

A close-up photograph of a woman with a black headscarf featuring a white decorative border. She is looking directly at the camera with a neutral expression. Her hand is visible near her face, possibly holding a baby or a small object. The background is slightly blurred, showing what appears to be a wooden structure.

**The missing
evidence:**
anaemia, postpartum
bleeding and
maternal death

Foreword

1. Introduction

- Maternal deaths and the Sustainable Development Goals
- Why are women dying in childbirth? The paradox of postpartum haemorrhage

2. The WOMAN-2 study

- The WOMAN Trials, tranexamic acid and anaemia

3. Results to date

- Does anaemia cause PPH?
- How does anaemia affect maternal wellbeing?
- Does episiotomy contribute to PPH?
- Which women should receive tranexamic acid?

4. The missing evidence and implications for research and practice

- The missing evidence
- Anaemia is a leading cause of PPH
- Implications for PPH diagnosis
- Implications for research and practice
- Changes in practice

5. What we must do now

6. References and further information

Foreword

Written by Ian Roberts and Haleema Shakur-Still, Co-leads of the WOMAN-2 Trial, and Eni Balogun, Senior Trial Manager of the WOMAN-2 Trial.

It felt like the air had been sucked out of the room. The results of six years' work by hundreds of doctors and midwives from Africa and South Asia stared back at us. Over 15,000 women had shared their experiences of giving birth with moderate or severe anaemia in the WOMAN-2 study.

But these were not the results that we expected. Tranexamic acid, a drug that undoubtedly reduces deaths from severe bleeding after childbirth, did not cut the number of postpartum haemorrhage (PPH) diagnoses. We had enrolled women with moderate or severe anaemia because these women are most likely to die during childbirth. But the percentage of women with a PPH diagnosis was similar in the tranexamic acid and placebo groups. It made no sense. Something had to be wrong.

Over 15,000 women shared their experiences of giving birth with moderate or severe anaemia

15k

Written by:

Ian Roberts, Haleema Shakur-Still, Ailish O'Sullivan and Sarah Marzouk from the WOMAN Trials team at the London School of Hygiene & Tropical Medicine.

The WOMAN-2 Trial is funded by the Bill & Melinda Gates Foundation (INV-007787) and the Wellcome Trust (WT208870/Z/17/Z).

Now we know what was wrong. It is anaemia rather than PPH that is killing mothers. Our understanding of PPH, often said to be the leading cause of maternal death worldwide, was seriously incomplete. Until recently, PPH was defined by the World Health Organization (WHO) as a vaginal blood loss of 500ml or more in the 24 hours after birth. But there is no threshold for women with anaemia. The women in our study were given a PPH diagnoses because of their anaemia and tranexamic acid is not a cure for anaemia.

Our late colleague Professor Bukola Fawole, an obstetrician from Nigeria, had warned us that “our women are different”. Despite using all the PPH treatments recommended by the WHO, women giving birth in Nigeria still have an astonishingly high death rate. Now we are closer to understanding why.

Naramatisho from Tanzania was different. The haemoglobin threshold for severe anaemia is 70 grams per litre (g/L), but Naramatisho gave birth with a haemoglobin of less than half that amount, 30 g/L. Anaemia had already taken her baby's life and was now threatening hers. After giving birth to her dead child, she lost consciousness, was diagnosed with PPH and only regained consciousness after a blood transfusion.

The WOMAN-2 data and stories like Naramatisho's demand an urgent review of PPH policy. We cannot overlook anaemia. We must face this discomfort of being wrong about PPH to stop women dying in childbirth.



Between 2000 and 2015, global maternal deaths fell by 33% proving that large reductions are possible. But, since then, progress has stalled.

33% ↓



1

1. Introduction

Maternal deaths and the Sustainable Development Goals

All mothers deserve a safe pregnancy and childbirth. Yet, maternal death rates in sub-Saharan Africa and South Asia remain stubbornly high. We present new results from the WOMAN-2 study, a large international clinical trial, that can be used by healthcare professionals and policymakers to reduce maternal deaths worldwide.

In 2015, the United Nations created 17 Sustainable Development Goals (SDGs) as “a shared blueprint for peace and prosperity for people and the planet, now and into the future”. SDG3.1 was a specific target to reduce the global maternal mortality ratio to less than 70 deaths per 100,000 live births by 2030.

Between 2000 and 2015, maternal mortality fell by 33% proving that large reductions are possible. But, progress has stalled. In 2023, the maternal mortality ratio was 197 deaths per 100,000 live births and the prospect of achieving the SDG target seems remote. But with good scientific data to guide our efforts, we can get the reduction back on track.

The WOMAN-2 study is the first large scientific investigation into whether anaemia could be a reason why so many mothers and babies are dying in childbirth.

Why are women dying in childbirth? The paradox of postpartum haemorrhage

Many policy reports on maternal mortality claim that PPH is the “leading cause of maternal death worldwide”. However, this statement overlooks one key epidemiological fact: PPH affects women everywhere, but almost all of the deaths are in low- and middle-income countries, mostly sub-Saharan Africa and South Asia. PPH is rarely fatal in high-income countries.

Until recently, the WHO defined PPH as a blood loss of 500ml or more within 24 hours of childbirth. In high-income countries, women can lose this much blood without serious consequences. Indeed, in many high-income countries the definition of PPH has been revised upwards to over 1,000ml.

But, in sub-Saharan Africa and South Asia, women can become critically ill after losing a few hundred millilitres of blood.

Half of all women of reproductive age in sub-Saharan Africa and South Asia have anaemia but surprisingly, there have been no large scientific studies of the effects of anaemia on women giving birth.

Anaemic women do not have enough haemoglobin to carry oxygen around their bodies and so the heart pumps the blood harder and faster. The mother’s pulse and respiratory rate is increased even at rest. The exertion of childbirth can cause her circulation to fail.





Tranexamic acid is a blood clot stabiliser that was discovered in Japan in the 1950s.

2



2. The WOMAN-2 study

The WOMAN Trials, tranexamic acid and anaemia

The WOMAN Trials Collaboration is an international alliance of doctors, midwives, patients and research scientists, coordinated by the London School of Hygiene & Tropical Medicine, working to provide the evidence needed to reduce maternal deaths.

In 2017, the WOMAN Trial, the first of the collaboration's global trials, showed that intravenous tranexamic acid (TXA), given within three hours of birth, reduced bleeding deaths by a third without serious adverse effects. TXA was immediately included in WHO guidelines and efforts to make TXA widely available worldwide are ongoing.

The recently completed WOMAN-2 study had two objectives. First, to examine the impact of moderate and severe anaemia on women giving birth. Second, to evaluate the effects of TXA on the risk of PPH and other important outcomes in these high-risk vulnerable women.

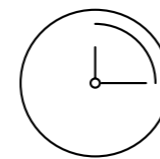
Surprisingly, there is no established definition of PPH for women with anaemia. The WHO recognised this when defining PPH. They said: "Clinicians may decide that in the circumstances of their practice that a lower level of blood loss should be the cut-off point for the institution of therapeutic action. This certainly should be the case where the mother is anaemic at the time of delivery or has other complicating medical conditions such as cardiac disease."

We therefore asked the doctors taking part in the WOMAN-2 study to consider a woman's haemodynamic status when diagnosing PPH, as they do in their usual clinical practice. We called this a "clinical diagnosis of PPH" even though it may involve bleeding of less than the usual 500ml threshold.

