What are factors affect drinking behavior?

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Abstract

We investigate factors associated with drinking behavior score in adolescents. A multilevel model is used to model 246 performances by 82 different adolescents between 14 to 16 years old. We find the drinking behavior score is higher for adolescents who have drinking peer and alcoholic parents. We also find that drinking behavior score tends to increase as adolescents age. Finally, we see that there is some variability in individual adolescent drinking behavior score over three year observation, that differences between adolescents themselves.

Background and Significance

In this report, we investigate factors related to teens' drinking behavior. Kristen L. Barry and Frederic C. Blow(2016) show that the number of alcoholics will also increase as people age. Steven Reinberg (2019) mentions that it takes longer for the body to break down alcohol as people age. It stays in the system longer. For all that, Steven Reinberg found that as people age, the alcohol intake will also increase. Arun Sondhi and Claire Turner(2011) show that it is hard for adolescents to get drunk without drinking with friends. In most situations, adolescents are drunk with their friends. Conor Gilliga and Kypros Kypri2(2012) shows that Many parents provided some alcohol to their adolescents and often cited the social norm of drinking among their adolescents' peers as a source of pressure to supply.

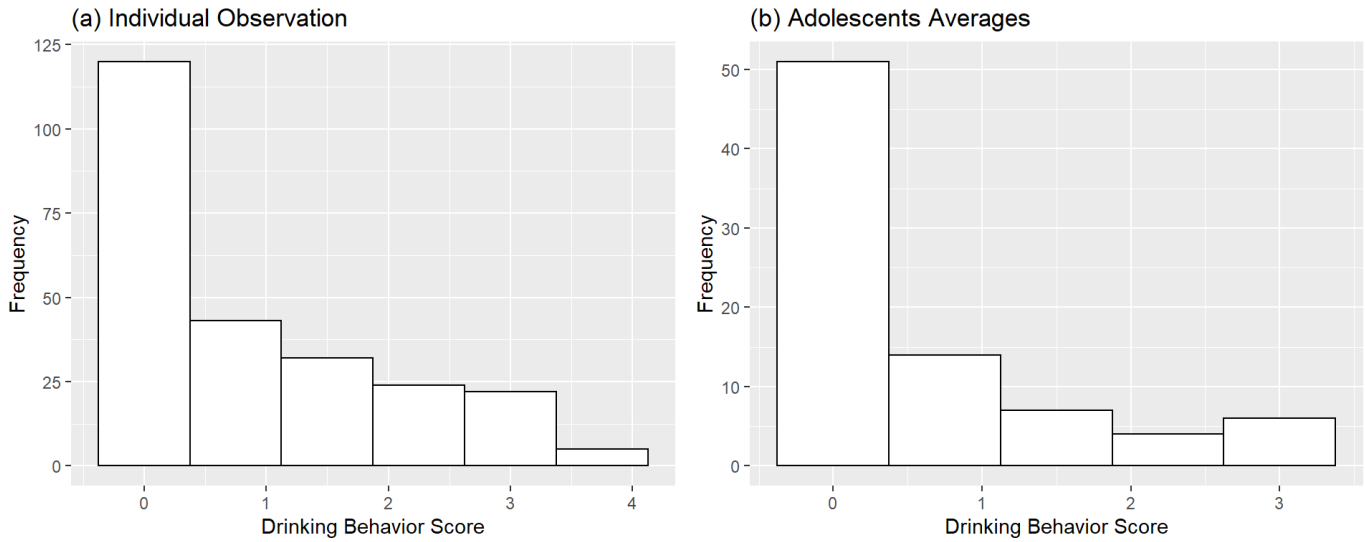
We are interested in exploring whether adolescents' age and whether adolescents have drinking friends are associated with adolescent's drinking behavior. We also explore whether gender and adolescents have alcoholic parents are also associated with adolescents' drinking behavior. Developing a better understanding of the factors associated with drinking behavior might help parents and communities solve adolescents' excessive drinking problems.

