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## The Long-term Effects of Self-Esteem on Depression: The Roles of Alcohol and Substance Uses during Young Adulthood<sup>1</sup>

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### Abstract

Using the National Longitudinal Surveys of Youth 1979, this study examines the roles of alcohol and substance use as mediators in the mechanism between self-esteem and depression, and investigates whether the mechanism works for both men and women. Results demonstrate that alcohol and substance use during young adulthood mediates the effect of self-esteem on depression among men. Furthermore, self-esteem during young adulthood remains a determinant of high depression in middle adulthood. However, we did not find evidence to support that same mechanism among women. Our findings provide insight into how self-esteem affects depression over the transition from young to middle adulthood, and elucidate potential gendered responsiveness to low self-esteem.

### Keywords

Self-esteem; Depression; Alcohol and Substance Use; Long-term effect; Mediation analysis

## INTRODUCTION

The relationship between self-esteem and depression has been extensively studied in health research over the past decade (Orth and Robins 2013; Sowislo and Orth 2013; Steiger et al. 2014; Trzesniewski et al. 2006). In order to explain the causal link between the two concepts, the vulnerability model assumes that low self-esteem leads individuals to be more vulnerable to depression (Klein, Kotov, and Bufferd 2011). Recent empirical studies using longitudinal data and cross-lagged regression models have also consistently supported the idea that self-esteem negatively predicts depression (Orth and Robins 2013). For example, adolescents with low self-esteem tend to be more depressed by the time they reach their

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mid-thirties (Steiger et al. 2014), which implies that there are long-term impacts of self-esteem on depression.

However, the theoretical model overlooks the question of whether there is any mediating mechanism connecting self-esteem and depression over time. That is, the mediators that may account for the vulnerability effect of self-esteem on depression remain underexplored. For example, low self-esteem may lead to high-risk behaviors or inappropriate coping behaviors that subsequently increase depression (Mann et al. 2004). Previous research has shown that low self-esteem is a determinant of health-risk behaviors, including alcohol and substances use (Baumeister 1990; Rosenberg 1965), among others that lead to compromised mental health in different ways by gender (Aneshensel, Rutter, and Lachenbruch 1991; Jessor 1991; Mirowsky and Ross 1995; Read and Gorman 2010). It indicates that behaviors may be one of the potential mediators linking self-esteem and depression, but little research has explicitly examined the role of health risk behaviors as mediators. Also, according to gender socialization theory, women are inclined to internalize negative emotions and men tend to externalize negative emotions via health risk behaviors (Elliott 2013; Simon 2002). Nevertheless, the gendered responses have not been situated in the relationship between self-esteem and depression. That is, it remains unclear whether the gendered responses explain how low self-esteem affects depression among men and women, respectively.

This study aims to fill this gap and advance the literature by proposing three interrelated hypotheses: (1) Alcohol and substance use mediates the effect of self-esteem on depression during young adulthood. (2) The low self-esteem observed in young adulthood has a detrimental impact on depression in middle adulthood and this relationship is still mediated by alcohol and substance use. (3) The mediating mechanism in (1) and (2) differs by gender as gendered responses may occur in emotional and behavioral realms. By testing these hypotheses, we can investigate how self-esteem contributes to depression over time and how different the mediation process is by gender.

## BACKGROUND

Self-esteem is defined as an individual's evaluation of his/her worth as a person, and is related to personal and social life outcomes (Rosenberg 1965; Steiger et al. 2014). For example, previous studies have demonstrated that low self-esteem leads to delinquency, poor health, and limited economic prospects while high self-esteem predicts better romantic relationships, job performance, and educational attainment (Donnellan et al. 2005; Orth, Robins, and Widaman 2012). As discussed above, many empirical studies have supported the vulnerability model, and theoretically, negative evaluations or beliefs about oneself are a significant factor related to depression (Beck 1967; Franck, De Raedt, and De Houwer 2007; Steiger et al. 2014). Moreover, self-esteem has been known to be malleable during adolescence after which it becomes relatively stable across one's lifetime (Longmore et al. 2004; Trzesniewski, Donnellan, and Robins 2003). That being said, self-esteem in young adulthood may play a role in determining one's depression during the later life stages. In addition, there are gender differences in the level of self-esteem. Generally, men are more likely to have higher levels of self-esteem, especially physical appearance, self-satisfaction, and athletic prowess, as well as global self-esteem (Gentile et al. 2009; Kling et al. 1999).

This gender difference may be one of the reasons why females usually have more psychological problems, such as higher incidences of suicide attempts, eating disorders, and depression in adolescence (Kearney-Cooke 1998).

Self-esteem and depression are sometimes regarded as one construct, but previous research has suggested that the two are distinct (Rosenberg, Schooler, and Schoenbach 1989; Sowislo and Orth 2013) in two ways. Theoretically, self-esteem is neither a sufficient nor a necessary criterion of a depressive symptom. Low self-esteem is not only related to depression, but also to learning disorders, antisocial behavior, eating disturbances, and suicidal ideation (Erol and Orth 2011). That is, self-esteem is a predisposing factor for other mental health issues, including depression. On the other hand, empirically, the correlation between self-esteem and depression is, moderate, at best (Longmore et al. 2004). A feeling of worthlessness, which indicates low self-esteem, is found only in a relatively small portion of people who are diagnosed with depression (Sowislo and Orth 2013). These discussions strongly indicate that self-esteem and depression are two distinct constructs, and that low self-esteem should be a key determinant of depression.

