

GEOGRAPHICAL VARIATIONS OF YOUTHFUL DRUG
INVOLVEMENT ACROSS RURAL AND URBAN AREAS
IN SEVEN LATIN AMERICAN COUNTRIES

By

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ABSTRACT

GEOGRAPHICAL VARIATIONS OF YOUTHFUL DRUG INVOLVEMENT ACROSS RURAL AND URBAN AREAS IN SEVEN LATIN AMERICAN COUNTRIES

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BACKGROUND: Geographical variations in youthful drug involvement within and across urban, and rural areas of Central America have been poorly studied in prior epidemiological evidence. **AIMS:** To determine if there is geographical variation in the cumulative occurrence (CO) of first trial of drugs by age 13 across countries, with attention to residence in ‘capital city’ vs. ‘non-capital’ areas. **METHODS:** Crude and adjusted odds ratio estimates (by covariates such as sex and age) based on multiple logistic regressions were calculated based on a secondary data analysis of 12,560 school-attending adolescents from seven countries in Central America (Panama, Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala and Dominican Republic). **RESULTS:** Alcohol and tobacco are the most popular NRDs (Non-Regulated Drugs) in both the total sample and across countries and there is geographical variation in the risk of first trial by age 13 of drugs such alcohol (Panama: aOR=1.93, Honduras aOR=1.54 and Costa Rica: aOR=1.34); tobacco (El Salvador: aOR=2.06, Honduras: aOR=1.71, Costa Rica: aOR=1.48 and Dominican Republic: aOR=1.36) and marijuana (Costa Rica: aOR=5.74). **CONCLUSIONS:** This study sheds light on a possible rural-urban gap, especially in relation to alcohol and tobacco and sources of this variation could be due to genetic, environmental, economical, cultural and social factors. **SUPPORT:** NIDA/NIH/FIC awards: D43TW05819; K05DA015799.

I dedicate this Master's Thesis to my family, especially...
to German, my beloved husband, for opening my mind to the harmony between science and
faith;
to my Parents Isaac and Irma, for being an eternal source of inspiration;
to Grand Mother Roberta for teaching me the meaning of generosity;
to Rocio, Milagros and Margiory for encouraging this work:
to all my nephews, in whose faces I see all the children of the world, they are the hope and
future and deserve our effort to give them a better healthy world.

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KEY TO ABBREVIATIONS

ALDH2*2	Aldehyde Dehydrogenase 2 Family, Allele 2
ADH1B*1	Alcohol Dehydrogenase 1B, Allele 1
ADH1B*3	Alcohol Dehydrogenase 1B, Allele 3
ADH1C*2	Alcohol Dehydrogenase 1C, Allele 2
aOR	Adjusted Odds Ratio
CICAD	Inter-American Drug Abuse Control Commission
CB	Confidence Bounds
CO	Cumulative Occurrence
CYP2E1c2	Cytochrome P4502E1, Allele c2
DALY	Disability Adjusted Life Years
IRB	Institutional Review Board
ICOHRTA	International, Clinical, Operational, and Health Services Research and Training Award
JHU	John Hopkins University
LSD	Lysergic Acid Diethylamide
MAMBI	Medio Ambiente Escolar
MSU	Michigan State University
NIH	National Institute of Health
NIDA	National Institute of Drug Abuse
NHSDA	National Household Survey on Drug Abuse
NRD	Non-Regulated Drugs

OAS	Organization of American States
ORDs	Other Regulated Drugs
PACARDO	PA (Panamá), CA (Centroamerica), RDO (the Dominican Republic)
PAHO	The Pan American Health Organization
RD	Regulated Drug
TOCA-R	Teacher Observation of Classroom Adaptation-Revised
UNODC	United Nations Office on Drug and Crime
UPCH	Universidad Peruana Cayetano Heredia
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Problem Statement

Drug use among children and youth is a major public health issue (1). Tobacco and alcohol are recognized as major problems in terms of public health for both children and youth despite governmental efforts to control drugs. For example, nearly one billion men and 250 million women smoke cigarettes and two billion people drink alcohol (2), causing a tremendous impact in mortality and morbidity rates (3). Moreover, the World Health Organization reported in 2002 that tobacco causes 8.8% of global mortality and 4.1% of disability adjusted life years (DALY), while alcohol causes 4% of deaths and disability (4). According to the United Nations Office on Drug and Crime, 4-5 percent of people aged 15-64 years old of the global population use internationally-regulated psychoactive drugs each year (UNODC, 2004). Cannabis is the most popular. Other drugs such as cocaine, opioids, and amphetamine-type stimulants are being used more and more in many places around the world (5). The outlook is worse if we consider that a decline in rates of most forms of substance abuse in adults has occurred, but these rates remain high in children since 1990 (6). Also, an early onset tendency of drug use has been reported in students from middle and high schools (7).

1.1.1 Urbanization, an Influence on Children's Drug Use

The environment in which children and youth grow, especially family characteristics and urbanization, have been recognized as variables associated with drug use for over a decade (8, 9, 10), and these are even more relevant if we consider that urbanization is increasing, with the consequent deterioration of healthy familial relations, thus making children and youth more vulnerable to the likelihood of drug use (11). The world urban population grew by 2.4% annually

between 1975 and 2000 (12), and the World Health Organization predicted in 2005 that by 2007, half of the human population will live in urban areas, and that by 2015 there will be 26 cities around the world with a population over 10 million, up from 15 cities in 1995 (10). But this urban growth will have a marked difference in favor of developing countries, with an annual urban growth of 3.2% in developing countries compared to 0.9% in developed countries (13). Latin America and the Caribbean regions are not exempt from this problem; urban growth rates of 2.7% have been reported (14).

It is important to mention that *urbanization* as a variable has measurement problems, since it can have different meanings (e.g., as referring to population movements or to a change in lifestyle which go beyond urban areas) (15). But some works have provided interesting advances; for example, George and Milligan proposed that what plays an important role is the status of “inner-city.” This status describes such an area as a disadvantaged urban neighborhood with few social or economic opportunities, low standards of housing, recreation and social service facilities, and a concentration of unemployed, drug- and/or alcohol-using, uneducated, and/or psychiatrically ill residents (16). Moreover, Tolan and colleagues have identified “four types of stress posing risks for inner-city children and youth”: (1) chronic environmental stress with dangers such as racism and economic inequity, (2) life events, (3) daily hassles, and (4) role strain due to an inability to achieve socially-prescribed goals (17, 18). Also, other factors (through urbanization) could cause drug involvement, such as availability of alcohol and other drugs, greater access to drug advertising, stressful living conditions due to urban context, relaxation of community norms, an increase in gang activity, and insufficient recreational facilities (resulting in high levels of youth boredom and the presence of drug markets) (19, 20). With respect to the last factor, Storr and colleagues showed evidence based on 1998 National Household Survey on Drug Abuse

(NHSDA) that people who live in a disadvantaged neighborhood are more likely to be approached by drug sellers. Thus, they confirmed that there is more probability of drug use in poor neighborhoods due to more drug purchase opportunity (21, 22, 23). It is possible that urban areas represent an important market place for drug dealers, increasing the risk of exposure to drugs.

In summary, the scientific literature provides evidence that individuals living in an urban context (characterized by a deterioration of social and family ties), coupled with an increased exposure to drugs, are more likely to use drugs. But, considering that we are living under the globalization phenomenon (either by high migratory movement or the media effect), it is possible that the urban life styles could spread broadly among rural areas, thinning the gap between rural and urban areas (15). In this sense, it is necessary to do more studies comparing patterns of drug use between urban and rural populations, especially in areas with a high trend of urbanization. Thus, we will be able to capture differences that allow us to design differentiated interventions for prevention of drug use.

1.1.2 The Spread of Children's Drug Use

There are two interesting theories about how drug use spread among individuals from our communities: the “Contagious Disease Model” and the “Social Contagion Model.” Extensive explanation of the “Contagious Disease Model” was provided by DeAlarcon in 1960 based on a heroin epidemic in a suburb of London (24). Later, Hughes applied the model studying the heroin epidemic in Chicago, and he observed that incidence of heroin use followed the course of contagious diseases (with changeable periods of epidemic spread and relative stillness) in which the person responsible for transmission (“contagious agent”) corresponded to close friends who initially have used heroin (25). Thus, the concept of “contagion” emerged as “a contextual effect

in which the probability that a person will develop a disease outcome is dependent upon the degree to which others in the community already have the outcome” (26, 27). Meanwhile, the “Social Contagion Model” explains the process through which information, trends, behaviors and other aspects of human behavior diffuse among persons in social networks (reinforcing the concept of “contagion”) (28). Applying all these concepts in explaining the spread of drug use among children, we discover that schools are the most important environment for adolescents: a world where they learn beliefs, values, knowledge and lifestyles, build networks, and meet peers who are influential for initiation into drug use (29, 30).

The urbanization process is a global phenomenon, which brings economic, social, and health challenges. Thus, scientists such as Ledoux and colleagues have proposed that the relationship between parents’ knowledge about where their children are and drug use varies with levels of urbanization. For example, they hypothesized that “perhaps, in a more rural environment, it might be easier for parents to know their children’s whereabouts” (11). Under this context it is possible that children whose parents do not know where they are could relate to deviant friends (such as, for example, drug users), and they will probably introduce their peers effectively to drug use (31), constituting the “contagion agents” that DeAlarcon and Hughes described in the 1970s.

In addition to the urbanization and other ‘macro-social’ processes, within-family processes may influence the spread of drug-taking and must be considered. A significant quantity of scientific literature reveals that youthful drug use is related to dysfunctional families, and scientists have tried to explain processes involved on this relationship through several theories (32). For example, the family system theory proposed that youths could learn to use drugs from parents or older siblings who were drug users (33). In social learning theory, scientists proposed that

youthful drug use is the result of family failure to transmit and teach resistance and communication skills to their children, which allows them to avoid drugs (34, 35). From the social control theory perspective, drug involvement could happen in youths with poor commitment and attachment to their families, generating a void that could be occupied by peers who were drug users (36, 38). Strain theory proposed that youthful drug involvement could be a final consequence of a social system that has few opportunities for youths (37).

While some processes related to family dynamics may be risk factors for drug involvement such as those listed above, there are also other processes that have scientifically been demonstrated to be protective factors. Thus, the research performed by senior scientist Anthony and his colleagues merits attention. These researchers conducted national and international studies from the 80's until today, which demonstrated that parental monitoring and supervision of their children, as well as other parenting behaviors (e.g., encouragement of religious activities in the behavioral repertoire) might serve as a protective shield against chances to try drugs and perhaps the later stages of drug involvement (39,40,41,42,43,44,45,46).

A more complete conceptual model has been articulated about within-family processes such as sharing of drugs between siblings, as well as parents' tobacco smoking, drinking, and other drug use as social role models for the behaviors of their offspring. One of most influential contributors to the theory and evidence in these more comprehensive models is Professor Judith Brook. This work on within-family processes and influences on drug involvement is summarized in Chapter 2.

1.2 Overarching Aims

In the present thesis, the overall goal is a better understanding of the epidemiology of youthful psychoactive drug use in both capital and non-capital areas of Spanish heritage countries in

Central America and the Caribbean with a special focus on the most prevalent drugs in the region such as alcohol, tobacco, marijuana, inhalants, and other international regulated drugs (such as ecstasy, crack and opiates). “Youthful drug involvement” refers to two separate phases: the earlier phase of the chance to try drugs (i.e. “drug exposure opportunity”) and the latter phase of actual drug use, once the chance to try has been experienced.

1.3 Research Questions

The present master’s thesis is based upon analysis of data gathered in 1999 and 2000 as part of the PACARDO project, a multinational collaborative study of youthful drug involvement performed in seven countries from Latin America: Panama, Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, and the Dominican Republic.

This study builds upon prior research and addresses the following questions:

Question 1: Is there any cross-national variation in the cumulative occurrence estimates for drug involvement by the end of early adolescence (through age 13)?

Question 2: What is the country-level variation in the estimated occurrence of alcohol, tobacco, inhalants and other youthful drug involvement, before and after covariate adjustment for sex and age?

Question 3: Is there any country-level variation in the degree of youthful drug involvement considering the location of the community in which the young people live?

CHAPTER 2

BACKGROUND AND SIGNIFICANCE

2.1 Background

The study of disease and health variations within and across urban and rural environments has a long history in public health research. To illustrate, modern epidemiology traces its origins to John Snow's study of within-urban variations in cholera mortality (47). More recent preoccupations have been focused on topics such as: (a) air pollution (48), (b) social inequality, which may have special importance in the developing world (49), and (c) social capital and health (50), as well as concerns about microsocial transactional environments that can affect health-related behaviors by bringing young people into environments more or less conducive to drinking and drug use (51, 52).

In this thesis research project, this tradition of research on the urban-rural continuum is brought into intersection with studies of youthful drinking of alcoholic beverages, tobacco smoking, and other drug involvement in the Central American region of the western hemisphere, where there are no more than a few prior published journal articles on urban-rural variations in youthful drug involvement (53).

However, some between-country heterogeneity in the epidemiological patterns on this area has been previously reported. For example, with respect to alcohol, the largest odds ratio estimate for alcohol use was observed in countries such as the Dominican Republic (15.9) whereas the smallest odds ratio estimate for alcohol use was observed in El Salvador (1.9). These findings remained statistically significant even after adjustment by covariates such as age, sex and school type (55).

An overview of recent basic findings from these surveys will set the stage for the current investigation of urban-rural differences. For example, the CICAD surveys found age-related increases in the cumulative occurrence of drinking, smoking, and other drug use, with lower estimates for 14 year olds and higher estimates for 17 year olds (54). A similar age-related pattern has been reported for Panama, Costa Rica, Nicaragua, Honduras, Guatemala, and the Dominican Republic, which were the countries participating in the PACARDO project surveys of school-attending youths in the late 1990s (55).

Another common finding in this region is a male excess. For example, the CICAD surveys found a prevalence of alcohol use in the last month among youths aged 12 or older of 43.3% for males and 36% for females in countries such as Panama in 2003 (54). The male-female ratio among high school students was 1.5:1 for alcohol in Panama and 5:1 for marijuana in Guatemala (56). Corresponding male-female ratios from the PACARDO surveys were 1.3 for alcohol, 2.0 for tobacco, and 2.7 for marijuana (55).

The issue of between-country heterogeneity in urban-rural contrasts has not yet been studied within these countries of Central America, and this is the specific gap in epidemiological evidence that this research project aims to fill.

An important methodological issue in this research is that urban-rural variations have been studied in relation to strata that provide a crude reflection of the urban-rural gradient, because in order to prevent disclosure of identities of individual participants, the detailed information about specific communities of study participants was not retained. The strata were: (1) capital city, (2) non-capital, (3) possibly capital, (4) possibly non-capital and (5) indeterminate.

2.1.1 Understanding the Complexity of Youthful Drug Involvement and its Consequences

Several theories have been proposed to explain the problem of youthful drug involvement.

Considering the individual framework of adolescence drug use, we have theories such as the “problem-behavior theory” which was extensively studied by Jessor. This theory is based on psychological, behavioral, and social constructs and sees the drug use problem as a “learned behavior that is functional, purposive, and may have utility --e. g. within a youth’s peer group” (57). Also, this theory proposes that there are psychosocial influences behind the conduct problem, which have explanatory variables that either reflects a “proneness” to instigate a behavior or “controls” against the behavior (58).

Another theory is the social control theory, proposed by Ensminger, Brown and Kellam (36). This theory proposes that the drug problem is the result of a weakening of involvement in the structure of a society and is due to three principal causes: strain (referring to the inconsistency between the objective aspirations and opportunities that society offers), social disorganization (referring to “social breakdown of the institutions”), and ineffective socialization which results in the following of inappropriate social models by youths (59, 60, 61). Also, two related theories, the "Social Learning Theory" and the “Primary Social Theory," delve into social complexity and propose that drug problems are a learned behavior in dysfunctional homes or schools ("Primary Social Theory") and reinforced by a social context that is reluctant to punish these practices ("Social Learning Theory") (62, 60).

Coming back to the “Contagious Disease Model,” this proposes that the drug use problem follows the behavior of an infectious disease: it departs from an initial infected case, obtains a maximum curve of cases, and declines as time progresses beyond the maximum. This model served as a base of the “Collective Behavior Theory” and the “Emergent Norm Theory.” The

first one allows the comprehension of the collectively processes imply in the youthful drug involvement, this establishes that within a big group of people, it is possible that individuals lose their own sense of individuality and are subject to be influenced by the larger group (63).

