

shapleyHALE: an R package for ordering-free decomposition of health-adjusted life expectancy change with population-level interaction indices, demonstrated using Global Burden of Disease Study data

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Appendix Text S1. Methodological details

This appendix provides the formal definitions and computational formulas for the health-adjusted life expectancy calculation, the Shapley value decomposition, the separation of mortality and disability effects, and the second-order interaction indices. All methods are implemented in the *shapleyHALE* package.

S1. Health-adjusted life expectancy (HALE)

For a given year and population, age-specific all-cause mortality rates m_x and all-cause YLD rates π_x are constructed by summing the corresponding cause-specific rates across all included causes. An abridged life table is built using the Chiang method: the probability of dying in the age interval $[x, x + n)$ is

$$q_x = \frac{n \times m_x}{1 + n(1 - a_x)m_x}$$

where n is the length of the interval and a_x is the fraction of the interval lived by those who die. For the open-ended interval (≥ 85 years), $q_{last} = 1$. The number of person-years lived in each interval is $L_x = n(l_x - d_x) + na_x d_x$ for closed intervals and $L_{last} = l_{last}/m_{last}$ for the open interval, where $T_x = \sum_{i=x}^{last} L_i$. Life expectancy at birth is $e_0 = T_0/l_0$.

HALE is obtained by replacing L_x with health-adjusted person-years $L_x^* = L_x(1 - \pi_x)$ and computing T_x^* analogously; then $HALE_0 = T_0^*/l_0$.

S2. Shapley-value decomposition

Let K be the set of all causes. For a subset $S \subseteq K$, define the value function $v(S)$ as the change in HALE obtained when the mortality and YLD rates of exactly the causes in S are switched from their baseline-year values to their target-year values, while causes not in S retain their baseline-year rates. The total change is $\Delta = v(K)$. The Shapley value for cause j is

$$\phi_j = \sum_{S \subseteq K \setminus \{j\}} \frac{|S|! (|K| - |S| - 1)!}{|K|!} [v(S \cup \{j\}) - v(S)]$$

Because explicit evaluation of all subsets is computationally prohibitive ($2^{|K|}$ terms),

we approximate ϕ_j by averaging the marginal contribution $v(S \cup \{j\}) - v(S)$ across M random permutations of K , where S is the set of causes that precede j in a given permutation.

S3. Decomposition into death and disability effects

To isolate the mortality-driven component of each cause, we repeat the Shapley decomposition keeping all YLD rates fixed at their baseline-year values; the resulting contributions are denoted ϕ_j^{death} . Conversely, fixing all mortality rates at baseline-year values yields the disability-driven component $\phi_j^{\text{disability}}$. By construction, $\phi_j = \phi_j^{\text{death}} + \phi_j^{\text{disability}}$.

S4. Second-order Shapley interaction index

The pairwise interaction between causes A and B is defined as

$$\begin{aligned} \phi_{AB} &= \sum_{S \subseteq K \setminus \{A, B\}} \frac{|S|! (|K| - |S| - 2)!}{(|K| - 1)!} [v(S \cup \{A, B\}) - v(S \cup \{A\}) - v(S \cup \{B\}) + v(S)] \end{aligned}$$

We computed ϕ_{AB} for the ten causes in each Socio-demographic Index quintile with the largest absolute total Shapley values using the same permutation-based strategy.

Appendix Table S1. Total Shapley contributions of the 10 leading causes to health-adjusted life expectancy change by Socio-demographic Index quintile, 1990–2023

SDI quintile	Cause	Point est	Lower	Upper
Low SDI	Enteric infections	2.640	2.418	2.940
Low SDI	Respiratory infections and tuberculosis	2.160	1.938	2.365
Low SDI	Other infectious diseases	1.871	1.550	2.201
Low SDI	Maternal and neonatal disorders	1.354	1.216	1.478
Low SDI	Neglected tropical diseases and malaria	1.239	1.000	1.574
Low SDI	Nutritional deficiencies	0.676	0.563	0.806
Low SDI	Unintentional injuries	0.469	0.397	0.533
Low SDI	Digestive diseases	0.383	0.340	0.438
Low SDI	Mental disorders	-0.336	-0.482	-0.252
Low SDI	Self-harm and interpersonal violence	0.212	0.186	0.241
Low-middle SDI	Enteric infections	2.483	2.363	2.788
Low-middle SDI	Respiratory infections and tuberculosis	2.009	1.843	2.199
Low-middle SDI	Maternal and neonatal disorders	1.250	1.115	1.373
Low-middle SDI	Other infectious diseases	1.217	1.026	1.395
Low-middle SDI	Cardiovascular diseases	0.577	0.397	0.693
Low-middle SDI	Unintentional injuries	0.536	0.459	0.594
Low-middle SDI	Nutritional deficiencies	0.481	0.396	0.599
Low-middle SDI	Neglected tropical diseases and malaria	0.435	0.376	0.555
Low-middle SDI	Digestive diseases	0.426	0.381	0.473
Low-middle SDI	Diabetes and kidney diseases	-0.397	-0.457	-0.312
Middle SDI	Respiratory infections and tuberculosis	1.306	1.207	1.409
Middle SDI	Cardiovascular diseases	1.125	0.958	1.250
Middle SDI	Enteric infections	1.028	0.930	1.141
Middle SDI	Maternal and neonatal disorders	0.775	0.696	0.856
Middle SDI	Other infectious diseases	0.627	0.558	0.720
Middle SDI	Digestive diseases	0.473	0.428	0.522
Middle SDI	Unintentional injuries	0.353	0.291	0.415
Middle SDI	Neglected tropical diseases and malaria	0.334	0.309	0.392
Middle SDI	Nutritional deficiencies	0.323	0.293	0.422
Middle SDI	Mental disorders	-0.295	-0.440	-0.213
High-middle SDI	Cardiovascular diseases	2.421	2.164	2.549
High-middle SDI	Respiratory infections and tuberculosis	0.976	0.891	1.040
High-middle SDI	Neoplasms	0.851	0.775	0.941
High-middle SDI	Maternal and neonatal disorders	0.729	0.665	0.788
High-middle SDI	Enteric infections	0.681	0.639	0.769
High-middle SDI	Unintentional injuries	0.604	0.511	0.683
High-middle SDI	Transport injuries	0.432	0.376	0.470

