SUPPLEMENTARY METHODS

Decomposition analysis

The decomposition method can be employed to assess the causes of changes in the incidents of specific diseases. In this study, we first utilized the decomposition methodology developed by Guoqing Hu [1,2] to analyze changes in type 2 diabetes mellitus related chronic kidney disease (CKD-T2DM) incident by considering factors such as population age structure (aging), population growth, and epidemiologic changes. In the decomposition analysis, the decomposition for each country and region was based on each country's own disease data and population data.

Using the difference in the number of incidence cases of CKD-T2DM in 1992 and 2021 as an example, we show how the number of incident attributable to these three factors was calculated. Age was divided using 5-year group, from 15–19 years old to 95 years and older. Let d_{ij}, n_{ij}, m_{ij}, and p_{ij} denote the number of incident, population size, age-specific incidence rate, and proportion of population for the i_{th} age group of the j_{th} year, respectively ($i=1, 2, \ldots, 17; j=1, 2$). Let D_1 and D_2, N_1 and N_2, M_1 and M_2 represent the total number of incident, population size and crude incidence rate for years 1992 and 2021, respecitvely (Supplementary Table 1).

$$D_1=\sum_{i=1}^{17} d_{i1}$$

$$D_2=\sum_{i=1}^{17} d_{i2}$$

$$N_1=\sum_{i=1}^{17} n_{i1}$$

$$N_2=\sum_{i=1}^{17} n_{i2}$$

$$M_1=D_1/N_1$$

$$M_2=D_2/N_2$$

$$m_{ij}=d_{ij}/n_{ij}$$

$$p_{ij}=n_{ij}/N_j$$

Using M_p, M_a, and M_m to represent the main effects of the changes in population size, in age structure and in incidence rates, and I_{pa}, I_{pm}, I_{am}, and I_{pam} to represent their two-way and three-way interactions, respectively. These terms are calculated as follows when using year 1992 as the reference:

$$M_p=\sum_{i=1}^{17}(N_2-N_1)p_{i1}m_{i1}$$

$$M_a=\sum_{i=1}^{17}N_1(p_{i2}-p_{i1})m_{i1}$$

$$M_m=\sum_{i=1}^{17}N_1p_{i1}(m_{i2}-m_{i1})$$

$$I_{pa}=\sum_{i=1}^{17}(N_2-N_1)(p_{i2}-p_{i1})m_{i1}$$

$$I_{pm}=\sum_{i=1}^{17}(N_2-N_1)p_{i1}(m_{i2}-m_{i1})$$

$$I_{am}=\sum_{i=1}^{17}N_1(p_{i2}-p_{i1})(m_{i2}-m_{i1})$$

$$I_{pam}=\sum_{i=1}^{17}(N_2-N_1)(p_{i2}-p_{i1})(m_{i2}-m_{i1})$$

The contribution of each factor includes its main effect and partial interactions with other factors.

(1) Suppose a%, b%, and c% of the two-way interaction between population size and age structure, population size and

Supplementary Table 1. Meaning of mathematical symbols in the decomposition formula

Age group, yr	1992 ($j=1$)				2021 ($j=2$)			
	Incident	Population	incidence	Age structure	Incident	Population	incidence	Age structure
15–19	d_{11}	n_{11}	m_{11}	p_{11}	d_{12}	n_{12}	m_{12}	p_{12}
20–24	d_{21}	n_{21}	m_{21}	p_{21}	d_{22}	n_{22}	m_{22}	p_{22}
25–29	d_{31}	n_{31}	m_{31}	p_{31}	d_{32}	n_{32}	m_{32}	p_{32}
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
90–94	D_{161}	n_{161}	m_{161}	p_{161}	d_{162}	n_{162}	m_{162}	p_{162}
≥95	D_{171}	n_{171}	m_{171}	p_{171}	d_{172}	n_{172}	m_{172}	p_{172}
Total	D_1	N_1	M_1	$P_1=1$	D_2	N_2	M_2	$P_2=1$

incidence change, and age structure and incidence change are allocated to the first factor, respectively. Accordingly, (100-a)%, (100-b)%, and (100-c)% of the three two-way interactions are allocated to the second factor. The three two-way interactions can be computed correctly only if a, b, and c are all equal to 50.