Moreover, when norms are not firmly established in the social dynamic, the behavior of a small minority of group members can appear to be accepted by the whole group, spreading contagiously from person to person (Emergent Norm Theory) (64).

The introductory chapter of this thesis report also alluded to urbanization processes as an example of macro-social influences on youthful drug involvement, as well as within-family processes that might account for clustering or spread of drug involvement within social groups.

In a family influence model from developmental psychology that is more comprehensive than the relatively simple models offered by Chilcoat, Chen, Anthony, and other epidemiologists, Professor Judith Brook has synthesized evidence from population studies from multiple countries of the world. To illustrate, in her report on studies of children and families in Colombia, she found that a strong parent-child relationship was related with lowered rates of adolescent drug use and other deflected behaviors and this relationship also persisted even when the child was living in high risk environments (65).

With respect to the consequences of youthful drug involvement, I have to emphasize this is a problem of epidemic levels in the United States and around the world, with terrible consequences that mean a high cost in both health and economical terms (66). In fact, substance use problems are considered to be major contributors to the global disease burden (67) and “illicit drug use is a substantial global cause of premature mortality and morbidity” (68). Considering substance use during adolescence, this increases the risk for subsequent addiction and medical/psychiatric problems, and could produce long-lasting adverse effects on the developing brain (69, 70). The

problem is especially worrying if we consider that youth who use drugs are much less likely to receive or seek treatment due to psychological factors or lack of knowledge (71, 72). All these factors determine the urgent need to delve into the phenomenon of youthful drug involvement in order to prevent future addictions and their consequences. Also, the fact that rural youths are changing their drug use patterns in the same way as urban youths deserves special attention. Thus, in this research we will study and analyze a database generated from an international collaborative study performed in seven Central American countries (the PACARDO study), areas where youthful drug involvement is experiencing fast epidemiological transitions and is poorly understood. The study of drug use among youth in the Central American epidemiological scene will allow us to get closer and to better understand what is happening in both the developing and developed countries.

From an economic point of view, some annual estimates have been reported. For example, the general economic cost of drug abuse in the US is close to \$180.9 billion (73, 74); \$68 billion is related to the problem of underage drinking and \$14.4 billion is associated with substance-related juvenile justice programs (31, 75). The economic outlook is more troubling if we consider that extra costs produced by drug abuse problem are assumed by the state and finally added to taxpayers' bills. For example, the United States government spends \$1,500 per year for every person involved in drugs (considering expenditures due to direct and indirect consequences), having as main beneficiaries those who began drug use at very young ages (31, 76).

2.1.2 Drug Use in Central America

There has been a rapid increase in problems associated with drug use in countries of Central America, especially among young people, creating health problems that cannot be appropriately addressed by government systems, probably due to the lack of economic and human resources,

and to policy instability. This context also explains the poor scientific research on the subject by the local scientific community and governmental entities. It was not until the year 1994 that the efficient American scientific support led by Dr. James C. Anthony arrived in Central America, and allowed the beginning of scientific and epidemiological research of youthful drug involvement with high international standards. Thus, having this concrete support and the collaboration of some local authorities of the governmental health system, the foundation of the PACARDO research project was possible. This huge scientific research initiative has been the source of numerous scientific papers during the last two decades (43, 44, 46, 55), and to this day there has not been published a similar research initiative in other developing countries. In the following pages, I will explain the most important findings with respect to youthful drug involvement in the PACARDO region.

2.1.2.1 Relative Frequency of Alcohol, Tobacco, and Internationally Regulated Drug Use

Alcohol and tobacco have been reported as drugs amply widespread in Central American countries (53, 55). Thus, in the PACARDO study a clear pattern of country-to-country variation in estimated cumulative incidence of alcohol involvement (with respect to “exposure opportunity” and “actual use” of drugs) was observed. Considering the total sample, the estimated cumulative incidences of exposure opportunity to alcohol and tobacco, were 58% (95% CB: 57; 59) and 37% (95% CB: 36; 38), respectively. On the other hand, the estimated cumulative incidences of actual use of alcohol and tobacco were 52% (95% CB: 51; 53) and 29% (95% CB: 28; 30), respectively.

With respect to the country-to-country variation for alcohol, the Dominican Republic was the country with the largest estimated cumulative incidence of both exposure opportunity and actual use (85% with 95% CB: 83; 87 and 81% with 95% CB: 78; 83, respectively); while Guatemala

was the country with the smallest estimated cumulative incidence of both exposure opportunity and actual use (30% with 95% CB: 28;33 and 26% with 95% CB: 24; 28, respectively). Also, the PACARDO study confirmed previous findings that tobacco has a pattern of country-to-country variation (42, 53, 77, 78, 79, 80). Thus, Costa Rica was the country with the largest estimated cumulative incidence of both exposure opportunity and actual use (56% with 95% CB: 53; 59 and 47 % with 95% CB: 44; 50, respectively); and Panama the country with the smallest estimated cumulative incidence of both exposure opportunity and actual use (22% with 95% CB: 19; 25 and 20% with 95% CB: 18; 23, respectively).

In relation to Internationally Regulated Drugs, since the 1990's, inhalants are the most prevalent drugs in the PACARDO region with a moderate variation in favor of marijuana (53, 55).

According to the PACARDO study, there is no clear pattern of country-to-country variation in either estimated cumulative incidence of exposure opportunity or actual use. Thus, considering the total sample, the estimated cumulative incidences of exposure opportunity to inhalants and marijuana were respectively 13% (95% CB: 12; 13) and 9% (95% CB: 8; 9) while the estimated cumulative incidences of actual use of inhalants and marijuana were respectively 5% (95% CB: 5; 6) and 4% (95% CB: 4; 5). The Dominican Republic and Honduras were the countries with the highest estimated cumulative incidence of exposure opportunity to inhalants (25% with 95% CB: 22-27 and 19% with 95% CB: 16-22, respectively) while the Dominican Republic was the country with the highest estimated cumulative incidence of actual use (11% with 95% CB: 10;13). For marijuana, closed countries such as Nicaragua and Honduras showed the highest estimated cumulative incidence of exposure opportunity (11% with 95% CB: 9;12 in both countries) while Costa Rica, El Salvador and Nicaragua showed the highest estimated

cumulative incidence of actual use (10% with 95% CB: 8-11; 7% with 95% CB: 6-9 and 5% with 95% CB:4-7, respectively).

2.1.2.2 General Pattern of Male Over-Representation

Descriptive studies performed in the PACARDO region since the 1990s did not find appreciable male-female differences with respect to using both non-internationally regulated drugs (such as alcohol and tobacco) and internationally regulated drugs (such as marijuana and inhalants); this was probably due to a tendency for more use of both kinds of drugs among males than among females (53). Subsequently, further studies (such as the PACARDO study) with a better methodological approach allowed the measurement of epidemiological parameters like the strength of association (e.g. Odds Ratios), and reveal that men in fact had a higher risk of using drugs in comparison to women (55). Also, it has been reported that “recent onset drug use was more common among males” (46).

According to PACARDO study “boys were more likely to have used all drugs” (55). Thus, males in comparison to females had an increased risk for exposure opportunity to alcohol (OR=1.33, 95% CB: 1.19; 1.48), tobacco (OR= 1.97, 95% CB: 1.77; 2.19), inhalants (OR= 1.28, 95% CB: 1.10; 1.48) and marijuana (OR=2.69, 95% CB: 2.26; 3.20). The same tendency has been observed for the risk of alcohol use (OR=1.33, 95% CB: 1.20; 1.48), tobacco (OR= 2.09; 95% CB: 1.88; 2.34), inhalants (OR=1.56, 95% CB: 1.30; 1.85) and marijuana (OR=4.08, 95% CB: 3.20; 5.30).

2.1.2.3 General Pattern of Age-Specific Onsets

Several studies performed in the PACARDO region have reported a clear general pattern about older students using drugs more frequently than younger students (53, 55). For example in the PACARDO study, younger students (aged between 10-14 years old) in comparison to older

students (aged between 15-17 years old) had less risk of exposure opportunity to alcohol (OR=0.48; 95% CI: 0.38; 0.60); tobacco (OR=0.50; 95% CI: 0.40; 0.62); inhalants (OR=0.66; 95% CI: 0.49;0.89) and marijuana (OR=0.27; 95% CI: 0.18;0.41). On the other hand, when older students (aged equal or more than 18 years old) were compared to students aged between 15-17 years old, the former had an increased risk of using drugs such as marijuana (OR=1.24; 95% CI: 1.02; 1.51); but no differences were found for drugs such as alcohol, tobacco and inhalants (ORs with $p > 0.05$ and 95% CIs that overlap 1).

2.1.2.4 Rural-Urban Variations

A search of the peer-reviewed scientific literature disclosed very little published epidemiological evidence on urban-rural variations in the occurrence of alcohol, tobacco, and internationally regulated drug use in the PACARDO project's region. One of the oldest serious scientific reports dated from 1996 (Panama), in which the research team integrated by González and colleagues reported, based on a cross-sectional study of 6,647 students, a predominant pattern of higher alcohol and tobacco use prevalence among urban students (alcohol: 44.4% vs. 30.1%; tobacco: 12.4% vs. 5.6%; urban and rural prevalence respectively). However, in relation to other drugs there was no evidence for urban- rural differences (53). Ten years later, another scientific paper was published based on a cross-sectional study of 982 students from El Salvador, in which Springer, Selwyn and Kelder confirmed the observed tendency of urban-rural differences among Central American students with respect to tobacco use and the disappearance of this gap for alcohol use. Thus, they found that "urban males" were more likely to have had lifetime and current use of tobacco than "rural males" (OR=1.42, 95% CI: 1.02; 2.11 and OR = 1.78, 95% CI: 1.11; 2.36, respectively), and "urban females" were more likely to have had lifetime and current use of tobacco than "rural females" (OR = 1.89, 95% CI: 1.14; 3.13 and OR = 2.98, 95% CI:

1.29; 7.06, respectively). The research team also reported no statistically significant differences between urban and rural students for episodic heavy drinking and lifetime marijuana use, even after controlling for sex (81). Findings related to change in alcohol use pattern among rural and urban students have also been reported in other countries from Central America such as Mexico (82). In this country, Martínez-Maldonado and colleagues published in 2008, results from a cross-sectional study of 359 students and these showed no statistically significant differences in relation to alcohol consumption among students from rural and urban areas.

Studying the differences between patterns of drug use among school students in rural and urban areas has been widely developed in industrialized countries such as the United States. For example, a study published by Swain, Beauvis, Edwards and Oetting in 1986, reported that the 12th-grade students from rural communities in the Rocky Mountain Region had significantly higher rates of alcohol and LSD use with respect to national data (83). Subsequently, another study conducted by Sarvela, Pape and Bajracharria in Illinois and published in 1990 reported that rural youths began drinking alcohol even earlier than urban youths from the same state (84). This pattern of highest rates of alcohol consumption among rural students has been confirmed in other international studies conducted in Canada (85) and Netherlands (86).

Tobacco use followed the same tendency of higher rates among rural students. Thus, Sarvela published interesting research in 1997 that showed “rural white males” smoked more often than any other racial group (30-day prevalence: 34%) (87), and Brady and Weitzman in 2007 reported higher alcohol and tobacco consumption rates in rural students (88). Finally, a huge study performed by Rhew and colleagues in a probabilistic sample of 18,767 students, taken from 24 small to moderate-sized towns in Washington, Oregon, Utah, Colorado, Illinois, Kansas, and Maine, showed that farm-dwelling youths in high school were more likely to use drugs such as

alcohol, smokeless tobacco, inhalants, and other illicit drugs than country youths or youths from towns (89).

In a WHO monograph on “Substance Use Among Young People in Urban Environments” published in 2005, Charles Parry and Isidore Obot, under an integral and complex conceptualization of urbanization as “a process by which an increasing proportion of populations come to live in urban centers” (which rises the proportion of people living in urban areas and produces a remarkable environment characterized by high stressors and reduced social buttress), revised several research from different countries around the world, and reported a predominant pattern of drug use among urban youths in South Africa, Nigeria, Japan and Israel, and recognized this environment as a risk factor of adolescent substance abuse (15).

2.1.3 Other Key Constructs Considered for this Thesis Project

In general, when a research project has a focus on individual differences or family influences on youthful drug involvement, there is a set of key constructs to be considered because they might function as confounding variables (i.e., alternative explanations for observed associations), or as effect-modifying variables that can be specified in advance on the basis of strong theory or prior evidence. Often, analyses are completed with these key constructs held constant via formation of stratified subgroups, via more fine-grained matching of individuals within risk sets, or via regression modeling of explicitly measured covariates. Results from work of this type can be very ambiguous and difficult to interpret when the epidemiological data originate in observational research with cross-sectional designs (e.g., when the key constructs can influence one another and are not ‘exogenous’ variables in the statistical analyses). Even when there is a two-wave prospective study design, the interpretation can be ambiguous when there are feedback loops linking key constructs with one another.

In the present thesis research project, with a focus on urban-rural differences, there is no theory or prior evidence to guide selection of key constructs that might serve a confounding function, other than unmeasured variables such as mobility of the family of origin that might result in a drug user's family moving from one district (e.g., rural) to another district (e.g., urban). For this reason, the only constructs held constant are male sex and age at the time of assessment.

Furthermore, there is no strong theory or prior evidence to guide specification of hypotheses about effect-modifying characteristics or conditions – i.e., variables that might modify the urban-rural relationships being estimated. For this reason, the thesis research project has not included probes for subgroup variations in the relationships, except as are required for regression diagnostics with respect to male sex and age. Any probing into other key constructs and their status as either confounding or effect-modifying variables would be speculative and exploratory at best. The resulting evidence could not be characterized as definitive. This is a topic to which the report returns in the Discussion, under the heading of model mis-specification and omitted variables.

2.2 Gaps in Evidence and Significance of Research

As outlined above, there is a general gap in the peer reviewed published evidence on urban-rural variations in the occurrence of youthful drug use within Central America and the Caribbean, despite evidence from other parts of the world that these differences might be important in our understanding of the epidemiology of youthful drug use (15). One purpose of this thesis research project is to begin to try to fill that gap.

If successful, evidence from this thesis research project should be useful in stimulating a more complete consideration of urban-rural differences. If youthful rural residents are found to be relatively spared from use of the internationally regulated drugs imported from other regions, but

not from locally available alcoholic beverages or tobacco, then public health authorities must give attention to maintenance of the 'autarceologic' or other shielding mechanisms that might help prevent and delay onset of use of these internationally regulated drugs. On the other hand, because cannabis often is grown in rural areas of the countries under study, it is possible that the pattern is the reverse of the general urban excess found elsewhere in the world. If so, additional public health attention must be directed toward increased protection of rural youths.

CHAPTER 3

MATERIALS AND METHODS

3.1 Background

The PACARDO project is the result of the research initiative from the senior and principal investigator, James C. Anthony, who in 1995 received support from several institutions concerned about the deepening of youthful drug involvement in Central American countries such as the Inter-American Drug Abuse Control Commission (CICAD), the Organization of American States (OAS), the Pan American Health Organization (PAHO), and principally the National Institute of Drug Abuse (NIDA), which provided the "Cross-National Research Group on Drug Use" grant. Given this significant support and excellent leadership, it was possible to count on the cooperation of members of the local health system of Panama, Costa Rica, Honduras, Guatemala, El Salvador and the Dominican Republic. Thus, the study's name "PACARDO" (the PACARDO name concatenates **PA** for Panamá, **CA** for Centroamérica, and **RDO** for República Dominicana) provides deserved recognition to these participating countries and research collaborators (55). Also, it is important to mention that all databases generated based on the PACARDO study constitute a valuable source of epidemiological information about youthful drug involvement that allowed the epidemiological training of several national and international students of Dr. Anthony from institutions such as JHU, MSU, Universidad de Chile and Peruvian University Cayetano Heredia (UPCH).

3.2 Research Design

The PACARDO research design is that of a cross-sectional survey. For the most part, these study analyses make use of cross-sectional survey retrospective age-of-onset data to shed new light on youthful drug involvement occurring before age 14.

3.3 Assessment Procedure

The PACARDO study was performed by a multinational research team that strictly followed a standardized research protocol that consisted of three phases. The first was explanation to the students about research aims, content, and the filling process of a self-administered survey based on the PACARDO questionnaire and assent document. Also, in this phase teachers were invited to complete a standardized rating called the Teacher Observation of Classroom Adaptation—Revised (TOCA-R) and a standardized PACARDO rating form on the classroom, school, and school neighborhood environment (called in Spanish the *Medio Ambiente Escolar*-MAMBI). The second phase was the execution of the survey, and the third was recollection of surveys and assent documents. The research team in each country was composed of the lead assessor, assessors, and research assistants, who had received prior training under the research protocol PACARDO study's guidelines.

