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# Adolescent Cigarette Use in the Americas: The Link with Depression

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## 1. Introduction

While society's understanding of the burden of disease associated with substance use and mental health disorders continues to grow, serious gaps remain in our ability to help all individuals with these disorders. It has been estimated that the use of tobacco and alcohol each represent 8.7% and 3.8% of all deaths worldwide. In addition, the Disability-Adjusted Life Years (DALYs) caused by alcohol, tobacco and illicit drug use are estimated to be 4.4%, 3.7% and 0.9%, respectively (WHO, 2009). Unfortunately, these gaps are likely to be substantially larger among racial and ethnic minorities and culturally diverse populations.

The purpose of this chapter is to describe the extent of comorbidity between depressive symptoms and tobacco use among adolescents in North, Central and South America. We accomplish this purpose via a thorough literature review of the subject and by empirically exploring the association between depressive symptoms and cigarette use among adolescents using data from several studies conducted in the Americas. These studies are (1) the National Survey of Drug Use and Health (NSDUH), a national household representative study of drug use and mental health in the United States; (2) the National Longitudinal Survey of Youth (NLSY), a longitudinal study of youth and their families also conducted in the United States; (3), data from several national studies of drug use conducted by various Latin American countries carried out in collaboration with the Organization of American States - Inter-American Drug Abuse Control Commission; and (4) the Santiago Longitudinal study (SLS), a longitudinal study of substance use among adolescents and their families underway in Santiago, Chile. We conclude the Chapter with a discussion of implications for prevention and treatment by reviewing the corresponding literature.

### 1.1 Depressive disorders and symptoms in the Americas

Data from the United States suggest that about 11% of the adolescent population experiences a depressive disorder in their lifetime (Merikangas et al., 2010). The lifetime prevalence of depression among adolescents in Canada is estimated to be around 7% (Cheung & Dewa, 2006). In Mexico City, the prevalence rate of major depression among 12-

to 17-year-old adolescents has been estimated to be approximately 7.6% (Benjet et al., 2009). Because we were not able to identify studies of mental health disorders in Latin American countries that used nationally representative samples to obtain country-wide estimates, we provide a brief review of findings from studies using adult populations. Overall, studies with adult populations in Latin America have found that depressive disorders account for approximately 7% of the disease burden in the region (WHO, 2003). Studies have estimated the prevalence rate of Major Depressive Disorder to be around 30% among the adult population seeking health care services in Emergency Departments in various countries in Latin America (Castilla-Puentes et al., 2008). Using the World Mental Health Composite International Diagnostic Interview in various countries in the Americas, the 12-month prevalence rate of mood disorders among adults, including major depression, ranges from 4.8% in Mexico, to 10% in Colombia, and 18.2% in the United States (WHO, 2004).

Data on depressive symptoms among adolescent populations are available for a few Latin American geographic areas and cities. For example, using a representative sample of adolescents residing in the Brazilian San Gonzalo municipal area, the second most populous area of the state of Rio de Janeiro, Avanci and colleagues (Avanci, Assis, & Oliveira, 2008) assessed depressive symptoms using the Self-Rating Questionnaire for Depression (SRQ-20) scale (Harding et al., 1980). The results suggested that 10% of this group exhibited depressive symptoms (Avanci, Assis, & Oliveira, 2008). In another study of Brazilian youth, one of children and adolescents attending public schools in the municipality of Ribeirão Preto, and using the Child Depression Inventory, it was found that 6.4% of the 5,000 6- to 18-year-olds exhibited depressive symptoms (Golfeto, D'Oliveira, Baptista, & Bisson, 2011). In addition, Camacho and colleagues (2009) carried out a school-based survey in the Colombian providence of Santander and found that the prevalence of major depressive disorder using the Spanish translation of the Center for Epidemiological Studies Depression Scale (CES-D) among adolescents was 11.5% (Camacho et al., 2009). Furthermore, the prevalence of depressive episodes among 12- to 17-year-old adolescents representing three urban cities in Peru was estimated to be 5.7% (Vargas et al., 2010) using the Mini International Neuropsychiatric Interview (Sheehan et al., 1998). Finally, among a representative sample of Chilean adolescents residing in the capital, Santiago, the prevalence rate of depressive symptoms was estimated to be 6.9% (Florenzano et al., 2009).

The results of the aforementioned studies provide varying rates of depressive symptoms among adolescents in Latin America. However, none of these studies used samples that allow for generalizations to the general population of adolescents in their respective countries, let alone the entire region. In fact, these studies have used samples representative of specific geographical regions or cities within individual countries. Further, each of the studies mentioned above have used different assessment tools when measuring depressive symptoms and depressive disorders. Thus, the varying estimates of depressive symptoms might be partly due to differences in how the assessment tools assess depression, rather than reflect true country-based differences in depressive symptoms. Our literature review indicates that there are currently no national representative studies of depressive symptoms or depressive disorders among adolescents in Latin America.

