Global, regional, national, and selected subnational levels of stillbirths, neonatal, infant, and under-5 mortality, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015

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Summary

Background Established in 2000, Millennium Development Goal 4 (MDG4) catalysed extraordinary political, financial, and social commitments to reduce under-5 mortality by two-thirds between 1990 and 2015. At the country level, the pace of progress in improving child survival has varied markedly, highlighting a crucial need to further examine potential drivers of accelerated or slowed decreases in child mortality. The Global Burden of Disease 2015 Study (GBD 2015) provides an analytical framework to comprehensively assess these trends for under-5 mortality, age-specific and cause-specific mortality among children under 5 years, and stillbirths by geography over time.

Methods Drawing from analytical approaches developed and refined in previous iterations of the GBD study, we generated updated estimates of child mortality by age group (neonatal, post-neonatal, ages 1–4 years, and under 5) for 195 countries and territories and selected subnational geographies, from 1980–2015. We also estimated numbers and rates of stillbirths for these geographies and years. Gaussian process regression with data source adjustments for sampling and non-sampling bias was applied to synthesise input data for under-5 mortality for each geography. Age-specific mortality estimates were generated through a two-stage age–sex splitting process, and stillbirth estimates were produced with a mixed-effects model, which accounted for variable stillbirth definitions and data source-specific biases. For GBD 2015, we did a series of novel analyses to systematically quantify the drivers of trends in child mortality across geographies. First, we assessed observed and expected levels and annualised rates of decrease for under-5 mortality and stillbirths as they related to the Soci-demographic Index (SDI). Second, we examined the ratio of recorded and expected levels of child mortality, on the basis of SDI, across geographies, as well as differences in recorded and expected annualised rates of change for under-5 mortality. Third, we analysed levels and cause compositions of under-5 mortality, across time and geographies, as they related to rising SDI. Finally, we decomposed the changes in under-5 mortality to changes in SDI at the global level, as well as changes in leading causes of under-5 deaths for countries and territories. We documented each step of the GBD 2015 child mortality estimation process, as well as data sources, in accordance with the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER).

Findings Globally, 5·8 million (95% uncertainty interval [UI] 5·7–6·0) children younger than 5 years died in 2015, representing a 52·0% (95% UI 50·7–53·3) decrease in the number of under-5 deaths since 1990. Neonatal deaths and stillbirths fell at a slower pace since 1990, decreasing by 42·4% (41·3–43·6) to 2·6 million (2·6–2·7) neonatal deaths and 47·0% (35·1–57·0) to 2·1 million (1·8-2·5) stillbirths in 2015. Between 1990 and 2015, global under-5 mortality decreased at an annualised rate of decrease of 3·0% (2·6–3·3), falling short of the 4·4% annualised rate of decrease required to achieve MDG4. During this time, 58 countries met or exceeded the pace of progress required to meet MDG4. Between 2000, the year MDG4 was formally enacted, and 2015, 28 additional countries that did not achieve the 4·4% rate of decrease from 1990 met the MDG4 pace of decrease. However, absolute levels of under-5 mortality remained high in many countries, with 11 countries still recording rates exceeding 100 per 1000 livebirths in 2015. Marked decreases in under-5 deaths due to a number of communicable diseases, including lower respiratory infections, diarrhoeal diseases, measles, and malaria, accounted for much of the progress in lowering overall under-5 mortality in low-income countries. Compared with gains achieved for infectious diseases and nutritional deficiencies, the persisting toll of neonatal conditions and congenital anomalies on child survival became evident, especially in low-income and low-middle-income countries. We found sizeable heterogeneities in comparing observed and expected rates of under-5 mortality, as well as differences in observed and expected rates of change for under-5 mortality. At the global level, we recorded a divergence in observed and expected levels of under-5 mortality starting in 2000, with the observed trend falling much faster than what was expected based on SDI through 2015. Between 2000 and 2015, the world recorded 10·3 million fewer under-5 deaths than expected on the basis of improving SDI alone.

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See **Editorial** page 1447

See **Comment** pages 1448 and 1450

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Interpretation Gains in child survival have been large, widespread, and in many places in the world, faster than what was anticipated based on improving levels of development. Yet some countries, particularly in sub-Saharan Africa, still had high rates of under-5 mortality in 2015. Unless these countries are able to accelerate reductions in child deaths at an extraordinary pace, their achievement of proposed SDG targets is unlikely. Improving the evidence base on drivers that might hasten the pace of progress for child survival, ranging from cost-effective intervention packages to innovative financing mechanisms, is vital to charting the pathways for ultimately ending preventable child deaths by 2030.

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Introduction

Substantial reductions in under-5 mortality have occurred worldwide during the past 35 years, with every region recording sizeable improvements in child survival.[1–8] National rates of decrease have varied substantially,[1,5] which has been attributed to rising levels of income per person;[9,10] greater educational attainment, especially in women of reproductive age;[11,12] lower fertility rates; strengthened public health programmes; and overall improvements in health technologies and systems.[13] Many view the development and scale-up of many life-saving interventions targeting various leading causes of under-5 deaths[14] as primary accelerants of child survival during this time, including insecticide-treated nets,[15,16] artemisinin-based combination therapies,[17] the prevention of mother-to-child transmission of HIV,[18] and a number of vaccines, such as for measles and rotavirus and the pneumococcal conjugate vaccine.[19] Further, expanding the provision of more long-standing interventions, such as oral rehydration therapy for diarrhoeal diseases or antibiotics for pneumonia, and addressing environmental risks, such as water and sanitation, probably contributed to reductions in under-5 mortality in many places.[20,21] Amid such advances were increased domestic funding and development assistance for health, particularly

Research in context

Evidence before this study

The Global Burden of Disease (GBD) study has a long history of generating comprehensive, comparable estimates of child mortality, and has continually refined current methods or developed new analytical approaches to maximise a full range of data sources and systems that track child survival. For the 2013 iteration of GBD, we evaluated the relative contributions of different factors, including number of births and education levels, to changes in under-5 mortality from 2000 to 2013. In recent years, several studies have sought to assess drivers of changes in child mortality, such as postulating trends caused by a subset of causes and indicators of technical progress. A shortcoming of these past approaches is that estimates of under-5 mortality levels and trends are typically produced within separate analytical frameworks, rather than unified estimation systems. GBD 2015 child mortality analyses feature several advances from previous rounds of the GBD, including an expanded set of territories and subnational geographies, additional causes, and critical examinations on the measurement and impact of changes in sociodemographic status on child survival.

Added value of this study

The GBD assessment of child mortality provides timely, robust evidence on documenting child health achievements during the Millennium Development Goal era, identifying causes and regions for which less progress occurred, and characterising the association between improving development and child survival. Estimates of child mortality by age (neonatal, post-neonatal, 1–4 years, and under-5), sex, and cause over time now include 519 geographies, a notable increase from the 264 included in GBD 2013. The under-5 mortality database has increased greatly since GBD 2013, and we implemented several methodological improvements, including data bias adjustments by data source and data type. For the first time, we estimated the number and rates of stillbirths across geographies and over time. Further, this analysis applies measures of Socio-demographic Index (SDI), a composite measure of income per person, educational attainment, and fertility for every geography year, to examine the association between changes in child mortality and improving levels of development.

Implications

This study provides the most comprehensive assessment so far of levels and trends of child mortality worldwide, linking recorded rates of change in under-5 mortality with expected rates of decrease based on SDI alone. Through a series of decomposition analyses, we identify which groups of causes contribute most to reductions in under-5 mortality across regions and the development spectrum. Comparisons of recorded levels and cause composition for child mortality with patterns expected based on SDI alone offer an in-depth, nuanced picture of where countries might need to refocus policies and resource allocation for accelerated improvements in child survival in the future.

resources dedicated to child health.[22,23] The Millennium Declaration[24] and the political and technical focus catalysed by Millennium Development Goal 4 (MDG4), arguably incited heightened policy attention and financial commitments to child health by national governments and development partners alike.

Despite such progress, most low-income and middle-income countries (LMICs) did not achieve the MDG4 target of reducing under-5 mortality by two-thirds between 1990 and 2015, which equates to a 4·4% annualised rate of decrease during this time.[5] From 1990 to 2000, the global rate of decrease for under-5 mortality averaged 2·0% (1·7–2·4) per year, and previous forecasts by the UN Inter-agency Group for Child Mortality Estimation (IGME) suggested that 62 of 195 countries would achieve MDG4 by 2015.[5] Further, at the global level, IGME estimated that MDG4 would be missed by 14 percentage points (ie, a 53% decrease in under-5 mortality between 1990 and 2015). The degree to which countries diverged in their pace of progress has prompted extensive debate and reflection on the various drivers of child health, including absolute and relative funding levels,[25] overarching governance,[26] health-system efficiencies,[27] and implementation of optimum intervention packages and specific health programmes.[13,28] Further, the relative effect of gains in sociodemographic status, advances in medical technologies, and reductions in cause-specific mortality remains contested. Previous studies postulate the effects of cause-specific death patterns on national trends in under-5 mortality,[7,29] and others have sought to isolate the effect of broader factors, including income per person and education.[30] However, few studies, if any, have systematically attributed changes in mortality due to leading causes of child deaths, as well as gains in overall development, across geographies and over time.

Enhanced estimation methods, as well as increased quantity and quality of data, not only show large disparities in under-5 mortality across and within countries,[1,5,31,32] but also emphasise distinct variations in survival by age group and cause among children younger than 5 years.[1,14,33,34] Previous studies report much slower decreases in mortality rates for neonates, or children younger than 28 days, than those recorded for post-neonates and children aged 1 to 4 years.[1,33] These findings have prompted a heighted focus on newborn health,[35] especially around the types of interventions and health services that might accelerate reductions in neonatal mortality.[36–38] Systematic disaggregation of levels and trends in neonatal mortality, particularly at subnational levels, can help focus local needs and strategies for improving newborn health. Recent analyses also bring renewed attention to late fetal and intrapartum deaths, known as stillbirths.[39,40] Especially in low-income areas, higher stillbirth rates have been associated with preventable maternal infections, including malaria and syphilis,[40] highlighting the importance of using a comprehensive analytic approach that can account for or link various exposures and socioeconomic factors related to stillbirths. In combination, these findings underscore the vital need to advance understanding of fetal risks and causes of early death associated with pregnancy or delivery across and within populations.

In 2015, the MDGs were replaced by the more all-encompassing, albeit less health-focused, Sustainable Development Goals (SDGs).[41] SDG3.2 is the main indicator for improving child survival, with targets of reducing under-5 mortality to fewer than 25 deaths per 1000 livebirths, decreasing neonatal mortality to fewer than 12 deaths per 1000 livebirths, and ending preventable deaths of newborns and children younger than 5 years, all by 2030. In view of these ambitious global goals, and the highly heterogeneous trends recorded in absolute and relative child mortality trends in the past, it is crucial to comprehensively assess factors that affected mortality trends in the past and to identify which ones might further improve child survival in the future.

The 2015 iteration of the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD 2015) provides the analytical framework from which reductions in child mortality can be thoroughly examined by age, geography, and cause over time. For GBD 2015, we analyse rates of under-5 mortality disaggregated by age group, as well as stillbirths, for 195 countries and territories from 1980 to 2015; however, much of this paper focuses on results between 1990 and 2015, aligning with the period of time covered by MDG4. Expanding on subnational analyses done for GBD 2013, we provide estimates of levels and trends in under-5 mortality at subnational levels for Brazil, China, India, Japan, Kenya, Mexico, Saudi Arabia, South Africa, Sweden, the UK, and the USA. Through a series of decomposition analyses and assessments of child mortality in relation to measures of sociodemographic status, we quantify differences in observed and expected gains in child survival given changes in development alone.

Methods

The methods used to generate estimates of under-5 mortality and age-specific death rates (early neonatal, late neonatal, post-neonatal, ages 1–4 years, infant, and under 5), contribute to broader GBD 2015 analyses and results on all-cause mortality and cause of death. Substantial detail on data inputs, processing, and estimation methods can be found in an accompanying GBD 2015 publication.[14] Here we provide a brief summary of our under-5 mortality estimation approach and accompanying analyses, including an assessment of mortality trends by Soci-demographic Index (SDI), and attribute changes in under-5 mortality to leading causes of death. We also describe our estimation of stillbirths by geography and over time.

	Stillbirths		Early neonatal (0–6 days)		Late neonatal (7–27 days)		Post-neonatal (28 days to 1 year)		Child (1–4 years)		Under 5 (0–4 years)	
	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate
1980	4564·42 (3341·20–6298·83)	35·32 (26·12–48·13)	3467·39 (3393·59–3534·22)	27·71 (26·37–28·94)	1543·04 (1525·70–1559·96)	12·69 (12·29–13·12)	4468·32 (4361·17–4572·96)	37·47 (35·04–39·85)	4643·93 (4470·80–4818·39)	40·92 (37·58–44·49)	14 122·69 (13 995·96–14 258·76)	113·82 (110·88–117·11)
1981	4517·94 (3310·03–6209·80)	34·48 (25·52–46·83)	3456·63 (3383·42–3523·71)	27·24 (25·92–28·43)	1516·58 (1500·77–1533·26)	12·29 (11·88–12·70)	4405·81 (4300·90–4506·72)	36·47 (34·08–38·77)	4538·98 (4366·43–4710·35)	39·67 (36·41–43·14)	13 918·00 (13 796·26–14 056·49)	110·97 (108·04–114·26)
1982	4477·11 (3322·49–6157·15)	33·62 (25·19–45·70)	3450·41 (3378·35–3516·82)	26·74 (25·45–27·90)	1490·82 (1474·30–1507·34)	11·88 (11·47–12·31)	4339·21 (4235·45–4441·98)	35·33 (32·94–37·59)	4,434·38 (4267·06–4598·46)	38·34 (35·13–41·88)	13 714·82 (13 589·45–13 857·12)	107·85 (104·80–111·36)
1983	4446·63 (3338·48–6038·33)	32·83 (24·87–44·10)	3451·08 (3379·46–3517·62)	26·27 (25·04–27·41)	1468·12 (1453·15–1484·66)	11·49 (11·08–11·93)	4395·90 (4228·10–4616·23)	35·13 (32·49–37·94)	4391·16 (4210·33–4575·38)	37·42 (34·12–40·92)	13 706·26 (13 502·87–13 954·64)	106·02 (102·58–109·92)
1984	4414·01 (3341·28–5878·18)	32·04 (24·46–42·24)	3451·40 (3380·96–3516·47)	25·81 (24·58–26·95)	1445·49 (1429·90–1462·11)	11·11 (10·70–11·55)	4343·05 (4177·90–4563·00)	34·05 (31·53–36·86)	4309·64 (4142·86–4480·44)	36·10 (32·99–39·37)	13 549·58 (13 353·43–13 793·75)	103·03 (99·70–107·22)
1985	4372·44 (3329·84–5815·48)	31·28 (24·01–41·20)	3444·53 (3373·90–3511·49)	25·37 (24·18–26·53)	1419·42 (1404·16–1435·52)	10·73 (10·33–11·20)	4198·69 (4086·96–4316·23)	32·37 (30·07–34·57)	4193·23 (4036·11–4354·84)	34·48 (31·56–37·46)	13 255·88 (13 120·30–13 398·93)	99·21 (96·09–102·89)
1986	4324·91 (3303·47–5687·58)	30·56 (23·53–39·83)	3430·87 (3362·62–3494·07)	24·94 (23·79–26·07)	1392·32 (1375·98–1408·90)	10·39 (10·01–10·83)	4095·77 (3997·51–4193·69)	31·12 (29·00–33·22)	4097·73 (3941·17–4255·73)	33·09 (30·34–35·95)	13 016·69 (12 893·07–13 137·64)	96·03 (93·02–99·64)
1987	4268·38 (3281·74–5574·35)	29·90 (23·16–38·72)	3413·24 (3345·71–3476·16)	24·58 (23·42–25·70)	1364·90 (1348·09–1380·90)	10·08 (9·70–10·52)	4034·29 (3937·80–4131·20)	30·28 (28·20–32·40)	4026·78 (3876·37–4185·56)	31·95 (29·21–34·86)	12 839·21 (12 714·31–12 965·82)	93·57 (90·57–97·16)
1988	4191·84 (3222·94–5475·83)	29·23 (22·64–37·86)	3382·27 (3315·87–3445·31)	24·21 (23·08–25·28)	1333·94 (1319·08–1349·92)	9·79 (9·42–10·21)	3960·20 (3864·38–4053·88)	29·47 (27·51–31·55)	3955·56 (3804·58–4,111·65)	30·91 (28·30–33·59)	12 631·98 (12 504·07–12 758·92)	91·23 (88·36–94·63)
1989	4103·42 (3155·33–5370·66)	28·62 (22·16–37·15)	3339·41 (3277·13–3403·54)	23·90 (22·83–24·92)	1299·73 (1285·45–1315·57)	9·53 (9·19–9·95)	3871·89 (3781·40–3966·14)	28·70 (26·84–30·71)	3857·17 (3709·77–4,011·25)	29·76 (27·26–32·53)	12 368·20 (12 253·57–12 483·93)	88·90 (86·13–92·11)
1990	4007·90 (3083·10–5236·38)	28·10 (21·77–36·41)	3288·20 (3224·96–3349·07)	23·63 (22·59–24·60)	1264·72 (1250·49–1279·28)	9·31 (8·97–9·68)	3784·52 (3693·53–3877·42)	28·09 (26·21–29·94)	3782·69 (3637·18–3933·80)	28·92 (26·55–31·67)	12 120·13 (12 010·80–12 239·54)	87·08 (84·45–90·05)
1991	3909·41 (3019·26–5069·41)	27·62 (21·48–35·55)	3233·63 (3172·82–3293·92)	23·41 (22·39–24·31)	1230·80 (1216·82–1244·35)	9·12 (8·79–9·47)	3695·00 (3601·95–3786·01)	27·57 (25·77–29·31)	3707·73 (3561·58–3857·32)	28·21 (25·95–30·87)	11 867·16 (11 761·90–11 972·98)	85·54 (83·10–88·24)
1992	3800·25 (2976·27–4886·14)	27·12 (21·38–34·62)	3168·04 (3106·90–3229·12)	23·15 (22·12–24·09)	1192·12 (1178·59–1205·93)	8·92 (8·61–9·26)	3582·20 (3493·61–3673·52)	26·94 (25·19–28·74)	3593·27 (3453·91–3735·14)	27·32 (25·04–29·82)	11 535·63 (11 426·11–11 636·72)	83·69 (81·18–86·25)
1993	3687·65 (2907·35–4735·37)	26·60 (21·10–33·92)	3098·80 (3037·91–3157·56)	22·88 (21·88–23·80)	1152·81 (1139·48–1166·25)	8·71 (8·41–9·02)	3467·75 (3381·02–3556·99)	26·32 (24·59–28·06)	3486·85 (3349·67–3624·72)	26·59 (24·47–28·95)	11 206·21 (11 110·76–11 310·27)	81·96 (79·60–84·56)
1994	3577·24 (2847·62–4544·93)	26·08 (20·88–32·92)	3037·42 (2977·47–3096·64)	22·65 (21·67–23·56)	1118·66 (1105·33–1133·13)	8·54 (8·23–8·85)	3372·75 (3287·97–3467·51)	25·85 (24·26–27·54)	3427·31 (3268·93–3578·27)	26·27 (24·13–28·58)	10 956·15 (10 836·81–11 103·59)	80·83 (78·57–83·29)
1995	3471·39 (2787·86–4366·54)	25·58 (20·65–31·97)	2970·80 (2910·75–3030·03)	22·37 (21·46–23·29)	1079·27 (1067·15–1091·46)	8·31 (8·04–8·60)	3285·45 (3200·44–3372·30)	25·42 (23·86–26·93)	3291·68 (3160·12–3422·11)	25·41 (23·42–27·47)	10 627·20 (10 534·17–10 728·52)	79·15 (77·10–81·31)
1996	3389·05 (2755·17–4219·81)	25·16 (20·56–31·15)	2914·02 (2856·68–2969·53)	22·11 (21·21–22·93)	1046·09 (1034·26–1057·84)	8·12 (7·86–8·39)	3190·20 (3106·86–3272·35)	24·89 (23·41–26·26)	3193·88 (3066·06–3323·32)	24·87 (22·91–26·96)	10 344·19 (10 255·67–10 441·05)	77·71 (75·85–79·66)
1997	3325·06 (2729·68–4111·07)	24·83 (20·48–30·53)	2862·34 (2805·44–2916·48)	21·84 (20·96–22·64)	1014·89 (1003·33–1027·15)	7·92 (7·67–8·18)	3100·92 (3016·31–3180·72)	24·35 (22·95–25·71)	3095·57 (2967·45–3227·97)	24·30 (22·38–26·32)	10 073·72 (9987·08–10 166·45)	76·22 (74·45–78·04)
1998	3252·85 (2679·00–4,002·19)	24·39 (20·18–29·85)	2813·68 (2759·54–2868·11)	21·55 (20·69–22·34)	985·58 (973·89–996·93)	7·72 (7·46–7·98)	3016·13 (2934·45–3095·42)	23·78 (22·39–25·17)	3003·76 (2876·08–3131·97)	23·75 (21·96–25·66)	9819·14 (9735·05–9907·36)	74·70 (72·90–76·52)

(Table 1 continues on next page)

	Stillbirths		Early neonatal (0–6 days)		Late neonatal (7–27 days)		Post-neonatal (28 days to 1 year)		Child (1–4 years)		Under 5 (0–4 years)	
	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate
(Continued from previous page)												
1999	3171·09 (2619·78–3878·74)	23·81 (19·76–28·98)	2767·68 (2713·91–2821·33)	21·22 (20·36–21·97)	956·75 (945·22–968·45)	7·50 (7·23–7·76)	2930·95 (2852·37–3009·62)	23·16 (21·79–24·52)	2910·24 (2782·65–3038·66)	23·14 (21·39–25·07)	9565·62 (9481·09–9652·39)	73·03 (71·20–74·90)
2000	3090·13 (2563·52–3751·10)	23·19 (19·32–28·02)	2721·60 (2666·35–2773·39)	20·86 (19·98–21·62)	927·49 (915·82–938·98)	7·26 (7·00–7·53)	2843·08 (2763·31–2918·67)	22·46 (21·15–23·77)	2810·32 (2688·05–2935·63)	22·44 (20·72–24·32)	9302·50 (9218·10–9386·18)	71·12 (69·33–73·03)
2001	3014·27 (2521·45–3629·82)	22·57 (18·95–27·06)	2676·78 (2621·56–2727·91)	20·46 (19·62–21·22)	899·27 (887·84–911·07)	7·02 (6·76–7·28)	2755·20 (2676·23–2831·45)	21·72 (20·44–22·98)	2710·94 (2589·72–2832·43)	21·68 (20·00–23·49)	9042·19 (8956·84–9127·83)	69·09 (67·17–71·02)
2002	2945·64 (2486·44–3536·51)	21·96 (18·61–26·26)	2632·58 (2579·35–2684·35)	20·03 (19·21–20·82)	872·56 (861·77–884·33)	6·78 (6·52–7·04)	2669·20 (2593·57–2744·00)	20·95 (19·67–22·21)	2614·51 (2497·63–2732·49)	20·90 (19·31–22·64)	8788·85 (8703·87–8873·68)	66·98 (65·07–68·94)
2003	2883·13 (2450·30–3432·10)	21·38 (18·24–25·36)	2587·51 (2536·18–2639·32)	19·57 (18·77–20·34)	846·66 (835·85–858·26)	6·54 (6·29–6·80)	2556·92 (2488·41–2631·87)	19·96 (18·75–21·15)	2505·81 (2387·30–2621·50)	19·98 (18·43–21·65)	8496·90 (8424·32–8578·98)	64·49 (62·74–66·38)
2004	2822·77 (2398·46–3342·95)	20·81 (17·74–24·56)	2541·18 (2490·19–2592·63)	19·10 (18·31–19·88)	821·44 (810·90–833·33)	6·30 (6·05–6·56)	2475·08 (2407·74–2548·10)	19·19 (18·00–20·33)	2419·48 (2302·48–2532·72)	19·21 (17·73–20·86)	8257·17 (8181·77–8342·34)	62·34 (60·55–64·29)
2005	2752·80 (2351·02–3241·05)	20·19 (17·29–23·68)	2492·25 (2439·11–2543·30)	18·61 (17·80–19·36)	795·67 (785·04–807·58)	6·06 (5·81–6·33)	2389·57 (2321·08–2460·22)	18·39 (17·28–19·53)	2319·16 (2211·24–2427·96)	18·30 (16·89–19·90)	7996·65 (7921·62–8081·51)	60·03 (58·15–61·99)
2006	2677·89 (2300·31–3132·63)	19·51 (16·81–22·75)	2444·92 (2393·69–2495·80)	18·14 (17·34–18·89)	771·64 (760·76–783·26)	5·83 (5·56–6·10)	2307·74 (2239·59–2375·84)	17·64 (16·57–18·76)	2224·50 (2117·95–2330·96)	17·43 (16·05–18·96)	7748·81 (7671·16–7829·99)	57·81 (55·82–59·82)
2007	2608·90 (2238·50–3052·02)	18·88 (16·25–22·02)	2399·66 (2348·31–2449·79)	17·67 (16·90–18·41)	749·16 (737·98–761·74)	5·62 (5·35–5·89)	2231·91 (2165·03–2298·04)	16·93 (15·88–18·07)	2135·85 (2032·78–2238·85)	16·62 (15·28–18·12)	7516·57 (7440·60–7604·72)	55·69 (53·60–57·78)
2008	2546·84 (2194·02–2972·40)	18·32 (15·82–21·31)	2357·29 (2306·72–2407·17)	17·24 (16·46–17·99)	728·66 (717·15–741·87)	5·43 (5·15–5·72)	2163·00 (2098·82–2224·69)	16·28 (15·22–17·42)	2061·12 (1959·62–2160·84)	15·91 (14·61–17·34)	7310·06 (7225·74–7408·43)	53·79 (51·58–56·10)
2009	2485·07 (2142·42–2891·93)	17·76 (15·35–20·61)	2313·06 (2263·54–2361·49)	16·81 (16·02–17·56)	707·89 (695·78–721·70)	5·24 (4·94–5·55)	2089·18 (2026·36–2150·70)	15·61 (14·52–16·71)	1968·96 (1868·41–2062·99)	15·08 (13·78–16·55)	7079·10 (6988·35–7178·71)	51·74 (49·33–54·14)
2010	2419·94 (2087·79–2824·25)	17·22 (14·89–20·04)	2264·25 (2214·86–2314·31)	16·37 (15·55–17·19)	686·86 (674·78–700·15)	5·05 (4·75–5·40)	2022·54 (1958·02–2083·52)	15·01 (13·87–16·14)	1902·19 (1803·78–1996·75)	14·46 (13·12–15·89)	6875·83 (6777·71–6980·62)	49·97 (47·34–52·70)
2011	2350·47 (2025·78–2732·56)	16·64 (14·38–19·29)	2214·81 (2165·09–2262·24)	15·93 (15·06–16·77)	665·33 (652·82–679·02)	4·87 (4·53–5·25)	1944·92 (1883·12–2005·91)	14·35 (13·22–15·52)	1806·20 (1712·64–1898·00)	13·62 (12·27–15·10)	6631·25 (6530·28–6737·69)	47·91 (45·12–50·92)
2012	2282·19 (1973·84–2669·70)	16·09 (13·95–18·77)	2168·30 (2118·47–2215·24)	15·52 (14·57–16·41)	645·09 (631·47–659·03)	4·69 (4·34–5·10)	1871·79 (1810·03–1932·00)	13·73 (12·57–14·95)	1728·34 (1634·29–1820·64)	12·94 (11·58–14·44)	6413·53 (6297·89–6,522·55)	46·11 (43·17–49·32)
2013	2225·15 (1916·54–2604·35)	15·64 (13·50–18·26)	2124·20 (2074·05–2173·09)	15·15 (14·16–16·10)	625·70 (611·59–640·35)	4·53 (4·16–4·96)	1807·71 (1748·13–1866·80)	13·20 (12·01–14·49)	1656·45 (1563·93–1752·38)	12·32 (10·93–13·86)	6,214·06 (6090·86–6332·79)	44·47 (41·29–48·02)
2014	2175·23 (1868·96–2564·58)	15·25 (13·14–17·94)	2080·13 (2031·06–2129·80)	14·79 (13·78–15·86)	606·19 (590·75–621·97)	4·38 (3·99–4·83)	1744·31 (1684·25–1804·67)	12·68 (11·46–14·13)	1588·47 (1494·61–1685·85)	11·75 (10·33–13·31)	6019·08 (5878·69–6153·38)	42·93 (39·54–46·89)
2015	2124·96 (1827·78–2521·12)	14·89 (12·83–17·62)	2034·23 (1982·93–2082·87)	14·45 (13·39–15·56)	587·23 (570·64–604·00)	4·23 (3·84–4·71)	1677·99 (1617·86–1741·50)	12·16 (10·93–13·63)	1521·40 (1425·62–1620·55)	11·20 (9·80–12·81)	5820·85 (5673·34–5965·06)	41·41 (37·93–45·45)

95% UIs are provided in parentheses. UI=uncertainty intervals.

Table 1: **Global deaths (thousands) and mortality rates (per 1000 livebirths) for stillbirths, early neonatal, late neonatal, post-neonatal, child, and under-5 age groups, both sexes combined, 1980–2015**

Our analyses presented here and elsewhere for GBD 2015 follow the recently proposed Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER),[42] which include the documentation of data sources and inputs, processing and estimation steps, and overarching methods used throughout the GBD study.

Geographical units of analysis

For GBD 2015, we analysed 195 countries and territories in the 21 GBD regions. Since GBD 2013, we added seven territories and expanded subnational analyses from three countries (China, Mexico, and the UK)[43–45] to include eight additional countries: Brazil, India, Japan, Kenya, Saudi Arabia, South Africa, Sweden, and the USA. Here, we present results at the global, regional, national, territory, and, for a subset of countries, subnational levels from 1980–2015. Countries for which subnational estimates are shown include Brazil (26 states and one district), China (33 provinces and municipalities), India (62 urban and rural administrative units), Japan (47 prefectures), Kenya (47 counties), Mexico (32 states), Saudi Arabia (13 regions), South Africa (nine provinces), Sweden (two regions), the UK (four nations and nine subregions for England), and the USA (50 states and the District of Columbia).

Data

Data sources and types used for estimating child mortality are described extensively elsewhere,[14] but in sum, vital registration (VR) systems, censuses, and household surveys with complete or summary birth histories served as primary inputs for our analyses. Other sources, including sample registration systems and disease surveillance systems, also contributed as input data. In total we applied formal demographic techniques to 8169 input data sources of under-5 mortality from 1950–2015. Overall data availability and availability by source data type varied by geography.