Basically, in the PACARDO study three instruments were used: the PACARDO questionnaire, the Teacher Observation of Classroom Adaptation—Revised (TOCA-R), and the *Medio Ambiente Escolar*-MAMBI questionnaire.

The PACARDO questionnaire is focused on the individual student's own perception of his/her health needs, including alcohol and drug involvement. The instrument evaluates in the students the degree of involvement in alcohol and other drug use, behavioral patterns, health status, psychiatric disorder, social competency (including peer relations), family system, school adjustment, and work. Within each of these PACARDO questionnaire domains, there are sub-domains of items that tap socially adaptive and maladaptive behaviors, affiliation with deviant or drug-using peers, parent supervision and monitoring, degree of identification with parents and parental values, as well as other constructs, each of which qualifies for inclusion as a suspected

individual-level risk factor for drug involvement. Also, the PACARDO questionnaire measures propensity for drug involvement (even if drug-taking has not begun), to gain more detailed information about frequency and patterns of use of tobacco, crack-cocaine, inhalants, and other drugs, neighborhood conditions that might influence drug involvement, perceived harmfulness of drug-taking, acculturation and identification with specific traditional or non-traditional cultural values and folkways, age at first opportunity to take individual drugs, and age at first use of individual drug classes. Individual-level characteristics of the youth such as age, sex, and family social class are also considered in the PACARDO questionnaire.

In the PACARDO project, there also were teacher ratings. For example, teachers completed a questionnaire version of the Teacher Observation of Classroom Adaptation-Revised (TOCA-R). In addition, the MAMBI questionnaire allowed teachers to rate the classroom, school climate, and school neighborhood environments, to the best of their abilities as independent observers. However, neither TOCA-R nor MAMBI ratings were integrated as part of this thesis research. More details about assessment procedure and instruments mentioned on this thesis can be found in original articles about the PACARDO study (44, 46, 55).

3.4 Human Subject Protection

The PACARDO study's research team developed two processes to ensure the protection of the research subjects' rights: (1) a "passive" parental consent process and (2) an "active" student assent process.

In the initial phase of the PACARDO study, each director of participating schools sent, several days before the survey date, a letter to parents' homes about aims and contents of the survey and how children could opt out of the survey, in case parents did not consent to their children's participation (following the PACARDO protocol's guidelines, student should mark a symbol to

designate "a missing value" along all survey questions). No parental signature was required in this process. With respect to the “active” student assent process, this was performed during the assessment session. Even though, parents had consented to the participation of their children; participating students were informed by the research team that in case they did not want to participate in the study they could decline to answer any and all survey questions. The student level participation rate was more than 98%, with typical student absenteeism rates (5% -7% in Costa Rica and even less rates in rest of countries).

The complete PACARDO research protocol was reviewed and approved by a United States National Institutes of Health initial review group in order to evaluate the scientific and public health relevance of the project and human subjects’ protections, before it obtained any funding from the National Institute on Drug Abuse. Additionally, the same protocol was approved by the John Hopkins University’s IRB (“Human Ethics” IRB) and at a local level by independent human subject committees from each participating country.

3.5 Data Processing and Quality Control

In order to ensure quality in the creation of PACARDO databases, research teams from all countries used a double-entry process along data entry using standardized Epi Info computer software (Centers for Disease Control and Prevention, Atlanta, Georgia, United States).

It is important to mention that the PACARDO research team developed a system to detect false positive reports about drug experiences or general response errors, through questions about opportunity to use or actual use of a fake drug called "cadrina". Thus, all students that positively reported these answers were excluded from the analysis (0.7% and 0.4% respectively).

3.6 Sampling Plan and Study Sample

The PACARDO research team applied multistage probability sampling methods with replacement that allowed having a sample with a nested structure and four levels of organization (going from the lowest to the highest level): (1) classroom, (2) school, (3) region, and (4) country. They originally got an approximate self-weighted total sample of 12,797 students, in which youths from capital and non-capital areas were well-represented, with a mean age of 16 years. The sample size conformation per country was the following: Panama (n=1,743), Costa Rica (n=1,702), Nicaragua (n=1,419), Honduras (n=1,752), El Salvador (n=1,628), Guatemala (n=2,530), and the Dominican Republic (n=2023). For purposes of this thesis, I decided to concentrate on students between 12 and 20 years old to preserve the mean age of 16 years. Thereby, the final sample size was 12,560 students with numbers per country close to the original sample.

3.7 Study Variables

3.7.1 Youthful Drug Use

As I mentioned previously, the phenomenon of “youthful drug involvement” in this thesis was analyzed in relation to its two phases: (1) opportunity to try a drug and (2) actual drug use, with respect to drugs such as alcohol, tobacco, inhalants and cannabis. In consequence, the main response variables are the following:

(1) **Opportunity to try drugs before age 14.**

This variable was built based on questions about age of first chance to try drugs: “How old were you the first time you had the opportunity to try (Drug)?” (e.g. “¿A qué edad tuvo la primera oportunidad de probar (droga) por primera vez?”), and age reported at the survey time (provided that the student's age is not greater than thirteen years). The

responses were converted to dichotomous variables: “yes” (if they have ever had an opportunity at an age less than 14 years) and “no” otherwise (if they have never had an opportunity). Students whose age of first opportunity was over 13 years old at the time of conducting the survey were coded as never having used by that date (“no”). Students who provided illogical answers were excluded from the analysis. One example of an illogical answer involved a 12 year old student who stated that their age of first opportunity occurred at age 18. This student was excluded.

(2) Drug use at age 13.

This variable was built based on questions about age of the first time the student had actually tried drugs: “How old were you the first time you tried (Drug)?” (e.g. “¿A qué edad probó (droga) por primera vez?”), and age reported at the survey time. The responses were converted to a dichotomous yes/no variables (actual drug use; no actual drug use). Thus, when students reported that age of the first use of drugs occurred during the last twelve months and their age did not exceed thirteen years at survey time, the variable was coded as “Yes” (1). Otherwise, the variable was coded as “No” (0). As before, students who provided illogical answers were excluded (e.g. when age of the first time to try drugs exceeded the reported chronological age). Likewise, I applied an input system data for those cases that met the mentioned conditions, but their age of “the first opportunity to try drugs” exceeded their age of “the first try of drugs.” Thus, for these cases, I assumed that in reality both phenomena happened at the same age (based on age of the first try of drugs). This system was applicable to very few cases (6 cases in total).

3.7.2 Capital Status

To begin, it was thought that it would be possible to code the student's home community as "urban" or "rural". Once the thesis work started, this distribution proved to be impossible to implement. Instead, with agreement of the guidance committee, the protocol was amended to different at students living in the capital city versus those living in other communities.

This variable was built based on the question about "community where student lives" (e.g. "comunidad dónde vives"). All communities' names reported by students at surveys within each school were inspected for the construction of this variable. The frequency of communities' names as reported within each school and the community and school location made it possible to construct the variable "Capital status" with the categories as shown in Figure 3.7.2.1 about "Operationalization of Capital Status Variable".

Figure 3.7.2.1:

Operationalization of Capital Status Variable

Within Each School:

1) How often do the students say a home community name that is within the capital city districts?

1A. 75% - 100%: "Capital"

1B. 50% - 74%: "Possibly Capital"

1C. < 50%: Indeterminate

2) How often do the students say a home community name that is outside the capital city?

1A. 75% - 100%: "Non-capital"

2B. 50% - 74%: "Possibly non-capital"

2C. < 50%: Indeterminate

Thus, based on this operationalization the Capital status variable codification applied the following rules: (1) if a community name was reported by students within a school with a frequency between 75%-100% and this community was located inside of capital area, students were coded as “living in capital area” but if this community was located outside the capital area, students were coded as “living in non-capital area”. (2) If a community name was reported by students within a school with a frequency between 50%-74% and this community was located inside of capital area, students were coded as “living in probably capital area” but if this community was located outside of capital area, students were coded as living in “probably non-capital area”. (3) Finally, if a community name was reported with a frequency less than 50% by students within a school, students were coded as “indeterminate”.

After this coding, I collapsed the “Possible” category with the more definite category to simplify the analysis. Also, it is important to mention it was not possible to perform these analyses for Guatemala due to uncertainty about the location of the home community of young people.

3.7.3 Socio-demographic Variables

Gender and age were the most important socio-demographic covariates considered for thesis analyses. Gender was evaluated through the dichotomous question “What is your gender?” (Cuál es tu sexo?), with two possibilities, male/female (masculino/femenino), and age was evaluated through the open question “How old are you?” (Cuántos años tienes?). Students answered this question with discrete numbers that allowed the original PACARDO research team to build an ordinal variable - spanning the age group, 12-20.

3.8 Analytic Plan

3.8.1 Aim 1

The first aim of this project is to determine cross-national variation in the cumulative occurrence (CO) estimates for drug involvement in terms of first try of drugs by the end of early adolescence (through age 13). I estimated these with 95% confidence bounds (CB) by means of Taylor series linearization, using svymean procedures with the STATA software (STATA Corp, 1985-2001). Also, for a better visualization of these results, these are represented via radar plots.

3.8.2 Aim 2

The second aim of this project is to determine variations in the cumulative occurrence of first trial use of drugs by age 13 across countries. Again, I estimated cumulative occurrence (CO) with 95% confidence bounds (CB) by mean of Taylor series linearization, using svymean procedures with the STATA software. Analyses are stratified by capital city codes outlined in section 3.7.2. Also, under this approach it is possible to evaluate the strength of the crude association between “First try of drugs by age 13” and “capital/non-capital” status. Thus, I performed analyses using logistic regression procedures.

The linear regression model has the form:

Model 1:

$$\text{logit Pr}(Y_{ij}=1) = \beta_0 + \beta_1 X_{ij}(\text{Capital/non-capital status}) + e_{ij}$$

Where i= individual and j = psu (school in this study).

The analysis addressed the “indeterminate” capitol variable code via exclusion. The main research questions were framed without consideration of the “indeterminate” category,

which was not anticipated. Rather than add complexity to the models by producing separate estimates for the “indeterminate” youths, the Stata “*subpop*” command was used to exclude them from analyses.

3.8.3 Aim 3

The third aim of this thesis project is to evaluate geographical variation in the cumulative occurrence of first trial of drugs by age 13 after statistical adjustment for sex and age. I calculated country-specific capital/non-capital odds ratios with statistical adjustment for sex and age based on the multiple logistic regression models using STATA software.

The linear regression model has the form:

Model 2:

$$\text{Logit Pr } (Y_{ij} = 1) = \beta_0 + \beta_1 X_{ij} (\text{Capital/non-capital status}) + \beta_2 \text{Sex}_{ij} + e_{ij}$$

Where: i = individual and j = psu (school in this study).

Model 3:

$$\text{Logit Pr } (Y_{ij} = 1) = \beta_0 + \beta_1 X_{ij} (\text{Capital/non-capital status}) + \beta_2 \text{Sex}_{ij} + \beta_3 \text{Age}_{ij} + e_{ij}$$

Where: i = individual and j = psu (school in this study)

CHAPTER 4

RESULTS

4.1 Demographic Profiles of Student Sample

Table 4.1.1 describes the characteristics of each country's PACARDO sample in relation to sex (male, female), age (in years), and urban-rural residence. For example, the sex distribution for the total sample reveals comparable percentages for males and females (47.1% and 51.5%, respectively). Honduras is the country with the highest female percentage (61.2% versus 38.8% for men), probably due to the fact that parents prefer to send their daughters to school while their sons are sent to farm or engage in agricultural activities. El Salvador has the highest male percentage (56.0%). But, for the case of Honduras, the overall mean student age was 16 years old without significant variation across countries. Additionally, Table 4.1.2 shows the majority of students from the total sample live in non-capital areas (46.4%). The Dominican Republic is the country with the highest percentage of students living in capital areas (39.2%) while Panama is the country with the highest percentage of students living in non-capital areas (63.3%). In Salvador, zero percent of students lived in capital areas, 2.16 % lived in non-capital areas, 9.83% lived in probably capital areas, 15.83% lived in probably non-capital areas and 72.17% of students were coded as "indeterminate" due to the fact that they reported several community names that were impossible to determine in terms of whether they were outside or within capital areas as well as their schools. In the case of Guatemala, no students lived in capital or probably capital areas, 13.80% lived in non-capital areas, 32.40% lived in probably non-capital areas and 53.80% of students were coded as "indeterminate".

4.2 Cumulative Occurrence for First Trial of Drugs by Age 13

Table 4.2.1 shows the summary of Cumulative Occurrence (CO) estimates and 95% Confidence Bounds (CBs) for First Trial use of Drugs (such as alcohol, tobacco, marijuana, inhalants and ORDs) by Age 13 in the PACARDO population. Considering all countries (last column of table 4.1), alcohol is reported as the most common drug among youths, followed by tobacco (33.0% and 14.0%, respectively), while the rest of the drugs analyzed are less frequently reported (marijuana: 1.0%, inhalants: 3.0%, and ORDs: 1.0%). A similar pattern is observed across countries.

4.2.1 Alcohol

As compared to other PACARDO project countries, the Dominican Republic estimate for alcohol before age 13 is in the top rank (54%; 95 % CB: 52%, 56%). Next in the rank order is Costa Rica (44%; 95% CB: 41%, 46%). In the middle ranks are Panama (29%), Honduras (31%) and Nicaragua (36%). Second from the bottom rank is El Salvador (22%, 95% CB: 20%, 23%). The cumulative occurrence of drinking alcohol before the 14th birthday is lowest in Guatemala (14%; 95% CB: 13%, 15%).

4.2.2 Tobacco

Results show that Costa Rica's estimate for tobacco by age 13 is in the top rank (24%; 95 % CB: 22%, 26%). The next country in the rank order is Honduras (18%; 95% CB: 16%, 20%). In the middle ranks are El Salvador (17%) and Nicaragua (13%). Two countries are on the second position from the bottom rank: Guatemala (12%, 95% CB: 10%, 13%) and Dominican Republic (12%, 95% CB: 11%, 14%). The cumulative occurrence of tobacco before the 14th birthday is lowest in Panama (6%; 95% CB: 5%, 7%).

4.2.3 Marijuana

With respect to the cumulative occurrence for first trial of marijuana by age 13, results show El Salvador is in the top rank (2%; 95 % CB: 1%, 2%). Next in the rank order with the same figure of 1% are Costa Rica, Honduras and Guatemala. Second from the bottom rank is Panama (0.4%; 95% CB: 0.1%, 0.7%). Nicaragua and Dominican Republic are countries on the first position from the bottom rank having the same figure of 0.2%.

4.2.4 Inhalants

The Dominican Republic estimate for inhalants before age 13 is in the top rank (10%; 95 % CB: 8%, 10%). Next in the rank order is Costa Rica (4%; 95% CB: 3%, 5%). In the middle ranks are Nicaragua, Honduras and El Salvador with the same cumulative occurrence of 2%. Panama and Guatemala are in the lowest position rank with a cumulative occurrence of marijuana before the 14th birthday of 1%.

4.2.5 Other Regulated Drugs (ORDs)

With respect to the cumulative occurrence for first trial of ORDs by age 13, results show that Honduras, El Salvador and the Dominican Republic are in the top rank with the same figure of 1%. Next in the rank order is Panama (0.4%; 95% CB: 0.1%, 0.7%). Finally, Costa Rica and Guatemala are countries on the first position from the bottom rank having the same cumulative occurrence of 0.3%.

4.2.6 Radar Plots for Estimated Cumulative Occurrence for First Trial of Drugs by Age 13

The country-specific radar plots in figure 4.2.1 simply provide a graphical display of the relative estimates started in Table 4.2.1. The value of a radar plot can be seen when it draws attention to patterns of estimates that otherwise might not be seen in a table. The radar plots illuminate the relative size of each country's estimates and relative size of each drug-specific estimate within each country.

The comparison of inhalants and marijuana is illustrative. Consider the relatively pointed shape of the polygon in the first row of radar plots. Contrast the flat base of the polygon for El Salvador and neighboring Guatemala, which conveys a picture of comparability of the estimates for these two things, not seen in the other countries.

4.3 Cumulative Occurrence (CO) for First Trial of Drugs by Age 13, with Attention to Capital and Non-capital Status

As shown in Table 4.3.1, before statistical adjustment for sex and age, there is some evidence of geographic variation in favor of more cumulative occurrence, mainly in capital areas, for drugs such as alcohol in Honduras, Panama and the total sample; tobacco in Costa Rica and Honduras, as well as in the total sample; and marijuana in Costa Rica and the Dominican Republic. In contrast, results also show geographic variation in favor of non-capital areas for Marijuana and ORDs in Nicaragua. But for inhalants, there is no statistically significance difference among the cumulative occurrence for first trial of this drug among capital and non-capital areas in each PACARDO country.

