Brief Report: Personality and Risk of Diabetes in Adults: Pooled Analysis of 5 Cohort Studies

Online Supplementary Material

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British Household Panel Survey (BHPS)

The British Household Panel Survey (BHPS) is a longitudinal survey of a nationally representative sample of over 5000 British households with annual follow-ups.[1] The original cohort included 10,264 individuals aged 16-97 at baseline in 1991, and was based on a clustered, stratified sample of addresses throughout Great Britain south of the Caledonian Canal (excluding North of Scotland and Northern Ireland). New participants have been included in the sample over the years if they are born to original sample member, if they have moved into a household in the original sample, or if a member of the original sample moves into a new household with one or more new people. In addition, the sample was enriched with additional recruitment of participants at waves 9 and 11, from Scotland and Wales, and from Northern Ireland, respectively, so extending the sample to cover the whole UK. The most recent (18th) follow-up of the BHPS was carried out in 2008-2009, after which the cohort has become part of the larger Understanding Society Study.

Personality was assessed in the 15th data collection wave in 2005 using a brief, 15-item version of the Big Five Inventory (BFI[2, 3]) with three items assessing each personality trait, rated on a 7-point scale. Cronbach alpha reliabilities were 0.54 for extraversion, 0.68 for emotional stability, 0.53 for agreeableness, 0.51 for conscientiousness, and 0.67 for openness to experience. Personality scales were calculated for individuals with no missing items in the scale, resulting in 13,825 participants with full personality data at baseline.

Height and **weight** were self-reported by the participants in the 16th data collection wave in 2006. Although this was 1 year after the measurement of personality, these data were treated as baseline measurements because no earlier data were available. **Body mass index (BMI)** was calculated from these data with the standard formula of BMI=weight in kilograms divided by squared height in meters. **Obesity** was determined as BMI≥30. Information on **smoking** (0=non-smoker, 1=current smoker), and **marital status** (0=single, 1=married/cohabiting) were derived from the participants' self-reports. Data on **race/ethnicity** was based on participants' self-reports and was coded as a dichotomous variable (0=white, non-Hispanic; 1=other). **Educational level** was determined on the basis of the highest achieved grade (0=primary education, 1=secondary education, 3=tertiary education). **Diabetes** was determined from the participant's response to the item "Diabetes" in an interview question *"Do you have any of the health problems or disabilities listed on this card?"* followed by a list of 15 illnesses. **Hypertension** was assessed by the item *"Heart/high blood pressure or blood circulation problems"*.

Study website:
http://www.esds.ac.uk/longitudinal/access/bhps/L33196.asp
http://www.understandingsociety.org.uk/

Health and Retirement Study (HRS)

The HRS is a nationally representative longitudinal study of more than 30,000 individuals representing the U.S. population older than 50 years.[4] Telephone or in-person interviews are conducted every 2 years, administered under the NIA and the University of Michigan's Institute for Social Research. As of 1998, the HRS consists of 4 sources of data collection: (1) The original HRS began as two distinct surveys that were merged in 1998, and are. The original HRS was initially administered in 1992 to a nationally representative sample of Americans born in the years 1931 through 1941. In the case of married couples, both spouses (including spouses who were younger than 51 or older than 61) were also interviewed; (2) The second survey, originally referred to as the Study of Assets and Health Dynamics Among the Oldest Old (AHEAD), was first administered in 1993 to a nationally representative sample of Americans born in 1923 or earlier (n=8,000) and merged with the HRS in 1998. In the case of married couples, interviews were conducted with both spouses; (3) In 1998, a subsample of individuals born between 1924 and 1930, referred to as Children of the Depression Age (CODA) was added to HRS; (4) Another subsample consisting of people born between 1942 and 1947 (War Baby cohort) was added to replenish the sample of people in their early 50s as the original HRS cohort aged. The Health Sciences Institutional Review Board at the University of Michigan approved the HRS.

Personality was measured using a self-reported instrument adapted from the MIDUS study[5] with 5 items for extroversion (α=0.74), 4 items for emotional stability (α=0.63), 5 items for agreeableness (α=0.78), 5 items for conscientiousness (α=0.63), and 7 items for openness to experience (α=0.79), rated on a 4-point rating scale. Mean scores for personality scales were calculated for individuals with a maximum of 1 missing item in the scale, resulting in 14,549 participants with full personality data at baseline. The personality instrument was administered to half of the sample in 2006 and to the other half in 2008. Thus, the study baseline was 2006 for half of the sample and 2008 for the other half of the sample. Baseline data on other covariates were derived from the year of personality assessment.

