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A new era for drinking? Epidemiological evidence on adolescent male-female differences in drinking incidence in the United States and Europe

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Abstract

Purpose—We seek answers to three questions about adolescent risk of starting to drink alcoholic beverages: (1) In new United States (US) data, can we reproduce a recently discovered *female excess* risk? (2) Has a female *excess* risk emerged in European countries? and (3) Might the size of country-level female-male differences (FMD) be influenced by macro-level gender equality and development processes?

Methods—Estimates are from US and European surveys of adolescents, 2010–2014. For US estimates, newly incident drinking refers to consuming the first full drink during the 12-month interval just prior to assessment. For all countries, lifetime cumulative incidence of drinking refers to any drinking before assessment of the sampled 15-to-16-year-olds.

Results—Cumulative meta-analysis summary estimates from the US show a highly reproducible female excess in newly incident drinking among 12-to-17-year-olds (final estimated female-male difference in risk, FMD = 2.1%; 95% confidence interval = 1.5%, 2.7%). Several European countries show female excess risk, estimated as lifetime cumulative incidence of drinking onsets before age 17 years. At the country level, the observed magnitude of FMD in risk is positively associated with the Gender Development Index (especially facets related to education and life expectancy of females relative to males), and with residence in a higher income European country.

Conclusions—New FMD estimates support reproducibility of a female excess risk in the US. In Europe, evidence of a female excess is modest. Educational attainment, life expectancies, and income merit attention in future FMD research on suspected macro-level processes that influence drinking onsets.

Keywords

Alcohol drinking; Male-female differences; Adolescents; United States; Europe

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1. Introduction

Studied epidemiologically across countries and cultures, drinking of alcoholic beverages tends to be male-oriented, with a generally consistent male excess in frequency and occurrence estimates across a broad age span [1–6]. Nonetheless, recent evidence on the *prevalence* of drinking suggests a narrowing of this '*gender gap*' in the United States (US) and in some other countries [1,2,4,7,8]. Moreover, new evidence has emerged for null differences and a possible reversal of the traditional male excess in drinking *prevalence* [9,10]. For example, across 36 European countries that participated in the 2011 European School Survey Project on Alcohol and Drugs (ESPAD), *prevalence* estimates for recently active drinking now show a robust *female excess* in five countries (as in 'departure from the null'), male-female parity in 22 countries, and a robust male excess in nine countries [10]. Corresponding US Monitoring the Future study estimates disclose a slight female excess prevalence in 8th graders, parity in 10th graders, and a male excess in the final secondary school year [9].

Attempting to account for the observed narrowing of a traditional 'gender gap' and possible *female excess*, scholars often have cited changing social norms as a major contributor, and note how traditional macro-level gender inequalities or increasing equalities might be at play [1,2]. Other determinants have been suggested, but these influences generally have been used to explain persistence of drinking after it has started, rather than risk of starting to drink [11,12].

In epidemiology, critiques of theoretical explanations of this type rely on robust empirical evidence gathered with attention to the field's basic guiding principles. Without declaring allegiance to one or another existing theoretical explanation for the observed dynamic changes in these female-male variations, we draw attention to some basic epidemiological principles that may deserve greater attention. Here we note that most of the published evidence shows male-female difference in the prevalence of *being* a drinker. Very few studies have estimated the *incidence rates or risk of becoming a drinker*, notwithstanding the fundamental epidemiological principle that prevalence of a condition will vary as the product of incidence rates for becoming affected and the persistence of the condition once it starts. In consequence, when the goal is causal inference about processes that lead toward males and females becoming newly incident drinkers, the existing empirical evidence on prevalence estimates falls short. It does not disclose whether the observed prevalence trends are due to male-female differences in drinking incidence rates, or are due to differences in duration of drinking, or both [13,14].

Applying this epidemiological principle, in an earlier inquiry based on US survey data, Johnson and Gerstein analyzed retrospectively ascertained age of onset data, and documented a rapidly decreasing male excess in the lifetime cumulative incidence of drinking by age 21 in the US (i.e., the 'lifetime' cumulative incidence proportion among survivors, CIPAS, sometimes erroneously called 'lifetime prevalence', as explained by Streiner et al.)[15,3]. A narrowing of the 'gender gap' also can be seen in World Mental Health Survey Consortium (WMHS) estimates for a large majority of WMHS countries. When comparing re-constructed age-specific drinking incidence rates for older versus the most recent birth cohorts of adult WMHS participants, in 14 of 17 countries it is possible to see much smaller male excess in the most recently born birth cohorts, as compared to older birth cohorts [16]. Nonetheless, given that many drinking onsets occur during adolescence, when re-constructed drinking incidence rates are based on interviews with adult survey participants, there is a heavy reliance on retrospective recall of drinking onset, especially in older cohorts. The possibility of differential recall across cohorts becomes prominent, as do other sources of survey errors [17–19].

