

Pregnancy, childbirth and the postpartum period: opportunities to improve lifetime outcomes for women with non-communicable diseases

Non-communicable diseases (NCDs), such as cardiovascular disease, malignant neoplasms, chronic respiratory diseases and diabetes, are the primary cause of death and disability among women,^{1,2} with women remaining susceptible throughout their life spans.³ Estimates indicate that women in most countries (88%) have a higher probability of dying before the age of 70 from an NCD than from communicable, perinatal and nutritional conditions combined.⁴ Most premature deaths due to NCDs (86%) occur in low and middle-income countries (LMICs),⁵ but health inequalities persist in high income countries (HICs) and NCDs affect some population groups more than others.⁴ In addition, the effects of the pandemic of NCDs on global health are intertwined with effects of climate change.⁶

Disparities in the impact of NCDs on subgroups of women in a HIC, such as Australia, provide an example of this where First Nations women are at higher risk of mortality from some NCDs^{14,15} and rates of disability-adjusted life years (DALYs) vary with socio-economic status and remoteness (Box 3).¹⁶

Most LMICs suffer from a complex burden of disease comprising infections, undernutrition and maternal mortality; the emerging challenge of NCDs; and problems directly related to globalisation, such as pandemics and climate change.¹⁷ Recent evidence suggests that women in low- and middle-income countries are also more likely to experience “multimorbidity” (two or more NCDs) than men.¹⁸ Australian data also show that more women than men are currently living with multimorbidity.¹⁹

Although diverse conditions fall under the umbrella of NCDs, many of them share five major common preventable risk factors: tobacco use, physical inactivity, harmful use of alcohol, unhealthy diet and air pollution.⁵ While the burden attributable to some risk factors among women decreased between 2000 and 2021, there have been increases for many cardiometabolic risk factors, including high levels of systolic blood pressure (contributing to 11% of NCD deaths in women aged 15–49 years globally in 2021), elevated fasting plasma glucose (6%), elevated low-density lipoprotein cholesterol (7%), and other risk factors related to obesity and metabolic syndrome.^{7,20} The burden from low physical activity and some dietary aspects (low intake of fruits, whole grains and vegetables; high intake of sodium) slightly increased. Ambient particulate matter pollution remained a leading contributor to DALYs.²⁰ Exposure to NCD risk factors is further increased by the effects of climate change,⁶ which have a disproportionate impact on women.²¹

Trends in NCDs

Globally, the proportion of deaths due to NCDs in women of reproductive age increased from 44% in 2010 to 52% in 2019.⁷ Although this trend has declined since the start of the coronavirus disease 2019 (COVID-19) pandemic, the absolute number of NCD deaths has continued to increase.⁷ In 2021, the most common NCD causes of death among women globally were cardiovascular disease (30% of total deaths in women); malignant neoplasms (14%); respiratory diseases (6%); neurological conditions (5%); and diabetes, digestive diseases and genitourinary diseases (3%).²

The United Nations 2030 Agenda for Sustainable Development recognises both NCDs and maternal mortality rates as major challenges^{8,9} (Box 1). Globally, progress towards the United Nations goals is variable. Reduced mortality from NCDs in women by 2030 is attainable in only 35 mostly HICs (19%), and requires a slight acceleration in decline in 50 countries (27%); with these goals not likely to be achieved in 86 countries (46%).⁴ In 15 countries (8%), NCD-related mortality rates have stagnated or increased. Although the global maternal mortality rate decreased between 2000 and 2020, it significantly increased between 2016 and 2020 in Europe, North America, Latin America and the Caribbean, and between 2000 and 2020 in eight countries, including the United States.¹⁰ The leading direct cause of maternal mortality is haemorrhage (27.1% globally); however, a similar proportion (27.5%) results from indirect causes, most of which pre-date pregnancy (>70%).¹¹ In Australia in 2018–2020, cardiovascular disease was one of the leading causes of maternal mortality¹² (Box 2).

