Drug and Alcohol Dependence 151 (2015) 110–114

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Personality and alcohol consumption: Pooled analysis of 72,949 adults from eight cohort studies

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ARTICLE INFO

Article history:
Received 14 January 2015
Received in revised form 4 March 2015
Accepted 7 March 2015
Available online 18 March 2015

Keywords:
The Five-Factor Model
Drinking
Meta-analysis
Addiction epidemiology
Psychology

ABSTRACT

Background: The role of personality as a determinant of alcohol consumption has long been debated, but prospective evidence is scarce.
Methods: We performed individual participant meta-analysis to examine the association between the Five-Factor Model personality traits (extraversion, neuroticism, agreeableness, conscientiousness, and openness to experience) and alcohol consumption using data from eight cohort studies sampled from the USA, UK, Germany, and Australia (total $n = 72{,}949$; mean age = 50 years, 54% female). Alcohol consumption was categorized into abstinence, moderate consumption, and heavy consumption.
Results: After adjustment for age, sex, and race, higher extraversion (odds ratio for 1 standard deviation's increase in the score; 95% confidence interval: 1.14; 1.01–1.29) and lower conscientiousness (0.89; 0.79–1.00) were associated with increased risk of transitioning from moderate to heavy alcohol consumption over time, and also with heavy alcohol consumption. Lower extraversion (0.91; 0.85–0.98), higher agreeableness (1.09; 1.02–1.15), and lower openness (0.90; 0.86–0.95) were associated with increased odds of transitioning from moderate consumption to abstinence as well as with alcohol abstinence.
Conclusion: Findings from this individual-participant meta-analysis suggest that high and increasing alcohol consumption is more common among extraverts and those low on conscientiousness whereas high agreeableness and low openness to experience may increase odds of reducing alcohol consumption and preferring abstinence.

1. Introduction

Heavy alcohol consumption is a major public health problem (World Health Organization, 2014), increasing the risk of cardiovascular diseases, liver disease, certain cancers, mental health problems, and premature mortality (Rehm et al., 2009; Jemal et al., 2011). Understanding the determinants of harmful levels of alcohol intake is important if progress is to be made in modifying this behavior. While socioeconomic status and mental health are established predictors, the role of other psychosocial factors has been much less well explored. The extent to which alcohol consumption is determined by personality has long been debated (Cloninger et al., 1988; Tarter, 1988).

The Five-Factor Model, which consists of five higher-order personality traits (extraversion, neuroticism, agreeableness, conscientiousness, and openness to experience), is recognized as the most comprehensive conceptualization of personality structure (John et al., 2008). Extraversion refers to sociability, social confidence, and sensitivity to positive emotions; neuroticism comprises low emotional stability, anxiety proneness, and sensitivity to negative emotions; agreeableness reflects features such as cooperativeness, kindness, and trust towards other people; conscientiousness is characterized by high self-control, flexibility, and adherence to social norms; and openness to experience is denoted by curiosity, broadmindedness, and creativity. In a meta-analysis

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http://dx.doi.org/10.1016/j.drugalcdep.2015.03.008
0376-8716/

that examined the cross-sectional association between the Big Five personality traits and alcohol consumption in a total sample of 20 studies (7886 participants), alcohol consumption was higher in individuals with low conscientiousness, low agreeableness, and high neuroticism (Malouff et al., 2007). Another meta-analysis of cross-sectional studies reported that individuals with alcohol-related substance disorder had higher levels of neuroticism and lower levels of conscientiousness compared to controls (Kotov et al., 2010). In addition, a meta-analysis investigating the associations between conscientiousness and health behaviors in a total sample of 32,137 participants from 65 studies found low conscientiousness to be associated with excessive alcohol use (Bogg and Roberts, 2004).

However, the interpretation of cross-sectional findings is not straightforward because observed associations may reflect both the effect of personality on alcohol use and the consequences of heavy alcohol consumption to personality. To date, we are aware of only two studies that have examined associations between personality and alcohol use longitudinally. In the Midlife in the United States study, higher neuroticism, higher extraversion, and lower agreeableness were associated with future alcohol problems (Turiano et al., 2012). In addition, in the Minnesota Twin Family Study, negative emotionality (i.e., high neuroticism) was associated with increased risky alcohol use (Hicks et al., 2012). Thus, longitudinal evidence is currently limited to these two studies from United States, and the extent to which these associations are generalizable remains unclear. Furthermore, there has been a lot of heterogeneity in the assessment of alcohol use in the published studies and also with the meta-analysis of published studies. For example, less than half of the 20 studies in the meta-analysis by Malouff et al. (2007) utilized a direct assessment of alcohol consumption, with the remainder using proxies such as alcohol-related problems.