In a departure from all of the prior studies on this topic, Seedall and Anthony focused on newly incident drinking among 12-to-17-year-olds and found a statistically robust 2.1% *female excess* in occurrence of newly incident drinking in the US [20]. A more recent US study provided additional substantiation of this female excess in the risk of becoming an underage drinker across adolescent years [21].

Nevertheless, as a final note of this introduction, we draw attention to recent concerns about reproducibility of findings, one of the most important but often neglected criteria when assessing scientific validity of evidence [22]. For this reason, we searched for opportunities to investigate reproducibility of the recently-reported female excess in risk of starting to drink alcoholic beverages during adolescence in the US [23].

Against this background, we designed the present inquiry to answer two primary research questions about female-male differences (FMD) in the risk of drinking onset, and to initiate an ecological exploration of what others have suggested as macro-level influences that might account for observed female-male variations. The two primary questions are: (1) “In new US data on risk of starting to drink during adolescence, can we reproduce the recently discovered *female excess* risk?” (2) “Is there evidence of a female *excess* risk in European countries?” The question that motivates a more exploratory ecological investigation is “Might the size of country-level FMD be influenced by macro-level gender equality and development processes?” In this work, we seek to address two major challenges for global research on use of alcohol and other drugs by young people: 1) a differentiation of causal relationships versus poorly specified associations, and 2) absence of evidence from low- and middle-income countries (LAMIC) [24]. Our tight focus on drinking incidence estimates and the inclusion of LAMIC countries represent steps intended to start addressing both of these issues.

2. Methods

2.1 Study design and samples

The study design is that of cross-sectional survey research on nationally representative samples of 12-to-17-year-old adolescents living in the US, as well as school-attending 15-to-16-year-old adolescents living in Europe. The study population for the US National Surveys on Drug Use and Health (NSDUH) consists of all non-institutionalized civilian residents aged 12-years-and-older, with re-sampling each year and standardized in-person assessments after IRB-approved parent consent and child assent processes. For this inquiry, NSDUH data are from 2010–2014, representing five additional independent surveys after the original Seedall-Anthony discovery of the US female excess in evidence from eight surveys conducted during 2002–2009 [25,26]. Each year's NSDUH sample of 12-to-17-year-olds is drawn irrespective of school attendance, and its sampling frame includes non-household group quarters such as homeless shelters. NSDUH participation levels range from 72%–76%, with a yield of more than 17,000 12-to-17-year-old interviewees each year. More details about NSDUH are shown in online monographs and many published articles [27,26,25].

For European estimates, we turned to published reports from the 2011 European School Survey Project on Alcohol and Drugs (ESPAD), with 28 high-income countries (HIC) and eight LAMIC, after exclusion of Albania and Moldova due to ESPAD-stated concerns about participation levels and inconsistent responding in those two countries [10]. Each country's ESPAD study population was defined in terms of its 1995 birth cohort, with a focus on 15-to-16-year-old adolescents attending school. A stratified sampling approach was used to draw samples of students in all countries (country specific n= 366 to 8202), with nationally representative samples in 32 of the 36 participating countries. In Germany, Belgium, Russia, and Bosnia-Herzegovina, the samples were limited to specific sites. The just-cited ESPAD report indicates that most students in sampled schools participated [10]. More details about ESPAD are provided in that report and in published articles [10,28–30].

In the US, the closest approximation to the 2011 ESPAD is the 2011 Monitoring the Future (MTF) study, from which the ESPAD questionnaire originated. The approximation is made possible because the MTF study population includes 10^{th} graders in a nationally representative sample of secondary schools. As compared with the ESPAD mean age of 15.8 years, the mean age of MTF 10^{th}-graders is 16.2 years (n = 7368 boys and 7588 girls). More details about MTF methods are available on the MTF website and in published reports (http://www.monitoringthefuture.org/) [31].

2.2 Assessments and Measured Variables

In NSDUH, private assessments are made via audio computer-assisted self-interviews (ACASI) with standardized multi-item modules on health and drugs, including alcohol. Items in the alcohol module assessed month, year, and age of the first full drink. Sex and student status are self-reported as male or female and as whether the adolescent is still in school, respectively. Age is from the birthdate.