### **Missing Links between Self-esteem and Depression**

Although the vulnerability model has been dominant recently, there is still a lack of research explaining the mechanisms between self-esteem and depression. The present study argues that health-risk behaviors, such as heavy drinking and substance use, should be included in the vulnerability model as mediators for three reasons. First, self-esteem influences behavior because individuals adopt or change their behaviors to either maintain or boost their self-esteem (Baumeister 1990; Jessor et al. 1995; Longmore et al. 2004). For example, people with low self-esteem are more likely to change their behaviors due to peer pressure (McGee and Williams 2000), and they tend to report more alcohol, cigarette, and marijuana use, and are at higher suicide risk than their counterparts with high self-esteem (Jones and Heaven 1998; Resnick et al. 1997). One explanation for this tendency is that those in the former group need to cope with negative feelings related to low self-esteem by participating in high-risk behaviors. It should be noted that while the theoretical link between self-esteem and high-risk behaviors is convincing, some empirical findings did not find evidence to bolster this argument (Baumeister 1990; Poikolainen et al. 2001; Wild et al. 2004), indicating that more research is needed.

Second, since high-risk behaviors may prevent an individual from achieving normal developmental tasks and carrying out social roles (Jessor 1991), engaging in high-risk behaviors could negatively influence one's mental and physical health (Rieker, Bird, and Lang 2010). Specifically, health compromising behaviors in adolescents and young adults may cause a long-lasting effect on health in later life (Read and Gorman 2010). Recent clinical research using fixed-effects modeling to control for confounding factors have concluded that alcohol use disorder or dependence leads to depression, rather than vice versa (Boden and Fergusson 2011; Fergusson, Boden, and Horwood 2009). Also, neuroscientists found that addiction or substance use disorder change both brain structure and function, which is related to the development of mental illness (Potenza et al. 2011; Volkow 2001). These studies suggest that more research on the relationship between risk behaviors and

depression is necessary in order to improve our understanding of the persistence of mental health disparities according to socioeconomic status, race/ethnicity, and gender.

Third, although previous research has found gender differences in mental health outcomes (Read and Gorman 2010), the effect of self-esteem on depression and its gendered mechanisms remains underexplored. Sociological literature has mainly focused on the social contexts that shape men and women's behaviors, roles, identities, and health (Horwitz and White 1987; Mirowsky and Ross 1995; Read and Gorman 2010; Verbrugge 1985). Specifically, gender socialization theory, which is most useful for explaining gender differences in mental health (Simon 2002), suggests that while women tend to internalize negative emotions, men tend to externalize negative emotions via health risk behaviors (Elliott 2013; Rosenfield, Vertefuille, and McAlpine 2000). Based on this perspective, Simon (2002) and other scholars (Horwitz and White 1987; Rosenfield and Smith 2010) argued that women's symptoms of depression and men's alcohol problems are "*functional equivalents*" (Simon 2002:1088). A review study also found that the depression that women experience and the behavioral disorders that men experience have been considered "*functionally equivalent indicators of misery*" (Hill and Needham 2013:83).

However, Hill and Needham (2013) found that there is no evidence that men substitute risky or unhealthy behaviors for affective disorders, such as depression. Also, they even asserted that "*some studies support the idea of gendered responsivity* [which means that women and men respond to stress in different ways], *but most do not*" (Hill and Needham 2013:86). According to their extensive reviews, there is no consistent evidence for gendered responsivity. While some studies claimed that stressors are more related to depression among women and to substance use disorder among men (Aneshensel et al. 1991), others found the opposite (Ross and Mirowsky 1996; Slopen et al. 2011). Moreover, many studies failed to find gendered responsivity to stressors (Turner and Marino 1994; Umberson et al. 1996). Hill and Needham (2013), therefore, concluded that researchers need to continue testing whether women and men respond to stressors in different ways.

Incorporating gender socialization theory into our aforementioned theoretical links between self-esteem and depression (i.e., vulnerability model), we anticipate that the effect of self-esteem on depression via health risk behaviors varies by gender. Taking consideration of the inconsistency in gendered responsivity to stressful conditions, this current study aims to advance our understanding of the gendered pathways between low self-esteem and high depression based on the vulnerability model. Should the gender socialization theory stand, we would expect that risky behaviors mediate the effect of low self-esteem on depression among men, rather than women. Although Mirowsky and Ross (1995) concluded that alcohol and substance use disorder may not account for lower levels of distress among men, the roles of substance use in the link between self-esteem and depression may provide insights about gendered responsivity to low self-esteem. To the best of our knowledge, little research has focused on the mediators linking self-esteem and depression and even less work investigates whether the mediating mechanisms work among both men and women (Al Nima et al. 2013; Kuster, Orth, and Meier 2012). However, these studies did not consider the role of health risk behaviors, which are more subject to interventions. More importantly, the samples of those two studies are small and non-representative and whether there is a gender

difference in mediation remains unexplored. This present study is among the first to investigate the role of alcohol and substance use in the relationship between self-esteem and depression, and to analyze the gender differences in that relationship using nationally representative sample.

