

**Father Absence in Early Childhood and the Development of Adolescent Risk Behaviors  
in a Ukrainian Cohort**

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THESIS

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## LIST OF ABBREVIATIONS

CI	Confidence interval
DAG	Directed acyclic graph
ELSPAC	European Longitudinal Study of Pregnancy and Childhood
FCOU	Family Children of Ukraine
GSEM	Generalized structural equation model
IRB	Institutional Review Board
OR	Odds ratio
SES	Socioeconomic status
UIC	University of Illinois at Chicago
UK	United Kingdom
US	United States of America
WHO	World Health Organization



## SUMMARY

Adolescent and adult health and behavior are greatly influenced by our experiences during childhood. Specifically, positive relationships with fathers are important to a child's social and psychological development. Two-parent families are often characterized by economic stability and shared caregiving responsibilities, resulting in a lower stress environment. Stressors in early childhood have been linked with substance abuse, increased morbidity, and maladaptive behavior later in life.

The Family Children of Ukraine (FCOU) birth cohort study was used to evaluate the relationship between a child's separation from father from birth to age seven on the development of negative socio-behavioral outcomes in adolescence.

Nearly 20% of FCOU respondents to the adolescent questionnaire were separated from their fathers in early childhood (18 months to three years of age). Children who were separated from their fathers in early childhood, had greater odds of early smoking and current smoking in adolescence (odds ratio: 1.79 [95%CI: 1.25, 2.55], and 2.11 [95% CI: 1.43, 3.10], respectively) compared to those who were not separated from their fathers. Children who were separated from their father in early childhood had 2.87 (95% CI: 1.51, 5.43) times greater odds of reporting that they were arrested, compared to children with present fathers in early childhood. These associations persisted in both multivariable and mediation analyses.

Children who experience separation from their fathers in early childhood are more likely to develop negative health and social behaviors in adolescence. Understanding the pathways through which this occurs is crucial to informing future interventions.

## I. INTRODUCTION AND BACKGROUND

### A. Introduction

Health behaviors are largely influenced by our experiences before young adulthood and in early childhood. Birth to five years of age represents a key period for social, behavioral, and psychological development<sup>1</sup>. This is consistent with the life course epidemiology framework that describes the psychosocial pathways that determine how early-life experience affects health and risk-taking behavior<sup>2-4</sup>. Family stability is critically important at this point because it establishes a socio-emotional foundation and secure environment that influences later experiences. In the absence of abuse or conflict in a home, two-parent homes tend to be more economically stable and have lower overall stress when parenting responsibilities can be shared. Father absence in early childhood generally places additional financial strain on a household and can reduce social interaction for a child that limits cognitive and behavioral development<sup>5</sup>. Previous studies have found a link between children's physical and psychological health, and the presence of a father in the child's life<sup>6,7</sup>. However, family dynamics are complex and subject to cultural norms that vary over time and differently across subgroups within a population<sup>5</sup>.

Empirically it is also difficult to investigate an association between early childhood exposures and later life outcomes using cross-sectional data due to recall bias and an increased risk of reverse causation<sup>5</sup>. Particularly in retrospective research, subjects are not able to remember all important events from their childhood, may have been too young to remember key events that have an impact later, or may remember things incorrectly. Using longitudinal birth cohorts allows us to prospectively follow children as they age and record life events and exposures, helping reduce bias and recall limitation. This establishes temporality that is often difficult to establish in cross-sectional studies. Though birth cohorts are prone to attrition and are

resource intensive, they allow us to make stronger inferences between an exposure and outcome when modeled correctly.

The Family Children of Ukraine (FCOU), is the Ukrainian branch of the European Longitudinal Study of Pregnancy and Childhood (ELSPAC). The European Longitudinal Study of Pregnancy and Childhood was initiated by the World Health Organization (WHO) in 1985 to study social, psychological, biologic, and environmental factors that impact the health and well-being of infants and children. The FCOU study is a longitudinal birth cohort using a geographically-determined data set that followed children from pre-birth to adolescence. Pregnant women were recruited from antenatal clinics in three Ukrainian cities: Kiev, Kamianske (formerly Dniprodzerzhynsk), and Mariupol. European Longitudinal Study of Pregnancy and Childhood self-report questionnaires were collected from the mother and her partner prior to birth, and the children's primary caregiver completed questionnaires at birth, six weeks of age, six months of age, three years of age (comprising questions covering six months to three years), and seven years of age (with questions covering age three to age seven). The teenager questionnaire was the first self-reported survey to be completed by the adolescents and included individuals from Kamiankse. Kamianske is an industrial city with a population of nearly 250,000 in the Dnipropetrovsk province in south-central Ukraine.

## **B. Ukraine**

Ukraine entered an economic recession with extreme inflation and a diminished middle class that significantly influenced family life following their independence from the Soviet Union in 1991<sup>7</sup>. Children in the FCOU birth cohort were born or in early childhood during this recession and recovery. In the last half of the twentieth century, father roles and family social norms in Ukraine and other eastern European countries were greatly influenced by Soviet policy that focused on a two-income household<sup>7</sup>. After the fall of the Soviet Union, it became common for children to be separated from their fathers due to changing economic and family norms<sup>7</sup>.

### **C. Separation from Father**

Across the world, there has been an increase in mother-only households that result in a varying degree of quality and contact between children and their biological fathers<sup>8</sup>. This can be due to many reasons including death, divorce/separation, or economic need. For example, a parent may leave the home for extended periods of time for migrant labor. It is challenging to study father absence since the father may leave the household, yet remain psychologically and emotionally supportive and connected with the child. This highlights the need to investigate the underlying reasons for father absence and the pathways through which the effect of father separation acts on outcomes in adolescence. Though father “absence” and “separation” may be defined differently in the literature, here they are used interchangeably.

### **D. Literature Review**

#### **1. Smoking and Drinking Behaviors**

Prior research on the effects of parent divorce or separation on the child socio-behavioral development has been primarily conducted in the United States and other western countries. Lacey et al<sup>9</sup>, used the United Kingdom (UK) Millennium Cohort Study to investigate the effect of parental absence, due to either death or separation, on smoking and drinking by age 11. They found that compared to children who did not experience a parental absence before age seven, those that did experience parental absence had 2.5 times increased odds of initiating smoking and 1.46 increased odds of drinking alcohol by age 11. These associations persisted after adjusting for the child’s age, birth weight, gestational age, and mother’s ethnicity, use of cigarettes during pregnancy, age at birth, and educational attainment. Lacey et al<sup>9</sup>, also investigated the reason for parental absence (death or other) and whether the mother, father, or both were absent from the child’s life. Though they did not find a significant association between the age of parental absence and odds of early smoking and alcohol consumption, there were

increased odds among those who experienced parental absence between the ages of three to five<sup>9</sup>.

Children who are exposed to a greater number of adverse childhood events (ACE) typically have greater odds of early smoking initiation and other risky behaviors in adolescence<sup>10,11</sup>. These adverse childhood experiences are grouped into eight categories, including: emotional, physical, and sexual abuse; physical abuse of their mother; parent divorce or separation; and having a member of the house incarcerated, mentally ill, or abuse drugs/alcohol. Similarly, Iakunchykova et al<sup>12</sup> investigated the impact of early life stressors on smoking initiation by age 13 and drinking initiation by age 12 among Ukrainian adolescents in the FCOU cohort. This study utilized 18 early life stressor questions from the age three and age seven general questionnaires which asked mothers if any of the stressors occurred recently in the child's life and if the child was impacted by the event. These included a question regarding if the child separated from the father. Iakunchykova et al<sup>12</sup>, did not find a relationship between any of the individual stressors and early smoking and drinking initiation, but they acknowledged that there may be different pathways between the individual stressors that contribute to alcohol use and smoking in adolescence.

