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The cumulative risk associated with demographic background characteristics among substance use treatment patients

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ABSTRACT

Background: A significant amount of research has been conducted on the association between demographic background characteristics and substance use treatment outcomes among adults, but this body of work has not yet examined how multiple factors in combination magnify the risk for post-treatment substance use.

Methods: The current study utilized a sample of 12,320 adults drawn from the Comprehensive Assessment and Treatment Outcome Research (CATOR) system to investigate how multiple demographic risk factors increase the likelihood of substance use after treatment.

Results: A series of bivariate analyses and multivariate binary logistic regression results demonstrated a clear pattern of increased risk in the presence of a greater number of positive demographic risk factors. These demographic risk factors also amplified the risk of post-treatment substance use in the presence of additional clinical indicators of treatment prognosis.

Conclusion: Select patient demographic background characteristics must be taken into consideration in the early treatment planning stages to improve long-term clinical outcomes.

Introduction

Research on substance use treatment continues to search for ways to promote and sustain successful recovery (i.e. remission) from substance use disorders. Much of this research has taken into account the clinical indicators of success, but some important factors are often overlooked. In the context of routine intake assessments, demographic background characteristics (i.e. age, committed relationship status, education level and employment status) are often taken-for-granted items that are quickly recorded in patients’ medical record before moving on to the heart of the assessment. This is in contrast to clinically relevant items, for which there is a greater emphasis in the development of appropriate treatment plans. Although clinical information is imperative to treatment placement and planning, much more attention needs to be paid to the risk posed by certain demographic background characteristics as they relate to post-treatment substance use.

Previous work in the area of the relationships between demographic background characteristics and post-treatment substance use has highlighted the importance of many of these factors. The role of employment in substance use recovery, for instance, has consistently been identified as a protective factor associated with various favorable post-treatment outcomes (Wickizer et al. 1994; Henkel 2011; Melvin et al. 2012). Employment counseling, designed to address unemployment and underemployment among adults seeking substance treatment, has been found to increase treatment retention and promote post-treatment abstinence from substance use (Gold 2004; Reif et al. 2004; Atherton & Torriello 2011). Employment has also been recognized a key factor in discouraging substance use while providing structure for adults in recovery (Magura 2003; Silverman et al. 2016).

In addition to consistent and stable employment, educational attainment is an important feature of adults’ substance use treatment success. Research has shown that many adults in treatment have reached distinct (i.e. graduation from high school or equivalent) levels of academic achievement, but the skills (e.g. reading comprehension, mathematics) generally associated with certain levels are often far lower (Holyn et al. 2015). Treatment patients with higher educational attainment have been found to be at lower risk for poor outcomes due to a greater likelihood of seeking treatment for alcohol use compared to drugs, initiating use later in life compared to less educated patients who started earlier and having higher rates of treatment retention (Sahker et al. 2015).

Patients’ age has also received some attention in the substance use treatment literature, especially as it relates to treatment success. Results have shown that older adult patients fare better after substance use treatment compared to their younger counterparts (Brennan et al. 2003; Lemke & Moos 2003). This is complimented by recent evidence, which
has shown that there are age-specific needs for younger adults seeking treatment for substance use disorders, particularly in the period of emerging adulthood between the ages of 18 and 25 years (Bergman et al. 2016). Substance use during early formative periods may differentially impact younger adults, which may contribute to the demand for specific treatment modalities focused on the targeted needs of this high-risk age group.

Social attachment in the form of a committed relationship can also be an important element of treatment success. Research has shown that involvement in a marital relationship can suppress drug use (Heinz et al. 2009). The positive influence, encouragement and support often associated with such a relationship can also encourage treatment retention, with patients not currently in a relationship experiencing higher rates of attrition (Joe et al. 1998; Brorson et al. 2013). In addition to the increased likelihood that patients will continue to engage with their primary treatment program, positive stable relationships have been found to promote many favorable clinical outcomes (Tracy et al. 2005; McKee et al. 2011). Overall, the evidence suggests that commitment to a stable, positive relationship can support patients throughout the treatment experience, ultimately increasing the likelihood of success.