To address these limitations and to clarify whether the five major personality traits are, in fact, important determinants of alcohol consumption, we pooled data from eight prospective cohort studies for an individual participant meta-analysis. To the best of our knowledge, the current study is the largest meta-analysis of multiple personality traits and alcohol consumption.

2. Materials and methods

2.1. Population

We searched two data repositories, the Inter-University Consortium for Political and Social Research (ICPSR; http://www.icpsr.umich.edu/icpsrweb/ICPSR/) and the Economic and Social Data Service (http://ukdataservice.ac.uk/), to identify potential large-scale cohort studies on personality and alcohol consumption. In order to be included, the studies needed to be open access, have information on participant's alcohol consumption, have a large sample size ($N > 1000$), and have personality measured using a 15-item or more comprehensive questionnaire based on the Five-Factor Model of personality. Eight cohort studies met these criteria: the National Longitudinal Study of Adolescent Health (Add Health), the German Socio-Economic Panel Study (GSOEP), the Household, Income and Labour Dynamics in Australia (HILDA) Survey, the Health and Retirement Study (HRS), the Midlife in the United States (MIDUS), the National Child Development Study (NCDS) the Wisconsin Longitudinal Study graduate (WLSG) sample, and the Wisconsin Longitudinal Study sibling (WLSS) sample. Unlike the other studies with alcohol consumption measured both at baseline and follow-up, Add Health and NCDS did not have follow-up data on alcohol consumption after the assessment of personality, and thus these two cohort studies were included only in the cross-sectional analyses. Relevant local ethics committees approved original data collection in these cohort studies. Full details of the included cohort studies and used measures can be found in the Supplementary Materials.

2.2. Measures

The Five-Factor Model of personality traits were assessed with the following standardized questionnaire instruments: 20-item International Personality Item Pool measure was used in Add Health (Donnellan et al., 2006); 15-item version of the Big Five Inventory (BFI) was used in GSOEP (John et al., 1991, 2008); 36-item inventory based on the Saucier's and Goldberg's Big Five Markers Scale was used in HILDA (Saucier, 1994); 25-item questionnaire was used in HRS and MIDUS (Lachman and Weaver, 1997); 50-item International Personality Item Pool questionnaire in NCDS (Goldberg, 1999); and 29-item version of the BFI was used in WLSG and WLSS (John et al., 1991, 2008).

In these studies, alcohol consumption at baseline and at follow-up was self-reported with questions regarding the frequency and amount of alcohol used. Exceptions were two studies where alcohol consumption was determined on the basis of self-reported frequency of drinking beer, wine, spirits, and cocktail drinks (GSOEP), and on how many times participants used much larger amounts of alcohol than they intended (MIDUS). Participants were grouped into three categories: abstinence; moderate consumption (women: 1–20 drinks per week; men: 1–27 drinks per week); and heavy consumption (women: more or equal than 21 drinks per week; men: more or equal than 28 drinks per week). Alcohol consumption was derived from interviews in HRS and from self-reported questionnaires in other studies. Study covariates were derived from self-reported questionnaires and face-to-face interviews and included: sex, age, marital status (single, married/cohabiting), race/ethnicity (0 = white, non-Hispanic; 1 = other), and educational level (0 = primary education, 1 = secondary education, 3 = tertiary education).

2.3. Statistical analysis

In each study, cross-sectional and longitudinal associations between personality traits and alcohol use were summarized using multinomial regression (0 = abstinence; 1 = moderate; 2 = heavy) where moderate alcohol consumption was used as a reference category. Odds ratios (ORs) were calculated for standardized personality scores (mean = 0, standard deviation [SD] = 1) and expressed as 1 SD increase in personality trait of interest. All effect estimates were adjusted for sex, age at baseline, and ethnicity/nationality (0 = non-Hispanic Caucasians, i.e., the majority in most cohort studies; 1 = other). Longitudinal analyses were further adjusted for individual follow-up period in months. Standard errors in cohort studies based on household sampling were calculated by using a robust estimator method to take into account the non-independence of individuals from the same households. The study-specific estimates were pooled by using random-effects meta-analysis. Heterogeneity in the effect sizes was examined using the I^2 estimates. Meta-analysis was performed with the 'metan' package of Stata, version 13.1, software (StataCorp LP, College Station, Texas).

