Alcoholic beverage preference and diabetes incidence across Europe: the Consortium on Health and Ageing Network of Cohorts in Europe and the United States (CHANCES) project

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Running head: Alcoholic beverage preference and diabetes in Europe

Abbreviations: Body Mass Index (BMI); coronary heart disease (CHD); confidence Interval (CI); the Consortium on Health and Ageing: Network of Cohorts in Europe and the United States (CHANCES); European Prospective Investigation into Cancer and Nutrition (EPIC); the Epidemiological Study on Chances for Prevention, Early Detection, and Optimized THERapy of Chronic Diseases at Old Age (ESTHER); Hazard Ratio (HR); MOnica Risk, Genetics, Archiving and Monograph (MORGAM)

Abstract

Background/Objectives: It is unknown if wine, beer, and spirit intake lead to a similar association with diabetes. We studied the association between alcoholic beverage preference and type 2 diabetes incidence in persons who reported to consume alcohol.

Subjects/Methods: Ten European cohort studies from the Consortium on Health and Ageing: Network of Cohorts in Europe and the United States (CHANCES) were included, comprising participant data of 62 458 adults who reported alcohol consumption at baseline. Diabetes incidence was based on documented and/or self-reported diagnosis during follow-up. Preference was defined as ≥70% of total alcohol consumed was either beer, wine or spirits. Adjusted hazard ratios (HRs) were computed using Cox proportional hazard regression. Single cohort HRs were pooled by random-effects meta-analysis.

Results: Beer, wine, or spirit preference was not related to diabetes risk compared with having no preference. The pooled HRs were HR 1.06 (95%CI 0.93, 1.20) for beer, HR 0.99 (95%CI 0.88, 1.11) for wine, and HR 1.19 (95%CI 0.97, 1.46) for spirit preference. Absolute wine intake, adjusted for total alcohol, was associated with a lower diabetes risk: pooled HR per 6 grams/day was 0.96 (95% CI 0.93, 0.99). A spirit preference was related to a higher diabetes risk in those with a higher BMI, in men and women separately, but not after excluding persons with prevalent diseases

Conclusions: This large individual-level meta-analysis among persons who reported alcohol consumption revealed that the preference for beer, wine, and spirits was similarly associated with diabetes incidence compared with having no preference.

Introduction

Diabetes mellitus is the fourth to fifth leading cause of death in most high-income countries[1]. In 2014, the International Diabetes Federation estimated the prevalence at 7.9% in Europe[1]. Two systematic reviews and meta-analyses, including 20 and 26 cohort studies each, revealed a non-linear U-shaped relationship between alcohol consumption and type 2 diabetes incidence in both men and women[2, 3]. The protective effect of alcohol consumption was largest with light to moderate consumption. Higher levels of ethanol consumption were not associated with diabetes or were associated with a higher risk[2, 3]. On the other hand, a more recent meta-analysis of 38 studies concluded these risk reductions might have been overestimated by including less healthy former consumers in the reference group[4]. Moreover, the protective association might be confined to women and non-Asian populations only[4].

Further research has indicated that the associations between alcohol and diabetes might be beverage-specific. A recent systematic review and meta-analysis of 13 prospective studies showed a strong protective association for wine consumption and type 2 diabetes, while for beer or spirits only a slight trend of a protective association was observed[5]. Within the European Prospective Investigation into Cancer and Nutrition (EPIC)-InterAct Study, moderate alcohol consumption was also related to a lower diabetes risk, in particular the consumption of red wine[6]. It was suggested that the association between alcohol and diabetes was likely to be explained by ethanol itself. Indeed, intervention studies have shown that alcohol increases levels of HDL-cholesterol, apoliprotein A1, and adiponectin, and reduces fibrinogen, fasting insulin and HbA_{1c} concentrations[7, 8]. Hence, the observed differences in association between wine, beer, and spirits and health outcomes might be due to socio-demographic and lifestyle factors associated with the preference and consumption of these beverages[9, 10]. However, differential effects of beer and wine on the glycemic response, as

expressed by their glycemic index, have also been observed. Beer induces a higher glucose response than wine, which may be related to the development of diabetes[11, 12]. Furthermore, due to its higher polyphenol content, red wine may exert additional benefits including reduction of blood pressure and inflammation and improving endothelial function[13].

Alcohol consumption is a complex exposure that can be characterized in different ways: the absolute amount, the drinking frequency, and the beverage type. It is statistically difficult to distinguish between the overall alcohol effect and the specific effects of beer, wine, and spirits in observational studies[14]. We aimed to disentangle beverage-specific effects, independent of those from the absolute ethanol consumption, by studying the association between alcoholic beverage consumption and preference and type 2 diabetes incidence. This was done by performing a meta-analysis of harmonized individual participant data from several European cohorts including a large proportion of elderly participants. Because this study focused on the type of alcoholic beverage, the analyses were restricted to persons who reported alcohol consumption. Moreover, because the consumption of wine, beer, or spirits is mainly determined by factors including age, sex, socio-economic status, country, and lifestyle, these variables will be taken as much as possible into account in the analyses to strengthen potentially causal inference.

Subjects and methods

Study design and population

The Consortium on Health and Ageing: Network of Cohorts in Europe and the United States (CHANCES) project is a coordinated multi-country study which aims to harmonize data from ongoing prospective cohort studies in Europe and the USA in order to produce evidence on

ageing-related health characteristics and on determinants of healthy ageing among the elderly in these countries[15].

The CHANCES project includes cohorts from 14 studies across Europe and the USA. In most CHANCES cohorts, elderly are defined as those who were 60 years or older at recruitment. The CHANCES project as a whole has received ethical approval by the Hellenic Health Foundation Committee on Bioethics (HHFCB). In the individual cohorts, all participants signed informed consent for the original studies.The authors of this study did not have any access to personal information regarding the participants included in this paper. All data that have been analyzed are based on the CHANCES harmonized variables and are completely anonymized. For the present study, the following ten European cohorts were eligible for analysis: the Zutphen Elderly Study (the Netherlands)[16], Rotterdam Study (the Netherlands)[17], the study centers in the Netherlands, Greece, and Sweden from the European Prospective Investigation into Cancer and Nutrition (EPIC) – Elderly study[18], the Tromsø Study (Norway)[19], the Epidemiological Study on Chances for Prevention, Early Detection, and Optimized THERapy of Chronic Diseases at Old Age (ESTHER) study (Germany)[20], and from the MOnica Risk, Genetics, Archiving and Monograph (MORGAM) study, the cohorts of FINRISK (Finland), Northern Sweden (Sweden), and MOLI-SANI (Italy)[21, 22]. An extensive overview of the cohorts included in the CHANCES project and data assessment has been published elsewhere[23]. **Table 1** displays the main characteristics of the included ten cohorts and participants.

Within the cohorts that were eligible for the present study, analyses were conducted upon all subjects who reported to consume alcohol, without any missing data on alcohol and followed up for diabetes incidence. Subjects with self-reported or independently ascertained prevalent

diabetes at baseline or with missing information on prevalent diabetes at baseline were excluded from analysis. **Supplemental Figure 1** shows the participant flow-charts of the ten included cohorts, comprising a total sample size of 63 458.

Data assessment and harmonization

Data in the CHANCES project have been collected within the framework of independent cohort studies, with different protocols for data collection and distinct original research foci. Data harmonization was a major task of the project and the data harmonization and conversion rules of the CHANCES project have been described elsewhere[23].

Alcoholic consumption and beverage preference

Baseline alcohol data were recorded either by self-administered or interview-based questionnaires. The EPIC-Elderly and Rotterdam Study applied a validated food frequency questionnaire (FFQ)[17, 24, 25] to assess alcohol intake. The Zutphen Elderly Study used a validated dietary history method to assess diet including alcohol[16]. The Tromsø Study, the ESTHER study, and MORGAM cohorts derived alcohol consumption from a general questionnaire. In the FINRISK Study, alcohol consumption during the previous week was assessed. If not already defined, average daily alcohol consumption in grams was estimated by adding the amounts of ethanol found in each standard drink or cohort specific size for beer, wine, and spirits. To ensure comparability across cohorts, a conversion rule was applied using standardized portion sizes (330 ml for a bottle of beer, 175 ml for a glass of wine, and 25 ml for a shot of spirit) and alcohol percentages in beer (4.5%), wine (12%), and spirits (37.5%).

As defined in previous studies, a person was classified as having a preference for beer, wine, or spirits, when the alcohol consumption from the respective drink comprised 70% or more of

the total alcohol consumption in grams per day. When the average alcohol consumption from beer, wine, or spirits did not add up to 70% of the total alcohol consumption, a person was classified as having no preference[26, 27]. To assess robustness of this definition, a sensitivity analysis was performed using a cut-off of 50%. Associations between the preference for beer, wine, or spirits and diabetes incidence compared to having no specific preference was assessed. Non-consumers, comprising never and former consumers, were not included in the analyses.

Next, the association between average daily intake from beer, wine, and spirits and diabetes incidence was studied. The absolute intakes of beer, wine, and spirits were adjusted for total alcohol consumption by the residual method[27]. In this procedure, intakes of the respective beverage were regressed upon their total alcohol consumption and the residuals from the regression were used in the analysis. These residuals represent the differences between each individual's actual intake and the intake predicted by their total alcohol consumption. Because residuals, by definition, have a mean of zero, a constant representing the mean intake in each population was added to every value to reflect actual consumption values[28]. The beer, wine, and spirit residuals are uncorrelated with total alcohol consumption and this allows variation due to the intake of beer, wine, and spirits to be evaluated directly. The beer, wine, and spirit residuals were analyzed in tertiles and per 6 g/day.

Information on drinking patterns, i.e. consumption frequency, was not available for all cohorts. Sensitivity analyses were performed adjusting the associations additionally for frequency of consumption (less than once a week, 1-2 days/week, 3-5 days/week, or 6-7 days/week) in the Tromsø Study, ESTHER, and MORGAM.

206 *Diabetes ascertainment*

207 Diabetes incidence was based on documented or self-reported type 2 diabetes during follow-
208 up or based on fasting glucose measures, depending on the available options within the
209 cohorts shown in Table 1.

210

211 *Covariate assessment*

212 Socio-demographic, lifestyle, and disease history data were assessed by self-administered
213 questionnaires or in interviews. Weight and height were either measured or self-reported, and
214 blood samples were drawn to determine total and HDL cholesterol. Diet quality was assessed
215 with the Healthy Diet Indicator (HDI) as developed by Jankovic *et al.*[29]. The HDI score
216 reflects adherence to the 2003 WHO dietary guidelines. The score ranges from 0 to 70 points
217 and includes 6 nutrients (saturated fatty acids, polyunsaturated fatty acids, mono- and
218 disaccharides, protein, cholesterol, dietary fiber) and 1 food group (fruit and vegetables) of
219 the 14 WHO guideline goals, which were available for the cohorts providing nutrition data[29].
220 Dietary intake data to calculate the HDI score were available for the Zutphen Elderly Study,
221 Rotterdam Study, and EPIC-Elderly. Self-reported physical activity was assessed by
222 questionnaires in the Zutphen Elderly Study, Rotterdam Study, EPIC-Elderly the Netherlands
223 and Greece, and ESTHER.

