Rutgers Alcohol Problem Index Scores at Age 18 Predict Alcohol Dependence Diagnoses Seven Years Later

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Abstract

Background—The Rutgers Alcohol Problem Index (RAPI) is widely used to assess adolescent drinking-related problems. We asked how well RAPI, administered in late adolescence, predicts alcohol diagnoses at age 25 in a 7-year follow-up.

Methods—At age 18, a population-based sample of Finnish twins completed RAPI by postal questionnaire; 597 (300 male) twins, from pairs discordant and concordant for age 18 RAPI scores, were interviewed at age 25 with the SSAGA, yielding DSM-IIIR diagnoses. Polychoric correlations between RAPI and alcohol diagnoses and symptoms, the area under the response operator characteristic (ROC) curve, and the odds ratio of outcome diagnosis per unit change in adolescent RAPI were analysed. Twin pairs discordant for both adolescent RAPI and adult diagnoses permitted within-family replications for the full sample and separately by sex.

Results—Nearly half the interviewed twins met diagnostic criteria for alcohol dependency (46.2%) or abuse (1.5%). Age 18 RAPI scores significantly correlated with diagnoses (0.52) and symptom counts (0.55). ROC analysis found a 74% probability that adolescent RAPI scores will be higher among those with an alcohol diagnosis at age 25 than for those without. The odds ratio of outcome alcohol diagnosis per unit increase in adolescent 18 RAPI exceeded 10.0. Within-family comparisons of 117 twin pairs discordant for both age 18 RAPI and age 25 alcohol diagnoses replicated the between-family associations. In both between-family and within-family analyses, RAPI was more predictive of alcohol diagnoses among females.

Conclusions—Our results offer evidence, including that from informative comparisons of co-twins discordant for both predictor and outcome, that RAPI scores in late adolescence robustly predict alcohol diagnoses in early adulthood. Accordingly, our results also provide new evidence that one pathway to problem drinking in early adulthood is a direct one from problem drinking in adolescence.

Keywords

Rutgers Alcohol Problems Index; Predicting Alcohol Diagnosis; Co-Twin Control Method

Introduction

The Rutgers Alcohol Problem Index (RAPI) is a self-report measure of alcohol-related problems in adolescence. It was developed from a nonclinical sample of 1308 adolescents

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(White & Labouvie, 1989); from an initial pool of 53 items, a unidimensional 23-item scale with good internal consistency (Cronbach's alpha = .92) was created. Correlations were substantial with current alcohol use (ranging from .20 – .57), but sufficiently low to suggest that RAPI provides information about problem drinking beyond that contained in direct reports of consumption patterns. Since its introduction two decades ago, the RAPI has become one of the most widely used assessment measures in the alcohol literature. Applications include studies of college student drinking and interventions (e.g., Levy & Earlywine, 2003; Neighbors, et al, 2004) and longitudinal and epidemiological studies from New Zealand to Norway, Russia, and Finland (e.g., Fergusson, et al 2002; Kopsov, et al, 2002; Pedersen & Skrondal, 1998; Viken, et al, 2007).

Despite its widespread use, absent from RAPI research literature is a test of the predictive association of RAPI scores with the subsequent development of clinical alcohol dependence diagnoses. Concurrent associations have been reported (Ginzler, et al, 2007), but to our knowledge, not longitudinal data to document the prospective association of RAPI with alcohol dependence diagnoses. Here, we report such data from a subsample of the *FinnTwin16-25* study, in which participants completed the RAPI at age 18 and in-person interviews assessing DSM alcohol dependence diagnoses at an average age of 25. An unusual strength of our study sample is that it consists of twin pairs, permitting us to test associations between RAPI and alcohol dependence symptoms and diagnoses *within* families, to confirm the standard between-family comparisons. Within-family analyses (co-twin control comparisons) provide a robust test of the association between variables, because they control for unmeasured between-family confounds (e.g., family structure and socio-economic status, parental drinking patterns and attitudes) that contribute to correlations observed in analyses of unrelated individuals (Dick, et al, 2000).

