Supplementary Appendix

List of Supplementary Tables and Figures

Table S1. Description of data characteristics

	Name	Definition	Age	Data source
Indicator				
Mortality rate (per 1,000 live births)	Infant mortality	The number of infants dying before reaching one year of age, per 1,000 live births in a given year.	0–4 years old	WHO
	Stillbirth	The number of babies born with no signs of life at 28 weeks or more of gestation, per 1,000 total births.		
	Neonatal mortality	The number of neonates dying before reaching 28 days of age, per 1,000 live births in a given year.		
	Under 5 years mortality	The probability per 1,000 that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year.		
	Acute lower respiratory infections	The number of deaths from acute lower respiratory infections, per 1,000 live births.		
	Congenital anomalies	The number of deaths from structural or functional anomalies that occur during intrauterine life, per 1,000 live births.		
	Prematurity	The number of deaths of babies born alive before 37 weeks of pregnancy, per 1,000 live births.		
	Birth asphyxia	The number of deaths from the failure to establish breathing at birth, per 1,000 live births.		
	Diarrheal disease	The number of deaths from the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual), per 1,000 live births.		
	Meningitis/Encephalitis	The number of deaths from a serious infection of the meninges or inflammation of the brain caused by any one of a number of viruses, per 1,000 live births.		
	Sepsis and other infections	The number of deaths from a organ dysfunction caused by a dysregulated host response to infection, per 1,000 live births.		
Prevalence (%)	Anemia	The prevalence of anemia in children under 5 years.	0–4 years old	WHO
	Overweight	The prevalence of overweight among children and adolescents, BMI > +1 standard deviations above the median.	5–9 years old	
	Obesity	The prevalence of obesity among children and adolescents, BMI > +2 standard deviations above the median.		
	Thinness	The prevalence of thinness among children and adolescents, BMI < -2 standard deviations below the median.		

Table S2. The analysis of children's health indicators in South Korea and North Korea from 2000 to 2017

Category		Sen's slope			Mann-Kendall methods		Linear regression		
		Sen's slope	95% CI		Mann-Kendall statistics	P-value	Estimate	95% CI	
Countries									
South Korea	Infant mortality	−0.21	−0.26	−0.16	−5.76	<0.001	−0.21	−0.24	−0.19
North Korea		−1.28	−1.50	−1.10	−5.76	<0.001	−1.46	−1.70	−1.23
South Korea	Stillbirth	−0.10	−0.14	−0.07	−5.43	<0.001	−0.10	−0.13	−0.08
North Korea		−0.75	−0.88	−0.63	−5.76	<0.001	−0.78	−0.89	−0.68
South Korea	Neonatal mortality	−0.25	−0.30	−0.20	−5.76	<0.001	−0.25	−0.28	−0.22
North Korea		−1.53	−1.86	−1.32	−5.76	<0.001	−1.91	−2.29	−1.53
South Korea	Under 5 years mortality	−0.25	−0.28	−0.22	−5.72	<0.001	−0.25	−0.27	−0.22
North Korea		−0.12	−0.13	−0.10	−5.72	<0.001	−0.12	−0.13	−0.11
South Korea	Acute Lower Respiratory Infections (mortality)	−0.01	−0.02	0.00	−3.94	<0.001	−0.01	−0.02	−0.01
North Korea		−0.33	−0.40	−0.29	−5.72	<0.001	−0.41	−0.49	−0.33
South Korea	Congenital anomalies (mortality)	−0.05	−0.07	−0.03	−4.94	<0.001	−0.06	−0.07	−0.05
North Korea		−0.10	−0.11	−0.09	−5.57	<0.001	−0.10	−0.11	−0.09
South Korea	Prematurity (mortality)	0.00	−0.06	0.03	0.19	0.847	0.01	−0.02	0.04
North Korea		−0.05	−0.26	0.22	−0.04	0.97	0.05	−0.15	0.26
South Korea	Birth asphyxia (mortality)	−0.02	−0.03	−0.01	−3.86	<0.001	−0.02	−0.02	−0.01
North Korea		−0.20	−0.24	−0.17	−5.72	<0.001	−0.23	−0.27	−0.19
South Korea	Diarrheal disease (mortality)	0.00	0.00	0.00	−1.54	0.123	0.00	0.00	0.00
North Korea		−0.16	−0.23	−0.14	−5.72	<0.001	−0.26	−0.33	−0.19
South Korea	Meningitis/Encephalitis (mortality)	0.00	0.00	0.00	−2.37	0.018	0.00	−0.01	0.00
North Korea		−0.09	−0.10	−0.07	−5.43	<0.001	−0.09	−0.11	−0.08
South Korea	Sepsis and other infections (mortality)	−0.01	−0.01	0.00	−3.05	0.002	−0.01	−0.01	0.00
North Korea		−0.08	−0.09	−0.07	−5.34	<0.001	−0.08	−0.09	−0.07

South Korea	Anemia (prevalence)	0.08	0.03	0.15	4.64	<0.001	0.12	0.08	0.17
North Korea		0.05	–0.13	0.22	0.46	0.649	0.05	–0.08	0.17
South Korea	Overweight (prevalence)	0.53	0.52	0.53	5.56	<0.001	0.53	0.53	0.54
North Korea		0.74	0.70	0.78	5.56	<0.001	0.74	0.72	0.77
South Korea	Obesity (prevalence)	0.26	0.26	0.27	5.56	<0.001	0.26	0.26	0.27
North Korea		0.40	0.37	0.44	5.56	<0.001	0.41	0.39	0.43
South Korea	Thinness (prevalence)	0.00	–0.01	0.00	–2.89	0.004	–0.01	–0.01	0.00
North Korea		–0.08	–0.08	–0.08	–5.42	<0.001	–0.08	–0.08	–0.08

Table S3. The daily nutrition per person in South Korea and North Korea from 1990 to 2017

