Using Tobit Regression Analysis to Further Understand the Association of Youth Alcohol Problems with Depression and Parental Factors among Korean Adolescent Females

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Objectives : This study characterized the extent to which youth depressive symptoms, parental alcohol problems, and parental drinking account for differences in alcohol-related problems among a large sample of adolescent females.

Methods : The stratified sample consists of 2077 adolescent females from twelve female-only high schools located in a large metropolitan city in the Republic of Korea. Students completed a questionnaire about alcohol use and alcohol problems, their parents' alcohol problems, and a number of risk and protective factors. Data were analyzed using tobit regression analyses to better characterize the associations among variables.

Results : Almost two-thirds of students who consume alcohol had experienced at least one to two alcohol-related problems in their lives and 54.6% reported at least one current symptom of depression, with nearly one-third reporting two depressive symptoms. Two-thirds of the students indicated that at least one parent had an alcohol-related problem, and that approximately 29% had experienced several problems. Results of tobit regression analyses indicate that youth alcohol-related problems are positively associated with depressive symptoms (p<0.01) and parent drinking problems (p<0.05). Parental drinking is no longer significant when the variable parental attention is added to the model. Decomposition of the tobit parameters shows that for every unit of increase in depressive symptoms and in parent drinking problems, the probability of a youth experiencing alcohol problems increases by 6% and 1%, respectively. For every unit of increase in parental attention, the probability of youth experiencing drinking problems decreases by 5%.

Conclusions : This study presents evidence that alcohol-related problems and depressive symptoms are highly prevalent among adolescent females. Although a comprehensive public health approach is needed to address drinking and mental health problems, different interventions are needed to target factors associated with initiation of alcohol problems and those associated with increased alcohol problems among those who already began experiencing such problems.

J Prev Med Public Health 2007;40(2):145-149

Key words : Adolescent, Female, Alcoholism, Depression, Regression analysis.

INTRODUCTION

Prior research has documented an increase in the prevalence of alcohol consumption among youth, particularly among females, in the Republic of Korea [1-2]. This is of concern given the inverse association that exists between age of initiation and transition into alcohol abuse and dependence [3] and co-occurring mental health problems [4]. Although a number of studies have identified factors that increase the likelihood of youth using alcohol and transitioning from experimentation to problematic drinking [5-6], studies focusing on Korean youth are few [1,2,7-10]. In general, these studies have found that the mean age of first diagnosis of alcoholism among Koreans tends to be significantly lower among children of alcoholics [7], and that depression, behavioral problems, and parents' drinking problems are positively associated with increased likelihood of problematic drinking among youth [2]. On the other hand, parental attention has been found to serve as a protective factor against youth alcohol consumption among youth in Korea [2] and elsewhere [11,12]. Adolescence is a time of transition and exploration. Positive parental attention conveys to the adolescent that she is cared for and is important to the adult. In turn, this contributes to the development of a stronger self-concept, increased ability to handle challenges adolescents face, and less reliance on negative peer influences, altogether resulting in adolescents making better choices. That there is a need to further understand factors associated with alcohol problems among youth in Korea is incontrovertible. To reduce the gap in knowledge that exists concerning alcohol use among adolescent females in Korea, an at-risk group, we sought to test if there is an interaction between students' depressive symptoms and parental drinking problems on risk of students' alcohol problems, including the examination of the potential protective effect of parental attention, using secondary data from a large study of alcohol use among adolescent females from the Republic of Korea.

A second purpose of the study was to demonstrate the use of tobit regression analyses, an underutilized statistical approach

in the substance abuse field, that contains many strengths appropriate to the data under investigation. It is often the case that with non-treatment populations, the sample of individuals who report experiencing alcohol-related problems is small because these behaviors tend to be rare events. As expected, many of the youth in this sample did not have alcohol problems leading to a large number of zero values for the dependent measure of alcohol problems. Economists have long observed that analysis of a dependent variable with a large number of zero values using ordinary least squares regression may lead to biased parameter estimates [13]. An approach commonly taken by researchers to handle these types of skewed data is to create a dichotomous variable (i.e., high vs. low or no problems) to be analyzed with logistic regression. Unfortunately, this approach results in loss of information and inefficiency because detailed information on the extent of alcohol problems, for instance, is collapsed into whether the youth has a drinking problem. The use of tobit regression analysis allows for appropriate analysis of dependent variables with large numbers of zero values without having to lose information by dummy coding these data.

