regions, combined with insecurity, will require tailored approaches to reach these hard-to-reach, high-risk women. Tappis et al[18] in their study examining coverage of intrapartum care in selected areas of Afghanistan also identified the importance of context-specific service delivery models to ensure women in high-conflict areas can access services. A major barrier to ensuring facility deliveries in some parts of the country was the inability to travel at night along major roads because of insecurity. Delivering health services to remote and mountainous areas is challenging especially in the context of insecurity, but strategies which strengthen the role of local community health workers and task shifting can be effective. A revised primary health care service delivery model, currently under development by the Ministry of Public Health, may provide an opportunity to integrate alternative approaches to facilitate reductions in stillbirth.

Mothers who did not receive ANC were three times more likely to experience stillbirth, and while quality did not appear to make a difference for all stillbirths, it did matter for intrapartum stillbirths. This suggests having any ANC is important for preventing stillbirths, but that quality and content of care may be critical for identifying and managing maternal conditions early that could lead to childbirth complications and intrapartum stillbirth. Overall, ANC utilisation was very low, and we measured quality according to whether the mother received any of the nine checks, not necessarily, the adequacy of the service or the initiation of treatment. Our measurement method may partly explain the absence of an overall effect of quality of ANC for stillbirths. These downstream factors are important to consider when assessing the effectiveness of ANC on stillbirth.[19] Further investigation is needed to examine the quality of care provided and adherence to recommended advice among women. Our analysis showed that areas that achieved higher coverage of ANC (ie, the Capital and Northern regions) actually had a higher proportion of women receiving lower quality of ANC. Ensuring adequate and high-quality ANC is one of the simplest and most cost-effective recommended interventions to reduce stillbirths.[20] Efforts to strengthen ANC are in progress where the Afghan government is administering a maternal and child health handbook that contains information on safe pregnancy, childbirth, and childcare to each pregnant woman and documents details of visits. It will be important to record the services received, pregnancy progress, and results from any screening tests in this handbook.

We identified several pregnancy conditions that were associated with stillbirth and are preventable. Signs of infection and antepartum bleeding were important determinants in our study and are well-established risks. Effective interventions exist for treating malaria and syphilis to reduce stillbirth,[21] and while malaria is endemic in some of the semi-arid eastern and northern provinces in Afghanistan, prevalence of syphilis and HIV in Afghanistan is generally very low and limited to high-risk groups such as injecting drug users and sex workers.[22,23] Further research is needed to identify common infections contributing to stillbirth in this setting. Hirose et al[24] identified that care-seeking delays in Afghanistan were higher among women experiencing severe infections compared to other complications with more concerning symptoms, so it would be important to ensure early detection and management of both bleeding and infections by

educating women and family members on the urgency of care-seeking for symptoms. Headaches during pregnancy were also a strong risk factor of both stillbirth and intrapartum stillbirth and likely a sign of pre-eclampsia or pregnancy-induced hypertension, which are known risk factors for stillbirth. Ensuring that ANC includes blood pressure checks and appropriate management will be critical for reducing complications that lead to stillbirth. Reduced fetal movements have rarely been examined in low-income countries but are a known risk factor for stillbirth.[25] Of all delivery complications, reduced fetal movements were one of the strongest determinants for both stillbirth and intrapartum stillbirth in our study. It would be important to ensure women understand the need to act upon any perceived reduction or change in fetal movements and that during the intrapartum period movements are closely monitored.

Variations exist on the effect of delivery location on stillbirth with some studies showing an increase in risk,[26] while others indicate a protective effect.[3] We found facility births had increased odds of stillbirth overall, but for intrapartum stillbirth place of birth had no effect. Referral bias, delays in care-seeking, or quality of care may account for these findings. The absence of an association with intrapartum stillbirths is likely related to the quality of care or care-seeking delays. A study examining delays in care-seeking in Afghanistan showed substantial departure and decision-making delays among pregnant women with life-threatening conditions.[27] Concerns regarding quality of intrapartum care in maternity hospitals in Afghanistan have also been documented.[28] Ballard et al.[29] in their Ethiopian study also found that women with an intrapartum emergency were twice as likely to give birth in a health facility and that facility births did not reduce stillbirth risk, suggesting the three delays were at play here.[30]

We could not include mode of delivery in our multivariable analysis, but caesarean births showed a high positive association with stillbirth in the univariate results. A study of over 50 000 births in Kabul hospitals identified high rates of stillbirth in caesareans done for obstructed labour, malpresentation, and uterine rupture, which are preventable with timely intervention.[31] We did not have data on indication for caesarean, but an assessment of 78 first-line referral facilities in Afghanistan found 88% of caesarean births were emergencies,[32] so it is likely most were unplanned. The ideal caesarean rate to observe reductions in intrapartum stillbirth is between 5% and 10%,[33] but here we found it was under 2% and more recent national data report a rate of only 3%[16]; therefore, improving access to caesarean would be important to prevent stillbirths in Afghanistan.