	South Korea			North Korea			South Korea			North Korea			South Korea			North Korea		
	Total Calorie (Kcal)	Plant calories (Kcal)	Animal calories (Kcal)	Total Calorie (Kcal)	Plant calories (Kcal)	Animal calories (Kcal)	Total protein (g)	Plant protein (g)	Animal protein (g)	Total protein (g)	Plant protein (g)	Animal protein (g)	Total fat (g)	Plant fat (g)	Animal fat (g)	Total fat (g)	Plant fat (g)	Animal fat (g)
Year																		
1990	2,853	2,457	395	2,370	2,135	235	89.3	56.1	33.2	75.72	59.01	16.71	72.2	46.7	25.5	46.24	28.58	17.65
1991	2,876	2,506	370	2,368	2,136	233	88.6	56.2	32.4	74.37	59.08	15.29	71.7	48.6	23	45.89	27.77	18.13
1992	2,912	2,514	398	2,222	2,042	181	90.1	56.5	33.6	68.05	55.48	12.57	73.6	48.2	25.4	38.77	25.09	13.68
1993	2,872	2,464	408	2,276	2,115	161	91.7	56.2	35.5	66.73	54.91	11.82	74.1	48.6	25.5	38.45	26.55	11.91
1994	2,950	2,534	416	2,246	2,105	141	94.5	58.1	36.4	64.89	54.98	9.9	77.3	51.2	26.1	37.25	26.66	10.59
1995	2,959	2,520	439	2,103	1,981	122	96.9	57.6	39.3	59.28	50.79	8.49	76.9	50.6	26.4	35.51	26.29	9.22
1996	2,948	2,495	453	2,080	1,968	112	98	56.8	41.1	58.46	50.53	7.93	77.7	51	26.8	32.66	24.31	8.35
1997	2,957	2,525	431	2,133	2,041	92	97	56.8	40.2	58.79	52.1	6.7	79.6	54.7	24.9	33.7	26.95	6.75
1998	2,819	2,416	404	2,121	2,012	108	93.6	56.2	37.4	57.43	50.18	7.25	72.8	49.3	23.5	32.59	24.32	8.27
1999	2,968	2,526	442	2,112	1,990	122	98.2	57.4	40.8	57.49	49.61	7.88	82.5	56.8	25.6	31.72	22.2	9.52
2000	3,010	2,579	431	2,147	2,014	132	97.1	55.9	41.2	61.15	52.36	8.78	80.1	55.9	24.1	35.82	25.6	10.23
2001	3,000	2,538	462	2,096	1,953	143	98.3	53.6	44.7	58.87	49.03	9.85	83.9	58.2	25.6	35.39	24.51	10.88
2002	2,991	2,515	477	2,182	2,022	159	98.5	52.6	45.8	62.11	51.75	10.36	85.2	58.7	26.5	37.43	25	12.43
2003	2,919	2,452	467	2,189	2,040	150	97.6	51.5	46.1	59.42	49.78	9.64	83.1	57.5	25.6	36.55	24.82	11.73
2004	2,990	2,524	466	2,206	2,054	152	99.4	52.7	46.7	60.27	50.57	9.7	85.8	60.7	25.1	37.45	25.65	11.8
2005	2,983	2,525	458	2,180	2,024	156	98.1	52.7	45.4	59.19	49.05	10.14	88.9	64.2	24.6	37	24.93	12.06
2006	2,989	2,511	478	2,141	1,999	142	100.9	52.8	48.1	57.87	48.14	9.73	88.3	62.9	25.5	34.88	24.04	10.84
2007	2,981	2,497	484	2,109	1,975	134	100.8	52.4	48.5	57.14	47.34	9.8	89	63	26	34.03	24.14	9.88
2008	2,957	2,484	474	2,095	1,969	126	96.8	50.1	46.7	56.72	46.96	9.76	88.6	62.8	25.9	34.35	25.34	9.01
2009	2,909	2,429	480	2,088	1,962	126	95.1	48.3	46.8	56.38	46.59	9.78	89.7	63.3	26.4	33.37	24.4	8.97
2010	2,990	2,504	487	2,089	1,963	126	97.4	50.1	47.3	55.8	46.14	9.66	94.1	67.3	26.8	33.78	24.72	9.07
2011	3,067	2,569	498	2,100	1,972	128	97.3	49.5	47.8	56.34	46.3	10.04	96	69.5	26.4	33.96	24.78	9.18
2012	3,112	2,607	505	2,105	1,975	130	98.8	50.1	48.7	55.36	45.26	10.1	99.7	72.7	26.9	35.94	26.61	9.33

2013	2,981	2,455	526	2,094	1,964	130	99.2	48.3	50.9	55	44.94	10.07	89.8	61.7	28.1	36.41	27.07	9.34
2014	3,058	2,503	555	2,080	1,952	128	102.7	48.6	54.1	54.15	43.72	10.43	98.1	68.6	29.5	37.17	28.22	8.95
2015	2,844	2,327	517	2,093	1,963	130	104.9	49.4	55.4	54.36	43.76	10.6	94.9	68.1	26.8	37.76	28.69	9.07
2016	2,860	2,323	537	2,058	1,926	132	104.8	48.9	56	54.33	43.49	10.83	98.6	70	28.6	34.68	25.46	9.22
2017	2,983	2,413	571	2,032	1,905	127	112.5	49.2	63.3	52.25	41.72	10.54	104.1	75.2	28.9	38.13	29.38	8.75