Although this research demonstrates demographic factors can significantly influence post-treatment substance use, there are other important issues to consider. Patients’ clinical severity of substance use is one of these known correlates of treatment outcomes. For example, patients who reported higher levels of alcohol consumption and more problems related to their alcohol use have been found to be less likely to achieve long-term remission from alcohol use disorder (Moos & Moos 2006). Similar results have been observed with smokers who reported higher pre-cessation nicotine levels and patients who reported polydrug use experiencing higher odds of relapse (Termorshuizen et al. 2005; Powell et al. 2010). Evidence has also shown injection of drugs to be another contributing factor to higher relapse rates among substance use treatment patients, with those who have injected being five times as likely to experience relapse compared to those who have not recently injected (Greenwood et al. 2001). Altogether, this work strongly suggests that a greater clinical severity of substance use can significantly increase patients’ risk for post-treatment substance use.

Researchers have also identified adolescent misconduct as a precursor to later substance use (Fergusson et al. 2007; Englund Egeland et al. 2008). The generally observed pattern in this work indicates adolescents who experience various forms of misbehavior appear to be more likely to engage in substance use and to use at greater levels later in life. From a retrospective point of view, adults experiencing several demographic risk factors for poor substance use treatment outcomes may have experienced behavioral problems in adolescence, which could make treatment more challenging. In combination, these factors could have significant additive effects as they interact with one another to influence substance use treatment outcomes.

Based on this previous work, demographic risk factors consistently appear in the literature related to outcomes of substance use treatment, with some of them garnering significantly more attention than others. The evidence suggests that employed, older, higher educated adults in a committed relationship seem to achieve more successful treatment outcomes. The literature examining these factors independently has shown them to significantly increase the probability of relapse and rearrest among adults involved in the criminal justice system (Kopak et al. 2016). However, this body of work has not closely examined the additive effects of age, marital status, employment and education, especially as they interact with other risks (i.e. clinical severity of substance use and adolescent misbehavior) for poor treatment outcomes. The current study was designed to fill this gap in the knowledge with a focused examination of the additive impact of employment, education, age and being involved in a committed social relationship as they relate to post-treatment substance use. Based on prior research, it was hypothesized that the more demographic risk factors present, the greater the risk of negative outcomes in the form of a higher likelihood of substance use after treatment. Existing work also suggests these risk factors will further enhance the risk of relapse in the presence of greater clinical severity of substance use and adolescent misconduct.

**Methods**

**Data and sample**

Data for the current study were drawn from the Comprehensive Assessment and Treatment Outcome Research (CATOR) system. This program was the largest independent (i.e. non-government funded and not owned by any individual treatment provider) substance use treatment program evaluation and served as one of the most comprehensive assessments of programs across the United States (Proctor & Herschman 2014). The system included an array of inpatient (e.g. residential) and outpatient programs, with inpatient programs generally including daily individual and group therapy while outpatient programs consisted of a minimum of nine hours of therapeutic care per week. All programs also focused on education and family therapy as well. Although there was some variation in program delivery techniques, all programs operated according to an abstinence-based approach. Human subject’s protection was approved by the Institutional Review Board of the Foundation supervising the study.

The CATOR system involved the collection of information in a longitudinal prospective evaluation design which was initiated at the time of admission to substance use treatment. Data collection continued after discharge with a 12-month follow-up assessment. Clinicians conducted an intake assessment, which consisted of a face-to-face interview involving self-reported diagnostic information, to serve as baseline data. Treatment staff did not have access to patients’ follow-up data to minimize potential social desirability of responses. This information related to several known correlates of recovery such as pretreatment indications of substance use, treatment history, criminal justice involvement, psychosocial factors and vocational functioning.
The total sample was comprised of 12,320 adults between the ages of 18 and 65 (\( M = 36.19, \ SD = 10.85 \)) who entered substance use treatment. Data derived from routine intake assessments as well as 12-month follow-up interviews were used for the present analysis. The majority (71\%) of patients was male and most were White (87\%). All participants met Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; American Psychiatric Association [APA], 1994) criteria for substance dependence on one or more substances. Individuals presenting criteria for abuse were not included. All treatment programs included in the CATOR project required patients to receive a dependence diagnosis to be admitted into the program. Thus, patients with less severe substance use indications (i.e. patients meeting criteria for substance abuse or those reporting less than three dependence criteria and no abuse criteria) were ineligible for inclusion in the project.