## **1.2 Cigarette use among adolescents in the Americas**

Data from the Monitoring the Future study, an ongoing yearly survey of drug use among school-attending adolescents in the United States, suggests that in 2010 7.1% of 8th-graders,

13.6% of 10th-graders, and 19.2% of 12th-graders in the United States had used cigarettes in the past 30 days (Johnston, O'Malley, Bachman, & Schulenberg, 2011). To further illustrate the extent of cigarette use among adolescents in the United States, we used publicly available data from the 2004-2009 NSDUH to obtain estimates of past-month cigarette use among adolescent males and females (see Table 1). The NSDUH, conducted by the U.S. Substance Abuse and Mental Health Services Administration, samples the civilian, noninstitutionalized population of the United States (including civilians living on military bases) 12 years of age or older (SAMHSA, 2009). The NSDUH is an annual nationwide survey that interviews about 70,000 randomly selected individuals aged 12 to 64 years. Only participants 12 to 17 years old were selected for the analyses conducted for the purpose of this Chapter. The survey has been carried out annually since 1991 but for the purpose of this Chapter we used data from 2004-2009. We restricted the data to these years because later in the Chapter we present data on depression among adolescents 12-17 years old using the NSDUH. The NSDUH included questions on adolescent depression only for the 2004-2009 years (see Table 3 later in the Chapter).

As shown in Table 1, the percent of adolescent males and females who have smoked a cigarette in the past month has shown a slight decrease since 2004. Perhaps more interesting, the percents of male and female recent smokers are fairly similar. This could suggest that the male risk factor for cigarette use is no longer applicable (Brook et al., 2008), or, that adolescent females are taking similar risks and engaging in similar risky behaviors as adolescent males. In fact, the same risk factors (such as lower parental education, living in a one parent family) for being a daily smoker have been identified to have an effect on both female and male adolescents (Voorhees, Schreiber, Schumann, Biro, & Crawford, 2002). Despite the sharing of risk factors, certain risk factors appear to more specifically influence adolescent females. Higher drive for thinness and higher stress levels during the transition to puberty are two such factors (Voorhees et al., 2002).

<b>Gender</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>
Total adolescent sample	18,294	18,678	18,314	17,727	17,842	17,705
Males	11.2	10.5	10.1	10.2	8.7	9.2
Females	12.5	11.1	11.1	9.7	9.0	8.6

Table 1. Percent of adolescents 12-17 years old who consumed cigarettes in the past month, by gender and year, in the United States: National Survey of Drug Use and Health (NSDUH) 2004-2009.

In Latin America, trend data are more limited but, as shown in Table 2, we find that there is considerable variety in the proportion of 12- to 17-year-olds in the region who have smoked cigarettes in the previous 30 days. Using data from the Organization of American States Inter-American Drug Abuse Control Commission indicate that Chile, Uruguay, and Argentina show the highest prevalence of past-month cigarette use across a range of years. In the most recent year for which data are available for Chile (2009), 35.6% of adolescent females and 30.6% of adolescent males smoked cigarettes in the past month. In Uruguay, data from the same year indicate that 21.1% of adolescent females and 15.5% of adolescent males have used cigarettes the past month. Data from 2007 for Argentina indicate that 22%

of adolescent females and 21.6% of adolescent males have smoked cigarettes in the previous 30 days. The countries that exhibit the lowest rates of previous 30 day smoking by adolescents are the Bahamas, Panama and Venezuela.

Country	2004		2005		2006		2007		2008		2009	
	M	F	M	F	M	F	M	F	M	F	M	F
Argentina			21.0	21.3			21.6	22.1				
Antigua			2.7	1.1			20.2	19.4				
Bahamas									1.6	1.6		
Barbados					3.6	3.2						
Bolivia	22.7	11.0							18.9	8.4		
Chile			38.4	44.3			32.7	37.9			30.6	35.6
Colombia	27.7	18.6										
Costa Rica					10.0	7.2					9.5	7.7
Ecuador			29.6	13.8								
El Salvador									13.2	5.9		
Honduras			12.89	5.91								
Panama									6.0	3.8		
Paraguay			17.7	12.3								
Peru			21.5	12.4			13.6	7.4				
Uruguay			21.1	29.5			19.9	24.3			15.5	21.1
Venezuela			5.2	2.8							2.8	6.6

Table 2. Percent of adolescents 12-17 years old who consumed cigarettes in the past month by year in Latin American countries.

### 1.3 Comorbidity of depression and cigarettes use: Etiological considerations

A variety of studies have suggested a relationship between cigarette smoking and depressive disorders and depressive symptoms. Although the exact mechanisms responsible for this relationship remain uncovered (Audrain-McGovern, Rodriguez, Cuevas, & Rodgers, 2009), the association between cigarette smoking and depressive disorders can be explained in several ways. First, depressive disorders may lead to cigarette use (Nezami et al., 2005; Wu & Anthony, 1999). Using data from the National Longitudinal Study of Adolescent Health, Munafò and colleagues (2008) found that among individuals who had never smoked at baseline, increases in depressive symptoms lead to smoking initiation but not to becoming regular smokers (Munafò, Hitsman, Rende, Metcalfe, & Niaura, 2008). Some have suggested that mood disorders may lead individuals to smoke due to their need to alleviate distressing symptoms they may be experiencing (Khantzian, 1997). The self-medication hypothesis, proposed by Khantzian (1985), states that individuals choose to use certain substances because they offer the individual alleviation from painful emotional states. The proposed pathway through which the self-medication hypothesis is thought to work involves individuals having low self-efficacy in the control of their own emotional states, which in turn, create a vulnerability for depressive symptoms that then is controlled through the use of tobacco (Minnix, Blalock, Marani, Prokhorov, & Cinciripini, 2011). Another suspected pathway, one that may particularly apply to females, suggests that adolescent females' expectations that smoking will reduce their negative affect may help explain the relationship between depression and cigarette use (Morrell, Cohen, & McChargue, 2010). Furthermore, others have suggested that depression increases

adolescents' risk of smoking by increasing their susceptibility to peer pressure from peers who smoke (Patton et al., 1998).