The WOMAN-2 study recruited 15,068 women with moderate and severe anaemia giving birth in hospitals in Pakistan, Tanzania, Nigeria and Zambia. The results have major implications for global efforts to reduce maternal mortality.



3



TXA, given within three hours of birth, reduced bleeding deaths by a third.

1/3



Women with severe anaemia were seven times as likely to die in childbirth than those with moderate anaemia.

Compared to women with moderate anaemia, women with severe anaemia are twice as likely to have a clinical diagnosis of PPH.

4



3. Results to date

Does anaemia cause PPH?

Maternal anaemia greatly increases the risk of a clinical diagnosis of PPH and death.

Our study data show that anaemia greatly increases the risk of a clinical diagnosis of PPH. Compared to women with moderate anaemia, women with severe anaemia are twice as likely to have a diagnosis of PPH. They are also diagnosed much sooner after giving birth.

Even after taking into account the differences between anaemic and non-anaemic women, the link between anaemia and a diagnosis of PPH remained strong. The clear stepwise increase in PPH with worsening anaemia strongly suggests a causal relationship.

Although women with severe anaemia had an increased risk of clinical PPH (Figure 1), our data suggest that their inability to tolerate normal bleeding could explain much of the increased risk of PPH and death.

For the same amount of bleeding, women with severe anaemia were more likely to have haemodynamic instability and troubling symptoms such as dizziness and vomiting than moderately anaemic women. Women with severe anaemia were twice as likely to have a PPH diagnosis despite losing less than 500ml of blood. For a similar blood loss, they were more often transfused and with multiple units.

Taken together, the results show that for women with severe anaemia, a diagnosis of clinical PPH is not only due to excessive bleeding but is often the consequence of normal or moderate bleeding.

Figure 1: Prebirth haemoglobin and the risk of clinically diagnosed PPH.

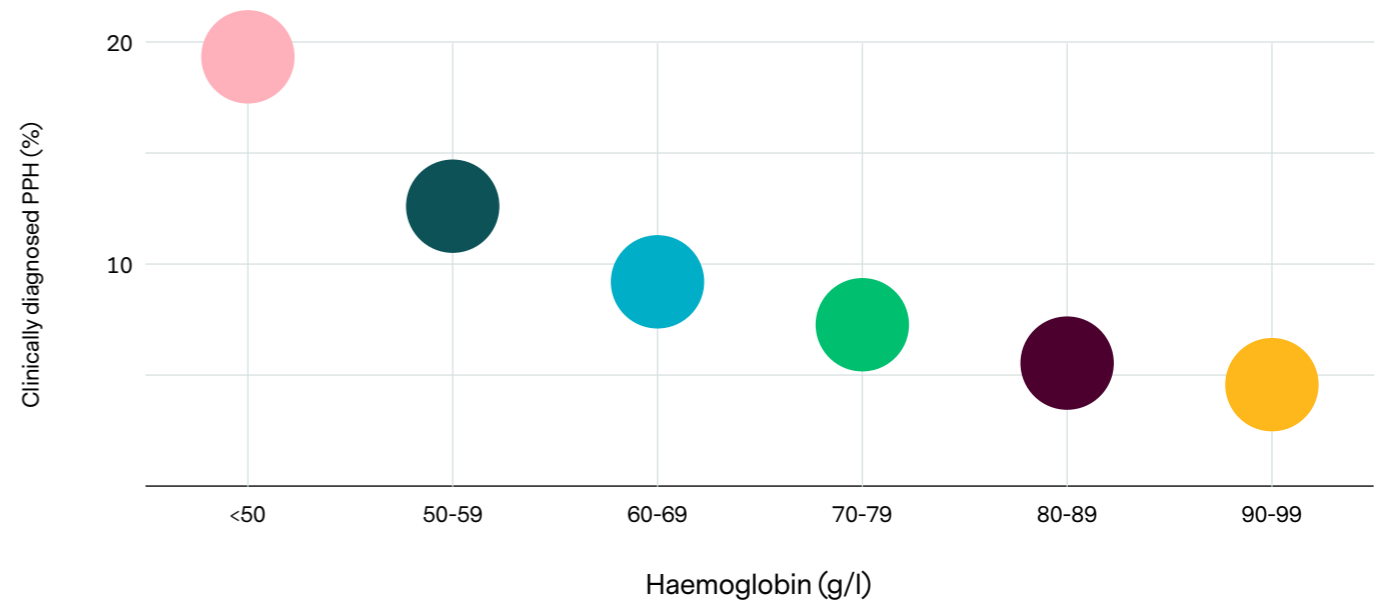


Figure 2: Data from the WOMAN-2 Trial on PPH, bleeding and other symptoms - by anaemia severity.

	Moderate anaemia	Severe anaemia	Very severe anaemia
Clinical PPH	6%	11%	20%
Dizziness	5%	8%	19%
Any oedema	4%	10%	20%
Haemodynamic instability	3%	5%	14%
Est. blood loss (ml)	280	290	300
Est. blood loss (ml)*	280	280	280

Moderate anaemia is Hb 70-99 g/L, severe anaemia is Hb 50-69 g/L, very severe anaemia is Hb < 50 g/L.
*Excluding women with antepartum haemorrhage.

5



Our research showed that anaemia increases the likelihood of premature births, traumatic births and stillbirths.

Women with severe anaemia were three times more likely to have a stillbirth than women with moderate anaemia.

How does anaemia affect maternal wellbeing?

The physical and emotional impact of anaemia on women during and after childbirth was far-reaching.

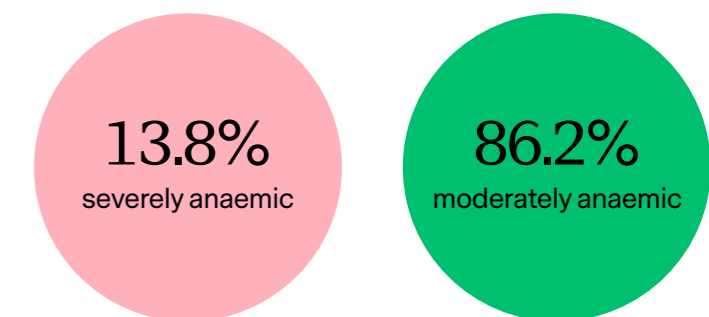
We found that moderate and severe anaemia have a major impact on the physical and mental wellbeing of women giving birth (Figures 2/3). With worsening anaemia, women report more:

- shortness of breath at rest and after exercise
- dizziness
- fatigue
- difficulty concentrating

Our research also showed that anaemia increases the likelihood of premature births and stillbirths. We see that these negative outcomes have a huge impact on the wellbeing of mothers. An astonishing 17% of women with severe anaemia had a stillbirth. The figure for women with moderate anaemia was 5% which is still much higher than for women without anaemia. Most women giving birth with moderate and severe anaemia leave hospital with an even lower haemoglobin concentration than before the birth. On average, the haemoglobin concentration fell by 9 g/L in women with moderate anaemia and by 17 g/L in women with severe anaemia.