Table S4. The number of doctors in South Korea and North Korea

	South Korea						North Korea	
	Total	Medical doctors	Dentists	Oriental medicine	Pharmacists	Medical and pharmacists (per 10,000 population)	Total	Medical and pharmacists (per 10,000 population)
Year								
1990	95,083	42,554	9,619	5,792	37,118	22.2	58,644	29
1993	112,046	51,518	12,180	7,569	40,779	25.4	67,254	31.9
1994	117,561	54,406	12,939	8,179	42,037	26.3	..	..
1995	122,852	57,188	13,681	8,714	43,269	27.2	..	..
1996	127,646	59,399	14,371	9,299	44,577	28	70,018	31.8
1997	133,101	62,609	15,383	9,289	45,820	29	70,901	31.9
1998	138,469	65,431	16,126	9,914	46,998	29.9	71,330	31.9
1999	147,559	69,724	17,276	11,345	49,214	31.7	71,785	31.9
2000	153,273	72,503	18,039	12,108	50,623	32.6	72,052	31.7
2001	158,848	75,295	18,887	12,794	51,872	33.5	72,332	31.6
2002	165,111	78,609	19,672	13,662	53,168	34.7	..	..
2003	170,708	81,328	20,446	14,553	54,381	35.6	..	..
2004	170,683	81,998	20,772	14,421	53,492	35.5	..	..
2005	177,050	85,369	21,581	15,271	54,829	36.7	..	..
2006	182,244	88,214	22,267	15,918	55,845	37.6	..	..

Year								
2007	188,509	91,475	23,126	16,732	57,176	38.7	..	..
2008	194,916	95,088	23,924	17,541	58,363	39.7	..	..
2009	201,191	98,434	24,639	18,401	59,717	40.8	77,481	32.2
2010	206,921	101,443	25,390	19,132	60,956	41.8	77,881	32.2
2011	212,652	104,397	26,098	19,912	62,245	42.6	88,553	36.4
2012	218,414	107,295	26,804	20,668	63,647	43.5	88,987	36.4
2013	221,619	109,563	27,409	21,355	63,292	43.9	89,416	36.4
2014	225,834	112,476	28,134	22,074	63,150	44.5	89,842	36.4
2015	233,753	116,045	28,953	23,245	65,510	45.8	90,267	36.4
2016	238,860	118,765	29,643	23,460	66,992	46.6	90,691	36.4
2017	244,785	121,638	30,344	24,187	68,616	47.7	91,120	36.4
2018	248,323	123,173	30,918	24,885	69,347	48.1	91,550	36.4
2019	254,931	126,795	31,640	25,592	70,904	49.3	91,980	36.4

The difference in the number of medical personnel between South Korea and North Korea shows the status of health infrastructure. Despite the limited access to North Korean data, the total number of medical personnel is much smaller in North Korea than South Korea. The health infrastructure in North Korea has been collapsed since 1990 when the financial crisis and natural disaster hit. This indicates that North Korea is less likely to have easier access to vaccination and better hygiene conditions.
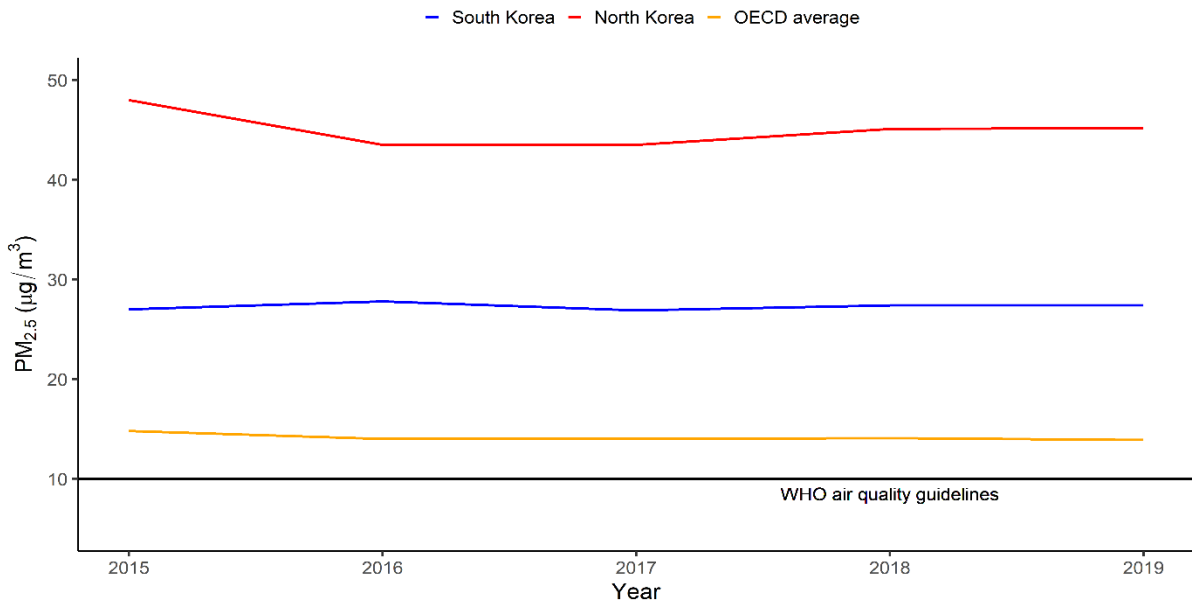
Fig. S1. The average annual concentration of $PM_{2.5}$ in South Korea and North Korea from 2015 to 2019.