## DATA AND METHODS

### Sample and Measures

To examine whether and how alcohol and substance use mediate the relationship between self-esteem and depression, we use the National Longitudinal Survey of Youth 1979 (NLSY79). The NLSY79 is a nationally representative sample of 12,686 young men and women who were at age between 14 and 22 when first surveyed in 1979. The respondents were interviewed annually through 1994 and biennially since then. The data contain information about respondents' family and social background, such as parents' socioeconomic status or neighborhood, individual personality, and mental/physical health outcomes. To consider different life stages, this study uses different waves of data, including 1979, 1982, 1987, 1988, 1989, 1992, and cross-round surveys when respondents were in their 40's or 50's. We restrict our sample to respondents who do not have missing data on the set of covariates used in our analysis ( $N = 3,562$ ). The NLSY79 offers sampling weights at each wave to ensure the representativeness of the samples. Given the longitudinal nature of the data, the Bureau of Labor Statistics also allows researchers to create custom weights that are specific to a study with a mixture of different waves of data. The results in this study were weighted with 1992 and 2012 sampling weights, respectively. In addition, as a sensitivity analysis, we applied custom weights to our models to understand whether our results vary dependent on those weights, which will be discussed in the last section.

**Dependent variable**—The dependent variables of this study are the *CES-D* (the Center for Epidemiologic Studies Depression) (Radloff 1977) scores at two waves. The first CES-D was measured in 1992 (respondents' ages range from 27 to 35) and the second CES-D was measured when respondents were in their 40's or 50's. Since 1998, the CES-D scale has been administered in the age 40+ health module and in the age 50+ health module of the NLSY79. Respondents' CES-D scores were calculated in the wave when respondents turned age 40 and 50, respectively. The computed score ranges from 0 (the least depressed) to 21 (the most depressed) points. One's most recent CES-D score is used as the dependent variable, indicating that the CES-D score in the 50+ module will replace that in the 40+ module for those who turned 50. Since the distribution of the depression measure was skewed, a square-root transformation is used to normalize the distribution of CES-D score (Walsemann, Gee, and Geronimus 2009).

**Independent variable**—The Rosenberg scale is designed to measure *self-esteem*, based on Rosenberg questions (Rosenberg 1965). Specifically, respondents were asked to rate the applicability of 10 statements, such as "I am a person of worth" and "I have a number of good qualities," in the 1987 survey (ages 22–30). Each value of these responses ranges from 0 (strongly disagree) to 3 (strongly agree). Therefore, the range of the self-esteem scores is from 0 to 30, a higher score indicating a higher level of self-esteem. The reliability and

validity of the Rosenberg scale have been examined elsewhere (McMullen and Resnick 2013; Robins, Hendin, and Trzesniewski 2001).

**Mediators**—Substance and alcohol use were measured during young adulthood in the NLSY79. For substance use, two variables were collected in 1988— the number of times respondents have used *cocaine* and *marijuana*—and the response values range from 0 (never) to 6 (100 or more occasions) for both substances.<sup>2</sup> As for alcohol use, two variables were used to measure heavy alcohol consumption or addiction in 1989, which are “frequency had a strong desire/urge to drink,” and “frequency needed to drink and could not think of anything else.” In this study, the former is labelled as *alcohol-urge*, and the latter is as *alcohol-addiction*. The values of these two variables range from 0 (never happened) to 4 (happened 3+ times in past year).

**Control variables**—Respondents’ sociodemographic and family background at the baseline (1979) are included in the analysis to account for the difference at the beginning of the survey. *Age* (ranging between 14 and 22), *the number of siblings* (0 – 16) and *mother’s and father’s educational attainment* (0= none, 16= 4<sup>th</sup> year college, 20= 8<sup>th</sup> year college or more) were controlled as continuous variables. Dummy variables were constructed to control for *race/ethnicity* (Hispanics, Blacks, and Whites = reference), *enrollment status* (not enrolled/completed less than 12<sup>th</sup> grade = reference, enrolled in high school, enrolled in college, and not enrolled/high school graduate) in the first survey, *poverty* (yes= 1), whether a respondent was *living with both mother and father* (yes= 1) and lived in *rural* areas (= 1). As discrimination has been considered as a key element of self-esteem (Hughes and Demo 1989; Rosenberg 1986), we considered *racial discrimination experience* when getting a good job in 1982 (yes= 1) in the analysis as a control variable.

### Analytical Strategy

Our analytic strategy has two stages. We first conducted descriptive statistics analysis and bivariate tests to understand whether there is any gender difference in the variables used in this study. The second stage was to examine the research hypotheses by implementing two regression models. The first model uses self-esteem in 1987 as the key treatment variable and the CES-D score in 1992 as the dependent variable. Substance use in 1988 and alcohol use in 1989 are included as the mediators. We further expanded the first model into the second model by including the CES-D score in the 40+/50+ modules as the ultimate dependent variable, with the CES-D score in 1992 serving as an independent variable. The second model not only helps us to evaluate the strength of the causation of depression, but also allows us to clarify whether low self-esteem in young adulthood affects depression in middle adulthood. The second model is inspired by the cross-lagged model suggested by Sowislo and Orth (2013) in which they use the depression measured in an earlier time period to predict later depression. This study stratified the sample by gender because previous literature has suggested that there are gender differences in the relationship between self-

<sup>2</sup>This study focused on marijuana and cocaine because the two substances are the most widely used substances and important determinants of individual outcomes, such as health, employment, and marital stability (DeSimone 2002; Kaestner 1997). Different types of substances including amphetamines, barbiturates, and tranquilizers were only measured in 1984, which makes it inappropriate to include them as mediators in this study, and information on other substances, such as opioids, is not available in NLSY79 data.



esteem and mental health (Kendler and Gardner 2014; Nolen-Hoeksema 2001; Parker and Brotchie 2010; Piccinelli and Wilkinson 2000).