Stillbirth data were extracted from major survey series, including Demographic and Health Surveys, the Centers for Disease Control & Prevention (CDC) Reproductive Health Surveys, UNICEF Multiple Indicator Cluster Surveys, and the WHO Multi-Country Surveys. We also used VR systems, birth registries, and literature sources. Following definitions for stillbirths used by previous studies,[39,40] we classified fetal deaths at 28 weeks or later and intrapartum deaths (ie, deaths that occurred after the onset of labour but prior to birth) as stillbirths. We collated 7579 geography-year datapoints from 1980–2015 on stillbirths, representing 350 countries, territories, and subnational locations in our analysis. The appendix provides additional detail on stillbirth data sources and processing steps (appendix pp 19–22).

See Online for appendix

All-cause under-5 mortality and age-specific mortality

The appendix presents the analytical steps involved in estimating all-cause under-5 mortality and death rates by age group: early neonatal (0–6 days), late neonatal (7–28 days), post-neonatal (29–364 days), and ages 1–4 years (appendix p 31). Details on data bias adjustments for under-5 mortality, using spatiotemporal Gaussian Process regression to generate a complete time series of under-5 mortality for all geographies and the age–sex model to produce estimates of mortality for early neonatal, late neonatal, post-neonatal, and ages 1–4 years have been extensively discussed previously[46] and in the appendix.

For subnational analyses, we rescaled estimates from lower administrative units to the national level because data densities were generally much higher at the national level than at the subnational. South Africa was the exception to this approach, where national-level estimates were generated by aggregating subnational estimates up to the national level.

To estimate mortality by age group and sex within the under-5 categorisation, we used a two-stage modelling process that has been described in detail elsewhere.[3,14] For this analysis, we report on early neonatal and late neonatal mortality results in aggregate as neonatal mortality; the appendix provides estimates of early and late neonatal mortality (appendix pp 35, 36).

Stillbirth analysis

In GBD 2015, for the first time, we generated estimates of stillbirths and stillbirth rates by location from 1980–2015. Drawing from data compiled by Blencowe and colleagues,[39] we expanded to include additional data from published literature, VR, and surveys. We estimated stillbirth trends by modifying the data synthesis model used for under-5 mortality. We applied a mixed-effects generalised linear model to quantify the ratio of stillbirth rates to neonatal mortality in natural logarithmic space. Our model covariates included educational attainment among women of reproductive age, skilled birth attendance, a random effect on neonatal mortality classified into 20 bins, random intercepts for each location, and data source-specific random effects nested within each location. Neonatal mortality was chosen for its strong coefficient of correlation with stillbirth rates (0·8). Source-specific fixed effects were included to adjust for biases inherent to a subset of data sources; the appendix provides the complete list of data source types (appendix p 21). Finally, we included a variable that accounted for different stillbirth definitions, encompassing the seven definitions found within our database. These definitions included fetal death after 28 weeks of gestation, 26 weeks of gestation, 24 weeks of gestation, 22 weeks of gestation, 20 weeks of gestation, weighing at least 1000 g, and weighing at least 500 g. There were also 1744 location-years where no definition was provided, which we included as an eighth undefined definition category. Stillbirth rates from surveys and complete vital registration systems where the definition of stillbirth

	Deaths per 1000 livebirths					Total stillbirths (thousands)	Total under-5 deaths (thousands)	Annualised rate of change for under-5 mortality		
	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
Global	14·89 (12·83 to 17·62)	18·62 (17·26 to 20·14)	12·16 (10·93 to 13·63)	11·20 (9·80 to 12·81)	41·41 (37·93 to 45·45)	2124·96 (1827·78 to 2521·12)	5820·85 (5673·34 to 5965·06)	–2·02 (–2·39 to –1·70)	–3·61 (–4·17 to –2·98)	–2·97 (–3·32 to –2·59)
High SDI	3·00 (2·71 to 3·36)	2·78 (2·61 to 2·98)	1·59 (1·50 to 1·69)	0·95 (0·86 to 1·06)	5·31 (5·04 to 5·63)	42·18 (38·15 to 47·25)	74·54 (72·97 to 76·25)	–3·90 (–4·12 to –3·69)	–3·26 (–3·61 to –2·88)	–3·52 (–3·74 to –3·28)
High-middle SDI	6·73 (5·90 to 7·70)	8·52 (7·52 to 9·63)	4·39 (3·86 to 5·00)	2·81 (2·48 to 3·18)	15·64 (13·92 to 17·66)	165·69 (145·07 to 189·86)	372·15 (355·30 to 388·69)	–3·65 (–4·42 to –2·91)	–4·61 (–5·41 to –3·73)	–4·22 (–4·75 to –3·69)
Middle SDI	10·15 (8·84 to 11·64)	12·90 (11·55 to 14·30)	6·26 (5·46 to 7·17)	4·40 (3·83 to 5·05)	23·40 (20·89 to 26·09)	372·28 (323·69 to 427·48)	868·83 (828·55 to 909·42)	–3·54 (–4·47 to –2·60)	–4·97 (–5·79 to –4·14)	–4·40 (–4·94 to –3·86)*
Low-middle SDI	24·01 (20·78 to 28·01)	29·14 (27·14 to 31·34)	17·59 (15·81 to 19·52)	16·63 (14·34 to 19·23)	62·07 (57·46 to 67·10)	1115·34 (962·28 to 1306·27)	2814·33 (2706·19 to 2924·44)	–2·56 (–2·87 to –2·27)	–3·63 (–4·17 to –3·08)	–3·20 (–3·53 to –2·86)
Low SDI	20·56 (15·95 to 27·02)	27·65 (25·65 to 29·87)	28·19 (25·05 to 31·74)	30·64 (26·17 to 35·37)	84·02 (75·99 to 93·24)	428·45 (330·77 to 566·64)	1688·71 (1615·60 to 1769·42)	–2·16 (–2·37 to –1·97)	–3·89 (–4·50 to –3·23)	–3·20 (–3·61 to –2·78)
High income	2·94 (2·71 to 3·22)	2·69 (2·50 to 2·91)	1·54 (1·44 to 1·65)	0·84 (0·73 to 0·96)	5·06 (4·75 to 5·40)	34·73 (31·99 to 37·99)	59·66 (58·68 to 60·76)	–3·91 (–4·11 to –3·75)	–2·68 (–3·11 to –2·25)	–3·17 (–3·43 to –2·91)
High-income North America	2·81 (2·71 to 2·92)	3·27 (3·08 to 3·45)	1·69 (1·55 to 1·82)	0·97 (0·75 to 1·21)	5·92 (5·71 to 6·14)	12·45 (12·00 to 12·93)	26·10 (25·83 to 26·36)	–3·24 (–3·35 to –3·13)	–2·03 (–2·27 to –1·77)	–2·51 (–2·65 to –2·36)
Canada	2·57 (2·15 to 3·12)	2·77 (2·54 to 3·02)	1·45 (1·31 to 1·58)	0·82 (0·62 to 1·06)	5·03 (4·72 to 5·38)	1·00 (0·84 to 1·21)	1·94 (1·82 to 2·08)	–3·15 (–3·47 to –2·84)	–1·34 (–1·78 to –0·88)	–2·06 (–2·32 to –1·79)
Greenland	5·87 (4·14 to 8·11)	8·62 (7·50 to 9·86)	4·43 (3·93 to 4·96)	1·97 (1·42 to 2·60)	14·95 (13·40 to 16·71)	<0·01 (<0·01 to 0·01)	0·01 (0·01 to 0·01)	–5·51 (–6·33 to –4·66)	–2·22 (–2·96 to –1·45)	–3·54 (–4·03 to –3·03)
USA	2·84 (2·73 to 2·95)	3·32 (3·14 to 3·50)	1·71 (1·57 to 1·85)	0·98 (0·74 to 1·25)	6·00 (5·80 to 6·21)	11·45 (11·02 to 11·91)	24·13 (23·90 to 24·36)	–3·27 (–3·38 to –3·16)	–2·06 (–2·29 to –1·82)	–2·54 (–2·68 to –2·40)
Australasia	3·65 (2·96 to 4·59)	2·09 (1·92 to 2·25)	1·32 (1·19 to 1·43)	0·76 (0·58 to 0·97)	4·16 (3·93 to 4·41)	1·38 (1·12 to 1·74)	1·56 (1·49 to 1·64)	–4·21 (–4·51 to –3·89)	–2·96 (–3·36 to –2·53)	–3·46 (–3·71 to –3·21)
Australia	3·71 (2·98 to 4·71)	2·04 (1·88 to 2·20)	1·19 (1·06 to 1·31)	0·72 (0·52 to 0·97)	3·94 (3·73 to 4·17)	1·18 (0·95 to 1·50)	1·25 (1·18 to 1·32)	–4·28 (–4·66 to –3·88)	–3·08 (–3·49 to –2·66)	–3·56 (–3·81 to –3·31)
New Zealand	3·34 (2·85 to 3·97)	2·32 (2·11 to 2·53)	1·99 (1·74 to 2·22)	0·97 (0·71 to 1·32)	5·27 (4·95 to 5·63)	0·20 (0·17 to 0·24)	0·32 (0·30 to 0·34)	–3·97 (–4·42 to –3·51)	–2·30 (–2·75 to –1·81)	–2·96 (–3·25 to –2·67)
High-income Asia Pacific	1·81 (1·64 to 2·01)	1·19 (1·07 to 1·32)	0·97 (0·87 to 1·08)	0·73 (0·60 to 0·88)	2·89 (2·68 to 3·15)	2·78 (2·51 to 3·09)	4·46 (4·19 to 4·73)	–4·14 (–5·62 to –2·89)	–4·18 (–4·71 to –3·58)	–4·16 (–4·81 to –3·48)
Brunei	4·06 (3·16 to 5·14)	3·86 (3·32 to 4·43)	2·50 (2·00 to 3·05)	2·57 (1·93 to 3·29)	8·90 (7·81 to 10·17)	0·03 (0·02 to 0·03)	0·06 (0·05 to 0·07)	–1·38 (–2·28 to –0·58)	0·03 (–0·91 to 1·06)	–0·53 (–1·15 to 0·10)
Japan	1·78 (1·58 to 2·02)	1·11 (0·99 to 1·24)	0·92 (0·80 to 1·06)	0·70 (0·53 to 0·88)	2·73 (2·50 to 2·98)	1·84 (1·64 to 2·09)	2·84 (2·76 to 2·91)	–2·88 (–3·14 to –2·59)	–3·48 (–4·06 to –2·90)	–3·24 (–3·58 to –2·88)
Singapore	2·20 (1·75 to 2·81)	1·05 (0·94 to 1·17)	0·67 (0·58 to 0·77)	0·45 (0·33 to 0·59)	2·17 (1·95 to 2·42)	0·08 (0·07 to 0·11)	0·08 (0·07 to 0·09)	–7·34 (–8·11 to –6·56)	–3·53 (–4·34 to –2·73)	–5·05 (–5·54 to –4·59)*
South Korea	1·82 (1·51 to 2·18)	1·34 (1·09 to 1·65)	1·09 (0·89 to 1·30)	0·80 (0·59 to 1·06)	3·22 (2·69 to 3·82)	0·83 (0·69 to 1·00)	1·47 (1·23 to 1·74)	–5·34 (–8·21 to –2·61)	–5·30 (–6·47 to –4·15)	–5·32 (–6·57 to –3·98)*

(Table 2 continues on next page)

	Deaths per 1000 livebirths					Total stillbirths (thousands)	Total under-5 deaths (thousands)	Annualised rate of change for under-5 mortality		
	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
(Continued from previous page)										
Western Europe	2·65 (2·39 to 2·95)	1·88 (1·64 to 2·17)	1·12 (1·00 to 1·24)	0·58 (0·49 to 0·68)	3·58 (3·18 to 4·05)	11·72 (10·53 to 13·05)	15·82 (15·01 to 16·71)	−4·92 (−5·08 to −4·77)	−3·16 (−3·95 to −2·36)	−3·87 (−4·34 to −3·37)
Andorra	1·38 (1·12 to 1·75)	0·98 (0·81 to 1·23)	0·64 (0·50 to 0·82)	0·29 (0·19 to 0·43)	1·91 (1·55 to 2·39)	<0·01 (<0·01 to <0·01)	<0·01 (<0·01 to <0·01)	−7·37 (−8·97 to −5·75)	−2·83 (−4·10 to −1·49)	−4·65 (−5·53 to −3·64)*
Austria	2·23 (1·91 to 2·66)	1·85 (1·60 to 2·16)	1·10 (0·97 to 1·25)	0·57 (0·43 to 0·77)	3·53 (3·12 to 3·99)	0·18 (0·16 to 0·22)	0·29 (0·25 to 0·33)	−5·34 (−6·09 to −4·67)	−3·16 (−4·10 to −2·22)	−4·03 (−4·57 to −3·52)
Belgium	2·43 (1·95 to 3·09)	1·93 (1·70 to 2·19)	1·27 (1·13 to 1·42)	0·61 (0·46 to 0·79)	3·81 (3·45 to 4·22)	0·32 (0·25 to 0·40)	0·50 (0·45 to 0·55)	−5·05 (−5·45 to −4·68)	−3·08 (−3·78 to −2·39)	−3·87 (−4·28 to −3·46)
Cyprus	2·92 (2·38 to 3·65)	2·80 (2·37 to 3·32)	1·44 (1·26 to 1·69)	0·54 (0·38 to 0·72)	4·78 (4·16 to 5·58)	0·02 (0·02 to 0·02)	0·03 (0·03 to 0·04)	−5·88 (−6·60 to −5·17)	−2·86 (−3·79 to −1·80)	−4·07 (−4·67 to −3·46)
Denmark	1·35 (1·12 to 1·62)	1·97 (1·63 to 2·39)	0·99 (0·85 to 1·14)	0·58 (0·42 to 0·79)	3·55 (3·02 to 4·18)	0·08 (0·07 to 0·10)	0·21 (0·18 to 0·25)	−5·04 (−5·81 to −4·30)	−2·97 (−4·09 to −1·85)	−3·80 (−4·47 to −3·13)
Finland	1·52 (1·27 to 1·86)	1·32 (1·05 to 1·69)	0·66 (0·53 to 0·83)	0·41 (0·28 to 0·59)	2·40 (1·89 to 3·03)	0·09 (0·07 to 0·11)	0·14 (0·11 to 0·18)	−5·10 (−6·13 to −4·05)	−3·71 (−5·42 to −2·04)	−4·27 (−5·24 to −3·31)
France	3·30 (2·67 to 4·07)	1·53 (1·16 to 2·02)	1·18 (0·94 to 1·44)	0·58 (0·41 to 0·82)	3·28 (2·59 to 4·15)	2·59 (2·10 to 3·20)	2·58 (2·04 to 3·25)	−4·85 (−5·25 to −4·51)	−3·40 (−4·99 to −1·86)	−3·98 (−4·93 to −3·05)
Germany	2·10 (1·79 to 2·50)	1·77 (1·46 to 2·20)	1·19 (1·02 to 1·38)	0·58 (0·42 to 0·78)	3·53 (3·01 to 4·22)	1·44 (1·23 to 1·72)	2·41 (2·05 to 2·88)	−5·53 (−5·87 to −5·17)	−2·71 (−3·82 to −1·52)	−3·84 (−4·49 to −3·15)
Greece	2·49 (2·09 to 2·97)	1·92 (1·74 to 2·13)	0·91 (0·81 to 1·01)	0·47 (0·34 to 0·63)	3·30 (3·03 to 3·61)	0·23 (0·19 to 0·27)	0·31 (0·28 to 0·34)	−5·25 (−5·75 to −4·78)	−4·21 (−4·81 to −3·58)	−4·62 (−4·99 to −4·26)*
Iceland	1·23 (1·01 to 1·53)	0·95 (0·81 to 1·13)	0·68 (0·56 to 0·80)	0·39 (0·27 to 0·54)	2·03 (1·72 to 2·38)	0·01 (<0·01 to 0·01)	0·01 (0·01 to 0·01)	−5·03 (−6·17 to −3·76)	−4·49 (−5·64 to −3·24)	−4·71 (−5·39 to −4·01)*
Ireland	2·87 (2·23 to 3·77)	1·83 (1·59 to 2·09)	1·13 (0·99 to 1·26)	0·56 (0·41 to 0·74)	3·51 (3·15 to 3·92)	0·20 (0·15 to 0·26)	0·24 (0·22 to 0·27)	−3·23 (−3·92 to −2·50)	−4·50 (−5·28 to −3·69)	−3·99 (−4·49 to −3·53)
Israel	2·55 (2·06 to 3·15)	1·85 (1·63 to 2·09)	1·24 (1·09 to 1·38)	0·75 (0·56 to 0·96)	3·84 (3·50 to 4·22)	0·43 (0·34 to 0·53)	0·64 (0·58 to 0·70)	−5·08 (−5·64 to −4·52)	−4·32 (−4·96 to −3·66)	−4·62 (−5·04 to −4·23)*
Italy	1·75 (1·44 to 2·16)	1·91 (1·54 to 2·39)	0·77 (0·64 to 0·92)	0·45 (0·31 to 0·60)	3·13 (2·55 to 3·83)	0·88 (0·72 to 1·08)	1·58 (1·29 to 1·93)	−5·52 (−5·94 to −5·13)	−3·74 (−5·09 to −2·40)	−4·45 (−5·25 to −3·64)*
Luxembourg	3·12 (2·59 to 3·84)	1·13 (0·97 to 1·33)	1·03 (0·88 to 1·21)	0·42 (0·30 to 0·57)	2·58 (2·23 to 2·99)	0·02 (0·02 to 0·02)	0·02 (0·01 to 0·02)	−6·57 (−7·64 to −5·36)	−4·04 (−5·03 to −2·98)	−5·05 (−5·71 to −4·41)*
Malta	3·05 (2·46 to 3·73)	4·16 (3·56 to 4·84)	1·46 (1·27 to 1·65)	0·65 (0·46 to 0·87)	6·25 (5·47 to 7·16)	0·01 (0·01 to 0·01)	0·02 (0·02 to 0·03)	−3·04 (−4·09 to −1·92)	−0·87 (−1·92 to 0·19)	−1·74 (−2·31 to −1·12)
Netherlands	2·24 (1·81 to 2·75)	2·18 (1·88 to 2·53)	1·00 (0·87 to 1·12)	0·73 (0·55 to 0·97)	3·91 (3·48 to 4·41)	0·40 (0·32 to 0·49)	0·69 (0·62 to 0·78)	−2·99 (−3·47 to −2·48)	−3·36 (−4·19 to −2·54)	−3·21 (−3·70 to −2·72)
Norway	2·09 (1·58 to 2·76)	1·34 (1·17 to 1·53)	0·86 (0·74 to 0·98)	0·51 (0·38 to 0·67)	2·71 (2·40 to 3·06)	0·13 (0·10 to 0·17)	0·17 (0·15 to 0·19)	−5·94 (−6·69 to −5·14)	−4·01 (−4·90 to −3·14)	−4·78 (−5·30 to −4·25)*

(Table 2 continues on next page)

	Deaths per 1000 livebirths					Total stillbirths (thousands)	Total under-5 deaths (thousands)	Annualised rate of change for under-5 mortality		
	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
(Continued from previous page)										
Portugal	2·09 (1·96 to 2·24)	1·39 (1·28 to 1·52)	0·97 (0·86 to 1·09)	0·60 (0·45 to 0·77)	2·97 (2·78 to 3·17)	0·17 (0·16 to 0·19)	0·25 (0·24 to 0·27)	−6·84 (−7·12 to −6·56)	−5·88 (−6·33 to −5·42)	−6·27 (−6·54 to −6·00)*
Spain	1·81 (1·50 to 2·21)	1·56 (1·35 to 1·80)	0·94 (0·82 to 1·07)	0·50 (0·37 to 0·66)	3·00 (2·65 to 3·40)	0·75 (0·62 to 0·91)	1·26 (1·11 to 1·42)	−5·46 (−5·89 to −5·01)	−3·99 (−4·86 to −3·14)	−4·58 (−5·07 to −4·06)*
Sweden	2·32 (1·75 to 3·06)	1·41 (1·23 to 1·65)	0·76 (0·66 to 0·88)	0·42 (0·30 to 0·57)	2·60 (2·26 to 2·99)	0·28 (0·21 to 0·36)	0·31 (0·28 to 0·34)	−6·15 (−6·97 to −5·37)	−2·65 (−3·66 to −1·60)	−4·05 (−4·64 to −3·47)
Switzerland	1·89 (1·64 to 2·18)	2·25 (1·86 to 2·74)	1·09 (0·96 to 1·25)	0·71 (0·51 to 0·92)	4·05 (3·45 to 4·75)	0·16 (0·14 to 0·19)	0·35 (0·29 to 0·41)	−3·96 (−4·61 to −3·29)	−2·47 (−3·56 to −1·38)	−3·07 (−3·72 to −2·42)
UK	4·08 (3·51 to 4·73)	2·56 (2·31 to 2·83)	1·46 (1·33 to 1·61)	0·68 (0·50 to 0·88)	4·69 (4·34 to 5·10)	3·33 (2·86 to 3·86)	3·81 (3·70 to 3·93)	−3·85 (−4·18 to −3·51)	−2·15 (−2·68 to −1·59)	−2·83 (−3·17 to −2·49)
England	4·09 (3·49 to 4·76)	2·57 (2·34 to 2·84)	1·46 (1·36 to 1·57)	0·69 (0·60 to 0·78)	4·71 (4·34 to 5·13)	2·87 (2·45 to 3·34)	3·28 (3·18 to 3·39)	−3·87 (−4·19 to −3·54)	−2·14 (−2·68 to −1·53)	−2·83 (−3·16 to −2·48)
Northern Ireland	4·10 (3·43 to 4·94)	3·21 (2·38 to 4·18)	1·37 (1·10 to 1·67)	0·76 (0·55 to 1·03)	5·33 (4·15 to 6·72)	0·10 (0·09 to 0·12)	0·13 (0·10 to 0·17)	−3·64 (−5·05 to −2·33)	−1·23 (−3·05 to 0·51)	−2·20 (−3·26 to −1·20)
Scotland	4·09 (3·51 to 4·68)	2·35 (1·86 to 2·88)	1·39 (1·17 to 1·62)	0·67 (0·47 to 0·91)	4·40 (3·67 to 5·21)	0·23 (0·19 to 0·26)	0·24 (0·21 to 0·29)	−3·83 (−4·60 to −3·00)	−2·64 (−3·94 to −1·38)	−3·11 (−3·86 to −2·40)
Wales	4·03 (3·46 to 4·72)	2·31 (2·07 to 2·60)	1·38 (1·24 to 1·53)	0·69 (0·51 to 0·91)	4·38 (4·02 to 4·80)	0·14 (0·12 to 0·16)	0·15 (0·14 to 0·16)	−3·75 (−4·64 to −2·80)	−2·21 (−2·97 to −1·43)	−2·82 (−3·25 to −2·43)
Southern Latin America	6·12 (5·10 to 7·48)	6·06 (5·69 to 6·47)	3·65 (3·33 to 3·97)	1·63 (1·23 to 2·10)	11·31 (10·75 to 11·93)	6·38 (5·31 to 7·81)	11·72 (11·31 to 12·15)	−3·83 (−3·91 to −3·74)	−2·85 (−3·20 to −2·49)	−3·24 (−3·44 to −3·03)
Argentina	5·38 (4·37 to 6·56)	6·80 (6·40 to 7·20)	3·97 (3·60 to 4·36)	1·85 (1·31 to 2·47)	12·57 (12·08 to 13·10)	4·07 (3·31 to 4·98)	9·47 (9·10 to 9·87)	−3·56 (−3·66 to −3·44)	−3·03 (−3·31 to −2·76)	−3·24 (−3·40 to −3·08)
Chile	8·81 (6·00 to 13·14)	3·94 (3·67 to 4·21)	2·63 (2·33 to 2·91)	1·06 (0·75 to 1·44)	7·61 (7·17 to 8·08)	2·08 (1·41 to 3·12)	1·78 (1·68 to 1·90)	−5·64 (−5·85 to −5·44)	−2·29 (−2·69 to −1·88)	−3·63 (−3·88 to −3·39)
Uruguay	4·64 (3·79 to 5·63)	4·89 (3·79 to 6·35)	3·59 (2·63 to 4·69)	1·13 (0·74 to 1·65)	9·58 (7·35 to 12·43)	0·23 (0·18 to 0·28)	0·47 (0·36 to 0·61)	−3·68 (−4·28 to −3·05)	−3·39 (−5·19 to −1·63)	−3·50 (−4·55 to −2·49)
Central Europe, eastern Europe, and central Asia	4·91 (4·03 to 6·13)	7·19 (6·27 to 8·16)	4·13 (3·51 to 4·90)	2·65 (2·24 to 3·14)	13·91 (12·15 to 15·95)	27·60 (22·63 to 34·49)	77·90 (72·86 to 83·58)	−1·48 (−1·96 to −0·96)	−4·65 (−5·56 to −3·72)	−3·38 (−3·94 to −2·84)
Eastern Europe	3·98 (3·13 to 5·17)	4·41 (4·02 to 4·96)	2·56 (2·25 to 2·90)	1·76 (1·39 to 2·18)	8·70 (8·00 to 9·60)	10·09 (7·94 to 13·12)	21·95 (20·24 to 24·16)	−0·62 (−1·28 to 0·09)	−5·51 (−6·13 to −4·81)	−3·56 (−3·92 to −3·15)
Belarus	2·12 (1·78 to 2·57)	2·91 (2·11 to 4·00)	1·72 (1·32 to 2·28)	1·08 (0·72 to 1·54)	5·70 (4·34 to 7·65)	0·24 (0·20 to 0·29)	0·64 (0·48 to 0·85)	−2·91 (−4·74 to −1·10)	−6·65 (−8·52 to −4·59)	−5·15 (−6·41 to −3·90)*
Estonia	1·97 (1·91 to 2·03)	1·46 (1·07 to 2·01)	1·10 (0·86 to 1·40)	0·74 (0·51 to 1·02)	3·30 (2·53 to 4·26)	0·03 (0·03 to 0·03)	0·05 (0·04 to 0·06)	−4·02 (−5·11 to −2·90)	−8·42 (−10·34 to −6·58)	−6·66 (−7·74 to −5·63)*
Latvia	3·20 (2·87 to 3·62)	2·57 (1·64 to 3·80)	1·50 (1·09 to 2·08)	1·14 (0·76 to 1·65)	5·20 (3·60 to 7·29)	0·06 (0·06 to 0·07)	0·10 (0·07 to 0·15)	−3·04 (−4·05 to −1·99)	−6·24 (−8·75 to −3·90)	−4·96 (−6·47 to −3·52)*

(Table 2 continues on next page)

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	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
(Continued from previous page)										
Lithuania	2·59 (2·24 to 3·04)	1·80 (1·44 to 2·26)	1·40 (1·17 to 1·66)	0·87 (0·64 to 1·17)	4·07 (3·44 to 4·89)	0·08 (0·07 to 0·09)	0·12 (0·10 to 0·15)	−2·33 (−3·01 to −1·64)	−6·71 (−7·90 to −5·45)	−4·95 (−5·66 to −4·21)*
Moldova	4·15 (3·56 to 4·90)	5·43 (3·66 to 8·21)	3·24 (2·08 to 4·57)	2·05 (1·25 to 3·26)	10·68 (7·16 to 15·38)	0·18 (0·15 to 0·21)	0·46 (0·31 to 0·67)	0·54 (−1·72 to 3·11)	−7·27 (−10·14 to −4·55)	−4·15 (−5·85 to −2·49)
Russia	4·09 (3·00 to 5·68)	4·43 (4·18 to 4·64)	2·56 (2·24 to 2·85)	1·78 (1·33 to 2·32)	8·75 (8·57 to 8·94)	7·48 (5·48 to 10·42)	15·92 (15·59 to 16·26)	−0·67 (−0·82 to −0·51)	−5·40 (−5·58 to −5·23)	−3·51 (−3·59 to −3·42)
Ukraine	4·16 (3·34 to 5·17)	4·89 (3·06 to 7·60)	2·83 (1·76 to 4·18)	1·91 (1·16 to 2·96)	9·60 (6·09 to 14·43)	2·02 (1·63 to 2·52)	4·66 (3·01 to 6·94)	−0·01 (−2·76 to 2·84)	−5·37 (−8·50 to −2·41)	−3·22 (−5·14 to −1·50)
Central Europe	3·05 (2·71 to 3·49)	3·03 (2·35 to 3·92)	1·94 (1·55 to 2·44)	0·92 (0·71 to 1·17)	5·88 (4·64 to 7·46)	3·50 (3·12 to 4·01)	6·78 (6·05 to 7·63)	−4·79 (−5·08 to −4·47)	−5·49 (−7·10 to −3·86)	−5·21 (−6·15 to −4·25)*
Albania	2·93 (2·41 to 3·56)	3·31 (2·28 to 5·02)	5·38 (3·60 to 7·48)	3·51 (2·34 to 5·13)	12·15 (8·48 to 17·15)	0·12 (0·10 to 0·14)	0·47 (0·33 to 0·66)	−4·35 (−6·10 to −2·40)	−5·26 (−7·85 to −2·74)	−4·89 (−6·42 to −3·48)*
Bosnia and Herzegovina	3·55 (3·03 to 4·24)	2·89 (2·42 to 3·42)	1·80 (1·52 to 2·10)	0·71 (0·52 to 0·96)	5·39 (4·64 to 6·24)	0·12 (0·10 to 0·14)	0·18 (0·16 to 0·21)	−5·21 (−5·86 to −4·56)	−4·67 (−5·76 to −3·60)	−4·89 (−5·51 to −4·28)*
Bulgaria	4·32 (3·65 to 5·09)	4·21 (2·95 to 5·78)	3·06 (2·09 to 4·36)	1·48 (0·99 to 2·16)	8·72 (6·22 to 12·09)	0·29 (0·25 to 0·35)	0·59 (0·42 to 0·82)	−0·29 (−0·92 to 0·35)	−4·71 (−7·07 to −2·60)	−2·94 (−4·32 to −1·64)
Croatia	1·68 (1·38 to 2·08)	2·70 (2·31 to 3·14)	1·07 (0·94 to 1·21)	0·64 (0·46 to 0·86)	4·40 (3·87 to 5·00)	0·07 (0·06 to 0·08)	0·18 (0·16 to 0·20)	−3·36 (−4·01 to −2·66)	−4·48 (−5·42 to −3·56)	−4·03 (−4·55 to −3·50)
Czech Republic	2·20 (2·18 to 2·21)	1·23 (1·04 to 1·45)	0·86 (0·72 to 1·01)	0·40 (0·29 to 0·54)	2·49 (2·12 to 2·93)	0·24 (0·23 to 0·24)	0·27 (0·23 to 0·31)	−8·04 (−8·77 to −7·27)	−5·10 (−6·30 to −3·92)	−6·27 (−6·93 to −5·60)*
Hungary	2·90 (2·30 to 3·61)	3·05 (2·05 to 4·39)	1·29 (1·00 to 1·70)	0·61 (0·38 to 0·88)	4·94 (3·51 to 6·87)	0·27 (0·21 to 0·33)	0·46 (0·32 to 0·63)	−4·87 (−5·50 to −4·24)	−4·97 (−7·28 to −2·70)	−4·93 (−6·31 to −3·63)*
Macedonia	7·88 (6·70 to 9·22)	5·82 (3·86 to 8·74)	2·69 (1·74 to 3·83)	1·09 (0·68 to 1·64)	9·57 (6·38 to 13·95)	0·19 (0·16 to 0·22)	0·22 (0·15 to 0·33)	−8·13 (−8·97 to −7·31)	−3·17 (−5·87 to −0·67)	−5·15 (−6·81 to −3·61)*
Montenegro	3·54 (2·84 to 4·50)	2·91 (1·99 to 4·10)	1·76 (1·35 to 2·27)	0·53 (0·34 to 0·77)	5·18 (3·78 to 7·01)	0·03 (0·02 to 0·03)	0·04 (0·03 to 0·05)	0·49 (−2·62 to 3·89)	−9·02 (−11·20 to −6·90)	−5·22 (−6·96 to −3·34)*
Poland	2·35 (2·02 to 2·78)	2·69 (1·80 to 3·91)	1·23 (0·95 to 1·61)	0·59 (0·38 to 0·85)	4·50 (3·18 to 6·29)	0·91 (0·78 to 1·08)	1·75 (1·24 to 2·45)	−6·40 (−6·73 to −6·06)	−4·89 (−7·21 to −2·67)	−5·49 (−6·86 to −4·17)*
Romania	3·46 (2·81 to 4·34)	3·62 (2·71 to 4·65)	3·27 (2·40 to 4·53)	1·47 (0·99 to 2·07)	8·34 (6·31 to 10·95)	0·62 (0·50 to 0·78)	1·51 (1·15 to 1·99)	−3·58 (−3·90 to −3·26)	−6·79 (−8·61 to −5·01)	−5·50 (−6·62 to −4·43)*
Serbia	4·88 (4·02 to 6·01)	4·30 (3·87 to 4·77)	2·43 (2·09 to 2·80)	1·01 (0·73 to 1·38)	7·72 (6·98 to 8·54)	0·44 (0·36 to 0·55)	0·70 (0·63 to 0·77)	−6·23 (−8·14 to −4·37)	−3·40 (−4·35 to −2·46)	−4·54 (−5·33 to −3·78)*
Slovakia	2·85 (2·79 to 2·91)	3·09 (2·51 to 3·76)	2·02 (1·68 to 2·44)	0·88 (0·64 to 1·18)	5·99 (5·01 to 7·16)	0·16 (0·16 to 0·17)	0·34 (0·29 to 0·41)	−3·80 (−4·57 to −2·96)	−3·21 (−4·41 to −1·96)	−3·45 (−4·19 to −2·69)
Slovenia	2·57 (2·20 to 3·06)	1·40 (1·20 to 1·64)	0·79 (0·67 to 0·92)	0·46 (0·33 to 0·61)	2·64 (2·29 to 3·04)	0·06 (0·05 to 0·07)	0·06 (0·05 to 0·07)	−6·23 (−7·19 to −5·20)	−4·75 (−5·86 to −3·71)	−5·35 (−5·96 to −4·74)*