4.3.1 Alcohol

There is evidence of geographic variation in the cumulative occurrence of alcohol by age 13 in the total sample (capital: 44%; 95% CB: 43%, 46% vs. Non-capital: 39%; 95% CB: 37%, 40%) and in countries such as Honduras and Panama (capital: 37%; 95% CB: 34%, 41% vs. Non-capital: 28%; 95% CB: 24%, 32% and capital: 36%; 95% CB: 31%, 41% vs. Non-capital: 25%; 95% CB: 23%, 27%, respectively). Little geographic variation in cumulative occurrence of alcohol was found for Costa Rica, Nicaragua, El Salvador and Dominican Republic. But, it is important to remark that El Salvador was the country with the lowest CO estimate among students from capital areas in comparison to the rest of countries (CO: 19%; 95% CB: 10%, 29%). The same tendency was observed for CO estimates in non-capital areas within this country (CO: 14%; 95% CB: 7%, 20%).

4.3.2 Tobacco

Concerning geographic variation in the cumulative occurrence of tobacco, some degree of variation can be seen for “all countries” (capital: 17%; 95% CB: 16%, 19% vs. Non-capital: 13%; 95% CB: 11%, 14%) and also occurs in countries such as Costa Rica and Honduras (capital: 28%; 95% CB: 25%, 31% vs. Non-capital: 21%; 95% CB: 18%, 33% and capital: 23%; 95% CB: 20%, 26% vs. Non-capital: 15%; 95% CB: 11%, 19%, respectively). Results show there is no statistically significant difference among the cumulative occurrence for first trial of tobacco by age 13 among capital and non-capital areas in Panama, Nicaragua, El Salvador and the Dominican Republic.

4.3.3 Marijuana

According to the results, Costa Rica and the Dominican Republic are countries that have statistically significant differences among the cumulative occurrence for first trial of tobacco by age 13 among capital and non-capital areas (capital: 2%; CB: 1%, 3% vs. non-capital: 0.4% ; CB: 0.0%, 0.8% and capital: 1%; CB: 0.0%, 0.1% vs. non-capital: 0.0%, respectively). Also, there is geographic variation in the cumulative occurrence of this drug in favor of non-capital areas in Nicaragua (capital: 0.0% vs. non-capital: 0.4%; CB: 0.0%, 0.4%). Analyses also show that there is no statistically significant difference among the cumulative occurrence for first trial of marijuana by age 13 among capital and non-capital areas in either the rest of PACARDO countries or the total sample.

4.3.4 Inhalants

All cumulative occurrences for first trial of inhalants by age 13 are very low in the PACARDO countries (capital: 1%-7% vs. Non-capital: 1%-9%) and total sample (capital: 4% vs. Non-capital: 5%). Moreover, due to overlap among their confidence bounds there is no evidence of geographic variation.

4.3.5 Other Regulated Drugs (ORDs)

Finally, with respect to cumulative occurrence for first trial of ORDs by age 13, there is evidence of geographic variation in favor of non-capital area in Nicaragua (capital: 0% vs. non-capital: 0.4%; CB: 0.0%, 0.9%). Cumulative occurrences differentiated by capital and non-capital status for each of the remaining countries and total sample are lower with overlap of their corresponding confidence bounds, supporting the conclusion that there is no evidence of geographic variation for this drug.

4.3.6 Radar Plots for Estimated Cumulative Occurrence for First Trial of Drugs by Age 13, with Attention to Capital and Non-capital Status

Illustration of results from Table 4.3.1 are shown as radar plots in Figure 4.3.1 differentiated by Capital and Non-capital status.

In general, radar plots show a similar pattern of shapes among capital and non-capital areas in each country and among neighboring countries, with large vertices and big flat bases for drugs such as alcohol and tobacco. But, radar plots from Costa Rica and Nicaragua merit attention. Costa Rica's capital radar plot shows a polygon of four vertices while non-capital radar plot shows a perfect triangle due to more cumulative occurrence for marijuana in capital areas. In the case of

Nicaragua, there is geographic variation among radar plots' shapes due to more cumulative occurrences for marijuana and ORDs in non-capital areas in this country. Finally, the Dominican Republic also shows different shapes between radar plots of capital and non-capital areas, due to a higher cumulative occurrence for marijuana in capital areas.

4.4 Estimated Association (Odds Ratio and 95% Confidence Interval) between First Trial of Drugs by Age 13 and Capital-Non capital Status (before and after Adjustment) in the PACARDO Study 1999-2000

Table 4.4.1 presents estimates of the country-specific capital-non capital odds ratios. Students living in capital areas from Panama are more likely to first try alcohol at age 13 than students living in non-capital areas of this country (OR=1.93 ; 95% CI:1.52,2.46). In the case of tobacco, El Salvador is the country which has the highest risk (OR=2.06; 95% CI: 2.06, 3.04). For marijuana, only children living in capital areas from Costa Rica have an increased risk for first trial by age 13 in contrast with their counterparts (OR=5.74; 95% CI: 1.82, 18.07).

Table 4.4.2 presents estimates of the country-specific capital-noncapital odds ratios, with statistical adjustment for sex and age based on the multiple logistic regression model. For the most part, the evidence in Table 4.4.2 is not appreciably different from the evidence of Table 4.4.1 (i.e., sex and age did not prove to be strong confounding variables in relation to estimates of these odds ratios).

4.4.1 Alcohol

As compared to other PACARDO project countries, children living in capital areas versus non-capital areas from Panama have the highest odds ratio for first trial of alcohol by age 13 (OR=1.93 ; 95% CI:1.52,2.46) which remains statistically significant after controlling for age and sex (aOR=1.85; 95% CI: 1.45,2.37). Next in the rank order is Honduras where children living in capital areas have a moderate risk for first trial of alcohol by age 13, even after controlling for the covariates mentioned (aOR =1.47; 95% CI: 1.17, 1.84). In the bottom rank is Costa Rica, where children in capital areas have an

adjusted odds ratio of 1.35 for first trial of alcohol by age 13 (aOR= 1.35; 95% CI: 1.11, 1.65). For the rest of the countries, there is no evidence of geographic variation.

4.4.2 Tobacco

Results of table 4.4.1 show there is geographic variation in favor of capital areas of risk for first trial of tobacco by age 13 in the majority of PACARDO countries. El Salvador is the country with the highest risk, followed by Honduras and Costa Rica (OR=2.06; 95% CI: 1.30, 3.25; OR=1.71; 95% CI: 1.24, 2.36; OR= 1.48; 95% CI: 1.19, 1.82, respectively). Also, these risks in these countries remain statistically significant even after controlling for covariates such age and sex (see results on table 4.4.2). In the bottom rank of risk is the Dominican Republic, where children living in capital areas still have more risk in contrast of their counterparts from non-capital areas for first trial of tobacco by age 13, even after controlling for covariates (OR= 1.36; 95% CI: 1.04, 1.77 vs. aOR=1.31, 95% CI: 1.01, 1.69).

4.4.3 Marijuana

With respect to the risk for first trial of marijuana by age 13, results show convincing and strong evidence of geographic variation for this risk in Costa Rica. Children living in capital areas have close to six times more risk for first trial of marijuana by age 13 than their counterparts from non-capital areas, and this risk remains statistically significant even after controlling for covariates such age and sex (OR=5.74; 95% CI: 1.82, 18.07 vs. aOR=5.70; 95% CI: 1.77, 18.33). There is no evidence of geographic variation for this risk in the rest of the countries, and a very small number of cases for variables of interest in Nicaragua and the Dominican Republic did not allow analysis at all for those countries.

4.4.4 Inhalants

Results show there is no evidence of geographic variation on risk in the PACARDO countries, probably due to very few cases of students that reported first trial of inhalants by age 13 across countries.

4.4.5 Other Regulated Drugs (ORDs)

As with inhalants, there is no evidence of geographic variation on risk for ORDs in the PACARDO countries, probably due to a similar small number of cases of students that reported their first trial of ORDs by age 13.

4.4.6 Forest Plots for Estimated Association (Odds Ratio and 95% Confidence Interval) between First Trial of Drugs by Age 13 and Capital-Non capital Status (before and after Adjustment) in the PACARDO Study 1999-2000

Figure 4.4.1 to Figure 4.4.10 display estimates in relation to a drug-specific forest plot, with an overall alcohol summary un-adjusted estimate of 1.39 (95% C.I. =1.16; 1.62) and adjusted estimate of 1.34 (95% C.I. =1.09; 1.59). Also, for the case of tobacco, overall summary estimates reach statistical significance (un-adjusted overall OR=1.42; 95% CI: 1.22, 1.62 and adjusted overall OR=1.39; 95% CI: 1.21, 1.57). For the rest of the drugs, none of the estimates reached statistical significance.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

5.1 Summary of Main Findings

The main findings of this study may be summarized succinctly. First, with respect to Aim 1, results obtained from analyses and sub-analyses performed in the total sample and in each country respectively showed that alcohol is the most popular non-regulated drug (NRD) when the first try was before age 13 (total sample: -cumulative occurrence (CO) of 33.0%), and this pattern is repeated across countries. But, when country-to-country comparisons were performed, we observed a substantial variation in the CO for first trial of alcohol by age 13. The largest estimate was from the Dominican Republic, where 52%-56% of participating students reported that they had first tried alcohol by age 13 while the smallest estimate was from Guatemala, where the percentage oscillated between 13%-15%. The second most popular NRD was tobacco in both the total sample and across countries, when first trial of tobacco by age 13 was evaluated. Also, we found country-by-country variation in the CO for first trial of tobacco by age 13. The largest estimate was from Costa Rica, where 22%-26% of participating students reported that they had their first trial of tobacco by age 13, while the smallest estimate was from Panama, where 5%-7% first tried tobacco at that age. Finally, the third most popular drug corresponded to inhalants. The CO estimate for this Regulated Drug (RD) in the total sample was 3%. The largest estimates came from Costa Rica and the Dominican Republic, with 4% and 9%, respectively. The estimates from the rest of the PACARDO countries fluctuated in the range of 1%-2%, with significant overlap of their 95% confidence bounds (CBs).

With respect to Aim 2, when we explored the potential role of capital/non-capital status of students over the pattern of first trial of drugs by age 13, we found that the 95% CBs for alcohol did not overlap only in the case of the total sample and in Panama and Honduras. In contrast, we

failed to demonstrate these differences in the rest of the countries, even in the Dominican Republic. For the case of the potential effect of capital/non-capital status of students over the pattern of first trial of tobacco by age 13, it was observed that the majority of countries had overlapping 95% CBs of CO estimations. Only the overall sample, Costa Rica, and Honduras had non-overlapping CBs. No differences were observed between CO estimates for inhalants from capital and non-capital areas, within each country and in the overall sample.

Third, with respect to Aim 3, when our analytical plan of measuring the strength of association between first trial of drugs by age 13 and capital/non-capital status was performed, we found that students living in capital areas had a significant increase of their risk in trying alcohol. This was the case for the total sample, Panama, Honduras and Costa Rica (overall OR = 1.39, 95% CI: 1.16 -1.62; OR = 1.93, 95% CI: 1.52-2.46; OR = 1.54, 95% CI: 1.22-1.94 and OR=1.34, 95% CI: 1.10-1.64, respectively). Furthermore, the majority of these odds ratios remained statistically significant after adjustment for covariates such as sex and age. This pattern of geographical variation of risk in favor of capital areas was also found for tobacco. The results showed odds ratios that were statistically significant for the overall sample, El Salvador, Honduras, Costa Rica and the Dominican Republic. Further analyses showed that these odds ratios remained statistically significant even after adjustment for third covariates such as sex and age (overall Adjusted-OR= 1.39; 95% CI: 1.21, 1.59; aOR = 1.82; 95% CI: 1.13, 2.95; aOR=1.65; 95% CI: 1.22, 2.23; aOR= 1.46; 95% CI: 1.19, 1.80 and aOR= 1.31; 95% CI: 1.01, 1.69, respectively). However, results also showed minimal strength of association for marijuana, supporting evidence that there is geographical variation of risk for first trial of this drug by age 13 only in Costa Rica. In that country, children living in capital areas had almost six times greater risk for first trial of marijuana by age 13 in comparison to their counterparts (aOR=5.70, 95% CI:

1.77,18.30). For inhalants and ORDs, results failed to demonstrate geographic variation in risk of first trial in any country –as well as in the overall sample.

5.2 Limitations, Strengths and Methodological Challenges

Before detailed discussion of these results, several of the more important study limitations merit attention. Of central concern is generalizability of the findings, since the survey population involved samples of school-attending youths. These results and conclusions may not be generalizable to all adolescents; they may pertain only to the countries under study. In addition, it was not possible to assess institutionalized or homeless adolescents, which are interesting subpopulations, often with higher prevalence of drug consumption. A noteworthy subpopulation in Central American countries, these youths often are found in capital areas, and have potential implications for the strength of this study (the exclusion from the sampling frame may mean that our proportions for the capital cities would be larger if they had been included). With respect to students who were absent at initial survey day, the original PACARDO research team developed a full methodology to get answers from those students during the next day of the survey, thus ensuring an excellent participation rate (55). Other limitations of the study correspond to potential measurement errors, including a possible recall bias (since several questions referred to age at first experience in the past). Underreporting bias (present in all surveys about drug use and other sensitive behavior) and non-response bias also may be present (due to absenteeism and refusal to participate). With respect to the last bias, the original research group of the PACARDO study adopted a methodological approach through which students absent on the survey day were assessed on a subsequent day, but this does not include students who were absent on both days. Additional limitations, but possibly no less important, are difficulties in establishing epidemiological parameters such as incidence (principally due to the study design, which was

cross-sectional instead of longitudinal) and difficulties -in establishing a relationship indicating temporal sequence (e.g. did drug use start before migration to capital city?).

Despite limitations such as these, the present study also possesses a number of counter-balancing strengths. First, I want to emphasize that all data used in the present thesis come from the PACARDO research study, which was the first multinational research project about youthful drug involvement (both legal and illegal drugs) with a nationally representative sample of youths in Central America. There have been no similar surveys in the region in terms of methodological quality and international collaborative efforts. The PACARDO sample size is also notable (considered in this thesis to be $n=12,560$, as described in the Methods section), and was very well distributed in each participating country. This sample size was obtained thanks to probabilistic sampling (multistage sampling) based on standardized research protocol shared by the research team across countries. The participation level of 98% exceeds what often is considered to be ideal (95%) for cross-sectional studies. Finally, other strengths that can be mentioned are related to the quality of standardized instruments and protection of human subjects. All instruments applied had been validated and translated professionally from English to Spanish, promoting comprehension during the surveys' execution and using back-translation to ensure accuracy. The surveys were performed only after the protocols had been approved by Institutional Review Boards of local institutions in each participating country and the sponsoring institutions. Parents and children provided passive consent and assent, respectively.

5.3 Relation to Prior Research and Hypotheses

Results of this study show that there was a different pattern in the first use of drugs by age 13 between youths who lived in capital and non capital areas of these countries. In fact, considering the total sample and countries such as Costa Rica and Honduras, living in capital areas might increase the risk of children trying alcohol or tobacco by age 13. The pattern found is consistent with findings from Martinez-Maldonado and colleagues' whose research was based in Mexico and published in 2008. In this transversal study that involved 359 adolescents, researchers found higher rates of tobacco and alcohol consumption among urban secondary students (82). Also, this tendency has been previously reported in research conducted in developed countries such as the United States. For example, Sarvela, Cronk and Isberner published a cross-sectional study in 1997, in which they reported higher 30-day prevalence of tobacco smoking among participants from urban areas (87).