The two models stratified by gender were implemented with the method newly developed by Karlson, Holm, and Breen (KHB method hereafter) to decompose the overall effect of self-esteem on depression into direct and indirect effects (Breen, Karlson, and Holm 2013). The former refers to the impact that stems directly from self-esteem on CES-D scores, whereas the latter indicates the influence on depression through mediators. Specific to this study, the indirect effects are those originating from self-esteem, going through the alcohol and substance use behaviors, and ultimately affecting one's depression score. As the KHB method is fairly new, we would like to discuss the advantages of the KHB method over the conventional mediation analysis techniques. First, the KHB method is built upon the classical mediation analysis process proposed by Baron and Kenny (1986) and allows researchers to examine multiple mediators simultaneously (Breen et al. 2013). As most readily available mediation analysis techniques only allow one mediator (Hayes 2013; Imai, Keele, and Tingley 2010), the KHB method is the most appropriate approach for examining the alcohol and substance use mechanisms at the same time. Second, unlike the traditional mediation analysis, the KHB method estimates all effects (i.e., overall, direct, and indirect) on the same scale, making comparisons across different mediators or coefficients reliable. This is especially true when multiple mediators are considered in the mediation analysis. The third advantage of the KHB method is the ability to include other confounding variables in the analytic framework without the scale identification issue. Given these merits, the KHB decomposition approach has been found to keep the features of decomposing a linear model (Karlson and Holm 2011). Furthermore, it permits a vector of mediators to be analyzed even in a nonlinear model (Kohler, Karlson, and Holm 2011). As the technical details of the KHB method have been discussed in detail by the developers (Breen et al. 2013; Karlson and Holm 2011; Kohler et al. 2011), we opted to exclude them here though they are available upon request. We used the KHB Stata module to implement the multivariate models (and the descriptive analysis) in Stata 13.

## RESULTS

Following the analytic strategy, we first conducted descriptive statistics analysis and the results were summarized in Table 1. The first column shows the descriptive statistics of our overall samples, followed by the results of men and women, respectively. The last two columns contain the test result for gender difference in a certain variable and variance inflation factors (VIFs). Several findings are noteworthy. First, we did not find gender differences in sociodemographic variables (except for perceived racial discrimination) and the test results suggested that the socioeconomic background and individual characteristics were comparable between male and female NLSY79 respondents. This finding should strengthen the evidence obtained from the multivariate analysis because the potential confounders (i.e., control variables) do not vary differently by gender. Second, unlike the control variables, we found significant differences in our key variables of interest—the CES-D scores at both time periods, self-esteem in 1987, and mediators. To be specific, we found that the depression level was consistently higher among women than men. Men's average self-esteem is higher than women's, even though the variation in self-esteem was similar

across gender (i.e., 0.11 for men and 0.12 for women). For the mediators related to substance use, men tended to report higher prevalence than did women and this gender difference was particularly applicable to alcohol-urge in 1989. It should be noted that we did not find a significant difference in alcohol-addiction between men and women. Based on the frequency analysis (results not shown), more than 90% of the respondents (both genders) reported no sign of alcohol addiction, which explains the lack of significance for this mediator.

In addition, we found the CES-D scores decreased from early (1992) to middle adulthood when respondents turned 40 or 50 and this trend holds for both genders. Beyond the descriptive statistics in Table 1, we performed the analysis to calculate the VIFs in order to examine whether multicollinearity among the independent variables is a concern. All the VIFs, in the last column of Table 1, were smaller than 5, indicating that multicollinearity should not bias our conclusions.

Table 2 presents the analytic results (by gender) using the KHB method for the first model where the CES-D score in 1992 was the dependent variable and the four alcohol and substance use variables were mediators. Note that all the control variables were considered in the KHB analysis but only the mediation analysis results were included in Table 2. For this model, we found that, first, consistent with the findings in the literature, an increase in self-esteem in 1987 significantly decreases depression during young adulthood (1992) overall. This finding stands for both genders ( $\beta = -.042$  and  $-.054$  for men and women, respectively). Second, despite the similar overall pattern across gender, we found that the mediating mechanisms work better for men than for women. To be specific, among men, the alcohol and substance use mediators during young adulthood jointly account for 16.37% ( $\beta = -0.007$ ;  $p < 0.001$ ) of the total effect of self-esteem on depression. By contrast, only 3.60% of the total effect can be attributed to the same mediators and this joint mediating effect is not significant. This finding echoes the gender socialization theory and suggests a gender difference in the mechanism linking self-esteem and depression during young adulthood. Third, after decomposing the contribution of each mediator, we found that alcohol-urge and addiction play a more important role than substance use (i.e., marijuana and cocaine) as they account for larger percentages of the total effect among men (both higher than 5%). Though the alcohol and substance use mechanisms did not adequately explain how women dealt with the effect of self-esteem, the KHB results indicated that alcohol-urge and alcohol-addiction outweighed marijuana and cocaine use—a similar pattern found for men.

Our second model used the CES-D score obtained when a respondent turned 40 or 50 years of age as the ultimate dependent variable and the CES-D score in 1992 was included in the KHB analysis as a control variable. The KHB results were shown in Table 3. The most noteworthy finding drawn from Table 3 is that even after controlling for earlier depression (in 1992), a one unit decrease in self-esteem in 1987 is still related to a 0.033 to 0.035 unit increase in the depression (i.e., square-root of CES-D scores) during middle adulthood for both gender. The effect of self-esteem on depression was found to last for almost two decades (from 1987 when respondents were aged 22–30 to their middle adulthood when they were at least 40 years old). Since this second model controls for CES-D score from 1992, it measures the mediating roles of substance use in 1989 in the relationship between



self-esteem in 1987 and the change in depression symptoms between 1992 and respondent's middle adulthood (ages 40's and 50's). It can be understood as that the effects of self-esteem and substance use in young adulthood lingered on mental health in middle age, even after controlling for the level of depression in young adulthood.