High-middle SDI	Chronic respiratory diseases	0.415	0.281	0.466
High-middle SDI	Other infectious diseases	0.356	0.320	0.394
High-middle SDI	Digestive diseases	0.353	0.314	0.388
High SDI	Cardiovascular diseases	2.624	2.380	2.765
High SDI	Neoplasms	0.913	0.846	0.976
High SDI	Maternal and neonatal disorders	0.481	0.451	0.515
High SDI	Transport injuries	0.428	0.398	0.451
High SDI	Mental disorders	-0.342	-0.518	-0.234
High SDI	Respiratory infections and tuberculosis	0.290	0.246	0.321
High SDI	Unintentional injuries	0.272	0.166	0.394
High SDI	Other non-communicable diseases	0.271	0.187	0.367
High SDI	Chronic respiratory diseases	0.218	0.159	0.247
High SDI	Digestive diseases	0.218	0.189	0.245

Notes: Shapley values represent the change in health-adjusted life expectancy in years attributed to each cause. Positive values indicate gains and negative values indicate losses. Point estimates are medians from 1,000 parametric bootstrap iterations, each using 5,000 random permutations. Lower and Upper are the 2.5th and 97.5th percentiles of the bootstrap distribution. The table lists the 10 leading causes in each Socio-demographic Index quintile. SDI = Socio-demographic Index.

**Appendix Table S2. Mortality-driven and disability-driven Shapley contributions
for all 22 causes by Socio-demographic Index quintile, 1990–2023**

SDI quintile	Cause	Mortality	Disability
Low SDI	Neglected tropical diseases and malaria	0.834	0.358
Low SDI	Nutritional deficiencies	0.424	0.228
Low SDI	Neoplasms	-0.131	-0.010
Low SDI	Cardiovascular diseases	0.172	0.001
Low SDI	Chronic respiratory diseases	0.157	-0.015
Low SDI	Digestive diseases	0.365	0.014
Low SDI	Neurological disorders	-0.008	-0.006
Low SDI	Mental disorders	0.000	-0.301
Low SDI	Musculoskeletal disorders	0.000	-0.011
Low SDI	Other non-communicable diseases	0.100	0.043
Low SDI	Skin and subcutaneous diseases	-0.005	-0.006
Low SDI	Transport injuries	-0.052	0.008
Low SDI	Unintentional injuries	0.407	0.056
Low SDI	Self-harm and interpersonal violence	0.217	-0.004
Low SDI	HIV/AIDS and sexually transmitted infections	0.158	-0.019
Low SDI	Respiratory infections and tuberculosis	2.128	0.026
Low SDI	Enteric infections	2.569	0.057
Low SDI	Other infectious diseases	1.839	0.021
Low SDI	Maternal and neonatal disorders	1.394	-0.041
Low SDI	Substance use disorders	0.002	0.010
Low SDI	Diabetes and kidney diseases	-0.019	-0.090
Low-middle SDI	Neglected tropical diseases and malaria	0.221	0.196
Low-middle SDI	Nutritional deficiencies	0.206	0.256
Low-middle SDI	Neoplasms	-0.134	-0.011
Low-middle SDI	Cardiovascular diseases	0.576	0.001
Low-middle SDI	Chronic respiratory diseases	0.143	-0.006
Low-middle SDI	Digestive diseases	0.404	0.020
Low-middle SDI	Neurological disorders	-0.020	-0.009
Low-middle SDI	Mental disorders	0.000	-0.324
Low-middle SDI	Musculoskeletal disorders	-0.002	-0.039
Low-middle SDI	Other non-communicable diseases	0.124	0.047
Low-middle SDI	Skin and subcutaneous diseases	0.002	-0.004
Low-middle SDI	Transport injuries	0.025	0.011
Low-middle SDI	Unintentional injuries	0.363	0.158
Low-middle SDI	Self-harm and interpersonal violence	0.016	0.005
Low-middle SDI	HIV/AIDS and sexually transmitted infections	-0.118	-0.021
Low-middle SDI	Respiratory infections and tuberculosis	1.964	0.042
Low-middle SDI	Enteric infections	2.429	0.053
Low-middle SDI	Other infectious diseases	1.190	0.025

Low-middle SDI	Maternal and neonatal disorders	1.338	-0.084
Low-middle SDI	Substance use disorders	0.012	0.020
Low-middle SDI	Diabetes and kidney diseases	-0.180	-0.192
Middle SDI	Neglected tropical diseases and malaria	0.062	0.257
Middle SDI	Nutritional deficiencies	0.094	0.217
Middle SDI	Neoplasms	-0.007	-0.017
Middle SDI	Cardiovascular diseases	1.122	0.007
Middle SDI	Chronic respiratory diseases	0.274	0.003
Middle SDI	Digestive diseases	0.448	0.025
Middle SDI	Neurological disorders	-0.055	-0.039
Middle SDI	Mental disorders	0.000	-0.280
Middle SDI	Musculoskeletal disorders	0.000	-0.040
Middle SDI	Other non-communicable diseases	0.102	0.065
Middle SDI	Skin and subcutaneous diseases	-0.010	-0.010
Middle SDI	Transport injuries	0.122	0.047
Middle SDI	Unintentional injuries	0.305	0.052
Middle SDI	Self-harm and interpersonal violence	0.050	0.021
Middle SDI	HIV/AIDS and sexually transmitted infections	-0.102	-0.014
Middle SDI	Respiratory infections and tuberculosis	1.316	-0.012
Middle SDI	Enteric infections	0.995	0.033
Middle SDI	Other infectious diseases	0.606	0.021
Middle SDI	Maternal and neonatal disorders	0.818	-0.042
Middle SDI	Substance use disorders	0.016	0.021
Middle SDI	Diabetes and kidney diseases	-0.052	-0.170
High-middle SDI	Neglected tropical diseases and malaria	0.056	0.122
High-middle SDI	Nutritional deficiencies	0.080	0.132
High-middle SDI	Neoplasms	0.859	-0.004
High-middle SDI	Cardiovascular diseases	2.429	0.008
High-middle SDI	Chronic respiratory diseases	0.419	0.001
High-middle SDI	Digestive diseases	0.324	0.027
High-middle SDI	Neurological disorders	-0.019	-0.047
High-middle SDI	Mental disorders	0.000	-0.323
High-middle SDI	Musculoskeletal disorders	0.003	-0.022
High-middle SDI	Other non-communicable diseases	0.182	0.045
High-middle SDI	Skin and subcutaneous diseases	-0.005	0.001
High-middle SDI	Transport injuries	0.380	0.048
High-middle SDI	Unintentional injuries	0.512	0.094
High-middle SDI	Self-harm and interpersonal violence	0.196	0.059
High-middle SDI	HIV/AIDS and sexually transmitted infections	-0.162	-0.043
High-middle SDI	Respiratory infections and tuberculosis	1.006	-0.029
High-middle SDI	Enteric infections	0.668	0.013
High-middle SDI	Other infectious diseases	0.340	0.016
High-middle SDI	Maternal and neonatal disorders	0.806	-0.074