###Data We use data collected by Curran, Stice, and Chassin (1997), on 82 adolescents at three time points starting at age 14. We use the survey which contains 4 items—(a) drank beer or wine, (b) drank hard liquor, (c) 5 or more drinks in a row, and (d) got drunk—were each scored on an 8-point scale, from 0="not at all" to 7="every day" to measure teens' drinking behavior. The data are discussed in **Beyond Multiple Linear Regression** (Roback and Legler, 2021), and are available on Github. (https://github.com/proback/BeyondMLR/blob/master/data/alcohol.csv (https://github.com/proback/BeyondMLR/blob/master/data/alcohol.csv)).

This is a multilevel data set, since some measurements taken on id (level 2), as well as the individual observation (level 1). Age pertains to individual observations, so it is level 1 variables. For the same id, coa (whether teens have alcohol parent), number of person's drinking friend, and male will not change, so coa, number of person's drinking friend, and male are level 2 variables.

```
##   id age coa male      peer   alcuse
## 1  1  14   1    0 1.2649111 1.732051
## 2  1  15   1    0 1.2649111 2.000000
## 3  1  16   1    0 1.2649111 2.000000
## 4  2  14   1    1 0.8944272 0.000000
## 5  2  15   1    1 0.8944272 0.000000
## 6  2  16   1    1 0.8944272 1.000000
```

The 'alcuse' variable measures the drinking behavior of adolescents, with high value indicating excessive drinking. Figure 1 displays histograms of drinking behavior scores for all 246 individual observations, as well as average drinking behavior score for the 82 adolescents.



Drinking Behavior (a) for all 246 observations and (b) average for each adolescents

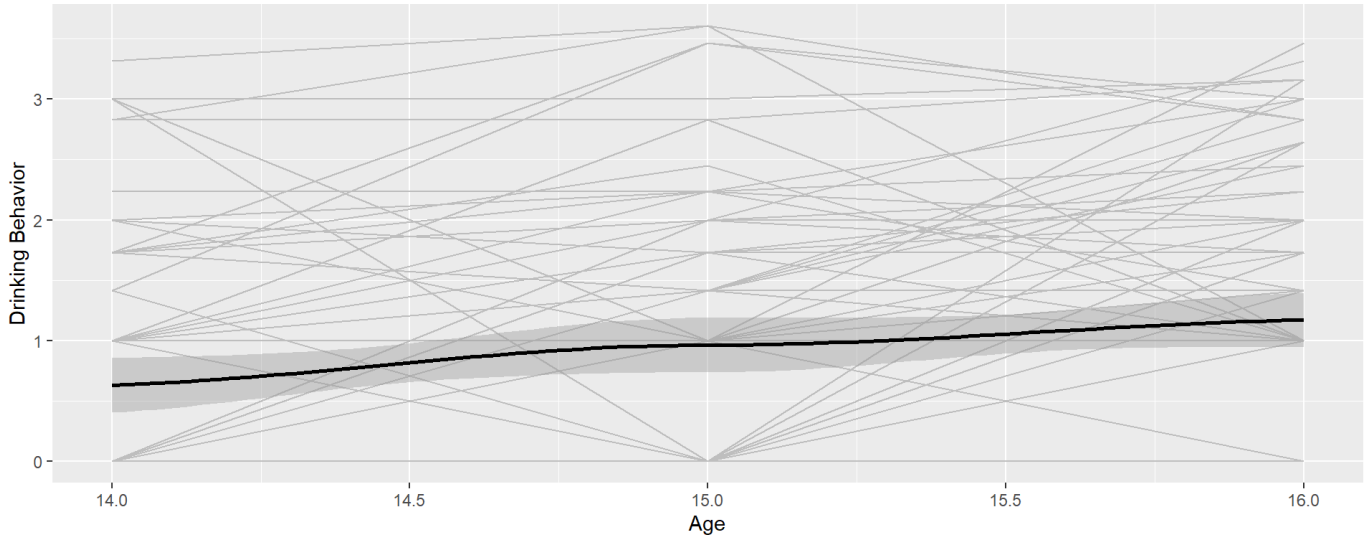
We see that both distributions of drinking behavior scores for individual observations and average are right-skewed, and most adolescents have 0.