ESPAD assessments are made via self-administered questionnaires, with an item to discriminate males and females, and with one item on alcohol drinking history: "On how many occasions (if any) have you had any alcoholic beverage to drink in your lifetime?" Non-zero responses designate the ever drinkers [10].

MTF assessment of drinking, also via self-administered questionnaire, is from this question: "Have you ever had any alcoholic beverage to drink--more than just a few sips?" A 'yes' answer designates ever drinkers. Self-report also designates sex as male or female.

This study's country-level indices and sex-specific indicators for gender equality and gender development are from the United Nation Human Development Reports (http://hdr.undp.org/en/2015-report, last accessed January 14, 2016). Two composite indices are the

Gender Inequality Index (GII) and Gender Development Index (GDI). GII incorporates five indicators: maternal mortality ratio, adolescent birth rate, share of parliamentary seats held by women, share of population with at least some secondary education, and participation in the labor force. GDI incorporates four indicators: mean years of schooling, mean expected years of schooling, mean life expectancy, and gross national income per capita (in $1000). GDI values are not available for either the Faroe Islands or Monaco. For Bosnia and Herzegovina, 'expected years of schooling' and GDI are not provided. For Liechtenstein, the UN report provides only 'mean expected years of schooling' and 'proportion of parliamentary seats held by women'.

2.3 Analysis approach

Analysis weights to address variation in sampling probabilities and post-stratification adjustment factors are applied in NSDUH and MTF analyses. In 11 ESPAD countries, analysis weights were used to bring samples into balance with the source populations, often to address non-proportionate stratification at the school level. Analysis weights were considered unnecessary for the remaining 25 ESPAD countries as a result of the representative sampling scheme and high participation levels [10].

NSDUH estimates used the same analysis-weighted approach that previously was used in the original Seedall & Anthony study. As estimated here, the incidence of drinking was conceptualized in terms of an analysis-weighted numerator consisting of newly incident drinkers arising from an analysis-weighted denominator that consists of newly incident drinkers plus individuals who had never had a full drink prior to the assessment date. By "analysis-weighted", we simply refer to weights based on standard sampling probabilities and post-stratification adjustment factors used in conventional analyses of data from surveys of this type [27,20]. The FMD estimates are from a general linear model with sex as the sole covariate. Standard errors and 95% confidence intervals (CI) are from the 'delta' method (Taylor series linearization).

The starting point for this study's novel cumulative meta-analysis approach was the NSDUH FMD estimate from the 2002–2009 Seedall & Anthony study. Then, the five FMD new estimates from 2010–2014 were assembled as estimates from five independent studies with non-overlapping samples [20,32]. Finally, the 2002–2009 FMD estimate and the five new estimates from 2010 to 2014 were summarized using the 'metacum' command for a 'cumulative meta-analysis'. The Stata 'metacum' approach used here discloses variability as each independent replication FMD estimate is added to the set, and produces an overall summary estimate via 'fixed effects' modeling because we found no appreciable heterogeneity in the estimates (chi-squared heterogeneity test=3.23; p=0.664; I^2<0.1%) [32–34].

It was not necessary to produce new point estimates from the ESPAD data because the required analyses for CIPAS of alcohol drinking already have been estimated and published in ESPAD reports. As such, we extracted country-specific lifetime cumulative incidence proportions for drinking, as well as numbers of boys and girls in ESPAD samples from the 36 participating countries [10]. Details provided on the ESPAD website and reports do not include variances, standard errors, or confidence intervals. Nonetheless, country-specific sample sizes for males and females made it possible to produce approximations for the confidence intervals (http://www.espad.org/) [10].

Each country's ESPAD MFD point estimate (p_d) was calculated by subtracting that country's male estimate from its female estimate (i.e., p_f-p_m). Variance was calculated using the standard formula, σ^2_d=[p_f (1–p_f)/n_f]+[p_m(1–p_m)/n_m], where p denotes the CIPAS, and n denotes the sample size with subscript $_f$ and $_m$ to denote female and male. An absolute value of the Z-score (p_d/$s.e._d$) greater than 1.96 denotes rejection of the null FMD at a 0.05 alpha level (i.e., a 'robust' difference).