High-middle SDI	Substance use disorders	0.042	0.035
High-middle SDI	Diabetes and kidney diseases	0.016	-0.139
High SDI	Neglected tropical diseases and malaria	0.006	0.042
High SDI	Nutritional deficiencies	0.010	0.131
High SDI	Neoplasms	0.928	-0.009
High SDI	Cardiovascular diseases	2.548	0.080
High SDI	Chronic respiratory diseases	0.221	-0.002
High SDI	Digestive diseases	0.182	0.033
High SDI	Neurological disorders	-0.049	-0.026
High SDI	Mental disorders	0.000	-0.329
High SDI	Musculoskeletal disorders	0.006	0.006
High SDI	Other non-communicable diseases	0.205	0.061
High SDI	Skin and subcutaneous diseases	-0.008	-0.014
High SDI	Transport injuries	0.336	0.086
High SDI	Unintentional injuries	0.200	0.080
High SDI	Self-harm and interpersonal violence	0.129	0.026
High SDI	HIV/AIDS and sexually transmitted infections	0.020	-0.007
High SDI	Respiratory infections and tuberculosis	0.382	-0.087
High SDI	Enteric infections	0.088	0.004
High SDI	Other infectious diseases	0.116	0.013
High SDI	Maternal and neonatal disorders	0.488	-0.006
High SDI	Substance use disorders	-0.065	-0.042
High SDI	Diabetes and kidney diseases	0.019	-0.144

Notes: Mortality and Disability are the Shapley values in years obtained by fixing disability rates or mortality rates at baseline, respectively. The two components sum exactly to the total point estimate for each cause. Values are point estimates computed with 5,000 random permutations. These point estimates may differ slightly from the bootstrap medians reported in Table S1. SDI = Socio-demographic Index.

Appendix Table S3. Pairwise Shapley interaction indices among the 10 leading causes by Socio-demographic Index quintile, 1990–2023

SDI quintile	Cause A	Cause B	Interaction
Low SDI	Respiratory infections and tuberculosis	Enteric infections	0.1888
Low SDI	Other infectious diseases	Enteric infections	0.1001
Low SDI	Maternal and neonatal disorders	Enteric infections	0.0754
Low SDI	Neglected tropical diseases and malaria	Enteric infections	0.0693
Low SDI	Nutritional deficiencies	Enteric infections	0.0383
Low SDI	Unintentional injuries	Enteric infections	0.0300
Low SDI	Digestive diseases	Enteric infections	0.0388
Low SDI	Mental disorders	Enteric infections	-0.0156
Low SDI	Self-harm and interpersonal violence	Enteric infections	0.0127
Low SDI	Enteric infections	Respiratory infections and tuberculosis	0.1888
Low SDI	Other infectious diseases	Respiratory infections and tuberculosis	0.0806
Low SDI	Maternal and neonatal disorders	Respiratory infections and tuberculosis	0.0620
Low SDI	Neglected tropical diseases and malaria	Respiratory infections and tuberculosis	0.0563
Low SDI	Nutritional deficiencies	Respiratory infections and tuberculosis	0.0291
Low SDI	Unintentional injuries	Respiratory infections and tuberculosis	0.0246
Low SDI	Digestive diseases	Respiratory infections and tuberculosis	0.0303
Low SDI	Mental disorders	Respiratory infections and tuberculosis	-0.0127
Low SDI	Self-harm and interpersonal violence	Respiratory infections and tuberculosis	0.0107
Low SDI	Enteric infections	Other infectious diseases	0.1001
Low SDI	Respiratory infections and tuberculosis	Other infectious diseases	0.0806
Low SDI	Maternal and neonatal disorders	Other infectious diseases	0.0501
Low SDI	Neglected tropical diseases and malaria	Other infectious diseases	0.0418
Low SDI	Nutritional deficiencies	Other infectious diseases	0.0223
Low SDI	Unintentional injuries	Other infectious diseases	0.0166
Low SDI	Digestive diseases	Other infectious diseases	0.0144
Low SDI	Mental disorders	Other infectious diseases	-0.0108
Low SDI	Self-harm and interpersonal violence	Other infectious diseases	0.0073
Low SDI	Enteric infections	Maternal and neonatal disorders	0.0754
Low SDI	Respiratory infections and tuberculosis	Maternal and neonatal disorders	0.0620
Low SDI	Other infectious diseases	Maternal and neonatal disorders	0.0501
Low SDI	Neglected tropical diseases and malaria	Maternal and neonatal disorders	0.0317
Low SDI	Nutritional deficiencies	Maternal and neonatal disorders	0.0174
Low SDI	Unintentional injuries	Maternal and neonatal disorders	0.0122
Low SDI	Digestive diseases	Maternal and neonatal disorders	0.0105
Low SDI	Mental disorders	Maternal and neonatal disorders	-0.0080
Low SDI	Self-harm and interpersonal violence	Maternal and neonatal disorders	0.0053
Low SDI	Enteric infections	Neglected tropical diseases and malaria	0.0693
Low SDI	Respiratory infections and tuberculosis	Neglected tropical diseases and malaria	0.0563
Low SDI	Other infectious diseases	Neglected tropical diseases and malaria	0.0418