Height and **weight** were self-reported by the participants, and **body mass index (BMI)** was calculated from these data with the standard formula of BMI=weight in kilograms divided by squared height in meters. **Obesity** was determined as BMI≥30. Information on **smoking** (0=never smoked, 1=ex-smoker, 2=current smoker), **marital status** (0=single, 1=married/cohabiting), and **leisure-time physical activity** (0=inactive, 1=moderately active, 2=very active) were derived from the participants' self-reports. Data on **race/ethnicity** was based on participants' self-reports and was coded as a dichotomous variable (0=white, non-Hispanic; 1=other). **Educational level** was determined on the basis of the highest achieved grade (0=primary education, 1=secondary education, 3=tertiary education). **Diabetes** was determined from the participant's response to question *"Has a doctor ever told you that you have diabetes or high blood sugar?"* **Hypertension** was similarly determined based on the question *"Has a doctor ever told you that you have high blood pressure or hypertension?"* **Mortality** data were derived from the National Death Index (NDI) and/or via household proxy reports of a non-respondent's vital status, recorded with month's accuracy. Data on causes of death have not been released in detail based on ICD codes but related causes have been categorized together. Diabetes-related mortality was thus determined as deaths for which cause of death was stated to be "*Diabetes; pre-diabetic; high blood sugar*".

Study website:
http://hrsonline.isr.umich.edu

Midlife in the United States (MIDUS)

The MacArthur Foundation Survey of Midlife Development in the United States (MIDUS) is based on a nationally representative random-digit-dial sample of non-institutionalized, English-speaking adults, aged 25 to 74 years, selected from working telephone banks in the coterminous United States in 1995-1996.[6,7] The total original sample (n=7108) includes main respondents (n=3487), their siblings (n=950), a city oversample (n=757), and a twin subsample (n=1914). Data were collected in a telephone interview and with a mail questionnaire. A follow-up study of the original cohort was conducted in 2004-2005.

Personality was assessed at baseline with a model based on the Five Factor Model,[5] including 5 items of extraversion (α=0.78), 4 items for neuroticism (α=0.75), 5 items for agreeableness (α=0.81), 4 items for conscientiousness (α=0.56), and 7 items for openness to experience (α=0.78). Items were rated using a 4-point rating scale on how well different adjectives described them (1=not at all, 4=a lot). Full data on personality traits at baseline were available for 6,261 participants.

Height and **weight** were self-reported by the participants, and **body mass index (BMI)** was calculated from these data with the standard formula of BMI=weight in kilograms divided by squared height in meters. **Obesity** was determined as BMI≥30. Information on **smoking** (0=never smoked, 1=ex-smoker, 2=current smoker), **marital status** (0=single, 1=married/cohabiting), and **leisure-time physical activity** (0=inactive, 1=moderately active, 2=very active) were derived from the participants' self-reports. Data on **race/ethnicity** was based on participants' self-reports and was coded as a dichotomous variable (0=white, non-Hispanic; 1=other). **Educational level** was determined on the basis of the highest achieved grade (0=primary education, 1=secondary education, 3=tertiary education). **Diabetes** was determined from the participant's response to item "Diabetes or high blood sugar" in a 29-item list of illnesses asking *"In the past 12 months, have you experienced or been treated for any of the following?"* The item for **hypertension** was *"High blood pressure or hypertension"*.

Study website:
http://www.midus.wisc.edu/

Wisconsin Longitudinal Study (WLS)

The Wisconsin Longitudinal Study has followed a random sample of 10317 participants (5326 women, 4991 men) who were born between 1937 and 1940 and who graduated from Wisconsin high schools in 1957.[8] After baseline data collection in 1957, survey data have been collected from the participants or their parents in 1964, 1975, 1992/3, and 2003/5. The present study used data from the 1993 follow-up. The WLS sample is broadly representative of white, non-Hispanic American men and women who have completed at least a high school education (among Americans aged 50 to 54 in 1990 and 1991, approximately 66 percent were non-Hispanic white persons who completed at least 12 years of schooling). It is estimated that about 75 percent of Wisconsin youth graduated from high school in the late 1950s – everyone in the primary WLS sample graduated from high school.