Internationally comparable measurements of average $PM_{2.5}$ concentrations are derived from satellite observations, chemical transport models, and ground monitoring stations. The x-axis indicates year. The y-axis indicates $PM_{2.5}$ $\mu g/m^3$ concentrations. The red line indicates the average $PM_{2.5}$ concentration in North Korea. The blue line indicates the average $PM_{2.5}$ concentration in South Korea. The orange line indicates the $PM_{2.5}$ concentration in OECD average. The green dash line indicates the WHO air quality guidelines (10 $\mu g/m^3$). Source: OECD Statistics.
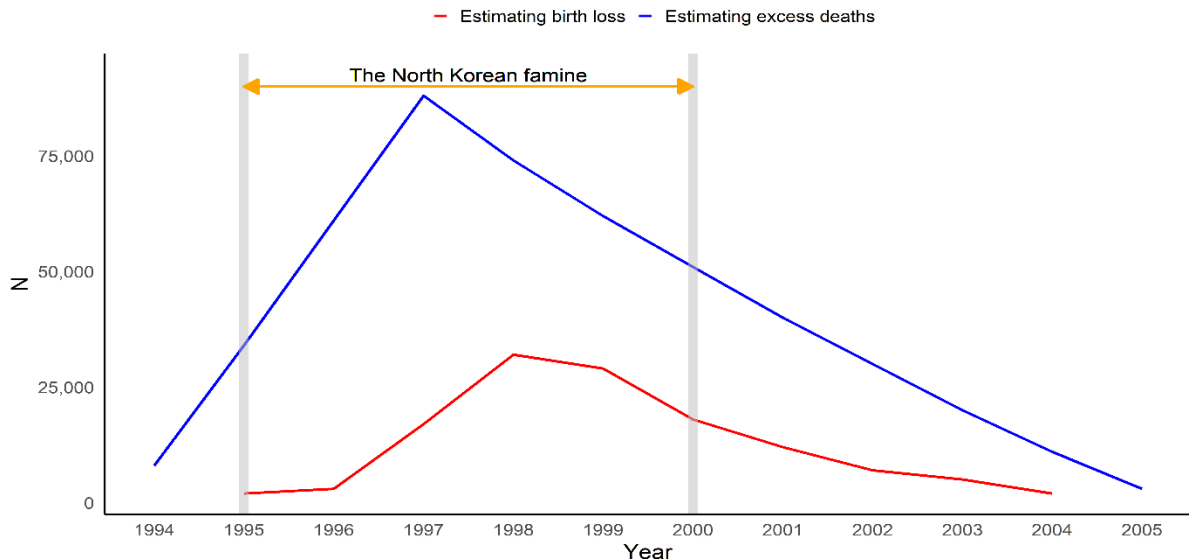
Fig. S2. The estimation of birth losses and excess deaths during the North Korean famine from 1994 to 2005.

The x-axis indicates years. The y-axis indicates counts (estimating birth loss or estimating excess deaths). The red line stands for the estimated birth loss and the blue line for the estimated excess deaths; The orange arrow means the period of North Korean famine from 1995 to 2000.

9
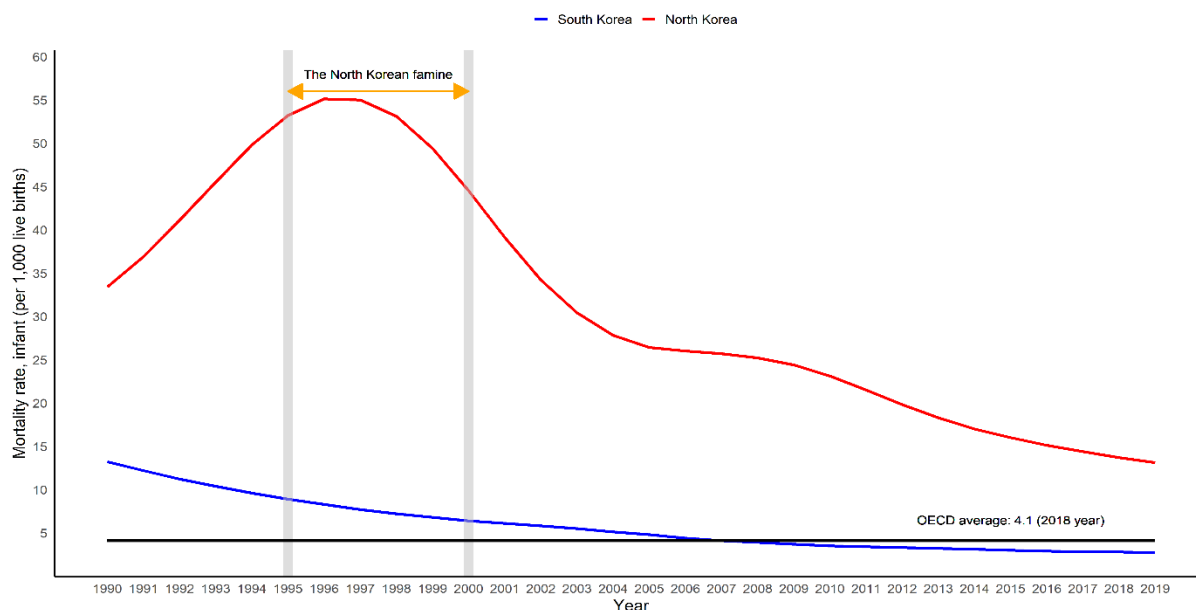
Fig. S3. The time–plot of annual infant mortality rates in South Korea and North Korea from 1990 to 2019.

The x-axis indicates years. The y-axis indicates the infant mortality rate per 1,000 live births. The red bar indicates North Korea. The blue bar indicates South Korea. The orange arrow means the period of North Korean famine from 1995 to 2000. The green dash line indicates the OECD average.


Fig. S4. Coal consumption in South Korea and North Korea from 2000 to 2017.

The x-axis indicates years. the y-axis indicates coal consumption (Mst). The red bars indicates coal consumption in North Korea.The blud bars indicates coal consumption in South Korea.