Further analysis of the data demonstrated a linear association between haemoglobin concentration and physical capacity. Physical capacity was assessed using a six-minute walk test, during which postpartum women completed a timed walk and both distance covered and reported breathlessness were recorded. Each 10 g/L increase in postpartum haemoglobin was associated with an additional 2.99 metres walked within six minutes and a 40% reduction in the odds of experiencing breathlessness after the test.

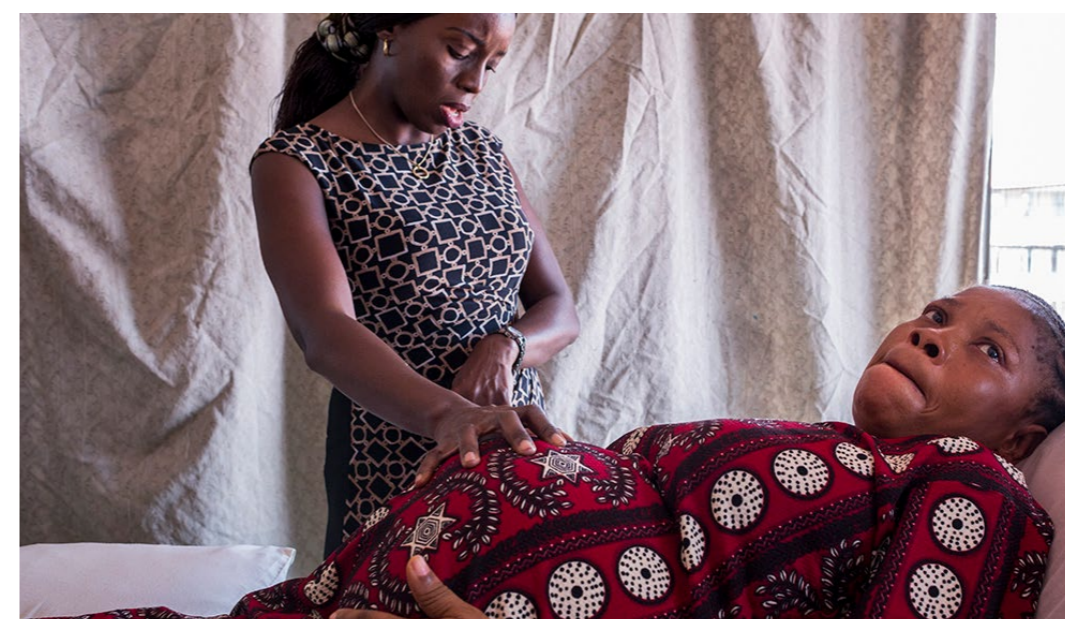
Of 15,066 women:



17%
of women with severe anaemia had a stillbirth

5%
of women with moderate anaemia had a stillbirth

6





Sana's story

Sana was a research assistant at Quaid-i-Azam University in Islamabad, Pakistan, before becoming a teacher at a public school. She got married in 2018 at the age of 24 and became pregnant soon after.

"In the third trimester, I was diagnosed with anaemia. My doctor said that my haemoglobin level was approximately 100g/L and they wanted it to be higher. So, every 15 days I got iron injections.

"I was always feeling numb, I was tired, I couldn't do much work. I had a feeling of tiredness, like I didn't have the energy to do anything.

"I didn't take anaemia seriously. But I had a terrible experience because of anaemia, I had a postpartum haemorrhage.

"There is very little knowledge, information and education about this, that you should take care of your haemoglobin.

"It's very important because it will have life-long effects on your body, on your mental health and your physical health."

"I was always feeling numb, I was tired, I couldn't do much work. I had a feeling of tiredness, like I didn't have the energy to do anything."



Naramatisho's story

Naramatisho, aged 45, was admitted to Mount Meru Regional Hospital, Arusha, Tanzania, with intrauterine foetal death and severe anaemia. Her haemoglobin level was reported to be 27g/L.

"Four months into my pregnancy, it started disturbing me. As soon as I got to four months, I almost had a miscarriage. I did not go to the hospital. I continued well; I didn't have any problems. I was active.

"I don't know why I came to the clinic, everything was good, the baby was kicking and everything was okay. But then I started feeling dizzy. I could not stand, somebody had to hold my hand, I had to be taken outside. I started feeling sick.

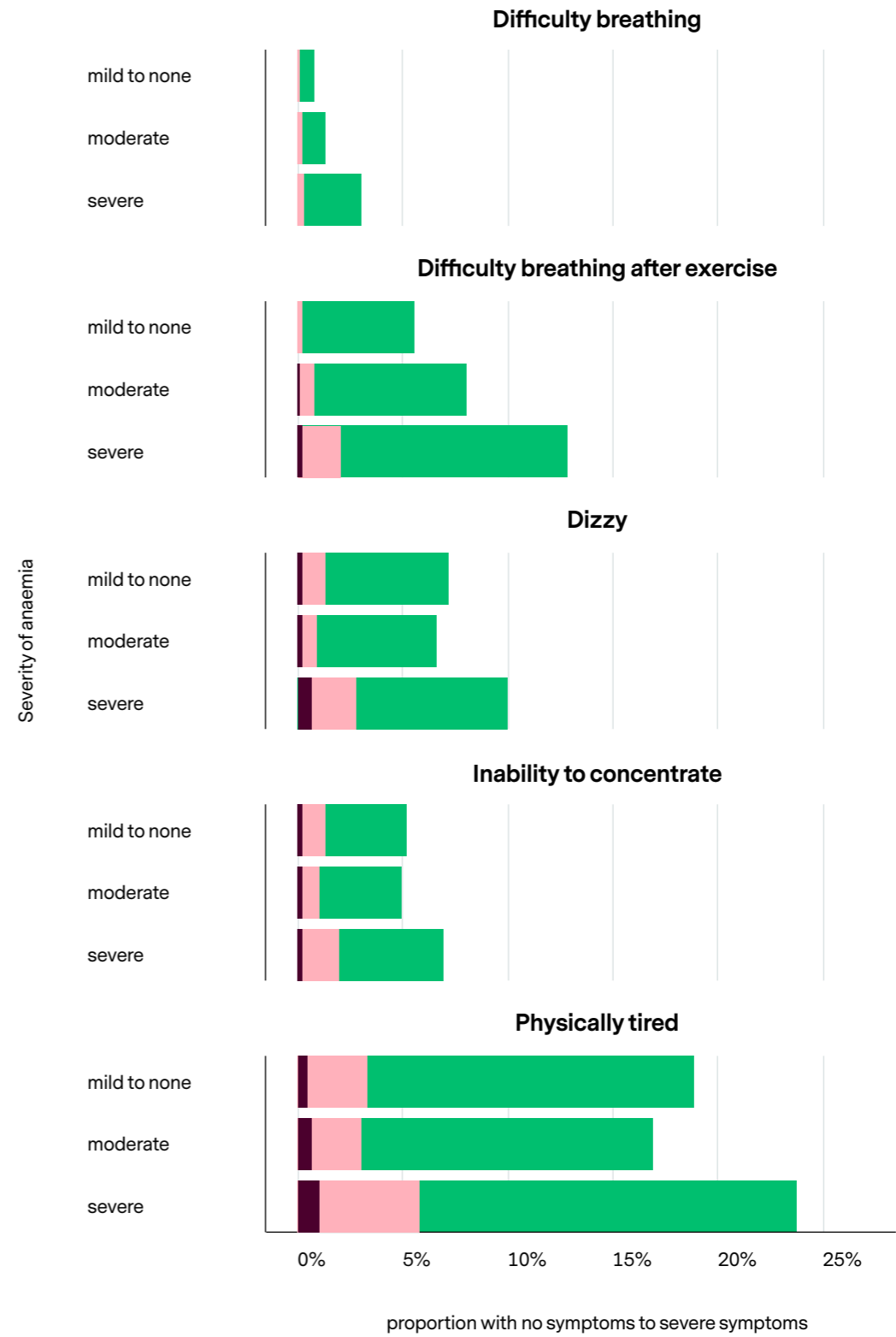
"I have lost other babies. I knew that my child was no more. She was no longer playful. And then she was totally quiet. I didn't feel OK. I lost consciousness. I almost died. They treated me and gave me blood, then I regained consciousness.