Next, we consider level one covariates ‘coa’(with alcohol parent), ‘peer’, and ‘male’. Figure 3 displays relationships between drinking behavior score and these variables.

Drinking Behavior Score by (a) with alcohol parent, (b) male, (c) peer

We see that their drinking behavior scores are higher for adolescents with alcohol parents than adolescents without alcohol parents on average. We also see that their drinking behavior scores do not have much difference for both males and females. By the scatter plot, we also see that the more friends who drink, the higher the drinking behavior score on average.

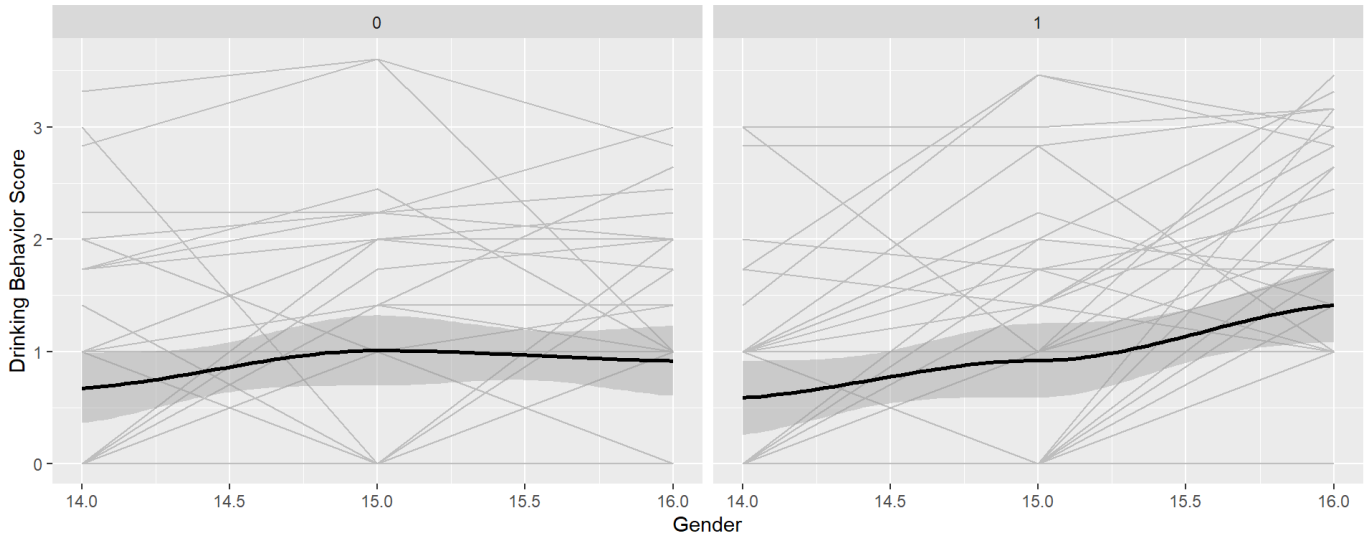
To further assess the relationship between age and drinking behavior, we create individual Spaghetti plot for all 82 adolescents, as seen in Figure 4.