Low SDI	Maternal and neonatal disorders	Neglected tropical diseases and malaria	0.0317
Low SDI	Nutritional deficiencies	Neglected tropical diseases and malaria	0.0132
Low SDI	Unintentional injuries	Neglected tropical diseases and malaria	0.0112
Low SDI	Digestive diseases	Neglected tropical diseases and malaria	0.0108
Low SDI	Mental disorders	Neglected tropical diseases and malaria	-0.0050
Low SDI	Self-harm and interpersonal violence	Neglected tropical diseases and malaria	0.0052
Low SDI	Enteric infections	Nutritional deficiencies	0.0383
Low SDI	Respiratory infections and tuberculosis	Nutritional deficiencies	0.0291
Low SDI	Other infectious diseases	Nutritional deficiencies	0.0223
Low SDI	Maternal and neonatal disorders	Nutritional deficiencies	0.0174
Low SDI	Neglected tropical diseases and malaria	Nutritional deficiencies	0.0132
Low SDI	Unintentional injuries	Nutritional deficiencies	0.0056
Low SDI	Digestive diseases	Nutritional deficiencies	0.0052
Low SDI	Mental disorders	Nutritional deficiencies	-0.0025
Low SDI	Self-harm and interpersonal violence	Nutritional deficiencies	0.0026
Low SDI	Enteric infections	Unintentional injuries	0.0300
Low SDI	Respiratory infections and tuberculosis	Unintentional injuries	0.0246
Low SDI	Other infectious diseases	Unintentional injuries	0.0166
Low SDI	Maternal and neonatal disorders	Unintentional injuries	0.0122
Low SDI	Neglected tropical diseases and malaria	Unintentional injuries	0.0112
Low SDI	Nutritional deficiencies	Unintentional injuries	0.0056
Low SDI	Digestive diseases	Unintentional injuries	0.0050
Low SDI	Mental disorders	Unintentional injuries	-0.0025
Low SDI	Self-harm and interpersonal violence	Unintentional injuries	0.0022
Low SDI	Enteric infections	Digestive diseases	0.0388
Low SDI	Respiratory infections and tuberculosis	Digestive diseases	0.0303
Low SDI	Other infectious diseases	Digestive diseases	0.0144
Low SDI	Maternal and neonatal disorders	Digestive diseases	0.0105
Low SDI	Neglected tropical diseases and malaria	Digestive diseases	0.0108
Low SDI	Nutritional deficiencies	Digestive diseases	0.0052
Low SDI	Unintentional injuries	Digestive diseases	0.0050
Low SDI	Mental disorders	Digestive diseases	-0.0022
Low SDI	Self-harm and interpersonal violence	Digestive diseases	0.0022
Low SDI	Enteric infections	Mental disorders	-0.0156
Low SDI	Respiratory infections and tuberculosis	Mental disorders	-0.0127
Low SDI	Other infectious diseases	Mental disorders	-0.0108
Low SDI	Maternal and neonatal disorders	Mental disorders	-0.0080
Low SDI	Neglected tropical diseases and malaria	Mental disorders	-0.0050
Low SDI	Nutritional deficiencies	Mental disorders	-0.0025
Low SDI	Unintentional injuries	Mental disorders	-0.0025
Low SDI	Digestive diseases	Mental disorders	-0.0022
Low SDI	Self-harm and interpersonal violence	Mental disorders	-0.0013
Low SDI	Enteric infections	Self-harm and interpersonal violence	0.0127

Low SDI	Respiratory infections and tuberculosis	Self-harm and interpersonal violence	0.0107
Low SDI	Other infectious diseases	Self-harm and interpersonal violence	0.0073
Low SDI	Maternal and neonatal disorders	Self-harm and interpersonal violence	0.0053
Low SDI	Neglected tropical diseases and malaria	Self-harm and interpersonal violence	0.0052
Low SDI	Nutritional deficiencies	Self-harm and interpersonal violence	0.0026
Low SDI	Unintentional injuries	Self-harm and interpersonal violence	0.0022
Low SDI	Digestive diseases	Self-harm and interpersonal violence	0.0022
Low SDI	Mental disorders	Self-harm and interpersonal violence	-0.0013
Low-middle SDI	Respiratory infections and tuberculosis	Enteric infections	0.1715
Low-middle SDI	Maternal and neonatal disorders	Enteric infections	0.0624
Low-middle SDI	Other infectious diseases	Enteric infections	0.0598
Low-middle SDI	Cardiovascular diseases	Enteric infections	0.0583
Low-middle SDI	Unintentional injuries	Enteric infections	0.0291
Low-middle SDI	Nutritional deficiencies	Enteric infections	0.0214
Low-middle SDI	Neglected tropical diseases and malaria	Enteric infections	0.0200
Low-middle SDI	Digestive diseases	Enteric infections	0.0440
Low-middle SDI	Diabetes and kidney diseases	Enteric infections	-0.0504
Low-middle SDI	Enteric infections	Respiratory infections and tuberculosis	0.1715
Low-middle SDI	Maternal and neonatal disorders	Respiratory infections and tuberculosis	0.0507
Low-middle SDI	Other infectious diseases	Respiratory infections and tuberculosis	0.0479
Low-middle SDI	Cardiovascular diseases	Respiratory infections and tuberculosis	0.0490
Low-middle SDI	Unintentional injuries	Respiratory infections and tuberculosis	0.0250
Low-middle SDI	Nutritional deficiencies	Respiratory infections and tuberculosis	0.0172
Low-middle SDI	Neglected tropical diseases and malaria	Respiratory infections and tuberculosis	0.0166
Low-middle SDI	Digestive diseases	Respiratory infections and tuberculosis	0.0332
Low-middle SDI	Diabetes and kidney diseases	Respiratory infections and tuberculosis	-0.0345
Low-middle SDI	Enteric infections	Maternal and neonatal disorders	0.0624
Low-middle SDI	Respiratory infections and tuberculosis	Maternal and neonatal disorders	0.0507
Low-middle SDI	Other infectious diseases	Maternal and neonatal disorders	0.0306
Low-middle SDI	Cardiovascular diseases	Maternal and neonatal disorders	0.0131
Low-middle SDI	Unintentional injuries	Maternal and neonatal disorders	0.0120
Low-middle SDI	Nutritional deficiencies	Maternal and neonatal disorders	0.0112
Low-middle SDI	Neglected tropical diseases and malaria	Maternal and neonatal disorders	0.0095
Low-middle SDI	Digestive diseases	Maternal and neonatal disorders	0.0097
Low-middle SDI	Diabetes and kidney diseases	Maternal and neonatal disorders	-0.0091
Low-middle SDI	Enteric infections	Other infectious diseases	0.0598
Low-middle SDI	Respiratory infections and tuberculosis	Other infectious diseases	0.0479
Low-middle SDI	Maternal and neonatal disorders	Other infectious diseases	0.0306
Low-middle SDI	Cardiovascular diseases	Other infectious diseases	0.0139
Low-middle SDI	Unintentional injuries	Other infectious diseases	0.0114
Low-middle SDI	Nutritional deficiencies	Other infectious diseases	0.0095
Low-middle SDI	Neglected tropical diseases and malaria	Other infectious diseases	0.0088
Low-middle SDI	Digestive diseases	Other infectious diseases	0.0101