(Table 2 continues on next page)

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(Continued from previous page)										
Central Asia	7·23 (5·95 to 8·98)	13·31 (11·00 to 15·87)	7·55 (5·89 to 9·63)	4·93 (3·92 to 6·13)	25·59 (21·16 to 31·10)	14·00 (11·50 to 17·42)	49·17 (44·30 to 54·66)	−1·74 (−2·51 to −0·95)	−4·49 (−5·80 to −3·22)	−3·39 (−4·18 to −2·61)
Armenia	6·35 (5·17 to 7·74)	7·82 (5·61 to 10·45)	4·07 (3·15 to 5·19)	3·13 (2·12 to 4·36)	14·95 (11·62 to 18·98)	0·25 (0·20 to 0·31)	0·59 (0·46 to 0·75)	−4·17 (−5·67 to −2·62)	−4·89 (−6·81 to −3·12)	−4·60 (−5·68 to −3·58)*
Azerbaijan	8·06 (6·47 to 10·22)	15·85 (12·79 to 19·17)	9·99 (6·96 to 13·98)	4·14 (2·78 to 6·00)	29·71 (23·10 to 37·70)	1·57 (1·26 to 2·00)	5·79 (4·50 to 7·35)	−2·25 (−3·77 to −0·68)	−5·18 (−6·99 to −3·42)	−4·01 (−5·16 to −3·01)
Georgia	4·99 (3·51 to 6·91)	9·57 (7·31 to 12·16)	4·60 (3·67 to 5·95)	3·31 (2·27 to 4·73)	17·39 (13·91 to 21·52)	0·27 (0·19 to 0·38)	0·95 (0·76 to 1·17)	−1·33 (−2·67 to 0·10)	−4·89 (−6·45 to −3·37)	−3·47 (−4·49 to −2·48)
Kazakhstan	6·38 (4·46 to 9·30)	9·18 (6·60 to 12·08)	4·50 (3·48 to 5·92)	3·74 (2·63 to 5·05)	17·33 (13·42 to 22·06)	2·42 (1·69 to 3·53)	6·54 (5·07 to 8·33)	−0·89 (−2·52 to 0·73)	−4·84 (−6·85 to −2·90)	−3·26 (−4·30 to −2·21)
Kyrgyzstan	8·12 (6·52 to 10·31)	17·00 (15·17 to 18·89)	7·71 (6·27 to 9·39)	4·50 (3·26 to 6·11)	28·96 (25·73 to 32·53)	1·26 (1·01 to 1·60)	4·45 (3·95 to 5·00)	−2·71 (−3·34 to −2·05)	−3·59 (−4·47 to −2·70)	−3·24 (−3·76 to −2·71)
Mongolia	5·74 (4·72 to 6·93)	14·34 (11·73 to 17·33)	8·25 (5·84 to 11·63)	5·75 (4·07 to 8·00)	28·09 (22·56 to 35·61)	0·40 (0·33 to 0·48)	1·94 (1·56 to 2·46)	−4·06 (−5·23 to −2·81)	−5·01 (−6·53 to −3·44)	−4·63 (−5·56 to −3·71)*
Tajikistan	8·37 (6·79 to 10·25)	15·39 (12·88 to 18·09)	11·45 (8·34 to 15·50)	6·34 (4·17 to 8·96)	32·84 (26·33 to 40·53)	2·16 (1·75 to 2·65)	8·34 (6·69 to 10·29)	−2·59 (−3·90 to −1·25)	−5·06 (−6·64 to −3·45)	−4·07 (−5·03 to −3·12)
Turkmenistan	8·88 (7·14 to 11·25)	19·18 (15·15 to 23·62)	13·00 (8·36 to 18·69)	7·94 (4·89 to 12·19)	39·61 (29·39 to 52·32)	1·00 (0·81 to 1·27)	4·43 (3·28 to 5·84)	−1·96 (−4·61 to 0·56)	−4·44 (−6·87 to −2·29)	−3·45 (−4·78 to −2·21)
Uzbekistan	6·94 (5·57 to 8·80)	12·78 (9·94 to 15·86)	6·51 (4·59 to 9·07)	5·10 (3·60 to 7·00)	24·20 (18·78 to 30·77)	4·66 (3·74 to 5·93)	16·15 (12·52 to 20·55)	−1·45 (−3·20 to 0·34)	−3·82 (−5·79 to −1·95)	−2·87 (−3·92 to −1·81)
Latin America and Caribbean	6·87 (5·97 to 8·08)	9·28 (7·29 to 11·60)	5·87 (4·77 to 7·42)	3·27 (2·59 to 4·02)	18·31 (14·72 to 22·83)	67·81 (58·94 to 79·93)	179·94 (172·04 to 188·67)	−4·73 (−5·39 to −4·04)	−3·76 (−5·28 to −2·31)	−4·15 (−5·04 to −3·30)
Central Latin America	5·56 (4·81 to 6·51)	8·26 (6·37 to 10·56)	5·17 (4·24 to 6·60)	3·38 (2·70 to 4·17)	16·72 (13·36 to 20·93)	26·10 (22·56 to 30·60)	78·22 (73·59 to 83·46)	−4·18 (−4·92 to −3·42)	−3·47 (−5·00 to −1·98)	−3·75 (−4·66 to −2·84)
Colombia	9·52 (8·08 to 11·43)	7·11 (4·90 to 9·75)	5·22 (3·97 to 6·96)	3·55 (2·46 to 4·91)	15·81 (11·79 to 21·03)	7·18 (6·08 to 8·63)	11·88 (8·86 to 15·80)	−2·96 (−4·06 to −1·89)	−2·75 (−4·86 to −0·79)	−2·83 (−4·05 to −1·67)
Costa Rica	5·83 (5·03 to 6·77)	5·16 (3·79 to 7·12)	2·95 (2·05 to 3·97)	1·67 (1·09 to 2·40)	9·75 (7·13 to 13·22)	0·41 (0·35 to 0·48)	0·68 (0·50 to 0·93)	−2·58 (−4·51 to −0·51)	−3·15 (−5·55 to −0·70)	−2·92 (−4·28 to −1·63)
El Salvador	2·90 (2·40 to 3·55)	5·14 (3·60 to 7·67)	3·84 (2·54 to 5·24)	2·33 (1·54 to 3·36)	11·27 (7·99 to 15·71)	0·31 (0·25 to 0·38)	1·19 (0·85 to 1·66)	−5·96 (−7·85 to −4·31)	−6·33 (−8·71 to −4·01)	−6·18 (−7·60 to −4·79)*
Guatemala	6·08 (4·52 to 8·04)	8·96 (7·48 to 10·64)	9·62 (7·23 to 12·89)	7·62 (5·57 to 10·06)	25·97 (21·21 to 31·77)	2·68 (1·99 to 3·55)	11·28 (9·22 to 13·79)	−4·55 (−5·24 to −3·81)	−4·54 (−5·88 to −3·30)	−4·55 (−5·39 to −3·73)*
Honduras	8·40 (6·84 to 10·48)	11·56 (9·61 to 13·58)	6·02 (4·73 to 7·66)	4·77 (3·54 to 6·21)	22·20 (18·87 to 26·53)	1·43 (1·16 to 1·79)	3·76 (3·19 to 4·49)	−4·08 (−4·73 to −3·39)	−3·27 (−4·39 to −2·08)	−3·60 (−4·28 to −2·90)
Mexico	4·35 (3·76 to 5·09)	8·32 (5·93 to 11·22)	4·51 (3·49 to 6·00)	2·61 (1·81 to 3·55)	15·37 (11·72 to 20·04)	10·24 (8·86 to 11·99)	36·12 (33·37 to 39·10)	−4·69 (−6·16 to −3·24)	−3·73 (−5·60 to −1·82)	−4·11 (−5·24 to −3·02)

(Table 2 continues on next page)

	Deaths per 1000 livebirths					Total stillbirths (thousands)	Total under-5 deaths (thousands)	Annualised rate of change for under-5 mortality		
	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
(Continued from previous page)										
Nicaragua	5·34 (4·40 to 6·61)	7·71 (5·92 to 9·68)	5·09 (4·22 to 6·17)	2·63 (1·87 to 3·62)	15·36 (12·58 to 18·74)	0·65 (0·54 to 0·81)	1·87 (1·53 to 2·29)	−5·67 (−6·44 to −5·00)	−5·60 (−6·96 to −4·28)	−5·63 (−6·44 to −4·82)*
Panama	5·12 (4·27 to 6·09)	8·15 (5·63 to 11·06)	4·78 (3·49 to 6·67)	4·73 (3·39 to 6·32)	17·55 (13·19 to 23·18)	0·39 (0·32 to 0·46)	1·32 (0·99 to 1·74)	−1·76 (−3·32 to −0·08)	−1·78 (−3·80 to 0·29)	−1·77 (−3·05 to −0·54)
Venezuela	4·68 (3·85 to 5·79)	9·06 (8·25 to 9·88)	4·75 (4·17 to 5·30)	3·15 (2·35 to 4·07)	16·87 (15·77 to 18·09)	2·82 (2·32 to 3·49)	10·12 (9·46 to 10·85)	−2·88 (−3·00 to −2·76)	−1·49 (−1·95 to −1·03)	−2·04 (−2·32 to −1·77)
Andean Latin America	6·64 (5·77 to 7·73)	9·04 (7·85 to 10·31)	5·98 (5·05 to 7·03)	4·28 (3·54 to 5·19)	19·19 (16·94 to 21·57)	8·01 (6·96 to 9·34)	23·00 (20·71 to 25·26)	−6·11 (−6·45 to −5·76)	−5·17 (−5·99 to −4·36)	−5·55 (−6·05 to −5·07)*
Bolivia	10·61 (8·05 to 14·25)	15·36 (12·80 to 17·99)	8·81 (6·46 to 11·68)	5·46 (3·81 to 7·60)	29·37 (24·19 to 35·66)	2·72 (2·06 to 3·66)	7·42 (6·11 to 9·02)	−4·88 (−5·43 to −4·37)	−5·62 (−6·94 to −4·37)	−5·32 (−6·11 to −4·56)*
Ecuador	6·06 (5·36 to 6·83)	6·95 (5·68 to 8·28)	6·44 (5·16 to 7·95)	4·46 (3·30 to 5·84)	17·75 (15·24 to 20·70)	2·02 (1·78 to 2·27)	5·86 (5·03 to 6·84)	−3·62 (−4·41 to −2·90)	−4·25 (−5·24 to −3·26)	−4·00 (−4·68 to −3·35)
Peru	5·30 (4·39 to 6·36)	7·57 (6·09 to 9·24)	4·58 (3·79 to 5·51)	3·71 (2·72 to 4·90)	15·79 (13·50 to 18·77)	3·28 (2·71 to 3·93)	9·72 (8·30 to 11·55)	−7·99 (−8·55 to −7·43)	−5·29 (−6·38 to −4·17)	−6·37 (−7·00 to −5·70)*
Caribbean	16·16 (11·60 to 23·36)	15·21 (12·17 to 18·89)	10·62 (7·35 to 14·83)	6·36 (4·28 to 9·41)	31·87 (23·96 to 42·23)	12·84 (9·17 to 18·69)	24·98 (20·34 to 30·68)	−3·75 (−4·51 to −3·00)	−2·65 (−4·58 to −0·76)	−3·09 (−4·23 to −1·98)
Antigua and Barbuda	8·96 (6·41 to 12·78)	7·34 (4·86 to 11·09)	3·15 (2·15 to 4·32)	2·43 (1·57 to 3·47)	12·87 (8·84 to 18·41)	0·01 (0·01 to 0·02)	0·02 (0·01 to 0·03)	−0·01 (−2·13 to 2·50)	−2·54 (−4·97 to −0·27)	−1·53 (−3·13 to 0·17)
The Bahamas	12·81 (9·72 to 17·15)	11·67 (6·33 to 20·60)	2·58 (1·57 to 4·87)	2·02 (1·08 to 3·32)	16·21 (9·06 to 28·81)	0·08 (0·06 to 0·10)	0·09 (0·05 to 0·17)	−5·73 (−10·16 to −1·30)	−0·83 (−5·30 to 3·18)	−2·79 (−5·41 to −0·15)
Barbados	11·28 (7·45 to 17·35)	11·04 (5·94 to 18·79)	3·66 (2·17 to 6·52)	1·58 (0·91 to 2·46)	16·22 (9·12 to 27·31)	0·04 (0·03 to 0·06)	0·06 (0·03 to 0·09)	−2·30 (−6·85 to 2·54)	−1·71 (−6·40 to 2·77)	−1·95 (−4·63 to 0·78)
Belize	11·33 (8·11 to 16·16)	9·40 (5·50 to 15·24)	4·08 (2·73 to 7·02)	3·27 (2·06 to 4·91)	16·67 (10·54 to 26·60)	0·09 (0·07 to 0·13)	0·14 (0·09 to 0·22)	−4·10 (−6·87 to −1·39)	−2·93 (−6·26 to 0·40)	−3·40 (−5·38 to −1·51)
Bermuda	5·93 (4·49 to 7·77)	2·61 (1·61 to 4·04)	1·18 (0·83 to 1·63)	0·54 (0·34 to 0·82)	4·32 (2·84 to 6·43)	<0·01 (<0·01 to 0·01)	<0·01 (<0·01 to 0·01)	−9·00 (−13·58 to −4·68)	−0·33 (−3·78 to 3·67)	−3·80 (−5·83 to −1·99)
Cuba	10·70 (8·23 to 14·18)	3·22 (3·00 to 3·48)	1·80 (1·60 to 1·99)	1·08 (0·82 to 1·40)	6·08 (5·77 to 6·46)	1·24 (0·95 to 1·65)	0·70 (0·67 to 0·75)	−4·88 (−5·11 to −4·63)	−2·15 (−2·52 to −1·74)	−3·24 (−3·45 to −3·01)
Dominica	14·17 (10·14 to 20·21)	15·60 (9·98 to 21·99)	6·31 (3·50 to 11·09)	4·74 (2·92 to 7·59)	26·45 (17·11 to 39·73)	0·02 (0·01 to 0·02)	0·03 (0·02 to 0·05)	−0·42 (−3·16 to 2·29)	0·62 (−2·47 to 3·51)	0·20 (−1·84 to 2·21)
Dominican Republic	8·13 (6·08 to 10·79)	15·08 (12·43 to 18·02)	6·30 (4·75 to 8·36)	3·79 (2·74 to 5·15)	25·00 (20·52 to 30·44)	1·77 (1·32 to 2·35)	5·41 (4·44 to 6·58)	−4·75 (−5·69 to −3·82)	−2·62 (−4·07 to −1·20)	−3·47 (−4·32 to −2·69)
Grenada	10·06 (7·20 to 14·35)	9·26 (4·77 to 16·06)	3·49 (1·92 to 6·31)	3·24 (1·86 to 5·37)	15·92 (8·68 to 27·47)	0·02 (0·01 to 0·03)	0·03 (0·02 to 0·06)	−2·97 (−8·39 to 3·01)	−1·65 (−6·34 to 2·82)	−2·18 (−5·10 to 0·70)
Guyana	11·96 (8·80 to 16·58)	16·83 (13·60 to 20·47)	7·17 (4·90 to 10·38)	4·18 (2·85 to 6·00)	27·96 (22·01 to 35·41)	0·18 (0·13 to 0·25)	0·41 (0·32 to 0·52)	−2·46 (−3·37 to −1·56)	−2·50 (−4·17 to −0·95)	−2·49 (−3·52 to −1·48)

(Table 2 continues on next page)

	Deaths per 1000 livebirths					Total stillbirths (thousands)	Total under-5 deaths (thousands)	Annualised rate of change for under-5 mortality		
	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
(Continued from previous page)										
Haiti	28·33 (17·49 to 46·39)	23·56 (18·54 to 29·60)	22·45 (14·81 to 32·24)	13·50 (8·04 to 21·41)	58·37 (42·11 to 79·74)	7·69 (4·69 to 12·81)	15·37 (11·08 to 21·05)	−4·37 (−5·47 to −3·30)	−3·30 (−5·53 to −1·14)	−3·73 (−5·05 to −2·46)
Jamaica	13·16 (10·34 to 16·59)	10·77 (6·38 to 16·32)	4·00 (2·68 to 6·63)	3·46 (2·24 to 5·07)	18·13 (11·58 to 27·58)	0·64 (0·50 to 0·81)	0·88 (0·56 to 1·33)	−2·24 (−6·28 to 1·67)	−1·29 (−4·85 to 2·15)	−1·67 (−3·72 to 0·28)
Puerto Rico	6·03 (4·45 to 7·99)	4·68 (4·09 to 5·32)	1·50 (1·31 to 1·74)	0·85 (0·62 to 1·13)	7·02 (6·24 to 7·92)	0·26 (0·19 to 0·35)	0·31 (0·27 to 0·34)	−2·83 (−3·25 to −2·38)	−3·35 (−4·18 to −2·55)	−3·14 (−3·62 to −2·66)
Saint Lucia	12·14 (8·86 to 16·91)	10·17 (4·97 to 17·64)	4·22 (2·20 to 8·30)	3·36 (1·85 to 5·59)	17·66 (9·22 to 31·46)	0·03 (0·02 to 0·05)	0·05 (0·03 to 0·09)	−4·45 (−9·88 to 1·13)	−0·85 (−6·00 to 3·70)	−2·29 (−5·21 to 0·55)
Saint Vincent and the Grenadines	12·02 (9·34 to 15·71)	13·81 (8·40 to 20·51)	4·94 (3·06 to 8·70)	3·29 (2·11 to 5·10)	21·92 (13·83 to 33·62)	0·02 (0·02 to 0·03)	0·04 (0·02 to 0·06)	−2·22 (−5·16 to 1·07)	−2·48 (−5·60 to 0·70)	−2·38 (−4·54 to −0·22)
Suriname	14·53 (11·02 to 19·50)	18·25 (15·00 to 22·15)	8·43 (6·10 to 11·96)	4·73 (3·10 to 6·92)	31·12 (24·92 to 39·54)	0·14 (0·11 to 0·19)	0·30 (0·24 to 0·39)	−1·34 (−2·51 to −0·14)	−2·40 (−3·62 to −1·07)	−1·97 (−2·93 to −1·01)
Trinidad and Tobago	9·98 (7·81 to 12·72)	13·21 (7·77 to 20·01)	4·01 (2·68 to 6·80)	2·10 (1·32 to 3·31)	19·23 (11·91 to 29·98)	0·19 (0·15 to 0·24)	0·37 (0·23 to 0·57)	−0·24 (−2·12 to 1·75)	−2·39 (−5·68 to 0·64)	−1·53 (−3·61 to 0·30)
Virgin Islands	7·21 (5·16 to 10·25)	5·41 (4·46 to 6·46)	2·14 (1·68 to 2·71)	1·17 (0·82 to 1·64)	8·70 (7·20 to 10·53)	0·01 (0·01 to 0·01)	0·01 (0·01 to 0·02)	−2·59 (−3·63 to −1·52)	−2·27 (−3·56 to −1·03)	−2·40 (−3·25 to −1·54)
Tropical Latin America	6·56 (5·88 to 7·35)	9·41 (7·10 to 12·00)	5·69 (4·64 to 7·26)	1·97 (1·36 to 2·74)	16·99 (13·44 to 21·40)	20·86 (18·66 to 23·38)	53·74 (50·08 to 57·67)	−5·02 (−6·62 to −3·43)	−4·03 (−5·90 to −2·28)	−4·43 (−5·45 to −3·44)*
Brazil	6·63 (5·91 to 7·41)	9·38 (7·08 to 11·98)	5·72 (4·67 to 7·29)	1·93 (1·30 to 2·72)	16·94 (13·40 to 21·36)	20·12 (17·94 to 22·53)	51·23 (47·60 to 55·14)	−5·12 (−6·80 to −3·46)	−4·08 (−5·94 to −2·28)	−4·50 (−5·51 to −3·50)*
Paraguay	5·24 (4·26 to 6·56)	10·04 (7·68 to 12·67)	4·97 (3·90 to 6·47)	3·00 (2·14 to 4·23)	17·91 (14·27 to 22·43)	0·74 (0·60 to 0·93)	2·51 (2·00 to 3·15)	−1·46 (−2·85 to −0·07)	−3·00 (−4·66 to −1·32)	−2·39 (−3·36 to −1·42)
Southeast Asia, east Asia, and Oceania	7·41 (6·00 to 9·13)	8·16 (6·84 to 10·12)	4·78 (3·89 to 5·76)	3·52 (2·79 to 4·38)	16·37 (13·68 to 19·63)	221·16 (178·89 to 273·10)	486·21 (457·30 to 515·88)	−3·59 (−5·07 to −2·00)	−6·26 (−7·58 to −4·95)	−5·19 (−6·11 to −4·27)*
East Asia	6·84 (4·86 to 9·44)	6·12 (4·23 to 9·02)	3·52 (2·42 to 4·67)	2·80 (1·81 to 4·09)	12·40 (8·78 to 17·24)	118·87 (84·29 to 164·36)	214·53 (197·97 to 232·25)	−3·34 (−5·98 to −0·59)	−7·75 (−10·35 to −5·33)	−5·99 (−7·59 to −4·44)*
China	6·87 (4·84 to 9·56)	6·07 (4·10 to 9·06)	3·50 (2·38 to 4·71)	2·80 (1·77 to 4·11)	12·32 (8·60 to 17·18)	115·38 (81·11 to 160·95)	206·24 (189·46 to 222·99)	−3·95 (−6·57 to −1·21)	−7·45 (−10·11 to −4·90)	−6·05 (−7·75 to −4·41)*
North Korea	6·30 (3·92 to 10·25)	10·33 (4·48 to 18·43)	5·46 (2·48 to 11·99)	3·54 (1·77 to 6·44)	19·22 (8·96 to 36·30)	2·29 (1·42 to 3·73)	6·91 (3·22 to 13·04)	9·89 (−3·24 to 20·62)	−13·77 (−21·61 to −3·87)	−4·30 (−8·41 to −0·10)
Taiwan (province of China)	5·62 (4·22 to 7·38)	2·99 (1·79 to 4·62)	1·65 (1·09 to 2·64)	1·94 (1·26 to 3·01)	6·56 (4·24 to 10·28)	1·21 (0·91 to 1·59)	1·38 (0·89 to 2·17)	−0·23 (−0·73 to 0·30)	−1·75 (−4·62 to 1·23)	−1·14 (−2·90 to 0·63)
Southeast Asia	8·05 (6·56 to 9·87)	10·94 (9·76 to 12·15)	6·30 (5·36 to 7·35)	4·41 (3·70 to 5·23)	21·51 (19·24 to 24·07)	98·07 (79·77 to 120·44)	260·36 (239·97 to 283·16)	−4·47 (−4·89 to −4·07)	−4·87 (−5·69 to −4·13)	−4·71 (−5·15 to −4·26)*
Cambodia	11·21 (8·84 to 14·08)	15·85 (14·10 to 17·65)	11·33 (9·06 to 13·95)	4·48 (3·13 to 5·99)	31·36 (27·22 to 36·01)	4·20 (3·31 to 5·29)	11·60 (10·07 to 13·32)	−1·92 (−2·51 to −1·33)	−7·54 (−8·56 to −6·59)	−5·30 (−5·89 to −4·75)*

(Table 2 continues on next page)

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	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
(Continued from previous page)										
Indonesia	8·50 (6·83 to 10·42)	12·45 (10·69 to 14·23)	6·88 (5·48 to 8·56)	4·52 (3·32 to 5·99)	23·68 (20·44 to 27·48)	43·17 (34·64 to 53·05)	119·59 (103·20 to 138·79)	−5·22 (−5·66 to −4·78)	−4·99 (−6·01 to −4·00)	−5·08 (−5·68 to −4·49)*
Laos	21·20 (13·88 to 32·89)	27·46 (22·71 to 33·46)	24·22 (17·33 to 33·52)	9·65 (5·68 to 14·98)	60·18 (45·77 to 77·70)	3·88 (2·52 to 6·09)	10·74 (8·17 to 13·89)	−2·57 (−3·70 to −1·50)	−5·77 (−7·75 to −4·00)	−4·49 (−5·67 to −3·38)*
Malaysia	4·15 (3·43 to 4·98)	3·06 (2·48 to 3·71)	1·97 (1·58 to 2·43)	1·48 (1·07 to 1·97)	6·50 (5·51 to 7·69)	2·12 (1·75 to 2·55)	3·27 (2·77 to 3·87)	−5·94 (−6·24 to −5·65)	−2·37 (−3·49 to −1·26)	−3·80 (−4·46 to −3·15)
Maldives	5·13 (3·98 to 6·53)	5·89 (4·75 to 7·54)	3·42 (2·77 to 4·13)	3·15 (2·29 to 4·14)	12·41 (10·34 to 15·16)	0·04 (0·03 to 0·05)	0·09 (0·08 to 0·11)	−6·27 (−7·05 to −5·50)	−7·07 (−8·25 to −5·84)	−6·75 (−7·51 to −5·92)*
Mauritius	8·34 (6·59 to 10·78)	7·93 (7·04 to 8·95)	3·25 (2·89 to 3·62)	2·28 (1·69 to 3·00)	13·41 (12·26 to 14·71)	0·12 (0·09 to 0·15)	0·19 (0·17 to 0·21)	−2·26 (−2·75 to −1·77)	−1·91 (−2·54 to −1·27)	−2·05 (−2·43 to −1·66)
Myanmar	8·59 (6·40 to 11·28)	16·37 (13·10 to 20·28)	10·21 (6·90 to 15·21)	6·12 (3·98 to 9·15)	32·37 (24·80 to 43·01)	8·17 (6·08 to 10·77)	30·72 (23·58 to 40·78)	−3·40 (−5·74 to −1·13)	−5·90 (−8·02 to −3·64)	−4·90 (−6·17 to −3·64)*
Philippines	8·37 (6·53 to 10·60)	11·01 (9·58 to 12·56)	6·12 (4·96 to 7·50)	6·23 (4·71 to 7·91)	23·19 (20·52 to 26·26)	19·83 (15·44 to 25·16)	54·21 (47·98 to 61·42)	−4·26 (−4·78 to −3·73)	−3·01 (−3·88 to −2·16)	−3·51 (−4·03 to −2·98)
Sri Lanka	4·01 (2·58 to 6·32)	4·42 (3·32 to 5·69)	1·64 (1·20 to 2·30)	2·02 (1·39 to 2·85)	8·07 (6·17 to 10·49)	1·30 (0·84 to 2·05)	2·64 (2·02 to 3·43)	−9·15 (−9·60 to −8·73)	−4·72 (−6·51 to −2·98)	−6·50 (−7·60 to −5·48)*
Seychelles	8·17 (6·20 to 10·97)	5·29 (4·24 to 6·75)	2·87 (2·16 to 3·55)	2·53 (1·78 to 3·45)	10·65 (8·58 to 13·19)	0·01 (0·01 to 0·02)	0·02 (0·01 to 0·02)	−2·73 (−3·91 to −1·55)	−1·54 (−3·08 to 0·01)	−2·02 (−2·95 to −1·10)
Thailand	3·43 (2·61 to 4·46)	3·35 (2·61 to 4·23)	1·30 (1·03 to 1·61)	1·00 (0·72 to 1·36)	5·64 (4·54 to 6·98)	2·46 (1·87 to 3·20)	4·08 (3·29 to 5·05)	−6·11 (−7·20 to −4·90)	−6·54 (−8·04 to −4·95)	−6·37 (−7·34 to −5·38)*
Timor-Leste	17·30 (12·21 to 24·10)	16·37 (11·50 to 22·15)	15·87 (8·35 to 26·63)	6·90 (3·85 to 12·62)	38·66 (23·92 to 59·18)	0·77 (0·54 to 1·08)	1·69 (1·04 to 2·59)	−3·37 (−4·80 to −1·88)	−6·86 (−10·08 to −3·94)	−5·46 (−7·39 to −3·72)*
Vietnam	7·46 (5·00 to 11·29)	6·98 (5·72 to 8·70)	3·71 (3·09 to 4·46)	2·79 (1·95 to 3·83)	13·43 (11·49 to 15·94)	11·89 (7·95 to 18·06)	21·23 (18·16 to 25·21)	−5·36 (−6·10 to −4·67)	−4·87 (−5·86 to −3·81)	−5·07 (−5·71 to −4·37)*
Oceania	14·42 (10·10 to 20·93)	13·71 (9·62 to 18·81)	16·65 (8·69 to 28·09)	9·53 (5·16 to 17·79)	39·38 (24·09 to 61·81)	4·21 (2·94 to 6·15)	11·32 (7·38 to 17·00)	−1·53 (−4·15 to 0·91)	−3·21 (−6·26 to −0·48)	−2·54 (−4·57 to −0·62)
American Samoa	4·86 (3·93 to 6·12)	3·07 (2·36 to 3·82)	2·50 (1·91 to 3·25)	1·54 (1·02 to 2·19)	7·09 (5·70 to 8·80)	0·01 (0·01 to 0·02)	0·02 (0·01 to 0·02)	−2·79 (−3·99 to −1·57)	−4·45 (−6·02 to −2·97)	−3·79 (−4·77 to −2·84)
Federated States of Micronesia	6·07 (4·18 to 8·96)	4·92 (3·23 to 7·77)	4·10 (2·61 to 5·77)	2·52 (1·47 to 3·92)	11·49 (7·70 to 16·79)	0·02 (0·01 to 0·02)	0·03 (0·02 to 0·04)	−5·38 (−9·24 to −1·69)	−4·86 (−7·83 to −1·82)	−5·07 (−6·96 to −3·27)*
Fiji	7·83 (6·49 to 9·39)	12·16 (7·94 to 16·89)	13·80 (7·22 to 24·50)	4·74 (2·64 to 8·51)	30·40 (18·20 to 48·60)	0·14 (0·11 to 0·17)	0·54 (0·32 to 0·86)	0·71 (−3·13 to 4·28)	0·35 (−3·47 to 4·01)	0·50 (−1·91 to 3·04)
Guam	12·07 (9·86 to 14·66)	8·47 (6·17 to 10·97)	5·95 (4·56 to 7·95)	3·14 (2·04 to 4·69)	17·47 (13·61 to 22·34)	0·04 (0·03 to 0·04)	0·05 (0·04 to 0·06)	−1·40 (−2·80 to −0·01)	2·67 (0·77 to 4·56)	1·04 (0·03 to 2·05)
Kiribati	12·67 (10·26 to 15·94)	15·16 (9·64 to 22·07)	16·38 (7·10 to 30·58)	8·04 (3·79 to 16·38)	39·08 (21·28 to 67·13)	0·04 (0·03 to 0·05)	0·12 (0·07 to 0·21)	−2·65 (−5·26 to 0·35)	−3·36 (−7·69 to 0·53)	−3·08 (−5·57 to −0·83)