Whereas no survey design effect estimates are presented in the ESPAD reports, we decided we should try to address the possibility of design or 'clustering' effects created by sampling schools and then multiple students within each sampled school. Because this departure from simple random sampling (SRS) generally means the SRS formulae for variance lead to spurious deflation of variance estimates, we turned to a series of specifications that inflate these variance calculations. Simulated inflation factors of 1.1, 1.2, and 1.3 create variances that are 10%, 20%, and 30% larger than an initial variance as calculated for surveys with simple random sampling (SRS). [Standard SRS variance formulae yield variance estimates that vary as a function of the point estimate (e.g., a proportion) and sample size, but do make design adjustments for interdependencies among survey respondents such that students within any sampled school or classroom units are more similar than students drawn at random from different units (e.g., due to peers in a school sharing alcohol with one another). Because published ESPAD reports state actual sample sizes without design-adjusted effective sample sizes, we modeled variance scenarios across this range of three plausible inflation factors]. The three factors simulate design adjustments for ESPAD variances by essentially down-weighting the actual sample size to produce effective sample sizes of 90%, 83%, and 77% of the actual number of participants as stated in the ESPAD reports (=1/1.1, 1/1.2, and 1/1.3). Similarly, 1.5 implies larger design effects where the effective sample size is only 67% of the actual number of ESPAD participants (= 1/1.5).

In order to make a direct comparison of US estimates with the ESPAD estimates, we applied the just-described approach to the MTF 2011 data for 10th graders and also to the 2011 NSDUH data on 15-to-16-year-old community residents still in school. We also used the NSDUH 2011 data to generate estimates with and without design effects in order to provide some empirical evidence concerning our assumptions about inflation factors.

We also explored estimates pertinent to theories about FMD in drinking, and sought to address the degree to which the size of country-level FMD in alcohol incidence might be influenced by macro-level gender equality and development processes. For this exploratory analysis, scatterplots can be used to show the relationship between FMD of the country-level gender-related indications and FMD in alcohol incidence. Next, a meta-regression approach was used to estimate the associations between each of the indicators and FMD in alcohol incidence. Similar to meta-analysis, there are two versions of meta-regression. The fixed-effects meta-regression is given by = β_0+$\beta_1 x_{1j}$+ η_j, where $\sigma^2_{\eta_j}$ is the variance of the FMD alcohol incidence estimate of country j. The random-effects version has an additional error term to allow between-study variation (i.e, y = β_0+$\beta_1 x_{1j}$+ η_j+ ε_j). Compared to linear regression, meta-regression has two advantages. First, meta-regression explicitly accounts for the sample size (and precision of estimates). That is, more precise estimates are given greater weights in the analysis. Second, the random-effects meta-regression allows residual heterogeneity not accounted for by the covariates in the model [35,36]. The coefficient of the estimate describes the increase in FMD in alcohol incidence associated with one unit increase in the covariate. Stata software was used for this work (Stata Corp, 2015) [37].

Results

Main results for the US are presented in Figure 1. Estimates indicate high reproducibility of an approximately 2% female excess in newly incident drinking among 12–17 year olds in the US (FMD = 2.1%; 95% CI=1.5%, 2.7%). No appreciable change is observed in the cumulative meta-analysis summary estimate for FMD when each year's new estimate is added to the original 2002–9 estimate. (It is important to note that these estimates are not restricted to school-attending youths; they include adolescents who have dropped out of school.)

Table 1 shows sex-specific lifetime cumulative incidence drinking estimates for students 15 or 16 years of age as well as FMDs, based on our analyses of data from the ESPAD 2011 survey reports. Before consideration of sampling variances (i.e., with a focus on point estimates only), a total of 13 ESPAD countries show a slight female excess in the risk of starting to drink by mid-adolescence (1%–5%). The largest female excess is observed for Monaco at 5%. Under an assumption of no survey design effect on variances, there are seven countries with a statistically robust female excess. Ukraine is the only LAMIC in these seven countries. Design adjustments for the departure from SRS produced no appreciable difference in conclusions until the design effect was specified as 1.3. With that simulated circumstance, the number of countries with a statistically robust female excess drops to five (Latvia, Hungary, Russian Federation, Lithuania, Estonia). With design effect set at 1.5, only Latvia shows female excess risk.

Before consideration of sampling variances, 17 countries show a male excess (1%–10%). The largest male excess is seen for Montenegro at 10%. Under the assumption of no survey design effects, 11 countries show a male excess. Four of these countries are LAMIC (i.e., Bulgaria, Montenegro, Romania, and Serbia). The male excess remains robust in all 11 countries under all specified design effects in this study. The majority of countries show male-female parity. Supplementary Figure S2 shows a forest plot with an inflation factor of 1.3. A large heterogeneity is observed and the meta-analysis summary shows a slight male excess (estimated FMD=−1%, 95% CI= −2%, <0%).