**Measures**

The dependent variable for the current study was post-treatment substance use. Patients who indicated any use of alcohol, marijuana, cocaine, other stimulants (e.g. amphetamines), barbiturates, opiates, tranquilizers, or hallucinogens in the initial 12-month period post-discharge from primary treatment were coded ‘1’. Patients who did not report the use of any of these substances were coded ‘0’. Although post-treatment substance use was self-reported, previous work has shown a relatively high level of compatibility between actual use and confirmatory evidence of abstinence among treatment patients (Hoffmann & Ninomuerto 1994).

A demographic risk index was constructed as the primary independent variable. Based on prior research identifying the correlation between demographic risk and persistent substance use (Zywiak et al. 1999), an additive measure was created to assess four background items including (1) age, (2) marital status, (3) highest educational level achieved and (4) employment status. Following previously established methods for creating additive clinical scales (e.g. Kenaszchuk et al. 2013), patients received one point on this demographic risk index for each of the four items, including if they were under 25 years of age, had never been married, had not received a high school diploma or GED, and were unemployed upon admission to treatment. Scores ranged from 0 to 4 with higher scores indicative of greater risk.

A secondary independent variable was constructed to assess the clinical severity of patients’ substance use. This measure was an additive scale of eight items, which included baseline responses to the items: (1) ‘Have you ever had withdrawal symptoms after stopping drinking?’ (coded ‘0’ for no and ‘1’ for yes), (2) ‘Have you ever had withdrawal symptoms after stopping drug use?’ (coded ‘0’ for no and ‘1’ for yes) and (3) ‘Did you use alcohol or drugs during a prior treatment episode?’ (coded ‘0’ for no and ‘1’ for yes). These eight items were summed to create an additive scale that ranged from 0 to 8, with larger values representing more severe cases of substance use at treatment initiation.

Based on prior evidence of a strong association between behavioral conduct and substance use treatment outcomes (Goldstein et al. 2007; Mariani et al. 2008), an adolescent risk behavior index, consistent with DSM-IV and DSM-5 criteria (APA, 1994, 2013) for conduct disorder, was included as another secondary independent variable. This eight-item additive scale was used to assess how many risk behaviors patients reported experiencing during adolescence, and addressed the following: (1) skipping school more than 10 times, (2) school suspension or expulsion, (3) arrest, (4) running away from home overnight more than once, (5) vandalism or destruction of property, (6) shoplifting or stealing, (7) sexual intercourse with more than one person and (8) starting physical fights. Each of these items was coded ‘0’ if patients indicated they had not been involved in the behavior and ‘1’ if they were involved in the behavior. The scores were summed, creating an index that ranged from 0 to 8 with higher values indicative of involvement in a greater number of adolescent risk behaviors.

Several additional indicators of risk were assessed. Patients were coded according to the number of substance dependence diagnoses received. Those who received one diagnosis were coded ‘0’ and those who received more than one substance dependence diagnosis were coded ‘1’. Prior involvement in the criminal justice system was also assessed. Patients who reported being arrested prior to treatment entry were coded ‘1’ and patients who were reported no history of arrests were coded ‘0’.

Analyses also controlled for several additional individual characteristics and clinical variables known to impact outcomes, including sex (Wechsberg et al. 1998), race/ethnicity (Montgomery et al. 2012) and treatment level (Finnin et al. 1996). Male patients were coded ‘0’ and female patients were coded ‘1’. Patients’ racial and ethnic background was also taken into account with patients that self-identified as White coded ‘0’ while patients who identified as Asian, Black, Hispanic, Native American, or ‘other’ were coded ‘1’ and classified as nonwhite. Patients who received treatment in a residential program were coded ‘0’ and those who received treatment in an outpatient program (i.e. day outpatient, evening outpatient, or combination of day/evening outpatient) were coded ‘1’.

**Data analysis**

All analyses were conducted with Stata 14 (StataCorp 2015). Analysis of variance, (ANOVA), Chi-square tests and t-tests were used to examine differences between pretreatment risk factors and post-treatment substance use according demographic background risk levels. Binary logistic regression models were also estimated to determine the associations...
between demographic risk and post-treatment substance use while controlling for influential clinical risk factors. A subsequent set of binary logistic regression models were used to test the interaction between demographic risk and clinical risk factors.