(Table 2 continues on next page)

	Deaths per 1000 livebirths					Total stillbirths (thousands)	Total under-5 deaths (thousands)	Annualised rate of change for under-5 mortality		
	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
(Continued from previous page)										
Marshall Islands	8·50 (6·88 to 10·69)	8·27 (4·03 to 13·30)	6·66 (3·68 to 12·09)	3·98 (2·22 to 6·57)	18·80 (10·57 to 31·03)	0·02 (0·01 to 0·02)	0·04 (0·02 to 0·06)	−1·09 (−6·29 to 3·71)	−4·83 (−9·17 to −0·57)	−3·33 (−5·86 to −0·87)
Northern Mariana Islands	4·38 (3·54 to 5·50)	2·47 (1·24 to 4·20)	2·13 (1·28 to 3·56)	1·37 (0·77 to 2·37)	5·97 (3·41 to 9·85)	0·01 (0·01 to 0·01)	0·01 (0·01 to 0·02)	−5·85 (−12·12 to 1·16)	−3·33 (−7·19 to 0·42)	−4·33 (−7·58 to −1·19)
Papua New Guinea	16·13 (11·11 to 23·83)	15·03 (10·60 to 20·67)	18·97 (9·63 to 32·07)	11·13 (5·78 to 21·32)	44·47 (26·83 to 70·50)	3·52 (2·41 to 5·24)	9·48 (5·72 to 15·00)	−1·94 (−4·90 to 0·83)	−3·53 (−6·66 to −0·70)	−2·90 (−4·99 to −0·92)
Samoa	5·31 (3·92 to 7·32)	3·41 (1·53 to 6·79)	2·82 (1·40 to 5·01)	2·47 (1·25 to 4·37)	8·68 (4·33 to 16·02)	0·03 (0·02 to 0·04)	0·04 (0·02 to 0·08)	−3·48 (−7·64 to 0·52)	−3·41 (−7·42 to 0·70)	−3·44 (−6·47 to −0·39)
Solomon Islands	9·37 (6·45 to 13·84)	8·33 (5·16 to 11·63)	6·91 (4·52 to 10·80)	4·68 (2·97 to 7·15)	19·79 (13·48 to 28·49)	0·16 (0·11 to 0·24)	0·34 (0·23 to 0·49)	−2·86 (−5·88 to 0·09)	−3·57 (−6·35 to −0·84)	−3·28 (−5·12 to −1·46)
Tonga	7·97 (5·89 to 10·99)	8·05 (4·30 to 12·77)	6·22 (3·65 to 10·97)	3·61 (2·06 to 5·81)	17·78 (10·51 to 28·77)	0·02 (0·02 to 0·03)	0·05 (0·03 to 0·08)	−0·61 (−3·62 to 2·39)	−2·23 (−5·42 to 0·97)	−1·58 (−3·93 to 0·71)
Vanuatu	10·95 (7·54 to 16·18)	11·32 (7·99 to 15·13)	10·19 (6·06 to 17·16)	5·76 (3·52 to 8·90)	27·04 (18·49 to 40·12)	0·08 (0·05 to 0·11)	0·19 (0·13 to 0·27)	−0·15 (−3·04 to 2·96)	−2·37 (−5·23 to 0·34)	−1·48 (−3·17 to 0·24)
North Africa and Middle East	10·97 (9·38 to 13·04)	14·01 (12·33 to 15·77)	9·21 (7·91 to 10·76)	7·32 (5·92 to 9·09)	30·24 (26·58 to 34·64)	148·55 (126·87 to 176·93)	404·01 (373·64 to 439·04)	−3·80 (−4·21 to −3·39)	−3·85 (−4·67 to −3·02)	−3·83 (−4·34 to −3·30)
Afghanistan	15·97 (12·79 to 19·77)	28·62 (24·72 to 32·99)	30·49 (23·98 to 38·24)	25·89 (17·32 to 36·33)	82·63 (69·49 to 98·00)	17·54 (14·00 to 21·79)	89·27 (75·54 to 105·62)	−1·86 (−2·73 to −1·01)	−3·19 (−4·37 to −2·08)	−2·66 (−3·47 to −1·91)
Algeria	15·33 (13·42 to 17·50)	12·64 (9·96 to 15·81)	6·28 (4·54 to 8·89)	3·98 (2·79 to 5·53)	22·74 (17·90 to 29·41)	14·57 (12·74 to 16·68)	21·31 (16·77 to 27·58)	−3·96 (−5·53 to −2·56)	−3·18 (−4·82 to −1·42)	−3·49 (−4·52 to −2·41)
Bahrain	5·22 (4·39 to 6·17)	3·80 (3·16 to 4·47)	1·95 (1·60 to 2·33)	0·88 (0·62 to 1·19)	6·62 (5·62 to 7·75)	0·10 (0·09 to 0·12)	0·13 (0·11 to 0·15)	−5·13 (−6·17 to −4·10)	−4·34 (−5·56 to −3·17)	−4·66 (−5·34 to −3·99)*
Egypt	10·53 (8·80 to 12·83)	12·06 (8·91 to 15·44)	5·98 (4·31 to 8·57)	3·63 (2·57 to 5·05)	21·54 (16·27 to 28·31)	26·48 (22·09 to 32·35)	53·29 (40·14 to 70·12)	−6·41 (−7·35 to −5·51)	−4·65 (−6·56 to −2·78)	−5·35 (−6·49 to −4·23)*
Iran	6·82 (5·71 to 8·10)	8·13 (5·59 to 11·36)	3·95 (2·94 to 5·26)	2·65 (1·74 to 3·89)	14·67 (10·80 to 19·53)	9·27 (7·75 to 11·02)	19·91 (14·65 to 26·49)	−6·54 (−8·92 to −4·20)	−6·51 (−8·92 to −4·13)	−6·52 (−7·86 to −5·23)*
Iraq	12·22 (9·47 to 16·09)	15·49 (13·35 to 18·00)	7·08 (5·59 to 9·09)	4·96 (3·29 to 7·17)	27·31 (23·20 to 32·62)	15·39 (11·89 to 20·34)	33·48 (28·90 to 39·22)	−2·37 (−2·97 to −1·73)	−2·93 (−4·08 to −1·74)	−2·71 (−3·39 to −1·99)
Jordan	5·03 (4·03 to 6·38)	7·73 (6·44 to 9·24)	3·53 (2·94 to 4·15)	3·57 (2·64 to 4·59)	14·76 (12·89 to 17·15)	1·01 (0·81 to 1·28)	2·92 (2·55 to 3·39)	−2·92 (−3·48 to −2·39)	−3·28 (−4·24 to −2·26)	−3·14 (−3·73 to −2·55)
Kuwait	5·49 (4·62 to 6·51)	4·39 (3·42 to 5·42)	2·38 (1·82 to 3·15)	1·43 (0·99 to 2·00)	8·19 (6·48 to 10·23)	0·41 (0·35 to 0·49)	0·61 (0·48 to 0·76)	−2·48 (−3·81 to −1·22)	−2·85 (−4·48 to −1·28)	−2·70 (−3·79 to −1·71)
Lebanon	6·82 (5·55 to 8·38)	4·40 (3·15 to 5·98)	2·21 (1·56 to 3·21)	1·52 (0·97 to 2·32)	8·11 (5·90 to 11·33)	0·59 (0·48 to 0·72)	0·67 (0·49 to 0·93)	−4·84 (−7·49 to −2·25)	−6·58 (−8·99 to −4·02)	−5·88 (−7·27 to −4·53)*
Libya	8·35 (6·98 to 10·16)	8·09 (5·68 to 11·05)	4·65 (3·45 to 6·28)	4·83 (3·26 to 6·85)	17·47 (13·16 to 22·58)	1·09 (0·91 to 1·33)	2·29 (1·76 to 2·97)	−3·90 (−5·39 to −2·46)	−3·17 (−4·73 to −1·61)	−3·46 (−4·61 to −2·32)

(Table 2 continues on next page)

	Deaths per 1000 livebirths					Total stillbirths (thousands)	Total under-5 deaths (thousands)	Annualised rate of change for under-5 mortality		
	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
(Continued from previous page)										
Morocco	11·36 (9·39 to 13·97)	12·65 (10·04 to 15·45)	5·81 (4·29 to 7·80)	4·13 (2·95 to 5·61)	22·44 (18·00 to 27·92)	8·04 (6·63 to 9·91)	15·70 (12·59 to 19·53)	−4·69 (−5·52 to −3·81)	−4·47 (−5·79 to −3·20)	−4·56 (−5·48 to −3·68)*
Palestine	5·33 (4·33 to 6·69)	9·87 (7·33 to 12·67)	4·63 (3·66 to 6·02)	2·85 (2·00 to 3·96)	17·27 (13·49 to 21·82)	0·81 (0·66 to 1·02)	2·58 (2·02 to 3·27)	−4·19 (−5·75 to −2·72)	−2·67 (−4·50 to −0·97)	−3·28 (−4·37 to −2·30)
Oman	5·19 (4·28 to 6·27)	4·65 (4·05 to 5·33)	2·61 (2·11 to 3·15)	2·13 (1·59 to 2·78)	9·37 (8·12 to 10·76)	0·43 (0·35 to 0·51)	0·75 (0·65 to 0·86)	−10·16 (−11·74 to −8·57)	−3·25 (−4·63 to −1·97)	−6·01 (−6·94 to −5·15)*
Qatar	4·48 (3·75 to 5·45)	4·65 (3·18 to 6·55)	2·39 (1·61 to 3·54)	1·63 (1·02 to 2·44)	8·64 (5·98 to 12·13)	0·12 (0·10 to 0·14)	0·22 (0·15 to 0·31)	−3·03 (−7·03 to 1·17)	−4·18 (−7·12 to −1·09)	−3·72 (−5·71 to −1·99)
Saudi Arabia	8·71 (7·24 to 10·65)	6·11 (4·35 to 9·21)	3·24 (2·21 to 4·36)	2·22 (1·41 to 3·17)	11·53 (8·29 to 16·27)	5·44 (4·52 to 6·66)	7·14 (6·30 to 8·08)	−6·65 (−8·33 to −5·03)	−4·86 (−6·55 to −3·09)	−5·57 (−6·90 to −4·23)*
Sudan	17·45 (14·23 to 21·74)	24·06 (19·90 to 29·36)	17·19 (12·38 to 23·43)	15·80 (10·37 to 23·80)	56·00 (43·27 to 73·73)	23·43 (19·04 to 29·32)	73·18 (56·67 to 96·28)	−3·16 (−4·30 to −2·02)	−3·74 (−5·54 to −1·84)	−3·51 (−4·56 to −2·44)
Syria	6·79 (5·26 to 8·94)	7·14 (5·99 to 8·51)	5·77 (4·28 to 7·46)	9·68 (4·89 to 15·47)	22·42 (16·20 to 29·32)	2·99 (2·31 to 3·95)	10·12 (7·31 to 12·89)	−7·03 (−7·91 to −6·12)	0·43 (−1·75 to 2·39)	−2·56 (−3·92 to −1·39)
Tunisia	8·07 (6·98 to 9·49)	7·40 (5·94 to 9·23)	3·51 (2·90 to 4·18)	2·96 (2·11 to 3·86)	13·81 (11·52 to 16·53)	1·64 (1·42 to 1·93)	2·78 (2·32 to 3·32)	−6·02 (−6·96 to −5·16)	−4·47 (−5·68 to −3·34)	−5·09 (−5·84 to −4·33)*
Turkey	4·44 (3·75 to 5·31)	9·34 (6·53 to 12·71)	4·85 (3·78 to 6·63)	2·46 (1·68 to 3·40)	16·56 (12·26 to 22·17)	5·75 (4·85 to 6·88)	21·38 (15·82 to 28·62)	−6·08 (−7·47 to −4·84)	−5·60 (−7·82 to −3·51)	−5·79 (−7·04 to −4·56)*
United Arab Emirates	2·36 (1·86 to 3·07)	2·93 (1·52 to 4·96)	1·52 (0·95 to 2·48)	1·05 (0·58 to 1·72)	5·49 (3·16 to 9·08)	0·23 (0·18 to 0·30)	0·54 (0·31 to 0·89)	−6·80 (−13·26 to −0·07)	−5·39 (−9·89 to −0·46)	−5·95 (−8·66 to −2·91)*
Yemen	15·05 (11·41 to 20·28)	20·94 (19·05 to 23·16)	17·97 (14·88 to 21·88)	15·65 (10·32 to 22·62)	53·58 (45·87 to 63·24)	13·09 (9·88 to 17·72)	45·46 (40·21 to 51·29)	−4·14 (−4·68 to −3·64)	−3·06 (−4·15 to −1·96)	−3·49 (−4·11 to −2·86)
South Asia	21·23 (19·02 to 23·60)	29·81 (27·23 to 32·67)	12·07 (10·31 to 14·11)	8·83 (6·96 to 11·19)	49·99 (44·94 to 56·26)	758·46 (677·97 to 845·20)	1749·40 (1678·32 to 1821·71)	−3·31 (−3·70 to −2·90)	−3·50 (−4·21 to −2·72)	−3·42 (−3·85 to −2·95)
Bangladesh	19·37 (16·81 to 22·25)	23·64 (21·76 to 25·60)	8·83 (7·58 to 10·31)	7·00 (5·19 to 8·98)	39·03 (36·05 to 42·67)	61·91 (53·57 to 71·32)	122·65 (113·26 to 134·12)	−4·92 (−5·27 to −4·58)	−5·10 (−5·66 to −4·48)	−5·02 (−5·36 to −4·67)*
Bhutan	19·61 (14·88 to 26·39)	25·66 (22·62 to 29·37)	10·98 (8·57 to 14·03)	8·00 (5·41 to 11·53)	44·07 (37·99 to 51·81)	0·27 (0·20 to 0·37)	0·60 (0·51 to 0·70)	−3·96 (−4·78 to −3·11)	−4·16 (−4·98 to −3·23)	−4·08 (−4·73 to −3·42)
India	20·25 (17·55 to 23·25)	29·06 (25·84 to 32·76)	11·74 (9·58 to 14·41)	8·80 (6·42 to 12·01)	48·90 (42·60 to 56·92)	533·14 (460·67 to 613·87)	1263·10 (1199·53 to 1326·80)	−3·21 (−3·69 to −2·74)	−3·59 (−4·51 to −2·60)	−3·44 (−4·01 to −2·84)
Nepal	14·02 (11·69 to 16·72)	21·56 (19·63 to 23·45)	8·99 (7·53 to 10·59)	6·79 (4·95 to 9·18)	36·93 (33·56 to 40·77)	8·21 (6·83 to 9·81)	21·38 (19·40 to 23·54)	−5·25 (−5·65 to −4·83)	−5·20 (−5·89 to −4·50)	−5·22 (−5·63 to −4·81)*
Pakistan	27·63 (23·15 to 32·80)	37·86 (34·77 to 41·33)	15·94 (13·62 to 18·50)	10·36 (7·33 to 13·78)	63·00 (57·35 to 69·35)	154·93 (129·19 to 184·84)	341·68 (311·32 to 376·04)	−2·01 (−2·41 to −1·59)	−2·41 (−3·06 to −1·76)	−2·25 (−2·65 to −1·85)
Sub-Saharan Africa	23·86 (18·55 to 31·28)	27·81 (26·11 to 29·83)	26·58 (24·02 to 29·60)	30·16 (26·20 to 34·40)	82·19 (75·85 to 89·58)	866·66 (669·90 to 1144·29)	2863·72 (2751·92 to 2985·44)	−1·67 (−1·87 to −1·51)	−3·86 (−4·38 to −3·29)	−2·99 (−3·32 to −2·63)

(Table 2 continues on next page)

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(Continued from previous page)										
Southern sub-Saharan Africa	18·08 (13·93 to 24·17)	20·01 (17·82 to 22·44)	16·73 (14·44 to 19·24)	10·33 (8·46 to 12·57)	46·36 (41·15 to 52·30)	33·61 (25·78 to 45·21)	83·41 (77·58 to 89·67)	−0·02 (−0·62 to 0·58)	−3·18 (−4·04 to −2·34)	−1·91 (−2·43 to −1·41)
Botswana	8·76 (5·94 to 12·61)	14·17 (11·40 to 17·40)	8·55 (5·87 to 12·15)	5·72 (3·76 to 8·42)	28·18 (22·11 to 36·57)	0·49 (0·33 to 0·71)	1·55 (1·22 to 2·01)	1·69 (0·38 to 3·00)	−5·43 (−7·03 to −3·80)	−2·58 (−3·60 to −1·53)
Lesotho	23·46 (15·36 to 36·42)	37·47 (32·64 to 42·98)	33·23 (26·16 to 41·07)	15·27 (10·34 to 21·97)	83·67 (70·34 to 99·44)	1·46 (0·95 to 2·29)	5·04 (4·24 to 5·99)	1·49 (0·86 to 2·17)	−1·60 (−2·82 to −0·37)	−0·36 (−1·10 to 0·35)
Namibia	12·69 (8·31 to 19·71)	20·43 (16·52 to 25·00)	11·73 (7·92 to 16·67)	8·89 (5·95 to 13·00)	40·52 (31·39 to 51·56)	0·93 (0·60 to 1·45)	2·90 (2·24 to 3·69)	−1·18 (−2·16 to −0·16)	−3·02 (−4·79 to −1·36)	−2·28 (−3·33 to −1·30)
South Africa	12·47 (10·63 to 14·75)	18·17 (15·74 to 20·83)	15·72 (12·02 to 20·11)	8·88 (6·80 to 11·40)	42·19 (35·83 to 49·68)	13·39 (11·39 to 15·87)	42·54 (38·62 to 46·80)	−0·84 (−1·46 to −0·22)	−3·67 (−4·76 to −2·66)	−2·54 (−3·20 to −1·94)
Swaziland	10·02 (7·74 to 12·80)	19·86 (17·26 to 22·67)	25·34 (19·83 to 32·10)	10·82 (7·28 to 15·56)	55·04 (45·04 to 66·61)	0·38 (0·29 to 0·49)	2·06 (1·69 to 2·50)	2·85 (2·02 to 3·66)	−3·54 (−5·02 to −2·09)	−0·98 (−1·85 to −0·17)
Zimbabwe	30·48 (20·58 to 45·95)	23·40 (20·90 to 26·09)	18·87 (15·40 to 22·70)	13·55 (9·67 to 18·39)	54·81 (48·09 to 63·31)	16·96 (11·32 to 25·94)	29·32 (25·76 to 33·87)	1·71 (1·18 to 2·23)	−2·34 (−3·27 to −1·33)	−0·72 (−1·27 to −0·17)
Western sub-Saharan Africa	28·44 (21·74 to 37·12)	32·43 (29·90 to 35·10)	28·94 (25·61 to 32·61)	41·24 (35·48 to 47·84)	99·18 (91·97 to 107·79)	443·68 (336·65 to 584·03)	1473·42 (1387·75 to 1561·28)	−1·45 (−1·72 to −1·21)	−3·55 (−4·07 to −3·00)	−2·71 (−3·01 to −2·39)
Benin	18·74 (16·16 to 21·63)	26·58 (23·42 to 29·79)	24·80 (20·41 to 29·68)	28·61 (21·55 to 37·16)	77·88 (69·51 to 88·30)	7·41 (6·37 to 8·58)	29·72 (26·54 to 33·64)	−2·53 (−2·96 to −2·12)	−3·91 (−4·69 to −3·07)	−3·36 (−3·84 to −2·86)
Burkina Faso	15·00 (11·44 to 19·32)	29·79 (25·65 to 33·98)	33·97 (27·24 to 41·69)	50·83 (40·17 to 61·82)	110·38 (100·10 to 123·03)	10·92 (8·30 to 14·13)	77·49 (70·37 to 86·34)	−1·57 (−1·94 to −1·17)	−3·17 (−3·83 to −2·44)	−2·53 (−2·94 to −2·11)
Cameroon	20·74 (11·19 to 38·23)	31·64 (27·18 to 35·92)	28·37 (22·48 to 34·52)	32·57 (23·99 to 43·02)	89·76 (77·87 to 103·40)	17·97 (9·58 to 33·66)	75·04 (65·04 to 86·46)	0·05 (−0·47 to 0·54)	−2·84 (−3·87 to −1·84)	−1·68 (−2·27 to −1·10)
Cape Verde	15·31 (8·43 to 26·30)	14·76 (13·23 to 16·26)	8·22 (6·83 to 9·77)	5·42 (3·98 to 7·09)	28·16 (25·31 to 31·32)	0·17 (0·09 to 0·30)	0·31 (0·28 to 0·34)	−2·40 (−3·62 to −1·24)	−3·10 (−4·09 to −2·13)	−2·82 (−3·30 to −2·37)
Chad	34·04 (23·49 to 48·26)	36·19 (31·37 to 41·64)	43·80 (35·27 to 54·06)	56·52 (43·75 to 71·41)	130·50 (115·86 to 148·82)	22·24 (15·16 to 31·95)	80·12 (71·08 to 91·22)	−0·94 (−1·44 to −0·46)	−2·26 (−3·00 to −1·47)	−1·73 (−2·22 to −1·20)
Côte d'Ivoire	19·89 (10·91 to 34·24)	36·44 (32·49 to 40·61)	31·68 (26·33 to 37·44)	28·43 (21·61 to 36·83)	93·49 (83·69 to 105·67)	17·04 (9·25 to 29·73)	77·06 (69·05 to 87·13)	−0·56 (−1·05 to −0·08)	−2·73 (−3·48 to −1·90)	−1·86 (−2·34 to −1·37)
The Gambia	24·44 (15·54 to 37·44)	20·98 (18·46 to 23·42)	10·73 (8·72 to 12·83)	14·35 (10·63 to 18·31)	45·39 (40·89 to 50·31)	2·09 (1·31 to 3·23)	3·70 (3·33 to 4·10)	−2·78 (−3·38 to −2·20)	−4·21 (−4·94 to −3·48)	−3·64 (−4·12 to −3·18)
Ghana	17·93 (10·75 to 29·93)	25·27 (22·44 to 28·11)	13·69 (11·25 to 16·37)	17·59 (13·30 to 22·36)	55·52 (49·76 to 62·70)	16·16 (9·60 to 27·27)	48·54 (43·54 to 54·78)	−2·21 (−2·67 to −1·74)	−3·81 (−4·56 to −2·97)	−3·17 (−3·64 to −2·68)
Guinea	10·93 (6·58 to 17·45)	35·21 (30·58 to 40·06)	32·68 (26·53 to 39·97)	45·01 (33·89 to 56·69)	108·75 (97·10 to 121·41)	5·08 (3·05 to 8·16)	49·12 (43·87 to 54·91)	−2·69 (−3·16 to −2·21)	−3·17 (−3·99 to −2·36)	−2·98 (−3·47 to −2·50)
Guinea-Bissau	31·55 (14·67 to 65·48)	36·78 (31·11 to 42·87)	38·07 (29·30 to 47·68)	54·45 (39·52 to 70·97)	123·91 (108·07 to 143·84)	2·21 (1·01 to 4·74)	8·25 (7·20 to 9·57)	−1·50 (−2·18 to −0·86)	−2·46 (−3·26 to −1·60)	−2·08 (−2·65 to −1·48)

(Table 2 continues on next page)

	Deaths per 1000 livebirths					Total stillbirths (thousands)	Total under-5 deaths (thousands)	Annualised rate of change for under-5 mortality		
	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
(Continued from previous page)										
Liberia	18·87 (10·18 to 34·79)	25·82 (23·53 to 28·40)	27·02 (23·03 to 31·56)	20·30 (15·15 to 26·50)	71·39 (64·64 to 79·71)	3·01 (1·61 to 5·64)	11·01 (9·98 to 12·31)	−3·01 (−3·51 to −2·53)	−5·67 (−6·41 to −4·92)	−4·61 (−5·03 to −4·15)*
Mali	33·07 (17·85 to 60·96)	40·60 (34·58 to 47·11)	35·74 (28·18 to 44·43)	59·78 (46·19 to 75·78)	130·20 (115·37 to 148·87)	26·00 (13·76 to 49·18)	96·66 (85·48 to 110·48)	−1·73 (−2·17 to −1·30)	−2·61 (−3·46 to −1·67)	−2·26 (−2·76 to −1·73)
Mauritania	16·58 (9·16 to 28·42)	26·53 (23·63 to 29·87)	13·11 (10·83 to 15·76)	16·39 (12·02 to 21·04)	55·04 (49·28 to 62·23)	2·27 (1·24 to 3·93)	7·31 (6·55 to 8·26)	−1·62 (−2·14 to −1·09)	−3·46 (−4·20 to −2·67)	−2·73 (−3·20 to −2·21)
Niger	19·97 (14·14 to 27·57)	24·08 (20·11 to 27·87)	31·67 (24·43 to 39·18)	61·14 (49·62 to 74·19)	112·77 (101·27 to 127·06)	20·04 (14·10 to 27·87)	105·55 (94·95 to 119·12)	−2·80 (−3·20 to −2·43)	−4·57 (−5·31 to −3·77)	−3·86 (−4·31 to −3·39)
Nigeria	36·48 (26·29 to 49·54)	34·59 (30·11 to 39·16)	29·24 (23·81 to 35·33)	43·77 (32·90 to 54·75)	103·84 (92·56 to 116·27)	270·38 (192·54 to 371·81)	726·58 (647·48 to 814·39)	−1·27 (−1·78 to −0·83)	−3·78 (−4·60 to −2·99)	−2·78 (−3·24 to −2·33)
São Tomé and Príncipe	12·13 (6·56 to 22·26)	17·57 (15·29 to 19·81)	9·97 (7·78 to 12·23)	11·24 (8·31 to 14·91)	38·29 (33·27 to 44·15)	0·08 (0·04 to 0·15)	0·24 (0·21 to 0·28)	−3·26 (−3·88 to −2·64)	−4·64 (−5·46 to −3·80)	−4·08 (−4·68 to −3·51)
Senegal	15·08 (11·57 to 19·40)	21·00 (18·64 to 23·35)	12·97 (10·74 to 15·34)	19·20 (14·90 to 24·06)	52·25 (48·23 to 57·16)	8·69 (6·64 to 11·22)	29·09 (26·90 to 31·84)	−2·04 (−2·40 to −1·70)	−5·41 (−5·98 to −4·79)	−4·06 (−4·40 to −3·70)
Sierra Leone	27·02 (14·58 to 49·82)	35·78 (31·99 to 39·48)	45·63 (38·51 to 53·36)	46·31 (35·75 to 57·27)	122·40 (113·03 to 132·22)	6·39 (3·39 to 12·02)	27·87 (25·78 to 30·17)	−1·55 (−1·97 to −1·16)	−3·61 (−4·20 to −3·03)	−2·79 (−3·13 to −2·45)
Togo	21·09 (15·54 to 28·04)	29·74 (26·30 to 33·20)	21·55 (17·81 to 25·73)	28·85 (21·86 to 36·14)	78·04 (71·17 to 86·48)	5·53 (4·05 to 7·40)	19·74 (18·02 to 21·86)	−1·61 (−2·08 to −1·14)	−3·03 (−3·66 to −2·36)	−2·47 (−2·86 to −2·05)
Eastern sub-Saharan Africa	19·17 (14·96 to 25·67)	24·22 (22·28 to 26·55)	24·02 (20·98 to 27·79)	20·65 (17·20 to 24·98)	67·32 (60·03 to 76·36)	267·94 (208·11 to 361·03)	908·80 (871·13 to 948·11)	−2·49 (−2·70 to −2·29)	−4·60 (−5·33 to −3·75)	−3·75 (−4·23 to −3·23)
Burundi	15·63 (11·15 to 21·13)	25·56 (20·60 to 31·89)	25·02 (17·69 to 34·70)	28·28 (17·25 to 44·22)	76·81 (57·35 to 104·34)	7·75 (5·50 to 10·53)	36·47 (27·31 to 49·55)	−0·44 (−1·45 to 0·60)	−5·13 (−7·18 to −3·01)	−3·26 (−4·49 to −2·00)
Comoros	16·11 (9·65 to 27·12)	22·38 (16·82 to 29·22)	13·88 (8·28 to 21·31)	8·38 (4·87 to 13·68)	44·02 (30·70 to 61·97)	0·43 (0·26 to 0·74)	1·15 (0·80 to 1·62)	−3·42 (−5·27 to −1·82)	−4·42 (−6·61 to −2·38)	−4·02 (−5·48 to −2·63)
Djibouti	27·65 (17·12 to 42·55)	23·42 (20·34 to 26·98)	23·15 (18·05 to 29·07)	20·41 (13·95 to 28·66)	65·50 (55·36 to 78·65)	0·63 (0·38 to 0·98)	1·44 (1·22 to 1·73)	−0·98 (−1·83 to −0·19)	−2·97 (−3·88 to −1·96)	−2·17 (−2·87 to −1·44)
Eritrea	19·91 (11·92 to 33·51)	22·13 (18·82 to 26·31)	21·18 (16·36 to 27·90)	25·40 (17·73 to 35·90)	67·15 (54·57 to 83·95)	3·56 (2·12 to 6·08)	11·73 (9·54 to 14·67)	−0·96 (−4·79 to 2·65)	−4·60 (−7·28 to −1·77)	−3·15 (−4·02 to −2·26)
Ethiopia	13·54 (10·24 to 17·47)	25·44 (22·52 to 28·47)	18·62 (15·27 to 22·66)	17·44 (12·65 to 22·91)	60·27 (53·72 to 68·47)	43·60 (32·85 to 56·49)	189·64 (168·99 to 215·35)	−3·46 (−3·90 to −3·03)	−5·77 (−6·53 to −4·91)	−4·84 (−5·32 to −4·32)*
Kenya	24·04 (19·14 to 29·85)	21·10 (19·16 to 23·16)	18·61 (15·73 to 21·77)	11·99 (8·73 to 16·00)	50·83 (45·37 to 57·64)	38·71 (30·65 to 48·34)	79·24 (74·06 to 84·78)	−0·41 (−1·01 to 0·15)	−3·70 (−4·49 to −2·85)	−2·39 (−2·87 to −1·89)
Madagascar	18·46 (11·08 to 30·94)	22·94 (19·43 to 27·00)	23·57 (17·94 to 30·45)	19·11 (12·74 to 27·21)	64·20 (51·93 to 80·64)	15·65 (9·31 to 26·55)	52·35 (42·32 to 65·61)	−2·90 (−3·79 to −2·01)	−3·41 (−4·84 to −1·90)	−3·21 (−4·09 to −2·24)
Malawi	15·20 (10·63 to 22·06)	26·86 (23·16 to 31·10)	28·56 (22·56 to 35·72)	30·36 (22·13 to 40·77)	83·35 (70·24 to 98·43)	10·27 (7·15 to 15·01)	54·39 (45·76 to 64·34)	−2·96 (−3·64 to −2·33)	−4·63 (−5·83 to −3·49)	−3·96 (−4·67 to −3·26)