Cumulative and chronic stress in childhood has been shown to result in morphological brain changes, hormone levels, gene expression, and the hypothalamic-pituitary-adrenal axis<sup>13</sup>. Enoch notes that these changes are also linked to the development of addictive behaviors through the mesolimbic dopamine reward pathway<sup>13</sup>. However, not all children with early life stress develop later negative behaviors<sup>5</sup>. This indicates that social and environmental factors in adolescence mediate the effects of early life stress.

## **2. Delinquency**

Family structure (or "household type"), parental support and style have been related with later delinquency and antisocial behavior, and many now support the interaction of risk factors in a child's environment as predictors for later antisocial behavior<sup>14,15</sup>. The Dunedin longitudinal

study distinguished risk factors between childhood-onset delinquency from delinquency that began in adolescence<sup>16</sup>. Moffitt and Caspi<sup>16</sup>, argue that antisocial behavior that displays prior to puberty tended to have inadequate parenting, and temperament and behavior problems, while adolescent-onset delinquents were more likely to be influenced by contextual factors (e.g., peer groups). While researchers did find significant differences in risk factors in this cohort between the two delinquent age-groups surrounding family socioeconomic status (SES), mother's age at birth, family type, and psychopathology in early life, they highlight that there are conflicted findings with other longitudinal studies<sup>16</sup>. Aguilar et al<sup>17</sup>, have found adolescents with delinquent behavior have higher perceptions of stress during adolescence.

In the early 1990s, the Oregon Youth Survey found that the relationship between SES and early delinquency among seventh-grade boys was mediated by parenting style<sup>18</sup>. Socioeconomic status was measured before parenting style, establishing temporality and requiring parenting style to be included as a mediator. This study supports the interconnectivity between SES and quality of father-child relationship, which would be influenced by parenting style. This study determined delinquency through arrest records and a General Delinquency Scale (questionnaire), which were found to be highly correlated.

Though the definition of delinquency differs within the literature, it is accepted as antisocial behavior and represents a risk factor for future negative behaviors<sup>19</sup>. This analysis will use self-reported arrest by age 15 to 18 as a measure for delinquency in adolescence. This represents maladaptive and antisocial behavior, and when taken in conjunction with other risk-taking behaviors (e.g., smoking and alcohol use), highlight the risks to future health and well-being. It is critical to understand the pathways and early risk factors for maladaptive behavior in order to reduce the later burden on society, families, and healthcare.

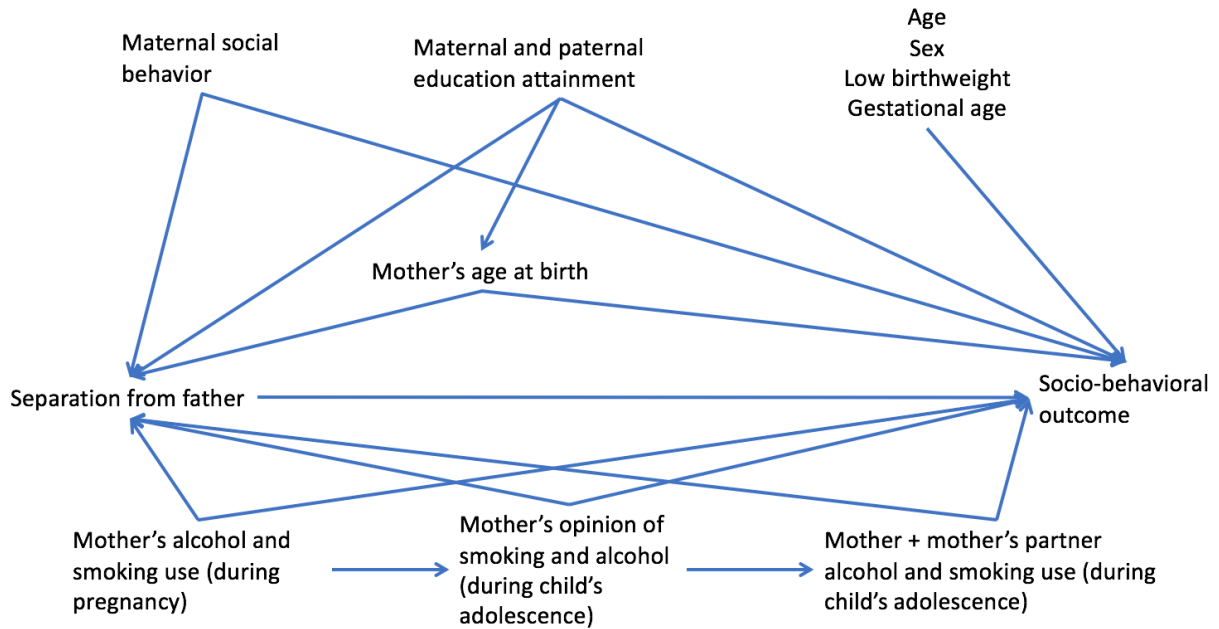
### **3. Confounding and Mediation**

Scientists have been interested in examining the effect of the parent-child relationship on health and behavior outcomes since the 1950s. However, up until the late 1990s, researchers

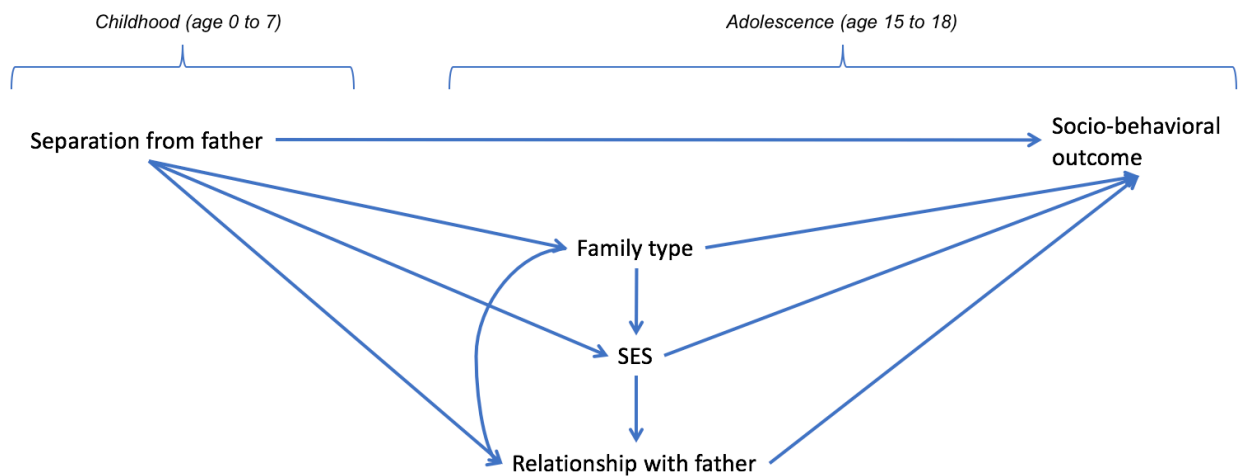
largely controlled for covariates in models investigating the effect of father absence on later health and behavioral outcomes by adjusting for them as confounders without considering the direction of causal pathways in conceptual models<sup>5,14</sup>. When investigating causation and association, a confounder is assumed to be associated with both the exposure and outcome, but is not in the causal pathway. Mediators are variables that lie in the causal pathway between the exposure and the outcome. The direct effect describes the causal path between the exposure and the outcome, where the exposure exerts a direct effect on the outcome. However, an indirect effect describes the causal path from the exposure to the mediator and the mediator to the outcome. In causal inference, it is inappropriate to analytically adjust for a mediator as a confounder because by “controlling” for it, we potentially introduce bias into our model or mask an association between the exposure and outcome<sup>20</sup>.