Lattice plots for drinking behavior by number of person's drinking peers

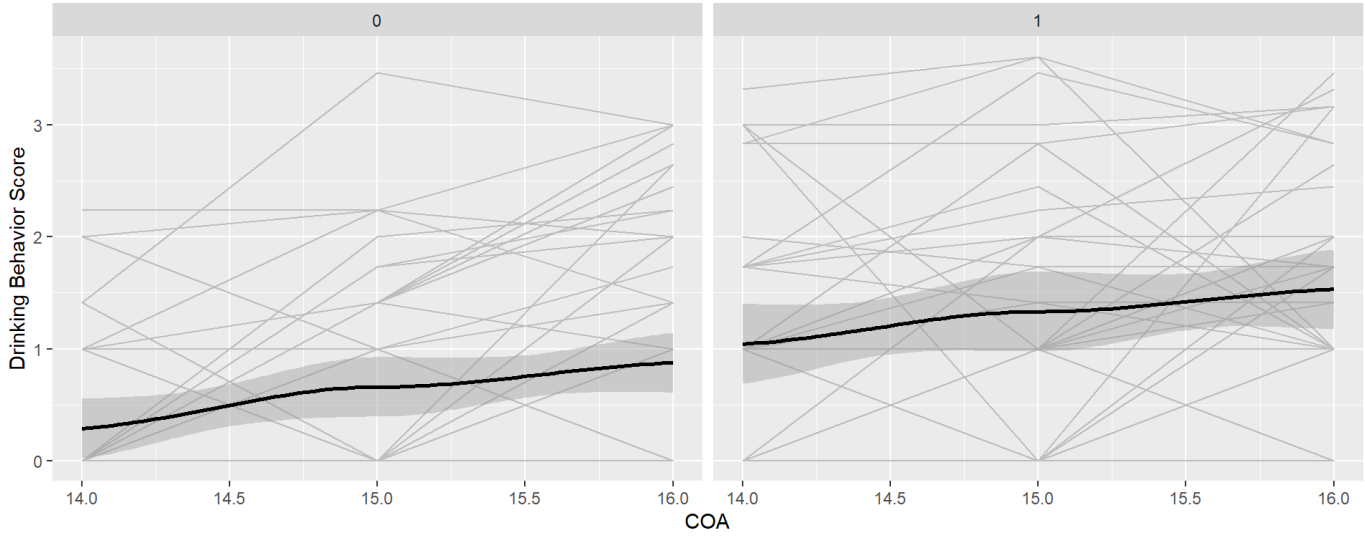
By observing the spaghetti plot for all 82 adolescents, we find that the drinking behavior score increases as adolescents age on average.

Next, we create spaghetti plots for level 2 variables, gender, peer, and coa will not change for each adolescent.



Spaghetti plots for gender as adolescents age.

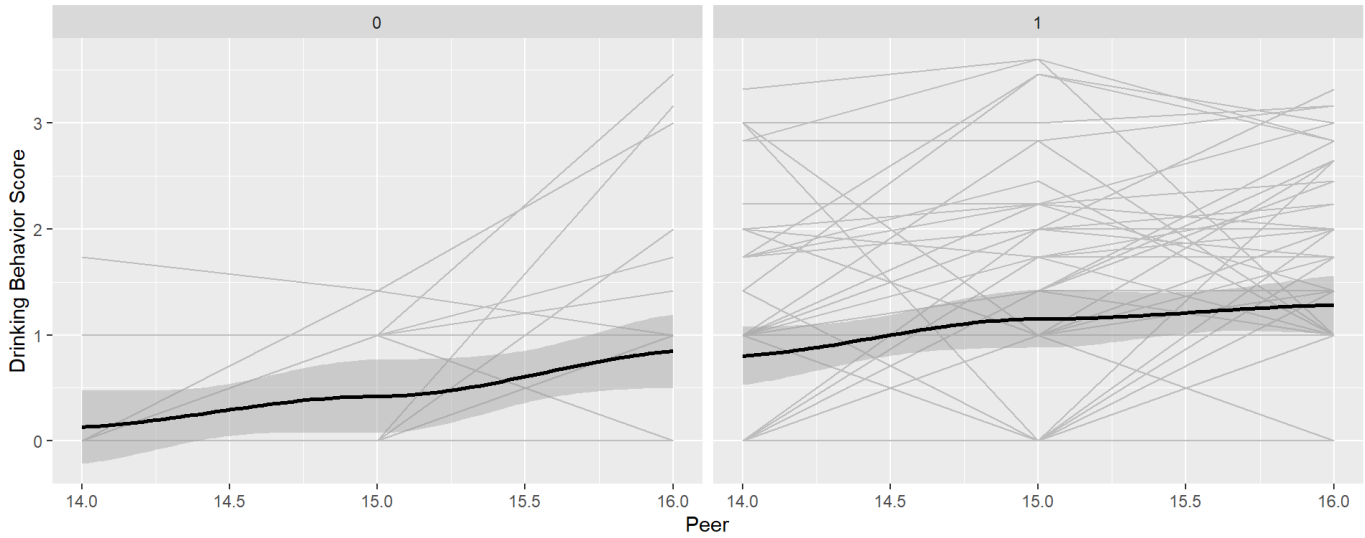
By observing the spaghetti plot for gender, we see that average drinking behavior scores increase slightly as female adolescents age. As male adolescents age, their average drinking behavior scores increase more rapidly than females.