224

225 *Statistical analysis*

226 The statistical analyses were performed using SAS, version 9.3, software (SAS Institute, Inc.,
227 Cary, North Carolina). Hazard Ratios (HRs) and 95% confidence intervals (CIs) for diabetes
228 were calculated using Cox proportional hazard regression. The proportional hazard
229 assumption was tested and not violated. Missing values for any of the covariates were
230 imputed using the multiple imputation method, in which all variables included in the

231 statistical models were included in the procedure. For each cohort, five duplicate datasets
232 were produced and after statistical inference on the duplicate datasets, pooled estimates were
233 calculated with PROC MIANALYZE[30]. In Model 1, HRs were adjusted for socio-
234 demographic factors: age (continuous; years), gender (not applicable for the Zutphen Elderly
235 Study, which is composed only of men), education (categorical: primary or less (low), more
236 than primary but less than college or university (middle), college or university (high)),
237 employment status (categorical: full-time or part-time employment and not of pensionable
238 age, self-employed, housewife and not of pensionable age, pensionable age and still working,
239 pensionable age and not working, stopped work before retirement age due to poor health,
240 unemployed and not of pensionable age; not applicable for SENECA and the Zutphen Elderly
241 Study, where only retired subjects are included), and prevalent coronary heart disease (CHD;
242 yes/no) or cancer (yes/no). Model 2 was additionally adjusted for the lifestyle factors:
243 smoking status (categorical: never, former, current), sports activity (continuous: hours per
244 week; physical activity data were not available for EPIC-Elderly Sweden, the Tromsø Study,
245 and MORGAM; total physical activity was used in the Rotterdam Study), and HDI-score
246 (continuous; dietary intake data to generate the HDI score was not available for ESTHER, the
247 Tromsø Study, and MORGAM).
248
249 Because the definition of alcoholic beverage preference is not based upon absolute alcohol
250 consumption, persons with a beer preference might, for instance, have a higher absolute
251 alcohol intake than persons with a wine preference. Thus, total alcohol consumption might be
252 a confounding factor. Due to the U-shaped relationship between total alcohol and diabetes[2,3],
253 additional adjustment for absolute alcohol consumption (gram/day) was evaluated using
254 fractional polynomials where the best fit regression model was selected with the SAS Macro
255 "Multivariable Fractional Polynomials"[31]. This macro uses an algorithm to determines the

256 inclusion and transformation of continuous covariates while taking into account their non-
257 linearity. In a stepwise approach, the algorithm constructs a fractional polynomial
258 transformation for the continuous covariate. Backward elimination selects the best
259 transformation of the covariate, e.g. linear, first degree or second degree. Depending on the P-
260 values associated with the best transformations, covariates may be eliminated from the model.
261 In all cohorts, absolute alcohol consumption was omitted from the best fit model. Because the
262 residuals of beer, wine, and spirit consumption are uncorrelated with total alcohol intake,
263 these HR were not adjusted for total alcohol.
264
265 Adjustment model 3 was additionally adjusted for BMI (linearly or second degree; kg/m^2);
266 this adjustment for BMI was also evaluated using fractional polynomials. BMI was omitted
267 from the best fit model in the Zutphen Elderly Study, included as a second degree variable in
268 ESTHER and FINRISK, and included linearly in the remaining cohorts. BMI is one of the
269 most important risk factors for diabetes, but is also on a possible causal pathway between
270 alcohol consumption and diabetes. Therefore, crude and adjusted BMI across alcoholic
271 beverage preference categories was estimated with multiple linear regression. To investigate
272 effect modification by BMI, stratified analyses were performed on persons with a BMI <25
273 and ≥ 25 kg/m^2 and the P-value for interaction was checked after including a product term in
274 the regression models. Furthermore, stratified analyses were performed for men and women
275 separately to check for potential effect modification. Finally, subjects with prevalent CHD or
276 cancer at baseline or a follow-up less than 2 years were excluded in a sensitivity analysis.
277
278 Cohort-specific HR estimates and 95% CIs for diabetes incidence from having a beer, wine,
279 or spirit preference compared with no preference and for a beer, wine, or spirit consumption
280 (per 6 gram/day) were pooled in meta-analyses, using adjustment model 3. Inverse variance

weighting was applied to give the largest weight to the study with the lowest variance. The random-effects model takes into account the between-study variance and the within-study variance. Heterogeneity between studies was assessed by the Q statistic and the I^2 index. I^2 was calculated as $I^2 = ((Q - df)/Q)*100$, where "df" stands for degrees of freedom, i.e. total number of studies (k) minus 1. Random-effects meta-analyses with inverse variance weighting were performed using the R package "meta" (R version 3.3.1). Statistical tests were two-sided and P-values <0.05 were considered statistically significant.

Results

In most cohorts, persons with a wine preference constituted the largest group, ranging from 44% in ESTHER (Germany) to 79% in MOLI-SANI (Italy) (**Supplemental Table 1**). In EPIC-Elderly Sweden, the Tromsø Study, FINRISK, and Northern-Sweden persons with no preference formed the largest group and in the Zutphen Elderly Study (the Netherlands), persons with a spirit preference comprised the largest group, i.e. 62%. Across all cohorts, those who preferred wine were relatively more highly educated and were more likely to be a never smoker, and female. Furthermore, those with a beer or spirit preference were more likely to be male and current smoker. Persons with no specific preference generally had the highest absolute alcohol consumption. After adjustment for age, sex, education, employment, prevalent diseases, smoking, alcohol, sports activity, diet, BMI was lowest among those with a beer or wine preference and BMI was highest among persons with a spirit preference (Supplemental Table 1).

The pooled HRs from the random-effects meta-analyses showed no significant association between having a preference for beer, wine, or spirits and diabetes incidence compared with having no specific preference after adjustment for age, sex, education, prevalent diseases,

lifestyle factors, and BMI (**Figure 1-3**). Pooled HR was 1.06 (95%CI 0.93, 1.20) for a beer preference, HR 0.99 (95%CI 0.88, 1.11) for a wine preference, and HR 1.19 (95%CI 0.97, 1.46) for having a spirit preference. Based on the I^2 index and the Q-statistic, between-study heterogeneity was observed for the effect estimates of having a spirit preference.

Separate HRs and 95% CIs for the associations between a beer, wine, or spirits and diabetes incidence according to the different levels of adjustment are shown in Supplemental Table 1. Compared with persons with no preference, a preference for beer, wine, or spirits was in most cohorts not significantly associated with diabetes incidence. In the Rotterdam Study, beer or spirit preference had a significant association with a higher diabetes incidence. In EPIC-Elderly Greece, having a wine preference tended to be associated with a lower diabetes incidence. Within the cohorts, additional adjustment for BMI (Model 3) had mixed, but small effects on the observed associations.

The pooled HR for the association between alcohol preference and incident diabetes among sub-groups and with additional adjustments are shown in **Table 2**. Diabetes risk among persons with a spirit preference was higher in those with a higher BMI, in men and in women, but not after excluding persons with prevalent diseases. Excluding persons with prevalent diseases yielded similar results to the findings including those persons. P-values for interaction by BMI were not significant for all cohorts and did not therefore give indication for effect modification. Furthermore, additional adjustment for consumption frequency and alternative analysis using 50% as a cut-off in the definition of preference showed similar associations.

Additionally, the association between the residuals of beer, wine, and spirit intake per 6 gram/day and diabetes incidence was assessed (**Figure 4-6**). Pooled HR was 1.03 (95%CI 0.99, 1.06) per 6 grams of beer intake, HR 0.96 (95%CI 0.93, 0.99) per 6 grams of wine intake, and HR 1.02 (95%CI 0.98, 1.06) per 6 grams of spirit intake. Cohort-specific HR according to tertiles and per 6 grams/day generally showed similar associations (**Supplemental Table 2**).

Discussion

This meta-analysis of individual participant data from ten prospective European cohorts comprising ~60,000 adults who reported at least some alcohol consumption showed that a preference for beer, wine or spirits was not associated with a lower or higher diabetes risk compared with having no specific preference, taking into account several socio-demographic and lifestyle variables.

To our knowledge, no other studies have investigated the association between alcoholic beverage *preference* and diabetes risk. However, a number of observational studies have assessed associations of absolute beverage-specific *consumption* and diabetes, showing inconsistent results. Among 36,527 Australian adults, Hodge *et al.* observed an inverse association between wine consumption and risk of type 2 diabetes, but not for beer or spirits[32]. In the EPIC-InterAct Study, a prospective case-cohort study of 16,154 participants and 12,403 incident diabetes cases, consumption of wine and fortified wine were most strongly related with a reduced diabetes risk[6]. Moreover, compared with a light consumption, men who did not consume beer had a reduced risk of diabetes in the EPIC-InterAct Study: HR 0.84 (95%CI 0.74, 0.95) and in women higher spirit consumption was associated with an higher diabetes risk (P-trend 0.044). Fagherazzi *et al.* observed an inverse association between wine

354 consumption and diabetes risk when compared to other types of alcoholic beverage among
355 66,485 women from the French E3N-EPIC cohort[33]. In contrast, Conigrave *et al.*, did not find
356 a protective effect of red wine on diabetes risk among 46,892 U.S. male health professionals,
357 whereas inverse associations for beer, spirits and white wine were similar and independent[34].
358 Moreover, two other studies in large U.S. cohorts also did not observe a specific protective
359 effect of wine consumption on diabetes risk compared with beer or spirit consumption[35, 36]. In
360 their meta-analysis of 13 prospective studies, Huang, Wang, and Zhang presented a pooled
361 RR of 0.85 (95% CI 0.80-0.89) for wine consumption, and RR 0.96 (95% CI 0.92, 1.00) for
362 beer consumption and RR 0.95 (95%CI 0.89-1.03) for spirit consumption and type 2 diabetes
363 risk compared to no or rare alcohol consumption[5]. In the present study, the pooled HR for
364 residuals of beer, wine, and spirit intake showed similar results: a higher wine intake was
365 related to a lower diabetes risk, even after fully taking into account total alcohol consumption.
366 This further confirms the consistent finding that constituents other than ethanol in red wine
367 may exert additional health benefits[13].
368
369 Several other studies have found differential effects for the type of alcoholic beverage and
370 diabetes risk, with a stronger beneficial association for wine consumption compared to
371 abstinence. These observations could either be explained by a true beneficial effect of wine
372 compared with beer and spirits, or by an artefact arising from residual confounding. Firstly, a
373 true differential effect for beer, wine, and spirits and diabetes incidence might be caused by
374 beneficial compounds other than ethanol in particular those found in wine. For example, a
375 randomized controlled cross-over trial in 67 men at high cardiovascular risk showed that red
376 wine rich in polyphenols with or without alcohol improved glucose metabolism[37]. This was
377 not confirmed in our study, where we have found no additional beneficial association for
378 having a wine preference compared to having no preference. Secondly, the observation might

be an artefact caused by confounding factors associated with the type of alcoholic beverage consumed. Indeed, the choice of alcoholic beverage is associated with a wide range of cultural, socio-demographic and lifestyle factors[9, 38], which may confound the association between alcohol and diabetes risk. Moreover, other important determinants of diabetes risk including age, gender, smoking status and overall drinking patterns differ across alcoholic beverage preference and study populations[10]. Therefore, we have adjusted the associations for age, gender, socio-economic status, and lifestyle factors including absolute alcohol consumption and BMI. However, we cannot exclude any residual confounding as a result of unmeasured or imprecisely measured confounders. Lastly, in previous studies there is a tendency to find an association for the alcoholic beverage that is most consumed. In the above mentioned studies into beverage type and diabetes risk, most of the alcohol was consumed as wine[6, 32, 33]. In our study, ten cohorts from seven European countries were included with varying preferences, suggesting this might have less influence on our findings and provided a wider insight into alcohol preference across Europe.

We observed a tendency toward a higher diabetes risk among persons with a spirit preference compared to those having no specific preference among men and women when analyzed separately and those with a higher BMI. This was also seen within EPIC-InterAct[6]. Cross-sectional studies have shown that a spirit preference is associated with an unhealthier lifestyle: persons who preferred spirits have been shown to have a higher BMI, are more likely to be smokers, and display unhealthier diet. Furthermore, spirits may be more often used for heavy binge drinking compared to wine[9, 10]. In the present study, we could only take consumption frequency into account in a subset of five cohorts. Furthermore, the association was attenuated when excluding persons with prevalent diseases or a short follow-up, indicating that some

degree of reverse causation might be present. Finally, we were not able to take diet and physical activity into account in all cohorts.

To avoid any bias by the inclusion of former drinkers, the current analysis was restricted to persons who reported some alcohol consumption. Furthermore, persons with no specific preference, i.e. mixed drinkers, were used as a reference. Most other observational studies have used non-consumers as a reference; however, this has been contested. Non-consumers are in general a heterogeneous group comprising lifetime abstainers and former drinkers. In many high-income countries, lifetime abstinence of alcohol is not normative and this group differs from alcohol consumers in other health determinants[39]. Moreover, former drinkers may have quit because of ill health arising from their former (heavy) alcohol use. As a result, these individuals are more vulnerable for morbidity and mortality and their ill health may confound the association between alcohol consumption and health outcomes. Using non-consumers as a reference group may overestimate the beneficial effects of alcohol[40]. On the other hand, in the meta-analysis of Di Castelnuovo *et al.*, there was still a protective effect of alcohol consumption in the general population after exclusion of former drinkers[41]. We were unable to take into account former alcohol consumption in all cohorts, but by restricting the analyses to alcohol consumers, possible confounding by abstinence or former alcohol consumption could not influence our results.

The association between alcoholic beverage preference and diabetes may be partly driven by obesity: since adiposity is on one causal pathway between absolute alcohol consumption and diabetes, adjusting for BMI may lead to overadjustment bias[42]. However, after multiple adjustments, those with a spirit preference had the highest BMI and persons with a beer or wine preference had the lowest BMI. Because BMI is a strong risk factor for developing

diabetes, the effect of moderate alcohol consumption might be strongest, in absolute terms, in those at higher risk. In our analysis, the association between spirit preference and diabetes incidence was higher among those with overweight or obese (BMI>25 kg/m^2). In contrast, Beulens *et al.* found that moderate alcohol consumption was more strongly related to a reduced diabetes risk in overweight men and women than in their normal weight counterparts[6]. Moreover, in the French E3N-EPIC cohort, overweight women consuming two or more glasses of wine per day had a lower diabetes risk, whereas in normal weight women consuming the same amount, no association was observed[33].

We aimed to disentangle beverage-specific effects, independent of those from the absolute ethanol consumption, by studying the association between alcoholic beverage preference and type 2 diabetes incidence. Beverage preference was used to classify the study population according to their alcohol intake. This approach of studying preference rather than absolute intake can thus be considered as a qualitative approach. Independent from the biological mechanisms associated with the chemical composition of the beverages, beverage preference *per se* may not be directly associated with diabetes incidence. Therefore, we have additionally studied the residuals of beer, wine and spirit intake, fully adjusted for total alcohol consumption by the residual method[28]; these analyses yielded similar findings. The number of cases distributed by beverage preference differed across the cohorts and were in some cohorts quite low, which may have affected the statistical power of the analyses. Non-consumers were excluded from the analysis to prevent non-consumers and former (heavy) consumers to affect the results. As a result, these findings only apply to alcohol consumers.