Although here framed as a predictive validity test of an adolescent questionnaire, results of our analyses bear on broader issues. That problem drinking in late adolescence robustly predicts DSM diagnosis of alcohol dependency in early adulthood, and confirmation of that predictive association in within-family comparisons of discordant co-twins, offers new evidence for a direct drinking pathway to problem drinking (Zucker, 2008), a direct causal pathway beyond the role of early drinking as a mediator of a pathway of externalizing behavior problems. And that evidence has practical implications for intervention, as well, directing specific attention to adolescents who exhibit high-density drinking and drinking-related problems.

Material and Methods

Sample

The interviewed twins were a subset of *FinnTwin16* (Rose, et al, 1999), a population-based study of all Finnish twin pairs in five consecutive twin birth cohorts (1975–79) with both members alive and resident in Finland at baseline. Twins were sequentially enrolled into the study (88% pair-wise participation rate) as they reached age 16, with follow-up at 17, 18 and 25. Selection of the interview sample began by identifying twin pairs *e*xtremely *d*iscordant *a*nd *c*oncordant for their RAPI scores at age 18. RAPI scores are moderately correlated in twins, and more so in MZ pairs, so the EDAC selection identified disproportionately more DZ than MZ (and more sister-sister than brother-brother) pairs with extreme discordance and more MZ than DZ pairs for extreme concordance. But the distribution of individual RAPI scores of interviewed twins overlaps the range of RAPI scores of the full epidemiological sample from which it was drawn, and it included 597 individuals with complete data for analysis (N=300 males and 297 females).

Measures

RAPI was included in third-wave questionnaires mailed to the full epidemiological cohort of twins at age 18. Because Finns complete mandatory education prior to that age, the RAPI item on whether alcohol use interfered with school work or exam preparation was omitted, creating a 22 item Finnish adaptation of RAPI with four response options (the highest response option from the original RAPI was omitted). To accommodate a small amount of missing data, we required completion of ≥18 of the 22 items to compute scale scores, with mean scores computed across all available items. And because RAPI scores show a strong positive skew (as do many measures of problem behavior), log-transformation of mean RAPI scores preceded computing correlations. In text containing descriptive information about RAPI scores to follow, raw RAPI scores or binary counts of RAPI consequences, where each of the 22 assessed consequences were coded as present (1) or absent (0), are presented, to facilitate interpretation of sample statistics.

Alcohol dependence diagnoses (both abuse and dependence) were assessed with DSMIII-R criteria using the Semi-Structured Assessment of the Genetics of Alcoholism (Bucholz et al., 1994). Face-to-face interviews were conducted by trained interview staff (cf. Rose et al, 2004) as part of a half-day research protocol. Mean age at interview was 25.64 (SD=1.33) years, which we refer to as age 25 throughout the manuscript.

Analyses

All analyses were conducted using SAS (Institute, 2001). Polychoric correlations were computed for associations between the log-transformed RAPI scores and alcohol dependence diagnoses and symptom counts. To measure the discriminatory power of RAPI to predict those who developed alcohol diagnoses, we report the c statistic, a measure of discrimination also known as the area under the receiver operating characteristic (ROC) curve (Cook, 2007). The ROC curve is a function of sensitivity (probability of a positive test result among those without a disorder) and specificity (probability of a negative test result among those without a disorder) for each value of the measure (here, RAPI scores at age 18). The ROC curve is a plot of sensitivity versus 1-specificity (false positive rate). The c statistic is equivalent to the probability that the measure is higher for a case than for a non-case. Finally, we report the odds ratios (ORs) with 95% confidence intervals (CIs) for the model. We used the SURVEYLOGISTIC procedure in SAS to take into account the dependent data structure of twins nested in families.