3. Results

3.1. Characteristics (Table 1)

The total analytical sample in the current study comprised 72,949 participants (age range 15–104, mean age 49.7 years, 54% women). A total of 46,160 participants were included in the longitudinal analysis where the mean follow-up time was 5.5 years. Across studies, between 13% and 76% of the participants reported never using alcohol at the study baseline. The proportion of heavy alcohol consumption ranged between 1% and 7% at baseline, and 1% and 6% at follow-up.

3.2. Cross-sectional and longitudinal associations between personality and alcohol use (Fig. 1)

Compared to moderate consumption, heavy alcohol consumption was associated with higher extraversion (OR 1.14; 1.09–1.20) and neuroticism (OR 1.20; 95% CI 1.06–1.37) and lower agreeableness (OR 0.85; 95% CI 0.82–0.89) and conscientiousness (OR 0.89; 95% CI 0.83–0.96). Abstinence was associated with lower extraversion (OR 0.86; 95% CI 0.81–0.92) and openness to experience (OR 0.88; 95% CI 0.84–0.93) and higher agreeableness (OR 1.08; 95% CI 1.02–1.15). There was significant heterogeneity across studies in the associations between neuroticism, conscientiousness, and heavy drinking (I^2 = 81%; I^2 = 53%; respectively). Study-specific cross-sectional associations are shown in Supplementary Figs. 1 and 2.

In longitudinal analysis, higher extraversion (OR 1.14; 95% CI 1.01–1.29) and openness to experience (OR 1.07; 95% CI 1.00–1.13) was related to higher likelihood of transition from moderate to heavy consumption. Lower extraversion (OR 0.86; 95% CI 0.81–0.92), higher neuroticism (OR 1.07; 95% 1.00–1.13), higher agreeableness (OR 1.09; 95% CI 1.02–1.15), and lower conscientiousness (OR 0.89; 95% CI 0.79–1.00) were associated with higher likelihood of transition from moderate consumption to abstinence.

Table 1
Descriptive characteristics of the eight cohort studies.

	Add Health	GSOEP	HILDA	HRS	MIDUS	NCDS	WLSG	WLSS
Country	US	Germany	Australia	US	US	UK	US	US
Number of participants								
Baseline	4949	18,155	11,016	13,871	6186	8697	6658	3417
Longitudinal	–	12,542	8412	12,579	4273	–	5692	2662
Age	29.0 (1.8)	47.4 (17.3)	43.8 (17.9)	67.3 (10.4)	46.8 (12.9)	50.3 (0.5)	54.1 (0.5)	53.2 (7.4)
Sex								
Men	45.7 (2260)	47.7 (8653)	46.8 (5153)	40.8 (5653)	47.6 (2946)	48.2 (4196)	46.1 (3070)	46.9 (1603)
Women	54.3 (2689)	52.3 (9502)	53.2 (5863)	59.2 (8218)	52.4 (3240)	51.8 (4501)	53.9 (3588)	53.1 (1814)
Education								
Primary	33.4 (1651)	16.3 (2800)	34.6 (3808)	18.6 (2571)	8.6 (528)	18.5 (1606)	–	5.2 (176)
Secondary	53.6 (2651)	61.2 (10,525)	44.4 (4886)	55.3 (7656)	59.3 (3662)	61.5 (5345)	72.1 (4799)	64.2 (2194)
Tertiary	13.1 (647)	22.5 (3878)	21.1 (2322)	26.2 (3629)	32.1 (1983)	20.1 (1745)	27.9 (1859)	30.6 (1047)
Nationality/ethnicity								
Majority	72.1 (3568)	93.0 (16,881)	79.2 (8730)	78.0 (10,821)	89.0 (5508)	98.0 (8521)	100.0 (6658)	100.0 (3417)
Minority	27.9 (1381)	7.0 (1274)	20.8 (2286)	22.0 (3050)	11.0 (678)	2.0 (176)	–	–
Marital status								
Married/cohabiting	41.6 (2057)	60.0 (10,902)	59.4 (6541)	64.0 (8872)	67.7 (4187)	69.8 (6072)	83.1 (5532)	80.6 (2754)
Single	58.4 (2892)	40.0 (7253)	40.6 (4475)	36.0 (4996)	32.3 (1996)	30.2 (2625)	16.9 (1125)	19.4 (663)
Follow-up time (months)	–	48.1 (1.6)	48.0 (1.3)	35.3 (16.0)	107.5 (6.3)	–	134.0 (4.2)	136.2 (6.3)
Baseline alcohol use								
Abstinence	41.0 (2028)	13.5 (2442)	39.8 (4385)	66.6 (9235)	75.9 (4697)	17.5 (1519)	45.2 (3011)	43.9 (1500)
Moderate	56.2 (2781)	80.0 (14,530)	54.5 (6006)	31.7 (4401)	21.8 (1349)	75.1 (6532)	54.0 (3596)	55.1 (1882)
Heavy	2.8 (140)	6.5 (1183)	5.7 (625)	1.7 (235)	2.3 (140)	7.4 (646)	0.8 (51)	1.0 (35)
Follow-up alcohol use								
Abstinence	–	14.2 (1781)	37.7 (3407)	65.9 (8285)	45.6 (1947)	–	29.8 (1698)	28.4 (757)
Moderate	–	79.5 (9996)	56.7 (5124)	32.7 (4116)	52.7 (2252)	–	68.8 (3914)	70.7 (1883)
Heavy	–	6.3 (791)	5.7 (512)	1.4 (178)	1.7 (74)	–	1.4 (80)	0.8 (22)