Low-middle SDI	Diabetes and kidney diseases	Other infectious diseases	-0.0095
Low-middle SDI	Enteric infections	Cardiovascular diseases	0.0583
Low-middle SDI	Respiratory infections and tuberculosis	Cardiovascular diseases	0.0490
Low-middle SDI	Maternal and neonatal disorders	Cardiovascular diseases	0.0131
Low-middle SDI	Other infectious diseases	Cardiovascular diseases	0.0139
Low-middle SDI	Unintentional injuries	Cardiovascular diseases	0.0088
Low-middle SDI	Nutritional deficiencies	Cardiovascular diseases	0.0051
Low-middle SDI	Neglected tropical diseases and malaria	Cardiovascular diseases	0.0053
Low-middle SDI	Digestive diseases	Cardiovascular diseases	0.0132
Low-middle SDI	Diabetes and kidney diseases	Cardiovascular diseases	-0.0131
Low-middle SDI	Enteric infections	Unintentional injuries	0.0291
Low-middle SDI	Respiratory infections and tuberculosis	Unintentional injuries	0.0250
Low-middle SDI	Maternal and neonatal disorders	Unintentional injuries	0.0120
Low-middle SDI	Other infectious diseases	Unintentional injuries	0.0114
Low-middle SDI	Cardiovascular diseases	Unintentional injuries	0.0088
Low-middle SDI	Nutritional deficiencies	Unintentional injuries	0.0035
Low-middle SDI	Neglected tropical diseases and malaria	Unintentional injuries	0.0036
Low-middle SDI	Digestive diseases	Unintentional injuries	0.0060
Low-middle SDI	Diabetes and kidney diseases	Unintentional injuries	-0.0049
Low-middle SDI	Enteric infections	Nutritional deficiencies	0.0214
Low-middle SDI	Respiratory infections and tuberculosis	Nutritional deficiencies	0.0172
Low-middle SDI	Maternal and neonatal disorders	Nutritional deficiencies	0.0112
Low-middle SDI	Other infectious diseases	Nutritional deficiencies	0.0095
Low-middle SDI	Cardiovascular diseases	Nutritional deficiencies	0.0051
Low-middle SDI	Unintentional injuries	Nutritional deficiencies	0.0035
Low-middle SDI	Neglected tropical diseases and malaria	Nutritional deficiencies	0.0024
Low-middle SDI	Digestive diseases	Nutritional deficiencies	0.0036
Low-middle SDI	Diabetes and kidney diseases	Nutritional deficiencies	-0.0026
Low-middle SDI	Enteric infections	Neglected tropical diseases and malaria	0.0200
Low-middle SDI	Respiratory infections and tuberculosis	Neglected tropical diseases and malaria	0.0166
Low-middle SDI	Maternal and neonatal disorders	Neglected tropical diseases and malaria	0.0095
Low-middle SDI	Other infectious diseases	Neglected tropical diseases and malaria	0.0088
Low-middle SDI	Cardiovascular diseases	Neglected tropical diseases and malaria	0.0053
Low-middle SDI	Unintentional injuries	Neglected tropical diseases and malaria	0.0036
Low-middle SDI	Nutritional deficiencies	Neglected tropical diseases and malaria	0.0024
Low-middle SDI	Digestive diseases	Neglected tropical diseases and malaria	0.0037
Low-middle SDI	Diabetes and kidney diseases	Neglected tropical diseases and malaria	-0.0027
Low-middle SDI	Enteric infections	Digestive diseases	0.0440
Low-middle SDI	Respiratory infections and tuberculosis	Digestive diseases	0.0332
Low-middle SDI	Maternal and neonatal disorders	Digestive diseases	0.0097
Low-middle SDI	Other infectious diseases	Digestive diseases	0.0101
Low-middle SDI	Cardiovascular diseases	Digestive diseases	0.0132
Low-middle SDI	Unintentional injuries	Digestive diseases	0.0060

Low-middle SDI	Nutritional deficiencies	Digestive diseases	0.0036
Low-middle SDI	Neglected tropical diseases and malaria	Digestive diseases	0.0037
Low-middle SDI	Diabetes and kidney diseases	Digestive diseases	-0.0095
Low-middle SDI	Enteric infections	Diabetes and kidney diseases	-0.0504
Low-middle SDI	Respiratory infections and tuberculosis	Diabetes and kidney diseases	-0.0345
Low-middle SDI	Maternal and neonatal disorders	Diabetes and kidney diseases	-0.0091
Low-middle SDI	Other infectious diseases	Diabetes and kidney diseases	-0.0095
Low-middle SDI	Cardiovascular diseases	Diabetes and kidney diseases	-0.0131
Low-middle SDI	Unintentional injuries	Diabetes and kidney diseases	-0.0049
Low-middle SDI	Nutritional deficiencies	Diabetes and kidney diseases	-0.0026
Low-middle SDI	Neglected tropical diseases and malaria	Diabetes and kidney diseases	-0.0027
Low-middle SDI	Digestive diseases	Diabetes and kidney diseases	-0.0095
Middle SDI	Cardiovascular diseases	Respiratory infections and tuberculosis	0.0580
Middle SDI	Enteric infections	Respiratory infections and tuberculosis	0.0318
Middle SDI	Maternal and neonatal disorders	Respiratory infections and tuberculosis	0.0204
Middle SDI	Other infectious diseases	Respiratory infections and tuberculosis	0.0159
Middle SDI	Digestive diseases	Respiratory infections and tuberculosis	0.0202
Middle SDI	Unintentional injuries	Respiratory infections and tuberculosis	0.0072
Middle SDI	Neglected tropical diseases and malaria	Respiratory infections and tuberculosis	0.0078
Middle SDI	Nutritional deficiencies	Respiratory infections and tuberculosis	0.0075
Middle SDI	Mental disorders	Respiratory infections and tuberculosis	-0.0060
Middle SDI	Respiratory infections and tuberculosis	Cardiovascular diseases	0.0580
Middle SDI	Enteric infections	Cardiovascular diseases	0.0582
Middle SDI	Maternal and neonatal disorders	Cardiovascular diseases	0.0144
Middle SDI	Other infectious diseases	Cardiovascular diseases	0.0181
Middle SDI	Digestive diseases	Cardiovascular diseases	0.0481
Middle SDI	Unintentional injuries	Cardiovascular diseases	0.0041
Middle SDI	Neglected tropical diseases and malaria	Cardiovascular diseases	0.0093
Middle SDI	Nutritional deficiencies	Cardiovascular diseases	0.0103
Middle SDI	Mental disorders	Cardiovascular diseases	-0.0052
Middle SDI	Respiratory infections and tuberculosis	Enteric infections	0.0318
Middle SDI	Cardiovascular diseases	Enteric infections	0.0582
Middle SDI	Maternal and neonatal disorders	Enteric infections	0.0158
Middle SDI	Other infectious diseases	Enteric infections	0.0125
Middle SDI	Digestive diseases	Enteric infections	0.0185
Middle SDI	Unintentional injuries	Enteric infections	0.0048
Middle SDI	Neglected tropical diseases and malaria	Enteric infections	0.0058
Middle SDI	Nutritional deficiencies	Enteric infections	0.0063
Middle SDI	Mental disorders	Enteric infections	-0.0044
Middle SDI	Respiratory infections and tuberculosis	Maternal and neonatal disorders	0.0204
Middle SDI	Cardiovascular diseases	Maternal and neonatal disorders	0.0144
Middle SDI	Enteric infections	Maternal and neonatal disorders	0.0158
Middle SDI	Other infectious diseases	Maternal and neonatal disorders	0.0090