In addition, after considering the depression score in 1992, the percentage of the effect mediated by the alcohol and substance use variables decreases in contrast to the first model. For men, the mediation percentage drops from 16.37% to 13.94%, while the joint mediating effect remains significant ( $\beta = -.005$ ;  $p < 0.01$ ). However, for women, the mediation was not statistically significant, suggesting that the alcohol and substance use mechanisms failed to explain the effect of self-esteem during young adulthood on depression during middle adulthood. Despite the decrease in the mediation percentage, the finding that alcohol-urge and alcohol-addiction are more important mediators than marijuana and cocaine use still holds, for men in particular.

Comparing the results of the first model with those of the second model makes it evident that including the transformed CES-D score in 1992 in the analysis attenuates, but does not eliminate, the total effect of self-esteem on depression during middle adulthood. The total effect shrank more than 20% for men  $((.042-.033)/.042 = 0.21)$  yet almost doubled for women  $((.054-.035)/.054 = 0.35)$ , which suggests that depression is more directly relevant to previous depression among women than men. The different level of change in the total effect (from Table 2 to Table 3) further narrows the gender gap in the action of self-esteem on depression, indicating that one's lack of self-esteem during young adulthood affects one's depression during middle adulthood in a fashion similar across genders.

## DISCUSSION

We now revisit our research hypotheses with the results shown above. We first hypothesized that the effect of self-esteem on depression during young adulthood is mediated by alcohol and substance use behaviors. According to our findings in Table 2, we confirmed this hypothesis, particularly for men. Using the self-esteem measured in 1987 and the CES-D score in 1992, we found that more than 16% of the total effect of self-esteem on depression can be mediated by men's alcohol and substance use behaviors, whereas it is not found among women. The result suggests that men's externalizing negative emotion via substance uses is ultimately associated with higher depression, which indicates substance uses partially operate as mediators among men.

We subsequently suggested that the self-esteem during young adulthood imposes an impact on one's depression during middle adulthood and the mediating roles of alcohol and substance use remain significant in our analysis. Our results in Table 3 partially bolster the second hypothesis. More specifically, the long-lasting effect was found for both genders; however, the mechanisms were found statistically significant only for men. The long-term mechanism is not entirely clear, but some studies have provided several plausible explanations for why these variables lead to a further increase in depression. First, addiction or substance use disorder change both brain structure and function, which is related to the development of mental illness (Potenza et al. 2011; Volkow 2001). In addition, low self-

esteem is damage to individual's self-concept and identities in the long-term, as well as the short-term, so that individuals with low self-esteem are likely to have difficulty trusting people and receiving less social support (Copeland et al. 2013; Wolke et al. 2013). This low self-esteem with interpersonal difficulties should be related to elevating depression in middle adulthood.

The last hypothesis stated that the mechanisms through alcohol and substance use vary by gender and there are two points worth mentioning. First, as shown in Tables 2 and 3, the alcohol and substance use mediators accounted for at least 14% of the total effect of self-esteem on depression for men. By contrast, these mediators are non-significant in both models for women. The results suggest that men are more likely to use alcohol and substances to cope with the negative effect caused by decreasing self-esteem than are women. We tested the equality of regression coefficients with the pooled standard errors of the difference in the estimates (Paternoster et al. 1998), but the test result did not indicate a significant difference in regression coefficients between men and women. The reason why gender differences in the mediation process are not significant is that the effect of alcohol and substance use on depression does not vary by gender. Second, it should be noted that the moderating effects of gender and self-esteem on the substance and alcohol use are statistically significant. As shown in Appendix Figure 1(a), 1(b), and 1(c), the effect of self-esteem on the substance and alcohol use (the frequency of cocaine use, the level of alcohol-urge and alcohol-addiction) significantly varies by gender, which supports the literature that shows male tend to externalize their negative emotion.

This study advances the literature in three ways. First and foremost, our findings not only echo the previous research suggesting that the vulnerability model holds across genders (Orth and Robins 2013; Sowislo and Orth 2013), but they also unveil the direct and long-lasting effect of self-esteem on depression (after almost two decades). Second, as discussed previously, little attention has been paid to investigating the mechanisms between self-esteem and depression. Using the NLSY79 data, this study is among the first to report that the alcohol and substance use mechanisms explain more than 14% of the total effect of self-esteem on depression and to suggest that the mechanisms linking low self-esteem and high depression work among men. Finally, these analyses provide general support for gender socialization theory. Women tend to internalize negative emotions, like low self-esteem, and there is little evidence that women's engaging in substance use disorder is a response to the stressor. On the contrary, men are more likely to externalize the negative emotions via risk behaviors, such as alcohol and substance uses. The relatively high prevalence of alcohol-urge among men may be understood as a consequence of men coping with the effects of low self-esteem (Kessler et al. 1994; Rieker et al. 2010).