Spaghetti plots for coa as adolescents age.

For adolescents with alcoholic parents and without alcoholic parents, the drinking behavior score increases for both of them as they age.

Then we create a binary variable (peer1), if the adolescent has drinking peer, then peer1 = 1. If the adolescent doesn't have a drinking peer, then peer1 = 0.



Spaghetti plots for drinking peer as adolescents age.

For adolescents with drinking peers and without drinking peers, the drinking behavior score increases for both of them as they age. For people who don't have a drinking peer, their drinking behavior score even increases faster than people who have drinking peers on average.

###Methods We now consider three different multilevel models for drinking behavior score ('alcuse'). Let Y_{ij} be the drinking behavior score of adolescent i before age j. We begin by fitting a model that accounts for whether or not the adolescent has a drinking friend, and their age. We include an interaction effect between drinking peer1 (peer1 = 1 if adolescents have a drinking friend) and age14(age14 = age - 14). The model includes a random intercept term, allowing average drinking behavior score to differ between adolescents, and a random term on the Age variable, allowing the effect of age to vary between adolescents. Mathematically, we write the model as:

Model 1:

$$\begin{aligned} Y_{ij} &= [\alpha_0 + \alpha_1 \text{Peer1}_i + \beta_0 \text{Age14}_{ij} + \beta_1 \text{Peer1}_i \text{Age14}_{ij}] \\ &\quad + [u_i + v_i \text{Age14}_{ij} + \epsilon_{ij}] \end{aligned}$$

where,

$$\begin{bmatrix} u_i \\ v_i \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_u^2 & \rho_{uv}\sigma_u\sigma_v \\ \rho_{uv}\sigma_u\sigma_v & \sigma_v^2 \end{bmatrix} \right)$$

and $\epsilon_{ij} \sim N(0, \sigma^2)$.

Alternatively, we consider a simplified version of the model that does not include the random effect v_i. This model assumes that average drinking behavior scores differ between adolescents, but that the effect of age is the same for each adolescent This model is written as

$$\begin{aligned} Y_{ij} &= [\alpha_0 + \alpha_1 \text{Peer1}_i + \beta_0 \text{Age14}_{ij} + \beta_1 \text{Peer1}_i \text{Age14}_{ij}] \\ &\quad + [u_i + \epsilon_{ij}] \end{aligned}$$

where $u_i \sim N(0, \sigma_u^2)$ and $\epsilon_{ij} \sim N(0, \sigma^2)$.

We use AIC and BIC to assess the fit of each model.

Model 1 achieves lower AIC (652) and BIC (680) scores than Model 2 (AIC=660, BIC=681), suggesting that the random effect of AGE is needed. Thus, we should allow the effect of age to vary between adolescents.

We now consider adding other covariates that might help explain drinking behavior score in adolescents We saw that coa(whether they have alcoholic parents) appeared to be associated with drinking behavior score, so we will add that variable to the model. This is a level two variable, since it pertains to adolescent, rather than individual observations. Although we could examine interactions between these and other variables in the model, including such interactions would make our results difficult to interpret. There does not seem to be a clear reason to expect any such interactions, so we will not include interaction terms for these new variables. The model is:

Model 3:

$$\begin{aligned} Y_{ij} = &[\alpha_0 + \alpha_1 \text{Peer1}_i + \alpha_2 \text{Coa}_i + \beta_0 \text{Age}_{ij} \\ &+ \beta_1 \text{Peer1}_i \text{Age}_{ij}] \\ &+ [u_i + \epsilon_{ij}] \end{aligned}$$

where $u_i \sim N(0, \sigma_u^2)$ and $v_i \sim N(0, \sigma_v^2)$.