The tobit procedure models the effect of the independent variables on an underlying latent variable [13], in this case, the propensity to exhibit drinking problems. While the directions of such parameter estimates may be informative, interpretation of the effect sizes for the independent variables can be difficult [14]. To address this issue, statisticians have developed a procedure to decompose estimates from the tobit model in order to develop more informative parameters [15]. In the present study, this analytic strategy allowed for modeling the extent to which independent variables--depressive symptoms, parental alcohol problems, and parental attention--explain the dependent variable, students' alcohol problems, conditioning on alcohol problems. That is, among youth who already

have developed alcohol problems, what are the predictors of the seriousness of alcohol problems? Simultaneously, the decomposition of tobit parameters also allowed for an examination of the extent to which the independent variables were able to distinguish between youth who have alcohol problems and those who do not.

METHOD

Ⅰ. Subjects

Study participants included 2,077 female high school students with a median age of 15 years. These students were sampled from twelve female-only high schools located in six administrative districts of the metro area city of Tae-gu, the Republic of Korea. Twelve of the 18 principals contacted from the female-only high schools in the city gave permission to conduct the study. The survey was conducted in 2001. Five classes were randomly selected from each school for a total of 60 classes. Nearly 87% of all students in each class participated once consent was obtained from parents and youths, who signed the consent form prior to questionnaire administration. Students without parental consent or who declined participation were asked to act as if they were completing the survey and to turn it in with no markings in the envelope to avoid being identified as non-participants.

Ⅱ. Instrument

Students completed a self-report instrument with questions selected from established questionnaires used in youth alcohol research internationally. The instrument's items were double translated. First, they were independently translated into Korean and then back into English by two Korean educators. Then, the instrument was pilot tested on a sample of 50 adolescent females in the Republic of Korea. The data from the pilot study were carefully examined for any language discrepancies and the MPLUS software [16] was used to obtain

the scales' factor structures using exploratory factor analysis. With these procedures questions that may have seemed appropriate but did not load on any factors were identified and eliminated. Subsequent analyses indicated that the constructs were highly correlated in the expected direction providing additional evidence of the validity of the constructs. For example, parental attention is inversely associated with students' depression symptoms, behavioral problems, peer deviance, and with students being withdrawn. In turn, the mental health constructs correlated in expected directions such that youth with more behavioral problems also experience more depressive symptoms and have more friends who have problems with the law.

The 23-item Rutgers Alcohol Problem Index (RAPI) [17] was used to identify students who had consumed alcohol in the past three years and to identify students with drinking related problems. Students were asked "How many times did the following things happen to you while you were drinking alcohol or because of your alcohol use during the last 3 years?" Two examples of questions are: "Had a fight, argument, or bad feeling with a family member" and "Kept drinking when you promised yourself not to." All items are measured on a scale that ranges from 0 (Never) to 4 (More than 10 times). Total scores could range from a low of 0 to a high of 92 (Cronbach's alpha=0.92). The six-item Children of Alcoholics Screening Test (CAST-6)[18] was used to measure the extent of parents' drinking problems. Examples of questions are: "Did you ever feel like hiding or emptying a parent's bottle of liquor?" and "Did you ever wish that a parent would stop drinking?" All items were dichotomous and the total score could range from a low of 0 (no problems) to a high of 6 (endorsed all six problems) (Cronbach's alpha=0.85). Finally, the Drug Use Screening Inventory (DUSI)[19] was used to measure students' depressive symptoms and parental attention. The two

Table 1. Association of drinking problems with depressive symptoms, parents' drinking problems, and parental attention among adolescent females: Results of tobit regression analyses

Independent Variable	Model 1 Coefficient (standard error)	Model 2 Coefficient (standard error)
Constant	-9.76 (7.10)	-4.76 (7.01)
Age	0.24 (0.45)	0.24 (0.45)
Depressive symptoms	1.89 (0.50)***	1.63 (0.50)***
Parent drinking problems	0.50 (0.21)**	0.39 (0.21)*
Depressive symptoms* Parent drinking problems	0.12 (0.16)	0.13 (0.16)
Parental Attention	-	-1.51 (0.24)***

*$p<0.10$, ** $p<0.05$, ***$p<0.01$

questions utilized to measure depressive symptoms are: "Have you felt sad a lot?" and "Do you often feel like you want to cry?" each with 'Yes-No' response categories. Students who answered both questions negatively were coded as zero; those answering either question affirmatively were coded as one, and those who endorsed both questions were coded as two (Cronbach's alpha=0.68). Parental attention was measured by asking the following four questions: "Are your parents or guardians aware of your likes and dislikes?", "Are your parents or guardians aware of what you think or feel about things that are important to you?", "Are your parents or guardians often aware of where you are and what you are doing?", and "Do you feel that your parents think you are important to them?" each with a 'Yes-No' response category for a range of 0 (no attention) to 4 (lots of attention) (Cronbach's alpha=0.66).