Results

Descriptive and bivariate statistics

An initial assessment was conducted to examine the bivariate relationships between demographic risk factors and clinical indicators of post-treatment substance use. As can be seen in Table 1, there were several observable trends, with the primary pattern demonstrating greater risk in groups presenting a demographic risk factor compared to the group which did not possess the same risk factor. For instance, patients under 25 years of age systematically demonstrated greater levels of risk compared to those over 25 years of age. Younger patients presented greater clinical severity of substance use ($t(12,318) = 4.09$, $p < 0.001$), higher levels of adolescent behavioral risk ($t(12,318) = 17.78$, $p < 0.001$), were more likely to have a prior arrest ($\chi^2 (1) = 236.64$, $p < 0.001$), and were also significantly more likely to have more than one substance dependence diagnosis ($\chi^2 (1) = 417.41$, $p < 0.001$) compared to patients 25 years of age or above.

Patients who reported never being married at baseline consistently demonstrated greater levels of risk relative to patients who reported a different relationship status. Patients who were never married reported elevated levels of clinical severity ($t(12,318) = 9.33$, $p < 0.001$), greater adolescent behavioral risk ($t(12,318) = 3.51$, $p < 0.001$), and were significantly more likely to receive more than one substance use disorder diagnosis ($\chi^2 (1) = 31.17$, $p < 0.001$) compared to patients who were employed at treatment initiation. The one exception to this pattern was prior arrest in that unemployed patients were no more likely ($\chi^2 (1) = 2.07$, $p = 0.15$) than employed patients to have been arrested prior to treatment entry.

There was also a consistent relationship between education and levels of clinical risk for post-treatment substance use. Compared to patients with higher levels of education, those with lower levels of education presented greater substance use severity ($t(12,318) = 5.50$, $p < 0.001$) and higher adolescent behavioral risk ($t(12,318) = 17.05$, $p < 0.001$). Patients with lower levels of education were also significantly more likely to have been arrested prior to treatment entry ($\chi^2 (1) = 51.74$, $p < 0.001$), and were more likely to meet criteria for more than one substance dependence diagnosis ($\chi^2 (1) = 9.44$, $p = 0.002$). In summary, the demographic variables were all associated with greater clinical risk and behavioral risk factors.

The next set of descriptive and bivariate statistics examined the relationships between demographic risk factor groups and clinical indicators of post-treatment substance use (Table 2). Analysis of variance results demonstrated clinical severity levels of substance use were significantly different across demographic risk factor groups ($F (4, N = 12,315) = 24.32$,

---

**Table 1.** Demographic risk factors and clinical indicators of 12-month post-treatment substance.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Clinical severity of substance use</th>
<th>Adolescent behavioral risk</th>
<th>Arrest history (%)</th>
<th>More than one SUD diagnosis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 25</td>
<td>2.91 (1.65)</td>
<td>2.43 (2.13)</td>
<td>51</td>
<td>57</td>
</tr>
<tr>
<td>25 and over</td>
<td>2.74 (1.58)</td>
<td>1.53 (1.89)</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never married</td>
<td>2.90 (1.66)</td>
<td>2.04 (2.02)</td>
<td>46</td>
<td>50</td>
</tr>
<tr>
<td>Other status</td>
<td>2.70 (1.56)</td>
<td>1.49 (1.90)</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>2.99 (1.64)</td>
<td>1.76 (2.11)</td>
<td>35*</td>
<td>39</td>
</tr>
<tr>
<td>Employed</td>
<td>2.68 (1.57)</td>
<td>1.61 (1.90)</td>
<td>34</td>
<td>33</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school or equivalent</td>
<td>3.02 (1.70)</td>
<td>2.64 (2.31)</td>
<td>44</td>
<td>39*</td>
</tr>
<tr>
<td>More than high school</td>
<td>2.73 (1.58)</td>
<td>1.56 (1.89)</td>
<td>33</td>
<td>34</td>
</tr>
</tbody>
</table>

Use. Note. All difference tests were significant with $p < 0.001$, except two. *indicates $p < 0.01$ and indicates lack of significance.