Nevertheless, this study does not provide support for the functional equivalence perspective. The "functional equivalents" argument emphasizes the gender difference in coping with negative emotion/stress with men externalizing stress with risk behaviors and women internalizing stress with depression (Horwitz and White 1987; Rosenfield and Smith 2010; Simon 2002). Should this "functional equivalents" argument stand in our study, we would expect that (1) risk behaviors (e.g., substance use) fully mediates the effect of self-esteem on depression among men and that (2) risk behaviors could not explain the association between

self-esteem and depression among women. According to our findings in Tables 2 and 3, we only obtain some support for the expectation among men because risk behaviors account for roughly 15 percent of the total effect of self-esteem on depression and the direct effect remains statistically significant. However, by contrast, we acquire stronger evidence to bolster the expectation for women as the mediating effects are trivial (less than 1 percent overall) and not statistically significant. Given these findings, we have to conclude that the functional equivalents argument does not stand in this study. It should also be noted that while we demonstrate higher prevalence of substance use among men, the mediation analysis does not suggest that engaging in risk behaviors is an effective approach to externalizing stress or low self-esteem in our data. This finding supports Mirowsky and Ross's arguments that substance use disorder does not protect men from depression and depression does not displace risk behaviors (Mirowsky and Ross 1995, 2003). It also echoes Hill and Needham's argument that depression among women and substance use disorder among men are not comparable indicators of misery. These contributions were further strengthened with our sensitivity analysis results, and by the fact that we did not find significant gender differences in the sociodemographic backgrounds of the respondents. Also, after applying different weights (i.e., the NLSY79 custom weights) to our models, our findings and conclusions were not altered, indicating that our results are fairly robust.

In spite of the contributions above, this study is subject to several limitations. For one, the generalizability of our findings is limited to the cohort who were born between 1957 and 1965, rather than the entire population. Second, while self-esteem and depression were measured using well-known scales, it is unclear whether using different measures would change our findings and conclusions. Third, since the measures of substance use are self-reported and based on single items, their reliabilities would be complemented by biological assessment techniques (Richter and Johnson 2001). Fourth, although treatment for depression may be an important factor influencing substance use, mental disorder, and self-esteem, there is no measure of treatment for depression in the data set. Future work could examine how treatment alters the relationship between self-esteem and depression. Fifth, though we are aware that the relationship between self-esteem and depression may be shaped by other unmeasured factors (e.g., social relationship), NLSY79 does not provide such information and more efforts are warranted in the future to investigate how these factors mediate the long-term effect of self-esteem on depression. Last but not least, future studies could examine factors mediating the relationship between self-esteem and depression in women. Although substance uses hardly worked as mediators in women sample of this study, other factors, such as coping skills and emotional support from family or friends, may be potential mediators.

This study carries important implications. First, our finding that alcohol and substance use mediates the effect of self-esteem suggests that behavioral intervention is necessary to help those with low self-esteem, men particularly, to avoid binge drinking and substance use. Such intervention techniques include addiction support groups, recovery hotlines, and rehabilitation sessions - ideally at the community-level. Second, given the long-lasting overall effect of self-esteem on depression, it becomes crucial to assist young adults with low self-esteem to regain the sense of worthiness and strengthen their self-confidence. For example, intervening programs, such as the cognitive behavioral treatment, would help to

improve self-esteem for adolescents because self-esteem is more malleable during one's early life span (Steiger et al. 2014). Finally, as the mechanisms linking women's self-esteem to depression remains little understood, more efforts are warranted to investigate the mediators, especially those that are amendable. Doing so will further promote population health and eventually reduce the gender health disparity in depression.

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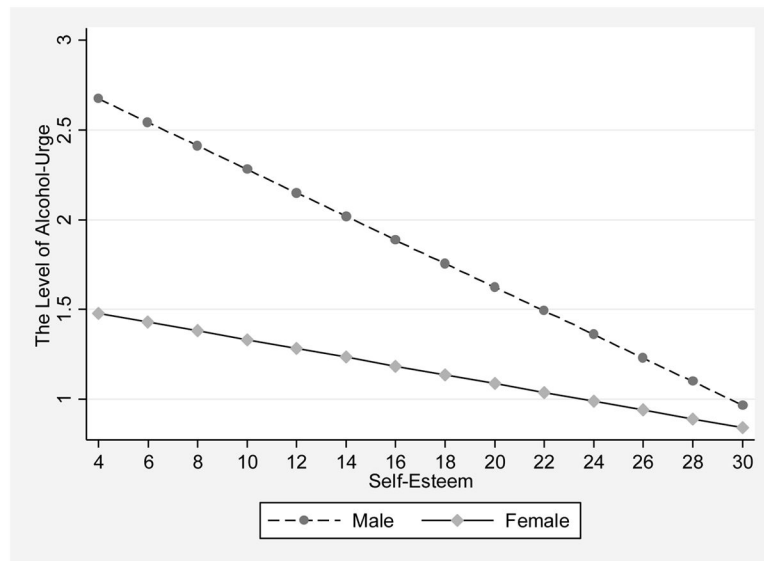
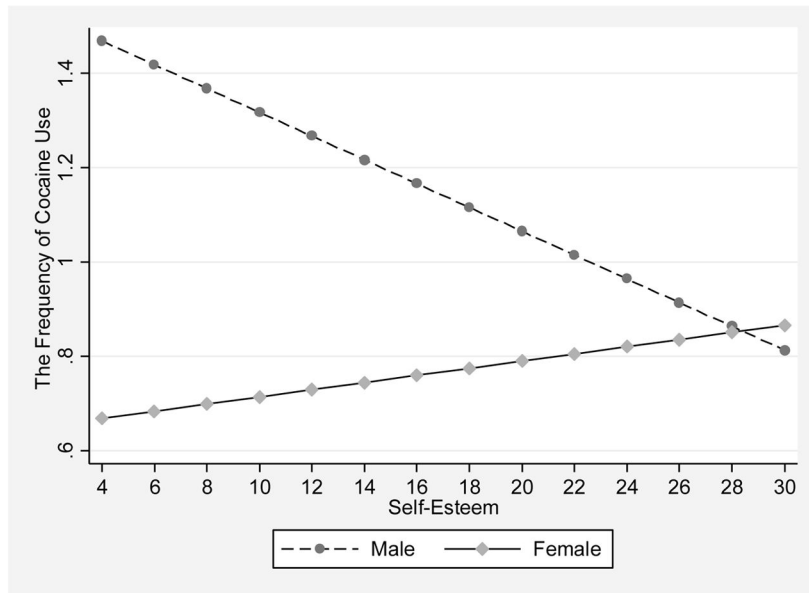
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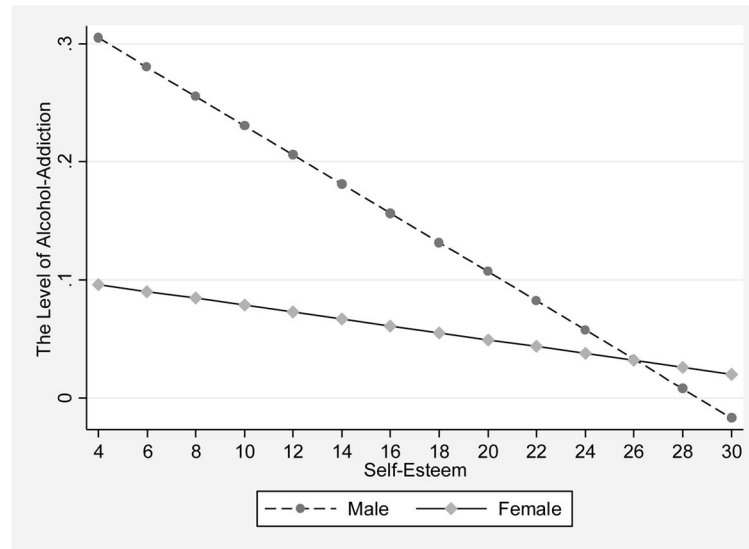
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**Appendix Figure 1.**