Note: Values are means (and standard deviations) or percentages (and number of participants). Because of missing data in covariates, numbers of covariate frequencies may not add up to the total number of participants with personality and baseline smoking data.
Add Health, National Longitudinal Study of Adolescent Health; BHPS, British Household Panel Survey; GSOEP, German Socio-Economic Panel Study; HILDA, Household, Income and Labour Dynamics in Australia; HRS, Health and Retirement Study; MIDUS, Midlife in the United States; NCDS, National Child Development Study; WLSG, Wisconsin Longitudinal Study Graduate Sample; WLSS, Wisconsin Longitudinal Study Sibling Sample.

Heterogeneity across studies was not statistically significant for associations between personality and increase or decrease of alcohol use. Study-specific longitudinal associations are shown in Supplement Figs. 3 and 4.

Fig. 1 shows that the strength of the associations between personality and alcohol consumption did not differ between cross-sectional and longitudinal analyses. However, only extraversion was consistently associated with alcohol consumption in cross-sectional and longitudinal analyses, whereas higher agreeableness and lower openness to experience were consistently associated with abstinence and transition from moderate alcohol consumption from abstinence. In addition, lower conscientiousness was associated with heavy drinking and transition from moderate to heavy consumption.

3.3. Sub-group analyses

Planned sub-group analyses between personality traits and alcohol consumption at the baseline are presented in Supplementary Tables 1 and 2. The cross-sectional association between low conscientiousness and heavy alcohol use was observed only among participants who were married (OR 0.82; 95% 0.72–0.92) but this difference was not observed in longitudinal analysis. Age, sex, education, marital status, and race/ethnicity were not sources of heterogeneity in the cross-sectional or in the longitudinal (Supplementary Tables 3 and 4) sub-group analyses.

4. Discussion

The main finding of this individual-participant meta-analysis of over 70,000 participants from eight cohort studies was that higher extraversion and lower conscientiousness were associated with increased risk of transitioning from moderate to heavy alcohol consumption over time, whereas higher neuroticism and lower agreeableness were associated with heavy alcohol consumption only in cross-sectional analysis. Alcohol abstinence was associated with lower extraversion, higher neuroticism, higher agreeableness, and lower openness. Except for neuroticism, these associations were replicated in longitudinal analysis of transitioning from moderate consumption to abstinence.

Current study is the largest meta-analysis of multiple personality traits and alcohol consumption and the results from the current study are in agreement with some but not all of the findings in previous studies. As in our meta-analysis, low conscientiousness, low agreeableness, and high neuroticism have been previously associated with higher alcohol consumption (Malouff et al., 2007). In clinical populations, higher neuroticism and lower conscientiousness have been associated with alcohol related substance disorders (Kotov et al., 2010). Whereas our findings and some previous individual studies have found an association between higher extraversion and alcohol consumption (Turiano et al., 2012; Cheng and Furnham, 2013), this association has not been confirmed in previous smaller-scale meta-analyses (Malouff et al., 2007; Kotov et al., 2010). In previous single studies, high extraversion, high neuroticism, and low agreeableness having been found to predict increase in alcohol consumption (Turiano et al., 2012; Hicks et al., 2012). However, our study indicates that high neuroticism may not be a risk factor for future risky alcohol use.