When applying the same method to the US MTF data, no female-male difference in lifetime cumulative incidence is found among 10th graders (56% in girls and 55% in boys; FMD=1%; z-value=1.00 to 1.23 for an inflation factor of 1.5 to 1.0, data not shown in a table). Similarly, in our lifetime cumulative incidence estimates that restricted the US NSDUH samples to school-attending 15-to-16-year-olds, we observed no female-male difference (FMD=3% for both age groups; z-value=1.41 to 1.74 for an inflation factor of 1.5 to 1.0). Supplementary Table S1 presents the NSDUH FMD estimates as well as standard errors with and without applying the design effects (i.e., to address clustering within local areas sampled during NSDUH field work). As expected, there is a slight inflation in standard errors when design effects are simulated.

In our exploratory ecological analyses specified at the country level, FMD in drinking incidence is positively associated with the composite GDI, but not GII. In addition, FMD in drinking incidence is also associated with residing in a high-income country in Europe. When looking at specific indicators of GDI and GII, FMD in drinking incidence was associated with the two education-related indicators (i.e., FMD in proportions of secondary education and FMD in mean years of schooling) and FMD in mean life expectancies (a component of GDI; Table 2). For example, one year increase of FMD in years of schooling is associated with an estimated 3.04% increase of FMD in cumulative incidence of alcohol drinking at a country level (95% CI= 1.19%, 4.90%). Scatterplots may help readers visualize the relationship between FMD in cumulative alcohol incidence and gender equality indicators (see supplementary material). Adding the US estimate does not introduce any appreciable differences in these estimates.

Discussion

This study's US data support the earlier Seedall-Anthony discovery of a *female excess* in newly incident drinking among 12–17 year olds in the US. After adding five more survey years to the eight years studied previously, we find a *female excess* of approximately 2% in the risk of becoming an underage drinker among 12-to-17-year-old adolescents. In contrast, data from the ESPAD indicate that girls are now surpassing boys in the risk of starting to drink in no more than a handful of European countries, including a subset of former Soviet Union territories. Nevertheless, this new evidence on adolescent drinking onsets draws attention to three potentially important issues. First, it is possible that the FMD in drinking incidence cannot be seen clearly in lifetime cumulative incidence estimates, but is seen only when the study design permits age-specific incidence estimation as is true in the NSDUH context. Second, it is possible that the FMD are spuriously attenuated when epidemiological sampling of the adolescent population experience is restricted to 15-to-16-year-olds still in school at that age. Newly incident drinking of school dropouts and other non-attending adolescents is counted in the overall NSDUH estimates, but not in the MTF (or ESPAD) estimates and not in the NSDUH estimate focused on school-attending young people. Third, achievement of statistical power to detect a robust 2%–3% FMD as a departure from the null apparently requires sample sizes much larger than now are available in most ESPAD country-specific surveys.

Major strengths of this study include the use of most recent nationally representative data of the US and the inclusion of data from 34 European HICs and LAMIC. The focus on 12-to-17-year-olds and the relatively narrow recall period for the NSDUH analysis on newly incident drinking constrained memory problems and recall bias, among other strengths as discussed elsewhere [27,21]. This study also may be useful to readers in its application of the cumulative meta-analysis approach, which qualifies as a novel statistical approach when the goal is to combine new study estimates with previously published meta-analysis estimates, as often is required to address otherwise neglected issues of reproducibility. The country-level ecological analysis may stimulate thinking about macrosocial aspects of social and political environments influencing patterns of underage drinking incidence, and may encourage additional development of the line of research seen in the GENACIS cross-national research program on cultural variations on male and female drinking [2].

A major limitation in this study is the absence of information about classroom- or school-level clustering as might influence survey design effects in estimates of variances of the ESPAD estimates, as well as the lack of information about the age at which drinking started among ESPAD participants. Nonetheless, this limitation does not invalidate the FMD point estimates from ESPAD; it simply affects the width of confidence intervals. Based on prior experiences as well as our inspection of the NSDUH data, one might consider our simulated modeling of survey design effects as 1.1, 1.2, and 1.3 as practical and 1.5 as conservative. Another limitation involves the study of NSDUH versus ESPAD estimates; they cannot be compared directly. There are differences in sampling (e.g., with respect to school attendance, as already noted), assessment (ACASI vs. paper-and-pencil), and the phenomenon of interest (i.e., the first full drink vs. any drinking occasion). In addition, cross-country variations in the implementation of study protocol often occur, and sensitivity of the assessments can differ across ESPAD countries.