Results

An average of 6.72 negative alcohol-related consequences indexed by the RAPI (range 0–22) was reported at age 18. The mean log-transformed RAPI score at age 18 was 0.34, SD = 0.26 (range 0 – 1.17), with no difference in means among males and females. Of 600 individuals with age 25 interview data (597 with age 18 RAPI scores), 277 (46.2%) met criteria for alcohol dependence (155 males; 122 females) and 9 (1.5%) met criteria for alcohol abuse (5 males; 4 females). Alcohol abuse and dependence diagnoses were collapsed for all subsequent analyses and collectively referred to as alcohol diagnoses. Age 18 RAPI scores significantly correlated with alcohol diagnoses ($r = 0.52$, $p<0.0001$) and with alcohol dependence symptoms ($r = 0.55$, $p<0.0001$). In the ROC analysis for all individuals, including sex as a covariate, the area under the curve, c, = 0.74, indicating a 74% probability that an age 18 RAPI score will be higher for an individual with an alcohol diagnosis at age 25 than one without an alcohol diagnosis (Figure 1). The odds ratio for an alcohol diagnosis per unit increase in RAPI score was 10.29 (95% CI = 6.32 – 16.74). We conducted further analyses separately on males and females to test for potential sex differences in the predictive ability of the RAPI. The correlation between RAPI scores at age 18 and alcohol

diagnoses at 25 was higher for females (r = 0.62, p<0.0001) than for males (r = 0.41, p<0.0001). Similarly, the AUC was higher for females (*c*= 0.79; OR = 20.75, 95% CI = 11.4 – 37.6) than for males (*c* = 0.69; OR = 5.61, 95% CI = 3.1 – 10.0).

The interviewed sample included 273 twin pairs with dissimilar RAPI scores at age 18 (mean difference = 7.9, range 1 – 36). In 76 of those pairs, both co-twins had an alcohol diagnosis at age 25, and in 80 pairs, neither twin did. However, 117 of the RAPI-discordant pairs were also discordant for alcohol diagnoses and are informative for within-pair comparisons. In 86 of those 117 pairs (74%), the twin with the higher RAPI score at age 18 was the twin with an alcohol diagnosis at age 25. Finally, we conducted within-family analyses separately for males and females, limiting tests to same-sex twin pairs. Although numbers are small, results are in the expected direction for both sexes: the twin with the higher RAPI score at age 18 is more likely the alcohol dependent individual at age 25. That held for 29/44 (66%) of doubly-discordant pairs of brothers and 32/41 (78%) doubly-discordant pairs of sisters, so within-pair comparisons parallel the between-family analyses in finding stronger predictive ability of the RAPI among females.

Discussion

We examined how well RAPI scores at age 18 predict alcohol diagnoses, assessed by structured interview, seven years later. Indexed by several statistics, RAPI in late adolescence is significantly associated with alcohol diagnoses at age 25. Interestingly, and perhaps surprisingly, the relationship between RAPI and the subsequent development of alcohol diagnoses appears stronger in females than in males. That result may reflect the pairwise selection procedure employed, the fact that extreme RAPI-discordance at age 18 characterizes more sister-sister than brother-brother twin pairs, and the further fact that in our sample of discordant twin pairs informative for within-family analysis, the average intra-pair difference in RAPI scores was nearly twice as large among sisters than brothers. Importantly, however, predictive validity of RAPI was replicated in within-family comparisons of both RAPI-discordant twin brothers and sisters: among pairs doubly discordant for adolescent RAPI scores and adult alcohol-related outcomes, the co-twin with the higher RAPI score was significantly more often the twin that met diagnostic criteria. Strikingly, the percent of discordant twins pairs (74%) showing the predicted association in these within-family comparisons maps onto the *c* statistic for the full sample between-family analysis (*c* = 0.74, indicating a 74% probability that an age 18 RAPI score will be higher for an individual with an alcohol diagnosis at age 25, compared to an individual without an alcohol diagnosis). Within-family analyses mirror the sex difference observed in between-family analyses; in both, RAPI scores were more predictive of alcohol diagnoses among females. Clearly, our analyses converge to provide new evidence of the utility of the RAPI for indexing individuals at high risk for development of alcohol related problems.