The CHANCES project is a large-scale multi-national collaboration of cohort studies including a large number of elderly persons. Pooled analyses of the individual participant data

453 from the different cohorts is a cost-efficient analytical approach and increases statistical
454 power considerably. However, we had to rely on secondary data collected according to
455 different study objectives and protocols, which may be a weakness[15]. With respect to type 2
456 diabetes incidence, the identification and verification of diabetes cases varied across the
457 cohorts. The oral glucose tolerance test is considered the gold standard of diabetes
458 ascertainment, but recently fasting glucose has been shown to be the most accurate method of
459 diabetes diagnosis[43]. Most cohort studies relied on self-reports, linkage with registries, HbA_{1c},
460 or fasting blood glucose measures. As a result, misclassification could have been present and
461 we might have underestimated the number of diabetes cases. However, only if this
462 misclassification is differential and related to alcohol preference, would it have influenced the
463 direction of the effect estimates, and yet our observed associations across cohorts were
464 broadly consistent. Furthermore, it is difficult to distinguish between type 1 and type 2
465 diabetes; therefore, some cohorts may not have been able to appropriately distinguish between
466 the types. Moreover, this issue is not restricted to this study only. Diagnosing diabetes can be
467 equivocal: the clinical diagnosis is based on a pre-specified cut-off point on a continuous
468 scale of declining glycemic control, but clinical practice will dictate how assiduously the
469 necessary tests are applied. Furthermore, the diagnosis is often based on the occurrence of
470 complications of the disease and the disease can remain asymptomatic for years. Hence, it has
471 been estimated that up to 50% of all type 2 diabetes patients are undiagnosed[44]. As a result,
472 the true association may have been underestimated.
473
474 This meta-analysis of individual participant data from ten cohorts among Europeans who
475 reported at least some alcohol consumption showed that beer, wine, and spirits were similarly
476 associated with diabetes incidence. The recommendations of the American Diabetes
477 Association for the prevention of diabetes suggest that if adults choose to drink alcohol, daily

intake should be limited to a moderate amount, i.e. no more than one drink per day for women and two drinks per day for men[45]. Our analysis offers little support for making beverage specific recommendation for diabetes prevention.

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DS, FK, EJMF designed the study and formulated the research question; OHF, DK, AT, TW, HB, KK, TL, SS, LI, and PB acquired the data and contributed reagents/materials/analysis tools; DS carried out the study, analyzed the data, and drafted the manuscript; All authors critically revised the manuscript for important intellectual content and approved of the final version to be published.

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Figure legends:

Figure 1. Forest plot with pooled Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) for the association between beer preference and diabetes incidence compared to having no preference adjusted for age, sex, education, employment status, prevalent coronary heart disease and cancer, smoking status, physical activity (if available), Healthy Diet Indicator score (if available), and BMI.

Figure 2. Forest plot with pooled Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) for the association between wine preference and diabetes incidence compared to having no preference adjusted for age, sex, education, employment status, prevalent coronary heart disease and cancer, smoking status, physical activity (if available), Healthy Diet Indicator score (if available), and BMI.

Figure 3. Forest plot with pooled Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) for the association between spirit preference and diabetes incidence compared to having no preference adjusted for age, sex, education, employment status, prevalent coronary heart disease and cancer, smoking status, physical activity (if available), Healthy Diet Indicator score (if available), and BMI.

Figure 4. Forest plot with pooled Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) for the association between residuals of beer consumption per 6 g/d and diabetes incidence adjusted for absolute alcohol intake, age, sex, education, employment status, prevalent coronary heart disease and cancer, smoking status, physical activity (if available), Healthy Diet Indicator score (if available), and BMI.

Figure 5. Forest plot with pooled Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) for the association between residuals of wine consumption per 6 g/d and diabetes incidence adjusted for absolute alcohol intake, age, sex, education, employment status, prevalent coronary heart disease and cancer, smoking status, physical activity (if available), Healthy Diet Indicator score (if available), and BMI.

Figure 6. Forest plot with pooled Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) for the association between residuals of spirit consumption per 6 g/d and diabetes incidence adjusted for absolute alcohol intake, age, sex, education, employment status, prevalent coronary heart disease and cancer, smoking status, physical activity (if available), Healthy Diet Indicator score (if available), and BMI.

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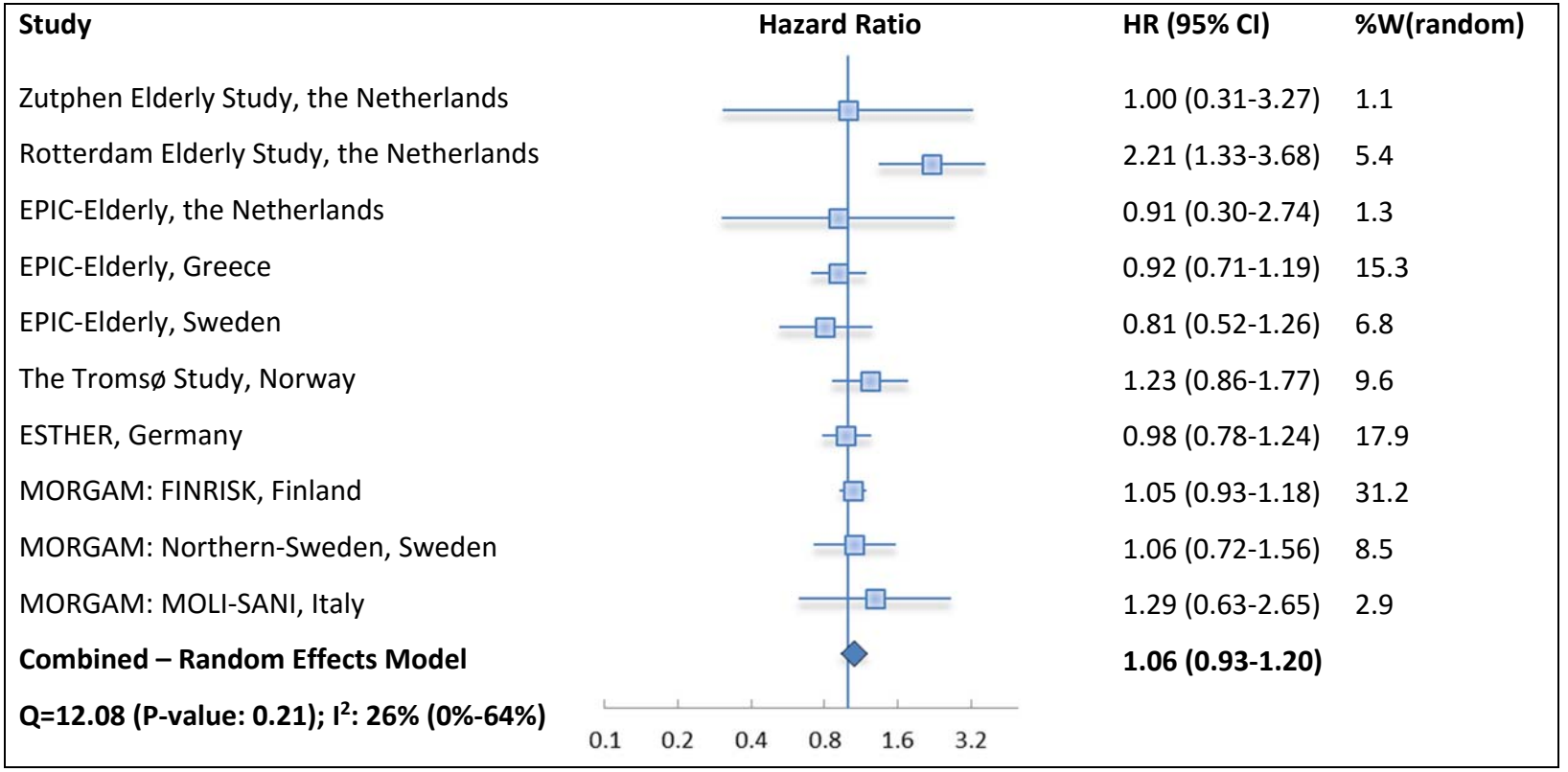

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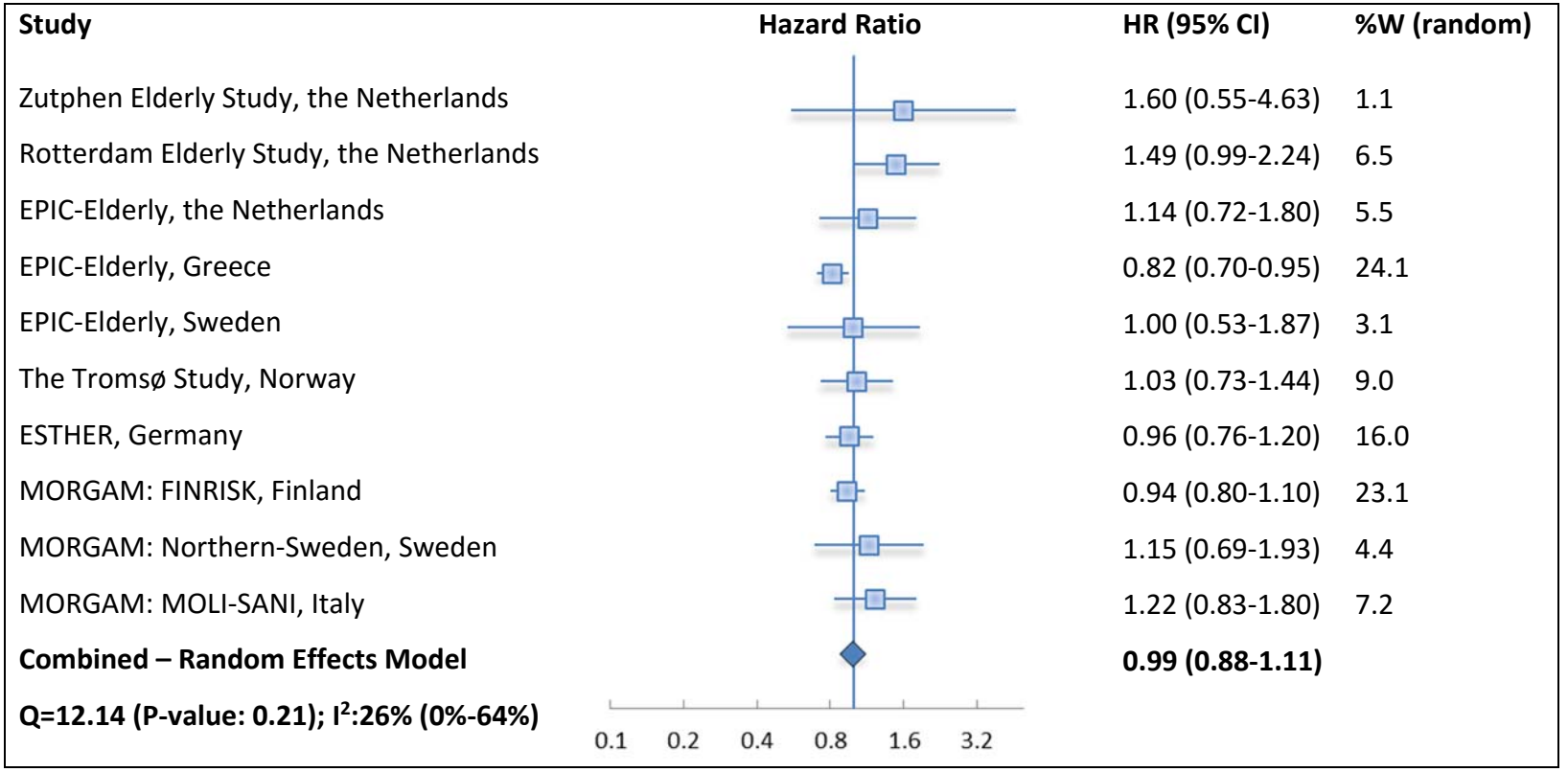