Generalization of the discovery of a female excess risk of adolescent drinking incidence to other countries clearly is premature. Any inference that gender development indices have causal importance with respect to drinking incidence also would be premature.

Notwithstanding limitations of this type, this study suggests a need for careful thinking about the traditional male excess in drinking prevalence, and should help launch a consideration of the possibility that adolescent females in some countries might have greater risk of starting to drink as compared to their male counterparts. Drinking onsets are thought to be shaped by many sources of variations, with interacting factors and processes, often studied at the individual level, but here considered in relation to macrosocial indicators of gender equality and development [38]. Numerous studies have looked into potential causes and mechanisms of the previously documented narrowing ‘gender gap’ [1,2,4]. A shifting social norm towards a more drink tolerating or promoting environment for females has been frequently hypothesized as a major contributor to this phenomenon [39,40]. Supporting evidence is seen from an international study that found smaller male excess in opportunities to drink in countries with greater gender equality [41]. According to our country-level analysis, among all gender inequality and development indicators studied here, GDI is a robust indicator for a general social environment that might be promoting, or might merely be correlated with, female underage drinking. Facets related to education and life expectancy are of special note. This type of facet of the larger social environment has been posited to interact with individual-level factors for promotion of risk-taking behaviors, including underage drinking in girls [42].

In future multi-national and cross-national research, it should be possible to extend sampling beyond school-attending youths at mid-adolescence, and to apply more sophisticated models to examine individual- and country-level variables simultaneously. Building from our findings, this line of research might incorporate country-level education-related indicators, life expectancy, and income levels as hypothesized exogenous determinants of FMD in individual-level risk of becoming an adolescent-onset drinker. Analyses of ESPAD data along these lines might produce a useful predictive model for the identification of subgroups of girls who are most vulnerable to any shifting social norm that are favorable to earlier onsets of female drinking.

In the background of essentially descriptive epidemiological research on the adolescent female excess in risk of becoming a newly incident drinker, there is a widespread appreciation that drinking during puberty is followed by numerous adverse consequences, especially for girls [38,39]. Our results suggest that the drinking onset pendulum has swung from a male excess to a female excess among adolescents in the United States and in a few European countries. Evidence of the type presented in this article can help motivate refinement of more effective prevention and intervention strategies directed toward the adverse outcomes of adolescent-onset drinking in females as well as in males. We hypothesize that primary and secondary prevention initiatives now focused on drinking by teen males might be usefully broadened to address female teens, with adaptation to local jurisdictions. A simple example involves fictional vignettes on display in current television public service announcements (PSA) developed and broadcasted with an intent to heighten awareness of dangers inherent in 'buzzed driving (while intoxicated)' versus PSAs intended to discourage 'SMS texting while driving' with US teens in mind. Our working hypothesis, based on recent experience, is that the buzzed driving PSAs disproportionately depict the 'buzzed' driver as male, whereas the SMS texting PSAs are more evenly balanced, with both female and male protagonists. If so, the evidence on teen drinking in the US, as well as in several of the ESPAD countries, is suggestive of a need to broaden these PSAs so that the male-female balance in the SMS texting PSAs also will be seen in the 'buzzed driving' PSAs. This example, focused on PSAs, represents one facet of primary prevention initiatives. A similar logic can be applied to the development of future initiatives for primary prevention of precocious drinking involvement, as well as secondary prevention programming, to the extent that male drinking otherwise might continue to be stressed in these initiatives.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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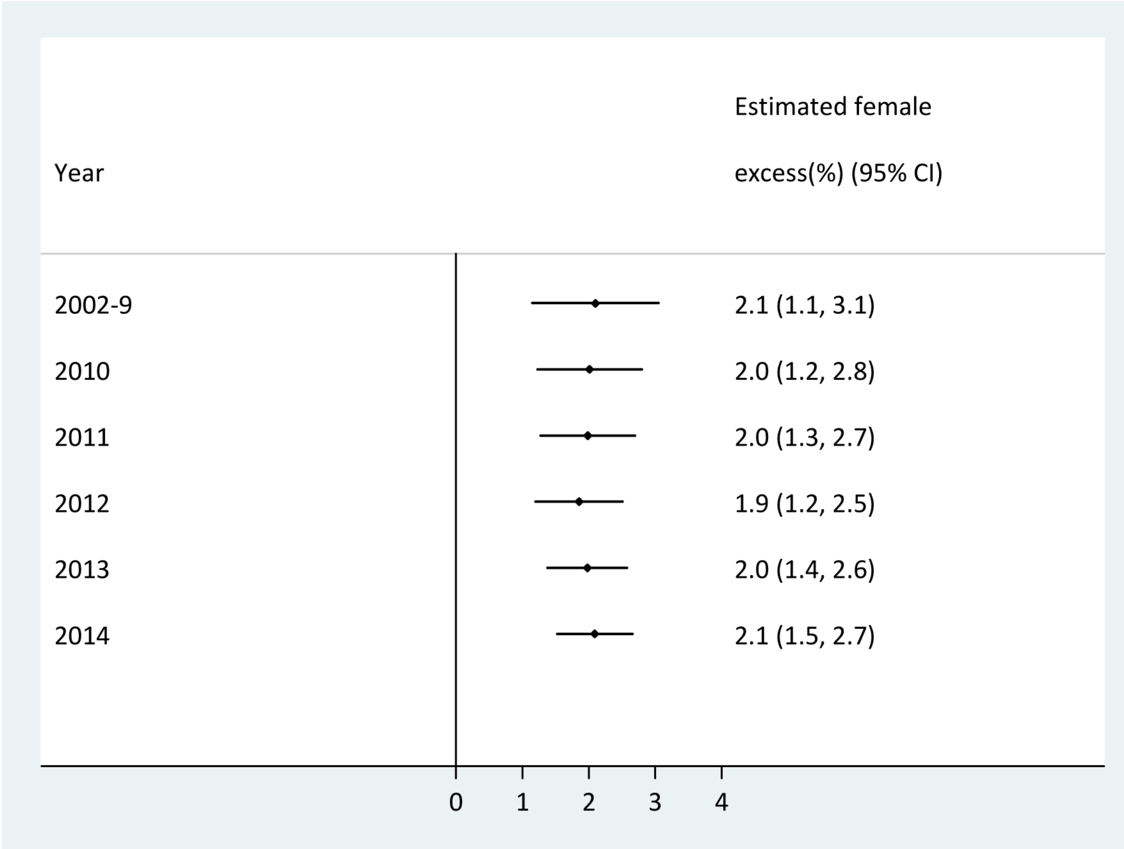