Male babies have an increased risk of stillbirth;[34] however, we only found a slightly increased risk among intrapartum stillbirths but not in the analysis of the full sample of stillbirths. This may have been affected by the skewed sex ratio among stillbirths in our sample which had almost 20% more male babies to female. This is higher than the usual 10% elevated risk of stillbirth in male babies.[34] The 2010 AMS[9] and 2015 Afghanistan DHS[16] both identified under-reporting of neonatal and under-five child female deaths, as have other household surveys from Afghanistan.[35] This might suggest that under-reporting could also be a problem with female stillborn deaths and partly contributing to the overall under-estimate of the true stillbirth burden. Under-reporting of stillbirths can occur due to social, cultural, or other factors including stigma or blame towards the mother or other consequences that might preclude disclosure.[36] Further investigation into these issues is needed for Afghanistan.

4.2 | Strengths of the study

A key strength of this study is the use of a large nation-wide population sample to identify risk factors for stillbirth. In addition, this survey collected a comprehensive range of sociodemographic, maternal, and fetal characteristics; maternal complications; and health care utilisation factors for stillbirths which are not usually available in similar household surveys in LMICs.

4.3 | Limitations of the data

There are several limitations to this study that should be considered. Although the 2010 AMS was a national survey, there was an underrepresentation of the South because of highly insecure areas that were not surveyed. Concerns about the accuracy of maternal and child mortality measures from this survey have been noted[37] and highlight the challenges with collecting reliable data in conflict zones. While we acknowledge this limitation, this is currently the only data source in the country with information to enable understanding of key determinants of stillbirth. Although an updated DHS was subsequently conducted, it did not capture health service utilisation, maternal, or fetal factors for stillbirth, which precludes the kind of analysis reported in this paper.

Collecting information on pregnancy histories is challenging in low-income settings, and stillbirths are known to be under-estimated by about 30% when collected through household surveys.[5] The overall stillbirth rate of 22.5 per 1000 births in our study is low given the high levels of neonatal and maternal mortality in the country. It is possible these estimates have been affected by under-reporting and the data quality concerns raised with the 2010 AMS. The exclusion of some rural areas of the South zone of Afghanistan during sampling because of security reasons also meant that the survey covered only 66% of the South (94% of urban and 63% of rural areas were sampled) and so many stillbirths from rural areas would not have been included. The lower stillbirth rates observed in the Southern region (17.8 per 1000 births) is likely to have been affected by under-sampling of rural areas of the south. Medical terminations are illegal in Afghanistan, so women may report these as stillbirths or omit them entirely which might affect the total number of pregnancies and stillbirths reported. Misclassification of stillbirths and early neonatal deaths is an issue with household surveys, but we have minimised this by using data from the VA. The reliability of using skin appearance to determine the timing of stillbirth may lead to an overestimate of intrapartum stillbirth.[38] Due to the small number of antepartum stillbirths, we were not able to model antepartum stillbirth risk factors separately to compare with the intrapartum stillbirth risk factors. Several known risk factors were

BOX 2 Recommendations for the prevention and reduction of stillbirth in Afghanistan

HEALTH SYSTEMS STRENGTHENING AND HEALTH SERVICE DELIVERY

- Improved coverage and monitoring of content of ANC for the early identification and management of high-risk pregnancies and early referral.
- The high number of intrapartum stillbirths indicates a need for improved quality and timely management of childbirth complications. Ensuring birth attendants at all levels of the health system are adequately trained and have the skills and resources available to manage complications will be essential.
- Increasing the availability and access to timely caesarean sections for high-risk pregnancies and minimising delays at the facility level.
- The highest burden of stillbirth in the country falls in the Central Highlands and among minority ethnolinguistic groups which will require specialised attention and targeted strategies.

COMMUNITY-BASED EDUCATION AND MOBILISATION

- Improve community awareness and education on key danger signs during pregnancy and childbirth that need immediate action.
- Sensitisation of community specifically about stillbirths and their prevention will also be important but will require additional strategies to overcome barriers and delays in care-seeking.