National statistics can mask the greater burden of NCDs for women in some groups, which is often exacerbated by intersecting forms of disadvantage.¹³

A life course approach

Risk factors for NCDs accrue over a woman’s life course, and prognosis worsens the longer NCDs are left untreated. NCDs during pregnancy affect maternal morbidity, mortality and long term health,

1 United Nations 2030 Agenda for Sustainable Development: targets 3.1 and 3.4

The United Nations 2030 Agenda for Sustainable Development was adopted by all member states in 2015. The Sustainable Development Goals (SDGs) include: SDG target 3.1 to reduce the global maternal mortality ratio to less than 70 maternal deaths per 100 000 live births, and SDG target 3.4 to reduce premature mortality from non-communicable diseases by one-third.⁹ To meet SDG target 3.1, the World Health Organization has also set targets to end preventable maternal mortality.⁸

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2 Cardiovascular disease as a leading cause of maternal mortality in Australia

In 2018–2020:¹²

- 8 mothers died from cardiovascular disease (16% of maternal deaths for this period);
- cardiovascular disease was the most common cause of indirect maternal death; and
- 2 of these deaths were due to cardiomyopathy, 2 due to acute myocardial infarction, 1 due to ischaemic heart disease, and 1 due to pulmonary hypertension secondary to substance abuse. Additional information on the remaining 2 deaths was not available.

In 2011–2020, 30 mothers (15% of maternal deaths for the period) died from cardiovascular disease, making it the most frequent cause of maternal death for this period.

3 Disparities in outcomes from non-communicable diseases (NCDs) in Australia

In 2018–22, First Nations women in Australia experienced higher death rates from some NCDs than their non-Indigenous counterparts:¹⁵

- coronary heart disease (9.5 v 9.0%);
- diabetes (8.7 v 2.8%); and
- chronic obstructive lung disease (7.0 v 4.1%).

In 2018, the disability-adjusted life years (DALY) rate per 1000 people for women from the lowest socio-economic group was higher than for women from the highest socio-economic group for:¹⁶

- cardiovascular diseases (1.7 times higher);
- type 1 (2.0 times higher) and type 2 diabetes (3.3 times higher);
- chronic obstructive pulmonary disease (1.5 times higher);
- asthma (1.9 times higher); and
- mental health conditions and substance use disorders (1.4 times higher).

The DALY rate also increased with remoteness, with higher rates in the most remote areas compared with major cities for:

- cardiovascular diseases (1.8 times higher);
- type 1 (1.4 times higher) and type 2 diabetes (2.2 times higher);
- chronic obstructive pulmonary disease (1.5 times higher);
- asthma (1.5 times higher); and
- mental health conditions and substance use disorders (0.9 times higher).

child morbidity and mortality, and in some cases have intergenerational effects.²² The NCDs more commonly affecting pregnant women include hypertension, diabetes, asthma, epilepsy and mental health conditions.²² As 80–90% of women conceive in their lifetime,¹⁹ a life course approach to women's health (that views pregnancy within a continuum) rather than a focus on sexual or reproductive conditions increases opportunities for clinicians and policy makers to implement screening, prevention, education and treatment of NCDs.³

While it is crucial that health services also take steps to prevent NCDs in women earlier in the life course,²³ improving sexual, reproductive, maternal, newborn and child health (SRMNCH) services to address NCDs will improve outcomes for women not only during pregnancy, childbirth and the postnatal period but across the life course.²²

Policy challenges

There are many challenges to addressing NCDs in the context of SRMNCH services. At the most fundamental

level, these include a lack of reliable prevalence data and inconsistent definitions of NCDs, which limit the accurate data collection and monitoring needed to guide policy change.²⁴ Further challenges include inadequate high quality evidence (addressing all clinically important conditions, pregnancy stages and contexts) and comprehensive clinical practice guidelines, both of which inform optimal, evidence-based care.^{25,26} There is also a lack of evidence for the safety of medications in pregnancy and for sex differences in the effectiveness and safety of different medications.²⁷

At the provider level, maternity care is often under-resourced. High quality care stretches beyond the antenatal and intrapartum periods, including preconception care and counselling, and long term chronic care. Although steps have been taken to integrate NCD and SRMNCH care in HICs, evidence of the effectiveness of such integration in LMICs is more limited.²⁸ An additional barrier is the lack of training and resources for health workers to competently detect and care for NCDs in pregnant women²² (Box 3).