10
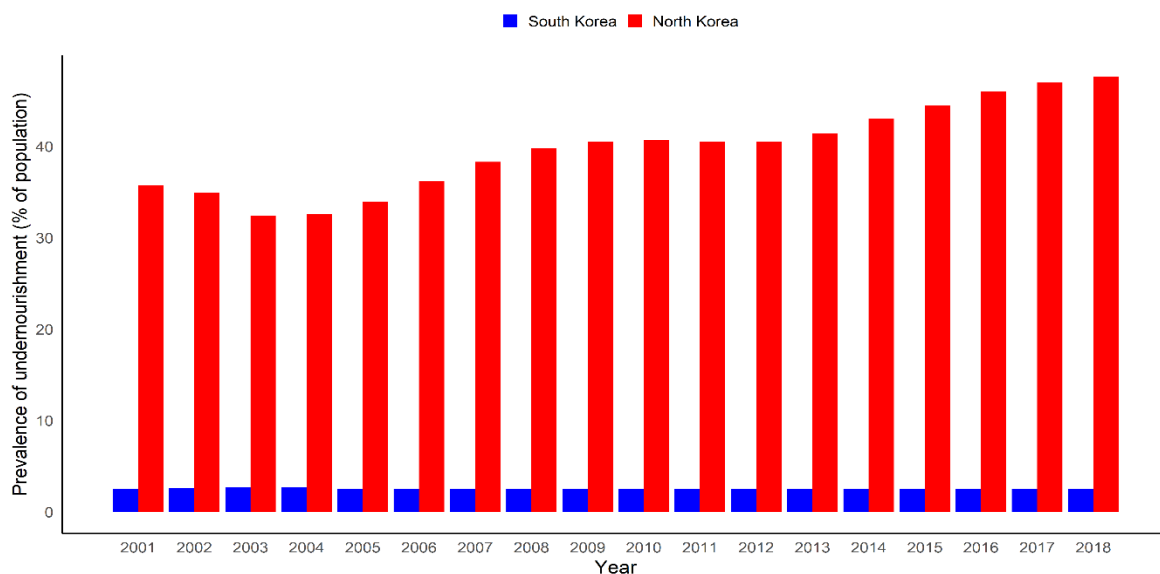
Fig. S5. The undernourished population of South Korea and North Korea.

The x-axis indicates years. The y-axis indicates prevalence of undernourishment (%). The red bars indicates prevalence of undernourishment in North Korea. The blue bars indicates prevalence of undernourishment in South Korea.
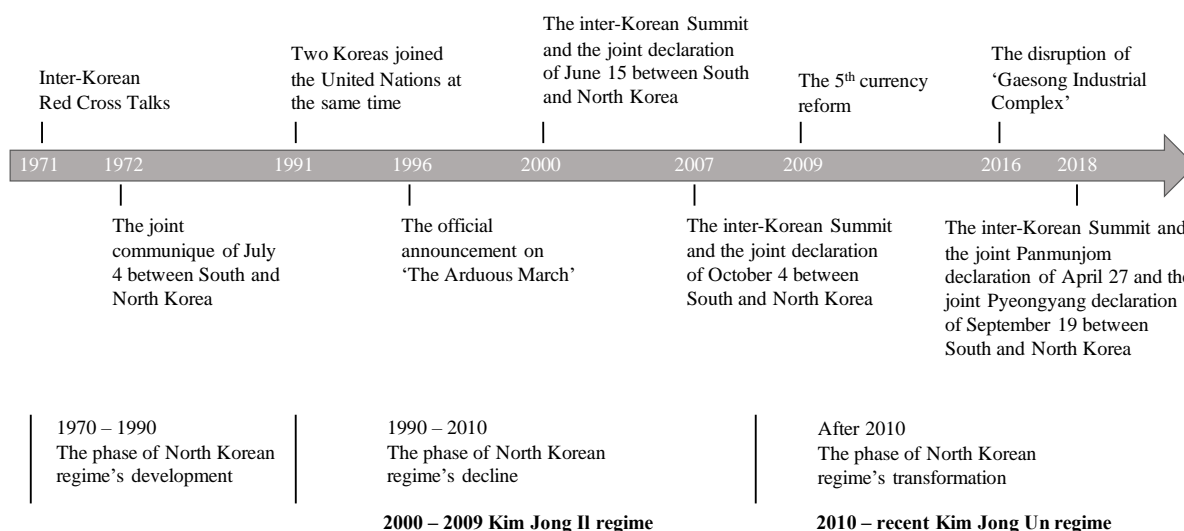