Second, cigarette smoking might lead to depressive disorders. Empirical investigations in the United States have shown that higher levels of depression are observed among adolescents who are current smokers, compared to levels of depression among adolescents who have never smoked and those who are former smokers (Martini, Wagner, & Anthony, 2002), but the exact mechanisms for this association have yet to be uncovered. For example, using longitudinal data from the United States National Longitudinal Study of Adolescent Health, Steuber and Danner (2006) found that current smokers were more likely to experience depressive symptoms, even after controlling for prior level of depression (Munafò et al., 2008; Steuber & Danner, 2006). For the past two decades, a considerable amount of empirical attention has been devoted to understanding the genetic factors associated with cigarette smoking. The result of such attention has been the uncovering of specific genes that may predispose individuals to experiencing a reward upon consuming nicotine (Barrueco, Alonso, & Gonzalez-Sarmiento, 2005; Gerra et al., 2005; Lerman et al., 1999). Nicotine itself has been found to have an influence on the neurotransmitter systems that are involved in the development of depression (Morisano, Bacher, Audrain-McGovern, & George, 2009). It has been hypothesized that neurochemical changes in the brain caused by depression, specifically in the cholinergic system (Dagyte, Den Boer, & Trentani, 2011), may create a vulnerability to seek the rewarding effects of smoking (Lerman et al., 1998). Of particular importance to this chapter is the research on genetic predisposition to smoking among adolescents who experience depression (Audrain-McGovern, Lerman, Wileyto, Rodriguez, & Shields, 2004). This research suggests that 11-th grade adolescent smokers with an DRD2 A1 allele are particularly susceptible to depressive symptoms. The interactions between depressive symptoms and the genetic predisposition may lead to a progression towards smoking.

A third explanation suggests that shared risk factors are involved in the etiology of both problems. Several studies from various countries have provided evidence that depressive disorders and cigarette use share similar, if not the same, environmental and genetic precursors (Fergusson, Boden, & Horwood, 2011; Hu, Davies, & Kandel, 2006; Kendler et al., 1993; Mykletun, Overland, Aaro, Liabo, & Stewart, 2008; Rohde, Lewinsohn, Brown, Gau, & Kahler, 2003). Using longitudinal data from New Zealand, Boden and colleagues (2003) found that even after controlling for environmental (e.g., experienced stressful life events, unemployment, and affiliation with deviant peers, among others) and genetic risk factors associated with cigarette use (e.g., nicotinic acetylcholine receptors CHRNA5, CHRNA3 and CHRNB4 (Chen et al., 2009)) and depressive symptoms (SLC6A15 (Kohli et al., 2011)) there remained a significant association between these two variables (Boden, Fergusson, & Horwood, 2010; Fergusson, Goodwin, & Horwood, 2003). Certainly more research is needed to understand the mechanisms responsible for the association between cigarette use and depressive symptoms (Munafò & Araya, 2010).

Regardless of the initiating factor, it has also been hypothesized that a reciprocal relationship exists between cigarette use and depressive symptoms whereby a feedback loop is likely to occur once smoking or depression symptoms manifest themselves (Breslau, Peterson, Schultz, Chilcoat, & Andreski, 1998). For instance, it has been found that individuals who use nicotine are at an increased risk for developing depression because of

the effect that nicotine has on the acetylcholine and catecholamine systems (Pomerleau & Pomerleau, 1984), which themselves have been implicated in the onset of depression (Carmody, Vieten, & Astin, 2007).

### 1.3.1 Studies of cigarette use and depression with North and Latin American populations

#### 1.3.1.1 North America

Studies using national representative samples of adolescents in the United States have found that those who report greater depression symptoms are at greater risk for smoking initiation (Moon, Mo, & Basham, 2010). Similarly, data from adolescents in California suggest that those who report greater depression during 6<sup>th</sup> grade are at greater risk for smoking initiation two years later (Weiss, Mouttapa, Cen, Johnson, & Unger, 2011). Further, higher levels of depressive symptoms at age 14 have been associated with a steeper rate of smoking progression (Audrain-McGovern, Rodriguez, & Kassel, 2009). Depressive symptoms also have been found to be particularly associated with increases in cigarette use among adolescent females (Whitbeck, Yu, McChargue, & Crawford, 2009). On the other hand, adolescent females who smoke cigarettes have been found to be at greater risk for depressive symptomatology (Groth & Morrison-Beedy, 2011).

We again used publicly available data from the U.S. NSDUH 2004-2009 to report the prevalence of a depression symptom and of lifetime and past-year major depressive episodes (MDE) (see Table 3). We then used data from the 2009 NSDUH to examine the bivariate correlation between these measures of depression and past-month cigarettes use among adolescent 12-17 years old (see Table 4).