This finding of geographical variation of first use of alcohol or tobacco by age 13 in favor of urban areas could be explained principally by socioeconomic factors related to environment and secondarily (and less likely) by biological mechanism. According to Richard and Danielle, based on twin studies conducted in Finland and other countries, "drinking initiation is determined by environmental influences" during early adolescent whereas in adulthood "drinking pattern is determined mostly by genetic factors, which themselves are subject to moderation by the environment" (90). Following this, it is possible that observed geographical variation could be due to the huge gap between capital and non-capital areas that characterize these countries and the rapid urbanization process the capital areas have been experiencing since the 1970s. These processes may have brought a marked increase in poor areas (91), even in the capital, with concurrent phenomena of rural-urban migration (92). Factors through which poverty might

increase risk of child drug involvement have been reported in the scientific literature by many prior investigators, and include violence, presence of drug trafficking, which facilitates exposure and buying of drugs, low quality education at level of public services, and in parents, poorer parental monitoring, and family dysfunction (33, 36, 39, 41, 61). With respect to the rural-urban migration phenomenon, one result can be "a move" of people "that by itself triggers ruptures in social connections and health care, extra stresses and discontinuity" (disruption hypothesis) or changed behaviors and attitudes to get social acceptance (adaptation hypothesis) (93,94). Thus, children who are rural-urban migrants might be more vulnerable to being involved in drugs. Also, it is important to mention that tourism is high in capital areas of Central American countries. Tourist places have been related to more drug-traffic (62). This circumstance increases the risk of both exposure to a drug and actual drug use among children. It is possible that Costa Rica and Honduras are countries especially beginning to show effects of this tourism pattern. With respect to the biological explanations for the observed geographical variation, it is important to mention the insightful contributions of researchers such as Caetano and Galvan, who have studied the relation between alcohol-metabolizing genes and ethnicity and its influence on alcohol consumption patterns and even on alcohol initiation in early adolescence (95, 96). In Asians the ALDH2*2 allele has been related to a protective effect against binge drinking, alcohol use and alcohol dependence (97) while the ADH1B*1 and ADH1C*2 alleles predict alcoholism in the same ethnic group as well as in people of European descent (98). In Mexican Americans, the ADH1C*2, ADH1B*1, and CYP2E1 c2 alleles are related to an increased risk for alcohol dependence (99, 100). In Blacks and Southwest Indians, the ADH1B*3 allele is related to a protective effect against alcoholism and alcohol-related birth anomalies (101, 102).

On the other hand, results also show that the risk of first use of drugs by age 13 between students from capital and non-capital areas was similar for alcohol in Nicaragua, El Salvador and Dominican Republic; for tobacco in Panama and Nicaragua; for Marijuana in Panama, Honduras and El Salvador; for inhalants in all countries considered in the analyses; and for ORDs in Panama, Costa Rica, Honduras and El Salvador and the Dominican Republic. With respect to the pattern found in Panama, this contrasts with what was previously reported by González and colleagues in 1996 (53). Thus, the research team found that experience with tobacco and alcohol was substantially higher among students from urban areas than students from rural areas but no significant geographical variations were observed for other drugs. For the case of El Salvador, Springer, Selwyn & Kelder reported also geographical variation in favor of urban areas for lifetime and current cigarette use, but they failed to find this for episodic drinking and lifetime marijuana use (81).

Potential explanations for these findings are the following: (1) similar cultural patterns between capital and non-capital areas, especially with respect to Non-Regulated Drugs (for example, "chicha" an alcoholic drink which is culturally well accepted in Central American countries and is part of traditional festivities such as baptisms, weddings, social and religious parties, to which children are exposed at an early age); (2) the fact that these countries could be on an advanced level of urbanization process, to the point that health levels have been seriously impaired due to a marked increase of poor communities in capital areas (91, 103); and (3) the possibility that the media exposure (newspapers, radio, TV and internet) with a high content of drug-use lifestyles has become common in both capital and non capital areas, perhaps creating a demand for the ORDs in non-capital areas that previously did not exist.

Finally, with respect to inhalants, all cumulative occurrences for first trial by age 13 were lower in the PACARDO countries (capital: 1%-7% vs. Non-capital: 1%-9%) and total sample (capital: 4% vs. Non-capital: 5%). Moreover, due to overlap among their confidence bounds there is no evidence of geographic variation. But, CO estimates for inhalants were highest for the Dominican Republic with slight predominance in favor of non-capital areas (capital: 7% vs non-capital: 9%). These findings were consistent with what was reported by the original PACARDO research team in 2004 (55). Thus, they found that the Dominican Republic had highest estimates of cumulative incidence (CI) for exposure opportunity and actual use for inhalants such as cobbler's glue or gasoline or diesel fuel (25% and 11%, respectively). Then, it is possible that students from non-capital areas within the Dominican Republic have a greater likelihood of first trial of inhalants by age 13 because there is no inhalants prevention program in these rural populations and these drugs have lower cost and great accessibility (108) as they do not require either networks or complex economic structure for their supply and distribution in comparison to cannabis or cocaine.

5.4 Future Directions for Research and Public Health Implications

There are several directions for future research, some of which are outlined below:

- Improve methodological assessment of effects of place on outcomes related to child drug involvement. Future research is needed for more accurate definitions of neighborhood -- for example, in terms of geography, social and physical characteristics, individual characteristics of community members and how they are influenced by the neighborhood (104).
- Perform longitudinal studies that allow us to measure prospective patterns and change in child drug involvement in both capital and non-capital areas, with special attention to the phenomenon of rural-urban migration.

- Following previous recommendations provided by Isidore Obot in her study about substance use in Nigerian urban youths (105), it will be interesting to study if urban youths from Central American countries have more chances to try new drugs (in terms of more availability, drug trafficking, drug users and permissible drug culture) and perhaps are also more exposed to influences from friends and the mass media than rural counterparts.
- Following previous ideas from Obot and Anthony provided in their study about school drop-out as a risk factor for injecting drug use among non-Hispanic American adults (106), it will be very interesting to study if school drop-out is also a risk factor for youthful drug involvement in urban and rural areas from Central American countries.
- Perform more studies considering the functionality and nature of families and its relation with youthful drug involvement, adjusted by urban-rural status (105, 107).
- Perform more studies in order to evaluate characteristics possessed by children who live in capital areas but do not develop drug involvement. This knowledge might allow us to move from the study of vulnerability to research on resilience, which may be necessary among children who live in risky places.
- Direct governmental budgets to programs designed to prevent child drug involvement, especially in poor communities in both capital areas and non-capital areas.
- Considering that the urbanization process will continue in the following decades in analyzed countries and this study is an excellent picture of how this process affected youthful drug involvement in capital and non-capital areas between 1999 and 2000 in the PACARDO region, Presidents from these countries should consider the study of this topic as a priority

within their mental health policies so that they can quickly determine areas with disappearing gaps and proceed to design updated and differentiated programs. Also, it is advisable they share similar policies and join efforts in forming community networks against drugs such as the Framework Convention on Tobacco Control (FCTC), which was initiated and founded by the World Health Organization in 2003 and has as members the majority of countries from the region with exception of the Dominican Republic (15, 109).

- Moreover, the future implementation of new mental health policies in PACARDO countries should consider complexities behind the youthful drug involvement problem. Thus, at the individual level, interventions or programs should work on developing esteem and resilience (110); at the familial level, strategies should strengthen communication and unity within the family, encouraging parental monitoring (39, 40); at the school level, strategies (as part of the academic curricula) should to delay and prevent the onset of drug use and raise awareness among school children about the negative effects of drug use (111) should be developed, as has been done in some African initiatives such as SACENDU (The South African Community Epidemiology Network on Drug Abuse) (112). Finally, at the social level, authorities should keep a regulatory approach based principally on scientific evidence and ethical consensus, fortifying existing laws and regulations, controlling efficient sale and marketing of non-internationally regulated drugs and fighting consistently against the sale of internationally regulated drugs (113). However, considering that migration is “a human right” recognized by The Universal Declaration of Human Rights in 1948 and Helsinki Declaration in 1975 (114, 115), and that the urbanization process will continue in the coming decades, the above strategies should be complemented by macrostrategies that combat social and economic disparities between capital and non-capital populations. Thus, the PACARDO

region's governments must plan rationally the growth of their new cities, providing access to education, housing and health, and strengthening healthy community networks that allow the involvement of young people in social life, work and religious activities, providing a hopeful social context with equal opportunities for youths regardless of their migrant status. Only under these circumstances, youths will find productive positions within their societies, an effective alternative to viewing drugs as a haven.

5.5 Potential Clinical and Public Health Implications

The implications of this study for immediate clinical and public health applications may be limited, but several questions and ideas should be considered:

- (1) Are there public programs in El Salvador's capital cities that account for the observed lower incidence of precocious drinking (19%) in that metropolitan area as compared to all other capital cities using this drug? If so, can these programs be adopted in other capital cities?
- (2) Are differences in the pattern of first trial of drugs observed among capital and non-capital areas due to biological factors, such the presence of some metabolizing genes that characterized ethnic groups present in the PACARDO participating countries?

5.6 Conclusions

1. Results of this study reveal some facets of the intrinsic complexity of processes that influence child drug involvement. The contrasts observed between capital and non-capital areas might be traced to various sources of variation: environmental, economical, cultural and social.
2. Evidence from this study sheds light on a possible rural-urban gap in terms of child drug involvement, especially in relation to drug compounds that are not subject to international regulations (NRDs): alcohol and tobacco. Public health practitioners already have good reasons to concentrate their efforts on alcohol and tobacco. This research may help focus

greater attention on outreach and early intervention for children in capital city areas, with strengthening of protective influences in non-capital areas.

3. Evidence from this study reveals that youthful drug involvement in Central America and part of the Caribbean region do not follow the same pattern across countries, some of them showed geographical variation between capital and non-capital areas with respect to cumulative occurrence and risk for first trial of drugs by age 13, while in others there is no such gap. Although, we are on the very initial phase of the research process to elucidate the reasons for these differences (we are sure that these differences are not due to age or sex), in terms of mental health policy addressed in those regions, authorities should consider these differences, enriching drug use prevention programs in urban areas and sharing programs in urban and rural areas (where there is no gap) and in close neighboring countries such as Nicaragua and El Salvador that have similar drug use patterns; simple measures that could cut costs and times.
4. Even though results from this study are only applicable to participating countries from Central America, it provides new evidence of geographical variation on youthful drug involvement that could be useful for researchers from the third world such as in South America and Africa, the last one being a complex continent which has different phases of the urbanization process. There are also several kinds of patterns in terms of youthful drug involvement among countries and even inside the same country. Thus, in Nigeria a high prevalence of caffeine, mild analgesics and hypnosedatives use among urban students from Lagos city (111) has been reported; high current use of stimulants (such as Kolanut and coffee), alcohol and sniffing agents among urban students from Ilorin city (113); and more past use of tobacco among rural students (but no geographical variation of stimulants, alcohol

and hypnosedatives use) in South Western Nigeria (116) has also been observed. In the case of South Africa, more drug use in favor of urban areas has been reported for alcohol, cannabis and methaqualone (112). Despite the development of certain preventive initiatives such as SACENDU (117) researchers from this continent maybe can find in the PACARDO study a source of inspiration and methodology to organize a multicollaborative study that allows them to perform comparative and more updated analyses.

APPENDIX

Table 4.1.1: Selected Demographic Characteristics of the School-attending Youth Samples in the PACARDO Study, 1999-2000.

Country	Schools	Age Range ** (Mean)	Male* (%)	Female* (%)	Total n
Panama	42	12-20 (16.4)	783 (48.2)	807 (49.7)	1,625
Costa Rica	51	14-20 (16.3)	778 (46.2)	891 (52.9)	1,685
Nicaragua	46	13-20 (16.4)	632 (44.8)	763 (54.1)	1,411
Honduras	47	13-20 (15.8)	679 (38.8)	1,070 (61.2)	1,749
El Salvador	51	12-20 (16.0)	906 (56.0)	698 (43.2)	1,617
Guatemala	64	12-20 (15.6)	1,288 (51.5)	1,162 (46.5)	2,500
Dominican Republic	59	12-20 (15.8)	854 (43.3)	1,082 (54.8)	1,973
Total	360	12-20 (16.0)	5,980 (47.1)	6,473(51.5)	12,560

(*)Summation of male and female percentages does not result in 100%, because there were students who did not answer questions pertaining to their sex.

(**) High age values are due to inclusion of adults within samples adolescent students (e.g. adults seeking literacy while attending evening Spanish language classes for adolescents).

Table 4.1.2: Distribution of the “Capital” Variable in the Youth Samples in the PACARDO Study, 1999-2000.

Country	Capital (%)	Non- Capital (%)	Probably Capital (%)	Probably Non-capital (%)	Indeter- minate (%)*	Total (%)
Panama	302	1,029	294	0	0	1,625
	18.52	63.32	18.09	0.00	0.00	100
Costa Rica	644	1,041	0	0	0	1,685
	38.22	61.78	0.00	0.00	0.00	100
Nicaragua	21	25	252	483	630	1,411
	1.49	1.77	17.86	34.32	44.65	100
Honduras	375	445	256	164	509	1,749
	21.44	25.44	14.64	9.38	29.10	100
El Salvador	0	35	159	256	1,167	1,617
	0.00	2.16	9.83	15.83	72.17	100
Guatemala	0	345	0	810	1,345	2,500
	0.00	13.80	0.00	32.40	53.80	100
Dominican Republic	774	1,199	0	0	0	1,973
	39.23	60.77	0.00	0.00	0.00	100
Total	2,116	4,119	961	1,713	3,651	12,560
	16.85	32.79	7.65	13.64	29.07	100

Table 4.2.1: Summary Table of Cumulative Occurrence for First Trial of Drugs by Age 13 and 95% Confidence Bounds (CBs) in the PACARDO Region, Specific for each Participating Country. Data from the NIDA PACARDO Project 1999-2000.

	<i>Panama</i> <i>n=1,625</i>	<i>Costa Rica</i> <i>n=1,685</i>	<i>Nicaragua</i> <i>n=1,411</i>	<i>Honduras</i> <i>n=1,749</i>	<i>El Salvador</i> <i>n=1,617</i>	<i>Guatemala</i> <i>n=2,500</i>	<i>Dominican Republic</i> <i>n=1,973</i>	<i>Total</i> <i>n=12,560</i>
Alcohol*								
First Try at Age 13, CO	0.29	0.44	0.36	0.31	0.22	0.14	0.54	0.33
95% CB	(0.27 – 0.31)	(0.41 - 0.46)	(0.33 - 0.38)	(0.29 - 0.33)	(0.20 - 0.23)	(0.13 - 0.15)	(0.52 - 0.56)	(0.33 - 0.34)
Tobacco*								
First Try at Age 13, CO	0.06	0.24	0.13	0.18	0.17	0.12	0.12	0.14
95% CB	(0.05 – 0.07)	(0.22-0.26)	(0.11 - 0.14)	(0.16 - 0.20)	(0.16 - 0.19)	(0.10 - 0.13)	(0.11 - 0.14)	(0.14 - 0.15)
Marijuana*								
First Try at Age 13, CO	0.004	0.01	0.002	0.01	0.02	0.01	0.002	0.01
95% CB	(0.001 – 0.007)	(0.01 - 0.02)	(0.000 - 0.005)	(0.00 - 0.01)	(0.01 - 0.02)	(0.01 - 0.01)	(0.000 - 0.004)	(0.01 - 0.01)
Inhalants*								
First Try at age 13, CO	0.01	0.04	0.02	0.02	0.02	0.01	0.09	0.03
95% CB	(0.01 – 0.02)	(0.03 - 0.05)	(0.01 - 0.02)	(0.02 - 0.03)	(0.01 - 0.03)	(0.01 - 0.02)	(0.08 - 0.10)	(0.03 - 0.04)
Other Regulated Drugs*								
First Try at age 13, CO	0.004	0.003	0.002	0.01	0.01	0.003	0.01	0.01
95% CB	(0.001 – 0.007)	(0.000 - 0.006)	(0.000 - 0.005)	(0.00- 0.01)	(0.01 - 0.02)	(0.001 - 0.006)	(0.01 - 0.02)	(0.01 - 0.01)

* Figures obtained from weighted analyses.