Figure 1 displays a directed acyclic graph (DAG) showing the relationship between the potential confounders in the effect of the exposure on the outcomes. Figure 2 illustrates the potential pathways through which the effect of father absence from the ages of 18 months to three years of age (hereafter referred to as “early childhood”) can affect later outcomes in adolescence. As previously stated, it is important to understand the underlying reasons for father absence or separation. Though there was not sufficient power to investigate different causes of separation (e.g., parent death) in this analysis, we accounted for downstream effects of separation through variables that were in the causal pathway, which acted as mediators. As shown in the DAG, separation from father in early childhood influences both the household type (mother-only, stepfather present, or two-biological parents present), the socioeconomic status during adolescence, and the quality of the relationship with the father during adolescence. Furthermore, because of the longitudinal design of the study, the exposure and potential mediators are also more likely to be correlated. This necessitates the use of a multiple mediational analysis to appropriately handle the covariance and correlation between variables<sup>21-</sup>

**FIGURE 1** Directed acyclic graph (DAG) illustrating the potential covariates in the relationship between separation from father in early childhood and the outcomes of interest during adolescence.



**FIGURE 2** Directed acyclic graph (DAG) illustrating the potential mediators in the causal pathway between separation from father in childhood and the outcomes of interest during adolescence.





**E. Significance**

Research investigating the effect of early-life conflict or separation from father and its negative health and behavioral outcomes later in life have been largely restricted to Western countries and comparatively stable economies. While previous studies have found a relationship between early life stressors and adolescent smoking or alcohol use, few studies have investigated the effect of early childhood separation from father on the development of negative socio-behavioral outcomes in adolescence. Childhood and adolescence represent a critical point in development where health and adaptive behaviors are learned and implemented, often predicting later morbidity and mortality.

**F. Research Question**

What is the relationship between separation from father, occurring between birth and seven years of age, on the development of negative socio-behavioral outcomes in adolescence in a Ukrainian cohort?

**G. Hypotheses**

Compared to children with fathers present during early childhood (birth to age seven), separation from father in early childhood results in increased odds of:

- 1) Early smoking initiation ( $\leq 13$  years of age).
- 2) Smoking during adolescence (15-18 years of age).
- 3) Early drinking initiation ( $\leq 12$  years of age).
- 4) Drinking during adolescence (15-18 years of age).
- 5) Delinquency or arrest during adolescence (15-18 years of age).

## II. METHODS

### A. Study Design and Sample Population

This study uses data from the Family Children of Ukraine (FCOU) cohort, which is the Ukrainian branch of the European Longitudinal Study of Pregnancy and Childhood (ELSPAC). Other countries that participated in ELSPAC include Great Britain, Czech Republic, Slovakia, Spain, Greece, Croatia, Estonia, and Russia. Women were enrolled during pregnancy and their offspring were followed to 18 years of age. European Longitudinal Study of Pregnancy and Childhood (ELSPAC) self-report questionnaires were collected from the mother and her partner prior to birth. This is a longitudinal birth cohort using a geographically-determined data set that followed children from pre-birth to adolescence. The original cohort contained 4,510 subjects who lived in Kiev, Kamianske (formerly Dniprodzerzhynsk), and Mariupol. Pregnant women in Ukraine were recruited from antenatal clinics in Kiev (n=1,148) and Kamianske (n=2,156) from December 1992 to June 1994. Additional women from Mariupol (n=1,206) were enrolled from August 1993 to August 1996. Cohort recruitment and study implementation have been described elsewhere<sup>24-26</sup>.

Health records were also reviewed and data was abstracted from birth through age seven. The adolescent questionnaire was completed by a subcohort of the original population, using only the Kamianske adolescents (n=1,060) and was the first self-administered questionnaire that was completed by the child. The previous questionnaires were completed by the child's primary caregiver, usually the mother.

Data analysis for these studies is conducted under University of Illinois at Chicago (UIC) Institutional Review Board (IRB) protocol #2003-0546. Data collection procedures for the different questionnaires have been approved under UIC IRB protocols #95-504, #1996-0336, and #2010-0330. The IRB for the Institute of Pediatrics, Obstetrics, and Gynecology in Kiev, Ukraine, also reviewed FCOU protocols and recruitment procedures.

**B. Exposure**

Early childhood separation from father was determined from the following ELSPAC self-completed questionnaires: birth, age three (covering 18 months to three years of age), age seven (covering age three to age seven), and adolescent (age 15 to 18). Caregivers were asked “did the child experience separation from their father (for any reason)” and selected from a range of answers including 1) “no, did not occur”, 2) “yes, did occur and did not affect the child”, or 3) “yes, did occur and affected the child”. Though the answer options included the caregiver’s perceived effect of separation on the child, ultimately the answers were dichotomized into whether separation occurred or not (yes/no). The terms “absence” and “separation” were used interchangeably in this analysis.

**C. Outcomes**

Negative socio-behavioral outcome variables were taken from the 15 to 18 years of age questionnaire that was completed by the adolescent. Outcome variables included 1) current smoking (within the last 30 days), 2) early smoking initiation (at or before 13 years of age), 3) current drinking (within the last 30 days), 4) early drinking initiation (at or before 12 years of age), and 5) self-reported problems with the police within the last year: “have you been arrested (or, have you been brought into a police station because of problems with the law).” All responses were dichotomized as yes/no.

**D. Covariates**

Potential confounders and mediators were collected *a priori* from the self-reported questionnaires collected during pregnancy (“About Yourself” and “Having Baby”), at birth, age seven, and adolescence (from both the child and mother).

**1. “About Yourself” Questionnaire**

Mother and father education attainment and mother’s socialization level were collected during pregnancy. These were categorized into less-than-secondary education, secondary or

secondary professional education, and at least some higher education. Mothers who reported getting together with two or more friends at least once a week were considered social. Partner support and socio-economic status (SES) were also collected at this time, but later excluded from the analysis due to the larger number of responses from the mothers.

## **2. “Having Baby” (20-week Gestation) Questionnaire**

This questionnaire collected the mother’s self-reported alcohol consumption and smoking status during the entire pregnancy. Mothers who reported any alcohol use within the first three months and around 20 weeks of gestation were considered to have used alcohol during their pregnancy. Mothers who reported any smoking during the first three months of pregnancy were also assigned as smokers. Mother’s self-reported drug use during pregnancy was evaluated and later excluded for small sample size.

## **3. Birth Medical Record**

Low birth weight was derived from birth medical records. Those with a birthweight at or below 2,500 grams were considered to have low birth weight. Premature birth, or gestational age, was also determined from the birth health record. Infants born prior to 38 weeks of gestation were considered to be premature.