Figure 1. Estimated cumulative meta-analysis summary of female excess in starting to drink alcohol for 12-to-17-year-olds. Data from the United States National Surveys on Drug Use and Health (NSDUH, unweighted n=54,806 for 2010–2014) [1]

[1]The 2002–9 estimate is extracted from a previous publication [20]. In the cumulative meta-analysis approach, each row shows whether and how the summary estimate is altered by the addition of the new survey evidence. That is, every estimate is a meta-analysis summary estimate. The ‘2010’ estimate is the meta-analysis summary for 2002–2010; the ‘2011’ estimate is the meta-analysis summary for 2002–2011, and so on.

Table 1

Estimated sex-specific ‘lifetime’ cumulative incidence proportions (%) for alcohol drinking and the estimated female-male difference (%) among 15-to-16-year-old students living in 34 European countries that participated in the 2011 European School Survey Project on Alcohol and Other Drugs (ESPAD, unweighted n=97,692).[1]

	Estimated cumulative incidence proportions		Female-male difference			
			Estimated Female-Male Difference	Confidence intervals with different variance inflations (DEFF = 1.0, 1.3, 1.5)		
Country	**Female**	**Male**		**No inflation**	**Inflation=1.3**	**Inflation=1.5**
Belgium	89	88	1	−2, 4	−2, 4	−3, 5
Bosnia	85	91	**−6**	**−8, −4**	**−9, −3**	**−9, −3**
Bulgaria	85	89	**−4**	**−7, −1**	**−7, −1**	**−7, −1**
Croatia	93	94	−1	−3, 1	−3, 1	−3, 1
Cyprus	84	90	**−6**	**−8, −4**	**−8, −4**	**−8, −4**
Czech. Republic	98	98	0	−1, 1	−1, 1	−1, 1
Denmark	92	95	**−3**	**−5, −1**	**−5, −1**	**−6, <0**
Estonia	96	94	**2**	**>0, 4**	**>0, 4**	<0, 4
Faroe Islands	85	88	−3	−9, 3	−9, 3	−10, 4
Finland	84	83	1	−1, 3	−2, 4	−2, 4
France	90	91	−1	−3, 1	−4, 2	−4, 2
Germany	91	94	**−3**	**−5, −1**	**−5, −1**	**−5, −1**
Greece	92	93	−1	−2, >0	−3, 1	−3, 1
Hungary	95	93	**2**	**>0, 4**	**>0, 4**	<0, 4
Iceland	56	56	0	−3, 3	−4, 4	−4, 4
Ireland	81	80	1	−2, 4	−3, 5	−3, 5
Italy	84	90	**−6**	**−8, −4**	**−8, −4**	**−8, −4**
Latvia	97	95	**2**	**1, 3**	**>0, 4**	**>0, 4**
Liechtenstein	93	90	3	−3, 9	−3, 9	−4, 10
Lithuania	96	94	**2**	**>0, 4**	**>0, 4**	<0, 4
Malta	90	91	−1	−3, 1	−3, 1	−3, 1
Monaco	97	92	**5**	**1, 9**	<0, 10	<0, 10
Montenegro	72	82	**−10**	**−13, −7**	**−13, −7**	**−13, −7**