Strategies to prevent hypertension and hyperglycaemia in young women before pregnancy could significantly benefit maternal health, but even approaches that are cost-effective and available are not universally implemented.²³

Gender inequality leads to worse health-related consequences for women, especially women from lower socio-economic groups.¹³ Although integrated NCD and SRMNCH care may improve access, social barriers to adequate ongoing care may remain. In some patriarchal settings, the health of women is a lower priority than that of other family members, and power imbalances and financial dependence restrict women's ability to access medical care.³ In addition, there are disparities in health equity research between high- and low-resource settings, with limited research available from LMICs on women's experience and health care disparities to drive policy change.²⁴

Ways forward

It is incumbent on policy makers, researchers and clinicians to take action to reduce preventable maternal deaths due to NCDs.

Supporting research and data collection

A standardised definition of NCDs would help to improve data collection and inform the development of NCD care at the intersection with maternal health as well as through a woman's life course.²⁴

Public health approaches to reduce risk factor prevalence

A focus on primary prevention has the potential to strengthen the ability of health systems to meet future challenges.^{29,30} Identifying and quantifying the impact of cardiometabolic risk factors can help prioritise resource use and regain momentum towards meeting the UN goals.²⁰ Although the global disease

4 The views of women and health care providers with experience of non-communicable diseases (NCDs)

The World Health Organization (WHO) hosted a stakeholder consultation webinar in December 2023 to identify common experiences and priorities related to pregnancy and chronic medical conditions. The webinar was attended by women with NCDs, clinicians, researchers and policy makers from 30 countries across all six global regions (204 participants, with translation into five languages). Key findings (quotations from participants) include:

- Stakeholders value a holistic, life course approach: "It's important that information is framed in terms of lifestyle changes that should be maintained beyond pregnancy and a whole family approach, rather than a short-term approach to get the condition under control during pregnancy".
- Integration of care is crucial: "NCDs in pregnancy should be fully integrated with routine maternal, newborn and child health services".
- Engagement with partners, family and community is essential: "Community advocacy is crucial to reduce the cultural pressure towards women with NCDs".
- All health care workers caring for pregnant women should receive training on NCDs: "Healthcare workers should have the right skills to diagnose and treat NCDs ... continuous refresher courses, mentorship and community awareness of NCDs".

burden attributable to some risk factors has reduced, continuing efforts are needed, especially in areas of socio-economic disadvantage.²⁰ It is likely that a focus on metabolic risk factors over the life course will bring the greatest public health benefits.

Climate mitigation measures, such as the switch to clean renewable energy, increasing access to active forms of transport, and production and consumption of locally produced plant-based fresh foods, can reduce NCD risk factors.⁶ Multisectoral approaches are needed to improve health system resilience in the face of climate crises.¹⁰

Integration of care

"Obstetric transition" provides a framework for understanding the dynamic process of reducing maternal mortality and morbidity. While HICs are generally further along the obstetric transition, LMICs are also shifting towards lower proportions of maternal deaths due to direct obstetric causes, and higher proportions due to indirect causes, including NCDs.³¹

As countries transition, different strategies are needed to address preventable maternal deaths globally and nationally.³¹ Health services can improve outcomes for women across the life course by integrating care for NCDs into SRMNCH services, and vice versa^{22,24,25} (Box 4). Efforts to integrate services should be accompanied by ongoing education and training²² (Box 4). Although integrated services may overload already strained care providers, these services can be more cost-effective and increase care provision for conditions associated with stigma (such as mental health problems),³² so that women not only survive pregnancy and childbirth but thrive afterwards.³³

Addressing inequalities

Enduring improvements in women's health will likely only be achieved if policy changes are accompanied by social change, including fundamental shifts in "who has what, who does what, who decides and who is valued

for what".³⁴ For instance, enabling women to access and benefit from improved services will require engagement with partners, families and community leaders (Box 4). In addition, there is an urgent need for adequately funded Indigenous-led solutions to perinatal health inequities for Indigenous families in HICs.³⁵

Providing global recommendations on screening and management of NCDs in maternity care

One aspect of the World Health Organization strategy to address NCD-related morbidity and mortality in women is the development of clinical practice guidelines on the screening and management of NCDs during the perinatal period. A stakeholder prioritisation exercise identified cardiovascular conditions, diabetes, haemoglobinopathies, mental health and substance use, and respiratory conditions as foci for these recommendations based on prevalence, the interaction between the condition and pregnancy, and the potential for intervention during routine maternal health care.