**Table 2.** Clinical indicators of 12-month relapse by demographic risk groups.

<table>
<thead>
<tr>
<th>Demographic risk level</th>
<th>Clinical severity of substance use</th>
<th>Adolescent behavioral risk</th>
<th>Arrest history (%)</th>
<th>More than one SUD diagnosis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero risk</td>
<td>2.59 (1.50)</td>
<td>1.33 (1.81)</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>One risk factor</td>
<td>2.74 (1.58)</td>
<td>1.57 (1.90)</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>Two risk factors</td>
<td>2.91 (1.65)</td>
<td>1.95 (2.05)</td>
<td>43</td>
<td>45</td>
</tr>
<tr>
<td>Three risk factors</td>
<td>2.95 (1.69)</td>
<td>2.23 (2.10)</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td>Four risk factors</td>
<td>3.21 (1.63)</td>
<td>2.43 (2.08)</td>
<td>53</td>
<td>64</td>
</tr>
</tbody>
</table>
with the group presenting all four risk factors recording the highest mean ($M = 3.21$) level of substance use severity. The same result was observed with regard to adolescent behavioral risk ($t(4, N = 12,315) = 75.99$, $p < 0.001$), which rose steadily from the group which presented zero demographic risk factors ($M = 1.33$) to the highest level, which was observed within the group presenting all four ($M = 2.43$) demographic risk factors.

**Multivariate binary logistic regression results**

A multivariate binary logistic regression model was estimated to assess the relationships between demographic risk and 12-month post-treatment substance use (Table 3). There were several significant results demonstrating the increased risk for 12-month post-treatment substance use experienced by patients who reported a greater number of demographic risk factors. Each additional indicator on the clinical severity of substance use scale was associated with a 15% increase ($OR = 1.15$, 95% CI = 1.12–1.19) in the likelihood of substance use within 12 months of discharge from treatment. A similar relationship was observed between adolescent behavioral risk and post-treatment substance use. Each additional indicator of adolescent behavioral risk was associated with a 6% increase ($OR = 1.06$, 95% CI = 1.04–1.08) in the likelihood of 12-month post-treatment substance use. Arrest history and number of substance use disorder diagnoses were not related to post-treatment substance use, but patients who participated in outpatient programs were significantly more likely ($OR = 1.16$, 95% CI = 1.05–1.27) than patients who participated in inpatient programs to report substance use within 12-months of discharge from treatment. Female patients were no more likely than male patients to report substance use within 12 months of discharge from treatment, but nonwhite patients had a significantly greater likelihood of substance use in this period compared to White patients ($OR = 1.39$, 95% CI = 1.25–1.55).

There were also several noteworthy results related to the indicators of demographic risk. The group which presented zero demographic risk factors was treated as the reference group. The group which presented one demographic risk factor was no more likely than the group which presented zero risk factors to report substance use within 12-months of discharge from treatment. This was the only group that was equally likely to report substance use after treatment as the group with zero risk. The group with two risk factors was 38% more likely ($OR = 1.38$, 95% CI = 1.24–1.54) to report substance use within the 12-month period following treatment discharge compared to the group which displayed zero demographic risk factors. The group which presented three demographic risk factors was more than two times ($OR = 2.09$, 95% CI = 1.81–2.41) as likely as the group which presented zero demographic risk factors to report substance use in the 12-month period following discharge from treatment. The group which presented four demographic risk factors was also more than two times ($OR = 2.42$, 95% CI = 1.87–3.14) as likely as the group which displayed zero demographic risk factors to report substance use in the 12-month period following discharge from treatment.

**Interaction results**

The significant associations observed in the bivariate analyses and the multivariate logistic regression model suggested the relationship between clinical severity of substance use and post-treatment substance use may have been stronger as levels of demographic risk increased. Likewise, the significant association between adolescent behavioral risk and post-treatment substance suggested that this relationship may have been stronger in the presence of elevated demographic risk. Based on this preliminary evidence, a final multivariate logistic regression model was estimated to test whether these two interactions (i.e. demographic-clinical risk and demographic-adolescent behavioral risk) were significant.