As shown in Table 3, in 2009 approximately 38% of adolescent males and 53% adolescent females reported ever having had a period of time lasting several days or longer when most of the day they felt sad, empty, or depressed. This corresponds to approximately 4.7 and 6.3 million boys and girls, respectively. In the same year, 8.4% and 17.8% of boys and girls, respectively, were estimated to have a MDE in their lifetime which corresponds to an estimated one million boys and 2.1 million girls. Finally, approximately 4.9% and 11.3% of boys and girls were estimated to have a MDE in the past year or an estimated 606 thousand and 1.3 million boys and girls, respectively. The NSDUH classified adolescents as having a MDE using the diagnostic criteria set forth in the 4<sup>th</sup> edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)* (APA, 2000) which specifies a period of 2 weeks or longer during which there is either (1) depressed mood or (2) loss of interest or pleasure and at least four other symptoms (out of 9) that reflect a change in functioning, such as problems with sleep, eating, energy, concentration, and self-image.

As shown in Table 4, a significantly higher percent of adolescent males who indicated they had "Ever felt sad, empty, or depressed most of the day lasting several days or longer" had smoked cigarettes in the past month (10.8%) than those who did not endorse this depression question (8.3%). Similarly, a considerably greater percent of adolescent females who indicated having felt sad, empty or depressed, reported smoking cigarettes in the past month (11.7%) compared to those who did not indicate feeling that way (5.0%). Once again, similar differences are observed in the percent of past-month smoking among adolescent males and females who met criteria for lifetime and past-year MDE compared to those who did not meet this criteria (see Table 4).

Depression Measure and Gender	2004	2005	2006	2007	2008	2009
Total adolescent sample	18,161	18,527	18,144	17,566	17,670	17,531
Ever felt sad, empty, or depressed most of the day lasting several days or longer						
Males	41.3***	41.2***	39.4***	37.8***	38.3***	38.0***
Females	56.3	55.9	54.6	51.8	52.4	53.0
Lifetime Major Depressive Episode						
Males	8.5***	7.9***	7.4***	7.5***	7.3***	8.4***
Females	19.6	19.8	18.4	18.0	18.8	17.8
Past-year Major Depressive Episode						
Males	5.0***	4.5***	4.2***	4.6***	4.3***	4.9***
Females	12.8	13.1	11.9	12.1	12.6	11.3

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

Table 3. Percent of male and female adolescents who had ever in their lives had a period of time lasting several days or longer when most of the day they felt sad, empty, or depressed, and by whether they met criteria for lifetime and past-year Major Depressive Episode: NSDUH 2004-2009.

Depression measure	% of adolescents who smoked cigarettes in the past month	
	Male	Female
Ever felt sad, empty, or depressed most of the day lasting several days or longer		
Yes	10.8**	11.7***
No	8.3	5.0
Lifetime Major Depressive Episode		
Yes	14.2***	16.2***
No	8.7	6.9
Past-year Major Depressive Episode		
Yes	16.0***	17.9***
No	8.8	7.3

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

Table 4. Percent of male and female adolescents who smoked cigarettes in the past month by whether they had ever in their lives had a period of time lasting several days or longer when most of the day they felt sad, empty, or depressed, and by whether they met criteria for lifetime and past-year Major Depressive Episode: NSDUH 2009.



Table 4 also shows that a slightly higher percent of females than males who reported depression symptoms and who were estimated to have a lifetime and past-year MDE reported smoking in the past month. However, these differences are not large (17.9% of girls vs. 16.0% of boys with past-year MDEs smoked in the past month).

To further examine the association between depression symptoms and cigarette use, we used data from the National Longitudinal Survey of Youth cohort that was first followed in 1997. The NLSY97 dataset consists of a nationally representative sample of U.S. residents who were born between 1980 and 1984 (OSU, 2007). Adolescents were first sampled and interviewed in 1997 and then were assessed yearly until 2008. The survey assesses adolescents' development in several areas; educational, labor market experiences, mental health, and drug use. The questions about mental health that relate to depressive symptoms were included in Waves 4, 6, and 8, that is, in years 2000, 2002, and 2004. Thus, the analyses we present below were based on these three waves of data. A total of 8,162 adolescents (Mean age at wave 4 = 17.9, SD=1.44, 49% female) were included in the analyses.

At each wave, the NLSY survey asked participants to report on the frequency with which they (a) felt down, (b) depressed, and (c) nervous in the past month. Response options for each of these questions ranged from "All of the time=4" to "None of the time=1". These responses were added to create a composite score of depression symptoms that could range from 3 to 12, with higher scores representing more depression symptoms. Two dependent variables measuring cigarette use were created. One measure consisted of a dichotomous Yes-No answer to a question about past-year cigarette use. The second measure was the total number of cigarettes smoked in the past 30 days, a variable created by multiplying the answers to the questions about the number of days youth indicated they had smoked cigarettes and the number of cigarettes they indicated they would usually smoke each day, in the past month. These variables were also created at each wave.

These data were used to examine if changes in depression symptoms over two successive waves, two years apart, were associated with changes in smoking status (no changes, initiated smoking, or quit smoking) over the prior year and, among smokers, with the total number of cigarettes smoked in the past month. Data were analyzed using multinomial logit regression and with ordinary least square regression, respectively.

