### **Supplement**

**Data selection**

Individuals aged 40–69 years were recruited between 2006 and 2010 (Sudlow et al., 2015). After excluding 36,001 participants with missing values on self-reported diabetes, 18,028 participants with a history of stroke and coronary heart disease (CHD), and 3201euglycemic and 420808 pre-diabetes in Figure 1, 24,467 individuals were selected in the main analysis.

All UKB participants N=502505

Missing HbA1c=36001

Stroke =1 and CHD =1 N=18028

pre

CVD-free with complete glycemic measures N=448476

Euglycemic 3201

Pre-DM 420808

All CVD-free T2D N=24467

Figure 1 Flow Chart of Data Selection.

**LCA procedure**

According to Table1, Group 3 has the highest entropy of 1 and low likelihood of -12440. the AIC and BIC were lower than others.

Table 1 Model fit indicators for LCA from 1 to 6 classes.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Models | LL | AIC | BIC | CAIC | Smallest class count (n) | Entropy | VLMR-LRT |
| Group 1 | -651169 | 1302397 | 1302632 | 1302660.723 | 0 | - | - |
| Group 2 | -168404 | 336891.5 | 337231.9 | 337273.9294 | 275 | 1 | 0 |
| Group 3 | -124401 | 248931.4 | 249458.2 | 249523.1902 | 275 | 1 | 0.299 |
| Group 4 | -330350 | 660923 | 661828 | 661940.1298 | 1683 | 0.899 | 0 |
| Group 5 | -107320 | 214862.8 | 215762.5 | 215873.5079 | 89 | 1 | 0.2678 |
| Group 6 | -109451 | 219170 | 220256.1 | 220390.0528 | 1 | 1 | 1 |

Note: AIC Akaike’s information criterion, BIC Bayes information criterion, CAIC consistent AIC.

Table 2 Covariates and Explanatory Variables List

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Description | Ukb Data\_Field | Coding |
| Age | Age at recruitment | n\_21022\_0\_0 |  |
| White | Ethnic background | n\_21000\_0\_0 | if race=1 then white=1; else if race>. then white=0  1 white, 2 Asian, 3 black,4 mixed and other |
| Sex | Sex | n\_31\_0\_0 | 0 Female 1 Male |
| Sleep duration | Sleep duration | n\_1160\_0\_0;n\_1160\_1\_0;n\_1160\_2\_0;n\_1160\_3\_0 | if n\_1160\_0\_0<7 Sleep=0 otherwise sleep=1 |
| Alcohol | Alcohol intake frequency. | n\_1558\_0\_0 | 1 Daily or almost daily (code 0) 2 Three or four times a week(code 0) 3 Once or twice a week(code 0) 4 One to three times a month(code 1) 5 Special occasions only(code 1) 6 Never(code 1) -3 Prefer not to answer (exclude) |
| DM diagnosis age | Age diabetes diagnosed | n\_2976\_0\_0 | -1 Do not know -3 Prefer not to answer |
| townsend | Townsend deprivation index at recruitment | n\_22189\_0\_0 |  |
| smoking | Smoking status | n\_20116\_1\_0~n\_20116\_3\_0 | -3 Prefer not to answer 0 Never 1 Previous 2 Current |
| Physical Activity | Summed MET minutes per week for all activity | n\_22035\_0\_0 | No-0 Yes-1 |
| Baseline hypertension | Imputation | baseHB; basehbmed | if n\_6150\_0\_0=4 | n\_6150\_0\_1=4 | n\_6150\_0\_2=4 | n\_6150\_0\_3=4 then baseHB=1;if n\_6177\_0\_0=2 | n\_6177\_0\_1=2 | n\_6177\_0\_2=2 | n\_6153\_0\_0=2 | n\_6153\_0\_1=2 | n\_6153\_0\_2=2 | n\_6153\_0\_3=2 then basehbmed=1 |
| Baseline dyslipidemina | Imputation | baselipmed; basehbmed; basedmmed; | if n\_6177\_0\_0=1 | n\_6177\_0\_1=1 | n\_6177\_0\_2=1 | n\_6153\_0\_0=1 | n\_6153\_0\_1=1 | n\_6153\_0\_2=1 | n\_6153\_0\_3=1 then baselipmed=1; if n\_6177\_0\_0=2 | n\_6177\_0\_1=2 | n\_6177\_0\_2=2 | n\_6153\_0\_0=2 | n\_6153\_0\_1=2 | n\_6153\_0\_2=2 | n\_6153\_0\_3=2 then basehbmed=1;  if n\_6177\_0\_0=3 | n\_6177\_0\_1=3 | n\_6177\_0\_2=3 | n\_6153\_0\_0=3 | n\_6153\_0\_1=3 | n\_6153\_0\_2=3 | n\_6153\_0\_3=3 then basedmmed=1; |
| Social Isolation | It include isolation and activity | n\_1031\_0\_0;n\_6160\_0\_0 | If Isolation =1 and Activity =1 Social Isolation=1 isolated (score=2) If Isolation =0 or Activity =0 Social Isolation=0 not isolated (1 or0) |
| Isolation | How often do you visit friends or family or have them visit you?” | n\_1031\_0\_0; | If n\_1031\_0\_0>=4 isolation=1 "friends and family visit less than once a month"  If n\_1031\_0\_0>0 and n\_1031\_0\_0<4 isolation=0 "friends and family visit beyond once a month" |
| Activity | “Which of the following [leisure/social activities] do you engage in once a week or more often? | n\_6160\_0\_0 ;n\_6160\_0\_1;n\_6160\_0\_2;n\_6160\_0\_3;n\_6160\_0\_4 | If n\_6160\_0\_0 >=1 activity=0 " participate 1more activity"  If n\_6160\_0\_0=-7 activity =1 "no participation in social activities at least weekly" |
| Loneliness | It include lone and close. | n\_2020\_0\_0;n\_2110\_0\_0 | If Lone=1 & close=1 Loneliness=0 If Lone=0 or close=0 Loneliness=1 |
| Lone | Do you often feel lonely? | n\_2020\_0\_0 | If n\_2020\_0\_0=1 "lonely" If n\_2020\_0\_0=0 "not lonely" |
| close | How often are you able to confide in someone close to you?” | n\_2110\_0\_0 | If n\_2110\_0\_0>=0 and n\_2110\_0\_0<2 close=1 "once every few months to never or almost never" If n\_2110\_0\_0>=2 close=0 "almost daily to about once a month" |
| neuroticism | Multiple Imputation | n\_20127\_0\_0 | >=3-0 <3-1 |
| Depression |  | n\_2050\_0\_0;n\_2060\_0\_0 | >=3-0 <3-1 |
| Anxiety |  | n\_2070\_0\_0;n\_2080\_0\_0 | >=3-0 <3-1 |
| diet | summing the intake of vegetables, fruit, fish, processed meat, and red meat | n\_1359\_0\_0;n\_1369\_0\_0;n\_1379\_0\_0;n\_1389\_0\_0 | If a total score > 4, diet=0;if the score >0 and <4, diet=1. |
| Obesity | Body mass index (BMI>=30) | n\_21001\_0\_0 | No-0 Yes-1 |