We also found that personality traits were associated with abstinence from alcohol at baseline and in the longitudinal analysis, a transition from moderate alcohol consumption to abstinence. To our knowledge, this is the first large-scale study where the role of personality in abstinence from alcohol has been examined. Individuals who do not drink alcohol are a mixed group of people including lifetime abstainers and individuals who do not drink alcohol due to ill health or previous alcohol related problems. Non-drinking and heavy drinking have been associated with sickness absence (Vahtera et al., 2002) and mortality (Ronksley et al., 2011).

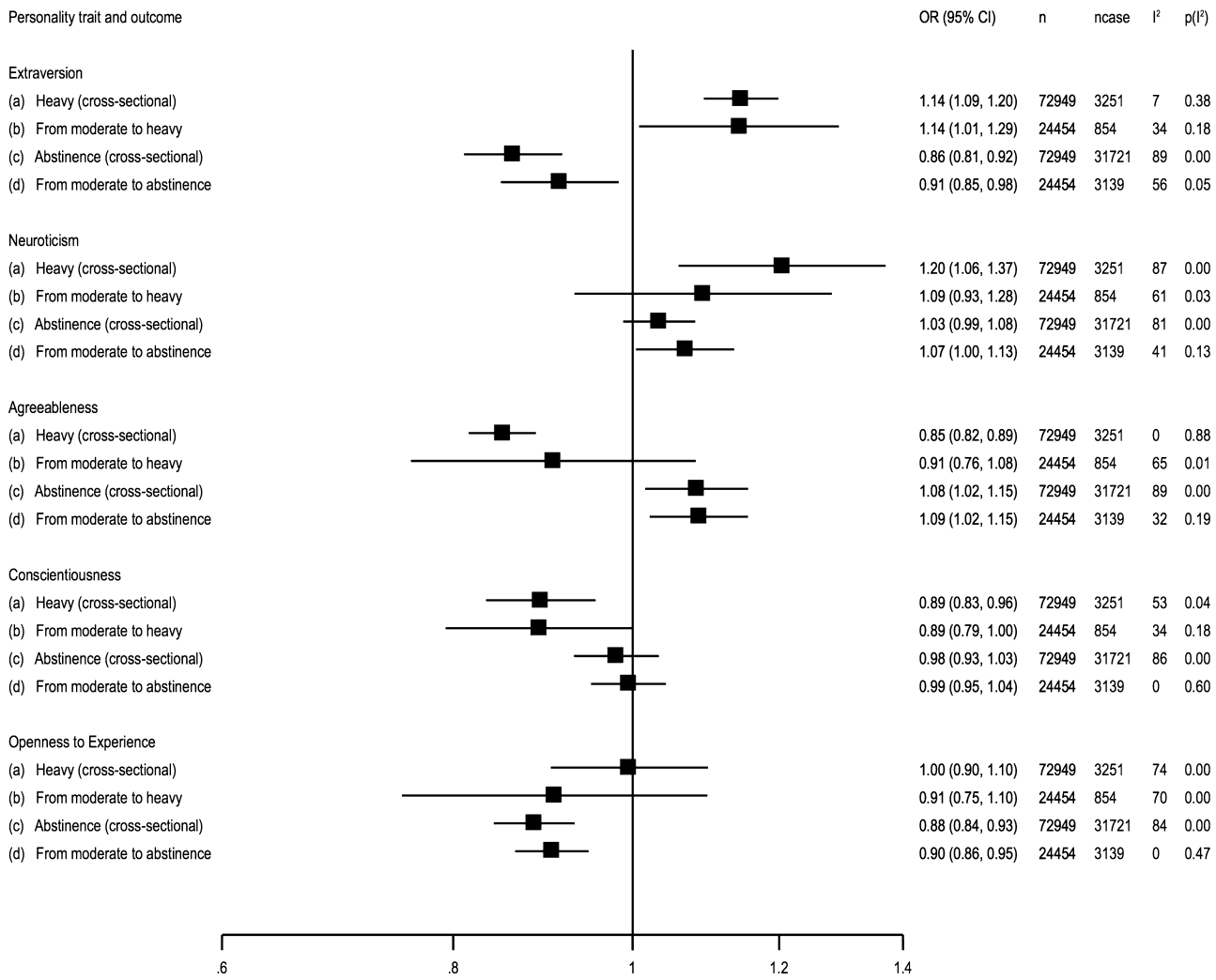

Fig. 1. Associations between the Five-Factor Model personality traits and (a) heavy alcohol consumption in baseline, (b) transition from moderate to heavy alcohol consumption, (c) abstinence in baseline, and (d) transition from moderate alcohol consumption to abstinence. Values are odds ratios per 1 standard deviation increment in personality trait. I^2 indicates the degree of heterogeneity in effect size across studies, and $p(I^2)$ gives the statistical significance for the heterogeneity. See Supplementary Figs. 1–4 for study-specific results.