The guidelines will provide globally relevant recommendations to ensure high quality care in the perinatal period and mitigate risks of NCDs. Two guidelines are currently under development; publication of recommendations on haemoglobinopathies is anticipated in late 2024 or early 2025, and recommendations on antenatal management of diabetes is expected in 2025 or 2026, with other aspects of diabetes care to follow.

Conclusion

Significant reduction of premature deaths from NCDs in women and preventable maternal morbidity and mortality will only be achieved if NCDs and SRMNCH are addressed together. Pregnancy provides an ideal opportunity to improve NCD-related outcomes for women, enabling lifelong benefits. Progress can be made by agreeing on standard definitions of NCDs, improving primary prevention including climate mitigation measures that reduce risk factors, taking action to address health inequities, gender inequality, and structural disadvantage, integrating NCD and SRNMCH services and providing high quality evidence-based guidelines that address the most important clinical questions for women and clinicians.

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- 1 World Health Organization. Global health estimates 2021: Global health estimates: leading causes of DALYs. Disease burden, 2000–2021 [website]. <https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys> (viewed Aug 2024).
- 2 World Health Organization. Global health estimates: cause-specific mortality, 2000–2021 [website]. <https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death> (viewed Aug 2024).
- 3 Carcel C, Haupt S, Arnott C, et al. A life-course approach to tackling noncommunicable diseases in women. *Nat Med* 2024; 30: 51–60.
- 4 Bennett JE, Stevens GA, Mathers CD, et al. NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4. *Lancet* 2018; 392: 1072–1088.
- 5 World Health Organization. Noncommunicable diseases fact sheet [website]. Geneva: WHO, Sept 2023. <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases> (viewed June 2024).
- 6 World Health Organization. Climate change and noncommunicable diseases: connections [website]. Geneva: WHO, 2023. <https://www.who.int/news/item/02-11-2023-climate-change-and-noncommunicable-diseases-connections#:~:text=There%20is%20increasing%20strong%20evidence,serious%20risks%20to%20men%20health> (viewed June 2024).
- 7 Institute for Health Metrics Evaluation. Global burden of disease study [website]. IHME. <https://vizhub.healthdata.org/gbd-results/> (viewed Aug 2024).
- 8 World Health Organization. Strategies toward ending preventable maternal mortality (EPMM). Geneva: WHO, 2015.
- 9 United Nations Department of Economic and Social Affairs. UN Sustainable Development Goal 3 targets and indicators [website]. United Nations, 2015. https://sdgs.un.org/goals/goal3#targets_and_indicators (viewed June 2024).
- 10 World Health Organization. Trends in maternal mortality 2000 to 2020: estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division [website]. Geneva: WHO, 2023. <https://iris.who.int/bitstream/handle/10665/366225/9789240068759-eng.pdf?sequence=1> (viewed May 2024).
- 11 Say L, Chou D, Gemmill A, et al. Global causes of maternal death: a WHO systematic analysis. *Lancet Glob Health* 2014; 2: e323–333.
- 12 Australian Institute of Health and Welfare. Maternal deaths in Australia 2018–2020. Australian Government, AIHW, 2023. Catalogue number PER 121.
- 13 Heise L, Greene ME, Opper N, et al. Gender inequality and restrictive gender norms: framing the challenges to health. *Lancet* 2019; 393: 2440–2454.
- 14 Australian Institute of Health and Welfare. Deaths in Australia [website]. Australian Government, June 2024. <https://www.aihw.gov.au/reports/life-expectancy-deaths/deaths-in-australia/content/about> (viewed June 2024).
- 15 Australian Institute of Health and Welfare. Deaths in Australia. Data tables [website]. Australian Government, Sept 2023. <https://www.aihw.gov.au/reports/life-expectancy-deaths/deaths-in-australia/data> (viewed June 2024).