"I have things to tell other women because now I have learnt. Once you feel sick, do not stay until it gets bad. Once you feel it, go to the hospital because that is where the doctor who will take care of you is."

"I have things to tell other women because now I have learnt."

Figure 3: Maternal symptoms at hospital discharge by severity of postpartum anaemia.

Intensity
Extremely
Quite a bit
Moderately



Does episiotomy contribute to PPH?

We found that a common obstetric practice may contribute to the worsening of maternal anaemia.

Although the WHO does not recommend routine episiotomy because the risks outweigh any potential benefits, many first-time mothers who took part in the WOMAN-2 study indeed had this procedure.

29% of the women who took part in the WOMAN-2 study had an episiotomy. The chance of first-time mothers having the procedure was 81% in Pakistan, 63% in Nigeria, 29% in Zambia and 15% in Tanzania. Furthermore, of all the first-time mothers who had an episiotomy, 81% had no pain relief.

Even after taking other factors into account, women with moderate or severe anaemia who had an episiotomy were twice as likely to be diagnosed with a PPH. They were also more likely to have a significant drop (more than 20 g/L) in their haemoglobin levels.

7



The WOMAN-2 study found that some common obstetric practices may contribute to the worsening of maternal anaemia.

29%

of the women who took part in the WOMAN-2 study had an episiotomy.



Eilima's story

Eilima, 20, delivered her first child at Mount Meru Regional Hospital, Arusha, Tanzania. She was severely anaemic and received an episiotomy. She experienced extreme pain and discomfort from this procedure.

"They tested my haemoglobin, did a urine test and also a pregnancy test. It [haemoglobin] was 108 g/L. I was given drugs for malaria and drugs for anaemia. I used them but I stopped when they started making me feel nausea.

"The third [haemoglobin] test was 88 g/L, then I went for the fourth test, and it was 79 g/L. The last test was 69 g/L.

"I was told to use the syrup drug although the more I used it, the more I felt nausea. It made me feel a lot of discomfort. When I took it, I would immediately vomit all the food. So, I stopped using it.

"When I was eight months pregnant, the abdominal pains started again. They were lower abdominal pains. The pain got intense and I went to the hospital. At the hospital, I was told the baby was turning. During the last week of the pregnancy before the due date, I started feeling unwell again.

"I was experiencing headaches. I also felt dizzy and started vomiting. I was put on oxygen because I had fatigue. I delivered afterwards."

The last haemoglobin test was:

69g/L

"I was experiencing headaches. I also felt dizzy and started vomiting. I was put on oxygen because I had fatigue. I delivered afterwards".

8



Which women should receive tranexamic acid?

TXA reduces excessive bleeding by inhibiting fibrinolysis. A recent meta-analysis of data on 54,404 women from five high-quality clinical trials on TXA for postpartum bleeding, that include the WOMAN Trials, found that TXA cuts life-threatening bleeding by a quarter and there was no evidence that TXA was any less effective in women with anaemia.

However, in the WOMAN-2 Trial, TXA did not prevent a PPH diagnosis. We believe that this is due to TXA being given too late in women who were unable to tolerate even a “normal” amount of bleeding. There was no evidence of any serious adverse events with TXA, but we will keep this under review.

Even in the worst case scenario when we assume some increased risk of thrombosis with TXA, our analyses show that there would be an overall reduction in deaths if all women giving birth in sub-Saharan Africa and South Asia received TXA at the time of delivery (Figure 4).

This highlights the importance of making TXA readily available and affordable wherever women give birth. To increase timely access to TXA for women with PPH in community settings, the Collaboration’s next objective is to identify alternative routes of administration.

We found that TXA could be given by a simple intramuscular injection, as opposed to the usual intravenous injection, and we are now doing a large international trial - I'M WOMAN - to generate more evidence of its potential effectiveness.



Sidra Yasmin

Sidra Yasmin (pictured) is a community midwife and works with her mother-in-law, Khadija Akhtar, a community health worker in Pakistan.

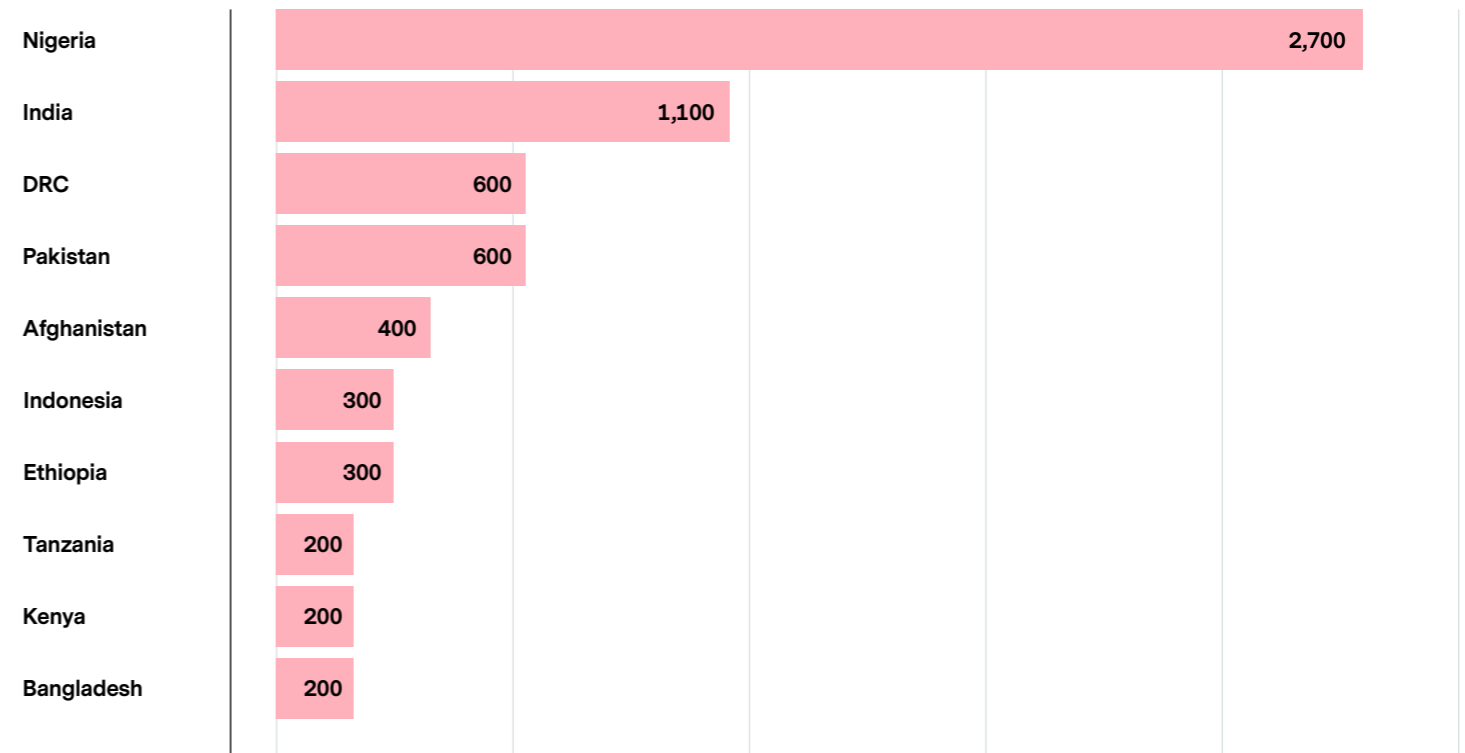
Sidra: “When we visit a patient’s home, they are about to deliver, so there should be an injection for use (in this situation). We cannot immediately give intravenous injections, as there is a shortage of staff, we are all alone and we have to look after the baby as well.