In addition to the main sample of the 1957 high school graduates, the WLS has also collected data on a selected sibling of a sample of the graduates.[9] The data collection in adulthood has been very similar although not entirely identical for the siblings as for the graduates. For the present purposes, the sibling sample was analyzed separately from the graduate sample, because the sampling frame of the individuals for the graduate cohort and sibling cohort was considered to sufficiently to justify the decision of not combining the samples.

Personality data were collected in 1992-1994 via mail questionnaire including a 29-version of the Big Five Inventory (BFI[2, 3]). Participants were asked whether they agreed or disagreed that certain personality descriptions fitted themselves using a 6-point rating scale. The Cronbach alpha reliabilities were 0.76 for extraversion in graduates/0.65 in siblings for extraversion, 0.78/0.63 for neuroticism, 0.69/0.70 for agreeableness, 0.64/0.70 for conscientiousness, and 0.61/0.70 for openness to experience. A mean score for a trait was calculated if no more than 2 items of the scale were missing, resulting in 6,674 WLS graduates and 3,969 WLS siblings with full personality data at baseline.

Height and **weight** were self-reported by the participants, and **body mass index (BMI)** was calculated from these data with the standard formula of BMI=weight in kilograms divided by squared height in meters. **Obesity** was determined as BMI≥30. Information on **smoking** (0=never smoked, 1=ex-smoker, 2=current smoker), **marital status** (0=single, 1=married/cohabiting), and **leisure-time physical activity** (0=inactive, 1=moderately active, 2=very active) were derived from the participants' self-reports. **Educational level** was determined on the basis of the highest achieved grade (0=primary education, 1=secondary education, 3=tertiary education). **Diabetes** was determined from the participant's response to question *"Has a doctor ever told you that you have diabetes?"* **Hypertension** was determined similarly with a question *"Has a doctor told you that you have high blood pressure or hypertension?"* **Mortality** data were derived from the National Death Index (NDI), and diabetes-related mortality was determined on the basis of ICD codes (ICD-9 code 250; ICD-10 codes E10-E14) including underlying cause of death and record axis conditions.

Study website:
http://www.ssc.wisc.edu/wlsresearch/

Acknowledgements

The authors wish to gratefully thank the original collectors of the data, and the ESDS (Economic and Social Data Service; http://www.esds.ac.uk/) and ICPSR (Inter-university Consortium for Political and Social Research; www.icpsr.umich.edu) for making the data available.

The research uses data from the Wisconsin Longitudinal Study (WLS) of the University of Wisconsin-Madison. Since 1991, the WLS has been supported principally by the National Institute on Aging (AG-9775 and AG-21079), with additional support from the Vilas Estate Trust, the National Science Foundation, the Spencer Foundation, and the Graduate School of the University of Wisconsin-Madison. A public use file of data from the Wisconsin Longitudinal Study is available from the Wisconsin Longitudinal Study, University of Wisconsin-Madison, 1180 Observatory Drive, Madison, Wisconsin 53706 and at http://www.ssc.wisc.edu/wlsresearch/data/. The interpretations, opinions, and inferences based on the data are solely the responsibility of the authors.

References

1. *British Household Panel Survey user manual volume A: Introduction, technical report and appendices*. Colchester: University of Essex; 2010.
2. John OP, Donahue EM, Kentle RL. *The "Big Five" inventory – version 4a and 5a*. Berkeley, CA: Institute of Personality and Social Research, University of California, Berkeley; 1991.
3. John OP, Naumann LP, Soto CJ. Paradigm shift to the integrative big-five trait taxonomy: History, measurement, and conceptual issues. In: John OP, Robins RW, Pervin LA, eds. *Handbook of personality: Theory and research*. New York, NY: Guilford Press; 2008:114-158.
4. Juster FT, Suzman R. An overview of the Health Retirement Study. *Journal of Human Resources*. 1995;30:S7-S56.
5. Lachman ME, Weaver SL. *The Midlife Development Inventory (MIDI) personality scales: Scale construction and scoring*. Waltham, MA.: 1997.
6. Brim OG, Baltes PB, Bumpass LL et al. *National Survey of Midlife Development in the United States (MIDUS), 1995-1996. [computer file]*. ICPSR02760-v4. Ann Arbor, MI: DataStat, Inc./Boston, MA: Harvard Medical School, Dept. of Health Care Policy [producers]. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2007-04-16.; 2007.
7. Ryff C, Almeida DM, Ayanian JS et al. *Midlife Development in the United States (MIDUS2), 2004-2006 [computer file]*. ICPSR04652-v1. Madison, WI: University of Wisconsin, Survey Center [producers]. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2007-03-22.; 2006.
8. Wollmering E, ed. *Wisconsin Longitudinal Study Handbook (12.10.07)*. 2007.
9. Hauser RM, Sewell WH, Clarridge BR. The influence of family structure on socioeconomic achievement: A progress report. *CDE Working Paper No 82-59*. 1982

eTable 1. Characteristics of participants reporting no diabetes at baseline.

