Pathways of Depression and Substance Use from Childhood to Young Adulthood: A Longitudinal Analysis

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Introduction

According to the WHO estimates, worldwide, the number of people with depression increased by more than 18% between 2005 and 2015. More than 80% of this disease burden is among people living in low-and middle-income countries (WHO, 2017). Adolescents are particularly vulnerable to developing mental health problems, and the majority of them often begin at an early age (Patel et al., 2007). Available data suggest that the prevalence of depression in the early ages ranges from 1.2% to 6.9% in different studies in India (Grover et al., 2019). The association between substance use and the resultant depressive disorder among adolescents has been well documented in recent literature. It is found that adolescents with frequent substance use had significantly higher scores on a measure of depression than their counterparts (Howard et al., 2019; Kaur et al., 2014; Kremer et al., 2014). Such a causal association is explained by the fact that depression may result from the biological or psychosocial consequences of substance use behaviors (Hernandez et al., 2016). Also the self-medication hypothesis asserts that risk taking is used to ameliorate depressive symptoms possibly through lowering impulse control or motivation (Chassin et al., 2009; Khantzian, 1997). Several studies support this pathway. For example, one study followed over 4000 adolescents from grades 9 to 12 and found those reporting higher depressive symptoms in grade 9 reported faster increases in tobacco and drugs use (Hooshmand, Willoughby, & Good, 2012).

Nevertheless, studies also suggest a reverse or bidirectional causation between substance use and depressive symptoms (Taylor, 2011; Wasil et al., 2020), indicating that adolescents having depressive symptoms turn to several types of substances to cope with the negative effect or depression and substance use co-occur in adolescence which leads to major life taking risks like suicides. A longitudinal study of African Americans from age 6 to 42 found increased substance use (alcohol, drugs, cocaine) in adolescence predicted psychological distress in young adulthood but only for men (Green, Zebrak, Robertson, Fothergill, & Ensminger, 2012).

Furthermore, there are gender and socioeconomic differences, with girls and children from higher socioeconomic strata being at greater risk for depression (Jha et al., 2017; Mathias et al., 2015; Singh et al., 2017). Sex complicates the self-medication hypothesis as adolescent females generally report more depression and less risk taking; the aforementioned studies did not examine sex differences (Chassin et al., 2009; Kann et al., 2014). Studies examining sex differences show conflicting results. For example, symptoms of depression were positively associated with alcohol, tobacco, and drug use in a clinical sample of 400 youths but relationships were not moderated by sex (Schwinn, Schinke, & Trent, 2012). In contrast, in a sample of ninth and 10th grade students, overall negative mood predicted rapid smoking escalation in boys, but only those with affect-related motives for smoking; for girls, negative mood variability predicted smoking escalations indicating moderation by sex (Weinstein & Mermelstein, 2013).

In the context of rapid social change being witnessed in India, it is very important to understand the factors leading to depression of adolescents that affect their educational attainment and career. Previous studies of the association between depression and substance use in adolescents are limited by cross-sectional design or, when longitudinal, by using non-representative samples, short time periods, or not examining both directions or sex differences (Brook, Brook, Zhang, Cohen, & Whiteman, 2002; Chinet et al., 2006). This paper prospectively examines directionality over a longer time period using the UDAYA sample and stratifying by sex. Based on prior research, we hypothesized greater support for the self-medication hypothesis for males and greater support for the reverse pathway for females.

Data and Methods

Data

The study utilized data from the Understanding the lives of adolescents and young adults (UDAYA) project survey conducted in two Indian states, namely, Uttar Pradesh and Bihar, in 2016 by Population Council under the guidance of the Ministry of Health and Family Welfare, Government of India. The UDAYA adopted a multi-stage systematic sampling design to provide the estimates for states as a whole as well as urban and rural areas of the states. The required sample for each sub-group of adolescents was determined at 920 younger boys (10–14 years), 2,350 older boys (15–19 years), 630 younger girls, 3,750 older girls, and 2,700 married girls in both states. The effective sample size for this study was 20,594 (boys-5969 and girls-14,625) adolescents aged 10–19 years.