(Table 2 continues on next page)

	Deaths per 1000 livebirths					Total stillbirths (thousands)	Total under-5 deaths (thousands)	Annualised rate of change for under-5 mortality		
	Stillbirths	Neonatal (0–27 days)	Post-neonatal (28 days to 1 year)	Child (1–4 years)	Under 5			1990–2000	2000–15	1990–2015
(Continued from previous page)										
Mozambique	20·67 (12·38 to 34·79)	25·45 (23·10 to 27·87)	31·86 (26·87 to 37·18)	22·72 (16·81 to 29·84)	77·93 (70·40 to 87·26)	22·98 (13·63 to 39·18)	83·36 (75·43 to 93·15)	−3·08 (−3·46 to −2·68)	−4·69 (−5·39 to −3·95)	−4·04 (−4·47 to −3·58)
Rwanda	14·94 (11·74 to 18·81)	24·84 (21·01 to 29·38)	20·30 (15·44 to 26·40)	21·99 (15·20 to 30·59)	65·64 (53·52 to 81·81)	5·50 (4·31 to 6·95)	23·77 (19·36 to 29·67)	0·26 (−0·48 to 1·00)	−5·88 (−7·25 to −4·43)	−3·42 (−4·28 to −2·54)
Somalia	29·64 (15·71 to 55·29)	31·28 (27·23 to 35·85)	40·75 (32·80 to 49·56)	44·57 (32·40 to 58·81)	112·16 (97·48 to 130·39)	14·43 (7·52 to 27·56)	51·69 (44·72 to 60·28)	−1·65 (−2·31 to −0·98)	−2·33 (−3·20 to −1·40)	−2·05 (−2·66 to −1·41)
South Sudan	56·25 (32·34 to 98·29)	28·44 (24·17 to 33·21)	40·97 (31·78 to 51·15)	41·62 (30·04 to 56·10)	107·03 (89·37 to 127·29)	26·71 (14·90 to 48·59)	46·41 (38·89 to 55·29)	−3·54 (−4·30 to −2·74)	−1·81 (−3·11 to −0·51)	−2·50 (−3·27 to −1·75)
Tanzania	18·77 (13·34 to 26·81)	22·07 (19·87 to 24·64)	23·46 (19·57 to 28·19)	15·77 (11·35 to 21·11)	60·08 (52·89 to 69·16)	39·52 (27·91 to 56·87)	121·97 (107·35 to 140·27)	−2·45 (−2·87 to −2·05)	−4·69 (−5·54 to −3·76)	−3·80 (−4·32 to −3·25)
Uganda	16·52 (12·18 to 22·02)	24·13 (21·82 to 26·64)	24·91 (21·08 to 29·52)	21·97 (16·47 to 28·03)	69·35 (62·82 to 77·42)	27·98 (20·53 to 37·49)	113·05 (102·61 to 126·20)	−2·49 (−2·86 to −2·12)	−4·24 (−4·92 to −3·50)	−3·54 (−3·96 to −3·10)
Zambia	15·37 (9·20 to 25·87)	21·06 (18·28 to 24·06)	24·97 (19·55 to 31·00)	21·41 (14·72 to 29·80)	65·93 (55·36 to 78·00)	10·08 (5·99 to 17·13)	41·67 (34·97 to 49·41)	−1·37 (−2·19 to −0·55)	−5·36 (−6·64 to −4·12)	−3·76 (−4·50 to −3·07)
Central sub-Saharan Africa	24·88 (18·06 to 34·18)	26·59 (23·28 to 30·09)	30·52 (24·70 to 37·05)	31·07 (22·98 to 40·95)	85·62 (71·79 to 100·74)	121·43 (87·50 to 168·32)	398·08 (336·14 to 465·42)	−1·13 (−1·94 to −0·34)	−3·77 (−4·97 to −2·63)	−2·72 (−3·41 to −2·02)
Angola	26·91 (15·63 to 45·91)	23·48 (19·28 to 28·33)	26·97 (19·60 to 35·59)	30·40 (19·26 to 44·25)	78·70 (60·29 to 100·90)	31·26 (17·90 to 54·28)	86·59 (66·23 to 111·40)	−2·01 (−3·43 to −0·51)	−4·55 (−6·49 to −2·78)	−3·54 (−4·64 to −2·51)
Central African Republic	41·43 (21·96 to 77·57)	40·16 (32·17 to 49·92)	47·80 (34·57 to 64·46)	44·57 (28·74 to 68·36)	126·78 (98·04 to 165·85)	7·13 (3·68 to 13·80)	20·58 (15·89 to 27·00)	−0·77 (−2·11 to 0·46)	−1·75 (−3·68 to 0·08)	−1·36 (−2·46 to −0·29)
Congo	17·44 (9·24 to 32·64)	21·22 (17·52 to 25·16)	17·22 (12·44 to 22·80)	18·77 (12·59 to 27·13)	56·13 (44·35 to 70·14)	2·97 (1·56 to 5·63)	9·24 (7·30 to 11·57)	1·58 (0·56 to 2·64)	−4·45 (−6·14 to −2·84)	−2·03 (−3·02 to −1·10)
Democratic Republic of the Congo	23·77 (15·85 to 34·50)	27·30 (22·82 to 32·32)	31·83 (23·72 to 41·25)	31·62 (21·19 to 45·21)	88·04 (70·19 to 108·92)	78·40 (51·82 to 114·95)	276·81 (220·61 to 343·56)	−0·93 (−1·99 to 0·10)	−3·63 (−5·21 to −2·20)	−2·55 (−3·53 to −1·64)
Equatorial Guinea	25·60 (11·63 to 54·10)	30·03 (24·16 to 37·70)	31·32 (21·85 to 44·10)	28·84 (17·28 to 45·82)	87·51 (65·48 to 118·55)	0·77 (0·34 to 1·68)	2·52 (1·89 to 3·41)	−0·70 (−2·05 to 0·70)	−3·99 (−5·82 to −2·12)	−2·67 (−3·89 to −1·41)
Gabon	17·30 (9·17 to 32·38)	21·66 (19·24 to 24·12)	14·41 (11·59 to 17·55)	10·74 (7·48 to 14·92)	46·11 (40·23 to 52·69)	0·90 (0·47 to 1·72)	2·35 (2·05 to 2·68)	−1·54 (−2·23 to −0·88)	−2·91 (−3·89 to −1·93)	−2·36 (−2·96 to −1·78)

*Geographies that achieved MDG4 based on a greater than 4·4% annualised rate of decline in under-5 mortality between 1990 and 2015. 95% UIs are provided in parentheses. MDG4=Millennium Development Goal 4. UIs=uncertainty intervals.

Table 2: **Stillbirth rates, neonatal, post-neonatal, child, and under-5 mortality rates (per 1000 livebirths), total under-5 deaths, and total stillbirths in 2015, annualised rates of change for under-5 mortality for 1990–2000, 2000–15, and 1990–2015, by countries and territories and subnational units in the United Kingdom, both sexes combined**

was fetal death after 28 weeks of gestation were used as reference sources in the data bias adjustment process. Other non-reference sources were adjusted based on data source fixed effects for surveys or complete VR and data source-specific random effects. The appendix provides additional details on the modelling process (appendix pp 20–22).

Under-5 populations and total deaths

Accurate estimates of total under-5 deaths hinge upon accurate estimates of under-5 populations, disaggregated by each age group, sex, geography, and year. For each age–sex-specific group, we modelled population as a function of livebirths for every year and corresponding death rates during each interval under analysis.

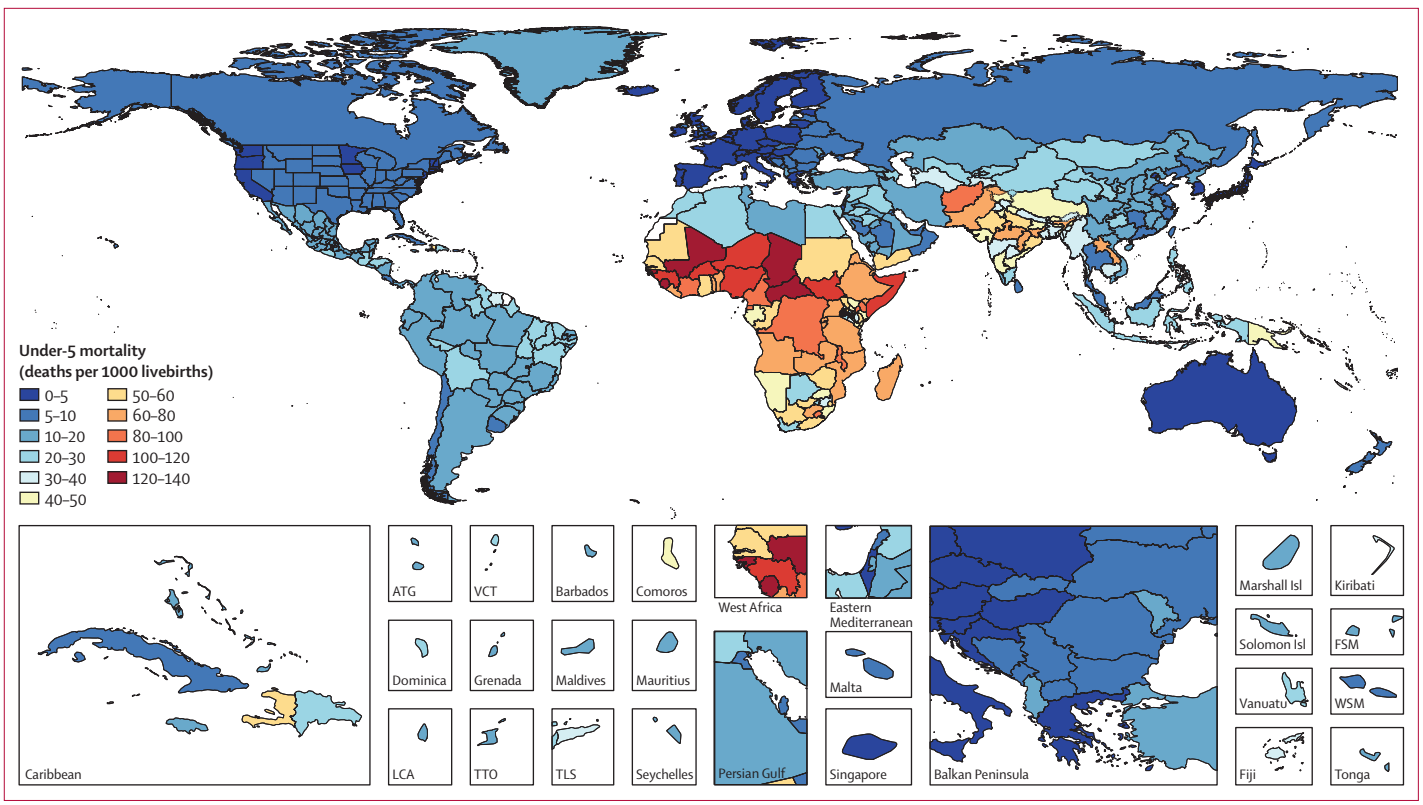


Figure 1: **Under-5 mortality rates by GBD subnational Level 1 geography, both sexes combined, 2015**
For each category shown in the legend, the range is inclusive of the minimum value and goes up to, but does not include, the maximum value. GBD=Global Burden of Disease. ATG=Antigua. VCT=Saint Vincent and the Grenadines. LCA=Saint Lucia. TTO=Trinidad and Tobago. TLS=Timor-Leste. Isl=islands. FSM=Federated States of Micronesia. WSM=Samoa.

The appendix provides population estimates (appendix pp 93–104).

Under-5 causes of death

The methods developed and used in GBD 2015, including the systematic approach to collating causes of death from different countries, mapping across different revisions and national variants of the International Classification of Diseases and Injuries (ICD); redistribution of deaths assigned to so-called garbage codes; and the overall and disease-specific cause of death modelling approaches are described in other publications[14,47–50] and in the appendix (appendix pp 24,25).

For GBD 2015, we assessed 249 causes of death across age groups. Because of cause-specific age restrictions (eg, no child deaths due to Alzheimer's disease and other dementias), not all causes of death were applicable for children younger than 5 years. The appendix provides the full GBD 2015 cause list (appendix pp 150–56), and additional information is published elsewhere.[14,51]

Socio-demographic Index

Expanding upon analyses from GBD 2013,[52] we studied patterns in child mortality as they related to measures of socioeconomic status and development. Drawing on methods used to construct the Human Development Index (HDI),[53] we created a composite indicator, the Socio-demographic Index (SDI), based on equally weighted estimates of lagged distributed income (LDI) per person, average years of education among individuals older than 15 years, and total fertility rate. SDI was constructed as the geometric mean of these three values. SDI values were scaled to a range of 0–1, with 0 equalling measures of the lowest educational attainment, lowest income, and highest fertility between 1980 and 2015, and 1 equalling measures of the highest educational attainment, highest income, and lowest fertility during this time. SDI was computed for every geography-year under analysis, providing a population-level indicator of overall development at a given time. We tested whether alternative lags of the components of SDI would provide a better predictor of outcomes such as life expectancy and age-specific probabilities of death. We found that using LDI, educational attainment, and the total fertility rate in the current year is the most predictive of these mortality outcomes. The appendix provides additional detail on SDI computation (appendix pp 23, 24) and additional information can be found elsewhere.[14]

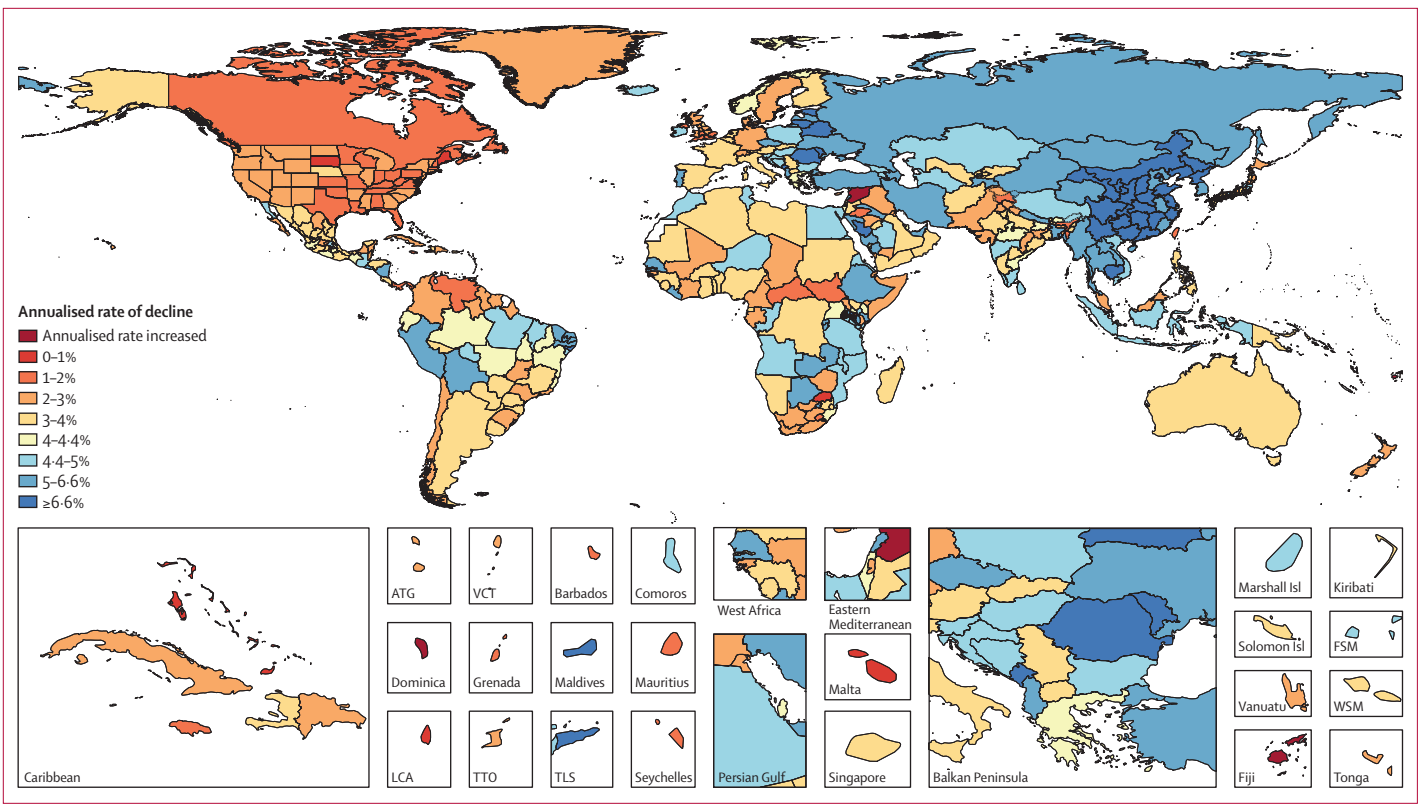


Figure 2: **Annualised rates of decrease in under-5 mortality by GBD subnational Level 1 geography, both sexes combined, 2000–15**
For each category shown in the legend, the range is inclusive of the minimum value and goes up to, but does not include, the maximum value. GBD=Global Burden of Disease. ATG=Antigua. VCT=Saint Vincent and the Grenadines. LCA=Saint Lucia. TTO=Trinidad and Tobago. TLS=Timor-Leste. Isl=islands. FSM=Federated States of Micronesia. WSM=Samoa.

Decomposing change in under-5 mortality rate by causes of death

Based on the age-specific, sex- specific, and cause-specific mortality results from GBD 2015,[14] we attributed changes in under-5 mortality rate between 1990 and 2015 to changes in leading causes of death in children younger than 5 years during the same period. To do this, we applied the decomposition method developed by Beltran-Sanchez and colleagues,[54] which has also been used for other GBD analyses.[14,43–45]

Uncertainty analysis

We propagated known measures of uncertainty through key steps of the mortality estimation processes, including uncertainty associated with varying sample sizes of data, source-specific adjustments to data used for all-cause mortality, model specifications for spatiotemporal Gaussian Process regression (ST-GPR) and cause-specific model specifications, and estimation procedures. Uncertainty estimates were derived from 1000 draws for under-5 mortality, age-specific mortality, and cause-specific mortality by sex, year, and geography from the posterior distribution of each step of the estimation process. These draws allowed us to quantify, and then propagate, uncertainty for all mortality metrics. Percent changes and annualised rates of change were calculated between mean estimates, while the uncertainty intervals associated with the percent changes were derived from the 1000 draws.

Role of the funding source

The funder had no role in study design, data collection, data analysis, data interpretation, or manuscript writing and submission for publication. The corresponding author had full access to all data in the study and final responsibility to submit the paper.

Results

Trends in child mortality and by age group

Between 1990 and 2015, global under-5 deaths decreased by 52·0% (95% UI 50·7–53·3), from 12·1 million (12·0–12·2) in 1990 to 5·8 million (5·7–6·0) in 2015 (table 1). Reductions in total deaths were similar for the post-neonatal and childhood (age 1–4 years) age groups, each decreasing at least 50% between 1990 and 2015; deaths in children aged 1–4 years fell most rapidly during this time (by 59·8%, 95% UI 57·8–61·6). Neonatal deaths fell at a slower pace, decreasing 42·4% (41·3–43·6) from 4·6 million (4·5–4·6) in 1990 to 2·6 million (2·6–2·7)

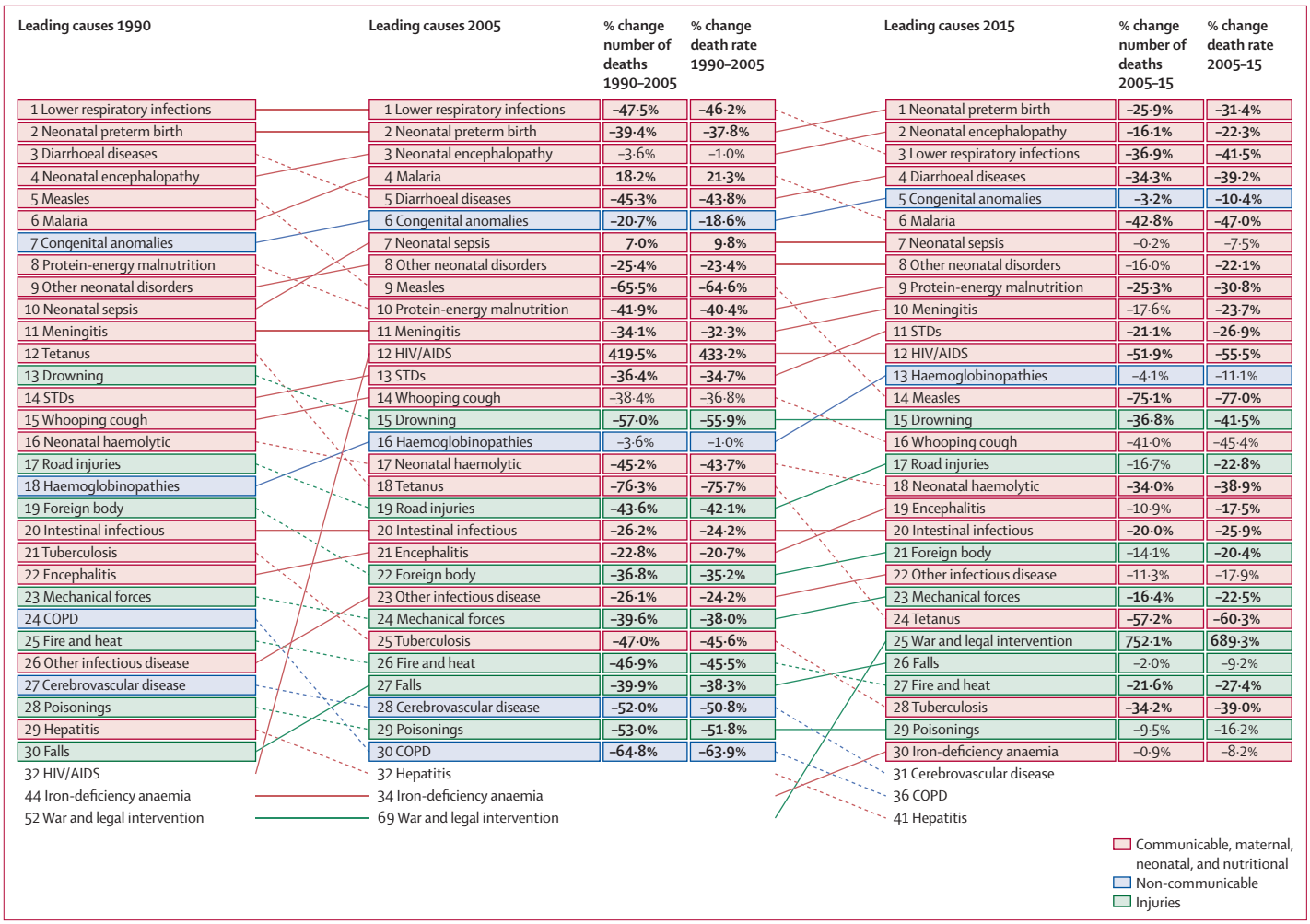


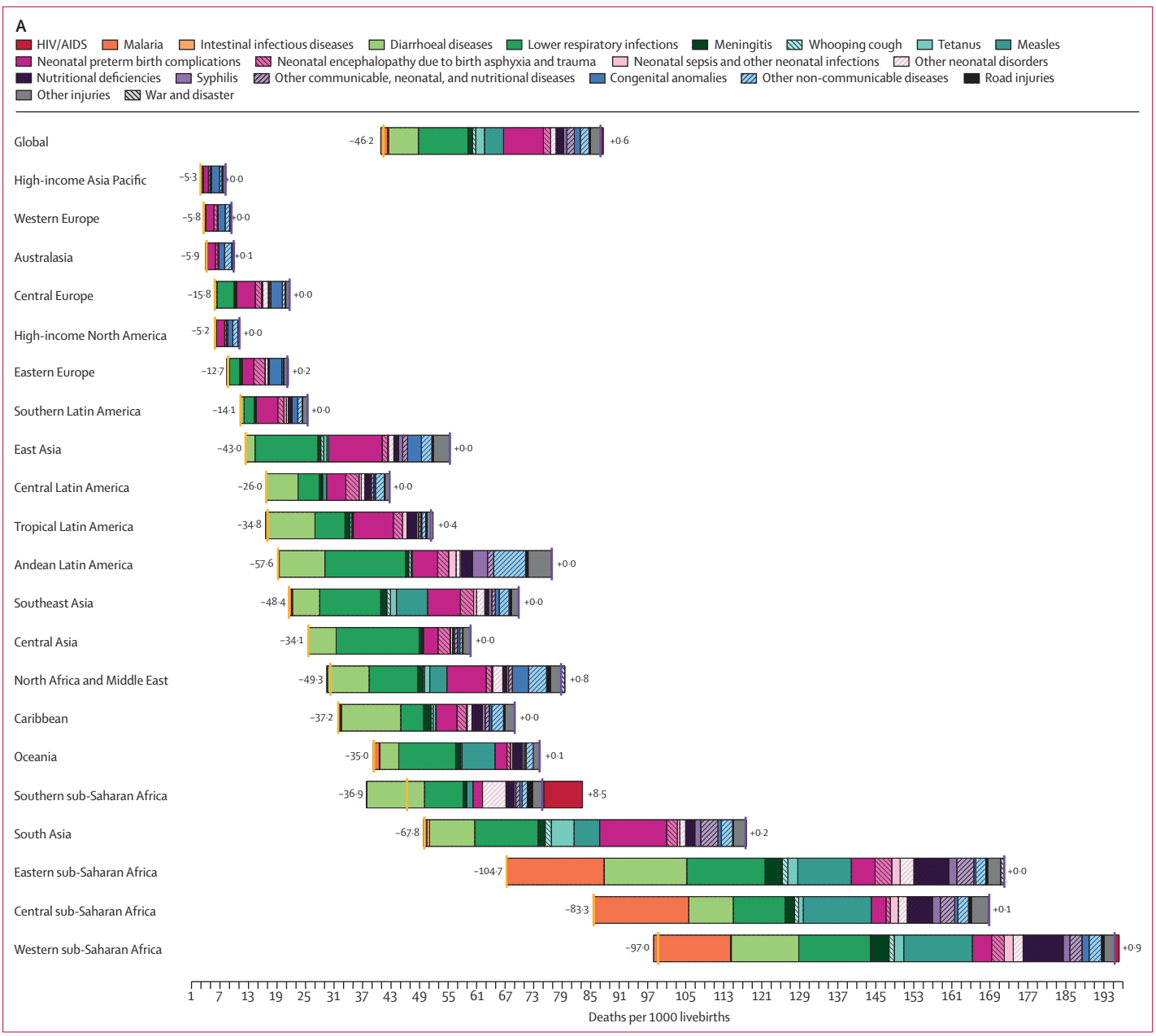
Figure 3: **Leading 30 causes of global under-5 deaths for both sexes combined for 1990, 2005, and 2015 at GBD cause hierarchy Level 3**

Causes are connected by lines between time periods. For the periods 1990–2005 and 2005–15, two measures of change are shown: percent change in the number of under-5 deaths and percent change in the under-5 mortality rate. Changes that are statistically significant are shown in bold. Neonatal preterm birth=preterm birth complications. Neonatal encephalopathy=neonatal encephalopathy due to birth asphyxia and trauma. Neonatal sepsis=neonatal sepsis and other neonatal infections. Neonatal haemolytic=haemolytic disease and other neonatal jaundice. STDs=sexually transmitted diseases. Intestinal infectious=intestinal nematode infections. Foreign body=pulmonary aspiration due to foreign body in the airway. COPD=chronic obstructive pulmonary disease. Fire and heat=injuries due to fire, heat, and hot substances. War and legal intervention=collective violence and legal intervention.

in 2015. In 1990, 37·6% (4·6 million, 4·5–4·6) of total under-5 deaths occurred during the first 28 days of life, 31·2% (3·8 million, 3·7–3·9) were post-neonatal, and 31·2% (3·8 million, 3·6–3·9) took place in children aged 1–4 years. By 2015, the composition of under-5 deaths shifted to 45·0% (2·6 million, 2·6–2·7) for neonatal, 28·8% (1·6 million, 1·6–1·7) for post-neonatal, and 26·1% (1·5 million, 1·4–1·6) for children aged 1–4 years.