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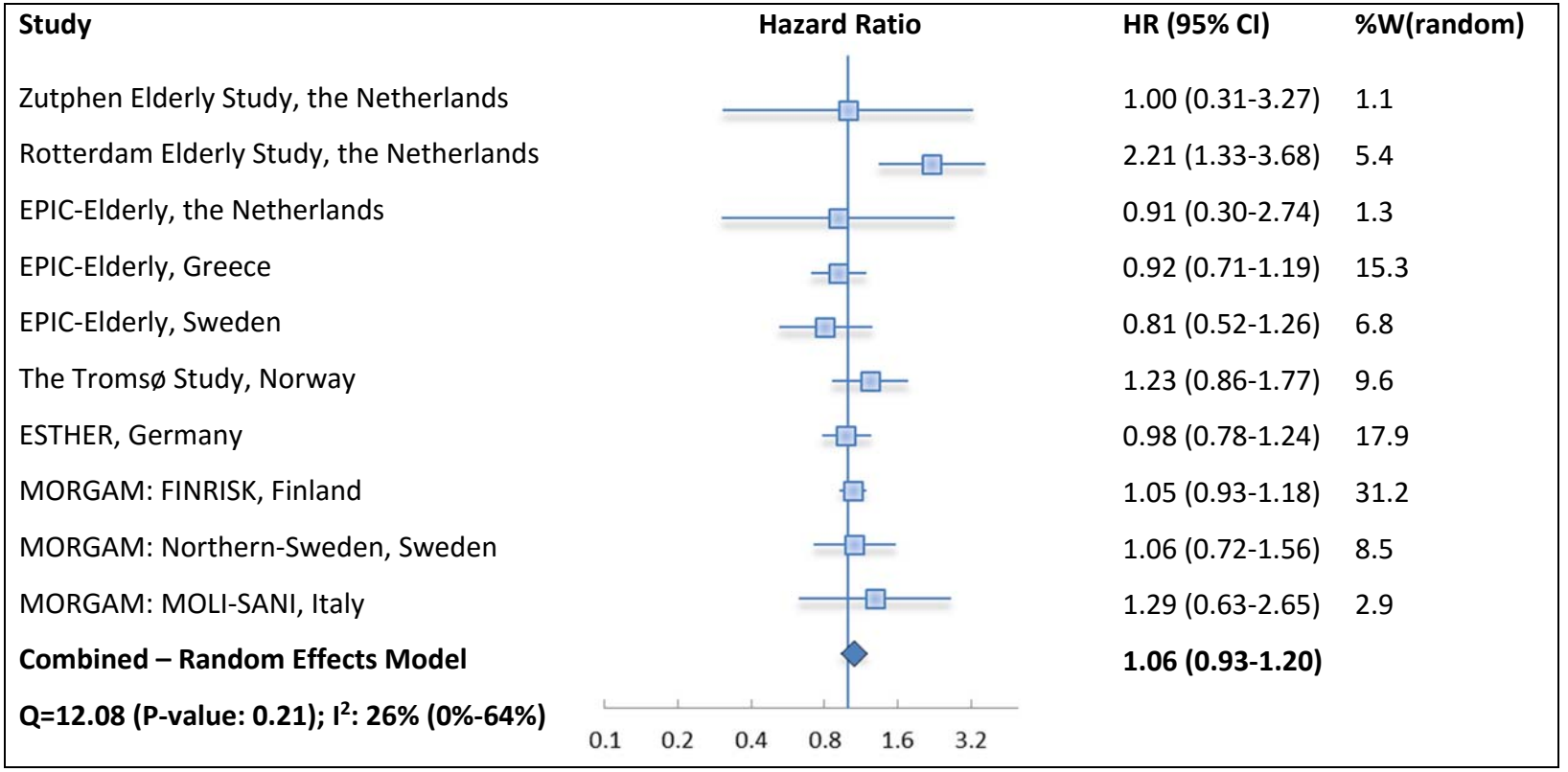

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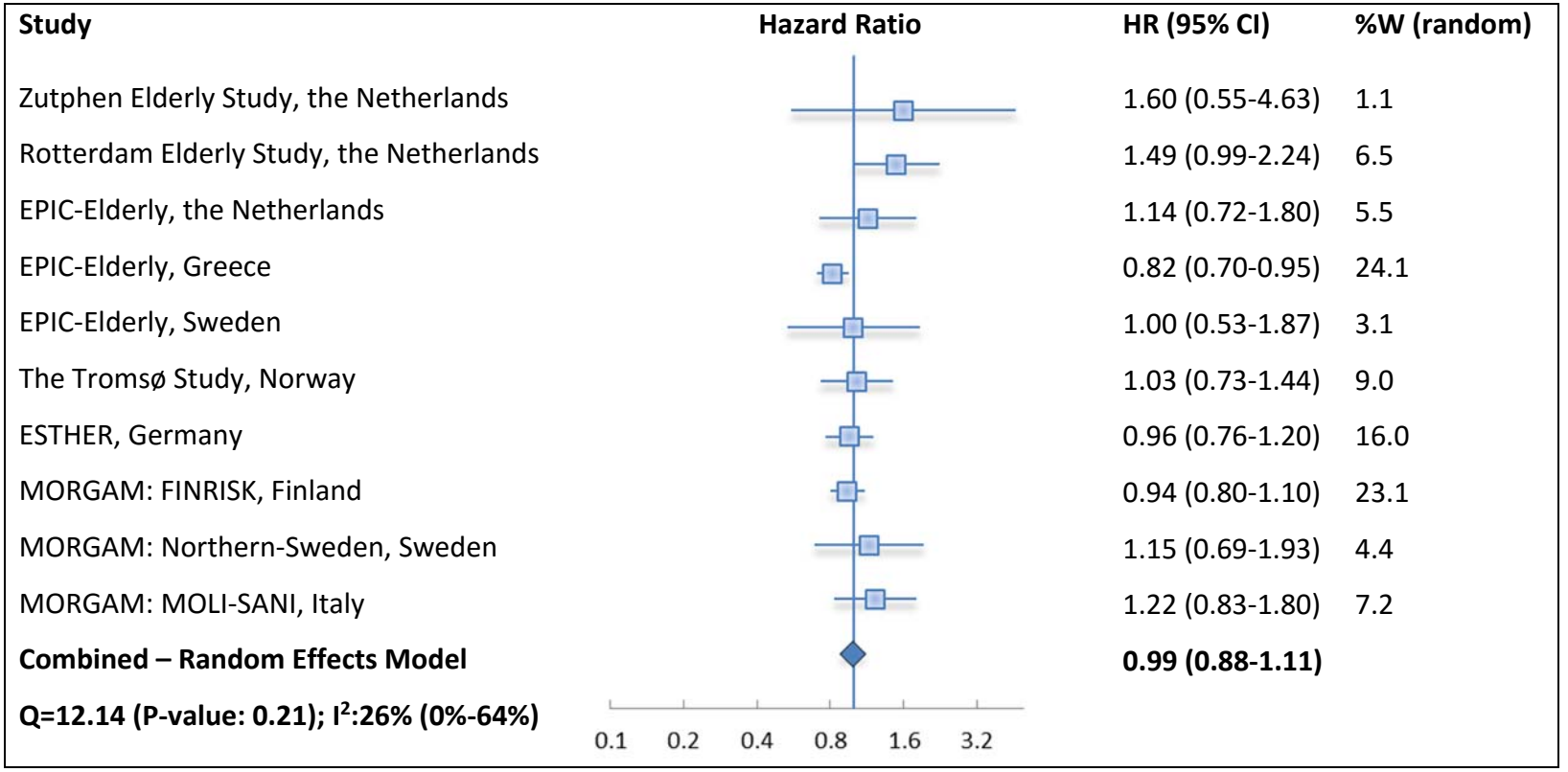

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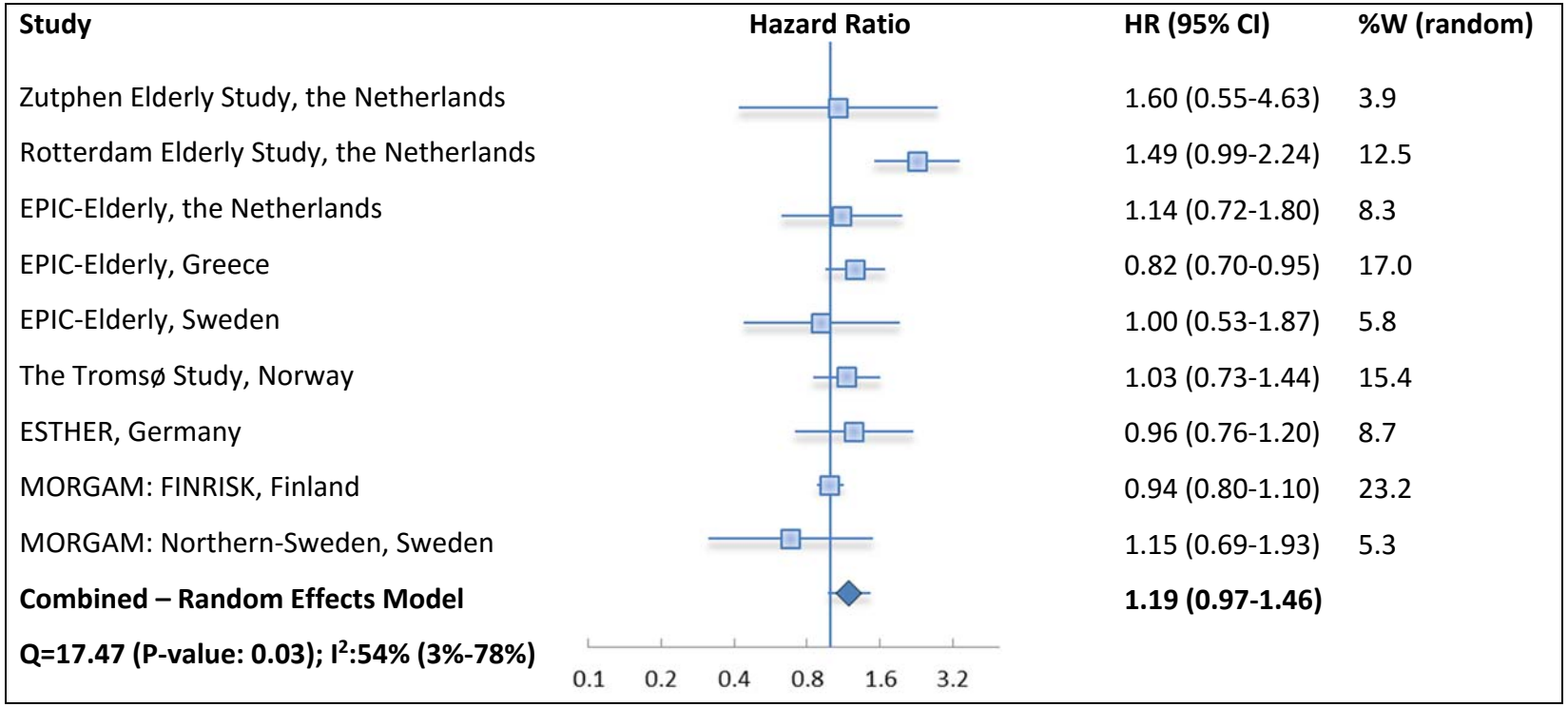

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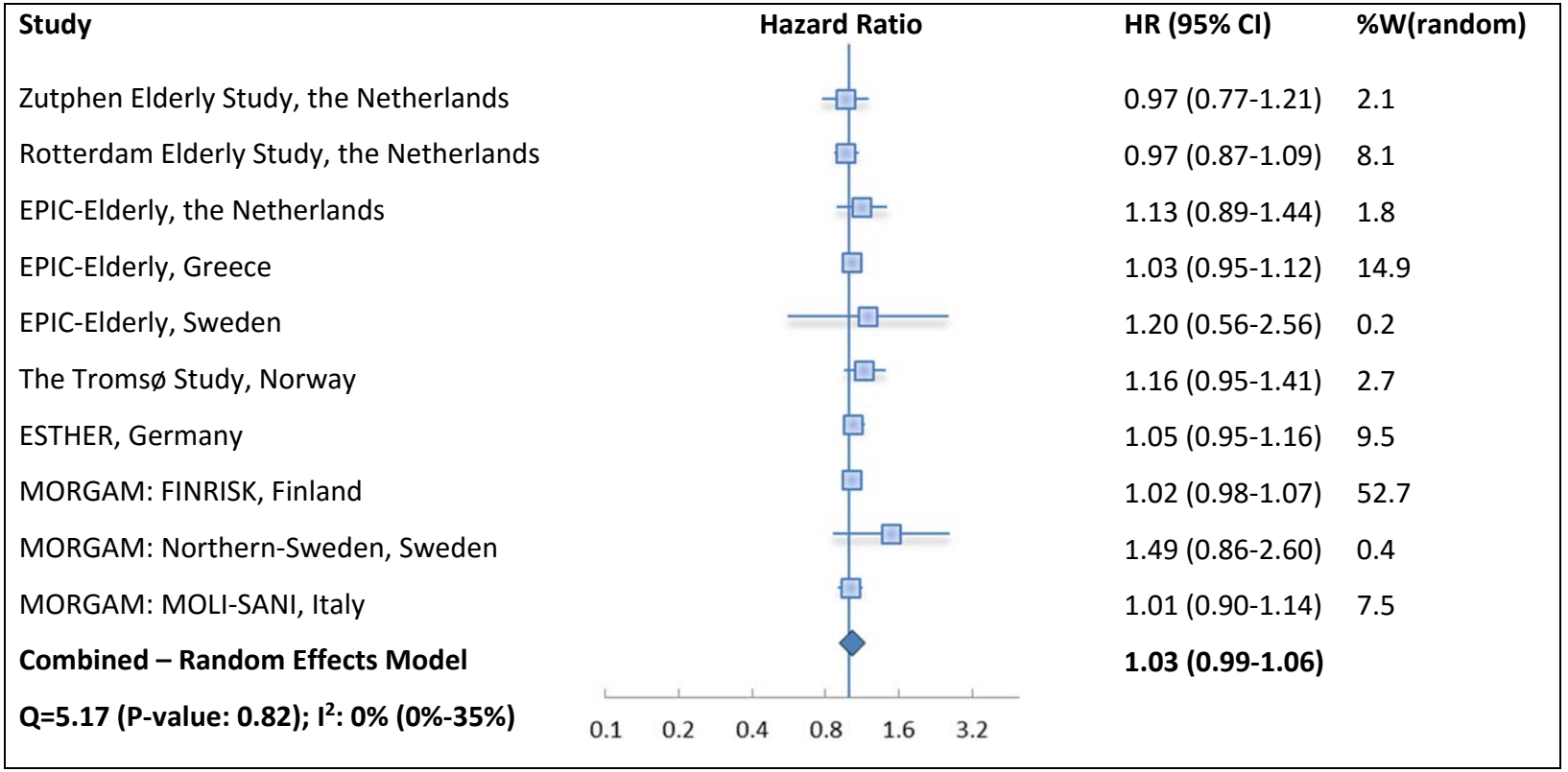