The first interaction tested was between clinical severity of substance use and demographic risk level. This interaction was statistically significant, providing evidence of a difference between the highest three demographic risk groups and the predicted probabilities of substance use within 12 months of discharge from treatment, conditional on levels of clinical severity of substance use. Specifically, there was a significant difference in the likelihood of substance use within 12 months of discharge from treatment between the group with zero demographic risk and the group with two demographic risk factors ($OR = 1.08$, 95% CI = 1.05–1.12), conditional on levels of clinical severity of substance use. A similar relationship was observed between the group which presented three demographic risk factors and the group which presented zero demographic risk factors ($OR = 1.18$, 95% CI = 1.13–1.23). There was also a significant increase in the

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$(SE)</th>
<th>Wald’s $\chi^2$</th>
<th>$p$</th>
<th>OR</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical severity</td>
<td>0.14 (0.01)</td>
<td>99.84</td>
<td>&lt;0.001</td>
<td>1.15</td>
<td>1.12</td>
<td>1.19</td>
</tr>
<tr>
<td>Adolescent risk behavior</td>
<td>0.06 (0.01)</td>
<td>30.73</td>
<td>&lt;0.001</td>
<td>1.06</td>
<td>1.04</td>
<td>1.08</td>
</tr>
<tr>
<td>Arrest history</td>
<td>0.08 (0.04)</td>
<td>3.36</td>
<td>0.067</td>
<td>1.08</td>
<td>0.99</td>
<td>1.17</td>
</tr>
<tr>
<td>More than one SUD diagnosis</td>
<td>-0.03 (0.05)</td>
<td>0.33</td>
<td>0.564</td>
<td>0.97</td>
<td>0.89</td>
<td>1.07</td>
</tr>
<tr>
<td>Outpatient treatment</td>
<td>0.15 (0.03)</td>
<td>9.36</td>
<td>0.002</td>
<td>1.16</td>
<td>1.05</td>
<td>1.27</td>
</tr>
<tr>
<td>Female</td>
<td>0.02 (0.04)</td>
<td>0.24</td>
<td>0.628</td>
<td>1.02</td>
<td>0.94</td>
<td>1.11</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>0.33 (0.05)</td>
<td>37.04</td>
<td>&lt;0.001</td>
<td>1.39</td>
<td>1.25</td>
<td>1.55</td>
</tr>
<tr>
<td>Demographic risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One risk factor</td>
<td>0.07 (0.05)</td>
<td>2.50</td>
<td>0.114</td>
<td>1.08</td>
<td>0.99</td>
<td>1.18</td>
</tr>
<tr>
<td>Two risk factors</td>
<td>0.32 (0.06)</td>
<td>32.52</td>
<td>&lt;0.001</td>
<td>1.38</td>
<td>1.24</td>
<td>1.54</td>
</tr>
<tr>
<td>Three risk factors</td>
<td>0.74 (0.07)</td>
<td>101.95</td>
<td>&lt;0.001</td>
<td>2.09</td>
<td>1.81</td>
<td>2.41</td>
</tr>
<tr>
<td>Four risk factors</td>
<td>0.88 (0.13)</td>
<td>44.32</td>
<td>&lt;0.001</td>
<td>2.42</td>
<td>1.87</td>
<td>3.14</td>
</tr>
</tbody>
</table>
likelihood of substance use in the 12-month period following treatment discharge for the group which presented four demographic risk factors relative to the group which presented zero demographic risk factors (OR = 1.22, 95% CI = 1.13–1.31), as it related to clinical severity of substance use. There was no significant difference in the likelihood of substance use within 12 months of discharge from treatment, as a condition of clinical severity of substance use, between the group which presented one demographic risk factor and the group which presented zero demographic risk factors (OR = 1.02, 95% CI = 0.99–1.05).

The predicted probabilities of substance use within 12 months of discharge from treatment, conditional on demographic risk group and clinical severity of substance use are presented in Figure 1. Low clinical severity, found on the left side of the figure, was represented by two indicators of the clinical severity of substance use. Moderate severity was represented by four items and high severity was represented by eight items. The group which presented zero demographic risk factors was predicted to have a 37% (95% CI = 0.36–0.38) likelihood of substance use within 12 months of discharge from treatment at a low clinical severity level of substance use. This predicted probability increased to 41% (95% CI = 0.39–0.44) at moderate clinical severity and 50% (95% CI = 0.45–0.55) likelihood of substance use within 12 months of discharge from treatment at high clinical severity level.