Appendix Figure 1(a). Moderating Effects of Gender (female= 1) and Self-Esteem (1987) on the Frequency of Cocaine use (1988) ( $\beta = .033$ ;  $p < .05$ )

Appendix Figure 1(b). Moderating Effects of Gender (female= 1) and Self-Esteem (1987) on the Level of Alcohol-urge (1989) ( $\beta = .041$ ;  $p < .01$ )

Appendix Figure 1(c). Moderating Effects of Gender (female= 1) and Self-Esteem on the Level of Alcohol-addiction (1989) ( $\beta = .009$ ;  $p < .1$ )

Note: National Longitudinal Survey of Youth 1979 (NLSY79); Ordinary least square regression is used; Gender differences in these models are statistically significant; Appendix 1(a), 1(b), and 1(c) models control for all covariates in Table 2.

**Table 1**  
 Descriptive Statistics of Variables by Gender, National Longitudinal Survey of Youth (NLSY) 1979, Weighted Means and Standard Deviation

	Overall (N= 3,562)		Men (N= 1,965)		Women (N= 1,597)		Gender Differences <sup>a</sup>	VIF
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
<b>Dependent variables<sup>b</sup></b>								
CES-D 1992 (0–21: the most depressed)	1.65	.02	1.53	.03	1.79	.03	***	
CES-D 40+/50+ (0–21: the most depressed) <sup>c</sup>	1.35	.02	1.21	.03	1.54	.04	***	
<b>Independent variable</b>								
Self-esteem 1987 (0–30: the highest self-esteem)	24.18	.08	24.39	.11	23.9	.12	**	1.15
<b>Mediators</b>								
Marijuana use 1988 (0–6: 100 or more occasions)	2.37	.04	2.53	.05	2.16	.05	***	1.7
Cocaine use 1988 (0–6: 100 or more occasions)	.89	.03	0.96	.04	.82	.04	*	1.67
Alcohol-urge 1989 (0–4: 3+ times in past year)	1.18	.03	1.33	.04	.98	.04	***	1.1
Alcohol-addiction 1989 (0–4: 3+ times in past year)	.05	.01	0.05	.01	.04	.01	-	1.06
<b>Sociodemographic variables</b>								
Age 1979	17.72	.05	17.72	.06	17.71	.07	-	2.98
Race/Ethnicity								
Hispanic	.06		.06		.05			1.42
Black	.10		.09		.10			1.39
Non-black, Non-Hispanic (reference)	.85		.85		.85			-
Enrollment status 1979								
Not Enrolled, completed less than 12th grade (reference)	.08		.08		.07			-
Enrolled in high school	.50		.52		.48			4.33
Enrolled in college	.18		.18		.19			2.63
Not enrolled, high school graduate	.24		.22		.26			2.9
Poverty (=1) 1979	.09		.08		.09			1.22
Mother's education (0–20)	11.97	.05	11.98	.06	11.96	.07		2.02
Father's education (0–20)	12.31	.07	12.35	.09	12.27	.09		1.9
# of siblings 1979	3.12	.04	3.06	.05	3.19	.06		1.23
Living with mother & father (=1) 1979	.81		.81		.80			1.05
Rural (=1) 1979	.21		.22		.20			1.12

	Overall (N= 3,562)		Men (N= 1,965)		Women (N= 1,597)		Gender Differences <sup>a</sup>		VIF
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Racial discrimination (=1) 1982	.05		.06		.04		.04		1.09

Note:

<sup>a</sup> Chi-square test and t-test (two-tailed) with weights are used to see the gender differences

\* p<.05;

\*\* p<.01;

\*\*\* p<.001

<sup>b</sup> CES-D has been transformed using the square-root.