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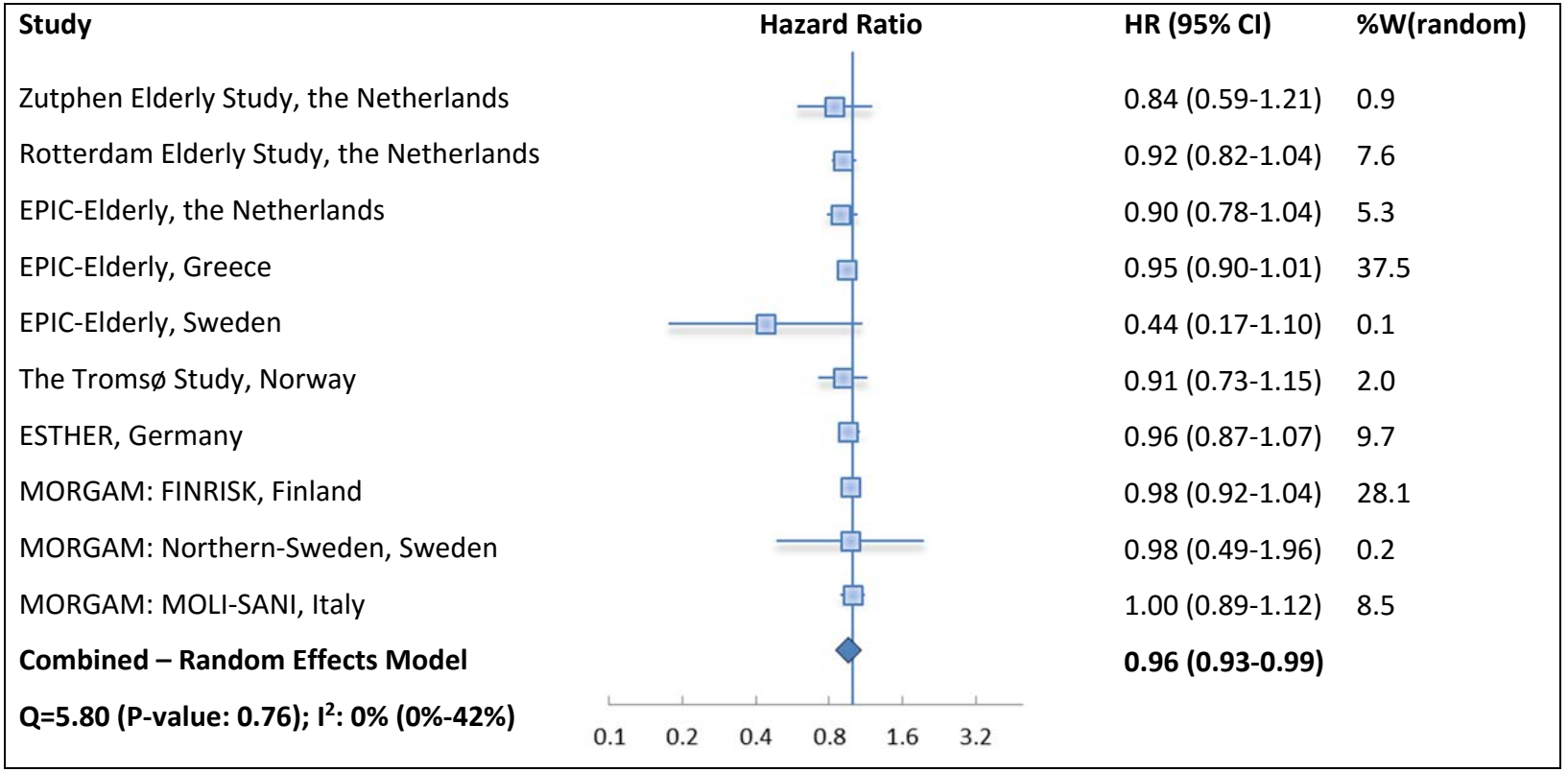

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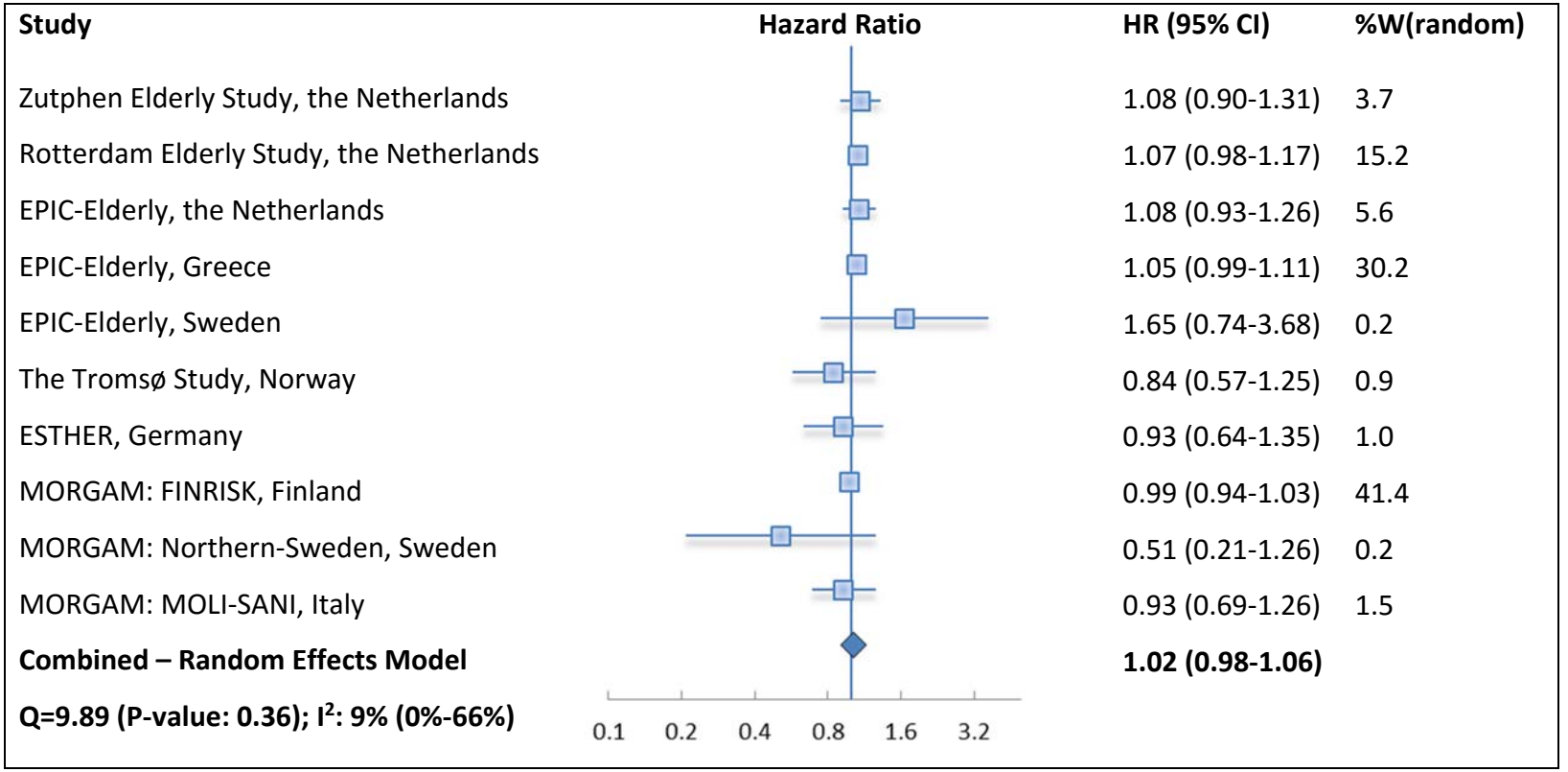

Supplemental Figure 1: Participant flow-charts of the ten included European cohort studies from the Consortium on Health and Ageing: Network of Cohorts in Europe and the United States (CHANCES) project.

Supplemental Table 1. Selected general characteristics across categories of alcoholic beverage preference and Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between having a beer, wine, or spirit preference and diabetes incidence compared to having no preference in 10 European cohorts based on multiple imputation results.

	Beer preference	Wine preference	Spirit preference	No preference
Zutphen Elderly Study				
N (%)	65 (12)	73 (13)	344 (62)	75 (13)
Age, years	70.5 (5.8)	72.1 (5.0)	72.2 (5.2)	71.8 (5.5)
Men, %	100	100	100	100
Ethanol consumption, g/day	13.5 [4.0-25.0]	3.8 [1.7-12.0]	18.8 [6.2-37.5	20.3 [8.4-44.9
University or college education, %	0	14	3	10
Current smokers, %	32	23	41	29
BMI, kg/m^2				
- Crude	26.0 (0.4)	24.7 (0.4)*	25.5 (0.2)	25.3 (0.4)
- Adjusted[a]	25.9 (0.4)	25.0 (0.4)	25.5 (0.2)	25.3 (0.4)
Diabetes cases / Person Years	6 / 756	9 / 747	27 / 3529	6 / 848
HR (95% CI): Model 1	1.00 (0.32-3.18)	1.34 (0.46-3.89)	0.95 (0.39-2.32)	1.00 (ref)
HR (95% CI): Model 2	1.04 (0.32-4.15)	1.46 (0.52-4.15)	0.96 (0.38-2.42)	1.00 (ref)
HR (95% CI): Model 3	1.00 (0.31-3.27)	1.60 (0.55-4.63)	1.07 (0.42-2.77)	1.00 (ref)
Rotterdam Study				
N (%)	182 (7)	1292 (53)	582 (24)	372 (15)
Age, years	62.4 (5.8)	64.8 (6.8)	66.2 (6.5)	64.0 (6.1)

Supplemental Table 1 (continued). Selected general characteristics across categories of alcoholic beverage preference and Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between having a beer, wine, or spirit preference and diabetes incidence compared to having no preference in 10 European cohorts based on multiple imputation results.

	Beer preference	Wine preference	Spirit preference	No preference
Men, %	88	17	72	71
Ethanol consumption, g/day	11.7 [3.0-25.7]	2.9 [0.6-9.1]	18.9 [7.5-31.8]	11.3 [3.6-24.9]
University or college education, %	13	8	11	18
Current smokers, %	31	17	28	22
BMI, kg/m^2				
- Crude	25.4 (0.3)	26.1 (0.1)*	26.2 (0.1)*	25.7 (0.2)**,***
- Adjusted[a]	25.6 (0.3)	26.0 (0.1)	26.4 (0.2)*,**	26.0 (0.2)***
Diabetes cases / Person Years	30 / 1756	155 / 13447	100 / 5321	32 / 3920
HR (95% CI): Model 1	2.10 (1.27-3.47)	1.43 (0.96-2.15)	2.30 (1.54-3.43)	1.00 (ref)
HR (95% CI): Model 2	2.15 (1.29-3.57)	1.48 (0.98-2.24)	2.38 (1.58-3.57)	1.00 (ref)
HR (95% CI): Model 3	2.21 (1.33-3.68)	1.49 (0.99-2.24)	2.28 (1.52-3.43)	1.00 (ref)
EPIC-Elderly the Netherlands				
N (%)	82 (2)	2802 (74)	384 (10)	525 (14)
Age, years	63.7 (2.6)	64.2 (2.7)	64.1 (2.5)	64.2 (2.7)
Men, %	39	2	13	12
Ethanol consumption, g/day	7.3 [1.3-20.1]	4.4 [1.3-13.1]	10.1 [1.8-25.7]	4.9 [1.5-12.8]
University or college education, %	7	16	8	12
Current smokers, %	40	15	29	17

Supplemental Table 1 (continued). Selected general characteristics across categories of alcoholic beverage preference and Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between having a beer, wine, or spirit preference and diabetes incidence compared to having no preference in 10 European cohorts based on multiple imputation results.