And (2) suppose d_1%, d_2%, and (100-d_1-d_2)% of the three-way interaction are allocated to population size, age structure, and incidence change, respectively. Given that there is no theoretical guidance for assigning the three-way interaction of the three factors, the method developers will distribute them equally [1], $d_1 = d_2 = ⅓ \times 100$.

Using A, M, and P to represent the number of deaths attributed to age structure, incidence change and population size defined by the method when using year 1992 as reference, the contributions of the three factors can be calculated as follows:

$$A = M_a + {}^1\!/\!_2 I_{am} + {}^1\!/\!_2 I_{pa} + {}^1\!/\!_3 I_{pam}$$

$$P = M_p + {}^1\!/\!_2 I_{pm} + {}^1\!/\!_2 I_{pa} + {}^1\!/\!_3 I_{pam}$$

$$M = M_m + {}^1\!/\!_2 I_{pm} + {}^1\!/\!_2 I_{am} + {}^1\!/\!_3 I_{pam}$$

An example

We decomposed the global incidents number of CKD-T2DM using global incidence data and demographic data for 1992 and 2021 as examples, and calculated the contribution of each factor to the increase in incidents number. The number of population and incidents from global in 1992 and 2021 are provided in Supplementary Table 2.

$$M_a = \sum_{i=1}^{17} N_1(p_{i2} - p_{i1}) m_{i1} = 3724646067 \times \left[(10.61\% - 13.89\%) \times \frac{0.16}{100000} + \cdots + (0.09\% - 0.03\%) \times \frac{16.11}{100000}\right] = 267653.19$$

$$I_{pa} = \sum_{i=1}^{17} (N_2 - N_1)(p_{i2} - p_{i1}) m_{i1} = (5879492084 - 3724646067) \times \left[(10.61\% - 13.89\%) \times \frac{0.16}{100000} + \cdots + (0.09\% - 0.03\%) \times \frac{16.11}{100000}\right] = 154847.31$$

$$I_{am} = \sum_{i=1}^{17} N_1(p_{i2} - p_{i1})(m_{i2} - m_{i1}) = 3724646067 \times \left[(10.61\% - 13.89\%) \times \left(\frac{0.13}{100000} - \frac{0.16}{100000}\right) + \cdots + (0.09\% - 0.03\%) \times \left(\frac{17.59}{100000} - \frac{16.11}{100000}\right)\right] = 51004.55$$

Supplementary Table 2. The number of population and type 2 diabetes mellitus related chronic kidney disease incidents from global in 1992 and 2021

Age group, yr	1992				2021			
	Incident	Population	Incidence, per 100,000	Age structure, %	Incident	Population	Incidence, per 100,000	Age structure, %
15–19	835	517,295,515	0.16	13.89	790	623,979,871	0.13	10.61
20–24	1,633	500,647,331	0.33	13.44	1,454	597,158,138	0.24	10.16
25–29	2,902	466,919,881	0.62	12.54	2,861	588,343,219	0.49	10.01
30–34	5,137	398,915,095	1.29	10.71	7,238	604,480,175	1.20	10.28
35–39	11,045	368,394,794	3.00	9.89	18,095	560,866,106	3.23	9.54
40–44	20,319	310,707,131	6.54	8.34	37,542	500,250,796	7.50	8.51
45–49	31,577	243,591,565	12.96	6.54	72,165	473,504,626	15.24	8.05
50–54	53,759	216,306,483	24.85	5.81	135,800	444,922,983	30.52	7.57
55–59	84,338	191,103,916	44.13	5.13	213,195	395,728,004	53.87	6.73
60–64	121,764	166,298,016	73.22	4.46	289,436	320,047,853	90.44	5.44
65–69	145,597	131,286,171	110.90	3.52	364,163	275,842,159	132.02	4.69
70–74	135,175	91,404,862	147.89	2.45	366,045	205,839,220	177.83	3.50
75–79	101,653	61,751,840	164.61	1.66	262,636	131,884,405	199.14	2.24
80–84	61,000	37,507,009	162.64	1.01	164,993	87,583,057	188.38	1.49
85–89	20,905	16,564,525	126.20	0.44	59,338	45,721,791	129.78	0.78
90–94	4,056	4,843,764	83.73	0.13	15,315	17,889,374	85.61	0.30
≥95	179	1,108,169	16.11	0.03	959	5,450,309	17.59	0.09
Total	801,872	3,724,646,067	21.53	100.00	2,012,025	5,879,492,084	34.22	100.00