Measures

Depressive symptoms

Depressive symptoms were assessed by asking nine questions using PHQ-9 scale from the respondents; the respondent was asked about the symptoms for the past 2 weeks only. The questions included, (a) had trouble falling asleep or sleeping too much, (b) feeling tired or having little energy, (c) poor appetite or eating too much, (d) trouble concentrating on things, (e) had little interest or pleasure in doing things, (f) feeling down, depressed, or hopeless, (g) feeling bad about yourself, (h) been moving or speaking slowly, (i) had thoughts that respondent would be better off dead. All the above questions were asked on a scale of four, i.e., 0 "not at all," 1 "less than once in a week," 2 "one week or more" and 3 "nearly every day." The scale of 27 points was then generated using egen command in STATA 17. The variable was treated as a count variable for the analytical purpose, with a Cronbach alpha value of 0.86 (Kroenke et al., 2001).

Substance Use

Substance use was recoded as "no" and "yes," i.e., respondents who either consume any type of substance, including either tobacco or alcohol consumption or any drugs, or do not consume tobacco or alcohol or any drugs.

Controls

The study used the following predictor variables.

1. Physical activity was categorized as "yes," i.e., engage in any physical activities, and "no," which involves respondents who do not engage in any physical activities. Physical activities also include respondents who participated in any games or sports.
2. Age, which was in years recoded as 10–12, 13–14, 15–17, and 18–19 years.
3. Sex of the respondent was available in the data as adolescent boys and adolescent girls.
4. Education was recoded as no education, 1–7, 8–9, and 10 and above years of education.
5. Marital status was recoded as never married and married. There were no cases of marriage dissolution.
6. Mother's education was recoded as no education, 1–7, 8–9, and 10 and above years of education.
7. Caste was recoded as Scheduled Caste and Scheduled Tribe (SC/ST) and non-SC/ST.
8. Religion was recoded as Hindu and non-Hindu. The category of non-Hindu was recoded so because the frequency of other religions was very low; therefore, for analytical purposes, the recoding was done in respective manner.
9. Wealth index was recoded as poorest, poorer, middle, richer, and richest.
10. Residence was available in data as urban and rural.
11. Data was available for two states, i.e., Uttar Pradesh and Bihar. The survey was conducted in these two states only

Statistical analysis

Using STATA 17 mean was calculated for depressive symptoms among adolescents over explanatory variables. Mean was calculated for outcome variables overall explanatory variables. Descriptive analysis was done to show the different characteristics of the population. To determine the association between the count outcome (in this case score of depressive symptoms 0–27) variable and other explanatory variables, the negative binomial regression method was used as the data was over-dispersed (variance was more than mean), as Poisson regression was not feasible to use. The negative binomial regression model does not assume an equal mean and variance and particularly correct for over- dispersion in the data, which is when the variance is greater than the conditional mean (Osgood, 2000). The equation for negative binomial distribution is given below

$$Pr(Y = y \mid \lambda, \alpha) = \frac{\Gamma(y + \alpha^{-1})}{y! \, \Gamma(\alpha^{-1})} (\frac{\alpha^{-1}}{\alpha^{-1} + \lambda})^{\alpha^{-1}} (\frac{\lambda}{\alpha^{-1} + \lambda})^{y}$$

The parameter λ is the mean incidence rate of y per unit of exposure. Exposure here is the count of depressive symptoms (0–27 scale).Four models were used for the analytical purpose to show the bidirectional nature, i.e., model-1, to show the unadjusted association between depressive symptoms at earlier age and substance use at later wave. Model-2 observed the adjusted relationship, model-3 unadjusted association between substance use at earlier wave and depressive symptoms at later wave and lastly model-4 observed the adjusted relationship, and we compared the fit of the model for males as compared with females again by using chi-square difference tests. longitudinal weights were used to adjust for unequal probability of selection into the sample and nonresponse over time. We test our assumptions of linearity in the ordinal substance use measures by treating the variables as ordinal and continuous in two different models and comparing the BIC between the two models.