	Beer preference	Wine preference	Spirit preference	No preference
BMI, kg/m^2				
- Crude	25.2 (0.4)	25.5 (0.1)	26.4 (0.2)*,**	25.6 (0.2)***
- Adjusted[a]	25.0 (0.4)	25.7 (0.1)	26.3 (0.2)*,**	25.6 (0.2)***
Diabetes cases / Person Years	4 / 416	167 / 13601	26 / 1927	22 / 2559
HR (95% CI): Model 1	0.75 (0.25-2.22)	1.28 (0.81-2.02)	1.22 (0.69-2.17)	1.00 (ref)
HR (95% CI): Model 2	0.88 (0.29-2.57)	1.23 (0.78-1.94)	1.20 (0.67-2.13)	1.00 (ref)
HR (95% CI): Model 3	0.91 (0.30-2.74)	1.14 (0.72-1.80)	1.11 (0.63-1.98)	1.00 (ref)
EPIC-Elderly Greece				
N (%)	510 (10)	2561 (48)	361 (7)	1884 (35)
Age, years	66.2 (4.5)	67.4 (4.5)	67.0 (4.3)	66.3 (4.3)
Men, %	47	46	74	52
Ethanol consumption, g/day	1.3 [0.6-8.5]	8.0 [1.2-16.0]	13.2 [4.4-21.3]	2.8 [1.3-12.5]
University or college education, %	4	2	3	7
Current smokers, %	12	13	29	16
BMI, kg/m^2				
- Crude	29.2 (0.2)	28.9 (0.1)	28.9 (0.2)	28.8 (0.1)
- Adjusted[a]	29.0 (0.2)	28.7 (0.1)	29.4 (0.2)**	29.0 (0.1)
Diabetes cases / Person Years	72 / 5407	377 / 28107	58 / 3717	308 / 20618
HR (95% CI): Model 1	0.99 (0.77-1.28)	0.78 (0.67-0.91)	1.37 (1.03-1.82)	1.00 (ref)

Supplemental Table 1 (continued). Selected general characteristics across categories of alcoholic beverage preference and Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between having a beer, wine, or spirit preference and diabetes incidence compared to having no preference in 10 European cohorts based on multiple imputation results.

	Beer preference	Wine preference	Spirit preference	No preference
HR (95% CI): Model 2	0.98 (0.76-1.27)	0.80 (0.69-0.94)	1.32 (1.00-1.76)	1.00 (ref)
HR (95% CI): Model 3	0.92 (0.71-1.19)	0.82 (0.70-0.95)	1.27 (0.95-1.68)	1.00 (ref)
EPIC-Elderly Sweden				
N (%)	958 (34)	413 (15)	137 (5)	1311 (47)
Age, years	60.4 (1.3)	60.3 (0.9)	60.4 (1.2)	60.3 (0.8)
Men, %	58	15	77	54
Ethanol consumption, g/day	0.9 [0.3-2.7]	1.6 [0.1-3.3]	2.0 [0.2-2.4]	2.9 [0.4-5.4]
University or college education, %	11	18	5	13
Current smokers, %	13	13	40	22
BMI, kg/m^2				
- Crude	25.6 (0.1)	25.5 (0.2)	26.7 (0.3)*,**	25.9 (0.1)***
- Adjusted[a]	25.5 (0.1)	25.5 (0.2)	26.8 (0.3)*,**	26.0 (0.1)*,***
Diabetes cases / Person Years	33 / 12680	14 / 5406	9 / 1821	53 / 17276
HR (95% CI): Model 1	0.81 (0.52-1.25)	1.00 (0.54-1.86)	1.34 (0.65-2.74)	1.00 (ref)
HR (95% CI): Model 2	0.80 (0.52-1.25)	1.00 (0.53-1.86)	1.31 (0.63-2.81)	1.00 (ref)
HR (95% CI): Model 3	0.81 (0.52-1.26)	1.00 (0.53-1.87)	0.92 (0.44-1.93)	1.00 (ref)
The Tromsø Study				
N (%)	722 (15)	1502 (30)	1042 (21)	1692 (34)

Supplemental Table 1 (continued). Selected general characteristics across categories of alcoholic beverage preference and Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between having a beer, wine, or spirit preference and diabetes incidence compared to having no preference in 10 European cohorts based on multiple imputation results.

	Beer preference	Wine preference	Spirit preference	No preference
Age, years	59.6 (8.4)	59.8 (8.8)	62.1 (8.6)	58.7 (7.7)
Men, %	76	28	74	71
Ethanol consumption, g/day	3.3 [1.7-6.1]	4.7 [2.4-7.1]	1.1 [1.1-2.6]	4.7 [2.8-8.1]
University or college education, %	18	33	10	28
Current smokers, %	38	29	50	34
BMI, kg/m^2				
- Crude	25.4 (0.1)	25.4 (0.1)	25.9 (0.1)*,**	25.9 (0.1)*,**
- Adjusted[a]	25.3 (0.1)	25.6 (0.1)	25.9 (0.1)*,**	25.8 (0.1)**
Diabetes cases / Person Years	45 / 9158	65 / 19853	72 / 12715	96 / 22094
HR (95% CI): Model 1	1.12 (0.78-1.60)	0.95 (0.68-1.34)	1.32 (0.96-1.81)	1.00 (ref)
HR (95% CI): Model 2	1.12 (0.78-1.60)	0.96 (0.68-1.34)	1.32 (0.96-1.81)	1.00 (ref)
HR (95% CI): Model 3	1.23 (0.86-1.77)	1.03 (0.73-1.44)	1.17 (0.85-1.61)	1.00 (ref)
ESTHER				
N (%)	1466 (28)	2305 (44)	107 (2)	1408 (27)
Age, years	61.5 (6.4)	61.5 (6.6)	63.2 (6.8)	62.0 (6.6)
Men, %	77	32	22	64
Ethanol consumption, g/day	6.6 [2.6-13.2]	5.6 [3.7-11.0]	0.8 [0.8-2.5]	9.1 [5.3-15.8]
Middle education, %	21	35	25	34
Current smokers, %	26	13	13	14

Supplemental Table 1 (continued). Selected general characteristics across categories of alcoholic beverage preference and Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between having a beer, wine, or spirit preference and diabetes incidence compared to having no preference in 10 European cohorts based on multiple imputation results.

	Beer preference	Wine preference	Spirit preference	No preference
BMI, kg/m^2				
- Crude	27.6 (0.1)	26.8 (0.1)*	28.0 (0.4)**	27.1 (0.1)*,**,***
- Adjusted[a]	27.4 (0.1)	27.0 (0.1)*	28.2 (0.4)*,**	27.1 (0.1)*,***
Diabetes cases / Person Years	165 / 9671	207 / 16394	14 / 736	140 / 9792
HR (95% CI): Model 1	1.07 (0.85-1.35)	0.98 (0.79-1.23)	1.42 (0.81-2.47)	1.00 (ref)
HR (95% CI): Model 2	1.05 (0.83-1.32)	0.97 (0.78-1.22)	1.39 (0.80-2.43)	1.00 (ref)
HR (95% CI): Model 3	0.98 (0.78-1.24)	0.96 (0.76-1.20)	1.25 (0.71-2.18)	1.00 (ref)
MORGAM: FINRISK				
N (%)	6410 (32)	3200 (16)	3410 (17)	6739 (34)
Age, years	41.5 (11.5)	47.3 (12.3)	46.8 (11.8)	44.6 (11.7)
Men, %	63	26	66	62
Ethanol consumption, g/day	7.0 [4.0-15.0]	3.0 [2.0-9.0]	8.0 [3.0-14.0]	13.0 [7.0-21.0]
University or college education, %	9	19	6	15
Current smokers, %	38	17	34	29
BMI, kg/m^2				
- Crude	25.7 (0.1)	25.9 (0.1)*	25.9 (0.1)*,**	26.2 (0.1)*,**,***
- Adjusted[aw]	25.9 (0.1)	26.1 (0.1)	25.5 (0.1)*,**	26.2 (0.1)*,***
Diabetes cases / Person Years	487 / 101570	229 / 50342	437 / 59893	557 / 105820
HR (95% CI): Model 1	0.98 (0.87-1.11)	0.89 (0.76-1.05)	1.08 (0.95-1.22)	1.00 (ref)

Supplemental Table 1 (continued). Selected general characteristics across categories of alcoholic beverage preference and Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between having a beer, wine, or spirit preference and diabetes incidence compared to having no preference in 10 European cohorts based on multiple imputation results.

	Beer preference	Wine preference	Spirit preference	No preference
HR (95% CI): Model 2	0.97 (0.86-1.10)	0.91 (0.78-1.07)	1.07 (0.94-1.21)	1.00 (ref)
HR (95% CI): Model 3	1.05 (0.93-1.18)	0.94 (0.80-1.10)	1.00 (0.88-1.13)	1.00 (ref)
MORGAM: Northern-Sweden				
N (%)	794 (26)	511 (17)	146 (5)	1581 (52)
Age, years	45.5 (13.4)	46.6 (11.6)	49.7 (11.6)	44.3 (11.7)
Men, %	72	10	81	65
Ethanol consumption, g/day	2.0 [1.0-6.0]	2.0 [1.0-2.0]	2.0 [1.0-2.0]	4.0 [3.0-6.0]
University or college education, %	15	26	2	19
Current smokers, %	23	27	40	30
BMI, kg/m^2				
- Crude	25.4 (0.1)	24.8 (0.2)*	26.7 (0.3)*,**,***	25.2 (0.1)**,***
- Adjusted[a]	25.2 (0.2)	25.2 (0.2)	26.1 (0.3)*,**	25.2 (0.1)***
Diabetes cases / Person Years	40 / 15215	25 / 10413	7 / 2728	77 / 31392
HR (95% CI): Model 1	0.99 (0.67-1.46)	1.05 (0.63-1.73)	0.88 (0.40-1.93)	1.00 (ref)
HR (95% CI): Model 2	1.04 (0.71-1.54)	1.10 (0.66-1.83)	0.87 (0.40-1.90)	1.00 (ref)
HR (95% CI): Model 3	1.06 (0.72-1.56)	1.15 (0.69-1.93)	0.68 (0.31-1.50)	1.00 (ref)
MORGAM: MOLI-SANI				
N (%)	618 (4)	11522 (79)	102 (1)	2268 (16)

Supplemental Table 1 (continued). Selected general characteristics across categories of alcoholic beverage preference and Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between having a beer, wine, or spirit preference and diabetes incidence compared to having no preference in 10 European cohorts based on multiple imputation results.

	Beer preference	Wine preference	Spirit preference	No preference
Age, years	49.6 (9.9)	56.7 (11.7)	50.7 (9.3)	49.6 (9.7)
Men, %	62	60	34	64
Ethanol consumption, g/day	4.0 [1.0-17.0]	18.0 [10.0-34.0]	2.0 [2.0-7.0]	8.0 [3.0-20.0]
University or college education, %	13	12	14	17
Current smokers, %	35	22	25	27
BMI, kg/m^2				
- Crude	27.3 (0.2)	27.8 (0.0)*	26.9 (0.4)**	27.6 (0.1)**
- Adjusted[a]	27.7 (0.2)	27.7 (0.0)	27.5 (0.4)	28.0 (0.1)**
Diabetes cases / Person Years	10 / 2758	255 / 20198	0 / 478	30 / 10319
HR (95% CI): Model 1	1.21 (0.59-2.49)	1.17 (0.80-1.73)	no cases	1.00 (ref)
HR (95% CI): Model 2	1.19 (0.58-2.44)	1.17 (0.80-1.73)	no cases	1.00 (ref)
HR (95% CI): Model 3	1.29 (0.63-2.65)	1.22 (0.89-1.80)	no cases	1.00 (ref)

* P-value <0.05 versus beer preference; ** P-value <0.05 versus wine preference; *** P-value <0.05 versus spirit preference.

[a] BMI adjusted for age, sex, education, employment, prevalent coronary heart disease or cancer, smoking status, sports activity (if available), and Healthy Diet Indicator (if available).

Model 1: Adjusted for age, sex, education, employment, and prevalent coronary heart disease or cancer;

Model 2: Model 1 additionally adjusted for smoking status, sports activity (if available), and Healthy Diet Indicator score (if available).

Model 3: Model 2 additionally adjusted for BMI.

Supplemental Table 2. Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between residuals of absolute consumption of beer, wine, and spirits and diabetes incidence in 10 European cohorts.