FURTHER RESEARCH

- Identification of the leading infections that may be contributing to stillbirth in Afghanistan requires further research and understanding.
- Improved understanding of bottlenecks and barriers at the health facility level in regard to the prevention of stillbirth.
- Assessment of the quality of antenatal and intrapartum care provided at the various levels of health facilities.
- Development of strategies to strengthen referral linkages and facilitate referral and reduce care-seeking delays at the community level.

COMMITMENT TO STILLBIRTH TARGETS IN NATIONAL HEALTH STRATEGIES AND POLICIES AND CONTINUED DATA COLLECTION ON STILLBIRTH

- Afghanistan's current National Health Policy for 2015-2020 and Reproductive, Maternal, Newborn Child and Adolescent Health (RMNCAH) Strategy for 2017-2021 do not include targets for stillbirth reduction. National commitment in future policies and strategies to the recommended targets agreed upon as part of the 2014 Every Newborn Action Plan and endorsed at the World Health Assembly will direct national attention, prioritisation, and funding towards reducing stillbirths.
- Future national population-based surveys should include a full pregnancy history similar to the 2010 Afghanistan Mortality Survey to ensure ongoing data availability on the key risk factors for stillbirths. This survey data will assist with tracking progress towards meeting the global target of 12 stillbirths per 1000 births by 2030 and identifying key areas of need for interventions.

not captured, and we could not adjust for them (ie, consanguinity, maternal nutrition, distance to health facility). Exposures related to the armed conflict including chemicals and radiation are known to increase the risk of stillbirth,[39] but we had no measurement of these exposures. Finally, it is possible there was under-reporting of the self-reported maternal complications due to recall bias.

4.4 | Interpretation

We provide for the first time the major risk factors associated with stillbirth in Afghanistan, where there was previously a complete absence of evidence to inform future interventions and prevention efforts. Evidence-based interventions to prevent stillbirth exist,[20] and their implementation should be a priority for Afghanistan. We outline some recommendations in Box 2. This study also demonstrates it is feasible to rapidly produce a comprehensive analysis of stillbirth determinants for other LMICs if appropriate DHS data were available. To achieve this outcome would require some modification to the standard DHS questionnaire format to include a full pregnancy history as opposed to a live birth history,[8] as well as the inclusion of stillbirth when collecting information on women's health care utilisation and maternal complications during pregnancy and childbirth. The 2010 AMS provides a model from which future household surveys can be adapted to collect better data for stillbirth.

5 | CONCLUSIONS

Countries affected by conflict and instability account for the largest burden of stillbirths,[40] but strategies to improve reproductive outcomes in these areas have not received sufficient global attention and is urgently needed. Development assistance

and international focus on Afghanistan have declined recently as the security situation has worsened, and gains in maternal and child health are at risk of deteriorating. To accelerate reductions in stillbirth, concerted efforts and commitment by the government and international donors are needed to invest in prioritising implementation of interventions to reduce stillbirth. Evaluating different approaches to overcome challenges in the access and utilisation of care during pregnancy and childbirth to ensure services can reach the most hard-to-reach women where the majority of stillbirths occur will be imperative for future stillbirth reduction in Afghanistan.

ACKNOWLEDGEMENTS

This study had no direct funding sources. During the completion of this work, AC was supported by an Australian Postgraduate Award funded through the Australian Commonwealth Government and CRG was supported by a National Health and Medical Research Council Career Development Fellowship (1087062). We would like to thank Mr Rafiqul Haider for preparation of the map, and Alison Gibberd for helpful discussions on the data analysis. We also acknowledge and thank the DHS programme for providing access to the 2010 Afghanistan Mortality Survey data set.

CONFLICT OF INTERESTS

The authors declare no competing interests.