“If the patient starts to bleed (excessively) after delivery, there should be some injection that can be administered immediately and intramuscularly, so that patients can be stabilised and recover quickly.”

Khadija: “If intramuscular TXA was available, it would be of great help as it could be administered immediately after bleeding. The woman can be packed and referred to the hospital. Meanwhile it will reduce the bleeding and would have resulted in saving human life.

“When I used to work, if TXA had been available and I had information about it, more lives could have been saved.”

Figure 4: Countries where most lives could be saved per year if TXA was affordable.



A series of studies showed that TXA is well tolerated and rapidly absorbed after intramuscular administration.

54,404 women were included in an analysis of where TXA could have the most impact:

54,404



4. The missing evidence and implications for research and practice

The missing evidence

In 2023 the WHO released “A roadmap to combat postpartum haemorrhage between 2023 and 2030”, which outlined the research, implementation and advocacy needed to cut postpartum haemorrhage.

However, the WOMAN-2 study results were not available when the roadmap was written, meaning that the critical role of anaemia was missing.

We now have this missing evidence, and it has huge implications for maternal health policy.

Anaemia could be responsible for half of severe PPH cases in sub-Saharan Africa and South Asia.

Anaemia is a leading cause of PPH

First, based on the prevalence of anaemia and the strength of the association between anaemia and severe PPH, we estimate that anaemia could be responsible for half of severe PPH cases in sub-Saharan Africa and South Asia (Figures 5/6).

Anaemia is also a strong risk factor for maternal death and so anaemia may be responsible for most maternal deaths.

In other words, our data suggest that anaemia rather than PPH is the leading cause of maternal death worldwide.

Unusual changes in heart rate or blood pressure in women with moderate or severe anaemia do not always mean they are experiencing heavy bleeding or need intravenous fluids. In many cases, these women already have an increased blood volume, and giving too much fluid could cause harm.

Figure 5: Moderate and severe anaemia in women and girls of reproductive age.

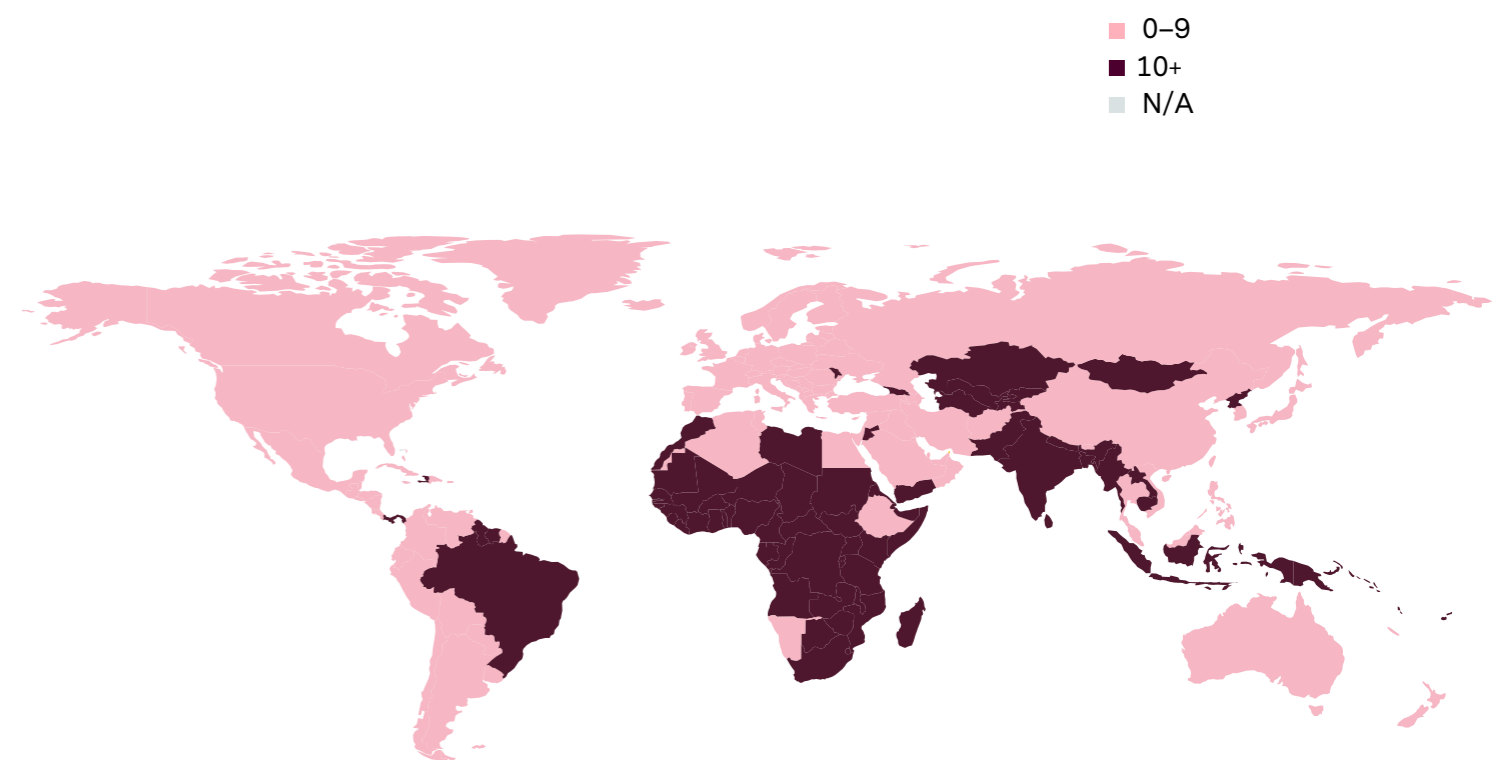


Figure 6: Maternal mortality ratio (MMR) per 100,000 live births.