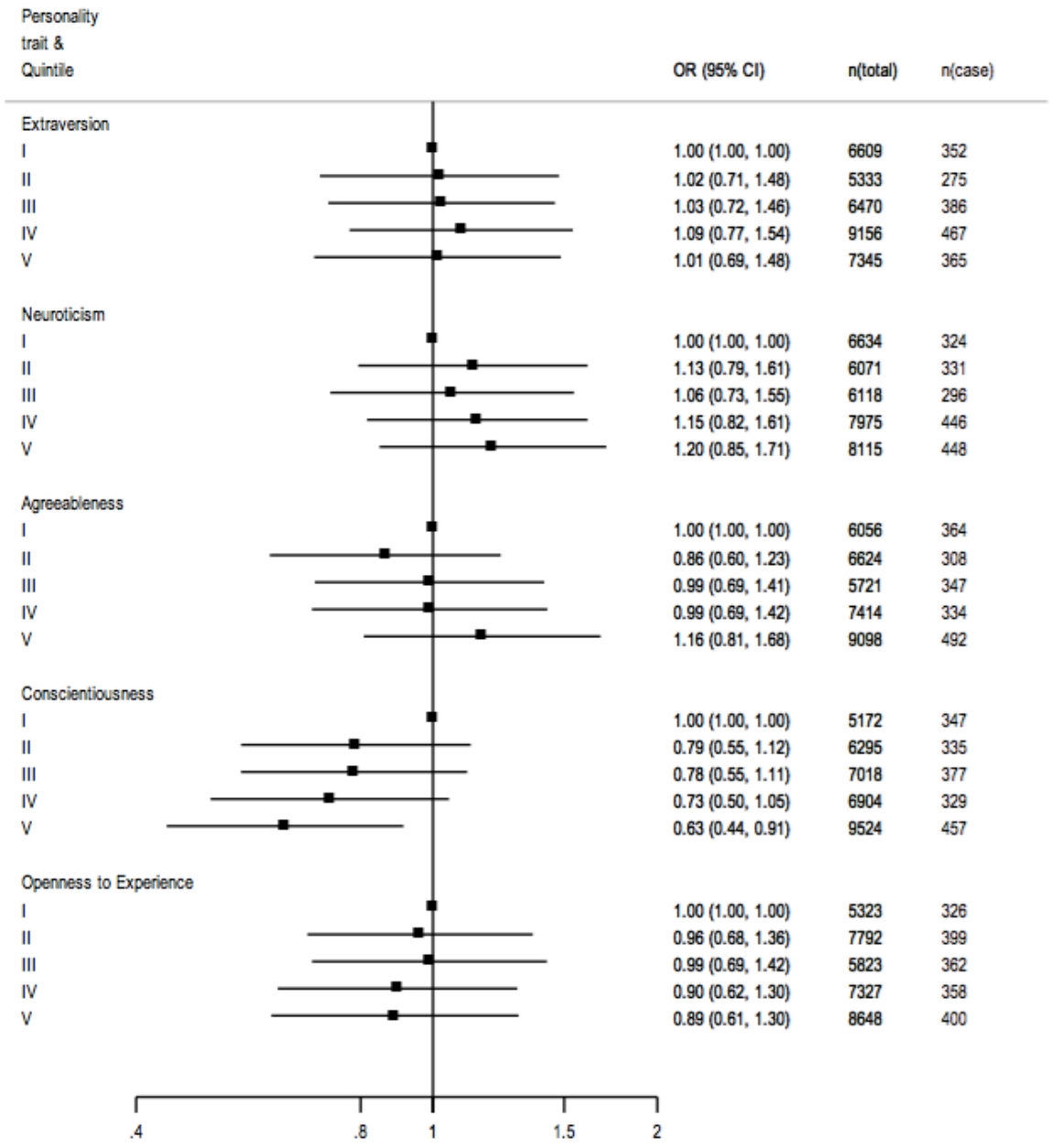
	BHPS	HRS	MIDUS	WLSG	WLSS
N	12416	10199	3733	5620	2945
Age (years)	45.15 (17.95)	66.61 (10.44)	47.03 (12.38)	54.13 (0.48)	52.46 (7.02)
<50y	7582; 61.1	337; 3.3	2218; 59.4	–	1002; 34.0
≥50y	4834; 38.9	9862; 96.7	1515; 40.6	5620	1943; 66.0
Incident diabetes at follow-up	210; 1.7	625; 6.1	258; 6.9	508; 9.0	244; 8.3
Follow-up time (years)	2.85 (0.49)	3.23 (1.03)	8.94 (0.52)	11.17 (0.35)	11.22 (0.49)
Total person-years	35393	32984	33359	62749	33043
Diabetes incidence (per 1000 person-years)	5.93	18.95	7.73	8.10	7.38
Sex					
Men	5571; 44.9	4016; 39.4	1643; 44.0	2550; 45.4	1348; 45.8
Women	6845; 55.1	6183; 60.6	2090; 56.0	3070; 54.6	1597; 54.2
Race/Ethnicity					
White, Non-Hispanic	10764; 86.7	8238; 80.8	3462; 92.7	5620	2945
Other	1652; 13.3	1961; 19.2	271; 7.3	–	–
Educational level					
Primary	3389; 27.3	1620; 15.9	235; 6.3	–	117; 4.0