In addition, a recent large-scale study ($n = 140{,}000$) showed that non-drinkers and heavy drinkers were more likely to report work-related stress when compared to moderate drinkers (Heikkilä et al., 2012). In future studies on personality and alcohol use, it is important to differentiate non-drinkers from moderate drinkers.

The mechanisms underlying the association between personality an alcohol use are not known. High extraversion is related to sensation seeking and sociability, which might explain the consistent association between extraversion and alcohol consumption. Especially among young adults and students, drinking is also a social activity (Wicki et al., 2010), and thus, it is possible that individuals with higher extraversion might consume more alcohol because they have more social interaction with other people. However, it is noteworthy that in this study the association between extraversion and alcohol use was similar among the younger and older participants.

Previous studies suggest that conscientiousness, which reflects self-control and capacity for long-term planning, might be the most important health-related personality trait (Bogg and Roberts, 2004). Low conscientiousness has been associated for example with obesity (Jokela et al., 2013a), diabetes (Jokela et al., 2014a), cardiovascular disease and stroke (Jokela et al., 2014b), and all-cause mortality (Jokela et al., 2013b). Current results confirming that low conscientiousness was also related to risky alcohol use at baseline and predicted onset of risky use at follow-up suggest that alcohol consumption might be one of the pathways between personality trait conscientiousness and health.

Cross-sectional subgroup analyses suggested that marital status might modify the association between low conscientiousness and heavy alcohol consumption. This difference was, however, not found in the longitudinal analysis. Other study covariates, i.e., age, sex, education, and race/ethnicity, did not further explain the heterogeneity that was observed in the cross-sectional findings. It is likely there are many socio-cultural and biological factors – which were not able to measure in the current study – that could explain heterogeneity across studies. Thus, further research is needed to identify these factors.

There are some effective ways to reduce alcohol consumption such as behavior counseling (Jonas et al., 2012), brief interventions (Moyer et al., 2002), and E-self-help interventions (Riper et al., 2011). It has also been shown that interventions targeted at individuals who display high amount of behavioral, emotional, and cognitive dispositions related to neuroticism are effective at least in adolescents in preventing and reducing problematic drinking (Conrod et al., 2011). The extent to which it could be useful to design such intervention programs also to adults is unclear. The present

findings suggest that it could be important to investigate whether current interventions programs would benefit from inclusion of personality.

4.1. Strengths and limitations

To the best of our knowledge, the current study is the largest meta-analysis to date of multiple personality traits and alcohol consumption. The examination of longitudinal associations between personality and changes in alcohol consumption is rare. As raw data were available at the level of the individual and not the study, publication bias was minimized. Limitation of the current study is that alcohol consumption was self-reported, and it is not known whether personality traits affect the accuracy and truthfulness of alcohol self-reports.

4.2. Conclusions

This individual-participant meta-analysis of over 72,949 individuals from the USA, UK, Germany, and Australia showed extraversion and low conscientiousness to be consistently associated with increased probability of risky alcohol consumption, whereas high agreeableness and low openness to experience were related to abstinence and decrease in alcohol consumption.

Role of the funding source

Nothing declared.

Contributors

C.H. analyzed the data and wrote a first draft of the manuscript. All authors contributed to the design of the study, interpretation of the data, and editing the manuscript.

Conflict of interest

No conflict declared.

Acknowledgements

M.E. is supported by the Academy of Finland (265977). G.D.B. is a member of the Alzheimer Scotland Dementia Research Centre funded by Alzheimer Scotland, and the University of Edinburgh Centre for Cognitive Ageing and Cognitive Epidemiology, part of the cross council Lifelong Health and Wellbeing Initiative (G0700704/84698). Funding from the BBSRC, EPSRC, ESRC, and MRC is gratefully acknowledged. M.V. is supported by the Academy of Finland (258598, 265174). M.K. is supported by the UK Medical Research Council (K013351), the Economic and Social Research Council, the Academy of Finland, and the US National Institutes of Health (R01HL036310, R01AG034454).

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.drugalcdep.2015.03.008.

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