Table 5 indicates that change in depression symptoms over two successive periods is a strong predictor of changes in smoking status over the same period, with or without controlling for age, age squared, and parental education ( $p < 0.01$ ). In other words, adolescents experiencing more depression symptoms over time were considerably more likely to have initiated smoking over the prior year, and, they also were less likely to quit smoking if they were smokers the year prior. Males were more likely to have smoked in the past year ( $p < 0.01$ ). However, the interaction of the variables, changes in depression symptoms with gender, was not significant suggesting that the association between changes in depression symptoms and smoking status over time is similar between adolescent males and females.

As shown in Table 6, adolescents who experience higher level of depressive symptoms over time have a greater risk of increasing the total number of cigarettes they smoke in the past 30 days, even after controlling for age, age squared, and parental education. And although adolescent males smoke more cigarettes, the interaction of changes in depression with

Variables	Quitter (1)	Initiated (2)	Quitter (3)	Initiated (4)	Quitter (5)	Initiated (6)
$\Delta$ Depression	- 0.06*** (0.02)	0.11*** (0.02)	-0.06*** (0.02)	0.10*** (0.02)	-0.06** (0.02)	0.09*** (0.03)
Male=1			0.05 (0.06)	0.35*** (0.06)	0.05 (0.06)	0.34*** (0.06)
( $\Delta$ Depression)*male					0.01 (0.04)	0.02 (0.03)
Age			0.36 (0.35)	-1.19*** (0.31)	0.36 (0.35)	-1.18*** (0.31)
Age squared			-0.01 (0.01)	0.03*** (0.01)	-0.01 (0.01)	0.03*** (0.01)
Parental education			-0.00 (0.01)	0.01 (0.01)	-0.00 (0.01)	0.01 (0.01)
Constant	-2.28*** (0.03)	-2.10*** (0.03)	-5.32 (3.34)	10.15*** (2.93)	-5.34 (3.34)	10.12*** (2.93)
Observations	14,557	14,557	13,486	13,486	13,486	13,486

Note:  $\Delta$ =Changes in. Robust standard errors in parentheses. Observations are pooled samples.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Table 5. Results of multinomial logit analysis to examine if changes in depression symptoms over two waves would be associated with adolescents being more likely to initiate or quit smoking (if they were smokers) two years later when compared to adolescents whose smoking status did not change between waves: NLSY97 Waves 4 (2000), 6 (2002), and 8 (2004).

gender was not significant. This suggests that the link between changes in depression symptoms and total number of cigarettes smoked in the past 30 days is similar among adolescent males and females.

The findings shown in Tables 4, 5 and 6 are interesting because if indeed depression symptoms are such important predictors of smoking, one would expect a much higher proportion of females becoming smokers. That this is not the case is an important indication of the complex etiology of smoking behaviors and the more likely scenario that any behavior such as smoking is influenced by genetic and environmental factors, including cultural, familial and societal that are inter-related.

To our knowledge, no studies in Latin America have examined the association between mental disorders and rates of cigarette use among adolescents with the exception of Mexico. It has been posited that in Latin America depressive symptoms are the most common risk factors that predispose adolescents to begin using cigarettes, second only to having a parent who has used substances (Baptista et al., 2006). Researchers in Mexico have examined baseline data from an ongoing cohort study of a representative sample of adolescents for different factors that might be associated with being experimenters (having tried a cigarette one or two times) compared to being a regular smoker (having smoked in the past 30 days).

Variables	Bivariate	Includes controls	Controls and Interaction
$\Delta$ Depression	7.79*** (2.68)	6.60** (2.81)	10.75*** (3.78)
Male=1		21.36** (9.44)	20.17** (9.43)
( $\Delta$ Depression) * male			-7.92 (5.62)
Age		-126.52** (56.56)	-129.63** (56.82)
Age squared		2.98** (1.47)	3.06** (1.48)
Parental education		-1.50 (1.70)	-1.44 (1.70)
Constant	31.70*** (4.57)	1,363.55** (539.80)	1,394.15** (542.29)
Observations	3,790	3,511	3,511

Note:  $\Delta$ =Changes in. Robust standard errors in parentheses. Observations are pooled samples.  
\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Table 6. Results of multiple regression analysis predicting if changes in adolescents depression symptoms over two waves predict changes in the total number of cigarettes smoked in the past 30 days between the waves: NLSY97 Waves 4 (2000), 6 (2002), and 8 (2004).

The results of this cross-sectional study of Mexican adolescents found that depression, as measured by the Zung scale, was associated with smoking, but only for adolescents who were regular smokers, not with experimenting with tobacco use (Arillo-Santillan et al., 2005). Among the adult, urban population in Mexico, current tobacco users have been found to have twice the odds of reporting elevated depressive symptoms than individuals who have never used tobacco (Benjet, Wagner, Borges, & Medina-Mora, 2004).

### 1.3.1.2 Central America and the Caribbean

Depressive symptoms have been found to be associated with increased odds of tobacco use among a convenience sample of about 5,000 Costa Rican adolescents that included students in private and public schools, adolescents in treatment for substance use, as well street youth (Obando, Kliever, Murrelle, & Svikis, 2004). Similarly, a study of six Central American countries (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama) including the Dominican Republic using national representative samples found that tobacco use was 2.9 times more likely to occur among adolescents with moderate behavioral problems (Vittetoe, Lopez, Delva, Wagner, & Anthony, 2002).