Ⅲ. Data Collection and Analysis

Missing values on the independent and dependent variables were very few and did not vary in any systematic manner. These missing values were replaced with multiple imputation derived values [20,21], using the NORM missing value software [22]. The analyses involved testing two models with tobit regression [13,23]. All tobit regressions were conducted with STATA 9. The first model consisted of examining the association of student drinking problems with depressive

symptoms, parent drinking problems, and the interaction these two variables. The second model included the same variables plus the variable parental attention, a potential protective factor. All analyses included age as a covariate. After the tobit model was completed, parameters from this model were separated into two distinct sets of more informative parameters according to the procedure developed by McDonald and Moffitt [15]. More details on the tobit model and the McDonald and Moffitt procedure are available elsewhere [14,15,23].

RESULTS

Participants included 2,077 adolescent females with a mean age of 15 years (sdev=0.64). Approximately 76% come from public schools and 24% from private schools. Nearly 12% of the student's parents had not completed high school, 51% had a high school degree, 7% had completed college, and 30% had a university degree.

A total of 1,430 students or 68.8% indicated they had consumed alcohol once in the three years prior to the survey. Those who reported consuming alcohol in the past three years were asked 23 questions about any problems they may have experienced due to their drinking. Nearly 63% reported experiencing at least one alcohol-related problem. When all students are included in the analyses, the average level of alcohol related problems is 2.89 (sdev=6.5) (out of a range of 0-92). Symptoms of depression were reported by nearly 55% of the youth. Of greater concern is the high prevalence of youth who reported two symptoms of depression (29%). Two-thirds of all 2077 students indicated that at least one of their parents had experienced an alcohol-related problem. The average level of parental attention was 3.0 (sdev=1.21)(from a scale of 0 to 4). Despite the relatively high average level of parental attention, nearly 30% of the students had scores of parental attention under

3 and 14% reported not receiving much attention at all (total score of 0 or 1).

Coefficients from tobit regression analyses are not readily interpretable as effect sizes [21]. Interpretation of these coefficients should focus on the positive or negative sign of the coefficient and whether or not it is statistically significant. Results of tobit regression analyses suggest that youth alcohol-related problems are positively associated with depressive symptoms (p<0.01) and parent drinking problems (p<0.05)(Table 1). However, when the variable parental attention is added to the model, this variable is not only inversely associated with students' drinking problems (p<.01) but the effect of parental drinking is no longer significant (p>.05). As can be seen in Table 1, the magnitude of the coefficient of the association between parental drinking and student drinking problems decreases from 0.50 (se=0.21) to 0.39 (se=0.21) (Table 1). The coefficient of the association between depressive symptoms and student drinking problems also decreased, from 1.89 (se=0.50) to 1.63 (se=0.50), but this change did not result in a loss of significance. No significant interaction was found between depressive symptoms and parental drinking on youth drinking problems (p>0.05) in both models.

Subsequently, we conducted further analyses on the results of Model 2 in order to simultaneously yet separately examine two important questions. First, among those exhibiting alcohol problems, what is the relationship of the independent variables with the seriousness of those problems? Second, to what degree do the independent variables distinguish those with alcohol problems from those who do not display such problems?

An examination of the results of the marginal effects of the independent variables on alcohol problems among youth with alcohol problems indicates that for every unit of increase in depressive symptoms and in parent drinking problems the occurrence of alcohol problems increases by 0.54 and 0.13 units, respectively

Table 2. Marginal effects of the independent variables on explaining levels of alcohol problems among youth with alcohol problems and on distinguishing youth who have alcohol problems versus those who do not have alcohol problems

Independent variable (IV)	Effect of IV on severity of youth levels of alcohol problems, among those experiencing problems	Effect of IV on probability of youth having alcohol problems versus not having alcohol problems
Age	0.08	1%
Depressive symptoms	0.54	6%
Parent drinking problems	0.13	1%
Depressive symptoms* Parent drinking problems	0.04	4%
Parental Attention	-0.50	-5%

(Table 2). On the other hand, for every unit of increase in parental attention youth receive, drinking problems decrease by 0.50 units. A second set of marginal effects attempted to distinguish between youth with and without alcohol problems. For example, for every unit of increase in depressive symptoms and in parent drinking problems, the probability of a youth experiencing alcohol problems increases by 6% and 1%, respectively. And, for every unit of increase in parental attention youth receive, the probability of youth experiencing drinking problems decreases by 5%.