## **4. Adolescent (15 to 18 years of age) Questionnaire**

Socioeconomic status (SES) was collected by asking the adolescents to describe their ability to purchase common materials and objects. Those who reported that they “do not have enough money for food” or “have enough money for food, but not clothes” were considered to have low SES. Middle SES included having “enough money for food and clothes, but not small electronic devices” and having “enough money for various purchases, but I have to borrow for larger purchases.” High SES included having “enough money for everything, but I have to save money for an apartment or car” and having “enough money for everything.” Middle and high SES were later combined for the mediation analysis to form a dichotomous variable.

Adolescents were asked to describe who “lived in [their] house with them currently,” which was used to derive the family type during adolescence either two-biological-parent, a stepfather, or a single mother. The variable was later dichotomized where the presence of a stepfather or single-mother home were combined into one category and two-biological parent household in the other. This questionnaire also collected information on the quality of the child’s relationship with their father (“in general, how happy are you with your relationship with your father?”). Adolescents who reported that they were very happy, happy, or neither happy nor unhappy were considered to have a good relationship with their father. Alternatively, those who were unhappy, very unhappy, or did not have a father were considered to have a poor relationship quality.

Adolescents were also asked how many of their friends smoked cigarettes and drank alcohol (“how many of your friends [smoke/drink alcohol]?”). Answer options included none, one or two, a few, most, and all. For the purpose of this analysis, answer options “one or two” and “a few”, and “most” and “all” were collapsed. No information was available on whether friends had problems with the law (i.e., were also delinquent).

## **5. Adolescent Questionnaire from Mother**

Mother’s and partner’s smoking and drinking use were collected from the self-report questionnaire during the child’s adolescence. Weekly alcohol consumers were defined as those who reported using alcohol weekly. Those who smoked at least one cigarette a week were considered smokers. The mother’s opinion of excessive alcohol consumption and smoking were also collected from this questionnaire.

## **E. Statistical Analyses**

### **1. Descriptive Statistics**

Summary statistics of the demographic characteristics of the total cohort (n=1,060) are presented. This includes the distribution of covariates across the analytic sample with non-

missing data on father absence in early childhood (n=835) to assess any potential differences that may have been caused by missing data. The distribution of the five outcome measures across the entire cohort and analytical cohort were also evaluated.

## **2. Confounder Selection and Multivariable Analyses**

Variables were selected *a priori* and the unadjusted odds ratio between the covariates and different outcomes were first investigated. The potential effect of the covariates in the exposure-outcome relationship were analyzed using stratification analysis to identify if effect modifiers or confounders caused a change of at least 20%. Potential effect modifiers were tested using the Breslow-Day Test ( $\alpha=0.05$ ). To minimize the introduction of bias in confounder selection, backward and stepwise model selection were also conducted (inclusion  $\alpha=0.15$  and exclusion  $\alpha=0.20$ ). Separate backward and stepwise model selection were also run using interaction terms for socio-economic status in adolescence. Multivariable models were conducted using confounders that were highlighted during the stratification analysis.

## **3. Mediation Analysis**

These data best fit a half-longitudinal model, given that the exposure was captured around 3 years of age and the mediators and outcome variables are collected in the adolescence questionnaire. A half-longitudinal design occurs when the exposure is measured at an earlier time point than the mediator and outcome, which are measured together at a later time point. The *a priori* directed acyclic graph illustrates the mediators within causal pathway and the correlation between the mediators, indicating a multiple mediation model (Figure 2). This correlation between the mediators and exposure would cause instability in the total effect estimate and confidence interval if modeled with standard multivariable logistic regression<sup>21</sup>. Correlation between the potential mediators and the exposure were analyzed using the CORR statement in Stata (StataCorp, LP, College Station, TX; release 14) and by observing the confidence intervals around the exposure-outcome estimate.

Establishing the presence of mediators followed the approach outlined by VanderWeele<sup>20</sup> and based on the Baron and Kenny<sup>27</sup> *causal steps strategy*. These steps highlight the direct, indirect, and total effects. First, unadjusted (step 1) and multivariable (step 2) analyses regressing the outcome on the exposure were conducted for the five adolescent socio-behavioral measures. Then, unadjusted (step 3) and multivariable (step 4) analyses separately regressed the individual mediators (i.e., adolescent SES, quality of adolescent's relationship with father, and household type during adolescence) on the exposure. It is generally accepted that if the effect between the exposure and outcome is weakened or nullified by the presence of a variable in a multivariable model and there is a causal association between the exposure and covariate supporting that a variable is a mediator<sup>20</sup>. While the Baron and Kenny<sup>27</sup> steps help establish the presence of a mediator, it is not required for all of these criteria be met in order to conduct a mediation analysis<sup>20,28</sup>.

A half-longitudinal mediational analysis is best analyzed using a structural equation model<sup>29</sup>. Structural equation models (SEM) allow researchers to estimate direct and indirect effects while handling the correlated error and covariance structure between variables<sup>20</sup>. However, SEM models require that the mediator and outcome variables are continuous<sup>30</sup>. Given the exposure, mediators, and outcome are dichotomous, a generalized structural equation model (GSEM) needed to be used to estimate the total effect<sup>22</sup>. Unfortunately, the GSEM module in Stata (version 14) does not yet have the capability to calculate the individual indirect effects and can only yield a total effect estimate, which was then used to derive an odds ratio and confidence interval.

SAS (version 9.4: SAS Institute, Inc., Cary, NC) was used to combine and modify datasets. All statistical analyses were conducted using Stata (StataCorp, LP, College Station, TX; release 14).

### III. RESULTS

#### A. Sample

The distribution of the exposure, potential mediators, and other covariates in the study are displayed in Table I. Nearly 20% of the sample experienced separation from father in early childhood. There did not appear to be any significant differences in distributions between the overall cohort and analytic cohort with available data on separation from father. Girls had higher rates of father absence in early childhood. Younger mothers (<20 years of age at childbirth) also had a higher proportion of child-father separation in early childhood than mothers aged 30-39 years of age at childbirth. Children with early childhood father absence also reported a higher proportion of absent fathers at seven years of age and during adolescence (45.7% and 74.6%, respectively). When compared to the overall sample, mothers of children with absent fathers had a higher proportion of self-reported smoking and alcohol use during pregnancy compared to the total analytic sample. Children with fathers absent in early childhood had a higher proportion of stepfather and mother only households (34.9% and 39.6%, respectively) than the overall sample. Adolescents with absent fathers were also more likely to report having lower SES and a poor quality of relationship with their father. Adolescents with absent fathers did not experience an increase in the likelihood of having friends who smoke or drink alcohol. Table II illustrates the distribution of the overall sample, analytic sample, and subgroup of children with absent fathers across the five different socio-behavioral outcomes. There is a greater proportion of adolescents with negative behavioral outcomes across all five measures.