Secondary	7202; 58.0	5682; 55.8	2133; 57.2	3979; 70.8	1828; 62.1
Tertiary	1823; 14.7	2887; 28.3	1359; 36.5	1641; 29.2	1000; 34.0
Marital status					
Married/Cohabiting	6591; 53.1	6680; 65.5	2675; 71.7	4733; 84.2	2406; 82.5
Single	5821; 46.9	3518; 34.5	1057; 28.3	887; 15.8	512; 17.5
Smoking					
Non-smoker	9387; 75.6	4436; 43.7	1896; 50.8	2572; 46.5	1337; 46.2
Ex-smoker	–	4334; 42.7	1120; 30.0	2041; 36.9	1108; 38.2
Current smoker	3029; 24.4	1381; 13.6	717; 19.2	913; 16.5	452; 15.6
Diagnosed with hypertension					
No	10460; 84.2	4697; 46.1	3165; 84.9	4523; 80.5	2256; 76.7
Yes	1956; 15.8	5502; 53.9	562; 15.1	1097; 19.5	686; 23.3
BMI at baseline	27.19 (4.87)	27.57 (5.43)	26.52 (5.08)	26.61 (4.33)	26.57 (4.47)
Leisure-time physical activity					
Inactive	–	3142; 30.8	1279; 34.3	1004; 18.1	423; 14.5
Moderately active	–	3597; 35.3	298; 8.0	1641; 29.5	797; 27.3
Highly active	–	3458; 33.9	2148; 57.7	2911; 52.4	1695; 58.1