### 1.3.1.3 South America

The relationship between depressive symptoms and cigarette use in South America has been primarily examined among adults. Among a Brazilian adult sample, individuals with moderate and severe scores of depression, measured by the Beck Depression Inventory,

were more likely to smoke (Bortoluzzi, Kehrig, Loguercio, & Traebert, 2011). One of the few studies examining this association among adolescents was conducted in Colombia. The study sampled about 500 adolescents attending four high schools in a large city in Colombia. They found that adolescents with clinically relevant depressive symptoms had odds of using cigarettes that were 1.91 times higher than those without clinically relevant depressive symptoms (Campo-Arias et al., 2007).

To further examine the potential association between depression symptoms and cigarette smoking among Latin American adolescents, we used data from a longitudinal study of substance use presently underway in Santiago, Chile. The study, called the Santiago Longitudinal study (Bares, Andrade, Delva, & Grogan-Kaylor, 2011; Bares, Andrade, Delva, Grogan-Kaylor, & Kamata, 2011; 2011), is a collaborative project between U.S. and Chilean institutions with funding from the U.S. National Institute on Drug Abuse (NIDA). The sample for the present analyses consisted of 660 adolescents with data on the variables of interest in both Waves 1 and 2, assessed about 1.5-2 years apart. Youth at Wave 1 were approximately 14 years old, 48% female, and of mid-to-low socioeconomic status. The average number of years of parental education was 9.9 years and the average monthly family income was 315,000 pesos (500 Chilean pesos is approximately \$1.00 US dollar). About 68% of the youth lived with both their father and mother. Participants for this study were recruited from a sample of approximately 1,700 families that participated in a study of nutrition when the youth were in infancy and 1,200 when the youth were 10 years old (Lozoff, et al., 2003). Between 2007 and 2010, over 1000 youth were successfully recruited. In 2007-2010, youth completed Wave 1 assessments consisting of a 2-hr interviewer-administered questionnaire with comprehensive questions on demographics, mental health, peer, family, and school characteristics. Wave 2 assessments have begun and will be completed in 2012. For the purpose of this Chapter we examined if depression symptoms at Wave 1 were associated at Wave 2 (1.5-2 years later) with (1) smoking initiation, quitting among those who had reported smoking in Wave 1, or no changes in smoking or non-smoking status and (2) if the total number of cigarettes smoked in the past month changed between waves.

Depressive symptoms were assessed by the ASEBA School-Age Form Youth Self Report (YSR) that measures levels of depression-anxiety and withdrawn-depression symptoms (Achenbach & Rescorla, 2001). The stem question for the thirteen items that make up these two scales is "Below is a list of items that describe kids. For each item that describes you now or within the past 6 months, please tell me if the item is (3) *very true or often true*, (2) *somewhat or sometimes true*, or (1) *is not true* (0).

We conducted two types of analyses. First, we used multinomial logit regression to examine if depression scores at Wave 1 for both variables (withdrawn-depression and anxious-depression) were associated with changes in lifetime smoking status 1.5-2 years later (Wave 2). The dependent variable, Smoking Changes, consisted of three categories: quitter, initiator, and no changer (the reference group). Then we used multiple regression analysis to examine if, among adolescents who had smoked at Wave 1, their withdrawn-depression and anxious-depression, symptoms were associated with changes in the total number of cigarettes smoked in the past month between the two waves.

Table 7 presents the results of the multinomial logit regression that examined if adolescents withdrawn-depression symptoms at Wave 1 were associated with changes in smoking status at Wave 2 (initiated smoking, quit smoking, or status did not change between waves).

Variables	Quitter	Initiated	Quitter	Initiated	Quitter	Initiated
	(1)	(2)	(3)	(4)	(5)	(6)
Withdrawn-Depression	-0.00 (0.08)	0.03 (0.03)	-0.03 (0.08)	0.05 (0.03)	-0.01 (0.11)	0.02 (0.05)
Male=1			0.09 (0.44)	0.12 (0.19)	0.25 (0.79)	-0.19 (0.35)
Withdrawn-depression * male					-0.04 (0.16)	0.07 (0.07)
Age			0.23 (6.11)	8.63*** (2.95)	0.21 (6.13)	8.47*** (2.95)
Age squared			0.01 (0.22)	-0.32*** (0.11)	0.01 (0.22)	-0.32*** (0.11)
SES			-0.14* (0.08)	0.06* (0.03)	-0.14* (0.08)	0.05 (0.03)
Constant	-3.03*** (0.39)	-1.23** (0.17)	-7.67 (42.13)	-58.78*** (19.96)	-7.63 (42.22)	-57.53*** (19.97)
Observations	663	663	660	660	660	660

Note: Robust standard errors in parentheses.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Table 7. Results of multinomial logit analysis to examine if adolescents with higher withdrawn-depression symptoms at Wave 1 would be more likely to initiate or quit smoking (if they were smokers) one-and-a-half to two years later (Wave 2) when compared to adolescents whose smoking status did not change between waves (never smoked at Wave 1 and neither at Wave 2 or smoked at Wave 1 and remained a smoker at Wave 2).