#### B. Relationship Between Age of Separation and Adolescent Outcomes

Table III provides unadjusted odds ratios displaying the relative odds of the five outcomes across the different time points that measured child-father separation. Though the relative odds of self-reported current use of cigarettes among children were significant at every age point after birth, the strongest relationship across the different outcomes can be observed



**Table I** DISTRIBUTION OF COVARIATES AND EXPOSURES IN FCOU COHORT.

Covariates	Overall n (%)	Restricting to Those with Father Absent (in Early Childhood) Responses n (%)	Those Whose Father was Absent (in Early Childhood, 18 months to age 3) n (%)
	n = 1,060	n = 853	170 (19.9)
<b>Sex</b>			
Boys	535 (50.5)	429 (50.3)	78 (45.9)
Girls	524 (49.5)	423 (49.7)	92 (54.1)
Missing	16	0	0
<b>Age, years</b>			
15	358 (38.5)	292 (38.9)	65 (43.9)
16	522 (56.1)	440 (58.7)	78 (52.7)
17	50 (5.4)	18 (2.4)	5 (3.4)
18	1 (0.1)	0	0
Missing	144	103	22
<b>Maternal Age at Birth</b>			
< 20	153 (14.5)	121 (14.3)	45 (26.5)
20 – 29	725 (68.7)	581 (68.5)	110 (64.7)
30 – 39	172 (16.3)	144 (17.0)	15 (8.8)
40+	5 (0.5)	2 (0.3)	0
Missing	21	5	0
<b>Birthweight</b>			
< 2,500 grams	26 (2.5)	21 (2.5)	5 (2.9)
≥ 2,500 grams	1,030 (97.5)	828 (97.5)	165 (97.1)
Missing	20	4	0
<b>Gestational Age</b>			
≤ 37 weeks (premature)	45 (4.3)	38 (4.5)	11 (6.5)
> 37 weeks	1,009 (95.7)	810 (95.5)	159 (93.5)
Missing	22	5	0
<b>Father Absent at Birth</b>			
Yes	103 (11.1)	79 (10.4)	26 (16.8)
No	829 (88.9)	679 (89.6)	129 (83.2)
Missing	143	94	15
<b>Father Absent from 3 to 7 years of age</b>			
Yes	188 (23.6)	159 (22.6)	63 (45.7)
No	607 (76.4)	544 (77.4)	75 (54.3)
Missing	280	149	32
<b>Father Absent from 15 to 18 years of age</b>			
Yes	449 (42.5)	356 (41.9)	126 (74.6)
No	607 (57.5)	493 (58.1)	43 (25.4)
Missing	19	3	1
<b>Mother Social at Birth</b>			
Yes	248 (24.9)	203 (25.2)	43 (26.1)
No	749 (75.1)	602 (74.8)	122 (73.9)
Missing	78	48	5
<b>Mother Smoked During Pregnancy</b>			
Yes	239 (25.2)	183 (23.7)	57 (36.3)
No	710 (74.8)	590 (76.3)	100 (63.7)
Missing	127	303	13
<b>Alcohol Use During Pregnancy</b>			
Yes	221 (27.9)	180 (27.4)	45 (32.6)
No	572 (72.1)	477 (72.6)	93 (67.4)
Missing	282	196	32
<b>Mother Drinks Alcohol Weekly (adolescence)</b>			
Yes	186 (18.9)	154 (19.4)	33 (20.8)
No	799 (81.1)	639 (80.6)	126 (79.2)
Missing	90	60	11
<b>Partner Drinks Alcohol Weekly (adolescence)</b>			
Yes	330 (38.6)	275 (39.8)	54 (43.9)
No	526 (61.5)	416 (60.2)	69 (56.1)
Missing	219	162	47

**TABLE I DISTRIBUTION OF COVARIATES AND EXPOSURES IN FCOU COHORT.**  
(continued)

Covariates	Overall n (%)	Restricting to Those with Father Absent (in Early Childhood) Responses n (%)	Those Whose Father was Absent (in Early Childhood, 18 months to age 3) n (%)
<i>Number of Friends that Drink Alcohol (adolescence)</i>			
None	136 (13.8)	109 (13.6)	19 (12.0)
A few or less	496 (50.3)	396 (49.4)	77 (48.7)
Most or all	354 (35.9)	397 (37.0)	62 (39.2)
Missing	74	51	12
<i>Mother Smokes (adolescence)</i>			
Yes	286 (28.3)	225 (27.8)	64 (40.5)
No	725 (71.7)	585 (72.2)	94 (59.5)
Missing	64	42	12
<i>Partner Smokes (adolescence)</i>			
Yes	473 (55.6)	376 (55.2)	80 (67.8)
No	377 (44.4)	305 (44.8)	38 (32.2)
Missing	225	172	52
<i>Number of Friends that Smoke (adolescence)</i>			
None	115 (11.4)	96 (11.7)	22 (13.7)
A few or less	511 (50.8)	411 (50.2)	71 (44.4)
Most or all	380 (37.8)	311 (38.0)	67 (41.9)
Missing	54	35	10
<i>Mother's Opinion of Excessive Consumption of Alcohol</i>			
Negative	996 (97.5)	804 (97.8)	156 (96.9)
Acceptable	25 (2.5)	18 (2.2)	5 (3.1)
Missing	54	31	9
<i>Mother's Opinion of Smoking</i>			
Negative	852 (83.0)	679 (82.4)	131 (80.9)
Acceptable	175 (17.0)	145 (17.6)	31 (19.1)
Missing	48	29	8
<i>Household Type at Adolescence</i>			
Two Parents (Biological)	607 (57.5)	493 (58.0)	43 (25.4)
Mother and Step-Father	172 (16.3)	138 (16.2)	59 (34.9)
Mother Only	277 (26.2)	219 (25.8)	67 (39.6)
Missing	19	3	6
<i>Adolescent SES</i>			
Low	178 (17.5)	140 (17.1)	37 (22.6)
Middle/High	837 (82.5)	678 (82.9)	127 (77.4)
Missing	60	35	6
<i>Poor Relationship with Father at Adolescence</i>			
Yes	191 (19.9)	163 (20.9)	45 (31.0)
No	767 (80.1)	617 (79.1)	100 (69.0)
Missing	117	73	25
<i>Mother Education Attainment</i>			
Less than secondary education	151 (14.9)	120 (14.7)	31 (18.8)
Secondary/secondary professional	668 (66.0)	534 (65.4)	108 (65.4)
Some or all higher education	193 (19.1)	162 (19.9)	26 (15.8)
Missing	63	37	5
<i>Father Education Attainment</i>			
Less than secondary education	137 (14.0)	104 (13.1)	24 (15.2)
Secondary/secondary professional	641 (65.4)	521 (65.7)	104 (65.8)
Some or all higher education	202 (20.6)	168 (21.2)	30 (19.0)
Missing	95	60	12

**TABLE II DISTRIBUTION OF OUTCOMES OF INTEREST IN FCOU COHORT.**

Outcomes	Overall n (%)	Restricting to Those with Father Absent (in Early Childhood) Responses n (%)	Those Whose Father was Absent (in Early Childhood) n (%)
	n = 1,060	n = 853	170 (19.9)
<i>Early Smoking Initiation</i> <sup>a</sup>			
Yes	271 (27.8)	233 (29.4)	65 (40.1)
No	704 (72.2)	559 (70.6)	97 (59.9)
Missing	85	61	8
<i>Current Smoking</i> <sup>b</sup>			
Yes	204 (20.5)	159 (19.8)	51 (31.3)
No	789 (79.5)	643 (80.2)	112 (68.7)
Missing	67	51	7
<i>Early Drinking Initiation</i> <sup>c</sup>			
Yes	256 (25.3)	225 (27.4)	55 (34.4)
No	756 (74.7)	595 (72.6)	105 (65.6)
Missing	48	33	10
<i>Current Drinking</i> <sup>b</sup>			
Yes	378 (41.9)	309 (42.1)	72 (48.7)
No	524 (58.1)	425 (57.9)	76 (51.4)
Missing	158	119	22
<i>Arrested/Legal Problems</i> <sup>d</sup>			
Yes	48 (5.1)	41 (5.3)	17 (11.3)
No	891 (94.9)	727 (94.7)	133 (88.7)
Missing	121	85	20

<sup>a</sup> At or before age 13<sup>b</sup> Within the last 30 days<sup>c</sup> At or before age 12<sup>d</sup> Within the last year

when father separation occurred in early childhood. Delinquency (or arrest) has the strongest relationship, where there is a 2.87 (95% CI: 1.51, 5.43;  $p=0.0007$ ) times increased odds of being arrested among adolescents whose fathers were absent in early childhood compared to children whose fathers were present.