All variables assessed at baseline except for incident diabetes at follow-up. Values are means (and standard deviations) for continuous variables and numbers; percentages for categorical variables. BHPS=British Household Panel Survey; HRS=Health and Retirement Study; MIDUS=Midlife in the United States study; WLSG=Wisconsin Longitudinal Study, Graduate sample; WLSS=Wisconsin Longitudinal Study, Sibling sample

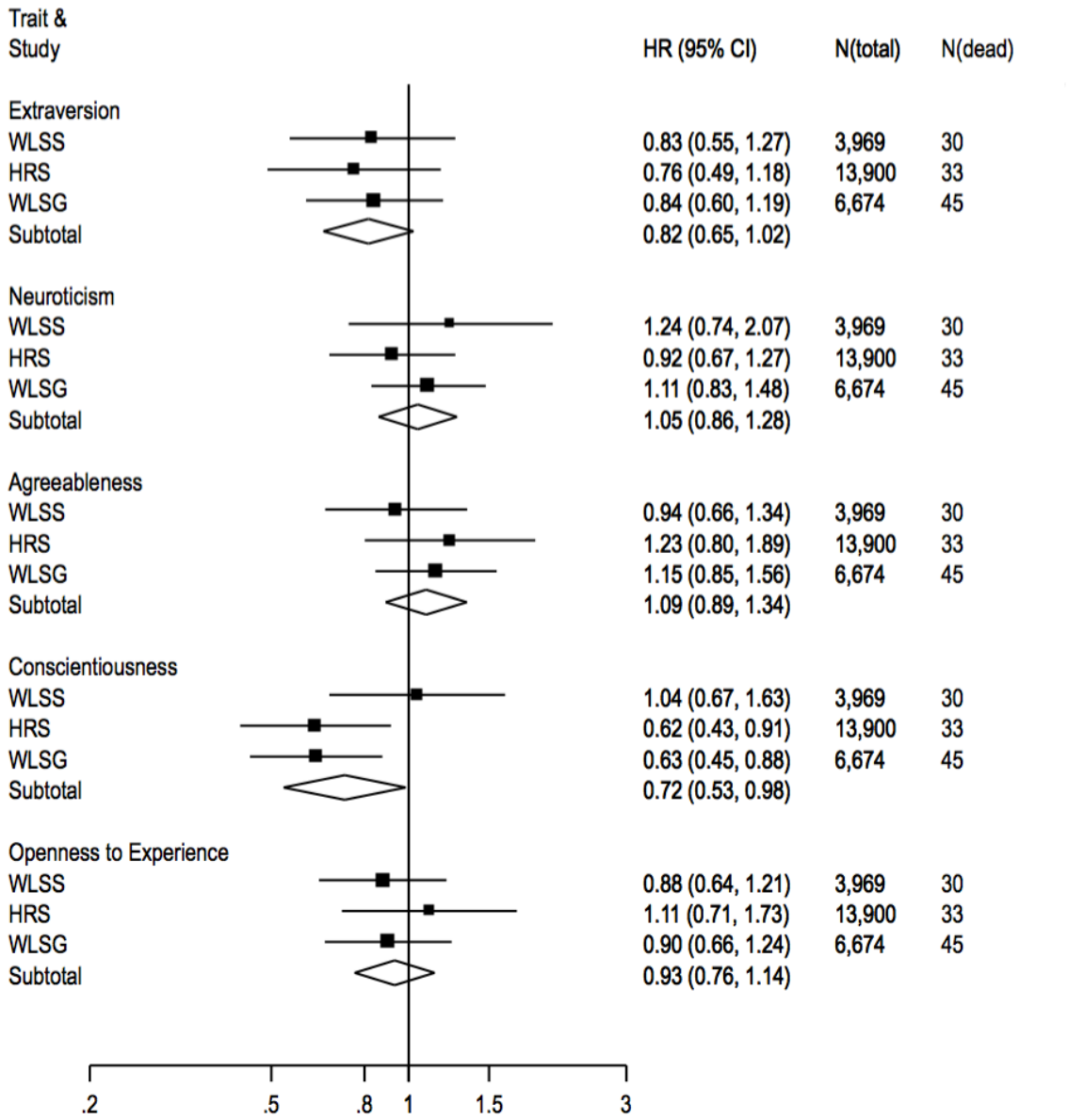
eTable 2. Baseline associations between conscientiousness and covariates in non-diabetic individuals

	OR (95% CI)*
Education (Tertiary vs. Lower)	1.16 (1.02-1.32)
Marital status (Married vs. Single)	1.15 (1.06-1.25)
Smoking (Current vs. Non/Ex-Smoker)	0.91 (0.87-0.96)
Physical inactivity (Physically inactive vs. Other)†	0.76 (0.73-0.78)
Obesity (Obese vs. Non-obese)	0.84 (0.79-0.89)
Blood pressure (High vs. Normal)	0.94 (0.89-0.98)

Note: N=up to 34,913 individuals from 5 studies. * Odds ratios per 1 SD increase in conscientiousness. † N=22,497 individuals from 4 studies (BHPS excluded)



eFigure 1. Associations between personality score quintiles and incident diabetes risk in the pooled sample (n= 34,913 individuals free of diabetes at baseline; 1,845 cases of incident diabetes). Values are odds ratios (and 95% confidence intervals). For each trait, the lowest quintile is the reference category (I=Lowest, V=Highest). Personality traits are mutually adjusted, and the model is further adjusted for sex, age, and race/ethnicity.



eFigure 2. Associations between personality traits and diabetes mortality. Values are hazard ratios per 1 standard deviation in personality trait score. Personality traits are mutually adjusted, and the associations are further adjusted for sex, age at baseline, race/ethnicity. Studies are sorted in increasing order of diabetes incidence (cases per total participants; see Supplementary eTable 1).