Figure 4.2.1: Radar Plots for Estimated Cumulative Occurrence (CO) for First Trial of Drugs by Age 13 per each Country Participating in the PACARDO Study, 1999-2000

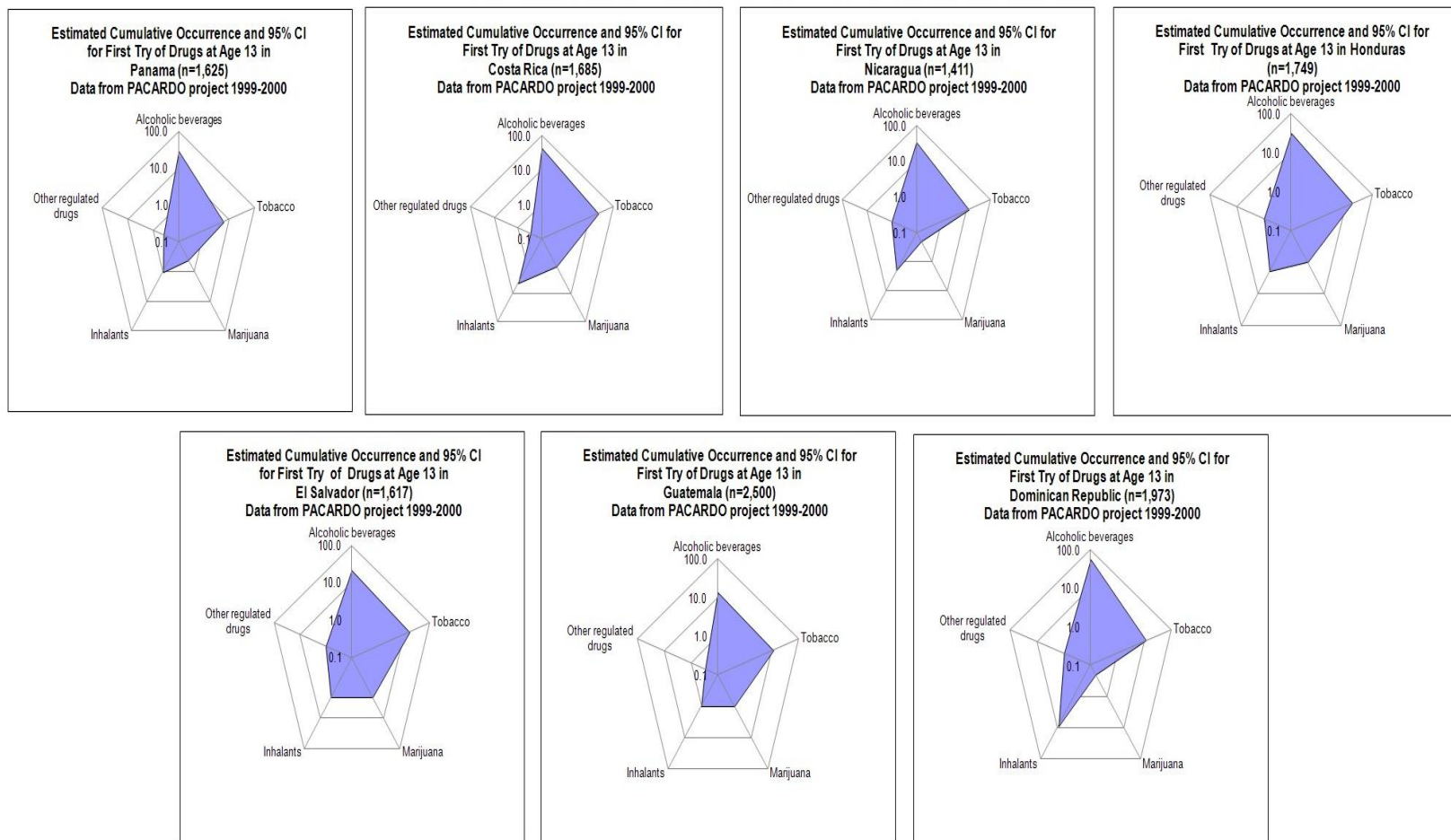


Table 4.3.1: Summary Table of Cumulative Occurrence (CO)† for First Trial of Drugs by Age 13, with Attention to Capital and Non-capital Status, and 95% Confidence Bounds (CBs) in the PACARDO Region, Specific for each Participating Country. Data from the NIDA PACARDO Project 1999-2000.

Drugs	Panama n=1,625		Costa Rica n=1,685		Nicaragua* n=1,411		Total Sample* N=12,560	
	Capital (n1=596)	Non-capital (n2=1,029)	Capital (n1=644)	Non-capital (n2=1,041)	Capital (n1=273)	Non-capital (n2=508)	Capital (n1=3,077)	Non-capital (n2=5,832)
Alcohol								
First Try at Age 13, CO	0.36	0.25	0.48	0.41	0.42	0.40	0.44	0.39
95% CB	(0.31 – 0.41)	(0.23 - 0.27)	(0.44 - 0.52)	(0.38 - 0.44)	(0.37 - 0.47)	(0.35 - 0.45)	(0.43 - 0.46)	(0.37 - 0.40)
Tobacco								
First Try at Age 13, CO	0.06	0.06	0.28	0.21	0.13	0.14	0.17	0.13
95% CB	(0.04 – 0.10)	(0.04 - 0.07)	(0.25 - 0.31)	(0.18 - 0.23)	(0.08 - 0.18)	(0.11 - 0.17)	(0.16 - 0.19)	(0.11 - 0.14)
Marijuana								
First Try at Age 13, CO	0.005	0.003	0.02	0.004	0.00	0.004	0.01	0.004
95% CB	(0.00 – 0.011)	(0.00 - 0.59)	(0.01 - 0.03)	(0.00 - 0.008)		(0.00 - 0.009)	(0.006 - 0.013)	(0.002 - 0.006)
Inhalants								
First Try at age 13, CO	0.01	0.01	0.04	0.04	0.01	0.01	0.04	0.05
95% CB	(0.002 – 0.021)	(0.002 - 0.017)	(0.02 - 0.05)	(0.03 - 0.05)	(0.00 - 0.02)	(0.00 - 0.02)	(0.03 - 0.05)	(0.04 - 0.05)
Other Regulated Drugs								
First Try at age 13, CO	0.01	0.003	0.002	0.004	0.00	0.004	0.01	0.01
95% CB	(0.00 – 0.011)	(0.00 - 0.006)	(0.00 - 0.003)	(0.00 - 0.009)		(0.00 - 0.009)	(0.00 - 0.01)	(0.00 - 0.01)

(†) Cumulative Occurrence (CO) and 95% Confidence Bounds (CBs) were obtained from weighted analyses. (*) Countries where in some cases, the capital/non-capital status were coded as "indeterminate." For this reason, summation of people (who live in capital and non-capital areas) does not sum the total population referred in the country.

Table 4.3.1 (cont'd)

Drugs	Honduras* n=1,749		El Salvador* n=1,167		Dominican Republic n=1,973		Total Sample* N=12,560	
	Capital (n1=631)	Non-capital (n2=609)	Capital (n1=159)	Non-capital (n2=291)	Capital (n1=774)	Non-capital (n2=1,199)	Capital (n1=3,077)	Non-capital (n2=5,832)
Alcohol								
First Try at Age 13, CO	0.37	0.28	0.19	0.14	0.56	0.53	0.44	0.39
95% CB	(0.34 – 0.41)	(0.24 - 0.32)	(0.10 - 0.29)	(0.07 - 0.20)	(0.53 - 0.60)	(0.50 - 0.56)	(0.43 - 0.46)	(0.37 - 0.40)
Tobacco								
First Try at Age 13, CO	0.23	0.15	0.21	0.12	0.14	0.11	0.17	0.13
95% CB	(0.20 – 0.26)	(0.11 - 0.19)	(0.13 - 0.29)	(0.08 - 0.15)	(0.12 - 0.16)	(0.09 - 0.13)	(0.16 - 0.19)	(0.11 - 0.14)
Marijuana								
First Try at Age 13, CO	0.01	0.01	0.03	0.02	0.01	0.00	0.01	0.004
95% CB	(0.002 – 0.023)	(0.00 - 0.02)	(0.01 - 0.04)	(0.001 - 0.033)	(0.00 - 0.010)		(0.006 - 0.013)	(0.002 - 0.006)
Inhalants								
First Try at age 13, CO	0.02	0.01	0.02	0.01	0.07	0.09	0.04	0.05
95% CB	(0.01 – 0.04)	(0.00 - 0.03)	(0.00 - 0.05)	(0.00 - 0.02)	(0.06 - 0.09)	(0.08 - 0.11)	(0.03 - 0.05)	(0.04 - 0.05)
Other Regulated Drugs								
First Try at age 13, CO	0.01	0.0004	0.01	0.003	0.01	0.01	0.01	0.01
95% CB	(0.00 – 0.01)	(0.00 - 0.011)	(0.00 - 0.02)	(0.00 - 0.011)	(0.00 - 0.02)	(0.01 - 0.02)	(0.00 - 0.01)	(0.00 - 0.01)

(†) Cumulative Occurrence (CO) and 95% Confidence Bounds (CBs) were obtained from weighted analyses. (*) Countries where in some cases, the capital/non-capital status was coded as "indeterminate." For this reason, summation of people (who live in capital and non-capital areas) does not sum to the total population referred to in the country.

Figure 4.3.1: Radar Plots for Estimated Cumulative Occurrence (CO) for First Trial of Drugs by Age 13, with Attention to Capital and Non-capital Status per each Country Participating in the PACARDO Study, 1999-2000

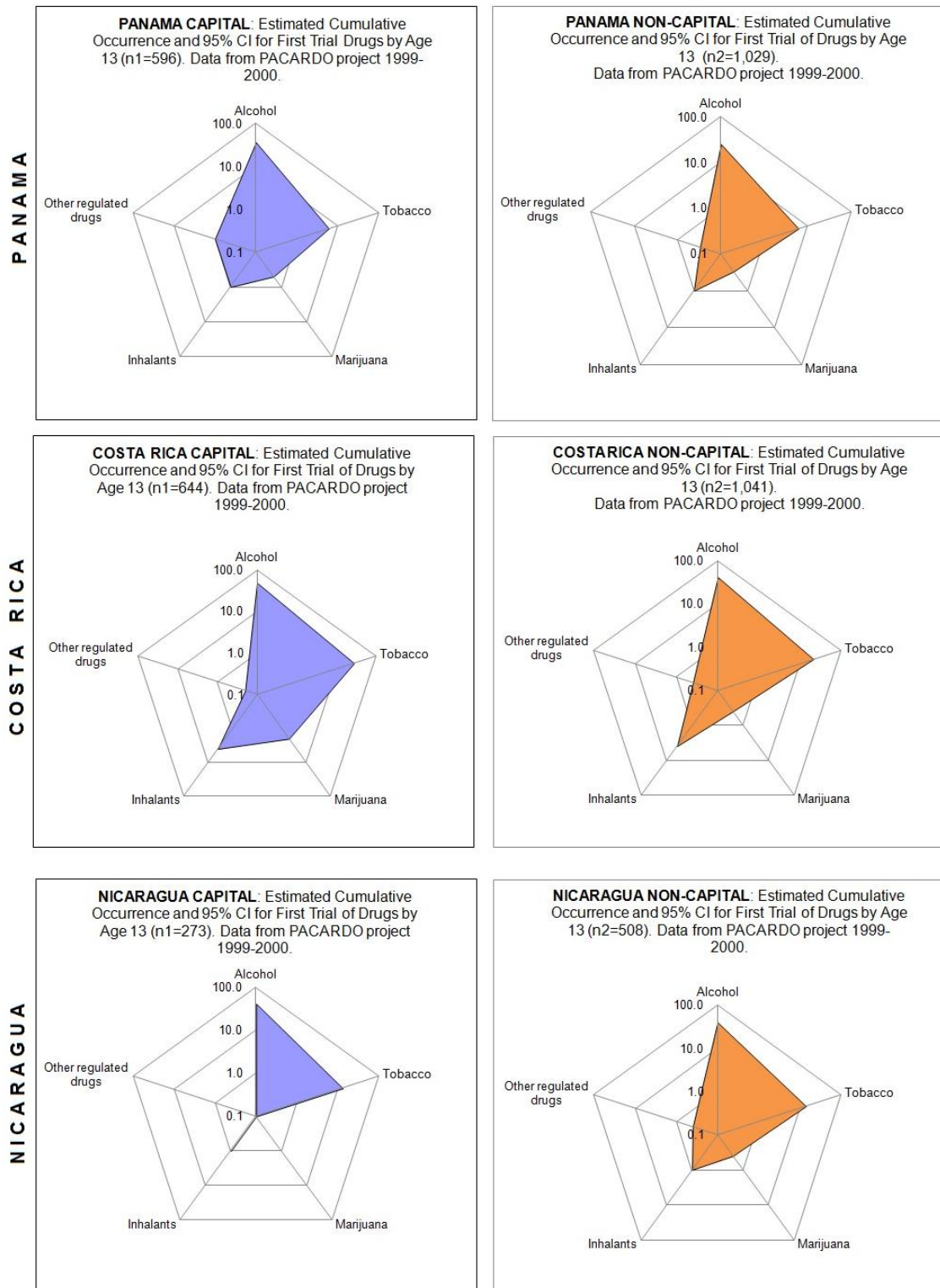


Figure 4.3.1 (cont'd)

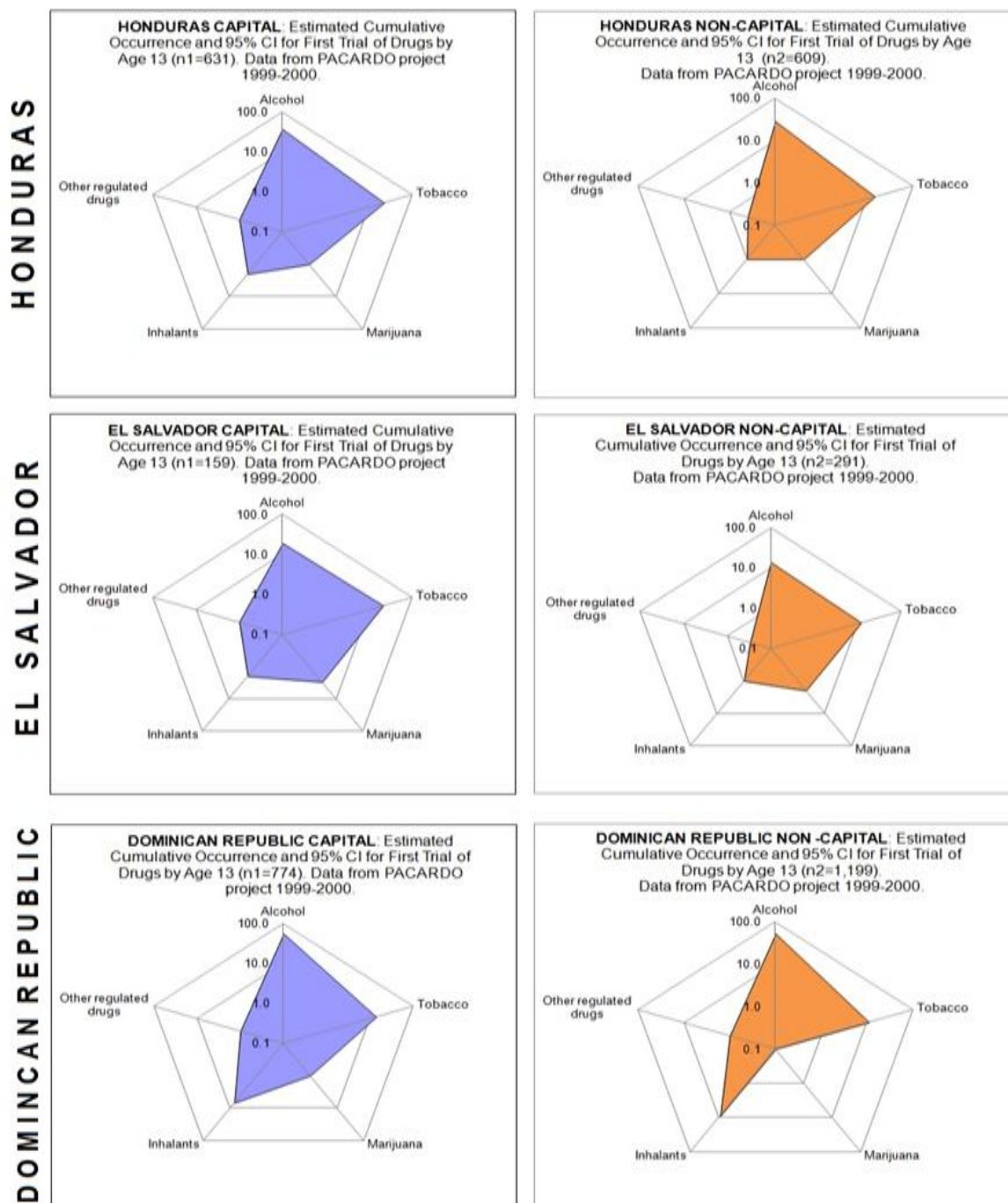


Table 4.4.1: Estimated Association (Odds Ratios and 95% Confidence Interval) between First Trial of Drugs by Age 13 and Capital-Non capital Status in the PACARDO Study 1999 – 2000.