Conceptual Framework

Results

The socio-demographic profile of the study population is shown in Table 1 first section. About 82% of adolescent boys and 30% of girls were physically active, and nearly 16% of adolescent boys and 2% of adolescent girls were using substance use. The majority of adolescents belonged to the 15–17 years age group (boys-46.4% and girls-45.3%). The mean score of depressive symptoms among adolescents by background characteristics was presented in Table 1 second section . Overall, adolescent girls (mean-2.3; SE: 0.03) had a higher mean score of depressive symptoms than adolescent boys (mean-1.1; SE: 0.03). Mean depressive symptoms were more among adolescent boys who were physically active (Mean-1.2; SE: 0.03), and the result was opposite for adolescent girls (Mean-2.0; SE: 0.05). Adolescents who were using substance use had higher depressive symptoms [mean-1.7; SE: 0.10 (boys) and mean-4.1; SE: 0.26 (girls)] compared to those who were not using. The mean of depressive symptoms increased with an increase in the age and was highest among adolescents aged 18–19 years [mean-1.6; SE: 0.08 (boys) and mean: 2.9; SE: 0.06 (girls)]. Interestingly, married adolescent girls (mean-3.0; SE: 0.06) had a higher mean of depressive symptoms than never married ones (mean-1.9; SE: 0.04). The mean depressive symptoms were more among SC/ST [mean-1.2; SE: 0.06 (boys) and mean-2.6; SE: 0.07 (girls)] adolescents than non-SC/ST. Adolescent boys belonged to rural areas (mean-1.2; SE: 0.04) had higher mean scores of depressive symptoms than those living in urban areas. Moreover, the result was opposite in the case of adolescent girls.

Table 1. Socio-economic and demographic profile of the study population along with Mean of depressive symptoms among adolescents by background characteristics.

| | | Sample Characteristics | | | | Mean of Depressive Symptoms | | | |
| | | Adolescent Boys | | Adolescent Girls | | Adolescent Boys | | Adolescent Girls | |
Variables		Sample	Percentage	Sample	Percentage	Mean	Standard error	Mean	Standard error
Physical activity									
	Yes	4,877	81.7	4,350	29.7	1.2	0.03	2	0.05
	No	1,092	18.3	10,275	70.3	1.1	0.07	2.4	0.04
Substance use									
	No	4,990	83.6	14,274	97.6	1	0.03	2.3	0.03
	Yes	979	16.4	351	2.4	1.7	0.1	4.1	0.26
Age (years)									
	10-Dec	944	6.5	1,322	22.2	0.7	0.04	0.7	0.06
	13-14	709	4.9	762	12.8	0.9	0.06	1.2	0.09
	15-17	6780	46.4	2,703	45.3	1.2	0.05	2.1	0.04
	18-19	6192	42.3	1,182	19.8	1.6	0.08	2.9	0.06
Education (years)									
	No education	190	3.2	1,890	12.9	0.8	0.12	2.7	0.1
	1-7	2,497	41.8	3,939	26.9	0.9	0.04	1.9	0.06
	8-9	1,754	29.4	4,093	28	1.2	0.05	2.5	0.06
	10 and above	1,528	25.6	4,703	32.2	1.6	0.07	2.3	0.05
Marital Status									
	Never Married	N.A	N.A	9,419	64.4	N.A	N.A	1.9	0.04
	Married	N.A	N.A	5,206	35.6	N.A	N.A	3	0.06
Mother's education (years)									
	No education	4,233	70.9	10,946	74.9	1.1	0.03	2.4	0.04
	01-Jul	615	10.3	1,476	10.1	1.3	0.1	2.3	0.1
	08-Sep	490	8.2	986	6.7	1.3	0.11	1.9	0.1
	10 and above	631	10.6	1,216	8.3	1	0.06	2	0.09
Caste									
	SC/ST	1,605	26.9	3,784	25.9	1.2	0.06	2.6	0.07
	Non-SC/ST	4,364	73.1	10,841	74.1	1.1	0.03	2.2	0.04
Religion									
	Hindu	5,001	83.8	11,479	78.5	1.1	0.03	2.3	0.04
	Non-Hindu	968	16.2	3,146	21.5	1.1	0.07	2.4	0.07
Wealth Index									
	Poorest	704	11.8	1,971	13.5	1	0.09	2.2	0.09
	Poorer	1193	20	2735	18.7	0.9	0.07	2.2	0.08
	Middle	1,374	23	3,188	21.8	1.3	0.07	2.3	0.07
	Richer	1,391	23.3	3,577	24.5	1.2	0.06	2.5	0.07
	Richest	1,391	21.9	3,154	21.6	1.3	0.06	2.3	0.06
Residence									
	Urban	1,030	17.3	2,356	16.1	1.1	0.04	2.5	0.05
	Rural	4,939	82.7	12,269	83.9	1.2	0.04	2.3	0.04
State									
	Uttar Pradesh	4069	68.17	9,855	67.4	1.1	0.04	2.3	0.04
	Bihar	1900	31.83	4,770	32.6	1.1	0.03	2.3	0.03
Total		**5969**	**100**	**14,625**	**100**	**1.1**	**0.03**	**2.3**	**0.03**