We note that the RAPI scale used with our sample was slightly modified from the original scale, as detailed in the methods. Many modifications of RAPI exist in the literature, including dichotomous scoring of items as ever/never experienced (Larimer et al., 2001) and adaptation to substances other than alcohol (Ginzler et al., 2007). An application of item response theory analysis to RAPI scores suggested an 18 item version removing items that showed differential item functioning (DIF) across age and gender (Neal, et al 2006). And the unidimensional nature of RAPI has been questioned (Martens, et al, 2007). But other studies of the psychometric properties of RAPI confirm a single factor (Neal et al., 2006), and in our sample, RAPI items load onto a single factor, and this held across different RAPI scoring algorithms suggested in the literature (dichotomously scored items; 18 item subset showing no DIF). Correlations between RAPI factor scores computed across these multiple methods with alcohol diagnoses showed little variability (ranging from 0.37 – 0.40; results

available upon request). Accordingly, our series of post-hoc exploratory analyses of different methods of scoring the RAPI suggest the robust utility of RAPI items and confirm its association with alcohol diagnoses across different scoring methods.

Our results also offer new evidence for a direct pathway from adolescent problem drinking to alcohol use disorders (AUD) in early adulthood. Long-term longitudinal studies in the USA (Merline, Jager, Schulenberg, 2008) and Finland (Pitkänen, et al, 2008) document the stability of heavy drinking from late adolescence into mid-adulthood and the robust prediction of symptoms of adult AUD from heavy drinking in late adolescence. That prediction is largely invariant across gender in these long-term longitudinal studies. Results from our analysis of a 7-year follow-up of Finnish twins from ages 18 to 25 add to these findings and replicate the predictive linkage in within-family comparisons of discordant co-twins, robustly among both discordant twin sisters and twin brothers. Alcohol use disorders may be as powerfully predicted from adolescent drinking and drinking-related behavior problems as from more indirect pathways such as that from early signs of disinhibitory behavioral under-control to early-onset problem drinking.

The predictive association of adolescent drinking patterns with alcohol use disorders is consistent across cultures, sampling procedures, and measures: in community sampling of Australian youth at ages 14–15 followed up at ages 20–21 (Bonomo et al, 2004) and among the 11,500 participants of the British Cohort Study assessed at ages 16 and 30 (Viner & Taylor, 2006). Such consistent evidence should direct intervention efforts on teenagers engaged in patterns of high-density drinking and drinking-related problems. Identifying adolescents at high risk for alcohol dependency is as an obvious, important priority. Our results suggest that screening for drinking-related problems with an instrument such as RAPI is one approach in effectively addressing that priority.

Acknowledgments

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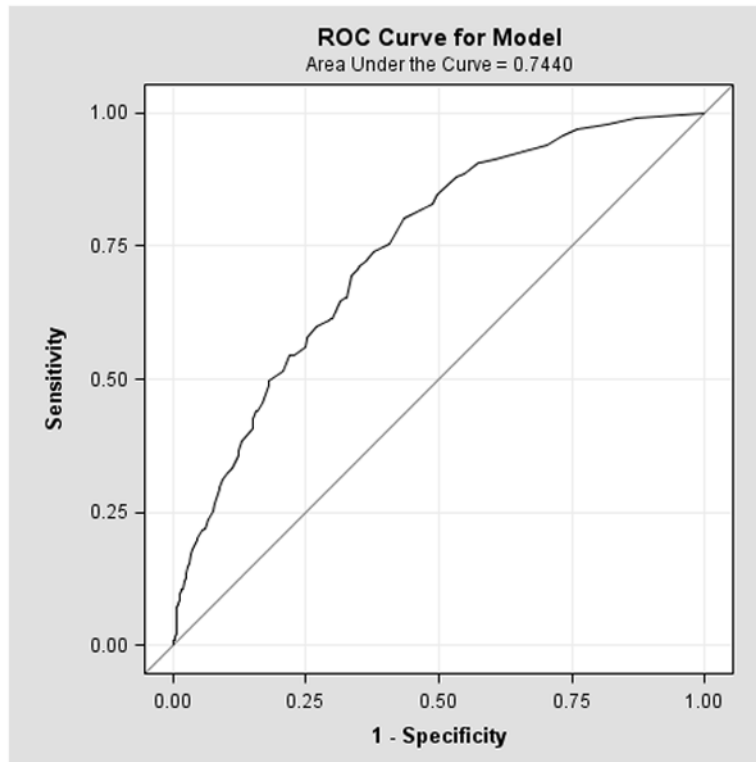
Figure 1.
Response operator characteristic (ROC) analysis for all subjects, including sex as a covariate.