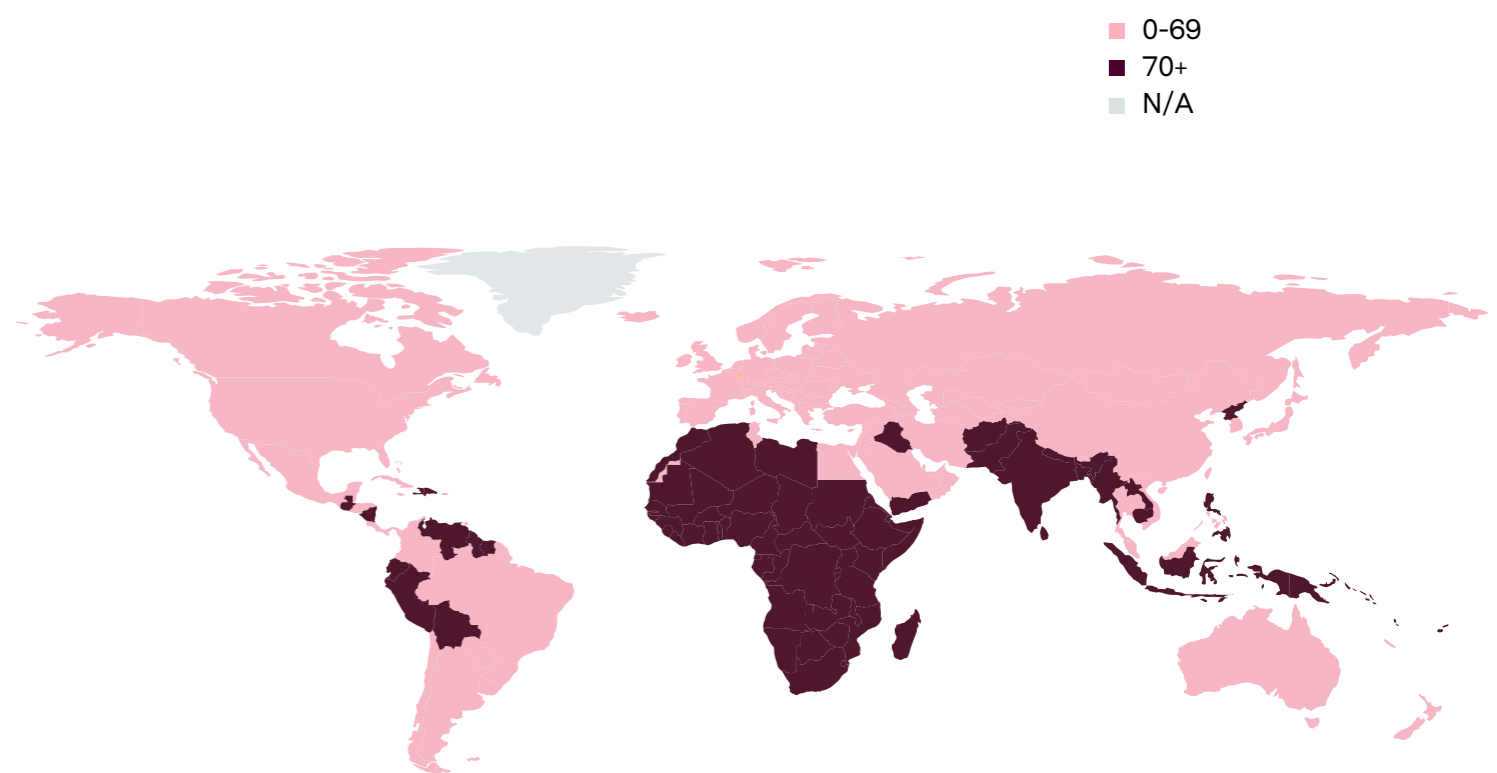


Figure 7: Ecological association between anaemia and maternal mortality. Source: data.worldbank.org