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REFERENCES

1. Lawn JE, Blencowe H, Waiswa P, et al. Stillbirths: rates, risk factors, and acceleration towards 2030. *The Lancet*. 2016;387(10018):587-603.
2. Ashish K, Wrammert J, Ewald U, et al. Incidence of intrapartum stillbirth and associated risk factors in tertiary care setting of Nepal: a case-control study. *Reproductive Health*. 2016;13(1):103.
3. McClure EM, Saleem S, Goudar SS, et al. Stillbirth rates in low-middle income countries 2010–2013: a population-based, multi-country study from the Global Network. *Reproductive health*. 2015;12(Suppl 2):S7.
4. Kujala S, Waiswa P, Kadobera D, Akuze J, Pariyo G, Hanson C. Trends and risk factors of stillbirths and neonatal deaths in Eastern Uganda (1982-2011): a cross-sectional, population-based study. *Trop Med Int Health*. 2017;22(1):63–73.
5. Cousens S, Blencowe H, Stanton C, et al. National, regional, and worldwide estimates of stillbirth rates in 2009 with trends since 1995: a systematic analysis. *Lancet*. 2011;377(9774):1319-1330.
6. Blencowe H, Cousens S, Jassir FB, et al. National, regional, and worldwide estimates of stillbirth rates in 2015, with trends from 2000: a systematic analysis. *Lancet Glob Health*. 2016;4(2):e98–e108.
7. WHO. *Every Newborn Action Plan: Progress Report May 2015*. Geneva: World Health Organization; 2015.
8. Christou A, Dibley MJ, Raynes-Greenow C. Beyond counting stillbirths to understanding their determinants in low- and middle-income countries: a systematic assessment of stillbirth data availability in household surveys. *Trop Med Int Health*. 2017;22(3):294-311.
9. ANPHI MOPH, CSO, ICF Macro, IIHMR, WHO (EMRO). Afghanistan Mortality Survey 2010. Calverton, Maryland, USA: Afghan National Public Health Institute, Ministry of Public Health (ANPHI/MoPH), Central Statistics Organization (CSO), ICF Macro, Indian Institute of Health Management Research (IIHMR), World Health Organization Regional Office for the Eastern Mediterranean (WHO/EMRO); 2011.
10. Aminu M, Unkels R, Mdegela M, Utz B. Adaji S, van den Broek N. Causes of and factors associated with stillbirth in low- and middle-income countries: a systematic literature review. *BJOG*. 2014;121:141-153.
11. Stanton C. *Perinatal Mortality in the Philippines: An Investigation Into the Use of Demographic Survey Data for the Study of Perinatal Mortality and its Determinants*. Baltimore, MA: The Johns Hopkins University; 1996.
12. Mosley WH, Chen LC. An analytical framework for the study of child survival in developing countries. *Popul Dev Rev*. 1984;10:25-45.
13. Victora CG, Huttly SR, Fuchs SC, Olinto MT. The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. *Int J Epidemiol*. 1997;26(1):224-227.
14. Lee AC, Mullany LC, Tielsch JM, et al. Community-based stillbirth rates and risk factors in rural Sarlahi, Nepal. *Int J Gynecol Obstet*. 2011;113(3):199-204.
15. Carvalho, T. S., L. C. Pellanda, and P. Doyle . 2018. "Stillbirth prevalence in Brazil: an exploration of regional differences." *J Pediatr (Rio J)* 94(2):200-206. doi: https://doi.org/10.1016/j.jped.2017.05.006.
16. CSO, Moph, ICF. *Afghanistan Demographic and Health Survey 2015*. Kabul. Afghanistan: Central Statistics Organization (CSO); 2017.
17. Akseer N, Bhatti Z, Rizvi A, Salehi AS, Mashal T, Bhutta ZA. Coverage and inequalities in maternal and child health interventions in Afghanistan. *BMC Public Health*. 2016;16(2):797.
18. Tappis H, Koblinsky M, Winch PJ, Turkmani S, Bartlett L. Context matters: Successes and challenges of intrapartum care scale-up in four districts of Afghanistan. *Glob Public Health*. 2016;11(4):387-406.
19. Pai M, Schumacher SG, Abimbola S. Surrogate endpoints in global health research: still searching for killer apps and silver bullets? *BMJ Glob Health*. 2018;3(2):e000755.
20. Bhutta ZA, Yakoob MY, Lawn JE, et al. Stillbirths: what difference can we make and at what cost? *Lancet*. 2011;377(9776):1523-1538.
21. Ishaque S, Yakoob MY, Imdad A, Goldenberg RL, Eisele TP, Bhutta ZA. Effectiveness of interventions to screen and manage infections during pregnancy on reducing stillbirths: a review. *BMC Public Health*. 2011;11(3):S3.
22. Todd CS, Ahmadzai M, Atiqzai F, et al. Seroprevalence and correlates of HIV, syphilis, and hepatitis B and C virus among intrapartum patients in Kabul, Afghanistan. *BMC Infect Dis*. 2008;8(1):119.
23. Todd CS, Nasir A, Stanekzai MR, et al. Prevalence and correlates of HIV, syphilis, and hepatitis B and C infection and harm reduction program use among male injecting drug users in Kabul, Afghanistan: a cross-sectional assessment. *Harm Reduct J*. 2011;8(1):22.
24. Hirose A, Borchert M, Cox J, Alkozai AS, Filippi V. Determinants of delays in travelling to an emergency obstetric care facility in Herat, Afghanistan: an analysis of cross-sectional survey data and spatial modelling. *BMC Pregnancy Childbirth*. 2015;15(1):14.