Worldwide, under-5 mortality rates fell 52·4% (95% UI 47·7–56·4) between 1990 and 2015, from 87·1 deaths per 1000 livebirths (84·5–90·1) in 1990 to 41·4 deaths per 1000 livebirths (37·9–45·5) in 2015. Global under-5 mortality decreased at a faster pace from 2000–15 (an annualised rate of decrease of 3·6%, 3·0–4·2) than from 1990–2000 (an annualised rate of decrease of 2·0%, 1·7–2·4). Similar to trends in total deaths by age group, mortality rates in post-neonates and children aged 1–4 years decreased faster than those recorded for neonates. In 2015, neonatal mortality (18·6 deaths per 1000 livebirths, 17·3–20·1) exceeded mortality rates estimated for all other age groups (post-neonatal and childhood).

In 2015, age-specific mortality rates and total under-5 deaths varied by region and country (table 2). Neonatal mortality rates generally exceeded levels recorded for other child age groups in many regions; for instance, in south Asia, neonatal mortality rates (29·8 per 1000 livebirths [95% UI 27·2–32·7]) exceeded mortality rates for other child age groups (eg, post-neonatal, at 12·1 per 1000 livebirths [10·3–14·1]) by double in 2015. For other regions, particularly western and central sub-Saharan Africa, mortality rates were higher in children



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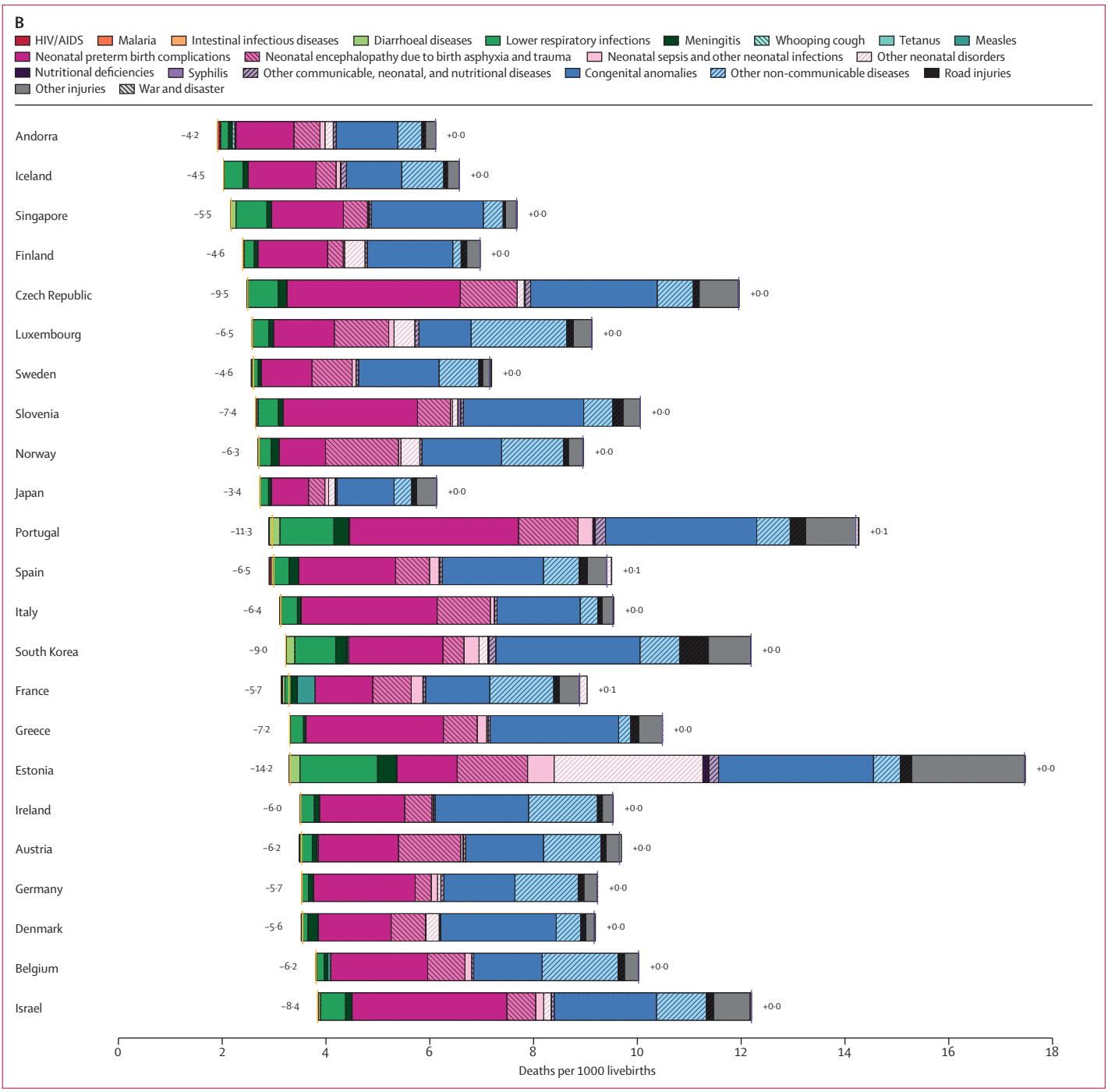
aged 1–4 years. Across countries, children in this age group had the largest difference in mortality rates, ranging from 0·3 deaths per 1000 livebirths (95% UI 0·2–0·4) in Andorra to 61·1 per 1000 livebirths (49·6–74·2) in Niger. At the regional level, 30·1% (1·7 million [95% UI 1·7–1·8 million]) of under-5 deaths occurred in South Asia, 25·3% (1·5 million [1·4–1·6 million]) in western sub-Saharan Africa, and 15·6% (909 000 [871 000–948 000]) in eastern sub-Saharan Africa. India recorded the largest number of under-5 deaths in 2015, at 1·3 million (1·2–1·3 million), followed by Nigeria (726 600 [647 200–814 600]) and Pakistan (341 700 [311 300–376 000]). Mali had the highest neonatal mortality rate in 2015 with 40·6 per 1000 livebirths (34·6–47·1); Central African Republic and Pakistan, with neonatal mortality rates of 40·2 per 1000 livebirths (32·2–49·9) and 37·9 per 1000 livebirths (34·8–41·3), respectively, recorded the second-highest and third-highest toll for neonatal mortality in 2015.

Figure 1 shows the heterogeneity for under-5 mortality rates across geographies. In 2015, under-5 mortality spanned from 1·9 per 1000 livebirths (1·6–2·4) in Andorra to 130·5 per 1000 livebirths (115·9–148·8) in



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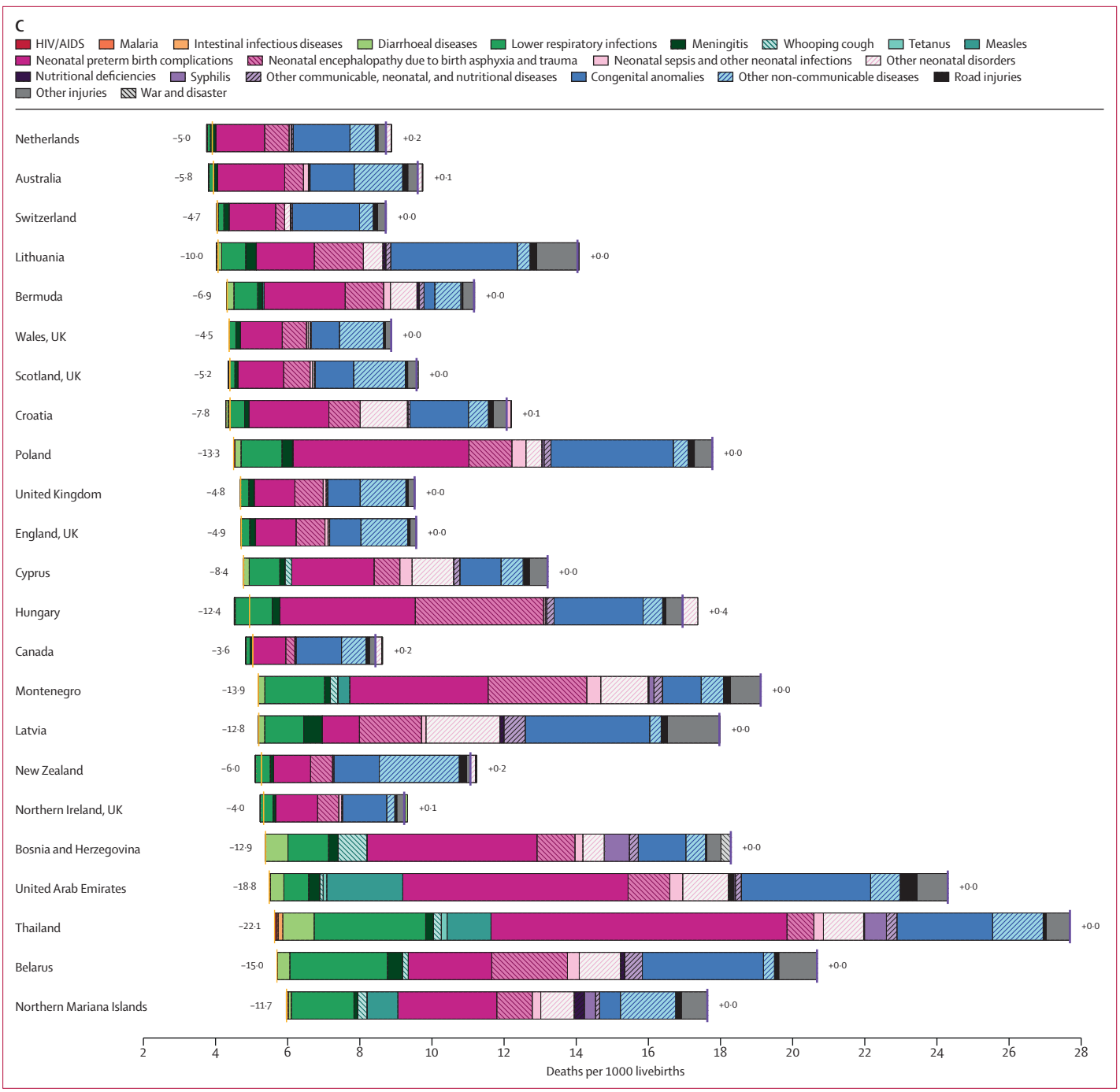
Chad. Among a subset of countries with subnational estimates, disparities in under-5 mortality were strikingly clear. At the national level, Kenya's under-5 mortality rate was 50·8 per 1000 livebirths (45·4–57·6) in 2015, but county-level rates ranged from 20·8 per 1000 livebirths (17·7–24·1) to 119·8 per 1000 livebirths (76·7–174·6). In Brazil, the national under-5 mortality rate was 16·9 deaths per 1000 livebirths (13·4–21·4) in 2015, with state-level rates spanning from 12·0 per 1000 livebirths (8·7–16·3) to 27·3 per 1000 livebirths (21·3–34·0).

MDG4 achievement and pace of progress

Absolute reductions in under-5 mortality at the global level equated to a 3·0% (2·6–3·3) annualised rate of



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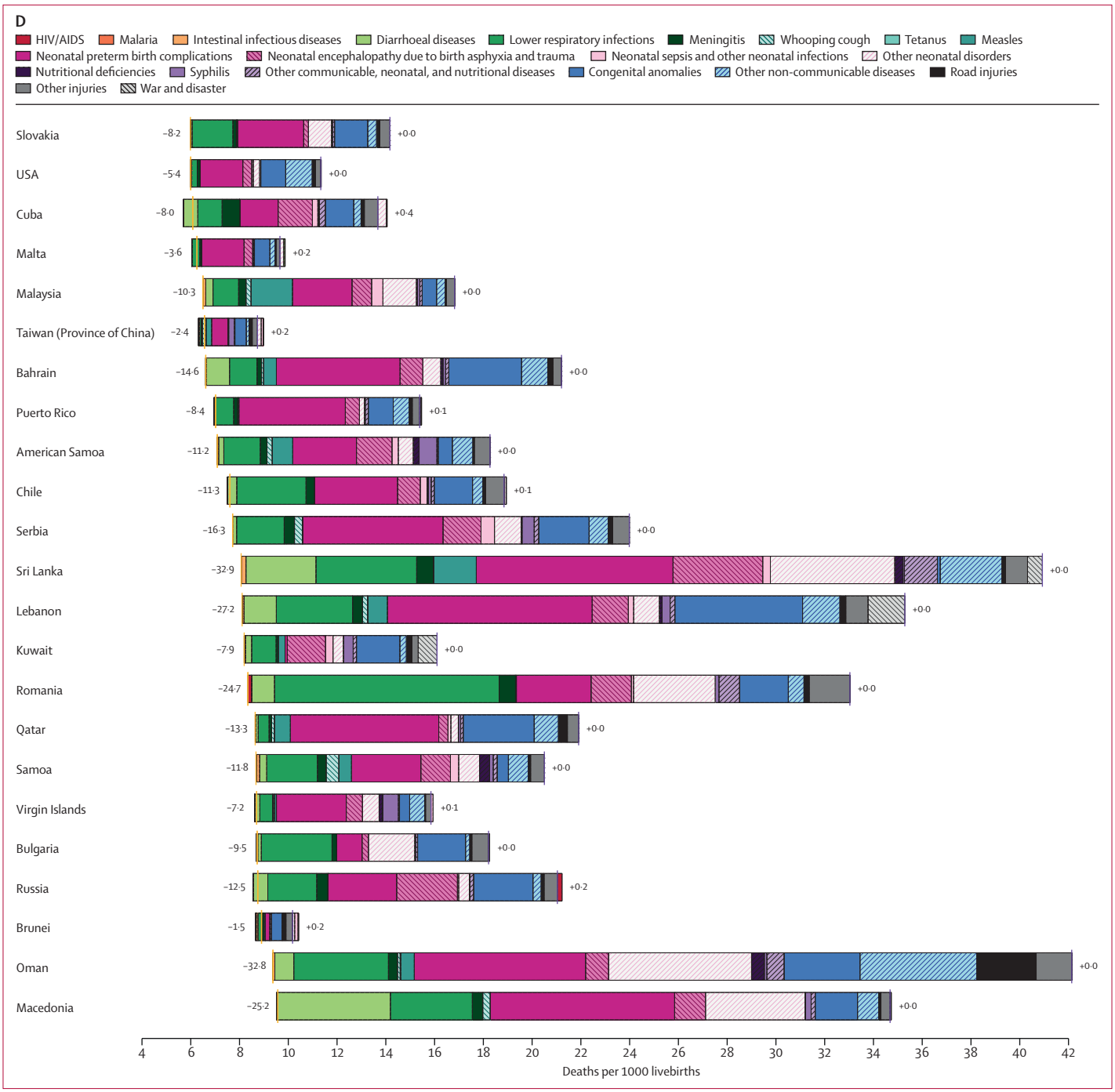
decrease between 1990 and 2015, falling well below the MDG4 target of 4·4% per year. Of the 195 countries and territories under analysis, 58 met or surpassed the MDG4 target of 4·4% annualised decrease between 1990 and 2015. Most of these countries were in north Africa and the Middle East, central Europe, southeast Asia, and western Europe, whereas only two were in sub-Saharan Africa. 32 of the countries and territories that achieved MDG4 were classified as lower-middle income or upper-middle-income countries by the World Bank, and only four of those that met MDG4 (Cambodia, Ethiopia, Liberia, and Nepal) were categorised as low-income countries.

Figure 2 shows annualised rates of decrease in under-5 mortality from 2000 to 2015, starting at the time the



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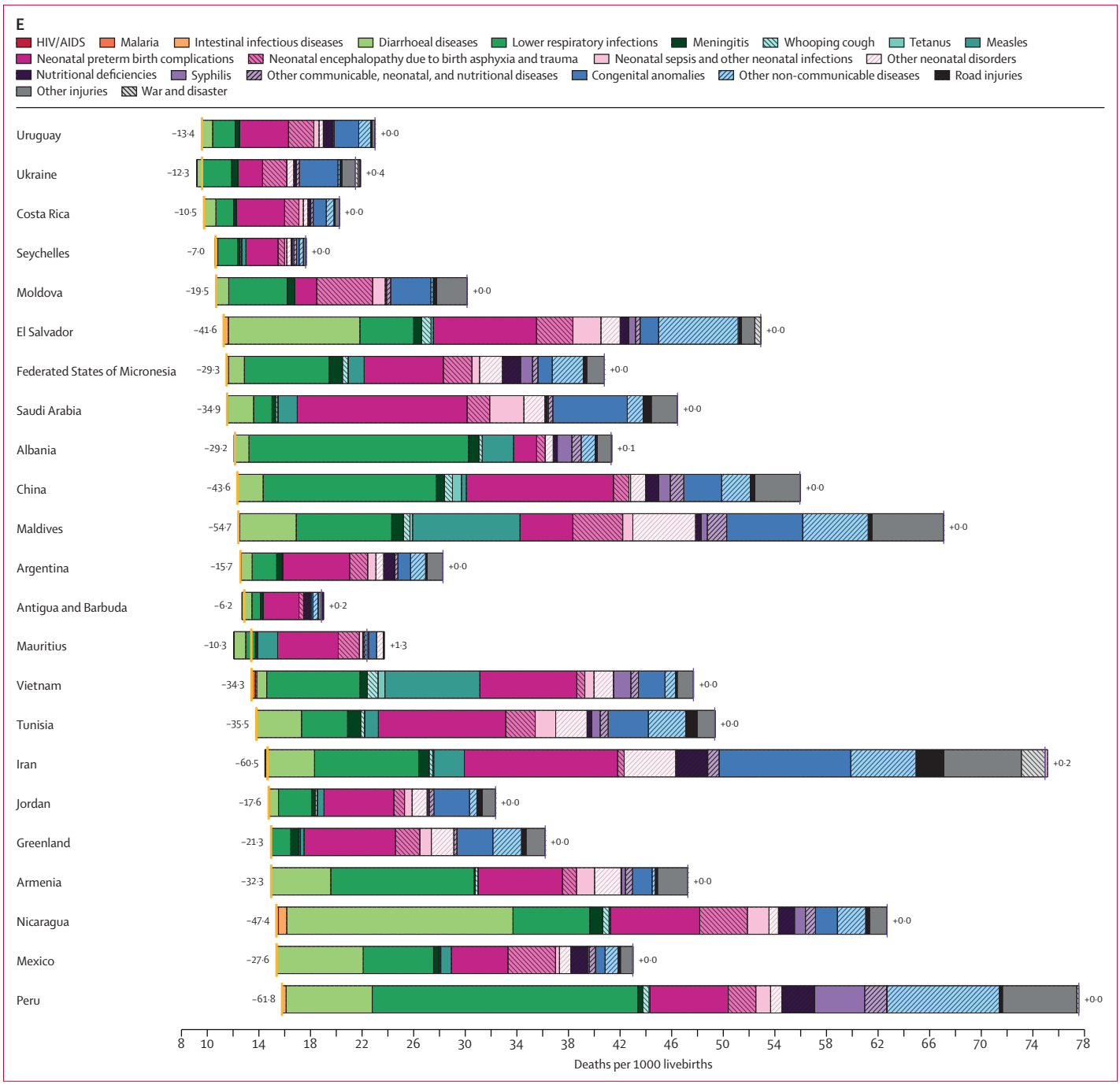
MDGs were declared. Geographies in blue met or exceeded an annualised rate of decrease of 4·4%, the pace required to achieve MDG4 starting in 1990. The figure emphasises the acceleration of progress in reducing under-5 deaths in many sub-Saharan African countries. 16 countries in sub-Saharan Africa achieved MDG4 pace reductions betwveen 2000 and 2015, compared with the two that achieved that rate of reduction between 1990 and 2015. Many countries in central Asia and eastern Europe, including Russia (5·4% [5·2–5·6]) and Azerbaijan (5·2% [3·4–7·0]), also reached or surpassed the MDG4 target for annualised rates of decrease from 2000–15; however, based on the MDG4 timeline of 1990–2015, these countries failed to achieve the target of 4·4% per year.



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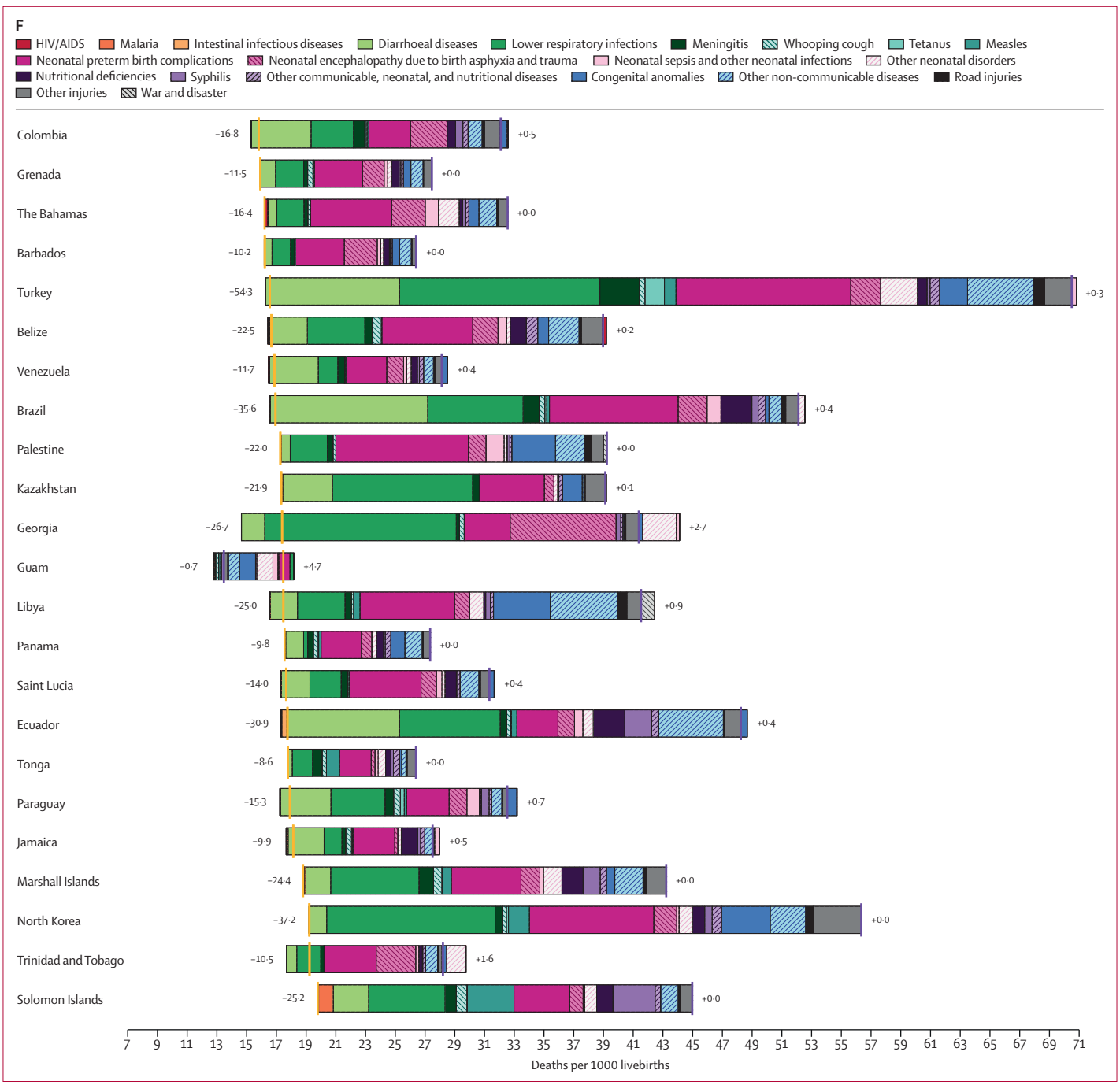
Global changes in under-5 deaths

While nearly all causes of under-5 deaths decreased by 2015, their relative rankings shifted over time (figure 3). From 1990–2005, only two of the leading causes of under-5 death had significant increases in lives claimed and relative ranks: malaria (an 18·2% [1·3–45·7] rise, from sixth to fourth) and HIV/AIDS (a 419·5% [374·8–461·5] rise, from 32nd to 12th). By contrast, global under-5 deaths due to various communicable diseases fell substantially, including diarrhoeal diseases (45·3% [40·0–50·0]), lower respiratory infections (47·5% [44·1–50·7]), measles (65·5% [51·2–75·9]), and tetanus (76·3% [72·4–79·0]). Under-5 deaths due to a number of injuries also decreased, including road injuries (43·6%



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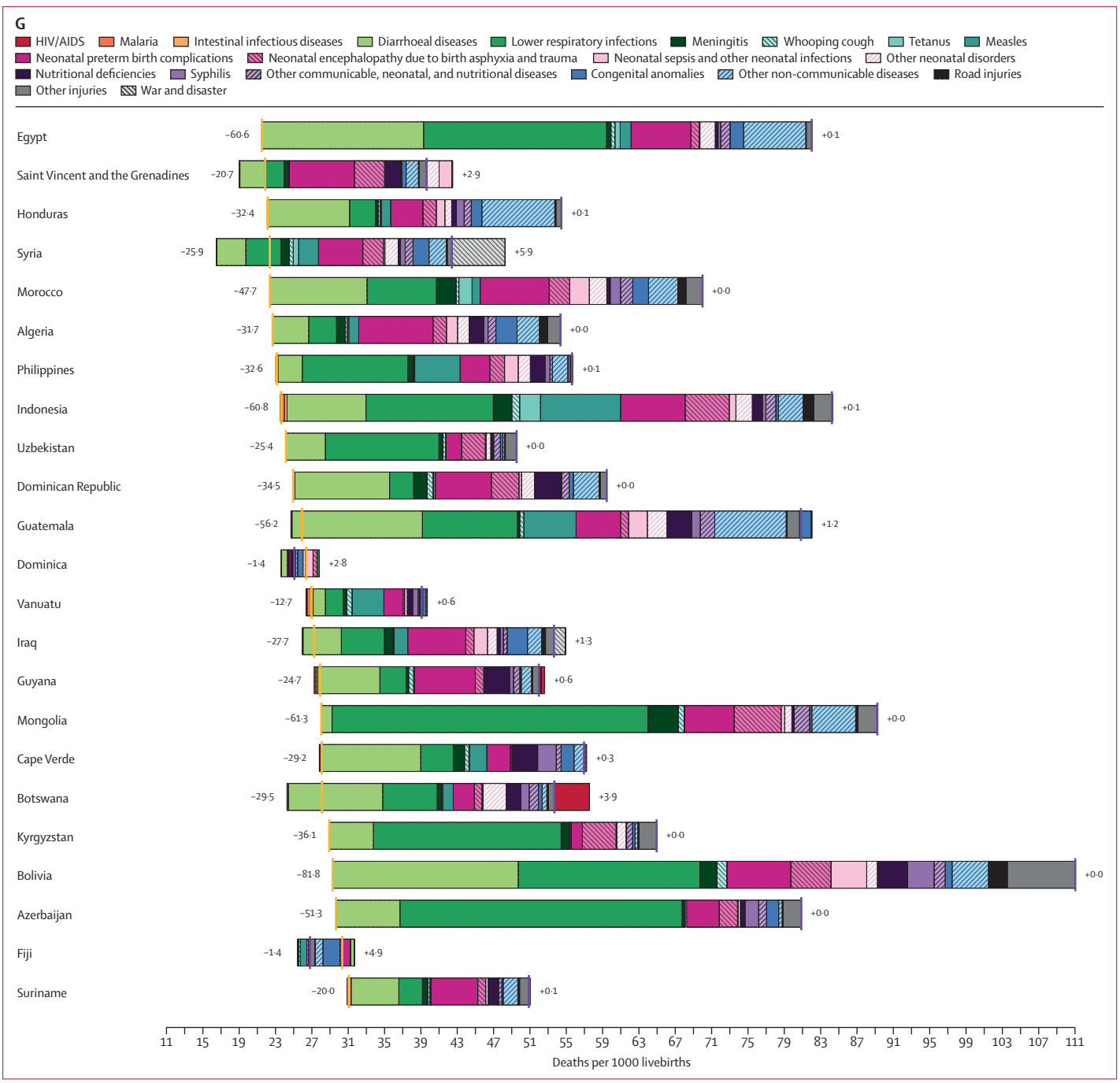
[31·6–51·8]) and drowning (57·0% [49·9–63·1]). Although total under-5 deaths due to congenital anomalies and haemoglobinopathies, such as sickle cell anaemia, decreased from 1990–2005, their relative rankings increased during this time. Between 2005 and 2015, the rise of malaria and HIV/AIDS reversed, with under-5 deaths due to these causes falling by 42·8% (29·4–54·6) and 51·9% (49·6 –54·2), respectively. These decreases continued for lower respiratory infections, diarrhoeal diseases, and tetanus, although the percent decrease over the most recent decade was not as high as in the previous 15 years; a similar trend was found for under-5 injury deaths, particularly for road injuries. Under-5 deaths due to measles, however, fell



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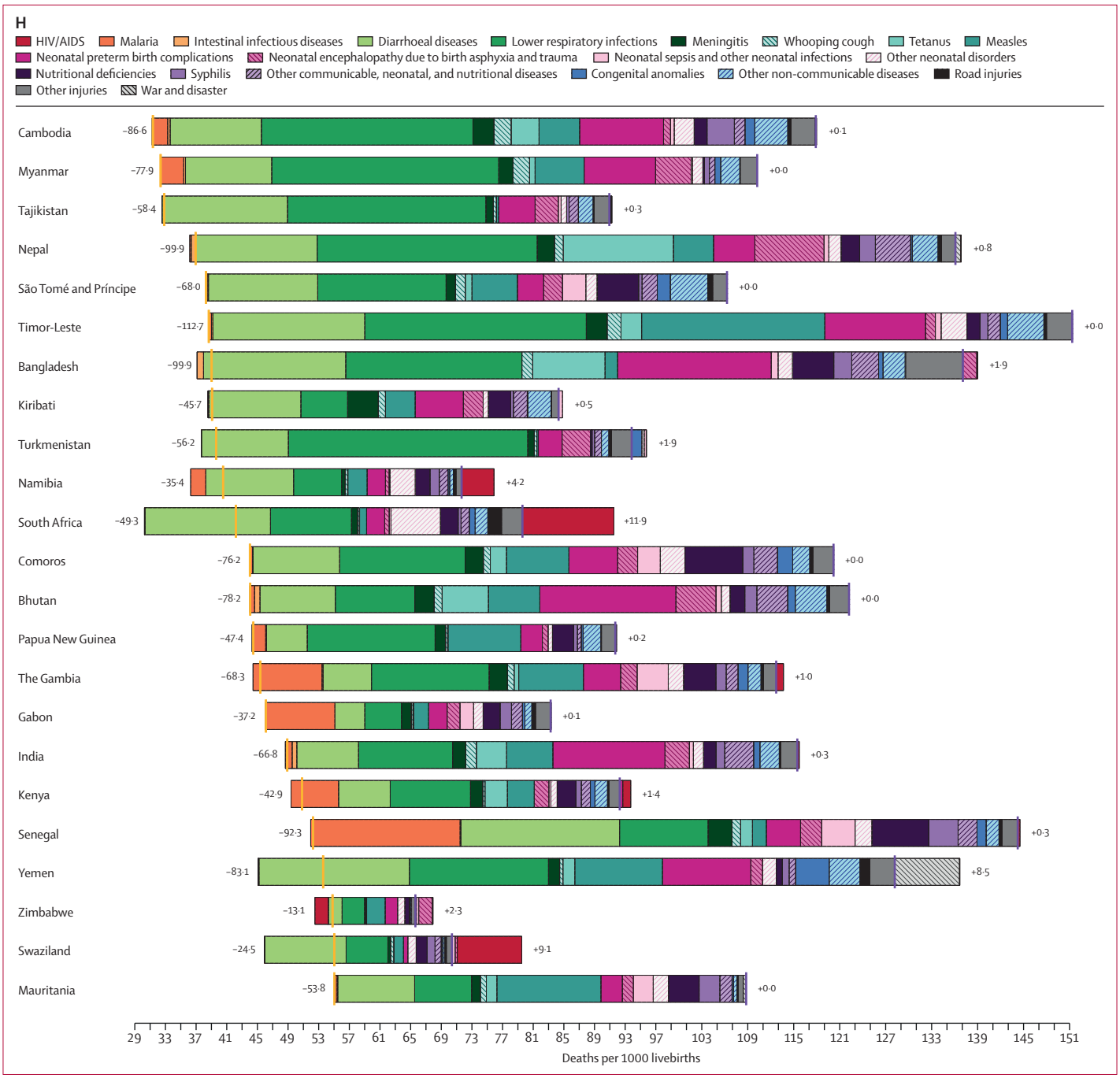
faster after 2005, dropping another 75·1% (59·6–84·5) by 2015. War rose to the 25th-leading cause of global under-5 deaths in 2015, largely driven by escalating mortality associated with ongoing conflicts in the Middle East. Notably, preterm birth complications and neonatal encephalopathy became the leading two causes of global under-5 deaths in 2015, despite experiencing moderate but statistically significant decreases in under-5 deaths from each cause. These shifts represent the relatively slower progress for reducing mortality due to neonatal conditions as compared with various communicable diseases. For under-5 deaths due to congenital anomalies and haemoglobinopathies, minimal changes between 2005 and 2015 led to increased relative ranks as well.



