**Supplementary Tables**

Table S1-4 are GAM estimates and statistical outputs. The model estimates and related standard errors (Std.Error) were shown for parametric terms. For non-parametric smooth terms, their estimated and reference degrees of freedom (i.e. edf, sumEDF, Ref.df) and their test statistics were shown.

**Table S1.** Relative fit of GAM analyzing the predictors for AD%. AIC = Akaike information criterion. sumEDF indicates the degrees of freedom of the models. Model 16 was selected as the best model because of the lowest AIC. (related to Figure 1B)

|  |  |  |  |
| --- | --- | --- | --- |
| **GAM** | **AIC** | **sumEDF** | **Formula** |
| 0 | -11055.96 | 157.91 | gam(AD% ~ 1 + s(Country, bs = "re")) |
| 1 | -11292.71 | 166.47 | gam(AD% ~ s(Country, bs = "re") + s(GDP)) |
| 2 | -11144.48 | 162.09 | gam(AD% ~ s(Country, bs = "re") + s(Year)) |
| 3 | -11545.51 | 169.48 | gam(AD% ~ s(Year) + s(GDP) + s(Country, bs = "re")) |
| 4 | -11579.22 | 176.77 | gam(AD% ~ te(Year, GDP) + s(Country, bs = "re")) |
| 5 | -12320.01 | 166.78 | gam(AD% ~ s(MHD%) + s(Country, bs = "re")) |
| 6 | -12372.69 | 171.04 | gam(AD% ~ s(MHD%) + s(Year) + s(Country, bs = "re")) |
| 7 | -12645.50 | 175.48 | gam(AD% ~ s(MHD%) + s(GDP) + s(Country, bs = "re")) |
| 8 | -12905.60 | 178.51 | gam(AD% ~ s(MHD%) + s(Year) + s(GDP) + s(Country, bs = "re")) |
| 9 | -12966.20 | 187.01 | gam(AD% ~ s(MHD%) + te(Year, GDP) + s(Country, bs = "re")) |
| 10 | -13094.57 | 182.37 | gam(AD% ~ te(MHD%, GDP) + s(Year) + s(Country, bs = "re")) |
| 11 | -12924.92 | 187.87 | gam(AD% ~ te(MHD%, Year) + s(GDP) + s(Country, bs = "re")) |
| 12 | -13523.58 | 263.55 | gam(AD% ~ te(MHD%, Year, GDP) + s(Country, bs = "re")) |
| 13 | -12523.69 | 178.17 | gam(AD% ~ te(MHD%, Year) + s(Country, bs = "re")) |
| 14 | -12883.89 | 180.03 | gam(AD% ~ te(MHD%, GDP) + s(Country, bs = "re")) |
| 15 | -13395.86 | 241.13 | gam(AD% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year, GDP) + s(Country, bs = "re"), data = complete |
| **16** | **-13674.22** | **274.60** | **gam(AD% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year, GDP) + ti(MHD%, Year) + ti(MHD%, GDP) + ti(GDP, Year) + s(Country, bs = "re"))** |
| 17 | -13352.09 | 217.49 | gam(AD% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year) + ti(MHD%, GDP) + ti(GDP, Year) + s(Country, bs = "re")) |
| 18 | -1359260 | 267.85 | gam(AD% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year, GDP) + ti(MHD%, GDP) + ti(GDP, Year) + s(Country, bs = "re")) |
| 19 | -13496.98 | 255.39 | gam(AD% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year, GDP) + ti(MHD%, Year) + ti(GDP, Year) + s(Country, bs = "re")) |
| 20 | -13667.62 | 258.97 | gam(AD% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year, GDP) + ti(MHD%, Year) + ti(MHD%, GDP) + s(Country, bs = "re")) |

**Table S2.** Estimated effects of MHD%, GDP per capita and year on AD%. (related to Figure 1B)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parametric coefficients** | | | | |
|  | **Estimate** | **Std.Error** | **t value** | **Pr(>|t|)** |
| **(Intercept)** | -2.9621 | 0.1505 | -19.68 | <2e-16 |
| **Approximate significance of smooth terms** | | | | |
|  | **edf** | **Ref.df** | **F** | **P value** |
| **s(MHD%)** | 8.345 | 8.853 | 71.963 | <2e-16 |
| **s(Year)** | 3.181 | 4.101 | 1.055 | 0.377 |
| **s(GDP)** | 8.496 | 8.922 | 23.766 | <2e-16 |
| **ti(MHD%, Year, GDP)** | 60.240 | 62.297 | 6.848 | <2e-16 |
| **ti(MHD%, Year)** | 12.943 | 13.939 | 6.873 | <2e-16 |
| **ti(MHD%, GDP)** | 12.343 | 13.472 | 14.821 | <2e-16 |
| **ti(Year, GDP)** | 11.061 | 11.999 | 1.533 | 0.105 |
| **s(Country)** | 156.986 | 158.000 | 1555.377 | <2e-16 |
| R-sq.(adj) = 0.994 Deviance explained = 99.4% | | | | |
| GCV = 0.0024044 Scale est. = 0.0022501 n = 4278 | | | | |