The first two columns in Table 7 present the bivariate analysis of the depression-cigarette status changes while columns (3)-(4) adds age, age squared, and SES as controls. Finally, columns (5)-(6) adds the controls and an interaction term representing the depression variable with gender (male) interaction. There was no significant association between adolescents' withdrawn-depressive symptoms at Wave 1 and changes in smoking behavior between Waves 1 and 2 (about 1.5-2 years apart). Age was positively associated with smoking initiation and higher SES was inversely associated with quitting, that is youth with higher SES are less likely to quit smoking.

Table 8 below presents the results of the multinomial logit regression that examined if adolescents anxious-depression symptoms at Wave 1 were associated with changes in smoking status at Wave 2 (initiated smoking, quit smoking, or status did not change between waves).

Variables	Quitter	Initiated	Quitter	Initiated	Quitter	Initiated
	(1)	(2)	(3)	(4)	(5)	(6)
Anxious-Depression	0.08 (0.05)	0.01 (0.02)	0.08 (0.05)	0.02 (0.03)	0.02 (0.07)	-0.02 (0.03)
Male=1			0.29 (0.45)	0.13 (0.19)	-0.50 (0.87)	-0.51 (0.36)
Anxious-Depression*male					0.12 (0.11)	<b>0.11**</b> (0.05)
Age			1.00 (6.21)	8.51*** (2.95)	1.48 (6.23)	8.47*** (2.95)
Age squared			-0.02 (0.22)	-0.32*** (0.11)	-0.04 (0.23)	-0.32*** (0.11)
SES			-0.12 (0.08)	0.05 (0.03)	-0.13 (0.08)	0.05 (0.03)
Constant	-3.55*** (0.42)	-1.18*** (0.17)	-13.34 (42.79)	-58.02*** (19.92)	-16.29 (42.96)	-57.52*** (19.94)
Observations	663	663	660	660	660	660

Note: Robust standard errors in parentheses.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Table 8. Results of multinomial logit analysis to examine if adolescents with higher anxious-depression symptoms at Wave 1 would be more likely to initiate or quit smoking (if they were smokers) one-and-a-half to two years later (Wave 2) when compared to adolescents whose smoking status did not change between waves (never smoked at Wave 1 and neither at Wave 2 or smoked at Wave 1 and remained a smoker at Wave 2).

As was the case with the earlier analysis, the first two columns present the bivariate analysis of the depression-cigarette status changes while columns (3)-(4) adds age, age squared, and SES as controls. Also, columns (5)-(6) adds the controls and an interaction term representing the depression variable with gender (male) interaction. As shown in Table 8, males with higher anxious-depression symptoms at Wave 1 were more likely to have started smoking at Wave 2. Age was positively associated with smoking onset but in this case, when controlling for anxious-depression symptoms, SES was not associated with quitting as had been the case earlier.

Then, we examined if, among smokers at Wave 1, there were changes in the total number of cigarettes smoked in the past 30 days between Waves 1 and 2 as a function of the adolescents' depression symptoms. The total number of cigarettes was created by multiplying two variables - the average number of cigarettes adolescents reported smoking on a given day in the past 30 days by the number of days they reported smoking in the past 30 days. Table 9 presents the results of the multiple regression analysis predicting if withdrawn-depression symptoms at Wave 1 predicted changes in the total number of cigarettes smoked between waves. There were no significant findings. Similarly, Table 10 presents the results of the multiple regression analysis predicting if anxious-depression

symptoms at Wave 1 predicted changes in the total number of cigarettes smoked between waves. There were also no significant findings.

Variables	Bivariate	Includes controls	Controls and Interaction
Withdrawn-Depressed	1.17 (3.49)	0.98 (3.26)	2.09 (5.07)
Male=1		3.04 (10.80)	15.62 (23.66)
Withdrawn-Depressed * male			-2.97 (5.70)
Age		53.78 (159.01)	60.77 (159.64)
Age squared		-1.83 (5.87)	-2.07 (5.88)
SES		-3.08 (2.22)	-2.89 (2.14)
Constant	32.50** (12.85)	-361.79 (1,072.43)	-417.42 (1,078.68)
Observations	154	153	153

Note: Robust standard errors in parentheses.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Table 9. Results of multiple regression analysis predicting if adolescents' withdrawn-depression symptoms at Wave 1, among smokers at Wave 1, predicted changes in the total number of cigarettes smoked in the past 30 days between Waves 1 and 2.

Variables	Bivariate	Includes controls	Controls and Interaction
Anxious-Depressed	-0.95 (1.92)	-1.06 (1.94)	-1.01 (2.82)
Male=1		0.17 (11.25)	1.00 (22.73)
Anxious-Depressed * male			-0.14 (3.62)
Age		53.33 (160.26)	53.09 (161.71)
Age squared		-1.80 (5.93)	-1.79 (5.99)
SES		-3.30 (2.33)	-3.31 (2.36)
Constant	43.86*** (11.46)	-348.82 (1,081.20)	-347.56 (1,089.32)
Observations	154	153	153

Note: Robust standard errors in parentheses.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Table 10. Results of multiple regression analysis predicting if adolescents' anxious-depression symptoms at Wave 1, among smokers at Wave 1, predicted changes in the total number of cigarettes smoked in the past 30 days between Waves 1 and 2.

These findings suggest that anxious-depression is not associated with changes in the number of cigarettes smoked in the past 30 days. Although the results in Table 9 suggest that anxious-depression is associated with being a current smoker, changes in symptoms of anxious-depression among this adolescent population does not change the number of cigarettes smoked.