- 16 Australian Institute of Health and Welfare. Burden of disease [website]. Australian Government, August 2024. <https://www.aihw.gov.au/reports-data/health-conditions-disability-deaths/burden-of-disease/overview> (viewed June 2024).
- 17 Frenk J, Gómez-Dantés O. The triple burden: disease in developing nations. *Harvard Int Rev*. 2011; 33: 36–40.
- 18 Asogwa OA, Boateng D, Marzà-Florensa A, et al. Multimorbidity of non-communicable diseases in low-income and middle-income countries: a systematic review and meta-analysis. *BMJ Open* 2022; 12: e049133.
- 19 Australian Institute of Health and Welfare. Multimorbidity [website]. Australian Government, June 2024. <https://www.aihw.gov.au/reports/australias-health/multimorbidity> (viewed June 2024).
- 20 Brauer M, Roth GA, Aravkin AY, et al. Global burden and strength of evidence for 88 risk factors in 204 countries and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet* 2024; 403: 2162–2203.
- 21 World Health Organization. Protecting maternal, newborn and child health from the impacts of climate change: a call for action [website]. WHO, Nov 2023. <https://www.who.int/publications/item/9789240085350> (viewed June 2024).
- 22 Akselrod S, Banerjee A, Collins TE, et al. Integrating maternal, newborn, child health and non-communicable disease care in the sustainable development goal era. *Front Public Health* 2023; 11: 1183712.
- 23 Simkovich SM, Foeller ME, Tunçalp Ö, et al. Integrating non-communicable disease prevention and control into maternal and child health programmes. *BMJ* 2023; 381: e071072.
- 24 Firoz T, Pineles B, Navrange N, et al. Non-communicable diseases and maternal health: a scoping review. *BMC Pregnancy Childbirth* 2022; 22: 1–14.
- 25 Jung J, Sultana S, Aziz S, et al. Mapping the research landscape: effectiveness of non-communicable interventions within antenatal, intrapartum and postpartum care: an overview of systematic reviews [abstract]. *J Paediatr Child Health* 2024; 60 Suppl: 116.
- 26 Jung J, Karwal EK, McDonald S, et al. Prevention and control of non-communicable diseases in antenatal, intrapartum, and postnatal care: a systematic scoping review of clinical practice guidelines since 2011. *BMC Med* 2022; 20: 1–17.
- 27 Sundari Ravindran TK, Teerawattananon Y, Tannenbaum C, Vijayasingham L. Making pharmaceutical research and regulation work for women. *BMJ* 2020; 371: m3808.
- 28 Kikuchi K, Ayer R, Okawa S, et al. Interventions integrating non-communicable disease prevention and reproductive, maternal, newborn, and child health: a systematic review. *Biosci Trends* 2018; 12: 116–125.
- 29 Lal A, Abdalla SM, Chattu VK, et al. Pandemic preparedness and response: exploring the role of universal health coverage within the global health security architecture. *Lancet Glob Health* 2022; 10: e1675–1683.
- 30 Atun R, Jaffar S, Nishtar S, et al. Improving responsiveness of health systems to non-communicable diseases. *Lancet* 2013; 381: 690–697.
- 31 Souza J, Tunçalp Ö, Vogel J, et al. Obstetric transition: the pathway towards ending preventable maternal deaths. *BJOG* 2014; 121: 1–4.
- 32 Manolova G, Waqas A, Chowdhary N, et al. Integrating perinatal maternal healthcare into maternal and perinatal services in low and middle income countries. *BMJ* 2023; 381: e073343.
- 33 UNICEF. The global strategy for woman’s children’s and adolescents’ health (2016–2030) [website]. New York: UNICEF, May 2016. <https://data.unicef.org/resources/global-strategy-womens-childrens-adolescents-health/> (viewed June 2024).
- 34 George AS, Amin A, de Abreu Lopes CM, Ravindran TKS. Structural determinants of gender inequality: why they matter for adolescent girls’ sexual and reproductive health. *BMJ* 2020; 368: 16985.
- 35 Hickey S, Roe Y, Ireland S, et al. A call for action that cannot go to voicemail: research activism to urgently improve Indigenous perinatal health and wellbeing. *Women Birth* 2021; 34: 303–305. ■