**Fig. S6.** Major historical events in the Korean Peninsula from 1970 to 2020.

The so-called 'Arduous March' was officially announced in 1996 and lasted until 1998 which caused severe malnutrition and stunting among children. This unfortunate event happened during the phase of North Korean regimen's decline (Kim Jong Il government). Although there were few inter-Korean Summits that see the possibility of peaceful cooperation since 2000, North Korea still suffers from economic difficulties. For example, the North Korean government forcibly enforced the 5th currency reform in 2009 that changes the value of money and then brought a disastrous damage to North Korean's financial stability and food supply. It might result in the increasing prevalence of anemia among North Korean children.
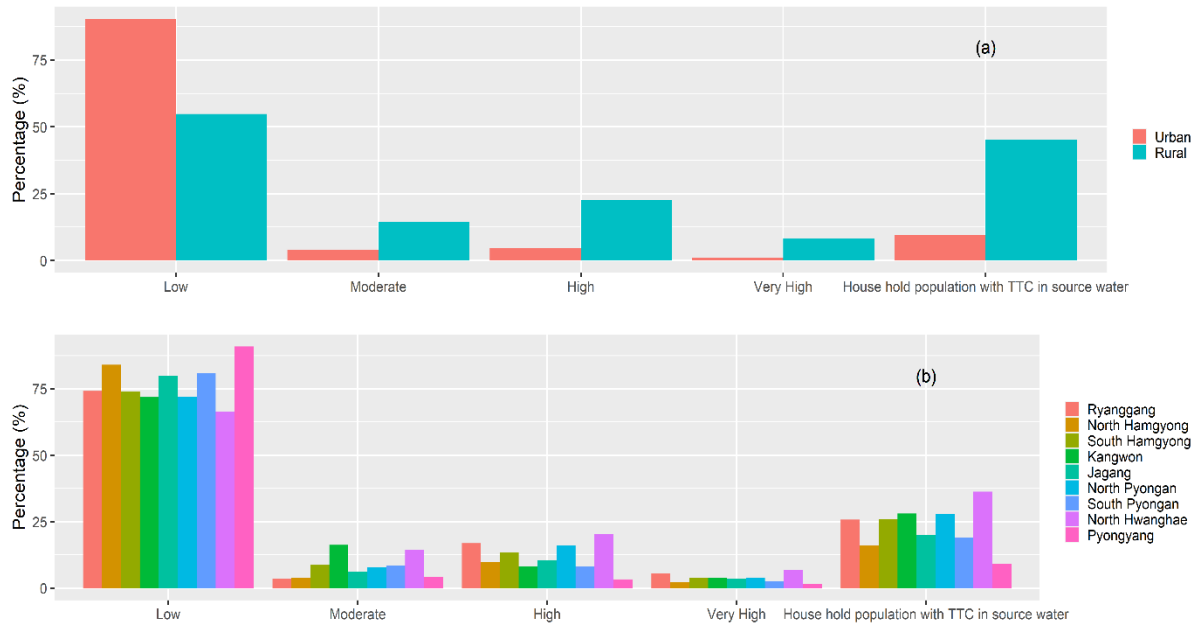
Fig. S7. Quality of source drinking water in North Korea in 2017.
(a) Risk level based on number of thermotolerant coliform (TTC) per 100ml by area; (b) Risk level based on number of thermotolerant coliform (TTC) per 100ml by province.
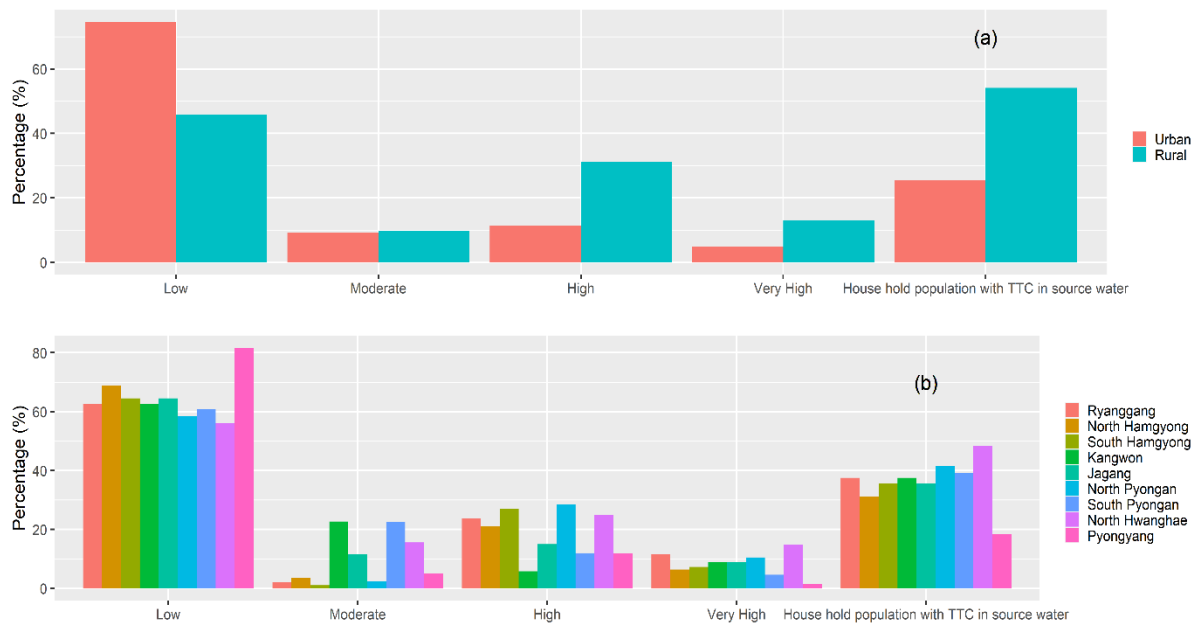

Fig. S8. Quality of household drinking water in North Korea in 2017.
(a) Risk level based on number of thermotolerant coliform (TTC) per 100ml by area; (b) Risk level based on number of thermotolerant coliform (TTC) per 100ml by province.
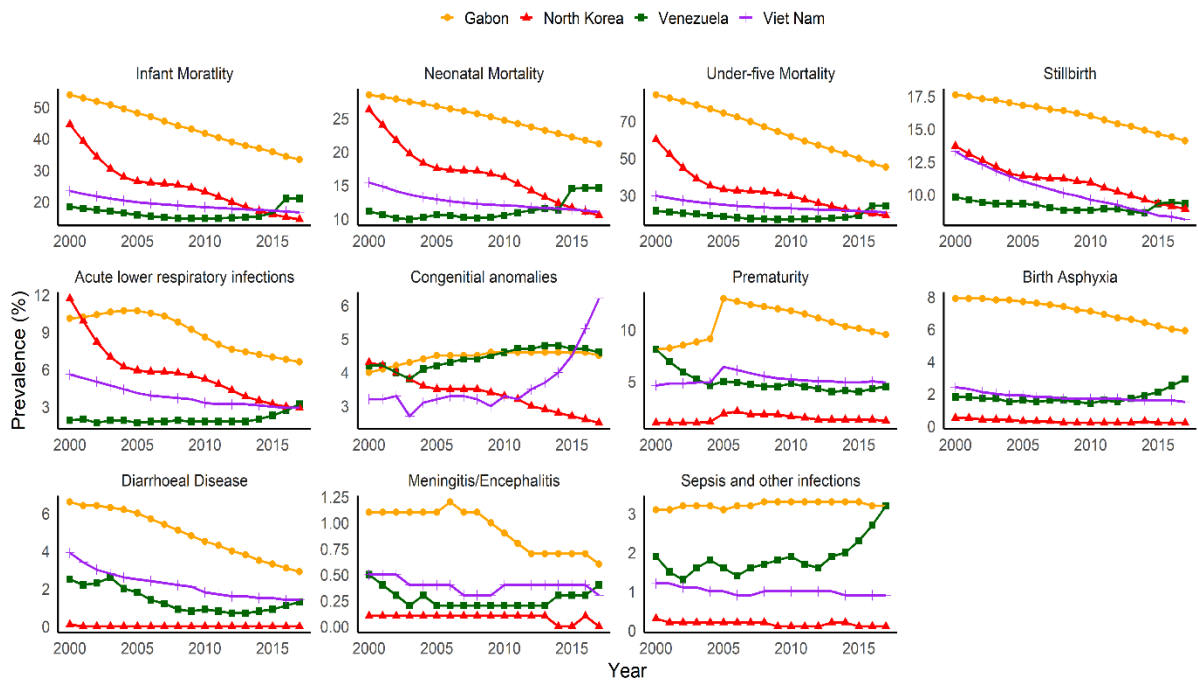
Fig. S9. Disease pattern of North Korea with developing countries (mortality rate per 1,000 live births).