Drugs	Panama n=1,625	Costa Rica n=1,685	Nicaragua† n=1,411	Honduras n=1,749	El Salvador n=1,617	Dominican Republic† n=1,973	Total N=12,560
Alcohol							
Capital	1.93 (1.52, 2.46) p < 0.001	1.34 (1.09, 1.64) p < 0.01	1.24 (0.93, 1.66) p > 0.05	1.54 (1.22, 1.94) p < 0.001	1.53 (0.79, 2.94) p > 0.05	1.12 (0.94, 1.34) p > 0.05	1.57 (1.43, 1.72) p < 0.001
Tobacco							
Capital	1.39 (0.84, 2.32) p > 0.05	1.48 (1.19, 1.82) p < 0.001	1.03 (0.65, 1.63) p > 0.05	1.71 (1.24, 2.36) p < 0.01	2.06 (1.30, 3.25) p < 0.01	1.36 (1.04, 1.77) p < 0.05	1.58 (1.39, 1.80) p < 0.001
Marijuana							
Capital	2.15 (0.42, 10.9) p > 0.05	5.74 (1.82, 18.07) p < 0.01		1.56 (0.47, 5.19) p > 0.05	1.50 (0.53, 4.23) p > 0.05		2.02 (1.18, 3.47) p < 0.05
Inhalant							
Capital	1.53 (0.55, 4.25) p > 0.05	0.95 (0.57, 1.57) p > 0.05	0.60 (0.13, 2.85) p > 0.05	1.64 (0.53, 5.04) p > 0.05	1.91 (0.31, 11.7) p > 0.05	1.92 (0.68, 1.25) p > 0.05	1.06 (0.84, 1.33) p > 0.05
Other Regulated Drugs (ecstasy, crack, opiates)							
Capital	2.22 (0.44, 11.1) p > 0.05	0.40 (0.04, 4.03) p > 0.05		1.29 (0.28, 5.97) p > 0.05	1.87 (0.13, 27.57) p > 0.05	0.68 (0.23, 1.97) p > 0.05	0.91 (0.46, 1.79) p > 0.05

(†) Countries with cells with “zeros” that do not allow regression analyses for some drugs such as marijuana and inhalants.

Table 4.4.2: Estimated Association (Adjusted Odds Ratios by Age and Sex, and 95% Confidence Interval) between First Trial of Drugs by Age 13 and Capital-Non capital Status in the PACARDO Study 1999 –2000.

Drugs	Panama n=1,625	Costa Rica n=1,685	Nicaragua† n=1,411	Honduras n=1,749	El Salvador n=1,617	Dominican Republic† n=1,973	Total N=12,560
Alcohol							
Capital	1.85 (1.45, 2.37) p < 0.001	1.35 (1.11, 1.65) p < 0.01	1.20 (0.89, 1.60) p > 0.05	1.47 (1.17, 1.84) p < 0.01	1.50 (0.74, 3.07) p > 0.05	0.99 (0.81, 1.21) p > 0.05	1.58 (1.44, 1.74) p < 0.001
Tobacco							
Capital	1.33 (0.82, 2.15) p > 0.05	1.46 (1.19, 1.80) p < 0.001	1.02 (0.63, 1.66) p > 0.05	1.65 (1.22, 2.33) p < 0.01	1.82 (1.13, 2.95) p < 0.05	1.31 (1.01, 1.69) p < 0.05	1.61 (1.42, 1.83) p < 0.001
Marijuana							
Capital	1.88 (0.37, 9.63) p > 0.05	5.70 (1.77, 18.30) p < 0.05		1.46 (0.45, 4.75) p > 0.05	1.32 (0.42, 4.09) p > 0.05		2.00 (1.18, 3.41) p < 0.05
Inhalant							
Capital	1.57 (0.54, 4.58) p > 0.05	0.91 (0.55, 1.53) p > 0.05	0.64 (0.15, 2.79) p > 0.05	1.64 (0.54, 4.97) p > 0.05	1.24 (1.85, 8.31) p > 0.05	0.86 (0.64, 1.17) p > 0.05	1.07 (1.33, 1.68) p < 0.001
Other Regulated Drugs (ecstasy, crack, opiates)							
Capital	2.67 (0.61, 11.7) p > 0.05	0.38 (0.04, 4.28) p > 0.05		1.23 (0.27, 5.51) p > 0.05	2.60 (0.09, 79.8) p > 0.05	0.73 (0.22, 2.41) p > 0.05	1.00 (0.49, 2.01) p > 0.05

(†) Countries with cells with “zeros” that do not allow regression analyses for some drugs such as marijuana and inhalants.

Figure 4.4.1: Forest Plot of Odds Ratio for First Trial of Alcohol by Age 13, Considering Capital and Non-capital Status in the PACARDO Study, 1999-2000

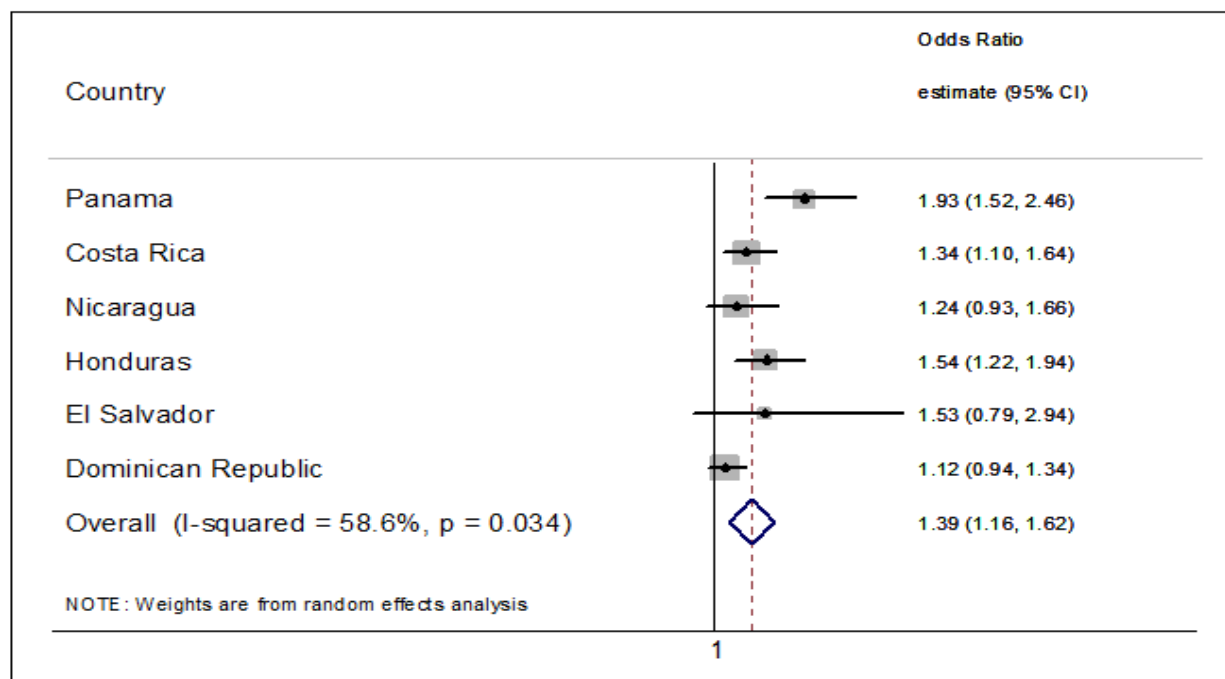


Figure 4.4.2: Forest Plot of Adjusted-Odds Ratio for First Trial of Alcohol by Age 13, Considering Capital and Non-capital Status in the PACARDO Study, 1999-2000

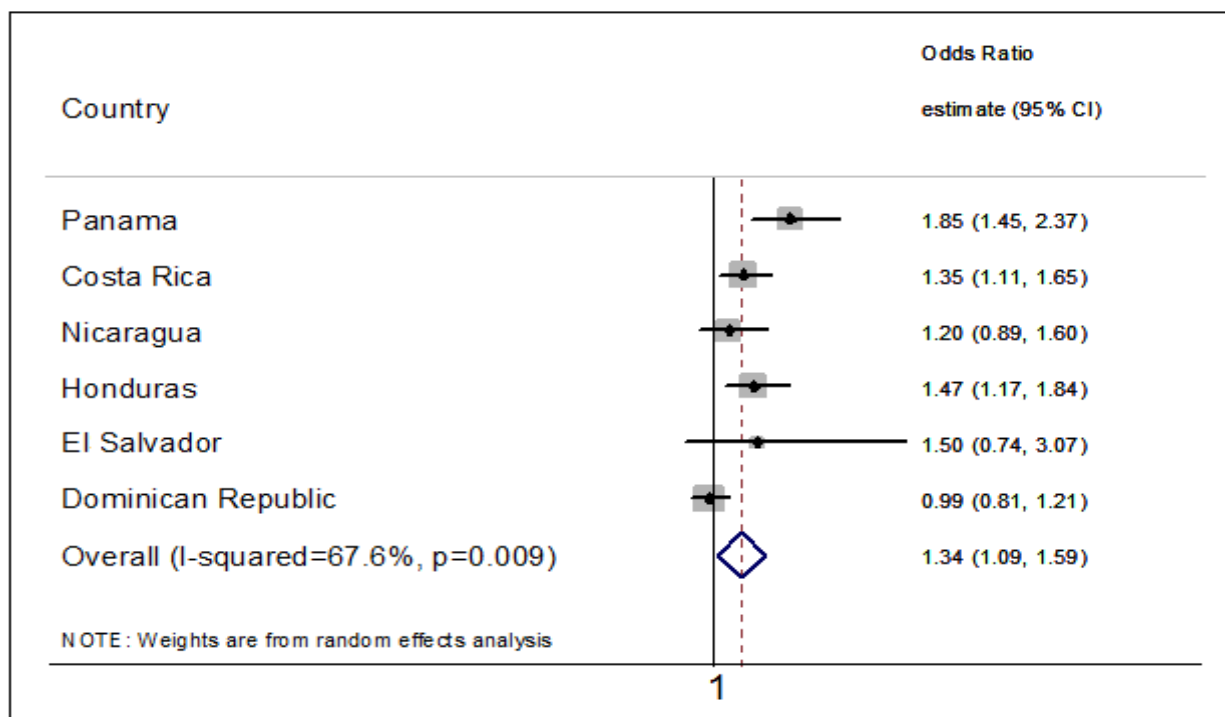


Figure 4.4.3: Forest Plot of Odds Ratio for First Trial of Tobacco by Age 13, Considering Capital and Non-capital Status in the PACARDO Study, 1999-2000

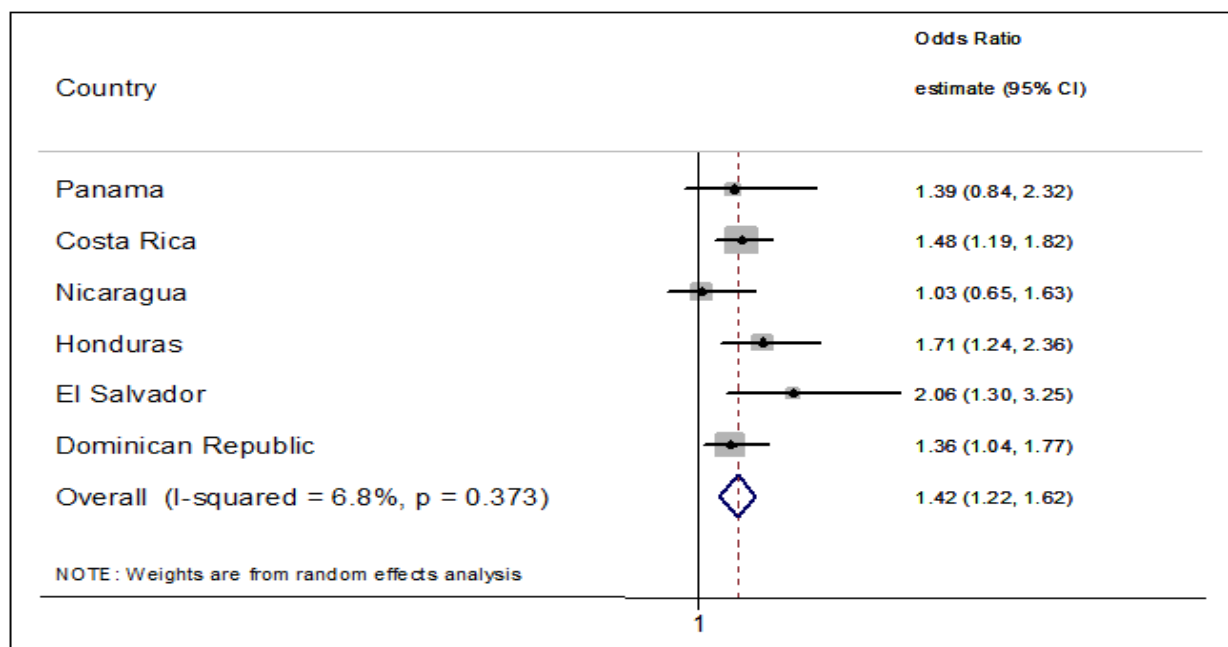


Figure 4.4.4: Forest Plot of Adjusted-Odds Ratio for First Trial of Tobacco by Age 13, Considering Capital and Non-capital Status in the PACARDO Study, 1999-2000

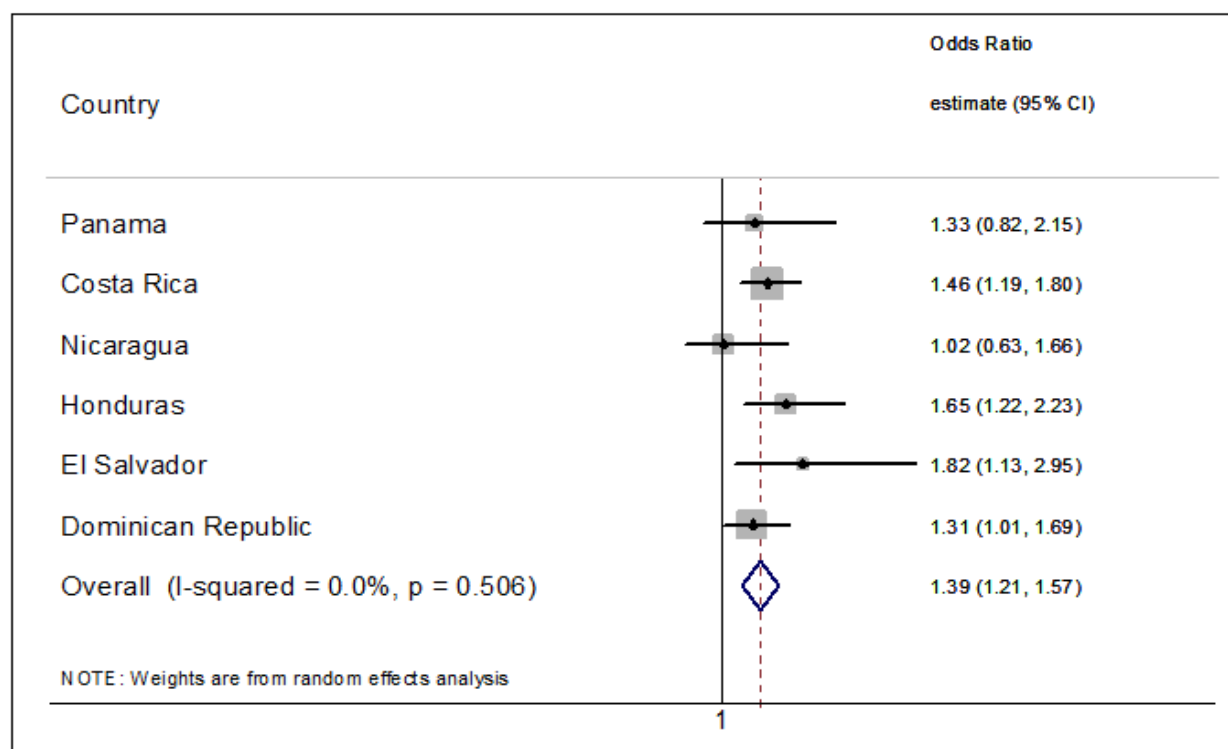


Figure 4.4.5: Forest Plot of Odds Ratio for First Trial of Marijuana by Age 13, Considering Capital and Non-capital Status in the PACARDO Study, 1999-2000