### C. Confounder Analyses

The unadjusted odds ratios between the covariates and early smoking and current smoking were displayed in Table IV. Compared to girls, boys had 1.67 (95% CI: 1.17, 2.37;  $p=0.004$ ) and 1.42 (95% CI: 1.04, 1.93;  $p=0.03$ ) times increased odds of current and early smoking, respectively. Adolescents also had increased odds of reporting early or current smoking if their mother or her partner were current smokers at the time of the teenager

**TABLE III** RELATIONSHIP BETWEEN SEPARATION FROM FATHER AND NEGATIVE SOCIO-BEHAVIORAL ADOLESCENT OUTCOMES ACROSS DIFFERENT TIME POINTS DURING CHILDHOOD.

Age child separated from father	Behaviors and outcomes in adolescence									
	Current Smoking OR (95%)	P	Early Smoking OR (95%)	P	Current Drinking OR (95%)	P	Early Drinking OR (95%)	P	Delinquency/Arrested OR (95%)	P
<i>Birth</i>										
Yes	1.24 (0.76, 2.02)	0.40	0.87 (0.53, 1.41)	0.56	0.83 (0.53, 1.32)	0.44	1.17 (0.74, 1.86)	0.50	1.61 (0.73, 3.55)	0.23
No	Reference		Reference		Reference		Reference		Reference	
<i>18 months to age 3 (early childhood)</i>										
Yes	2.11 (1.43, 3.10)	0.0001	1.79 (1.25, 2.55)	0.002	1.39 (0.97, 1.99)	0.06	1.48 (1.02, 2.13)	0.03	2.87 (1.51, 5.43)	0.0007
No	Reference		Reference		Reference		Reference		Reference	
<i>Age 3 to 7</i>										
Yes	1.85 (1.27, 2.71)	0.001	1.17 (0.82, 1.67)	0.39	1.26 (0.88, 1.82)	0.12	1.05 (0.74, 1.50)	0.77	1.41 (0.70, 2.83)	0.33
No	Reference		Reference		Reference		Reference		Reference	
<i>Age 15 to 18</i>										
Yes	1.44 (1.06, 1.96)	0.02	1.19 (0.90, 1.57)	0.21	1.09 (0.83, 1.42)	0.54	1.24 (0.96, 1.65)	0.14	1.44 (0.83, 2.53)	0.20
No	Reference		Reference		Reference		Reference		Reference	

questionnaire. The mother's favorable opinion of smoking also had a 1.91 (95% CI: 1.26, 2.89;  $p=0.002$ ) times increased odds of current smoking. Friend smoking and drinking use were significantly associated with increased odds of current smoking and early smoking initiation.

Table V displays the unadjusted odds ratios between the covariates and early drinking and current drinking. Mother's alcohol use during pregnancy resulted in increased odds of adolescents' current drinking (1.63 [95% CI: 1.13, 2.37;  $p=0.009$ ]). The mother's current drinking status is also a strong predictor of the child's current drinking use during adolescence and early drinking initiation. The mother's partner weekly alcohol consumption results in a 1.75 (95% CI: 1.26, 2.43;  $p=0.0009$ ) increased odds of the adolescent reporting current alcohol use. Adolescents who reported that most or all of their friend's smoke or drink alcohol had higher odds of

**TABLE IV UNADJUSTED ODDS BETWEEN THE COVARIATES, AND CURRENT AND EARLY SMOKING AMONG ADOLESCENTS.**

	Behaviors and outcomes in adolescence			
	Current Smoking OR (95%) n = 802	P	Early Smoking OR (95%) n = 792	P
<i>Age, years</i>				
15	Reference		Reference	
16	1.28 (0.87, 1.89)	0.83	0.78 (0.56, 1.09)	0.31
17	1.43 (0.45, 4.58)	0.69	0.27 (0.06, 1.22)	0.12
<i>Sex</i>				
Boys	1.67 (1.17, 2.37)	0.004	1.42 (1.04, 1.93)	0.03
Girls	Reference		Reference	
<i>Maternal Age at Birth</i>				
< 20	Reference		Reference	
20 – 29	0.92 (0.56, 1.51)	0.98	0.97 (0.62, 1.51)	0.97
30 – 39	0.99 (0.54, 1.83)	0.98	1.13 (0.65, 1.95)	0.97
<i>Premature</i>				
Yes	1.37 (0.63, 2.97)	0.43	1.06 (0.51, 2.20)	0.87
No	Reference		Reference	
<i>Birthweight</i>				
< 2,500 grams	1.46 (0.52, 4.12)	0.47	1.42 (0.55, 3.65)	0.47
≥ 2,500 grams	Reference		Reference	
<i>Mother Social at Birth</i>				
Yes	0.98 (0.65, 1.47)	0.91	1.10 (0.76, 1.58)	0.62
No	Reference		Reference	
<i>Mother Smoked During Pregnancy</i>				
Yes	1.12 (0.73, 1.71)	0.60	1.08 (0.74, 1.57)	0.69
No	Reference		Reference	
<i>Alcohol Use During Pregnancy</i>				
Yes	1.04 (0.67, 1.61)	0.86	1.40 (0.96, 2.05)	0.08
No	Reference		Reference	
<i>Mother's Opinion of Alcohol</i>				
Negative	Reference	0.40	Reference	0.36
Acceptable	0.53 (0.12, 2.35)		0.56 (0.16, 1.97)	
<i>Mother's Opinion of Smoking</i>				
Negative	Reference	0.002	Reference	0.34
Acceptable	1.91 (1.26, 2.89)		1.21 (0.82, 1.80)	
<i>Household at Teen</i>				
Two-Parent (Biological)	Reference		Reference	
Stepfather	1.81 (1.16, 2.84)	0.01	1.44 (0.95, 2.18)	0.26
Mother Only	1.09 (0.72, 1.66)	0.31	1.30 (0.91, 1.87)	0.65
<i>SES at Teenage Questionnaire</i>				
Low	1.59 (1.04, 2.45)	0.03	1.34 (0.89, 2.01)	0.16
Middle/High	Reference		Reference	
<i>Poor Relationship with Father</i>				
Yes	2.11 (1.41, 3.16)	0.0003	1.59 (1.09, 2.31)	0.01
No	Reference		Reference	
<i>Mother Education Attainment</i>				
< Secondary	Reference		Reference	
Secondary	1.22 (0.72, 2.07)	0.29	0.87 (0.56, 1.36)	0.65
> Secondary	0.98 (0.52, 1.85)	0.62	0.88 (0.52, 1.50)	0.79
<i>Father Education Attainment</i>				
< Secondary	Reference		Reference	
Secondary	1.31 (0.73, 2.34)	0.44	1.24 (0.75, 2.04)	0.84
> Secondary	1.26 (0.65, 2.44)	0.71	1.43 (0.81, 2.52)	0.25
<i>Mother Current Smoker</i>				
Yes	1.95 (1.35, 2.83)	0.0004	1.67 (1.20, 2.34)	0.002
No	Reference		Reference	
<i>Partner Current Smoker</i>				
Yes	1.61 (1.07, 2.41)	0.02	1.51 (1.07, 2.15)	0.02
No	Reference		Reference	
<i>Number of Friends that Smoke</i>				
None	Reference		Reference	
A few or less	3.45 (1.22, 9.73)	0.02	1.92 (1.05, 3.50)	0.03
Most or all	14.37 (5.17, 39.91)	<0.0001	3.83 (2.09, 6.99)	<0.0001
<i>Mother Drinks Alcohol Weekly</i>				
Yes	1.08 (0.69, 1.69)	0.74	1.24 (0.84, 1.83)	0.27
No	Reference		Reference	