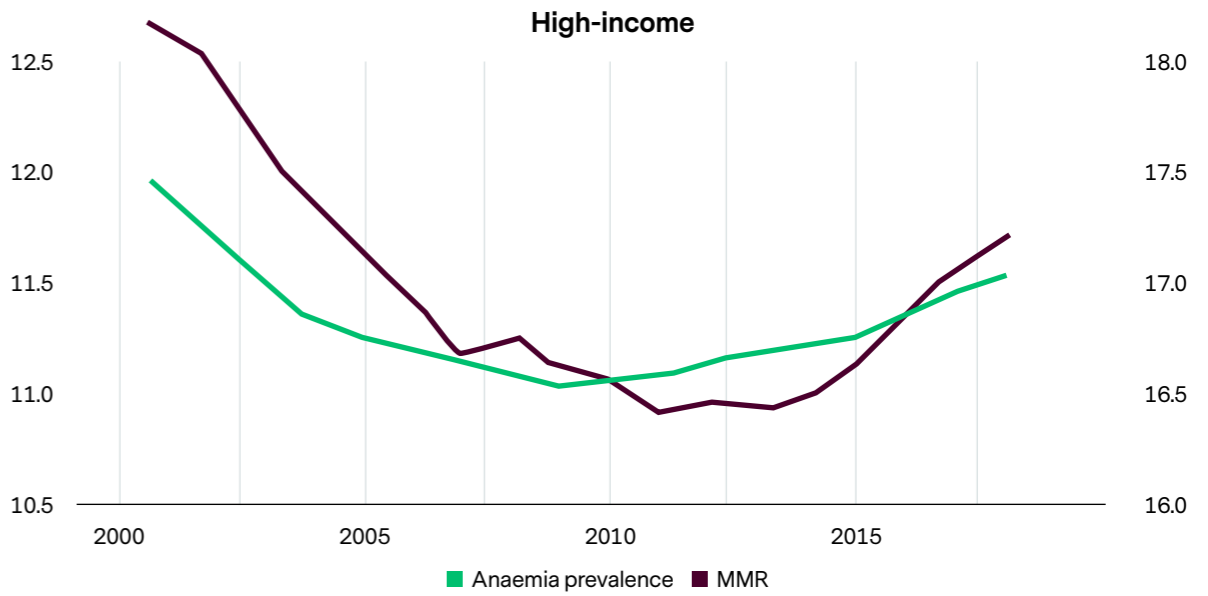
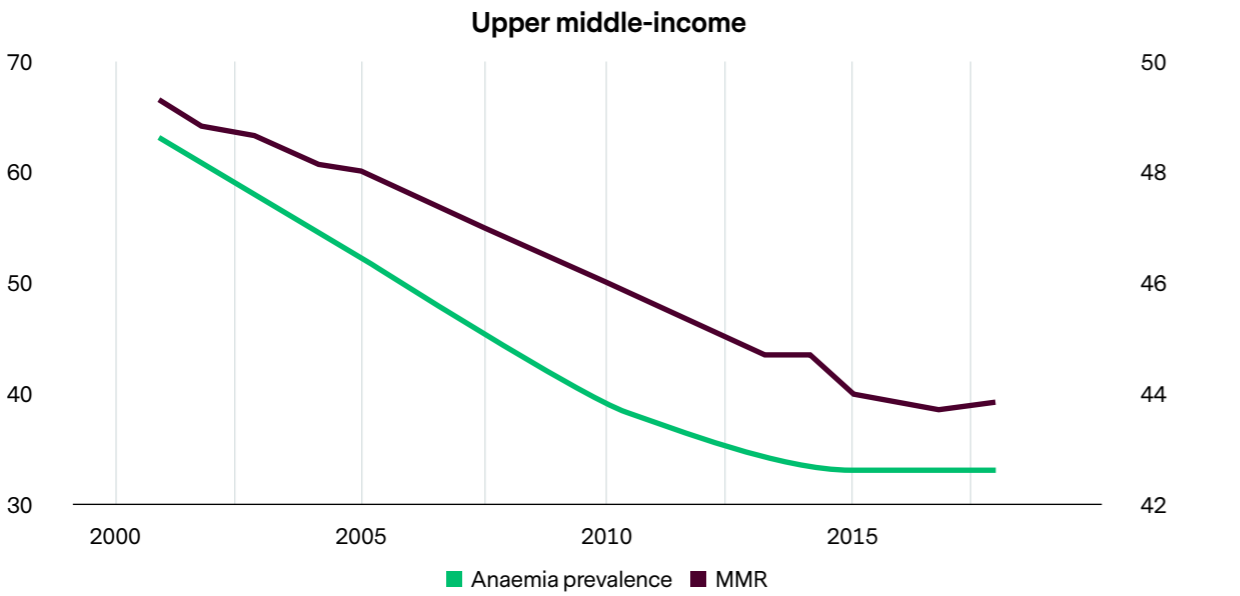
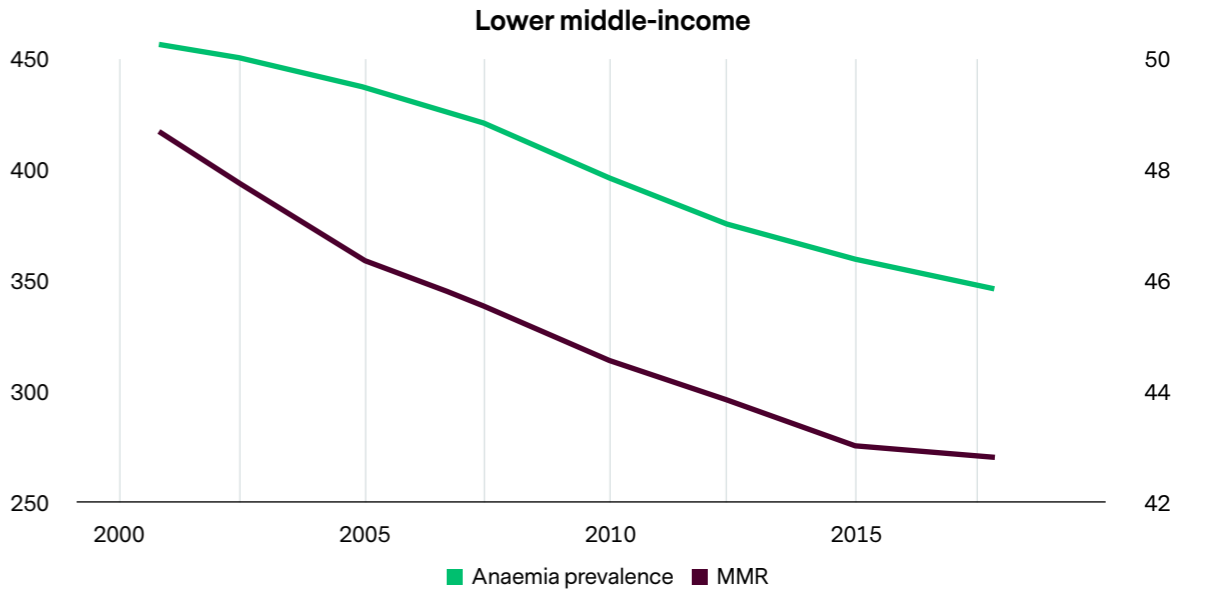
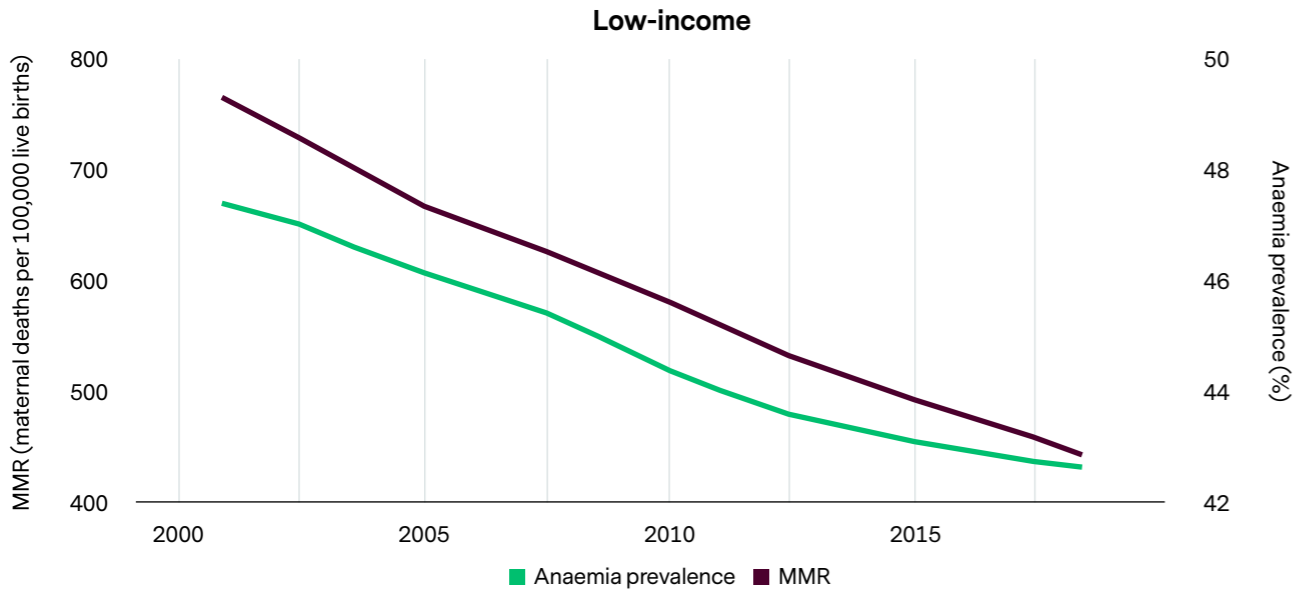
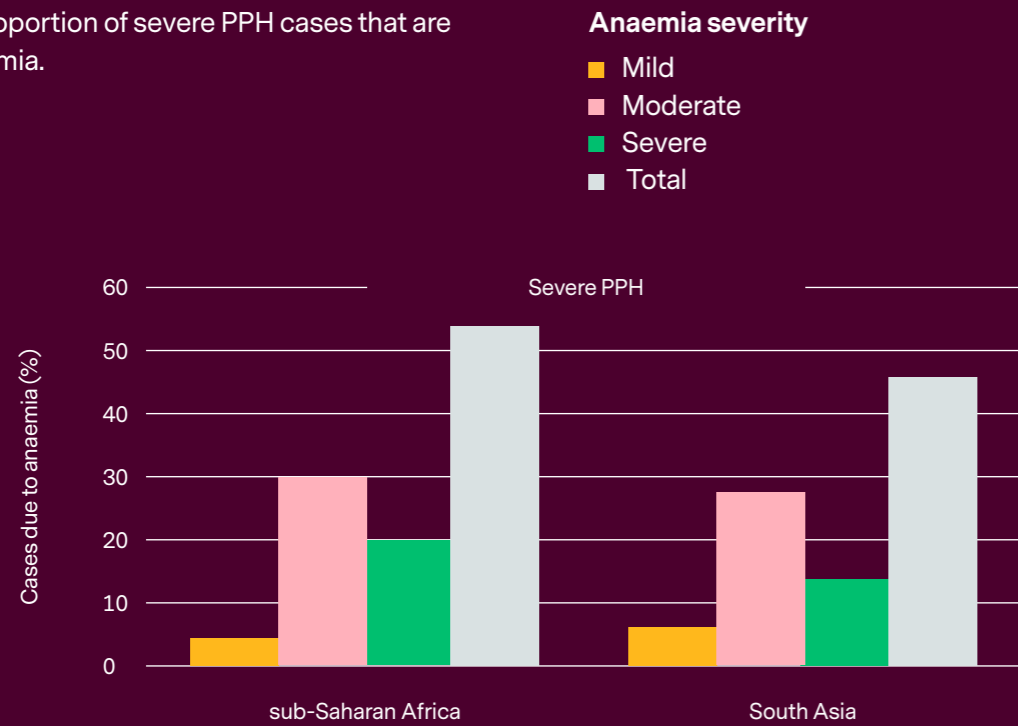