## 2. Discussion

Data for the United States suggest that about 10% of 12- to 17-year-old adolescents have used cigarettes in the previous 30 days. The prevalence of past 30-days cigarette use among 12- to 17-year-old adolescents in Latin America vary greatly from a low of 1.6% in the Bahamas to a high of 35.6% in Chile. Data from the United States indicate that about 11% of adolescents experience a depressive disorder in their lifetime while data from Mexico suggest that the rate there is about 7.6% of adolescents. The rate of depression symptoms for adolescents in two municipal areas in Brazil were 6.4% and 10%. After a thorough search, we were not able to identify any studies of depression symptoms among adolescents in Latin American countries.

High rates of co-occurrence have been reported for cigarette use and depressive symptoms (McKenzie, Olsson, Jorm, Romaniuk, & Patton, 2010; Weiss et al., 2011). The available evidence suggests that adolescents with a substance use disorder and a mental disorder are more psychologically distressed (Essau, 2011; Oesterle, 2008). Although a great deal of literature supports the link between cigarette use and depression symptoms during adolescence much of this work comes from the United States. In fact, our analysis using a nationally representative sample of adolescents in the United States indicate that adolescent males and females experiencing more depression symptoms over time were considerably more likely to have initiated smoking and were less likely to have quit smoking if they were smokers the year prior. Among the Chilean adolescent sample, males with higher anxious-depression symptoms over time, but not withdrawn-depression symptoms, were more likely to smoke than males who experience less changes in these symptoms. These findings suggest the way(s) by which we understand the link between depressive symptoms and cigarette use among adolescents might be specific to the stressors experienced by youth in their respective countries.

Given the large variations in smoking among adolescents in the Americas, examining the association between smoking and depression symptoms in each country warrants further attention. Doing so might elucidate some of the unique risk and protective factors in place throughout the region.

The analyses we conducted to further examine the potential associations between the two variables, smoking and depressive symptoms, showed that changes in depressive symptoms are strong predictors of adolescent initiating cigarette use and with smoking greater number of cigarettes. The results of the analyses conducted to examine the relationship between depressive symptoms and cigarette use among adolescents Santiago, Chile, indicate that the positive association between anxious-depression symptoms and ever smoking 1.5 to 2 years later was found to only occur among adolescent males and not females. This suggests that anxious-depression might be creating a special vulnerability among adolescent males to seek the effects of nicotine to dampen their distress while



adolescent females might have a different way of coping with distressing depressive symptoms. Future work devoted to understanding the mental health of adolescents in Latin America is needed to better understand the differential relationship between gender, depression symptoms, and smoking.,

Because adolescents with a substance use disorder and a mental disorder are more psychologically distressed (Essau, 2011; Oesterle, 2008), some have suggested that they also exhibit a greater need for health care services. In fact, Georgiades and colleagues have found that among those who use tobacco during adolescence, 26.5% go on to develop major depressive disorder in adulthood (2007). In addition, individuals with clinical scores of depression at a baseline measurement have been found to be more susceptible to initiate smoking 18 months later (Minnix et al., 2011) further stressing the need to help youth prevent smoking and help smokers quit as well as find better ways to treat youth who suffer from depression. Interventions for adolescent smokers who experience depressive symptoms might target modifiable factors, rather than those that may not be modifiable at this point in time (Green & Kreuter, 2005). Modifiable risk factors could include adolescents' self-efficacy (Stevens, Colwell, Smith, Robinson, & McMillan, 2005) and perceptions of body image (Rodríguez-Esquivel, Cooper, Blow, & Resor, 2009), which have been found to be associated with both cigarette use and depressive symptoms (Kulbok et al., 2008). Because many countries in Latin America are involved in the production of tobacco products, it may be necessary to implement social-influence interventions for these high risk populations (Noland et al., 1998). At this point, interventions to reduce genetic susceptibility to depressive symptoms and progression of cigarette smoking might not be feasible.

Interventions and treatment programs for adolescent tobacco use and tobacco prevention need to be sensitive to the adolescents' gender, developmental stage and cultural backgrounds, among other identities. Some preventive interventions for cigarette use are currently available for minority youth in the United States (Prokhorov et al., 2010) but the existence of tobacco prevention and research on the effectiveness of such interventions among adolescents in Latin America are lacking. Because interventions that are effective with one group of adolescents may not be effective with other groups of adolescents (Foraker, Patten, Lopez, Croghan, & Thomas, 2005), there is a critical need for the development and evaluation of interventions targeting cigarette use but also comorbid cigarette use and depressive symptoms among adolescents in Latin America.

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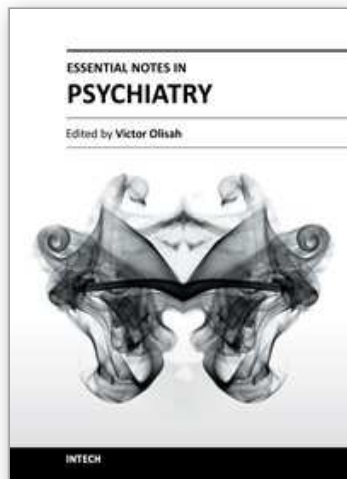
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