Middle SDI	Digestive diseases	Maternal and neonatal disorders	0.0063
Middle SDI	Unintentional injuries	Maternal and neonatal disorders	0.0043
Middle SDI	Neglected tropical diseases and malaria	Maternal and neonatal disorders	0.0040
Middle SDI	Nutritional deficiencies	Maternal and neonatal disorders	0.0042
Middle SDI	Mental disorders	Maternal and neonatal disorders	-0.0036
Middle SDI	Respiratory infections and tuberculosis	Other infectious diseases	0.0159
Middle SDI	Cardiovascular diseases	Other infectious diseases	0.0181
Middle SDI	Enteric infections	Other infectious diseases	0.0125
Middle SDI	Maternal and neonatal disorders	Other infectious diseases	0.0090
Middle SDI	Digestive diseases	Other infectious diseases	0.0068
Middle SDI	Unintentional injuries	Other infectious diseases	0.0033
Middle SDI	Neglected tropical diseases and malaria	Other infectious diseases	0.0032
Middle SDI	Nutritional deficiencies	Other infectious diseases	0.0031
Middle SDI	Mental disorders	Other infectious diseases	-0.0027
Middle SDI	Respiratory infections and tuberculosis	Digestive diseases	0.0202
Middle SDI	Cardiovascular diseases	Digestive diseases	0.0481
Middle SDI	Enteric infections	Digestive diseases	0.0185
Middle SDI	Maternal and neonatal disorders	Digestive diseases	0.0063
Middle SDI	Other infectious diseases	Digestive diseases	0.0068
Middle SDI	Unintentional injuries	Digestive diseases	0.0023
Middle SDI	Neglected tropical diseases and malaria	Digestive diseases	0.0034
Middle SDI	Nutritional deficiencies	Digestive diseases	0.0035
Middle SDI	Mental disorders	Digestive diseases	-0.0021
Middle SDI	Respiratory infections and tuberculosis	Unintentional injuries	0.0072
Middle SDI	Cardiovascular diseases	Unintentional injuries	0.0041
Middle SDI	Enteric infections	Unintentional injuries	0.0048
Middle SDI	Maternal and neonatal disorders	Unintentional injuries	0.0043
Middle SDI	Other infectious diseases	Unintentional injuries	0.0033
Middle SDI	Digestive diseases	Unintentional injuries	0.0023
Middle SDI	Neglected tropical diseases and malaria	Unintentional injuries	0.0017
Middle SDI	Nutritional deficiencies	Unintentional injuries	0.0014
Middle SDI	Mental disorders	Unintentional injuries	-0.0014
Middle SDI	Respiratory infections and tuberculosis	Neglected tropical diseases and malaria	0.0078
Middle SDI	Cardiovascular diseases	Neglected tropical diseases and malaria	0.0093
Middle SDI	Enteric infections	Neglected tropical diseases and malaria	0.0058
Middle SDI	Maternal and neonatal disorders	Neglected tropical diseases and malaria	0.0040
Middle SDI	Other infectious diseases	Neglected tropical diseases and malaria	0.0032
Middle SDI	Digestive diseases	Neglected tropical diseases and malaria	0.0034
Middle SDI	Unintentional injuries	Neglected tropical diseases and malaria	0.0017
Middle SDI	Nutritional deficiencies	Neglected tropical diseases and malaria	0.0008
Middle SDI	Mental disorders	Neglected tropical diseases and malaria	-0.0003
Middle SDI	Respiratory infections and tuberculosis	Nutritional deficiencies	0.0075
Middle SDI	Cardiovascular diseases	Nutritional deficiencies	0.0103

Middle SDI	Enteric infections	Nutritional deficiencies	0.0063
Middle SDI	Maternal and neonatal disorders	Nutritional deficiencies	0.0042
Middle SDI	Other infectious diseases	Nutritional deficiencies	0.0031
Middle SDI	Digestive diseases	Nutritional deficiencies	0.0035
Middle SDI	Unintentional injuries	Nutritional deficiencies	0.0014
Middle SDI	Neglected tropical diseases and malaria	Nutritional deficiencies	0.0008
Middle SDI	Mental disorders	Nutritional deficiencies	-0.0004
Middle SDI	Respiratory infections and tuberculosis	Mental disorders	-0.0060
Middle SDI	Cardiovascular diseases	Mental disorders	-0.0052
Middle SDI	Enteric infections	Mental disorders	-0.0044
Middle SDI	Maternal and neonatal disorders	Mental disorders	-0.0036
Middle SDI	Other infectious diseases	Mental disorders	-0.0027
Middle SDI	Digestive diseases	Mental disorders	-0.0021
Middle SDI	Unintentional injuries	Mental disorders	-0.0014
Middle SDI	Neglected tropical diseases and malaria	Mental disorders	-0.0003
Middle SDI	Nutritional deficiencies	Mental disorders	-0.0004
High-middle SDI	Respiratory infections and tuberculosis	Cardiovascular diseases	0.0794
High-middle SDI	Neoplasms	Cardiovascular diseases	0.1500
High-middle SDI	Maternal and neonatal disorders	Cardiovascular diseases	0.0279
High-middle SDI	Enteric infections	Cardiovascular diseases	0.0796
High-middle SDI	Unintentional injuries	Cardiovascular diseases	0.0324
High-middle SDI	Transport injuries	Cardiovascular diseases	0.0358
High-middle SDI	Chronic respiratory diseases	Cardiovascular diseases	0.1152
High-middle SDI	Other infectious diseases	Cardiovascular diseases	0.0207
High-middle SDI	Digestive diseases	Cardiovascular diseases	0.0622
High-middle SDI	Cardiovascular diseases	Respiratory infections and tuberculosis	0.0794
High-middle SDI	Neoplasms	Respiratory infections and tuberculosis	0.0235
High-middle SDI	Maternal and neonatal disorders	Respiratory infections and tuberculosis	0.0148
High-middle SDI	Enteric infections	Respiratory infections and tuberculosis	0.0149
High-middle SDI	Unintentional injuries	Respiratory infections and tuberculosis	0.0101
High-middle SDI	Transport injuries	Respiratory infections and tuberculosis	0.0083
High-middle SDI	Chronic respiratory diseases	Respiratory infections and tuberculosis	0.0138
High-middle SDI	Other infectious diseases	Respiratory infections and tuberculosis	0.0065
High-middle SDI	Digestive diseases	Respiratory infections and tuberculosis	0.0093
High-middle SDI	Cardiovascular diseases	Neoplasms	0.1500
High-middle SDI	Respiratory infections and tuberculosis	Neoplasms	0.0235
High-middle SDI	Maternal and neonatal disorders	Neoplasms	0.0096
High-middle SDI	Enteric infections	Neoplasms	0.0181
High-middle SDI	Unintentional injuries	Neoplasms	0.0104
High-middle SDI	Transport injuries	Neoplasms	0.0110
High-middle SDI	Chronic respiratory diseases	Neoplasms	0.0263
High-middle SDI	Other infectious diseases	Neoplasms	0.0063
High-middle SDI	Digestive diseases	Neoplasms	0.0157