<sup>c</sup> Because of missing observations, the numbers of samples when respondents are 40's or 50's are decreased to 1,676 and 1,401, for male and female, respectively.

**Table 2**

Total, Direct, and Mediating Effects of Self-esteem on Depressive Symptoms in Young Adulthood (ages 27–35), using KHB Mediation Analysis and Decomposition Results by Gender, NLSY79<sup>†</sup>

Self-esteem	Men (N = 1,965)			Women (N = 1,597)		
	Estimates	Robust SE	Mediation Percentage	Estimates	Robust SE	Mediation Percentage
Total Effect	-.042***	.007	NA	-.054***	.029	NA
Direct Effect	-.035***	.007	NA	-.052***	.029	NA
Mediating Effect	-.007***	.002	16.37%	-.002	.006	3.60% <sup>a</sup>
<i>via</i>						
Marijuana use	-.002*	.001	4.70%	-.000	.000	.65%
Cocaine use	.000	.001	-.49%	.000	.000	-.42%
Alcohol-urge	-.003*	.001	6.44%	-.001 <sup>‡</sup>	.001	2.44%
Alcohol-addiction	-.002*	.001	5.72%	-.000	.001	.91%

Note:

<sup>†</sup> All models control for age, the number of sibling, mother's and father's educational attainment, race/ethnicity, enrollment status, poverty, whether a respondent was living with both mother and father and lived in rural areas, and racial discrimination experience. CES-D scale uses a square-root transformation.

<sup>a</sup>This indirect effect is not statistically significant.

<sup>‡</sup> p<.1;

\* p<.05;

\*\* p<.01;

\*\*\* p<.001, two-tailed test.

NA= Not Available.



**Table 3**

Total, Direct, and Mediating Effects of Self-esteem on Depressive Symptoms in Middle Adulthood (ages 40's – 50's), using KHB Mediation Analysis and Decomposition Results by Gender, NLSY79<sup>†</sup>

Self-esteem	Men (N = 1,676)			Women (N = 1,401)		
	Estimates	Robust SE	Mediation Percentage	Estimates	Robust SE	Mediation Percentage
Total Effect	-.033***	.008	NA	-.035***	.009	NA
Direct Effect	-.029***	.008	NA	-.035***	.009	NA
Mediating Effect	-.005**	.002	13.94%	.000	.001	-.74% <sup>a</sup>
<i>via</i>						
Marijuana use	-.001	.001	2.36%	.000	.000	-.24%
Cocaine use	-.000	.001	.27%	.001	.001	-1.94%
Alcohol-urge	-.003*	.001	8.08%	-.001	.001	1.73%
Alcohol-addiction	-.001	.001	3.22%	.000	.001	-.28%

Note:

<sup>†</sup> All models control for previous depressive symptoms level (1992), in addition to the control variables that were included in Table 2. CES-D scale uses a square-root transformation.

<sup>a</sup> This indirect effect is not statistically significant

\* p<.05;

\*\* p<.01;

\*\*\* p<.001, two-tailed test.

NA= Not Available.

Appendix Table 1

Moderating Effects of Gender (female= 1) and Self-Esteem (1987) on the Use of Cocaine (1988), Alcohol-urge (1989), and Alcohol-addiction (1989), NLSY79

	Model (1) Cocaine		Model (2) Alcohol-urge		Model (3) Alcohol-addiction	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
<b>Independent variable</b>						
Self-esteem 1987 (0-30)	-0.025**	0.010	-0.066***	0.011	-0.012**	0.004
<b>Sociodemographic variables</b>						
Female	-0.930**	0.348	-1.362***	0.373	-0.247 <sup>+</sup>	0.129
Age 1979	-0.024	0.022	-0.020	0.023	-0.003	0.005
Race/Ethnicity						
Hispanic	0.059	0.078	-0.161 <sup>+</sup>	0.088	0.014	0.020
Black	-0.28***	0.071	-0.291***	0.078	0.014	0.022
Enrollment status 1979						
Enrolled in high school	-0.382**	0.134	-0.296*	0.141	-0.083*	0.054
Enrolled in college	-0.263 <sup>+</sup>	0.137	-0.328*	0.148	-0.090*	0.045
Not enrolled, high school graduate	-0.145	0.130	-0.292*	0.138	-0.080*	0.045
Poverty (=1) 1979	0.049	0.096	-0.089	0.102	0.001	0.025
Mother's education (0-20)	0.047**	0.014	0.026 <sup>+</sup>	0.014	0.004	0.003
Father's education (0-20)	0.040***	0.011	0.001	0.011	-0.001 <sup>+</sup>	0.002
# of siblings 1979	-0.001	0.013	0.014	0.015	-0.009**	0.003
Living with mother & father (=1)	-0.213**	0.070	-0.142	0.079	-0.056*	0.023
Rural (=1) 1979	-0.126 <sup>+</sup>	0.066	0.027	0.080	-0.011	0.015
Racial discrimination (=1) 1982	0.084	0.121	0.188	0.131	-0.000	0.030
<b>Female * Self-Esteem 1987</b>	<b>0.033*</b>	<b>0.014</b>	<b>0.041**</b>	<b>0.015</b>	<b>0.009<sup>+</sup></b>	<b>0.005</b>
N		3,562		3,562		3,562
R <sup>2</sup>		0.04		0.04		0.03

Note: Ordinary least square regression is used for Appendix Figure 1(a), 1(b), and 1(c).

p<.001, two-tailed test.  
\*\*\*  
;10>d  
\*\*  
;50>d  
\*  
;1>d  
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