Figure 8: Proportion of severe PPH cases that are due to anaemia.



Implications for PPH diagnosis

Second, our data have major implications for the diagnosis of PPH. Women with moderate and severe anaemia can develop shock and organ failure after only moderate bleeding, therefore even the updated WHO definition of PPH fails to identify many women at high risk of death or near miss.

As part of our research, we set out to determine how accurate a diagnosis of PPH was in women with anaemia. The data showed that measuring blood loss alone was not accurate in identifying women at high risk of PPH death.

To reduce maternal deaths, a different model is needed which includes diagnostic and prognostic criteria, including:

- haemodynamic instability
- maternal haemoglobin
- and other major risk factors

Implications for research and practice

Third, our data have major implications for research and practice to reduce maternal deaths. However, the WHO roadmap, a landmark publication in this area, only includes anaemia in one of its priority 15 research questions.

To make progress towards SDG3.1, we must identify the important research questions relevant to the prevention, diagnosis and treatment of anaemia in pregnancy and the optimal management of women giving birth with moderate and severe anaemia.

In 2024, Unitaid called for proposals to accelerate the uptake of products to tackle anaemia and to develop new programmes and delivery strategies, but further investment is urgently needed.

We are encouraged to see that anaemia has been recognised in new guidelines released by the WHO, FIGO and ICM in October 2025, which call for a major shift in how PPH is prevented, diagnosed and treated.

Changes in practice

A life-course approach to anaemia prevention, detection and treatment in women and girls of reproductive age is needed to reduce the global rate of maternal deaths.

Before pregnancy and childbirth.

- **Screen for anaemia:** All women should be screened for anaemia before and during pregnancy, and their haemoglobin levels should be known when giving birth. This requires laboratory infrastructure or the use of point of care haemoglobinometers.
- **Treat anaemia:** Iron deficiency is a common cause of anaemia. Iron, folic acid and multiple micronutrient supplements or intravenous iron preparations must be available. This requires the availability of the necessary diagnostic tests. A recent randomised trial carried out in Nigeria, showed that intravenous iron reduced the prevalence of iron deficiency and iron deficiency anaemia to a greater extent than oral iron and was considered safe. This new evidence should be taken into account when caring for pregnant women with anaemia.
- **Treat and manage infections:** Infections, such as malaria, and inherited conditions, such as red blood cell disorders, should be identified, treated and managed properly, as they can contribute to anaemia.
- **Tackle the taboo:** Menstrual bleeding can be the cause of and caused by anaemia. Breaking the taboos about menstruation is necessary for women and girls to receive the care that they need to prevent anaemia.

In childbirth.

- **PPH diagnosis:** Better ways to identify women at high risk of death or near miss are needed.
- **Respectful care:** Common obstetric practices, such as episiotomy, that increase the risk of PPH and exacerbate anaemia must only be used when the benefits clearly exceed the harms.
- **Give fluids with caution:** Some women with anaemia have fluid retention and cardiac failure and intravenous fluids and blood should be given with caution. Because their PPH diagnosis may be due to anaemia rather than excessive bleeding, they might not need large volumes of fluid. Fluid overload can cause breathing difficulties and is one of the leading causes of transfusion-related death.
- **Use TXA:** This proven lifesaving drug should be available and affordable for all women giving birth, particularly those in sub-Saharan Africa and South Asia.

After childbirth.

- **Better family planning:** Greater attention to the family planning needs of women after childbirth, for example increasing birth spacing, could contribute to anaemia prevention.
- **Use TXA in surgery:** The wider use of TXA in all elective surgery will reduce surgical bleeding and conserve blood for use in situations of life-threatening bleeding in childbirth.

All women should be screened for anaemia before and during pregnancy and after birth. We showed anaemic women were being sent home with worse anaemia.



5. What we must do now

Between 2000 and 2015, there was a steady reduction in the global prevalence of anaemia in pregnant women and a similar reduction in the maternal mortality ratio. Since then, both have stalled.

The WOMAN-2 study, the first large epidemiological study of women giving birth with moderate or severe anaemia in sub-Saharan Africa and South Asia, strongly suggests a causal relationship between these two critical maternal health measures.

In this report, we have presented the missing evidence that could have a huge impact on the lives of mothers and their babies.

As it stands, however:

- Anaemia prevention and treatment is **missing** from the PPH research agenda
- Anaemia prevention and treatment is **missing** from PPH prevention policy and practice
- Lifesaving TXA is **missing** from the settings where women give birth
- The voices of women are **missing** from the decision making processes that affect them

Advocacy and decisive action to cut the prevalence and severity of anaemia in women and girls is urgently needed to reduce maternal deaths.

We hope this report can help bring about this change.

10



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Cover image: A woman holds a baby close to her chest. Image taken from the documentary Her Life Matters

1. A woman looks down smiling at a newborn baby who sleeps in her arms. Image taken from the documentary Her Life Matters.
2. Blood being arranged for transfusion for Nosheela as she suffers from severe postpartum haemorrhaging at Holy Family Hospital in Rawalpindi, Pakistan. Saiyna Bashir © Wellcome Trust.
3. A mother smiles looking down at her baby in her arms. Saiyna Bashir © Wellcome Trust.
4. A woman looks straight at the camera while her baby breastfeeds.
5. Sobia meets her newborn baby at the high-risk postnatal ward after suffering from postpartum haemorrhaging during labour. Holy Family Hospital, Rawalpindi. Saiyna Bashir © Wellcome Trust
6. In Nigeria, Dr Nike Bello times the contraction of a woman to be sure that it is frequent and strong enough before she sends the patient to the labour ward. Etinosa Yvonne © Wellcome Trust
7. A woman lies in a hospital bed looking down at the cannula in her hand. Image taken from the documentary Her Life Matters
8. A woman lies in a hospital bed looking out into the ward. Image taken from the documentary Her Life Matters
9. Three syringes lie in a metal tray prepared to be delivered to prevent life-threatening bleeding. © Sheikh Khurram
10. A female doctor wearing a protective apron and gloves holds a syringe into a vial of medicine.

Back cover:

Patient at Adeoyo Maternity Teaching Hospital, Ilorin, Nigeria. Aanuoluwapo Olaleye © / LSHTM

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