High-middle SDI	Cardiovascular diseases	Maternal and neonatal disorders	0.0279
High-middle SDI	Respiratory infections and tuberculosis	Maternal and neonatal disorders	0.0148
High-middle SDI	Neoplasms	Maternal and neonatal disorders	0.0096
High-middle SDI	Enteric infections	Maternal and neonatal disorders	0.0096
High-middle SDI	Unintentional injuries	Maternal and neonatal disorders	0.0070
High-middle SDI	Transport injuries	Maternal and neonatal disorders	0.0048
High-middle SDI	Chronic respiratory diseases	Maternal and neonatal disorders	0.0047
High-middle SDI	Other infectious diseases	Maternal and neonatal disorders	0.0049
High-middle SDI	Digestive diseases	Maternal and neonatal disorders	0.0040
High-middle SDI	Cardiovascular diseases	Enteric infections	0.0796
High-middle SDI	Respiratory infections and tuberculosis	Enteric infections	0.0149
High-middle SDI	Neoplasms	Enteric infections	0.0181
High-middle SDI	Maternal and neonatal disorders	Enteric infections	0.0096
High-middle SDI	Unintentional injuries	Enteric infections	0.0069
High-middle SDI	Transport injuries	Enteric infections	0.0059
High-middle SDI	Chronic respiratory diseases	Enteric infections	0.0136
High-middle SDI	Other infectious diseases	Enteric infections	0.0046
High-middle SDI	Digestive diseases	Enteric infections	0.0082
High-middle SDI	Cardiovascular diseases	Unintentional injuries	0.0324
High-middle SDI	Respiratory infections and tuberculosis	Unintentional injuries	0.0101
High-middle SDI	Neoplasms	Unintentional injuries	0.0104
High-middle SDI	Maternal and neonatal disorders	Unintentional injuries	0.0070
High-middle SDI	Enteric infections	Unintentional injuries	0.0069
High-middle SDI	Transport injuries	Unintentional injuries	0.0046
High-middle SDI	Chronic respiratory diseases	Unintentional injuries	0.0055
High-middle SDI	Other infectious diseases	Unintentional injuries	0.0034
High-middle SDI	Digestive diseases	Unintentional injuries	0.0042
High-middle SDI	Cardiovascular diseases	Transport injuries	0.0358
High-middle SDI	Respiratory infections and tuberculosis	Transport injuries	0.0083
High-middle SDI	Neoplasms	Transport injuries	0.0110
High-middle SDI	Maternal and neonatal disorders	Transport injuries	0.0048
High-middle SDI	Enteric infections	Transport injuries	0.0059
High-middle SDI	Unintentional injuries	Transport injuries	0.0046
High-middle SDI	Chronic respiratory diseases	Transport injuries	0.0061
High-middle SDI	Other infectious diseases	Transport injuries	0.0026
High-middle SDI	Digestive diseases	Transport injuries	0.0043
High-middle SDI	Cardiovascular diseases	Chronic respiratory diseases	0.1152
High-middle SDI	Respiratory infections and tuberculosis	Chronic respiratory diseases	0.0138
High-middle SDI	Neoplasms	Chronic respiratory diseases	0.0263
High-middle SDI	Maternal and neonatal disorders	Chronic respiratory diseases	0.0047
High-middle SDI	Enteric infections	Chronic respiratory diseases	0.0136
High-middle SDI	Unintentional injuries	Chronic respiratory diseases	0.0055
High-middle SDI	Transport injuries	Chronic respiratory diseases	0.0061

High-middle SDI	Other infectious diseases	Chronic respiratory diseases	0.0036
High-middle SDI	Digestive diseases	Chronic respiratory diseases	0.0108
High-middle SDI	Cardiovascular diseases	Other infectious diseases	0.0207
High-middle SDI	Respiratory infections and tuberculosis	Other infectious diseases	0.0065
High-middle SDI	Neoplasms	Other infectious diseases	0.0063
High-middle SDI	Maternal and neonatal disorders	Other infectious diseases	0.0049
High-middle SDI	Enteric infections	Other infectious diseases	0.0046
High-middle SDI	Unintentional injuries	Other infectious diseases	0.0034
High-middle SDI	Transport injuries	Other infectious diseases	0.0026
High-middle SDI	Chronic respiratory diseases	Other infectious diseases	0.0036
High-middle SDI	Digestive diseases	Other infectious diseases	0.0026
High-middle SDI	Cardiovascular diseases	Digestive diseases	0.0622
High-middle SDI	Respiratory infections and tuberculosis	Digestive diseases	0.0093
High-middle SDI	Neoplasms	Digestive diseases	0.0157
High-middle SDI	Maternal and neonatal disorders	Digestive diseases	0.0040
High-middle SDI	Enteric infections	Digestive diseases	0.0082
High-middle SDI	Unintentional injuries	Digestive diseases	0.0042
High-middle SDI	Transport injuries	Digestive diseases	0.0043
High-middle SDI	Chronic respiratory diseases	Digestive diseases	0.0108
High-middle SDI	Other infectious diseases	Digestive diseases	0.0026
High SDI	Neoplasms	Cardiovascular diseases	0.1470
High SDI	Maternal and neonatal disorders	Cardiovascular diseases	0.0174
High SDI	Transport injuries	Cardiovascular diseases	0.0346
High SDI	Mental disorders	Cardiovascular diseases	-0.0098
High SDI	Respiratory infections and tuberculosis	Cardiovascular diseases	0.0138
High SDI	Unintentional injuries	Cardiovascular diseases	-0.0078
High SDI	Other non-communicable diseases	Cardiovascular diseases	0.0009
High SDI	Chronic respiratory diseases	Cardiovascular diseases	0.0579
High SDI	Digestive diseases	Cardiovascular diseases	0.0398
High SDI	Cardiovascular diseases	Neoplasms	0.1470
High SDI	Maternal and neonatal disorders	Neoplasms	0.0059
High SDI	Transport injuries	Neoplasms	0.0101
High SDI	Mental disorders	Neoplasms	-0.0036
High SDI	Respiratory infections and tuberculosis	Neoplasms	0.0051
High SDI	Unintentional injuries	Neoplasms	0.0012
High SDI	Other non-communicable diseases	Neoplasms	0.0034
High SDI	Chronic respiratory diseases	Neoplasms	0.0118
High SDI	Digestive diseases	Neoplasms	0.0088
High SDI	Cardiovascular diseases	Maternal and neonatal disorders	0.0174
High SDI	Neoplasms	Maternal and neonatal disorders	0.0059
High SDI	Transport injuries	Maternal and neonatal disorders	0.0028
High SDI	Mental disorders	Maternal and neonatal disorders	-0.0022
High SDI	Respiratory infections and tuberculosis	Maternal and neonatal disorders	0.0032