Discussion

Depression among adolescents has been rising around the world (Sharma, 2016). Various risk factors have been outlined for depression among adolescents; however, this study understands the need to examine depression and its associated factors among adolescents in India's two economically backward states, namely, Uttar Pradesh and Bihar. Our paper provides evidence of depression among adolescents aged 10–19 years. This study included 20,594 adolescents aged 10–19 years and confirmed that depression was higher among late adolescents (15–19 years), educated adolescents, married adolescents, and adolescents who consumed any substance.

We assessed the relationship directionality between depressive symptoms and substance use from adolescence into young adulthood using two states data of India. Overall, we found support for each pathway. Depressive symptoms were associated with increases in later smoking for females and drugs use frequency for males, consistent with the self-medication hypothesis though contrary to our hypothesis of a stronger relationship for males (Khantzian, 1997). Smoking was also associated with later increases in depressive symptoms for both males and females, and the relationship was stronger for females, consistent with our hypothesis. Our most robust finding is that an increase in depressive symptoms among females is significantly associated with a nearly two-day later increase in monthly smoking. Evidence of depression self-medication with tobacco smoking has been found elsewhere, perhaps because tobaccos have been linked with increases in positive affect and decreases in negative affect, both of which are implicated in depression (Audrain-Mcgovern, Rodriguez, & Leventhal, 2015; Burns et al., 2004; Hedeker, Mermelstein, Berbaum, & Campbell, 2009; Hooshmand et al., 2012).

Taken together, our findings suggest a bidirectional relationship between depressive symptoms and tobacco smoking for females. This could be interpreted as evidence that self-medication of depressive symptoms with nicotine does not ameliorate the symptoms (Chaiton et al., 2010). Further, as females increase their tobacco smoking frequency, they are engaging in a non-normative activity that could increase interpersonal stress, thereby increasing depressive symptoms (Ge et al., 1994; Nelson et al., 2008; Rudolph, 2002). Past studies that tested for bidirectional associations using Add Health data (Goodman & Capitman, 2000; Hallfors et al., 2005) and a sample of Canadian adolescents (Hooshmand et al., 2012) did not find them. However, they used different measures of smoking and different time frames and one explained the bidirectional association away with potential confounders.

Limitations

Our findings should be considered in the context of this study's limitations. The study has some limitations also. The data was collected for only two states of India, and therefore, findings shall not be generalized to the population. The depression was categorized based on nine questions, and the study sought to answer those questions based on self-reporting from the adolescents. This study could not confirm the diagnosis of depression clinically. Another possible limitation could be the time period for reporting depression; the respondents were asked about the symptoms for the past 2 weeks only. A qualitative probe into the research question might have helped us understand the phenomenon in a better way. Despite the above limitations, the study provides first-hand information of depression among adolescents in India's two most economically backward states.

Conclusion

Findings from this study demonstrated a higher mean depression score among late adolescents, educated adolescents, adolescent girls, and adolescents who were consuming substance and were physically inactive. Findings call out the need for health promotion interventions in decreasing educational stress. School-based programs are important in targeting adolescents with depression, and such programs have proven efficacy school-based programs reduce depressive symptoms among adolescents.

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