The same trend was observed for the group which presented two demographic risk factors. At low clinical severity, the group with two demographic risk factors had a 41% (95% CI = 0.39–0.42) likelihood of substance use within 12 months of discharge from treatment. This probability increased to 49% (95% CI = 0.47–0.52) at moderate clinical severity and 65% (95% CI = 0.60–0.70) at high clinical severity. The group with four demographic risk factors displayed the greatest probability of substance use within 12 months of discharge from treatment, as it related to clinical severity. This group had a 47% (95% CI = 0.43–0.50) likelihood of substance use within 12 months of discharge from treatment at low clinical severity. This probability increased to 61% (95% CI = 0.54–0.68) at moderate clinical severity, and rose to 83% (95% CI = 0.75–0.91) at high clinical severity.

A similar series of tests was conducted to assess the relationship between demographic risk levels and 12-month post-treatment substance use, conditional on levels of adolescent behavioral risk. Multivariate logistic regression results indicated that this interaction was significant, demonstrating a stronger relationship between demographic risk and post-treatment relapse in the presence of greater adolescent behavioral risk. Although there was no significant difference between the group which presented one demographic risk factor and the group with zero demographic risk (OR = 1.00, 95% CI = 0.96–1.04), there were significant differences between the subsequent demographic risk groups and the group which presented zero demographic risk factors. The group with two demographic risk factors experienced a significant increase in the likelihood (OR = 1.07, 95% CI = 1.03–1.12) of substance use within 12 months of discharge from treatment relative to the group with zero demographic risk, as a function of adolescent risk behavior. A similar relationship (OR = 1.17, 95% CI = 1.11–1.23) was observed between the group which presented three demographic risk factors and the group which presented zero demographic risk factors, conditional on levels of adolescent risk behavior. Evidence also demonstrated this significant relationship (OR = 1.20, 95% CI = 1.10–1.31) between the group which presented four demographic risk factors and the group which presented zero demographic risk.

The predicted likelihood of 12-month post-treatment substance use between demographic risk groups, as it related to adolescent behavioral risk, are presented in Figure 2. The group which presented zero demographic risk factors experienced a 40% (95% CI = 0.39–0.42) likelihood of substance use in the 12-month period following discharge from treatment at low levels of adolescent behavioral risk. This probability of substance use increased slightly to 42% (95% CI = 0.39–0.45) at moderate levels of adolescent behavioral risk and 45% (95% CI = 0.39–0.51) at high risk. The group which presented two demographic risk factors experienced a higher probability (44%, 95% CI = 0.42–0.45) of substance use in the 12-month period following discharge from

![Figure 1. Predicted probabilities of 12-month post-treatment substance use by demographic risk group and clinical severity of substance use. Low severity is defined by two indicators of the clinical severity of substance use; moderate severity is defined by four indicators, and high severity is defined by eight indicators.](image-url)
treatment compared to the zero demographic risk group. This probability also increased as adolescent behavioral risk rose, to 49% (95% CI = 0.46–0.52) at moderate risk and 59% (95% CI = 0.53–0.65) at high risk. A similar pattern was observed in the group which presented four demographic risk factors. This group experienced a 49% (95% CI = 0.45–0.53) likelihood of substance use with the 12-month period following discharge from treatment at low levels of adolescent behavioral risk. The likelihood of post-treatment substance use in the group which presented four demographic risk factors increased to 60% (95% CI = 0.52–0.67) at moderate levels of adolescent behavioral risk and 77% (95% CI = 0.66–0.89) at high risk.

**Discussion**

The current study was designed to empirically examine the relationship between demographic risk factors, clinical risk factors (i.e. substance use severity, adolescent behavioral risk) and post-treatment substance use among adult patients. The first important finding demonstrated the presence of any one of the four demographic risk factors (i.e. less than 25 years of age, having never been married, unemployment at the time of treatment admission and earning less than a high school diploma/GED) was systematically associated with greater clinical risk, including prior behavioral problems, arrest and more than one substance dependence diagnosis at the time patients entered treatment. These results emphasize the importance of considering various demographic risk factors in the development of appropriate treatment plans at the time patients enter treatment.