	Estimated cumulative incidence proportions		Female-male difference			
			Estimated Female-Male Difference	Confidence intervals with different variance inflations (DEFF = 1.0, 1.3, 1.5)		
Country	Female	Male		No inflation	Inflation=1.3	Inflation=1.5
Norway	70	69	1	−2, 4	−3, 5	−3, 5
Poland	86	89	**−3**	**−5, −1**	**−5, −1**	**−5, −1**
Portugal	67	76	**−9**	**−13, −5**	**−14, −4**	**−14, −4**
Romania	76	83	**−7**	**−10, −4**	**−10, −4**	**−11, −3**
Russia	86	82	**4**	**1, 7**	**>0, 8**	<0, 8
Serbia	85	89	**−4**	**−6, −2**	**−6, −2**	**−6, −2**
Slovakia	95	94	1	−1, 3	−1, 3	−1, 3
Slovenia	93	94	−1	−3, 1	−3, 1	−3, 1
Sweden	76	76	0	−3, 3	−4, 4	−4, 4
Ukraine	90	87	**3**	**>0, 6**	<0, 6	<0, 6
United Kingdom	90	90	0	−3, 3	−3, 3	−3, 3

[1] Bold font indicates $p < 0.05$ rejection of null FMD hypothesis. Negative point estimate means male excess, and positive point estimate means female excess. ‘No inflation’ represents a scenario where there truly is no design effect induced by the departure from Simple Random Sampling (SRS). An inflation factor of 1.3 denotes a more plausible assumption that the ESPAD survey approach produced a tangible design effect with the stated sample size actually being larger than the design-adjusted sample size. Similarly, 1.5 implies larger design effects with variances that are 1.5 times larger than the variance from the SRS approach.

Table 2

Estimated slope coefficients from the country-level meta regression for the relationship of female-male differences in drinking incidence and gender equality measures in 34 countries participating in the European School Survey Project on Alcohol and Other Drugs.[1]

	Estimate	95% CI
Gender Inequality Index	0.20	−17.33, 17.74
Maternal mortality ratio	0.04	−0.16,0.24
Adolescent birth rate	>−0.01	−0.16,0.15
Proportion of parliamentary seats held by women	>−0.01	−0.13,0.13
FMD proportion of secondary education[2]	**0.30**	**0.10,0.51**
FMD labor participation[2]	0.17	−0.11,0.44
Gender Development Index[3]	**7.24**	**2.29, 11.21**
FMD mean years of schooling[2]	**3.04**	**1.19,4.90**
FMD mean expected years of schooling[2]	0.30	−1.54,2.09
FMD mean life expectancies[2]	**0.66**	**0.14,1.19**
FMD GNI per capita (PPP) [2]	−0.09	−0.33,0.15
High income country (vs. low- and middle-income country)	**4.26**	**1.40, 7.12**

[1]Estimated female-male differences in drinking incidence are for lifetime cumulative incidence of drinking in 15-to-16-year-olds from ESPAD. All indices and indicators are missing for Faroe Islands and Monaco; all but ‘mean expected years of schooling’ and ‘proportion of parliamentary seats held by women’ are missing for Liechtenstein; ‘expected years of schooling’ and GDI is missing for Bosnia and Herzegovina.

[2]FMD, female-male difference

[3]Regression coefficients connote the increase in female excess in cumulative drinking incidence associated with one unit increase in the indicators at a country level. The range for Gender Development Index (GDI) is 0.60 to 1.03. In order to make the regression coefficient more substantively meaningful, we divided this index by 10. Therefore, the coefficient connotes the increase in female excess of drinking incidence (%) associated with 0.1 unit of increase in GDI.