DISCUSSION

The present study shows a high proportion of adolescent females using alcohol and experiencing alcohol-related problems and a large number experiencing depressive symptoms. The use of tobit regression allowed for appropriate analysis of a dependent variable with a large number of zeros, created by the relatively large number of youth in the sample with no alcohol problems. However, coefficients from tobit analyses may not be interpretable in a straightforward fashion. Further decomposition of the tobit coefficients, following the method proposed by McDonald and Moffit [15] provided estimates of more intuitively understandable effects: the probability of alcohol problems, and the level of alcohol problems among those who experience such problems. Both parental drinking problems and the students' depressive symptoms were significantly associated with levels of drinking problems, though the magnitude of these associations decreased when parental attention was included in the model.

The study findings point to important modifiable risk factors that can be targets of preventive interventions. For example, governmental policies aimed at discouraging access to and excessive consumption of alcohol, among both minors and adults, could result in important reductions in alcohol problems in the population. Simultaneously, recent longitudinal research indicates that a preceding episode of major depression greatly increases the risk of alcohol dependence, particularly in women [24], and suggests that interventions aimed at addressing the factors that lead to increased depressive symptoms among adolescent females could decrease alcohol problems as well [25]. It is important to note, however, that the cross-sectional nature of the study prevents us from making causal statements regarding the association between the variables studied. It is plausible, for example, that youth who experience alcohol-related problems are subsequently more likely to experience depressive symptoms. None-theless, the high prevalence of depressive symptoms observed in this study should be of concern independent of whether these are precursors or consequences of heavy alcohol consumption. Depression is currently ranked as one of the most costly and disabling illnesses in the world, and individuals with comorbid alcohol disorders have significantly worse outcomes [24,26,27].

Other study limitations, besides the cross-sectional design, include the self-report nature of the data and the lack of data from secondary sources such as parents, teachers, and peers. Social desirability may be a problem but if this is the case, then the alcohol and mental health problems reported in this study are likely to underestimate the extent of these problems in the population at large. While obtaining data from other sources may serve to corroborate the self-report data, in this study these data are not available. Despite these limitations, the large sample size and the multiple constructs studied provide evidence of health and mental health problems that a large portion of the youth population may be experiencing in Korea.

In conclusion, an additional unique aspect of the present study is that the results of the tobit regression analyses allowed us to probe more deeply into the associations between the independent variables and students' drinking problems. We found that depression, parental drinking problems, and parental attention can fairly well explain differences in students' drinking problems.

Thus, the studied variables may be used to predict both the degree of drinking problems, as well as to distinguish between students who do not have alcohol-related problems and those who do. These findings suggest that the characteristics of youth who do not drink or who drink without experiencing alcohol problems differ from the characteristics of youth who do drink, and who do experience alcohol related problems. Further research is needed to identify these different developmental pathways to better inform public health interventions. To be effective, interventions targeting youth who already drink and are beginning to experience alcohol-related problems might need to be different from those that aim to prevent youth from drinking at all.

SUMMARY

All of these factors are modifiable and can thus be targets of interventions. Development of public campaigns aimed at educating the public about the consequences of heavy drinking may result in a reduction in this

behavior and improved health in the population. Further educating parents about ways their behaviors influence those of their daughters (e.g., drinking by parents influences youth drinking and parental attention serves as a protective factor against heavy drinking among adolescents) may provide parents with additional tools to more positively influence their teenage daughters' development. Helping parents acquire more information and skills to better understand what adolescents go through can certainly lead to better developmental outcomes among youth. Finally, great emphasis should be placed on developing programs aimed at screening for and treating depressive symptoms among youth. Identifying and reducing rates of depression can help prevent both, the short and long-term detrimental consequences of this mental health problem. These interventions can be developed in multiple settings such as schools where large populations of youth may be reached, through public media campaigns, in youth centers, and in treatment centers.

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