These results also converge with prior work on the importance of accounting for demographic risk factors in the context of substance use treatment. Recent research has focused on the need for employment interventions as one way to address the relapse risk associated with under- and unemployment among substance use patients (Ginexi et al. 2003; Webster et al. 2014). Given the significant relationship between gainful employment and relapse, treatment approaches must include an element for workforce preparation or occupational advancement to maximize effectiveness.

Treatment programs must also consider the ages of patients given the evidence demonstrating younger patients experience greater risk for relapse. New treatment modalities are being developed, some of which utilize technological approaches, to reach younger patients (e.g. Gonzales et al. 2014; Sanchez & Bartel 2015). These innovative modalities represent one way to capitalize on younger patients’ use of technology to increase retention and promote active engagement in recovery behaviors.

Relationship status has also been identified in prior research as a contributing factor to successful recovery (Tracy et al. 2005). This is part of a general social support system that can contribute to long-term recovery, but patients who cannot benefit from the encouragement generally found in a committed relationship will need to develop this from alternative sources. Building a network through the utilization of peer-enhanced recovery may be a viable approach for patients who are not in a committed relationship (Smith et al. 2016).

The results from the current study also underscore recent evidence highlighting the importance of education as an indicator of treatment success. Research has shown less educated patients present a higher risk of relapse after treatment for a variety of substance use disorders (Walker et al. 2004; McKay et al. 2005; Agnosti 2013). Patients with less education may experience an array of challenging life circumstances and stress which can contribute to a higher probability of relapse. A few of these hardships include financial strain due to underemployment and sporadic work that is characteristic of many low wage positions.

It is also important to recognize how demographic risk factors compound on one another to elevate the risk for post-treatment relapse. The observed findings clearly highlight an increased likelihood of 12-month post-treatment substance use in the presence of two or more demographic risk factors. It is reasonable to suspect that younger, unmarried, unemployed and relatively low educated patients would likely encounter several extenuating life circumstances that would put them at elevated risk for substance use after...
discharge from treatment. These challenges must be addressed if treatment programs aspire to successful long-term recovery from substance use after discharge from treatment.

The importance of demographic risk factors was reinforced further when examined in conjunction with indicators of adolescent behavioral risk as well as clinical risk factors. Demographic risk factors interacted with both of these risk indices in a similar manner, magnifying the probability of post-treatment relapse to substance use. This finding stressed the significant influence of demographic risk on treatment outcomes as the other risk indices also increased.

This study offers new information about the relationship between demographic risk factors and post-treatment relapse, but it is not without its limitations. The CATOR system was largely comprised of private nonprofit treatment facilities which were willing to participate in an external performance evaluation. These selection criteria may limit the representativeness of the facilities included in the current study. Although the system included a large sample of facilities and patients, there was limited representation of racial and ethnic minority group members. It is also important to note only patients who met dependence criteria for admission to treatment were included in the study. Patients with mild substance use disorders were not accurately represented in these data. Data were also comprised of self-reports gathered through formal behavioral health assessments and should be interpreted accordingly.

There are also several important areas which warrant further inquiry. Patients with lower educational attainment, for example, may need specialized interventions to help address greater risk for relapse. This is also the case for patients who enter treatment in the absence of a committed relationship. Further study of the effectiveness of the social support systems of unmarried patients can help strengthen the treatment experience. Additional research is also necessary to investigate differences in demographic risk factors between racial and ethnic groups, as well as examination of the relationship between risk factors and post-treatment relapse to substance use to determine the extent to which these vary according to race or ethnicity.

Guidelines for effective treatment highlight the need to match a treatment protocol to individual’s particular problems and needs (National Institute on Drug Abuse 2012). This approach is usually followed closely when it comes to conducting clinical needs assessments and documenting the rationale for treatment placement. However, demographic risk factors are usually only indirectly taken into account, perhaps through financial eligibility and access to certain types of programs. Given the significant association between these risk factors and post-treatment substance use, demographic risk should also be taken into account when matching treatment services to patients’ needs. Age-appropriate program options (Keurbis & Sacco 2013; Mawson et al., 2015) and employment interventions (Magura et al., 2004; Laudet, 2012), for example, should be given serious consideration. Failure to do so may inhibit patients’ long-term post-treatment success.

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