The x-axis indiciates year. The y-axis indicates mortality rate per 1,000 live births. The yellow line indicates mortality rate in Gabon, the red line indicates mortality rate in North Korea, the green line indicates mortality rate in Venezuela, and the purple line indicates mortality rate in Vietnam.
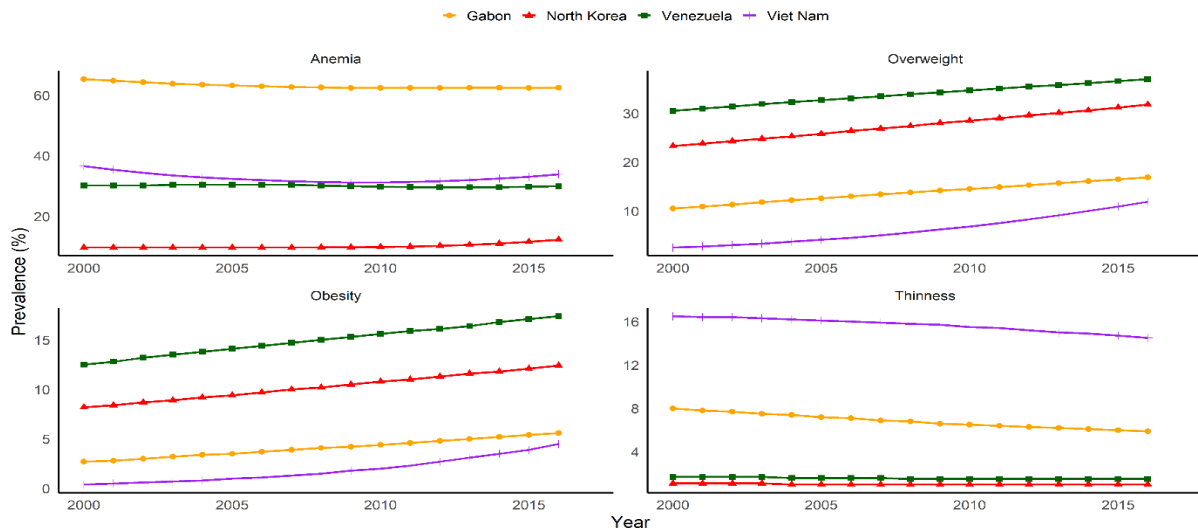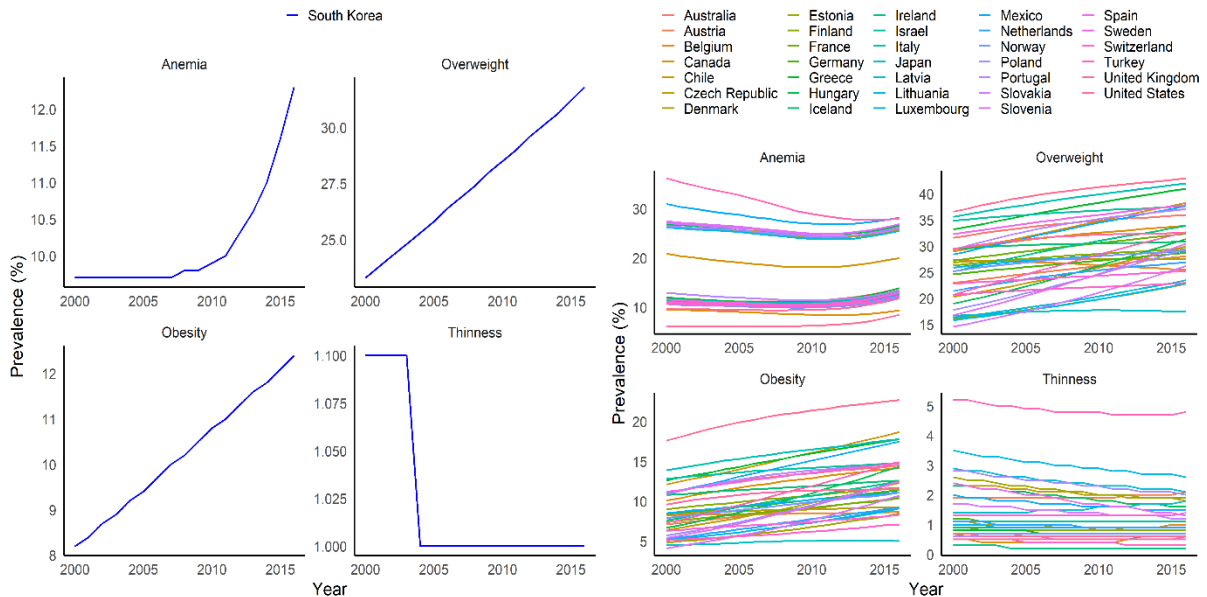

Fig. S10. Disease pattern of North Korea with developing countries (prevalence (%)).