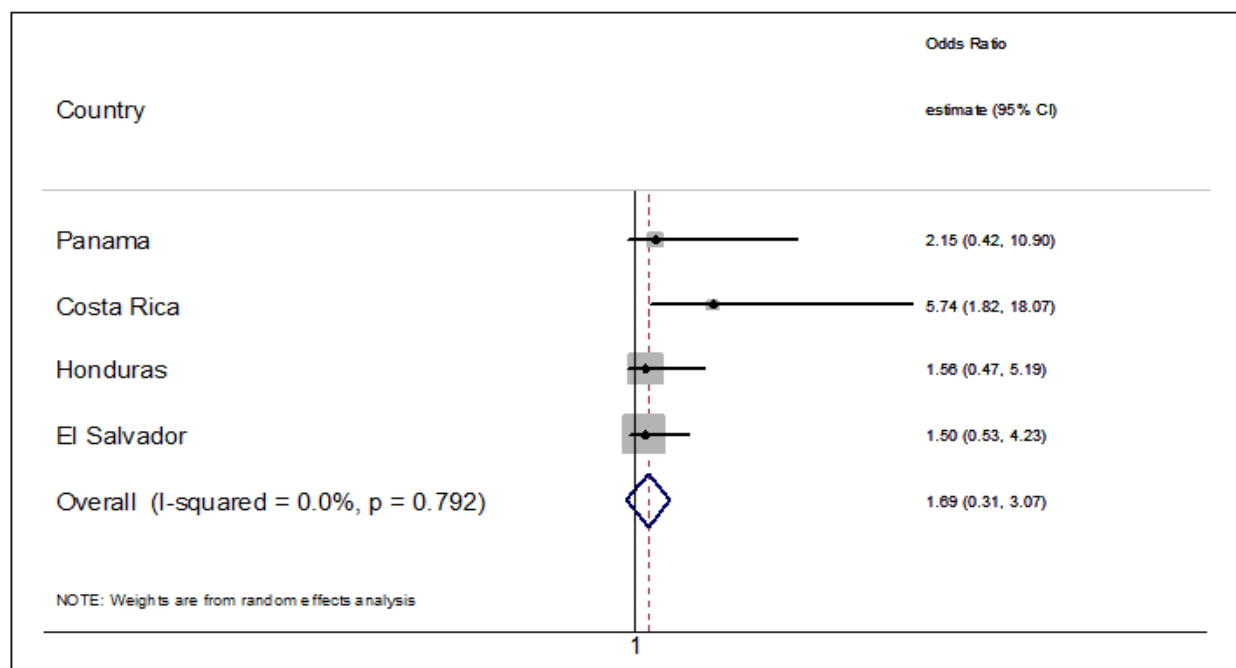


Figure 4.4.6: Forest Plot of Adjusted-Odds for First Trial of Marijuana by Age 13, Considering Capital and Non-capital Status in the PACARDO Study, 1999-2000

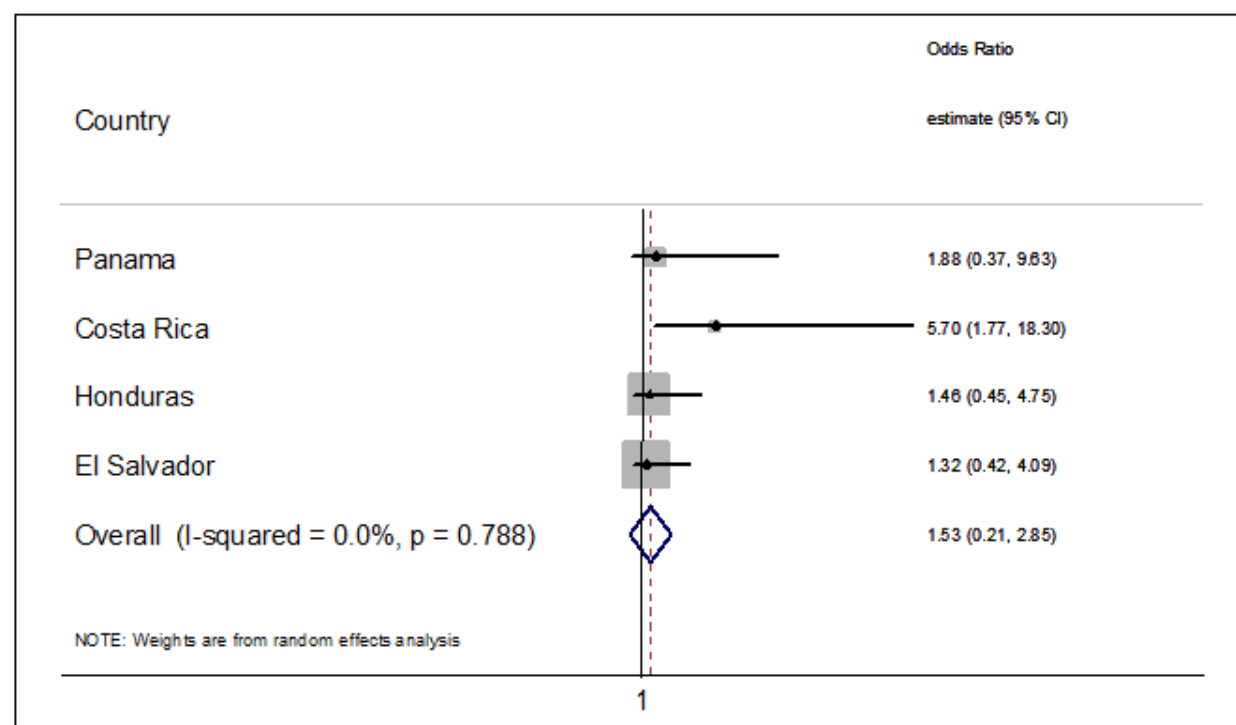


Figure 4.4.7: Forest Plot of Odds Ratio for First Trial of Inhalants by Age 13, Considering Capital and Non-capital Status in the PACARDO Study, 1999-2000

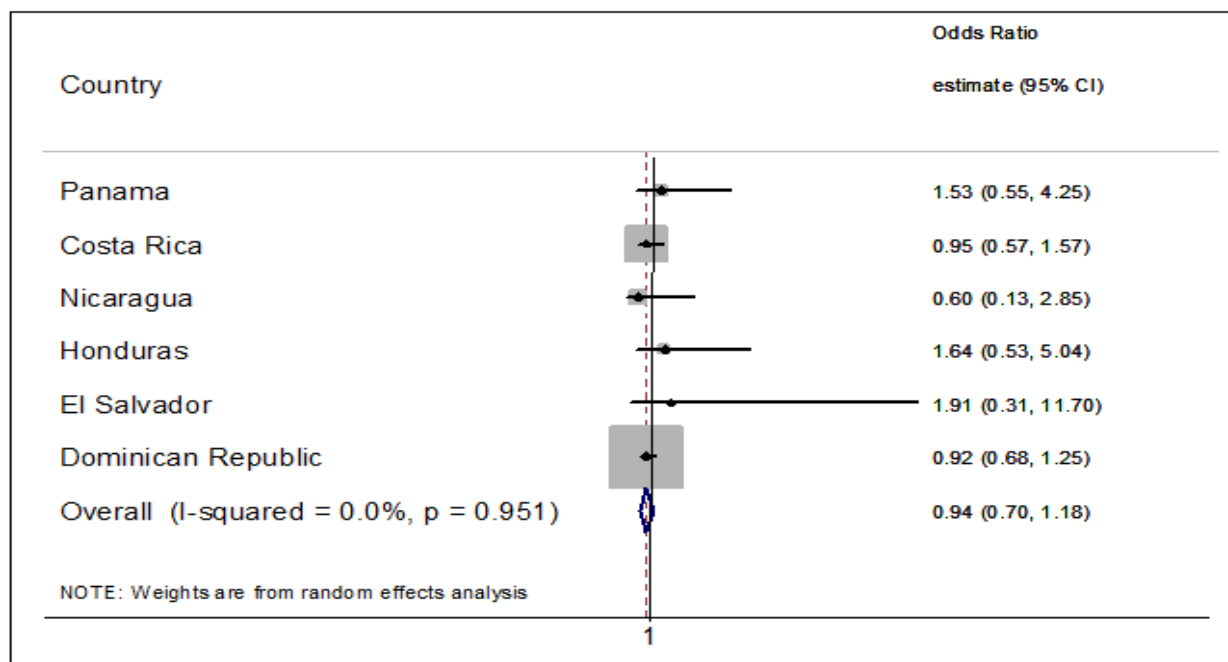


Figure 4.4.8: Forest Plot of Adjusted-Odds Ratio for First Trial of Inhalants by Age 13, Considering Capital and Non-capital Status in the PACARDO Study, 1999-2000

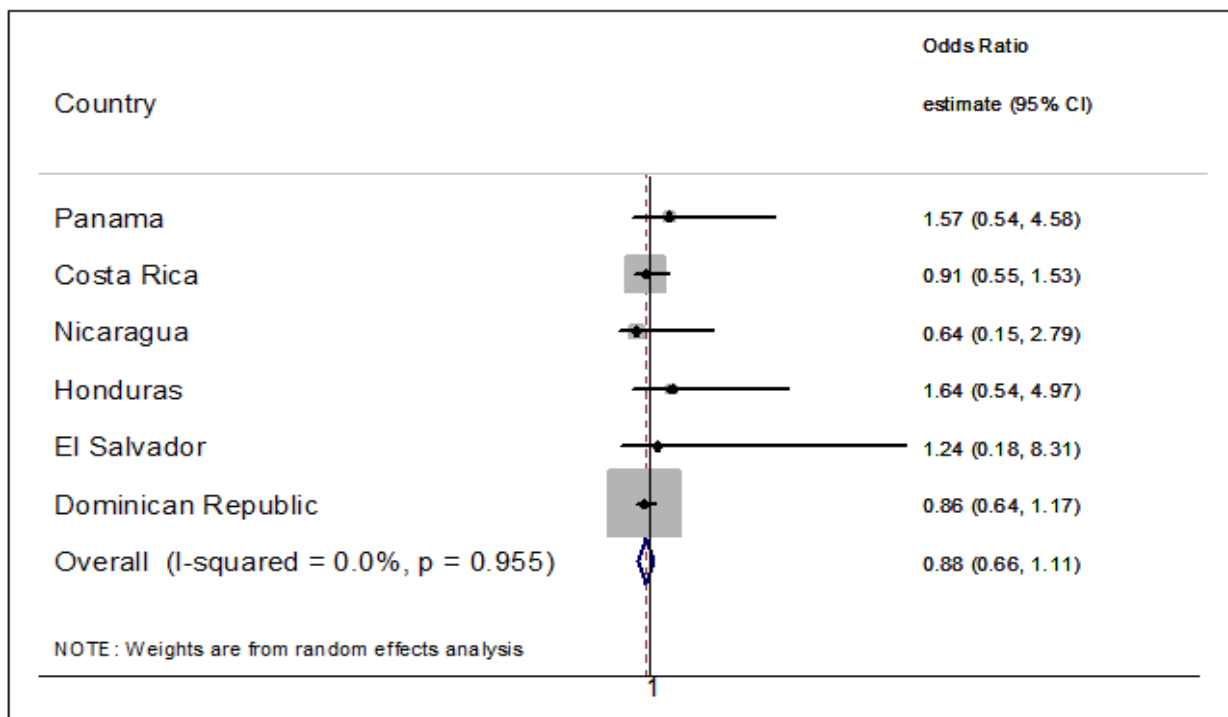


Figure 4.4.9: Forest Plot of Odds Ratio for First Trial of Other Regulated Drugs (ORDs) by Age 13, Considering Capital and Non-capital Status in the PACARDO Study, 1999-2000

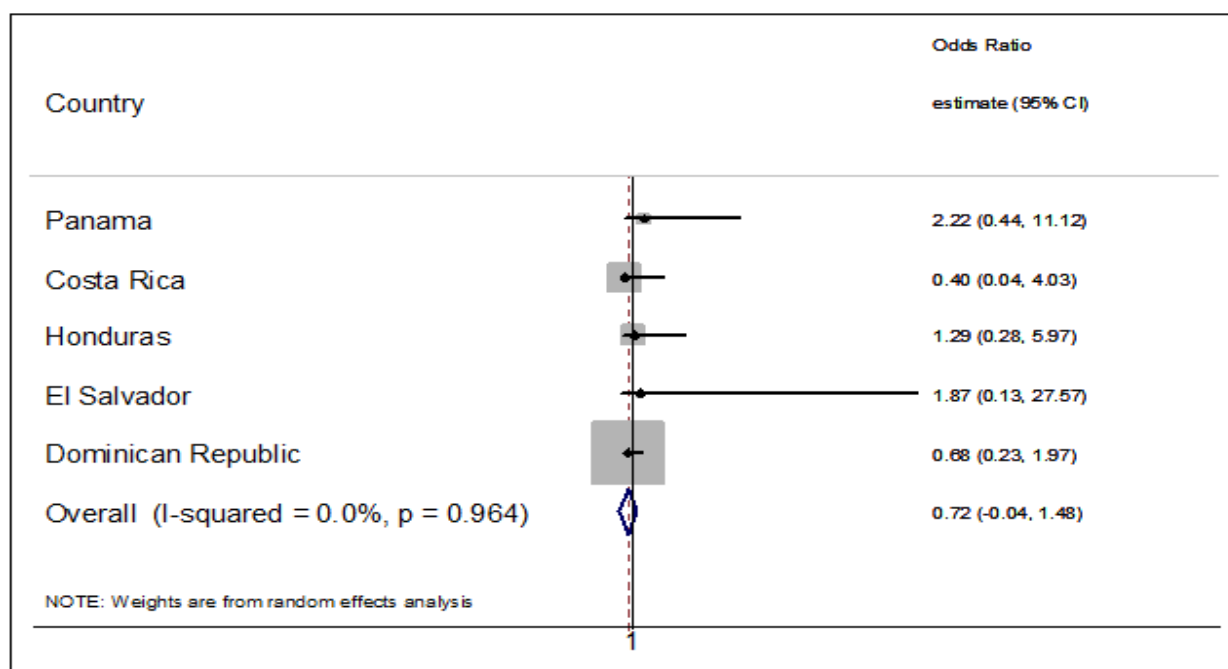
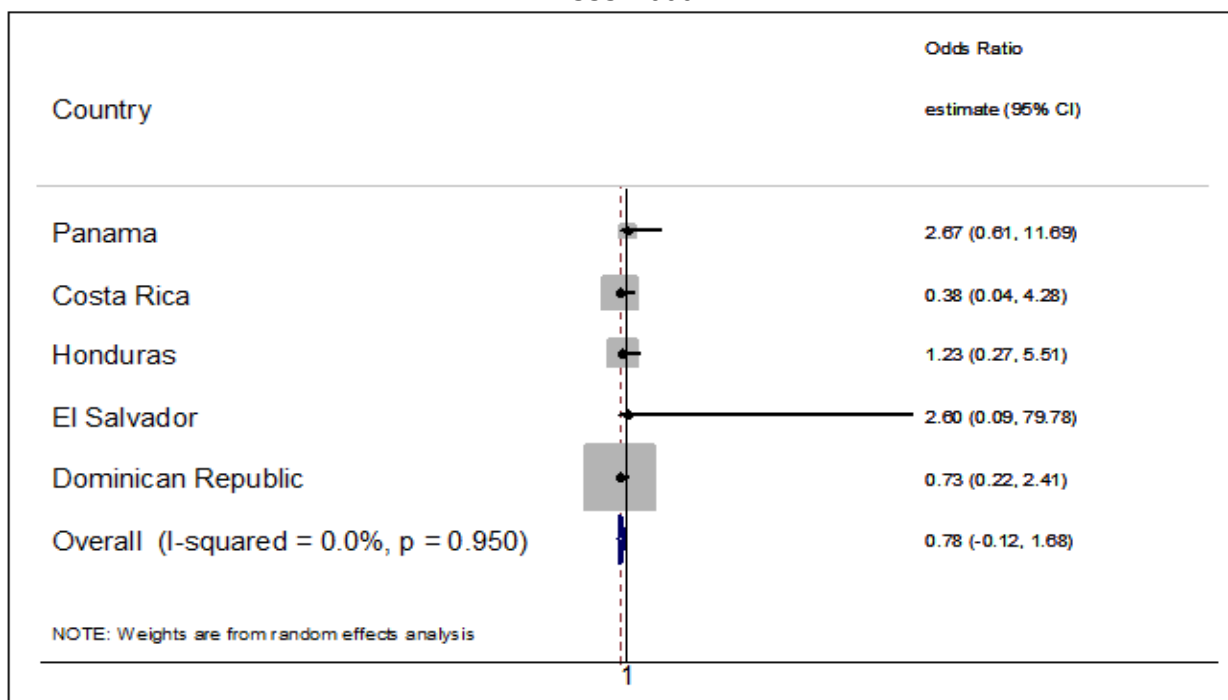


Figure 4.4.10: Forest Plot of Adjusted-Odds Ratio for First Trial of Other Regulated Drugs (ORDs) by Age 13, Considering Capital and Non-capital Status in the PACARDO Study, 1999-2000



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