25. Heazell A, Warland J, Stacey T, et al. Stillbirth is associated with perceived alterations in fetal activity – findings from an international case control study. *BMC Pregnancy Childbirth*. 2017;17(1):369.
26. Ha YP, Hurt LS, Tawiah-Agyemang C, Kirkwood BR, Edmond KM. Effect of Socioeconomic deprivation and health service utilisation on antepartum and intrapartum stillbirth: population cohort study from Rural Ghana. *PLoS One*. 2012;7(7):e39050.
27. Hirose A, Borchert M, Niksear H, et al. Difficulties leaving home: a cross-sectional study of delays in seeking emergency obstetric care in Herat, Afghanistan. *Soc Sci Med*. 2011;73(7):1003-1013.
28. Kim Y-M, Zainullah P, Mungia J, Tappis H, Bartlett L, Zaka N. Availability and quality of emergency obstetric and neonatal care services in Afghanistan. *Int J Gynecol Obstet*. 2012;116(3):192-196.
29. Ballard K, Belete Z, Kinfu H, Tadesse M, Amin M, Atnafu H. The effect of prenatal and intrapartum care on the stillbirth rate among women in rural Ethiopia. *Int J Gynecol Obst*. 2016;133(2):164-167.
30. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. *Soc Sci Med*. 1994;38(8):1091-1110.
31. Guidotti RJ, Kandasamy T, Betrán AP, et al. Monitoring perinatal outcomes in hospitals in Kabul, Afghanistan: The first step of a quality assurance process. *J Matern-Fetal Neonat Med*. 2009;22(4):285-292.
32. Kim YM, Tappis H, Zainullah P, et al. Quality of caesarean delivery services and documentation in first-line referral facilities in Afghanistan: a chart review. *BMC Pregnancy Childbirth*. 2012;12:14.
33. Goldenberg RL, McClure EM, Bann CM. The relationship of intrapartum and antepartum stillbirth rates to measures of obstetric care in developed and developing countries. *Acta Obstet Gynecol Scand*. 2007;86(11):1303-1309.
34. Mondal D, Galloway TS, Bailey TC, Mathews F. Elevated risk of stillbirth in males: systematic review and meta-analysis of more than 30 million births. *BMC Med*. 2014;12(1):220.
35. Viswanathan K, Becker S, Hansen PM, et al. Infant and under-five mortality in Afghanistan: current estimates and limitations. *Bull World Health Organ*. 2010;88(8):576-583.
36. Haws RA, Mashasi I, Mrisho M, Schellenberg JA, Darmstadt GL, Winch PJ. "These are not good things for other people to know": how rural Tanzanian women's experiences of pregnancy loss and early neonatal death may impact survey data quality. *Soc Sci Med*. 2010;71(10):1764-1822.
37. Hill K. Gains in Afghan Health: Too Good to Be True? 2012 http://www.cgdev.org/doc/blog/Gains_in_Afghan_Health_CGD_Talk_pdf.pdf. Accesed 26 February 2018.
38. Gold KJ, Abdul-Mumin AR, Boggs ME, Opare-Addo HS, Lieberman RW. Assessment of "fresh" versus "macerated" as accurate markers of time since intrauterine fetal demise in low-income countries. *Int J Gynaecol Obstet*. 2014;125(3):223-227.
39. Keasley J, Blickwedel J, Quenby S. Adverse effects of exposure to armed conflict on pregnancy: a systematic review. *BMJ Global Health*. 2017;2(4):e000377.
40. Wise PH, Darmstadt GL. Confronting stillbirths and newborn deaths in areas of conflict and political instability: a neglected global imperative. *Paediatrics and International Child Health*. 2015;35(3):220-226.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: Christou A, Dibley MJ, Rasooly MH, et al. Understanding country-specific determinants of stillbirth using household surveys: The case of Afghanistan. *Paediatr. Perinat. Epidemiol.*. 2019;33:28–44. https://doi.org/10.1111/ppe.12530