The x-axis indiciates year. The y-axis indicates prevalence(%). The yellow line indicates prevalence in Gabon, the red line indicates prevalence in North Korea, the green line indicates prevalence in Venezuela, and the purple line indicates prevalence in Vietnam.
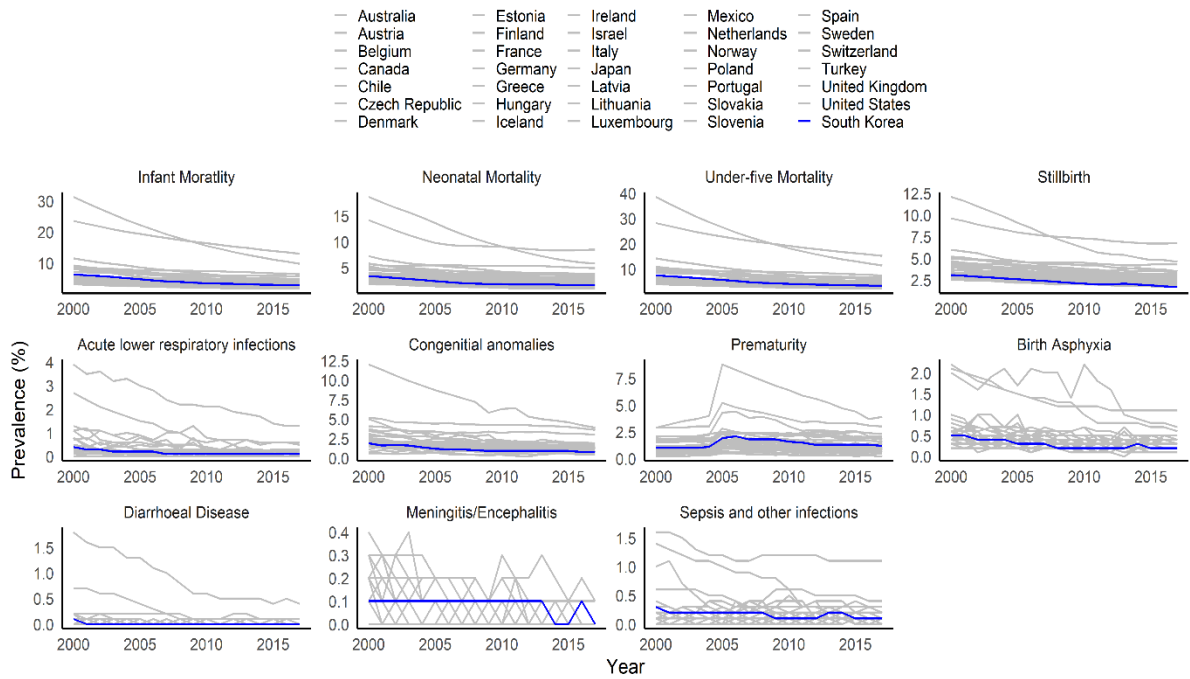
Fig. S11. Disease pattern of South Korea with developed countries (mortality rate per 1,000 live births).

The x-axis indiciates year. The y-axis indicates mortality rate per 1,000 live births. The blue line indicates mortality rate in South Korea. The gray line indicates the developed countries.

Fig. S12. Disease pattern of South Korea with developed countries (prevalence (%)).
The x-axis indiciates year. The y-axis indicates prevalence(%). The blue line indicates prevalence in South Korea.
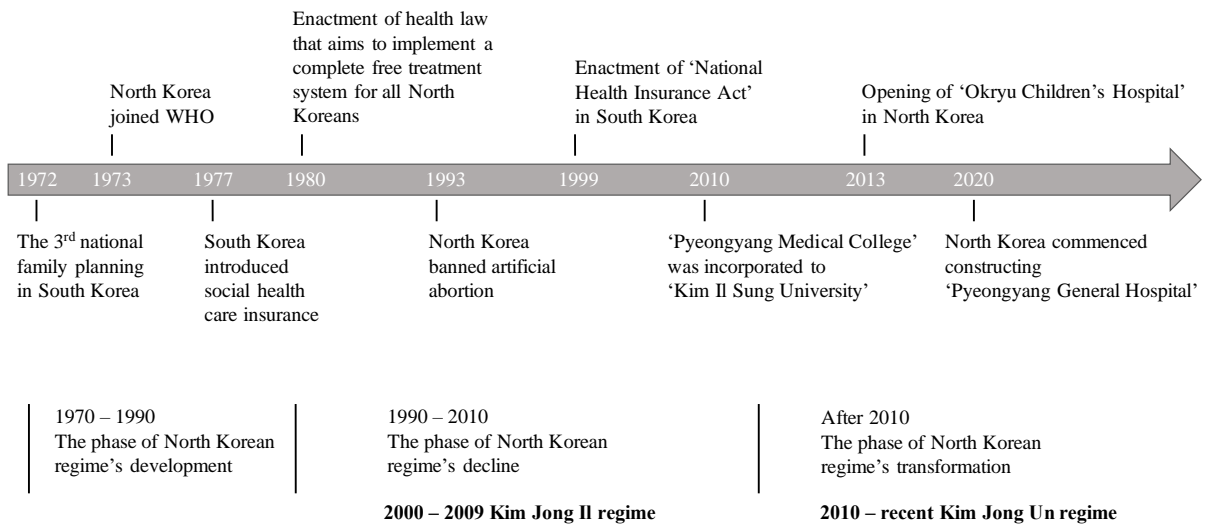
Fig. S13. History of health and medical care policy in North Korea from 1970 to 2020.