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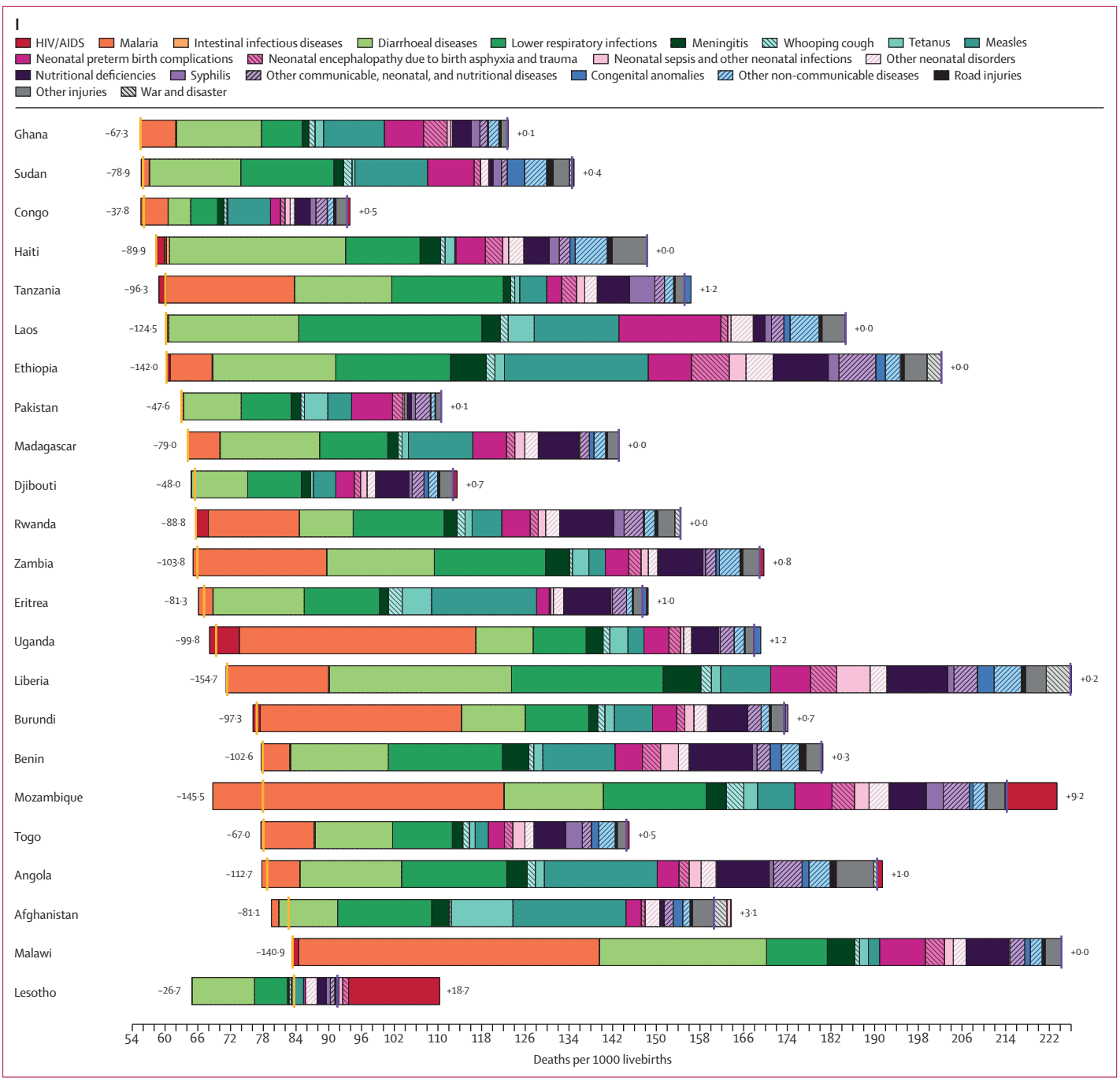
Decomposing changes in under-5 mortality by causes of death

Figure 4 charts changes in under-5 mortality from 1990–2015, as attributable to changes in leading causes of under-5 deaths, for each country and territory. The vertical purple line indicates under-5 mortality in 1990 and the vertical orange line reflects under-5 mortality in 2015. The relative composition of each geography's horizontal bar illustrates how the change in cause-specific mortality contributed to overall changes in under-5 mortality between 1990 and 2015. Causes to the left of the 1990 line represent decreases in cause-specific mortality from 1990 to 2015.

Cause-specific drivers of reduced rates of under-5 mortality substantially varied by country, although some



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regional trends emerged. For many high-income countries that already had under-5 mortality rates lower than 20 per 1000 livebirths in 1990, decreasing mortality due to neonatal disorders and congenital anomalies led to even lower under-5 mortality by 2015. In places known for their marked gains in overall development since 1990 (eg, China, Iran, Bhutan, and the Maldives), large reductions in death rates due to several causes—preterm birth complications, congenital anomalies, lower respiratory infections, and injuries—led to these countries' equally sizeable decreases in under-5 mortality. For Latin America and several countries in southeast Asia, progress in under-5 mortality was associated mainly with decreasing death rates from lower respiratory infections, diarrhoeal

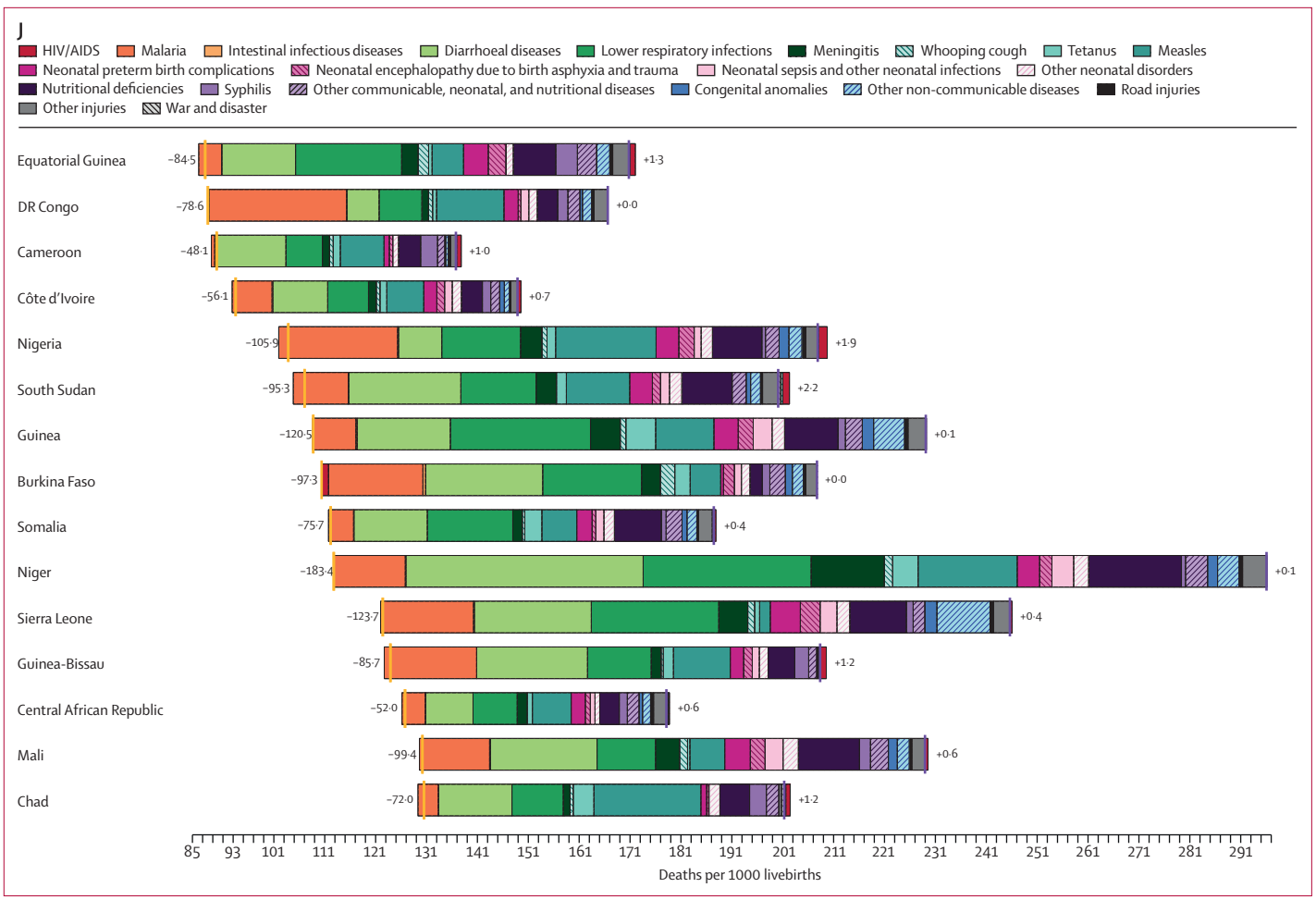

Figure 4: **Attribution of changes in under-5 mortality for 21 GBD regions and countries, territories, and subnational units in the UK to changes in major groups of causes of under-5 death, both sexes combined, 1990–2015**

Locations are ordered by increasing under-5 mortality in 2015. The purple and orange lines show under-5 mortality rates in 1990 and 2015, respectively. Causes to the right of the 1990 under-5 mortality values reflect causes that contributed to increases in under-5 mortality between 1990 and 2015. Causes to the left of the 1990 under-5 mortality values contributed to decreases in under-5 mortality between 1990 and 2015.

diseases, measles, and preterm birth complications. Decreasing malaria mortality rates served as the main force behind overall decreases in under-5 mortality for several countries in sub-Saharan Africa. In Uganda, Mozambique, Malawi, and Burundi, reductions in under-5 malaria deaths accounted for at least 35% of their total decreases in under-5 mortality. Several countries in sub-Saharan Africa, including Niger, Mali, Benin, and Liberia, could also attribute their improvements in child survival to reduced mortality from nutrition deficiencies; however, such progress was generally far exceeded by the gains made against infectious diseases. Unlike higher-income countries, mortality rates due to neonatal disorders decreased at a much slower pace in sub-Saharan Africa, and thus minimally contributed to overall reductions in under-5 mortality.

Across countries and territories under analysis, only three geographies (Dominica, Fiji, and Guam) had overall increases in under-5 mortality between 1990 and 2015; nonetheless, in some other countries, high rates of mortality due to HIV/AIDS or war lessened the potential for even greater gains for child survival since 1990. For example, in Lesotho, decreases in under-5 mortality due to diarrhoeal diseases and lower respiratory infections were almost completely counteracted by the country's toll of HIV/AIDS. The effects of war on child survival were evident for Syria and Yemen, where rising war-related deaths offset large decreases in under-5 mortality due to diarrhoeal diseases and lower respiratory infections.

SDI and under-5 mortality at regional and global levels

In view of the strong association between SDI and under-5 mortality, we examined regional trends for under-5 mortality and SDI to identify where progress was faster or slower than would be expected based on changes in SDI alone over time. In figure 5, each point represents a successive year from 1990 to 2015, reflecting trends in observed and expected under-5 mortality for each GBD

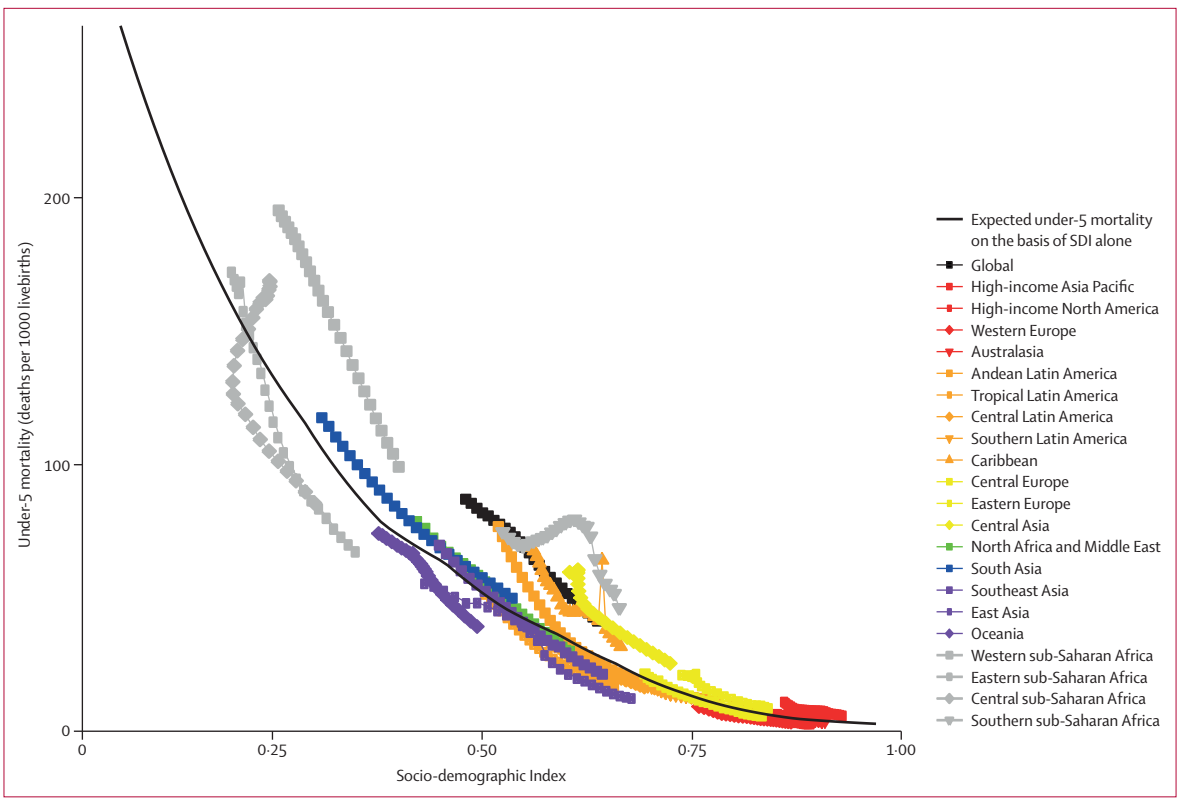

Figure 5: **Co-evolution of under-5 mortality with SDI globally and for GBD regions, 1990–2015**
Coloured lines show global and region values for under-5 mortality. Each point in a line represents one year starting at 1990 and ending at 2015. In all regions, SDI has increased over time, so progress in SDI is associated with points further to the right and later years for a given region. The solid black line represents the expected under-5 mortality based on SDI alone. SDI=Socio-demogrpahic Index. GBD=Global Burden of Disease.

region. The black line denotes expected levels of under-5 mortality based on rising SDI alone, which means that estimates above the black line are higher than expected given measures of SDI, and those below are lower than expected based on SDI alone.

For higher-income regions, observed under-5 mortality generally followed expected trends over time and with increasing SDI. Western Europe and high-income Asia Pacific consistently recorded under-5 mortality rates that were somewhat lower than expected, based on SDI, whereas high-income North America posted slightly higher under-5 mortality rates than expected over time and given SDI. After experiencing under-5 mortality equalling or above expected rates given SDI in the 1990s, several regions, including Andean, Central, and tropical Latin America, as well as north Africa and the Middle East, had under-5 mortality rates falling below expected levels based on SDI by 2015; such progress was especially pronounced for Andean Latin America. Observed under-5 mortality consistently exceeded expected levels, based on rising SDI, in the Caribbean and central Asia, whereas under-5 mortality rates fell increasingly below expected levels for Oceania. Under-5 mortality trends and their relation to increasing SDI diverged across regions in sub-Saharan Africa. Although observed levels of under-5 mortality exceeded expected rates in central and eastern sub-Saharan Africa in the 1990s, both regions saw marked reductions in observed under-5 mortality over time and experienced under-5 mortality rates far below expected levels by 2015; however, on average, these regions were still among those with the lowest levels of SDI in 2015. Notably, under-5 mortality in central sub-Saharan Africa largely decreased during a period of time when SDI decreased in the region. For western and southern sub-Saharan Africa, observed under-5 mortality remained higher than expected levels from 1990–2015, although increasing SDI in western sub-Saharan Africa corresponded with observed under-5 mortality rates moving closer to expected levels. In southern sub-Saharan Africa, under-5 mortality rose between 1995 and 2005, despite increasing SDI, fuelled by the escalating HIV/AIDS epidemic. Observed rates of under-5 mortality substantially decreased from 2006 to 2015, yet southern sub-Saharan Africa's levels of under-5 mortality still exceeded expected rates given its SDI during that time period.

With increasing SDI, expected levels and composition of under-5 mortality shifted in a noticeable pattern; figure 6 depicts these trends as assessed across

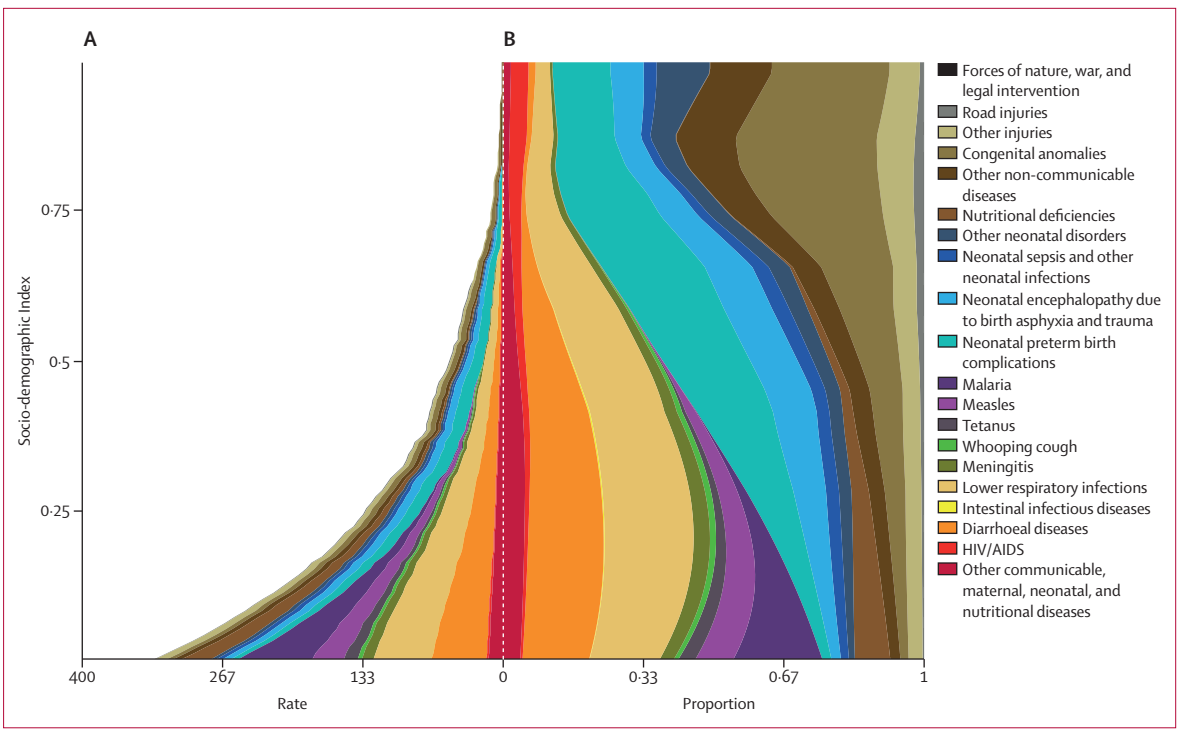

Figure 6: **The expected relationship between rates of under-5 mortality by cause (A) and the proportion of child deaths due to each cause (B) with SDI, both sexes combined, 1980–2015**

These stacked curves represent the average relationship between SDI and each cause of under-5 mortality observed across all geographies over the time period 1980–2015. The y axis goes from lowest SDI up to highest SDI. To the left of the midline are under-5 mortality rates, and the right-hand side shows the proportion of the total in order to highlight the different cause pattern in high SDI locations. SDI=Socio-demographic Index.

geographies and over time, representing the average relationship between expected causes of under-5 mortality along measures of SDI. At the lowest levels of SDI, communicable causes, especially lower respiratory infections and diarrhoeal diseases, accounted for most under-5 deaths. Nutritional deficiencies and neonatal disorders, which kill thousands of children under 5 worldwide, comprised a smaller proportion of overall deaths at the lowest levels of SDI. Even a moderate rise in SDI led to large absolute reductions in under-5 death rates and marked changes in cause composition. Under-5 deaths due to malaria and measles plummeted with gradual increases in SDI, highlighting the substantial effects of development for a subset of diseases. At the same time, mortality due to neonatal disorders accounted for an increasing proportion of under-5 deaths; reductions in mortality from lower respiratory infections are slower as well. By an SDI of 0·75, infectious diseases led to very few under-5 deaths. At this level of SDI, neonatal disorders and congenital anomalies accounted for the majority of under-5 deaths, though overall deaths were quite low.

SDI and child mortality at country, territory, and subnational levels

Distinctive, but highly heterogeneous, patterns emerged across and within regions when we compared observed under-5 mortality rates and annualised rates of change to expected levels and pace of change for under-5 mortality given SDI in 2015. Figure 7 shows the ratios of observed and expected under-5 mortality by geography in 2015, colour coded by the magnitude of differences between observed and expected under-5 mortality.

Geographies where the ratio of observed and expected under-5 mortality fell well below 1·00 were mainly in Central America, many states in Brazil, east and southeast Asia, and western Europe. A subset of countries in north Africa and the Middle East (eg, 0·44 in Palestine and 0·43 in Morocco), and eastern sub-Saharan Africa (eg, 0·57 for Ethiopia and 0·65 for Mozambique) also had lower levels of observed under-5 mortality than expected given SDI. Turkmenistan, Guam, and Azerbaijan had the highest ratios for observed and expected under-5 mortality, each exceeding a ratio of 3·00. There was also a high level of heterogeneity at the subnational level. In Kenya, 14 of 47 counties had levels of under-5 mortality in 2015 that were well below what was expected given their SDI while seven counties experienced levels that were somewhat higher than expected. In China, 30 of 33 provinces and municipalities recorded ratios equal to or below 1·00, highlighting countrywide gains in under-5 mortality, whereas all subnational geographies in the USA and South Africa had higher levels of observed under-5 mortality than expected rates based on SDI.

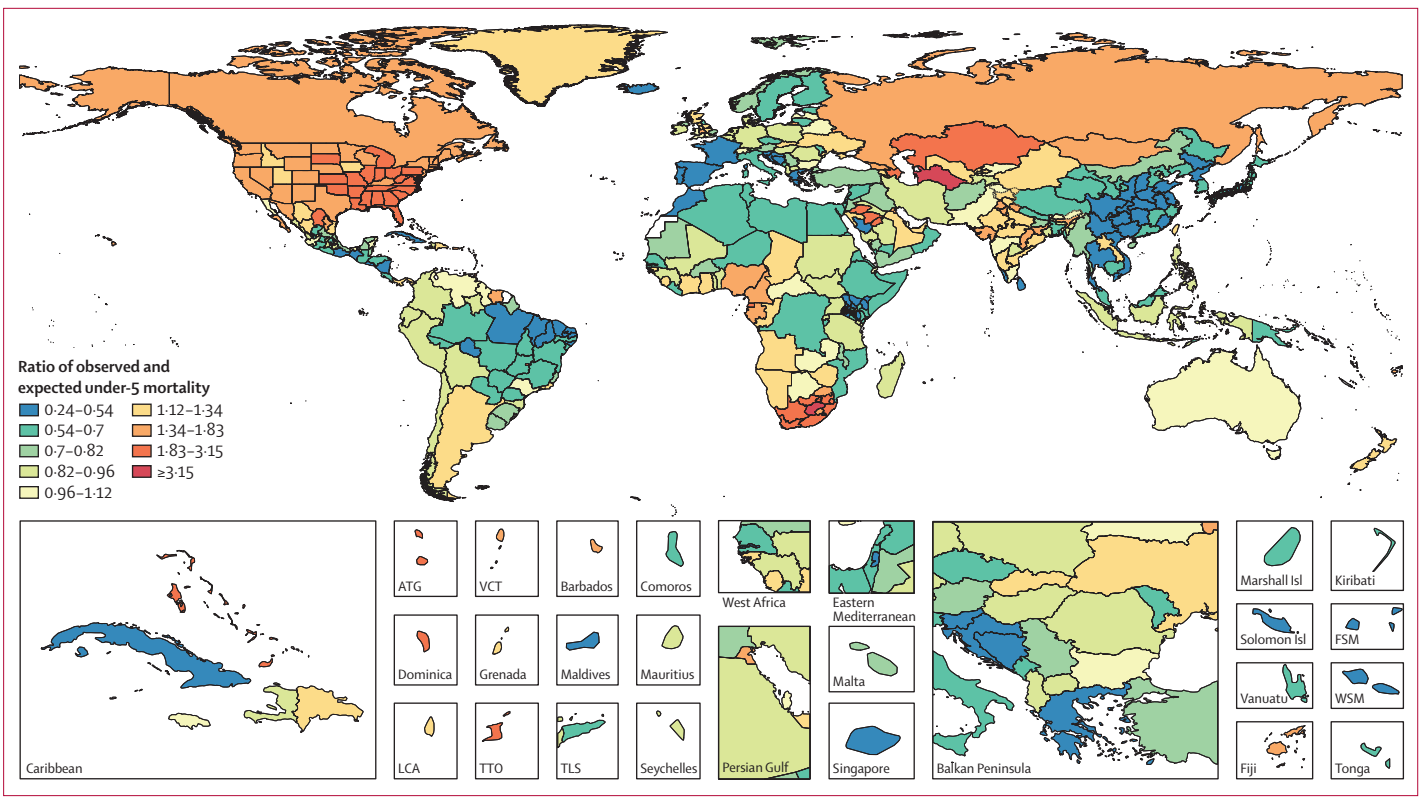

Figure 7: **Ratio of observed levels of under-5 mortality to expected levels of under-5 mortality on the basis of SDI alone by GBD subnational Level 1 geography, both sexes combined, 2015**
Expected levels of under-5 mortality and annualised rates of change were estimated based on SDI. For each category shown in the legend, the range is inclusive of the minimum value and goes up to, but does not include, the maximum value. SDI=Socio-demographic Index. GBD=global burden of disease. ATG=Antigua. VCT=Saint Vincent and the Grenadines. LCA=Saint Lucia. TTO=Trinidad and Tobago. TLS=Timor-Leste. Isl=islands. FSM=Federated States of Micronesia. WSM=Samoa.