**Table S3.** Relative fit of GAM analyzing the predictors for asthma%. AIC = Akaike information criterion. sumEDF indicates the degrees of freedom of the models. Model 16 was selected as the best model because of the lowest AIC. (related to Figure 1C)

|  |  |  |  |
| --- | --- | --- | --- |
| **GAM** | **AIC** | **sumEDF** | **Formula** |
| 0 | -6005.396 | 163.74 | gam(Asthma% ~ 1 + s(Country, bs = "re")) |
| 1 | -6046.657 | 167.44 | gam(Asthma% ~ s(Country, bs = "re") + s(GDP)) |
| 2 | -6084.177 | 168.63 | gam(Asthma% ~ s(Country, bs = "re") + s(Year)) |
| 3 | -6182.928 | 177.04 | gam(Asthma% ~ s(Year) + s(GDP) + s(Country, bs = "re")) |
| 4 | -6221.603 | 185.02 | gam(Asthma% ~ te(Year, GDP) + s(Country, bs = "re")) |
| 5 | -6372.593 | 172.60 | gam(Asthma% ~ s(MHD%) + s(Country, bs = "re")) |
| 6 | -6498.153 | 177.68 | gam(Asthma% ~ s(MHD%) + s(Year) + s(Country, bs = "re")) |
| 7 | -6466.578 | 181.16 | gam(Asthma% ~ s(MHD%) + s(GDP) + s(Country, bs = "re")) |
| 8 | -6629.696 | 186.90 | gam(Asthma% ~ s(MHD%) + s(Year) + s(GDP) + s(Country, bs = "re")) |
| 9 | -6683.406 | 194.13 | gam(Asthma% ~ s(MHD%) + te(Year, GDP) + s(Country, bs = "re")) |
| 10 | -6600.789 | 192.65 | gam(Asthma% ~ te(MHD%, GDP) + s(Year) + s(Country, bs = "re")) |
| 11 | -6577.306 | 195.48 | gam(Asthma% ~ te(MHD%, Year) + s(GDP) + s(Country, bs = "re")) |
| 12 | -7170.909 | 279.89 | gam(Asthma% ~ te(MHD%, Year, GDP) + s(Country, bs = "re")) |
| 13 | -6472.943 | 187.27 | gam(Asthma% ~ te(MHD%, Year) + s(Country, bs = "re")) |
| 14 | -6414.504 | 187 | gam(Asthma% ~ te(MHD%, GDP) + s(Country, bs = "re")) |
| 15 | -7067.771 | 240.75 | gam(Asthma% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year, GDP) + s(Country, bs = "re"), data = complete |
| **16** | **-7392.585** | **283.31** | **gam(Asthma% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year, GDP) + ti(MHD%, Year) + ti(MHD%, GDP) + ti(GDP, Year) + s(Country, bs = "re"))** |
| 17 | -6882.094 | 225.35 | gam(Asthma% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year) + ti(MHD%, GDP) + ti(GDP, Year) + s(Country, bs = "re")) |
| 18 | -7338.786 | 276.73 | gam(Asthma% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year, GDP) + ti(MHD%, GDP) + ti(GDP, Year) + s(Country, bs = "re")) |
| 19 | -7288.454 | 272.75 | gam(Asthma% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year, GDP) + ti(MHD%, Year) + ti(GDP, Year) + s(Country, bs = "re")) |
| 20 | -7300.799 | 270.62 | gam(Asthma% ~ s(MHD%) + s(Year) + s(GDP) + ti(MHD%, Year, GDP) + ti(MHD%, Year) + ti(MHD%, GDP) + s(Country, bs = "re")) |

**Table S4.** Estimated effects of MHD%, GDP per capita and year on asthma%. (related to Figure 1C)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parametric coefficients** | | | | |
|  | **Estimate** | **Std.Error** | **t value** | **Pr(>|t|)** |
| **(Intercept)** | -2.5808 | 0.3884 | -6.644 | 3.43e-11 |
| **Approximate significance of smooth terms** | | | | |
|  | **edf** | **Ref.df** | **F** | **P value** |
| **s(MHD%)** | 8.843 | 8.988 | 41.649 | <2e-16 |
| **s(Year)** | 6.572 | 7.790 | 10.306 | <2e-16 |
| **s(GDP)** | 8.611 | 8.955 | 13.542 | <2e-16 |
| **ti(MHD%, Year, GDP)** | 61.876 | 62.917 | 10.092 | <2e-16 |
| **ti(MHD%, Year)** | 15.244 | 15.697 | 7.572 | <2e-16 |
| **ti(MHD%, GDP)** | 7.423 | 8.617 | 12.316 | <2e-16 |
| **ti(Year, GDP)** | 10.745 | 11.955 | 7.951 | <2e-16 |
| **s(Country)** | 162.993 | 164.000 | 639.022 | <2e-16 |
| R-sq.(adj) = 0.97 Deviance explained = 97.2% | | | | |
| GCV = 0.011746 Scale est. = 0.011022 n = 4592 | | | | |