**TABLE IV UNADJUSTED ODDS BETWEEN THE COVARIATES, AND CURRENT AND EARLY SMOKING AMONG ADOLESCENTS. (continued)**

	Behaviors and outcomes in adolescence			
	Current Smoking OR (95%)	P	Early Smoking OR (95%)	P
<i>Partner Drinks Alcohol Weekly</i>				
Yes	1.38 (0.94, 2.02)	0.10	1.41 (1.00, 1.99)	0.05
No	Reference		Reference	
<i>Number of Friends that Drink</i>				
None	Reference		Reference	
A few or less	2.05 (1.05, 3.98)	0.04	2.06 (1.20, 3.54)	0.009
Most or all	4.35 (2.25, 8.43)	<0.0001	3.25 (1.88, 5.62)	<0.0001

**TABLE V UNADJUSTED ODDS BETWEEN THE COVARIATES, AND CURRENT AND EARLY DRINKING.**

	Behaviors and outcomes in adolescence			
	Current Drinking OR (95%) n = 734	P	Early Drinking OR (95%) n = 820	P
<i>Age, years</i>				
15	Reference		Reference	
16	1.01 (0.73, 1.40)	0.29	0.95 (0.68, 1.33)	0.90
17	1.85 (0.67, 5.12)	0.23	0.97 (0.34, 2.82)	0.996
<i>Sex</i>				
Boys	0.81 (0.61, 1.09)	0.16	1.07 (0.74, 1.38)	0.94
Girls	Reference		Reference	
<i>Maternal Age at Birth</i>				
< 20	Reference		Reference	
20 – 29	1.20 (0.77, 1.85)	0.97	1.11 (0.70, 1.76)	0.97
30 – 39	1.29 (0.76, 2.20)	0.97	1.00 (0.57, 1.76)	0.98
<i>Premature</i>				
Yes	0.93 (0.47, 1.82)	0.83	0.69 (0.31, 1.53)	0.36
No	Reference		Reference	
<i>Birthweight</i>				
< 2,500 grams	0.91 (0.37, 2.26)	0.84	0.43 (0.13, 1.48)	0.17
≥ 2,500 grams	Reference		Reference	
<i>Mother Social at Birth</i>				
Yes	1.12 (0.79, 1.58)	0.53	1.19 (0.82, 1.72)	0.36
No	Reference		Reference	
<i>Mother Smoked During Pregnancy</i>				
Yes	1.31 (0.92, 1.88)	0.14	1.18 (0.81, 1.72)	0.38
No	Reference		Reference	
<i>Alcohol Use During Pregnancy</i>				
Yes	1.63 (1.13, 2.37)	0.009	1.14 (0.78, 1.68)	0.49
No	Reference		Reference	
<i>Mother's Opinion of Alcohol</i>				
Negative	Reference	0.53	Reference	0.84
Acceptable	1.40 (0.48, 4.03)		1.11 (0.39, 3.20)	
<i>Mother's Opinion of Smoking</i>				
Negative	Reference	0.02	Reference	0.08
Acceptable	1.57 (1.07, 2.32)		1.41 (0.96, 2.09)	
<i>Household at Teen</i>				
Two-Parent (Biological)	Reference		Reference	
Stepfather	1.36 (0.90, 2.05)	0.11	1.27 (0.83, 1.94)	0.70
Mother Only	0.95 (0.67, 1.35)	0.27	1.36 (0.95, 1.94)	0.61
<i>SES at Teenage Questionnaire</i>				
Low	0.89 (0.59, 1.34)	0.58	0.54 (0.34, 0.87)	0.01
Middle/High	Reference		Reference	
<i>Poor Relationship with Father</i>				
Yes	1.30 (0.89, 1.88)	0.17	1.73 (1.19, 2.52)	0.004
No	Reference		Reference	
<i>Mother Education Attainment</i>				
< Secondary	Reference		Reference	
Secondary	1.22 (0.79, 1.89)	0.83	1.03 (0.65, 1.64)	0.54
> Secondary	1.60 (0.95, 2.68)	0.07	1.31 (0.76, 2.25)	0.22
<i>Father Education Attainment</i>				
< Secondary	Reference		Reference	
Secondary	1.33 (0.83, 2.13)	0.58	1.03 (0.63, 1.70)	0.44
> Secondary	1.46 (0.85, 2.52)	0.25	1.40 (0.80, 2.45)	0.13
<i>Mother Current Smoker</i>				
Yes	1.49 (1.07, 2.07)	0.02	1.18 (0.83, 1.66)	0.36
No	Reference		Reference	
<i>Partner Current Smoker</i>				
Yes	1.12 (0.81, 1.55)	0.51	0.85 (0.60, 1.20)	0.34
No	Reference		Reference	
<i>Number of Friends that Smoke</i>				
None	Reference		Reference	
A few or less	2.42 (1.36, 4.29)	0.003	1.25 (0.71, 2.20)	0.43
Most or all	6.68 (3.74, 11.95)	<0.0001	3.40 (1.95, 5.93)	<0.0001

**TABLE V** UNADJUSTED ODDS BETWEEN THE COVARIATES, AND CURRENT AND EARLY DRINKING. (continued)

	Behaviors and outcomes in adolescence			
	Current Drinking OR (95%)	P	Early Drinking OR (95%)	P
<i>Mother Drinks Alcohol Weekly</i>				
Yes	2.15 (1.47, 3.14)	<0.0001	1.83 (1.25, 2.67)	0.002
No	Reference		Reference	
<i>Partner Drinks Alcohol Weekly</i>				
Yes	1.75 (1.26, 2.43)	0.0009	1.23 (0.87, 1.74)	0.25
No	Reference		Reference	
<i>Number of Friends that Drink</i>				
None	Reference		Reference	
A few or less	3.13 (1.75, 5.59)	<0.0001	1.66 (0.92, 2.98)	0.09
Most or all	12.10 (6.72, 22.80)	<0.0001	5.74 (3.22, 10.24)	<0.0001



early drinking initiation (3.40 [95% CI: 1.95, 5.93;  $p < 0.0001$ ] and 5.74 (95% CI: 3.22, 10.24;  $p < 0.0001$ ), respectively). Having any friends that smoke or drink is significantly associated with higher odds of current alcohol use among adolescents.

The unadjusted odds ratios between the covariates and the odds of being arrested, or having legal problems, by 15 to 18 years of age is displayed in Table VI. Compared to girls, boys are 3.38 (95% CI: 1.63, 6.99;  $p = 0.0006$ ) times more likely to have been arrested. Among children with mothers who socialized with two or more friends at least once a week while pregnant had decreased odds of being arrested in adolescence (0.52 [95% CI: 0.27, 1.01]). Interestingly, friend smoking or alcohol use is not associated with being arrested in adolescence.