Zutphen Elderly Study	Q1	Q2	Q3	Per 6 g/d
Beer consumption (residuals)				
N	185	186	186	557
Cases / Person Years	14 / 1968	18 / 1903	16 / 2009	48 / 5880
HR (95% CI): Model 1	1.00 (ref)	1.47 (0.71-3.02)	1.25 (0.60-2.64)	0.98 (0.80-1.20)
HR (95% CI): Model 2	1.00 (ref)	1.47 (0.71-3.05)	1.30 (0.61-2.77)	0.98 (0.79-1.21)
HR (95% CI): Model 3	1.00 (ref)	1.47 (0.70-3.07)	1.23 (0.58-2.62)	0.97 (0.77-1.21)
Wine consumption (residuals)				
N	190	181	186	557
Cases / Person Years	15 / 1915	14 / 1859	19 / 2106	48 / 5880
HR (95% CI): Model 1	1.00 (ref)	0.92 (0.44-1.91)	1.25 (0.62-2.52)	0.89 (0.64-1.23)
HR (95% CI): Model 2	1.00 (ref)	0.93 (0.45-1.95)	1.19 (0.58-2.43)	0.85 (0.60-1.20)
HR (95% CI): Model 3	1.00 (ref)	0.90 (0.43-1.90)	1.12 (0.55-2.30)	0.84 (0.59-1.21)
Spirit consumption (residuals)				
N	189	184	184	557
Cases / Person Years	20 / 2095	13 / 1952	15 / 1833	48 / 5880
HR (95% CI): Model 1	1.00 (ref)	0.69 (0.34-1.41)	0.77 (0.39-1.54)	1.06 (0.88-1.26)
HR (95% CI): Model 2	1.00 (ref)	0.73 (0.35-1.50)	0.81 (0.41-1.63)	1.07 (0.89-1.28)
HR (95% CI): Model 3	1.00 (ref)	0.81 (0.39-1.68)	0.94 (0.47-1.90)	1.08 (0.09-1.31)

Supplemental Table 2 (continued). Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between residuals of absolute consumption of beer, wine, and spirits and diabetes incidence in 10 European cohorts.

Rotterdam Study	Q1	Q2	Q3	Per 6 g/d
Beer consumption (residuals)				
N (%)	809	815	804	2428
Cases / Person Years	109 / 8118	112 / 8283	96 / 8042	317 / 24444
HR (95% CI): Model 1	1.00 (ref)	1.07 (0.82-1.41)	0.88 (0.67-1.17)	0.98 (0.87-1.10)
HR (95% CI): Model 2	1.00 (ref)	1.08 (0.82-1.42)	0.88 (0.66-1.17)	0.97 (0.86-1.10)
HR (95% CI): Model 3	1.00 (ref)	1.06 (0.80-1.39)	0.87 (0.62-1.15)	0.97 (0.87-1.09)
Wine consumption (residuals)				
N (%)	810	819	799	2428
Cases / Person Years	125 / 7627	99 / 8250	93 / 8567	317 / 24444
HR (95% CI): Model 1	1.00 (ref)	0.74 (0.55-1.00)	0.67 (0.50-0.90)	0.89 (0.79-1.01)
HR (95% CI): Model 2	1.00 (ref)	0.74 (0.55-1.00)	0.68 (0.50-0.91)	0.90 (0.79-1.01)
HR (95% CI): Model 3	1.00 (ref)	0.79 (0.54-0.98)	0.72 (0.54-0.98)	0.92 (0.82-1.04)
Spirit consumption (residuals)				
N (%)	810	819	799	2428
Cases / Person Years	89 / 8471	110 / 8359	118 / 7613	317 / 24444
HR (95% CI): Model 1	1.00 (ref)	1.28 (0.96-1.70)	1.43 (1.08-1.91)	1.09 (0.99-1.19)
HR (95% CI): Model 2	1.00 (ref)	1.30 (0.97-1.72)	1.41 (1.06-1.87)	1.09 (0.99-1.19)
HR (95% CI): Model 3	1.00 (ref)	1.26 (0.95-1.68)	1.33 (1.00-1.77)	1.07 (0.98-1.17)

Supplemental Table 2 (continued). Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between residuals of absolute consumption of beer, wine, and spirits and diabetes incidence in 10 European cohorts.

EPIC-ELDERLY: The Netherlands	**Q1**	**Q2**	**Q3**	**Per 6 g/d**
Beer consumption (residuals)				
N	1264	1265	1264	3793
Cases / Person Years	67 / 6097	71 / 6120	81 / 6286	219 / 18503
HR (95% CI): Model 1	1.00 (ref)	1.01 (0.72-1.41)	0.97 (0.69-1.35)	1.07 (0.85-1.36)
HR (95% CI): Model 2	1.00 (ref)	0.95 (0.67-1.35)	0.96 (0.68-1.35)	1.10 (0.87-1.40)
HR (95% CI): Model 3	1.00 (ref)	0.79 (0.55-1.14)	0.83 (0.59-1.17)	1.13 (0.89-1.44)
Wine consumption (residuals)				
N	1265	1264	1264	3793
Cases / Person Years	78 / 6291	87 / 6172	54 / 6040	219 / 18503
HR (95% CI): Model 1	1.00 (ref)	1.20 (0.88-1.64)	0.87 (0.61-1.24)	0.90 (0.79-1.03)
HR (95% CI): Model 2	1.00 (ref)	1.16 (0.84-1.59)	0.85 (0.59-1.22)	0.88 (0.76-1.01)
HR (95% CI): Model 3	1.00 (ref)	1.03 (0.66-1.37)	0.95 (0.66-1.37)	0.90 (0.78-1.04)
Spirit consumption (residuals)				
N	1265	1266	1262	3793
Cases / Person Years	54 / 6068	87 / 6159	78 / 6276	219 / 18503
HR (95% CI): Model 1	1.00 (ref)	1.43 (1.01-2.02)	1.18 (0.83-1.69)	1.09 (0.95-1.26)
HR (95% CI): Model 2	1.00 (ref)	1.41 (0.99-2.00)	1.19 (0.83-1.70)	1.12 (0.97-1.29)
HR (95% CI): Model 3	1.00 (ref)	1.14 (0.79-1.63)	1.04 (0.72-1.49)	1.08 (0.93-1.26)

Supplemental Table 2 (continued). Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between residuals of absolute consumption of beer, wine, and spirits and diabetes incidence in 10 European cohorts.

EPIC-ELDERLY: Greece	**Q1**	**Q2**	**Q3**	**Per 6 g/d**
Beer consumption (residuals)				
N	1784	1775	1757	5316
Cases / Person Years	251 / 19614	296 / 19127	268 / 19109	815 / 57849
HR (95% CI): Model 1	1.00 (ref)	1.48 (1.24-1.76)	1.29 (1.09-1.54)	1.04 (0.96-1.12)
HR (95% CI): Model 2	1.00 (ref)	1.46 (1.23-1.74)	1.26 (1.06-1.50)	1.02 (0.94-1.10)
HR (95% CI): Model 3	1.00 (ref)	1.39 (1.17-1.66)	1.20 (1.00-1.43)	1.03 (0.95-1.12)
Wine consumption (residuals)				
N	1769	1765	1782	5316
Cases / Person Years	273 / 18828	280 / 19263	262 / 19759	815 / 57849
HR (95% CI): Model 1	1.00 (ref)	0.84 (0.71-1.00)	0.66 (0.55-0.78)	0.93 (0.88-0.98)
HR (95% CI): Model 2	1.00 (ref)	0.88 (0.73-1.04)	0.69 (0.58-0.82)	0.94 (0.90-0.99)
HR (95% CI): Model 3	1.00 (ref)	0.89 (0.63-0.89)	0.75 (0.63-0.89)	0.95 (0.90-1.01)
Spirit consumption (residuals)				
N	1770	1820	1726	5316
Cases / Person Years	260 / 19497	284 / 20037	271 / 18315	815 / 57849
HR (95% CI): Model 1	1.00 (ref)	1.23 (1.03-.46)	1.49 (1.26-1.78)	1.08 (1.02-1.14)
HR (95% CI): Model 2	1.00 (ref)	1.21 (1.02-1.45)	1.45 (1.22-1.72)	1.06 (1.01-1.12)
HR (95% CI): Model 3	1.00 (ref)	1.12 (0.94-1.34)	1.35 (1.13-1.61)	1.05 (0.99-1.11)

Supplemental Table 2 (continued). Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between residuals of absolute consumption of beer, wine, and spirits and diabetes incidence in 10 European cohorts.

EPIC-ELDERLY: Sweden	**Q1**	**Q2**	**Q3**	**Per 6 g/d**
Beer consumption (residuals)				
N	932	949	936	2819
Cases / Person Years	27 / 12276	48 / 12507	34 / 12400	109 / 37183
HR (95% CI): Model 1	1.00 (ref)	1.99 (1.22-3.25)	1.14 (0.68-1.91)	0.99 (0.48-2.03)
HR (95% CI): Model 2	1.00 (ref)	2.02 (1.24-3.31)	1.16 (0.69-1.95)	1.00 (0.48-2.06)
HR (95% CI): Model 3	1.00 (ref)	1.99 (1.22-3.77)	1.31 (0.78-2.22)	1.20 (0.56-2.56)
Wine consumption (residuals)				
N	941	921	957	2819
Cases / Person Years	39 / 12435	43 / 12173	27 / 12576	109 / 37183
HR (95% CI): Model 1	1.00 (ref)	1.31 (0.83-2.08)	0.85 (0.50-1.45)	0.54 (0.23-1.29)
HR (95% CI): Model 2	1.00 (ref)	1.32 (0.83-2.10)	0.85 (0.50-1.45)	0.54 (0.23-1.29)
HR (95% CI): Model 3	1.00 (ref)	1.21 (0.46-1.35)	0.79 (0.46-1.35)	0.44 (0.17-1.10)
Spirit consumption (residuals)				
N	939	956	924	2819
Cases / Person Years	21 / 12366	43 / 12604	45 / 12213	109 / 37183
HR (95% CI): Model 1	1.00 (ref)	2.14 (1.26-3.62)	2.04 (1.21-3.44)	1.76 (0.86-3.61)
HR (95% CI): Model 2	1.00 (ref)	2.13 (1.26-3.63)	2.02 (1.19-3.43)	1.76 (0.85-3.64)
HR (95% CI): Model 3	1.00 (ref)	2.05 (1.20-3.49)	1.86 (1.10-3.15)	1.65 (0.74-3.68)

Supplemental Table 2 (continued). Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between residuals of absolute consumption of beer, wine, and spirits and diabetes incidence in 10 European cohorts.

Tromsø	**Q1**	**Q2**	**Q3**	**Per 6 g/d**
Beer consumption (residuals)				
N	1562	1752	1644	4958
Cases / Person Years	79 / 20158	97 / 22559	102 / 21103	278 / 63819
HR (95% CI): Model 1	1.00 (ref)	1.11 (0.82-1.50)	1.07 (0.79-1.45)	1.11 (0.91-1.36)
HR (95% CI): Model 2	1.00 (ref)	1.11 (0.82-1.50)	1.07 (0.79-1.45)	1.11 (0.91-1.36)
HR (95% CI): Model 3	1.00 (ref)	1.03 (0.76-1.39)	1.16 (0.85-1.57)	1.16 (0.95-1.41)
Wine consumption (residuals)				
N	1662	1733	1563	4958
Cases / Person Years	114 / 20596	100 / 22534	64 / 20689	278 / 63819
HR (95% CI): Model 1	1.00 (ref)	0.92 (0.70-1.21)	0.70 (0.50-0.97)	0.88 (0.71-1.09)
HR (95% CI): Model 2	1.00 (ref)	0.92 (0.70-1.22)	0.70 (0.50-0.98)	0.88 (0.71-1.09)
HR (95% CI): Model 3	1.00 (ref)	0.95 (0.56-1.10)	0.79 (0.56-1.10)	0.91 (0.73-1.15)
Spirit consumption (residuals)				
N	1708	1617	1633	4958
Cases / Person Years	80 / 22496	80 / 21103	118 / 20220	278 / 63819
HR (95% CI): Model 1	1.00 (ref)	1.02 (0.75-1.40)	1.41 (1.05-1.91)	1.07 (0.74-1.54)
HR (95% CI): Model 2	1.00 (ref)	1.02 (0.75-1.40)	1.41 (1.04-1.92)	1.06 (0.73-1.53)
HR (95% CI): Model 3	1.00 (ref)	0.85 (0.62-1.16)	1.08 (0.79-1.46)	0.84 (0.57-1.25)

Supplemental Table 2 (continued). Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between residuals of absolute consumption of beer, wine, and spirits and diabetes incidence in 10 European cohorts.

ESTHER	**Q1**	**Q2**	**Q3**	**Per 6 g/d**
Beer consumption (residuals)				
N	1589	1932	1765	5286
Cases / Person Years	143 / 11176	186 / 13686	197 / 11731	526 / 36593
HR (95% CI): Model 1	1.00 (ref)	1.08 (0.86-1.34)	1.12 (0.89-1.40)	1.06 (0.95-1.18)
HR (95% CI): Model 2	1.00 (ref)	1.10 (0.88-1.37)	1.11 (0.89-1.39)	1.05 (0.95-1.17)
HR (95% CI): Model 3	1.00 (ref)	1.07 (0.86-1.34)	1.05 (0.84-1.32)	1.05 (0.94-1.16)
Wine consumption (residuals)				
N	1667	1792	1827	5286
Cases / Person Years	191 / 11018	175 / 12681	160 / 12894	526 / 36593
HR (95% CI): Model 1	1.00 (ref)	0.88 (0.71-1.10)	0.83 (0.67-1.04)	0.94 (0.85-1.05)
HR (95% CI): Model 2	1.00 (ref)	0.90 (0.72-1.13)	0.84 (0.67-1.06)	0.95 (0.85-1.05)
HR (95% CI): Model 3	1.00 (ref)	0.92 (0.72-1.13)	0.90 (0.72-1.13)	0.96 (0.87-1.07)
Spirit consumption (residuals)				
N	1865	1834	1687	5286
Cases / Person Years	166 / 12075	184 / 12834	176 / 11683	526 / 36593
HR (95% CI): Model 1	1.00 (ref)	1.18 (0.94-1.47)	1.11 (0.89-1.37)	1.06 (0.74-1.53)
HR (95% CI): Model 2	1.00 (ref)	1.20 (0.96-1.49)	1.12 (0.91-1.39)	1.05 (0.73-1.51)
HR (95% CI): Model 3	1.00 (ref)	1.12 (0.90-1.39)	1.03 (0.83-1.27)	0.93 (0.64-1.35)

Supplemental Table 2 (continued). Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between residuals of absolute consumption of beer, wine, and spirits and diabetes incidence in 10 European cohorts.