High SDI	Unintentional injuries	Maternal and neonatal disorders	0.0019
High SDI	Other non-communicable diseases	Maternal and neonatal disorders	0.0028
High SDI	Chronic respiratory diseases	Maternal and neonatal disorders	0.0014
High SDI	Digestive diseases	Maternal and neonatal disorders	0.0014
High SDI	Cardiovascular diseases	Transport injuries	0.0346
High SDI	Neoplasms	Transport injuries	0.0101
High SDI	Maternal and neonatal disorders	Transport injuries	0.0028
High SDI	Mental disorders	Transport injuries	-0.0014
High SDI	Respiratory infections and tuberculosis	Transport injuries	0.0021
High SDI	Unintentional injuries	Transport injuries	0.0015
High SDI	Other non-communicable diseases	Transport injuries	0.0015
High SDI	Chronic respiratory diseases	Transport injuries	0.0027
High SDI	Digestive diseases	Transport injuries	0.0023
High SDI	Cardiovascular diseases	Mental disorders	-0.0098
High SDI	Neoplasms	Mental disorders	-0.0036
High SDI	Maternal and neonatal disorders	Mental disorders	-0.0022
High SDI	Transport injuries	Mental disorders	-0.0014
High SDI	Respiratory infections and tuberculosis	Mental disorders	-0.0017
High SDI	Unintentional injuries	Mental disorders	-0.0009
High SDI	Other non-communicable diseases	Mental disorders	-0.0010
High SDI	Chronic respiratory diseases	Mental disorders	-0.0008
High SDI	Digestive diseases	Mental disorders	-0.0007
High SDI	Cardiovascular diseases	Respiratory infections and tuberculosis	0.0138
High SDI	Neoplasms	Respiratory infections and tuberculosis	0.0051
High SDI	Maternal and neonatal disorders	Respiratory infections and tuberculosis	0.0032
High SDI	Transport injuries	Respiratory infections and tuberculosis	0.0021
High SDI	Mental disorders	Respiratory infections and tuberculosis	-0.0017
High SDI	Unintentional injuries	Respiratory infections and tuberculosis	0.0012
High SDI	Other non-communicable diseases	Respiratory infections and tuberculosis	0.0018
High SDI	Chronic respiratory diseases	Respiratory infections and tuberculosis	0.0013
High SDI	Digestive diseases	Respiratory infections and tuberculosis	0.0012
High SDI	Cardiovascular diseases	Unintentional injuries	-0.0078
High SDI	Neoplasms	Unintentional injuries	0.0012
High SDI	Maternal and neonatal disorders	Unintentional injuries	0.0019
High SDI	Transport injuries	Unintentional injuries	0.0015
High SDI	Mental disorders	Unintentional injuries	-0.0009
High SDI	Respiratory infections and tuberculosis	Unintentional injuries	0.0012
High SDI	Other non-communicable diseases	Unintentional injuries	0.0013
High SDI	Chronic respiratory diseases	Unintentional injuries	-0.0002
High SDI	Digestive diseases	Unintentional injuries	0.0002
High SDI	Cardiovascular diseases	Other non-communicable diseases	0.0009
High SDI	Neoplasms	Other non-communicable diseases	0.0034
High SDI	Maternal and neonatal disorders	Other non-communicable diseases	0.0028

High SDI	Transport injuries	Other non-communicable diseases	0.0015
High SDI	Mental disorders	Other non-communicable diseases	-0.0010
High SDI	Respiratory infections and tuberculosis	Other non-communicable diseases	0.0018
High SDI	Unintentional injuries	Other non-communicable diseases	0.0013
High SDI	Chronic respiratory diseases	Other non-communicable diseases	0.0005
High SDI	Digestive diseases	Other non-communicable diseases	0.0006
High SDI	Cardiovascular diseases	Chronic respiratory diseases	0.0579
High SDI	Neoplasms	Chronic respiratory diseases	0.0118
High SDI	Maternal and neonatal disorders	Chronic respiratory diseases	0.0014
High SDI	Transport injuries	Chronic respiratory diseases	0.0027
High SDI	Mental disorders	Chronic respiratory diseases	-0.0008
High SDI	Respiratory infections and tuberculosis	Chronic respiratory diseases	0.0013
High SDI	Unintentional injuries	Chronic respiratory diseases	-0.0002
High SDI	Other non-communicable diseases	Chronic respiratory diseases	0.0005
High SDI	Digestive diseases	Chronic respiratory diseases	0.0028
High SDI	Cardiovascular diseases	Digestive diseases	0.0398
High SDI	Neoplasms	Digestive diseases	0.0088
High SDI	Maternal and neonatal disorders	Digestive diseases	0.0014
High SDI	Transport injuries	Digestive diseases	0.0023
High SDI	Mental disorders	Digestive diseases	-0.0007
High SDI	Respiratory infections and tuberculosis	Digestive diseases	0.0012
High SDI	Unintentional injuries	Digestive diseases	0.0002
High SDI	Other non-communicable diseases	Digestive diseases	0.0006
High SDI	Chronic respiratory diseases	Digestive diseases	0.0028

Notes: Interaction indices are second-order Shapley interaction indices expressed in years. Positive values indicate synergy, where the combined effect exceeds the sum of individual effects. Negative values indicate antagonism. The 10 causes with the largest absolute total Shapley values were selected in each SDI quintile. Indices were calculated from 5,000 random permutations and summarised as medians over 1,000 bootstrap iterations. SDI = Socio-demographic Index.