We also noted geographic differences between observed and expected annualised rates of change for under-5 mortality between 2000 and 2015. Of the 195 countries and territories assessed, 125 had annualised rates of decline that were faster than expected based on change in SDI alone. Compared with expected rates of change, observed rates of annualised decline were generally faster in sub-Saharan Africa and throughout the Asia Pacific. Exceptions included Chad and Lesotho in sub-Saharan Africa, and Malaysia in southeast Asia. The appendix further illustrates these differences (appendix p 39).

Expected changes in under-5 mortality due to SDI

Figure 8 shows the global trend in the observed number of under-5 deaths and the number of under-5 deaths expected based on the average relationship with SDI. From 1990–2000, the global trend in observed under-5 deaths generally followed the expected trend based on SDI. In 2000, observed under-5 deaths fell below expected levels, at about 9·3 million (95% UI 9·2–9·4) under-5 deaths. From 2000–15, the gap between observed and expected under-5 deaths widened. In 2015, based on SDI, global under-5 deaths were expected to decrease to 6·8 million; however, we recorded 5·8 million (5·7–6·0 million) under-5 deaths in 2015. Cumulatively, between 2000 and 2015, 10·3 million fewer under-5 deaths occurred worldwide than was expected on the basis of improving SDI alone.

Stillbirths

Worldwide, 2·1 million (1·8–2·5) stillbirths occurred in 2015, representing a 47·0% (35·1–57·0) decrease from 4·0 million (3·1–5·2) in 1990. In view of the fact that livebirths worldwide have increased slightly from 138·6 million to 140·6 million during the same time, the decrease in number of stillbirths is all the more encouraging. Stillbirth rates decreased 47·0% (35·6–56·8) during this time, declining from 28·1 per 1000 (21·8–36·4) in 1990 to 14·9 per 1000 (12·8–17·6) in 2015. Figure 9 displays stillbirth rates across geographies in 2015, which ranged from 1·2 per 1000 (1·0–1·5) in Iceland to 56·3 per 1000 (32·3–98·2) in South Sudan. Western and central sub-Saharan Africa recorded among the highest stillbirth rates, with eight countries experiencing rates exceeding 25 per 1000 in 2015. South and southeast Asia saw stillbirth rates span from 3·4 per 1000 (2·6–4·5) in Thailand to 27·6 per 1000 (23·1–32·8) in Pakistan. In Europe, nine countries documented stillbirth rates lower than two per 1000, whereas no country or territory in the Americas had stillbirth rates

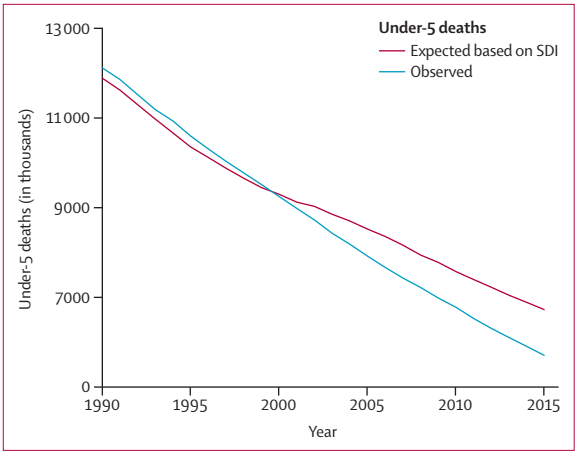

Figure 8: **Global trends in under-5 deaths, observed and expected on the basis of Socio-demographic Index alone, 1990–2015**

lower than 2·5 per 1000. Large decreases in stillbirth rates have been found in many countries from 1990–2015. Notably, in 156 of 195 countries included in GBD 2015, stillbirth rates decreased more quickly since 2000 than between 1990 and 2000.

Discussion

Since its establishment in 2000, MDG4 has been viewed as a major catalyst for heightened political, social, and financial commitments to improve child survival, and specifically, to reduce under-5 mortality by two-thirds by 2015. Yet the duration of assessment for MDG4 spanned 1990–2015,[24] a decision that ultimately affected which countries could be considered on pace—equalling or exceeding an annualised rate of decline of 4·4%—to achieve this target. As part of the GBD 2015 study, we identified 58 countries that met or surpassed this threshold between 1990 and 2015, and 36 were deemed to be low-income, lower-middle-income, or upper-middle-income countries. By contrast, from 2000–15, 73 countries reached or exceeded this pace of decline, and many more were in sub-Saharan Africa. However, amid these gains, 23 countries still reported under-5 mortality rates exceeding 75 deaths per 1000 livebirths in 2015, three times higher than the recently proposed SDG target for 2030.[41] Further, while absolute differences between countries with the lowest and highest rates of child survival have narrowed since 1990, by 2015, under-5 mortality still ranged from fewer than two deaths per 1000 livebirths in Andorra to more than 130 deaths per 1000 livebirths in Chad. These findings emphasise the pressing need to better assess how various factors may accelerate or hinder progress for reducing under-5 mortality.

As a novel extension of GBD 2015 analyses, we assessed global trends in under-5 deaths, in terms of what we recorded and what we could have expected solely on the basis of SDI. From 1990–2000, global trends in under-5 deaths were consistent with improving levels of SDI. The high correlation recorded for SDI and under-5 deaths, which was found across geographies during this time, was probably mediated through several pathways, including improved access to and demand for public health services and medical care, and reduced risks for various childhood diseases, including malnutrition, poor water and unsafe sanitation, and pollution.[55] However, from 2000 onwards, we observed greater gains in reducing under-5 deaths than what would be expected in view of increases in SDI alone. This accelerated pace of progress led to 10·3 million fewer under-5 deaths since 2000, a time that marked a new era focused on improving child health.

Such hastened, faster-than-anticipated gains in survival and longevity have been studied previously, including Preston's attribution of shifts in the association between life expectancy and income per person to technical innovations[10] and several studies that identify medical technologies or health-sector research and development activities as the main, if not singular, drivers of reduced mortality.[13,30,56] Alternatively, such gains also have been accredited to increased investments in child health programmes,[22] as well as packages of cost-effective interventions targeting disorders that disproportionately affect children.[10,13] Recent analyses show that accelerated reductions in under-5 mortality can be traced to the scale-up of multiple health interventions since 2000, including insecticide-treated nets, prevention of mother-to-child transmission of HIV, and the introduction of new vaccines, alongside improved indicators of socio-economic development.[57] The timing of such gains in child survival from 2000–15, which far exceeded the expected pace of progress based on improved SDI, cannot be ignored, as this progress directly coincided with an escalated policy focus on—and development assistance allocated to—child health.

Many factors probably underpin these findings, and they should be thoroughly examined in future studies; based on our current analyses and data, we cannot reliably parse out and attribute decreases in under-5 mortality to specific interventions, health policies, or the intersection of heightened development and health system performance by geography. Here we delve further into GBD 2015 findings for child mortality, specifically as they relate to the MDG4 era, changes in SDI, and changes in cause-specific mortality in children younger than 5 years.

MDG4 and the future of improving child survival

To chart potential pathways for achieving continued reductions in under-5 mortality, as well as the proposed SDG goals for child survival, it is of immense value to examine where and why particular countries have decreased under-5 mortality, and at faster rates, than gains in SDI alone would predict. Costa Rica and Cuba, which are heralded as model countries for elevating both income

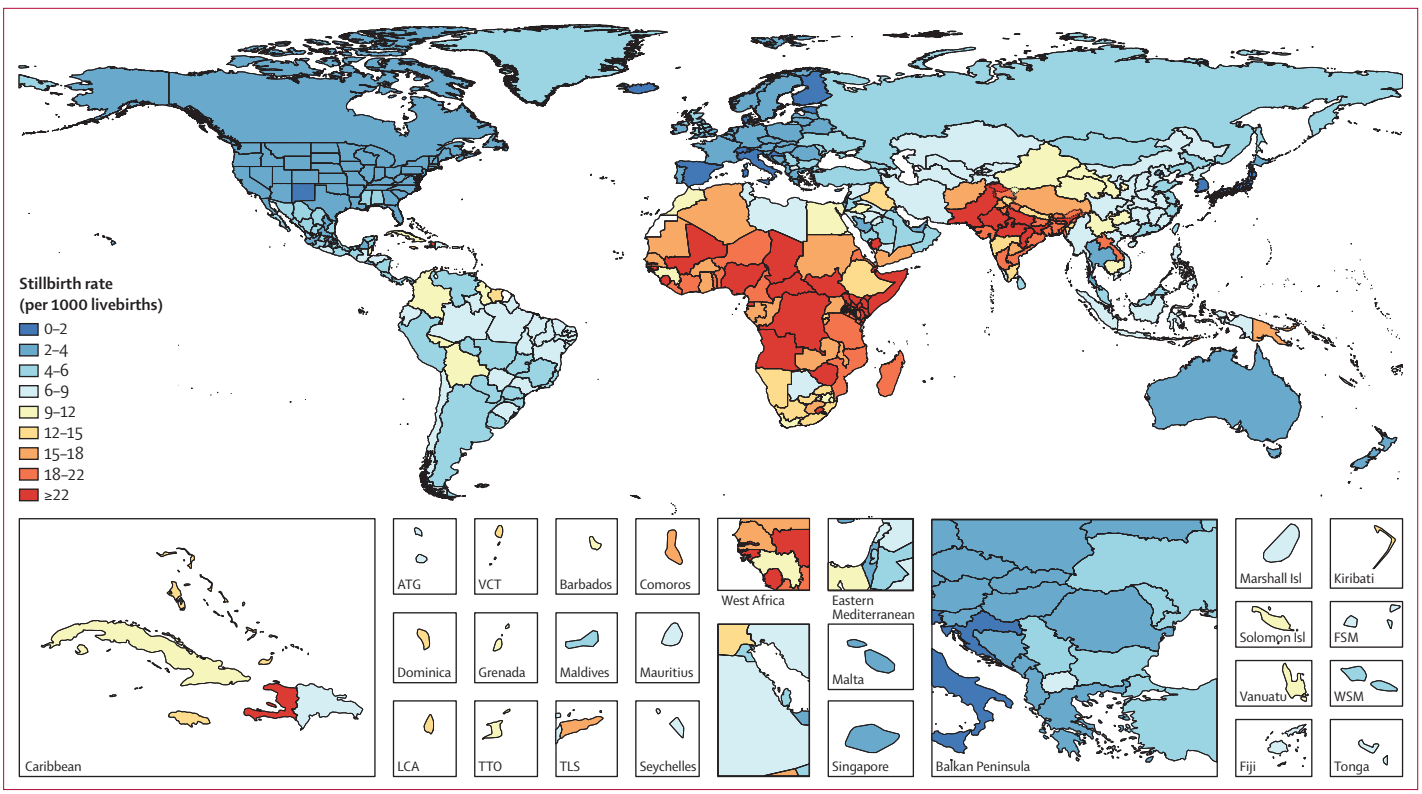

Figure 9: **Stillbirth rates by GBD subnational Level 1 geography, both sexes combined, 2015**
For each category shown in the legend, the range is inclusive of the minimum value and goes up to, but does not include, the maximum value. GBD=Global Burden of Disease. ATG=Antigua. VCT=Saint Vincent and the Grenadines. LCA=Saint Lucia. TTO=Trinidad and Tobago. TLS=Timor-Leste. Isl=islands. FSM=Federated States of Micronesia. WSM=Samoa.

and health outcomes since the 1990s,[13] achieved lower levels of under-5 mortality than expected on the basis of SDI alone by 2015; however, their pace of progress in reducing under-5 mortality from 2000 to 2015 was slower than expected based on increases in SDI. Chile and China, the other two countries that comprise the lauded 4Cs,[13] also recorded lower-than-expected levels of under-5 mortality in 2015, particularly China; in terms of their annualised rates of change for under-5 mortality since 2000, nearly every province and municipality in China saw the pace of declining under-5 mortality exceed expected rates, whereas Chile's rate of decline was somewhat slower than expected on the basis of SDI. In combination, these examples stress the importance of assessing both absolute levels and relative pace of progress when identifying country outliers in performance.

For GBD 2015, four low-income countries—Cambodia, Ethiopia, Liberia, and Nepal—met or exceeded the MDG4 annualised pace of decrease for both time periods (1990–2015 and 2000–2015), representing several success stories for improving child health. As shown by our decomposition analyses, substantial reductions in under-5 deaths due to lower respiratory infections and diarrhoeal diseases contributed decreases in overall under-5 mortality across these four countries. Further, in Ethiopia, decreasing under-5 deaths due to measles and nutritional deficiencies also were major factors in improving child survival, which might be related to the country's implementation of accelerated measles control strategies during the 2000s[58] and continued efforts to address historical challenges with malnutrition.[59] The group of low-income countries that met or exceeded the MDG4 pace of decrease since 2000 markedly grew, also including Malawi, Niger, Rwanda, Tanzania, and Zambia, which provides concrete evidence that rapid decreases in under-5 mortality are achievable, even in lower-resource settings. Within countries known for subnational inequalities, including Brazil and Kenya, observed rates of decrease in under-5 mortality in some regions (eg, northeast Brazil; western and southern areas of Kenya) highlight the potential for progress amid long-standing disparities. It is an unlikely coincidence that many of these geographies also recorded lower under-5 levels in 2015 and faster rates of decrease since 2000 than expected based on SDI. MDG4 country case studies highlight the importance of multi-sectoral approaches to improving child health,[60–62] such as implementing policies to achieve universal access to primary care for women and children, increasing overall government spending on maternal and child health, and enacting programmes that promote educational attainment and empowerment among women. Expanded cases studies examining the drivers of

faster-than-expected reductions in under-5 mortality, particularly among countries of similar SDI, could provide powerful examples of policy and financing options to sustain, and accelerate, gains in child survival in the post-MDG era.

In moving from MDG4 to SDG3.2, targets for child survival also shift from a focus on relative progress to achieving absolute targets. By 2015, we found that 120 countries already recorded under-5 mortality rates below 25 per 1000 livebirths, and 118 countries had neonatal mortality rates under the target of 12·5 per 1000 livebirths. Some of the remaining countries, including Mali, Chad, and the Central African Republic, experienced levels of under-5 mortality exceeding 125 per 1000 livebirths in 2015; to achieve SDG3.2 by 2030, these countries would need to reduce their under-5 mortality at a rate faster than 10% per year. Such large, continuous reductions in under-5 mortality are essentially unprecedented in recent decades, with the exception of a few counties in China.[32] Subsequently, the pursuit and potential achievement of SDG3.2 depends on sustained, targeted investments and long-term commitments to enabling policy environments. In an era of stagnating development assistance for health and relatively weak prospects for sizeable growth for domestic health financing in low-income countries,[22,23] depending on elevated funds as the primary accelerant of child survival will likely leave many countries short of achieving SDG3.2 by 2030. Instead, the combination of continuing investments in proven, high-impact child health programmes, including immunisation programmes and malaria interventions, targeting development assistance for health to countries with the highest child mortality rates, and establishing innovative financing mechanisms and efficiency gains is crucial.

Changes in under-5 causes of death and their contribution to reducing under-5 mortality

By 2015, global under-5 deaths from the vast majority of causes markedly decreased, yet their relative pace of decrease varied substantially from 1990–2005 and 2005–15. For some causes, including measles, tetanus, diarrhoeal diseases, and lower respiratory infections, large decreases in under-5 deaths occurred during both time periods. Such sustained gains may be related to the continued expansion of routine immunisation programmes, reduced exposure to risks such as poor sanitation and household air pollution,[55] and improved access to health services and care-seeking behaviours for childhood illnesses, particularly in lower-income countries.[63] Additionally, increasingly more high-burden countries have introduced new vaccines,[64] such as pneumococcal conjugate vaccine and the rotavirus vaccine, all of which have likely contributed to decreases in under-5 deaths due to lower respiratory infections and diarrhoea. Despite these gains, however, lower respiratory infections remain a leading cause of under-5 death in many low-income and middle-income countries, underscoring the importance of addressing underlying risks for lower respiratory infections and heightened lower respiratory infection mortality (eg, various types of pollution and malnutrition),[65,66] as well as improving access to timely diagnosis and treatment.

Global under-5 deaths due to malaria and HIV/AIDS increased from 1990 to 2005 but then decreased between 2005 and 2015. The epidemic mortality peaks for malaria and HIV/AIDS were 2003 and 2005, respectively;[14] as a result, HIV/AIDS accounted for a much higher proportion of under-5 deaths in 2015 than in 1990 for several southern sub-Saharan African countries. If a similar decomposition analysis was done for countries like Zimbabwe since 2005, decreases in under-5 HIV/AIDS deaths would be a primary driver of decreased under-5 mortality. Such gains were likely prompted by the introduction and scale-up of prevention of mother-to-child transmission of HIV and antiretroviral therapy in countries with large HIV/AIDS epidemics.[67] By contrast, even though under-5 malaria deaths peaked between 2000 and 2015, under-5 malaria deaths were much lower in 2015, especially in sub-Saharan Africa, than during the 1990s. The effects of decreasing malaria mortality on overall child survival have been sizeable, as evidenced by its contributions toward reducing under-5 mortality in Malawi and Mozambique. Such reductions have been linked to the scale-up of several malaria interventions, including insecticide-treated nets and artemisinin-based combination therapies.[68]

Trends and effects of congenital anomalies, neonatal conditions, and injuries on under-5 mortality—essentially non-infectious causes of child death—varied by region and country income level. For higher-income countries, where under-5 mortality rates were already quite low in 1990, decreases in deaths due to preterm birth complications, various neonatal disorders, and congenital anomalies accounted for the vast majority of gains by 2015. These trends are likely related to improvements in medical technologies and access to intensive neonatal care. By contrast, in lower-income settings, health facilities often are not fully equipped and staffed to treat complex neonatal conditions,[69] and when they are, other barriers to care, such as cost and travel time to facilities, may prevent some of the highest risk women from seeking critical health services.[70] Effective interventions and services exist to prevent many of these conditions,[71] or at minimum avert premature death from them, including multiple antenatal care visits and case management of neonatal sepsis;[37] however, they often require multifaceted medical care or policy options that, at present, are not fully funded or prioritised by development partners and national governments alike.

For many upper-middle-income and lower-middle-income countries, overall and relative decreases in under-5 mortality were quite heterogeneous. In some countries, such as Bangladesh, decreasing deaths due to drowning

contributed to reductions in under-5 mortality since 1990, reflecting the likely implementation of policies that address heightened risks for these unintentional injuries.[72] Declining under-5 deaths due to congenital anomalies were associated with improved child survival in countries such as the Maldives and Iran, but for many countries in Latin America, including Brazil, minimal changes occurred for under-5 deaths due to these causes. Further, in some Latin American countries, such as Colombia and Venezuela, under-5 mortality rates from congenital anomalies slightly increased by 2015, albeit not significantly so. In light of the region's current Zika virus outbreak and its potential to spread to other geographies,[73,74] improved monitoring of congenital anomalies, both in terms of mortality and incidence, is of high priority.

By examining the cause composition of under-5 mortality across levels of SDI, we can consider the optimal suite of interventions that are most relevant to a geography's progression of development. At the lowest levels of SDI, the dominance of infectious diseases (namely diarrhoeal diseases, lower respiratory infections, malaria, and measles) and nutritional deficiencies underscores the potential impact of scaling up interventions targeting these causes, particularly in terms of accelerating gains in child survival beyond expected rates based on SDI. Particularly for the lowest two quintiles for SDI, several effective public health strategies exist for further reducing under-5 mortality,[20,75] including the introduction and scale-up of new and long-standing vaccines (ie, pneumococcal conjugate vaccine, rotavirus, and measles); expanding access to oral rehydration therapy and antibiotics; increasing the proper use of various malaria interventions, including insecticide-treated nets and artemisinin-based combination therapies; and addressing nutritional deficiencies through supplementation and the promotion of exclusive breastfeeding. By contrast, for geographies in the second and third quintiles of SDI, neonatal conditions accounted for the majority of under-5 deaths. This characterisation, framing epidemiological transitions in terms of under-5 mortality and SDI, uniquely captures the importance of neonatal causes and their toll on child survival as amid gains in development. To reach the very low levels of under-5 mortality achieved by many high-income countries (ie, less than five deaths per 1000 livebirths), effectively treating and preventing neonatal conditions are obstacles that countries will need to clear with increasing SDI.

Stillbirths

Amid gains in under-5 and neonatal mortality, moderate progress also occurred for reducing the world's burden of stillbirths. Globally, total stillbirths decreased 47·0% (35·1–57·0%) since 1990, decreasing from 4·0 million (3·1–5·2 million) in 1990 to 2·1 million (1·8–2·5 million) in 2015, and stillbirth rates dropped from 28·1 per 1000 (21·8–36·4 per 1000) to 14·9 per 1000 (12·8–17·6 per 1000) during this time. Such reductions, particularly in countries such as Brazil, have been associated with improved access to antenatal care and addressing known maternal risks for stillbirth.[40] While specific risks for stillbirth may vary by country and within countries (eg, the distribution of genetic risk for congenital conditions are likely to differ across regions and local communities), the commonalities in risk profiles experienced across these high-burden countries (ie, large rural populations with low access or utilisation of antenatal care and skilled birth attendance, as well as the inadequate detection and treatment of maternal conditions during pregnancy) cannot be ignored.[40]

In comparing GBD 2015 stillbirth findings with those published by the Stillbirth Epidemiology Investigator Group (SEIG),[39,40] we found that our results are highly correlated with previous estimates for 2000 and 2015 (0·891). At the country level, however, the average relative difference between GBD and SEIG estimates for 2015 was –31·3%, indicating that GBD stillbirth results were generally lower than those produced by SEIG. Relative differences ranged from –321·3% to 64·8%, with 49 countries experiencing absolute differences in their point estimates that exceeded 50%. Notably, countries for which the largest differences occurred between GBD and SEIG were rarely those with the highest stillbirth rates. Differences in point estimates for stillbirths mainly emerged from the use of divergent modelling strategies; in particular, for GBD, we applied a unified modelling strategy that drew from consistent, comparably generated covariates across geographies and over time. Further, we used source-type fixed effects and source-specific random effects nested within each country in order to properly account for potential non-sampling biases from different data sources. In combination, these methods allowed us to generate an internally consistent times series of total and rates of stillbirths across geographies.

As emphasised by others,[39,40] many countries with the highest stillbirth burdens have limited data systems documenting stillbirths and existing sources are prone to biases. Further, we found that extensive crosswalking across the eight stillbirth definitions encountered in our analysis, as well as adjusting for non-sampling bias for data sources, had substantial effects on stillbirth estimation at various geographic levels. This further demonstrates the critical importance of more standard data collection and synthesis approaches for stillbirths, particularly as we collectively seek to better quantify local burdens of stillbirth and identify cost-effective options for their prevention.

Comparing GBD and IGME estimates

In recent years, both the GBD and IGME have produced annual assessments of trends in child mortality.[1,2,5,6,76] GBD 2015 estimates and the most recent estimates from IGME are highly correlated (0·983) across the

187 countries and time period (1990–2015) they both cover; however, for some countries, there are notable differences. In comparing absolute values of mean relative differences for estimates of under-5 mortality between GBD 2015 and IGME, we found a mean absolute relative difference of 20·4% in 2015, normalised to the GBD 2015 estimates. The range of country-level relative differences is much larger. Absolute relative differences in 2015 between the two organisations' estimates exceeded 20% for 74 countries and were between 10% and 20% in 43 countries. While our estimates were correlated (0·768), and we identified a similar quantity of countries achieving MDG4 (ie, 59 from IGME and 58 from GBD), variation emerged in terms of which countries actually met the target by 2015. 42 countries were identified as achieving MDG4 by both GBD and IGME, whereas 16 countries were acknowledged as having achieved MDG4 by GBD but not by IGME, and 17 countries were categorised as achieving MDG4 by IGME but not by GBD (the appendix provides a detailed comparison). Results for sub-Saharan Africa were especially discrepant, as we identified only two countries, Ethiopia and Liberia, having achieved MDG4 between 1990 and 2015, and IGME reported ten countries reaching MDG4 (Eritrea, Ethiopia, Liberia, Madagascar, Malawi, Mozambique, Niger, Rwanda, Tanzania, and Uganda).[5] In view of the recorded variations across estimates, and the uncertainty associated with estimating annualised rates of change, we recommend judicious interpretation of particular claims about the achievement or non-achievement of MDG4.

Such differences in estimates stem from a number of factors. First, our approaches to data processing differ. In GBD, methods are used to calculate under-5 mortality rates from summary birth histories,[1,77] which consist of four different modelling strategies as informed by characteristics of the raw data composing the summary birth histories. These improved methods address two main shortcomings of previous summary birth history methods, which are still currently used by IGME and other organisations:[5,6] unstable estimates of under-5 mortality for the years immediately before survey data collection; and the short span of time covered by estimates. We have subjected our summary birth history models to extensive validation testing, which documents the improved accuracy of our methods for analysing summary birth history data.[77] Second, there are notable differences in the modelling strategies used by GBD and IGME. Developed during the 2013 iteration of GBD, we apply a data bias adjustment before ST-GPR, which is the modelling step from which final estimates and corresponding 95% uncertainty intervals are generated. This adjustment allows us to correct for non-sampling biases from each data source within each country upon designating reference sources.[1] Reference source selection is informed by documentation of data quality and insights provided by the extensive GBD network of collaborators.

Improving child mortality data coverage and quality

Data quantity and quality for under-5 mortality, especially in low-income and middle-income countries, has steadily improved over the past three decades; nonetheless, most available data for under-5 mortality in these settings are derived from survey instruments and do not originate from fully functional, complete VR systems. In recent years, honed methods for extracting and synthesising measures of under-5 mortality from surveys, especially summary birth modules, and subnational health information systems have supported more accurate, timely generation of under-5 estimates.[1,77] However, in the absence of VR data, high levels of uncertainty accompany these measures and the risk of biased estimates persists. For monitoring age-specific mortality and stillbirths, these measurement challenges are only amplified, as the quantity and standardisation of data collection for these indicators are much lower. SDG targets call for improved data monitoring for countries, including an indicator that refers to the need for birth registration, a key component of VR systems, for all populations by 2030.[41] Increased and sustained investments in building and maintaining complete VR systems, especially in LMICs, have the potential to strengthen responsiveness to and accountability for continuing to improve child health in the post-MDG era.

Limitations

Amid its strengths and methodological advances, the present study has several limitations. First, although the quantity of data available to estimate under-5 mortality is quite high for most countries, potential for bias exists across the various data sources. We have sought to account for these biases by identifying the highest quality reference source for each country and adjusting estimates from other sources accordingly. Nonetheless, bias might remain for selected reference data sources. Second, less data are available to systematically disaggregate estimates of under-5 mortality into age-specific values for early neonatal, late neonatal, post-neonatal, and ages 1–4 years by geography and year; subsequently, age-specific results in many countries are more model dependent. A similar limitation applies to stillbirth estimation. Third, limitations associated with cause-specific estimation, as detailed in an accompanying publication,[14] apply to our decomposition analyses for attributing changes in causes of death to changes in under-5 mortality. Fourth, due to computational constraints, we were unable to fully propagate uncertainty associated with covariates used to estimate cause-specific mortality and so-called garbage code redistribution algorithms. Sensitivity analyses for under-5 mortality indicate that the omission of uncertainty

estimates from the first-stage model covariates did not significantly alter final estimates of under-5 mortality. Fifth, results evaluated in terms of SDI, such as ratios for observed and expected under-5 mortality, may be affected by the potential for measurement error in the individual components comprising SDI (ie, income per person, educational attainment, and total fertility rate). However, because it is comprised of three inputs, our SDI indicator will be less sensitive to measurement error than placing countries on the development continuum using income per person alone, and the improved correlation coefficient between SDI and under-5 mortality as compared with income per person alone provides further support to this idea. Sixth, our assessment of observed trends in under-5 deaths, as compared with expected trends based on SDI alone, cannot provide causal attribution. Rather, this examination resulted in a strong empirical correlation and provides a useful framework from which to benchmark levels and trends of under-5 deaths, taking into account where a geography is along the development continuum.

Our summary measure of SDI included key components of sociodemographic development, but it is possible that, in some contexts, other indicators may be more strongly linked to under-5 mortality, and thus the correlation between SDI and under-5 mortality may vary. Seventh, our estimation of stillbirth rates makes use of many data sources from low-income and middle-income countries that are facility based. Stillbirths from these sources are likely to be biased upwards because of women with high-risk pregnancies or difficult labour being more likely to go to a facility. In addition, there may be location-specific variations in the effect of different case definitions. We have attempted to systematically correct for this bias, but this correction is based on statistical analysis and not on detailed studies in each location. Eighth, our analyses could not account for the full range of inequalities that might be experienced within countries and subnational administrative areas. We have substantially increased the number of subnational geographies for GBD 2015, but further expansion hinges upon greater data availability and stakeholder interest in leading subnational GBD analyses. In future iterations of the GBD, we hope to further examine the effects of more localised measures of inequality, particularly for income and other socioeconomic factors, on child health outcomes across geographies. And lastly, as with other estimations of under-5 mortality and stillbirth rates, our estimates for the most recent years are based on extrapolation using our data synthesis models due to data availability. As new data from surveys and censuses become available, our estimates in the future will certainly be affected.

Conclusion

Global achievements in improving child survival serve as one of the most notable success stories in recent times, signifying the effect of international collaboration and focus on ending preventable mortality. Although these gains have been near universal across geographies, the pace of progress varied markedly, especially in terms of what could be expected based on corresponding improvements in overall development. Accelerated, faster-than-anticipated reductions in under-5 mortality occurred between 2000 and 2015 in many lower-income countries, highlighting the crucial role of scaling up effective child health interventions above and beyond sociodemographic advances. Large decreases in under-5 deaths due to many infectious diseases contributed to reductions in under-5 mortality, strengthening the evidence base for tackling these lethal, preventable conditions that disproportionately affect the poor. Overall neonatal mortality, death due to specific neonatal causes and congenital anomalies, and stillbirths moderately decreased, but such gains were mainly concentrated in higher-income countries. In evaluating shifts in composition of under-5 mortality across epidemiological transitions, the persistent toll of neonatal conditions, especially as countries moved from low levels of development and effectively reduced under-5 deaths from infectious diseases, is clear. The prioritisation of funding and programmes that address the risks for neonatal death and stillbirths will probably emerge as a vital need for countries where reductions in under-5 mortality have stagnated or occurred at a slower pace than expected given their level of development. As the world shifts away from the MDG era and toward the SDGs, we must draw from lessons learned from countries where child survival has improved the fastest and design targeted, effective strategies to accelerate reductions in child mortality for the places with the furthest to go.

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Christopher J L Murray, Haidong Wang, and Nancy Fullman prepared the first draft. Alan D Lopez and Christopher J L Murray conceived the study and provided overall guidance. All other authors provided data, developed models, reviewed results, initiated modeling infrastructure; or reviewed and contributed to the report; or both.

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