Model 3 acheives an AIC value of 640, an improvement over Model 1. On the other hand, the BIC value for Model 3 is 671, which is also smaller than Model 2. Since Model 1 is a nested sub-model of Model 3, we can compare the models with a likelihood ratio test. The null hypothesis is that model 1 adequately fits the data. This test yields a χ^2 test statistic of 16.6 on 1 degrees of freedom, resulting in a low p-value, suggesting that the larger Model 3 is preferred.

We fit Model 3 to the data. The first table displays estimates of σ_v^2 σ_u^2 and σ^2.

	grp	vcov	sdcor
1	id	25.3015083	5.0300605
2	id	0.1240859	0.3522583
4	Residual	0.3611088	0.6009233

$\sigma_v^2 = 0.12$ = the variance between adolescents in rates of change in drinking behavior scores during the three-year observation period. $\sigma_u^2 = 25.3$ = the variance between adolescents at age 14 behavior scores. $\sigma^2 = 0.36$ = the variance in within-adolescents deviations.

The next table shows the estimates of fixed effects and their associated standard errors, t-statistics, and p-values.

	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	-5.2041723	1.7748413	85.46599	-2.9321902	0.0043184
peer1	2.3557708	2.0561697	85.19928	1.1457084	0.2551238
coa	0.6956534	0.1647372	79.05735	4.2228057	0.0000640
age	0.3581094	0.1204437	85.22537	2.9732515	0.0038307
peer1:age	-0.1175664	0.1396452	85.22537	-0.8418936	0.4022038

We estimate that the drinking behavior score for an adolescent who has drinking peers increases 0.14 points on average, assuming other variables are held constant. However, since p-value is large(0.26), there is no significant evidence that there is a relationship between whether having drinking peers and drinking behavior score. There is significant evidence(p<0.001) that the drinking behavior score will increase 0.7 on average for

adolescents who have alcoholic parents, assuming all other variables in the model are held constant. There is significant evidence(p=0.003) that the drinking behavior score will increase 0.36 on average adolescents age increases by one year, assuming all other variables in the model are held constant. Adolescents who have drinking peers have an estimated mean increase in drinking behavior score of 0.36-0.12 = 0.24 points per year over the three-year observation period, 0.12 points lower than the mean yearly increase among adolescents who don't have drinking peers. However, since the p-value is large(0.4), we have no evidence that the interaction term is significant.

Discussion and Conclusions

Our results show that on average, adolescents who have drinking peer have higher drinking behavior score than adolescents who don't have drinking peer. It verifies that Arun Sondhi and Claire Turner's(2011) statement, but since p-value of 'peer1' is small, this variable isn't statistically significant. There is significant evidence that adolescents have alcoholic parents have higher drinking behavior score than adolescents who don't have alcoholic parents on average. We also have significant evidence that as adolescents age, their drinking behavior score will increase on average. There are also some signs that adolescents who have drinking peers have slightly higher drinking behavior score than adolescents who don't have over the three-year observation period, but this interaction is not statistically significant.Finally, we see that there is some variability in individual adolescent drinking behavior score over three year observation, that differences between adolescents themselves.

Our results are based on a sample of 82 adolescents over three-year observations. While they provide insight, we should be careful not to generalize them to a longer observation period. Future research might further explore the potential link between adolescents' health and drinking behavior. Further research along this line will help communities identify potential excessive drinking adolescents, and communities can make these potential young alcoholics aware of the harm of alcohol to reduce the number of young alcoholics.

References

Kristen L. Barry and Frederic C. Blow(2016). Drinking Over the Lifespan Focus on Older Adults. Alcohol Res. 2016; 38(1): 115–120.

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