MORGAM: FINRISK	**Q1**	**Q2**	**Q3**	**Per 6 g/d**
Beer consumption (residuals)				
N	6455	6069	7235	19759
Cases / Person Years	645 / 103702	493 / 99754	572 / 114169	1710 / 317624
HR (95% CI): Model 1	1.00 (ref)	0.82 (0.73-0.92)	0.96 (0.86-1.08)	0.97 (0.93-1.02)
HR (95% CI): Model 2	1.00 (ref)	0.85 (0.75-0.96)	0.96 (0.86-1.07)	0.97 (0.93-1.02)
HR (95% CI): Model 3	1.00 (ref)	0.95 (0.84-1.07)	1.09 (0.97-1.22)	1.02 (0.98-1.07)
Wine consumption (residuals)				
N	6643	6477	6639	19759
Cases / Person Years	705 / 108162	548 / 108167	457 / 101296	1710 / 317624
HR (95% CI): Model 1	1.00 (ref)	0.81 (0.72-0.91)	0.79 (0.69-0.89)	0.95 (0.88-1.02)
HR (95% CI): Model 2	1.00 (ref)	0.84 (0.75-0.95)	0.82 (0.72-0.93)	0.96 (0.89-1.02)
HR (95% CI): Model 3	1.00 (ref)	0.95 (0.78-1.01)	0.89 (0.78-1.01)	0.98 (0.92-1.04)
Spirit consumption (residuals)				
N	7069	6188	6502	19759
Cases / Person Years	511 / 105964	445 / 1005545	754 / 111116	1710 / 317624
HR (95% CI): Model 1	1.00 (ref)	0.81 (0.71-0.92)	1.03 (0.92-1.16)	1.06 (1.01-1.11)
HR (95% CI): Model 2	1.00 (ref)	0.85 (0.75-0.97)	1.05 (0.94-1.18)	1.05 (1.01-1.10)
HR (95% CI): Model 3	1.00 (ref)	0.83 (0.73-0.95)	0.92 (0.82-1.03)	0.99 (0.94-1.03)

Supplemental Table 2 (continued). Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between residuals of absolute consumption of beer, wine, and spirits and diabetes incidence in 10 European cohorts.

MORGAM: MOLI-SANI	**Q1**	**Q2**	**Q3**	**Per 6 g/d**
Beer consumption (residuals)				
N	4811	5065	4634	14510
Cases / Person Years	110 / 20994	117 / 22226	68 / 20533	295 / 63753
HR (95% CI): Model 1	1.00 (ref)	1.32 (1.00-1.74)	1.04 (0.76-1.42)	1.04 (0.92-1.18)
HR (95% CI): Model 2	1.00 (ref)	1.33 (1.00-1.75)	1.04 (0.76-1.42)	1.04 (0.92-1.17)
HR (95% CI): Model 3	1.00 (ref)	1.26 (0.95-1.66)	1.03 (0.75-1.41)	1.01 (0.90-1.14)
Wine consumption (residuals)				
N	4797	5271	4442	14510
Cases / Person Years	75 / 21702	115 / 23140	105 / 18911	295 / 63753
HR (95% CI): Model 1	1.00 (ref)	1.15 (0.85-1.56)	0.97 (0.71-1.33)	0.98 (0.87-1.10)
HR (95% CI): Model 2	1.00 (ref)	1.16 (0.85-1.57)	0.97 (0.71-1.33)	0.98 (0.87-1.10)
HR (95% CI): Model 3	1.00 (ref)	1.14 (0.73-1.36)	1.00 (0.73-1.36)	1.00 (0.89-1.12)
Spirit consumption (residuals)				
N	4750	5075	4685	14510
Cases / Person Years	104 / 19857	106 / 22123	85 / 21772	295 / 63753
HR (95% CI): Model 1	1.00 (ref)	1.23 (0.92-1.64)	1.08 (0.80-1.45)	0.93 (0.68-1.27)
HR (95% CI): Model 2	1.00 (ref)	1.23 (0.92-1.65)	1.09 (0.81-1.46)	0.93 (0.68-1.27)
HR (95% CI): Model 3	1.00 (ref)	1.21 (0.91-1.62)	1.02 (0.76-1.37)	0.93 (0.69-1.26)

Supplemental Table 2 (continued). Hazard Ratios (HRs) and 95% Confidence Intervals (CIs) of the associations between residuals of absolute consumption of beer, wine, and spirits and diabetes incidence in 10 European cohorts.

MORGAM: North-Sweden	**Q1**	**Q2**	**Q3**	**Per 6 g/d**
Beer consumption (residuals)				
N	1101	911	1020	3032
Cases / Person Years	55 / 21790	44 / 18329	50 / 19628	149 / 59748
HR (95% CI): Model 1	1.00 (ref)	1.11 (0.74-1.65)	1.04 (0.70-1.55)	1.44 (0.84-2.46)
HR (95% CI): Model 2	1.00 (ref)	1.15 (0.77-1.73)	1.11 (0.74-1.65)	1.46 (0.87-2.47)
HR (95% CI): Model 3	1.00 (ref)	1.15 (0.77-1.72)	1.11 (0.75-1.66)	1.49 (0.86-2.60)
Wine consumption (residuals)				
N	784	1224	1024	3032
Cases / Person Years	40 / 14853	63 / 24261	46 / 20633	149 / 59748
HR (95% CI): Model 1	1.00 (ref)	0.96 (0.64-1.44)	0.93 (0.58-1.48)	0.87 (0.44-1.69)
HR (95% CI): Model 2	1.00 (ref)	0.98 (0.65-1.48)	0.92 (0.57-1.48)	0.87 (0.45-1.67)
HR (95% CI): Model 3	1.00 (ref)	0.99 (0.66-1.68)	1.05 (0.66-1.68)	0.98 (0.49-1.96)
Spirit consumption (residuals)				
N	1042	1012	978	3032
Cases / Person Years	46 / 20310	47 / 20377	56 / 19060	149 / 59748
HR (95% CI): Model 1	1.00 (ref)	0.98 (0.65-1.48)	1.09 (0.72-1.65)	0.93 (0.68-1.27)
HR (95% CI): Model 2	1.00 (ref)	0.99 (0.66-1.50)	1.05 (0.70-1.60)	0.67 (0.29-1.54)
HR (95% CI): Model 3	1.00 (ref)	0.89 (0.59-1.34)	0.88 (0.58-1.33)	0.51 (0.21-1.26)

Model 1: Adjusted for age, sex, education, employment, and prevalent coronary heart disease or cancer;
Model 2: Model 1 additionally adjusted for smoking status, sports activity (if available), and Healthy Diet Indicator score (if available).
Model 3: Model 2 additionally adjusted for BMI.

Table 1. Cohort characteristics of the ten included European cohorts from the Consortium on Health and Ageing: Network of Cohorts in Europe and the United States (CHANCES) project and number of included persons who reported to consume alcohol.

Cohort	Sub-cohort or country	Baseline period	Follow-up period	Follow-up length, median [P25-P75]	Ascertainment of incident diabetes type 2	N	Age category	Males, %
Zutphen Elderly Study	The Netherlands	1985	1985-2010	9.7 [5.0-15.0]	Self-report and current treatment and non-fasting glucose measures using the WHO definition[46].	557	≥60 y	100
Rotterdam Study	The Netherlands	1990	1997-2013	12.2 [7.0-13.1]	Followed-up using information from general practitioners, pharmacies' databases, and follow-up examinations. Defined as being registered by a general practitioner as having type 2 diabetes and meeting at least one of the following four criteria: fasting plasma glucose concentration ≥7.0 mmol/L, random plasma glucose concentration ≥11.1 mmol/L, use of anti-diabetic mediation, and/or following dietary guidelines for type 2 diabetes.	2428	≥55 y	44
EPIC-Elderly	The Netherlands	1993-1997	1993-2005	4.9 [4.1-5.0]	Self-reported diagnosis in the follow-up questionnaires and/or a urinary glucose strip test for detection of glucosuria, and/or linkage with the Dutch register of hospital discharge diagnoses[47].	3793	≥60 y	6

Table 1 (continued). Cohort characteristics of the ten included European cohorts from the Consortium on Health and Ageing: Network of Cohorts in Europe and the United States (CHANCES) project and number of included persons who reported to consume alcohol.

Cohort	Sub-cohort or country	Baseline period	Follow-up period	Follow-up length, median [P25-P75]	Ascertainment of incident diabetes type 2	N	Age category	Males, %
	Greece	1994-1999	1994-2011	11.4 [9.9-12.5]	Collected during follow-up through self-report and current treatment; cases were not validated.	5316	≥60 y	50
	Sweden	1992-1996	1992-2011	13.2 [12.1-14.2]	Followed up through linkage with the Swedish diabetes register and verified by biomarker measurements of impaired glucose tolerance and impaired fasting glucose in a few cases.	2819	≥60 y	51
The Tromsø Study	Norway	1994-1995	1994-2010	15.6 [10.0-16.0]	Linkage with diabetes-related or cardiovascular diseases discharge diagnosis at the only hospital serving the Tromsø population or verified by self-report or observed HbA_{1c}-values >6.5% during follow-up. Some of the cases were validated using medical records or a non-fasting glucose measurement.	4958	≥45 y	59

Table 1 (continued). Cohort characteristics of the ten included European cohorts from the Consortium on Health and Ageing: Network of Cohorts in Europe and the United States (CHANCES) project and number of included persons who reported to consume alcohol.

Cohort	Sub-cohort or country	Baseline period	Follow-up period	Follow-up length, median [P25-P75]	Ascertainment of incident diabetes type 2	N	Age category	Males, %
ESTHER	Germany	2000-2003	2000-2007	7.9 [5.3-8.1]	The cohort was systematically searched for diabetes events and incident cases were validated with medical records during follow-up. In addition, subjects with HbA_{1c} ≥ 6.5% at 8-year follow-up were classified as subjects with incident type 2 diabetes in order to identify undiagnosed cases.	5286	48-75 y	53
MORGAM	FINRISK (Finland)	1982-2002	1982-2010	14.0 [8.9-23.8]	Through linkage to the national Hospital Discharge Register, Causes of Death Register, and drug reimbursement registers[48].	19759	24-74 y	57
	MOLI-SANI (Italy)	2005-2010	2005-2011	4.3 [3.3-5.4]	Cases were identified and validated through linkage to the National Medication Register and to the Local Diagnosis Registers[48].	14510	35-99 y	60
	Northern-Sweden (Sweden)	1986-1994	1986-2011	20.8 [17.8-24.5]	Based on self-reported diagnosis in a phone interview and/or linkage with Hospital Discharge Records[48].	3032	24-74 y	58

Table 2. Pooled Hazard Ratios (95% CI) from random-effects meta-analyses for the association between having a beer, wine, or spirit preference compared to having no preference according to sub-groups and additional analyses.

	Beer preference	Wine preference	Spirit preference	No preference
BMI				
- <25 kg/m^2	1.24 (0.95-1.61)	1.07 (0.85-1.36)	0.89 (0.44-1.82)	1.00 (ref)
- ≥25 kg/m^2	1.05 (0.95-1.15)	0.95 (0.85-1.06)	1.26 (1.06-1.51)	1.00 (ref)
Sex				
- Men	1.26 (0.93-1.71)	1.17 (0.92-1.50)	1.27 (1.01-1.59)	1.00 (ref)
- Women	1.23 (0.89-1.70)	1.08 (0.85-1.37)	1.33 (1.11-1.60)	1.00 (ref)
Excluding persons with prevalent diseases*	1.04 (0.95-1.15)	0.99 (0.87-1.13)	1.16 (0.95-1.42)	1.00 (ref)
Additional adjustment for frequency pattern	1.05 (0.95-1.16)	0.98 (0.87-1.10)	1.01 (0.90-1.14)	1.00 (ref)
Definition alcoholic beverage preference with cut-off 50%	1.06 (0.93-1.21)	0.93 (0.77-1.12)	1.10 (0.93-1.31)	1.00 (ref)

* Defined as persons with prevalent heart disease or cancer or a follow-up ≤2 years.

Models adjusted for age, sex, education, employment, prevalent coronary heart disease or cancer, smoking status, sports activity (if available), Healthy Diet Indicator score (if available), and BMI.