#### **D. Establishing the Presence of Mediators and Multiple Mediation Analyses**

Tables displaying the exposure-outcome relationship stratified by potential confounders are included in the appendix. The correlation matrix between the exposure, potential mediators, and other covariates within the model are displayed in Table VII. Family type in adolescence has the highest correlation among the three mediators with separation from father at age three and the child-father relationship quality (>30%). The mother's education attainment and smoking status is also correlated with her partner's education level and smoking status.

Table VIII represents the first step of the Baron and Kenny<sup>27</sup> causal steps strategy by describing the direct effect between separation from father in early childhood and the five different negative socio-behavioral outcomes in adolescence. There is a 3.16 (95% CI: 1.65, 6.05;  $p < 0.001$ ) times increased odds of an adolescent reporting being arrested among those with absent fathers in early childhood compared to those with present fathers. Table IX displays the second causal step strategy by quantifying the indirect effect pathway from the exposure to the three different mediators. Out of the three mediators, separation from father in early

**TABLE VI UNADJUSTED ODDS BETWEEN THE COVARIATES AND DELINQUENCY.**

	Behaviors and outcomes in adolescence	
	Delinquency/Arrest OR (95%)	P
	n = 727	
<i>Age, years</i>		
15	Reference	
16	1.36 (0.66, 2.78)	0.75
17	1.27 (0.16, 10.35)	0.93
<i>Sex</i>		
Boys	3.38 (1.63, 6.99)	0.0006
Girls	Reference	
<i>Maternal Age at Birth</i>		
< 20	Reference	
20 – 29	1.04 (0.42, 2.56)	0.97
30 – 39	0.83 (0.26, 2.66)	0.98
<i>Premature</i>		
Yes	0.46 (0.06, 3.46)	0.44
No	Reference	
<i>Birthweight</i>		
< 2,500 grams	----	
≥ 2,500 grams	----	
<i>Mother Social at Birth</i>		
Yes	0.52 (0.27, 1.01)	0.05
No	Reference	
<i>Mother Smoked During Pregnancy</i>		
Yes	1.46 (0.72, 2.95)	0.29
No	Reference	
<i>Alcohol Use During Pregnancy</i>		
Yes	0.69 (0.30, 1.62)	0.40
No	Reference	
<i>Mother's Opinion of Alcohol</i>		
Negative	Reference	0.93
Acceptable	1.10 (0.14, 8.48)	
<i>Mother's Opinion of Smoking</i>		
Negative	Reference	0.64
Acceptable	1.21 (0.54, 2.72)	
<i>Household at Teen</i>		
Two-Parent (Biological)	Reference	
Stepfather	2.35 (1.05, 5.28)	0.18
Mother Only	2.01 (0.97, 4.16)	0.44
<i>SES at Teenage Questionnaire</i>		
Low	1.84 (0.87, 3.89)	0.10
Middle/High	Reference	
<i>Poor Relationship with Father</i>		
Yes	1.89 (0.95, 3.78)	0.07
No	Reference	
<i>Mother Education Attainment</i>		
< Secondary	Reference	
Secondary	0.63 (0.27, 1.45)	0.22
> Secondary	0.88 (0.34, 2.31)	0.79
<i>Father Education Attainment</i>		
< Secondary	Reference	
Secondary	0.61 (0.27, 1.39)	0.81
> Secondary	0.44 (0.15, 1.30)	0.21
<i>Mother Current Smoker</i>		
Yes	1.89 (0.97, 3.67)	0.06
No	Reference	
<i>Partner Current Smoker</i>		
Yes	1.87 (0.90, 3.87)	0.09
No	Reference	
<i>Number of Friends that Smoke</i>		
None	Reference	
A few or less	0.51 (0.19, 1.31)	0.17
Most or all	1.11 (0.44, 2.81)	0.82
<i>Mother Drinks Alcohol Weekly</i>		
Yes	1.47 (0.70, 3.12)	0.31
No	Reference	

**TABLE VI UNADJUSTED ODDS BETWEEN THE COVARIATES AND DELINQUENCY.**  
(continued)

	Behaviors and outcomes in adolescence	
	Delinquency/Arrest OR (95%)	P
<i>Partner Drinks Alcohol Weekly</i>		
Yes	1.55 (0.78, 3.07)	0.20
No	Reference	
<i>Number of Friends that Drink</i>		
None	Reference	
A few or less	1.01 (0.37, 2.76)	0.99
Most or all	1.39 (0.51, 3.81)	0.52

**TABLE VII CORRELATION MATRIX BETWEEN EXPOSURE, POTENTIAL MEDIATORS, AND POTENTIAL CONFOUNDERS.**

	1	2	3	4	5	6	7	8	9	10	11
1) Separation from father - age 3	1.0										
2) Relationship quality with father	0.13	1.0									
3) SES	0.11	0.14	1.0								
4) Family type in adolescence	0.37	0.36	0.08	1.0							
5) Sex (Boy/Girl)	-0.04	-0.07	-0.03	-0.04	1.0						
6) Mother social at birth	0.03	-0.03	-0.05	-0.03	0.01	1.0					
7) Mother educational attainment	-0.07	0.02	-0.01	-0.09	-0.07	0.01	1.0				
8) Partner educational attainment	-0.04	0.04	0.03	-0.09	-0.04	0.05	0.50	1.0			
9) Mother's smoking status	0.15	-0.05	0.02	0.11	-0.04	0.04	-0.15	-0.11	1.0		
10) Partner's smoking status	0.13	0.01	0.06	0.06	0.03	0.01	-0.08	-0.10	0.34	1.0	
11) Partner's weekly alcohol consumption	0.01	0.001	0.04	-0.04	-0.02	0.03	0.08	0.03	0.07	0.17	1.0

**TABLE VIII UNADJUSTED ODDS BETWEEN SEPARATION FROM FATHER AT AGE THREE AND THE DEVELOPMENT OF NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE.**

Separated from father in early childhood	OR (95% CI)				
	Early Smoking	Current Smoking	Early Drinking	Current Drinking	Delinquency
Yes	1.84 (1.29, 2.64)***	2.24 (1.52, 3.31)***	1.51 (1.04, 2.19)*	1.40 (0.97, 2.00)	3.16 (1.65, 6.05)***
No	Reference	Reference	Reference	Reference	Reference

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001

**TABLE IX UNADJUSTED ODDS BETWEEN SEPARATION FROM FATHER AT AGE THREE AND THE THREE POTENTIAL MEDIATORS.**

Separated from father in early childhood	OR (95% CI)		
	Low SES	Step-Father or Single Mother Household	Poor Relationship with Father
Yes	1.56 (1.02, 2.38)*	5.71 (3.90, 8.35)***	1.97 (1.32, 2.96)**
No	Reference	Reference	Reference

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001

**TABLE X UNADJUSTED ODDS OF BETWEEN POTENTIAL MEDIATORS AND NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE.**

Mediator	OR (95% CI)				
	Early Smoking	Current Smoking	Early Drinking	Current Drinking	Delinquency
Low SES					
Yes	1.34 (0.96, 1.93)	1.42 (0.97, 2.09)	0.58 (0.38, 0.89)***	0.70 (0.48, 1.02)	1.84 (0.93, 3.65)
No	Reference	Reference	Reference	Reference	Reference
Step-Father or Single Mother Household					
Yes	1.25 (0.94, 1.65)	1.50 (1.10, 2.04)*	1.26 (0.95, 1.68)	1.12 (0.86, 1.47)	1.71 (0.96, 3.08)
No	Reference	Reference	Reference	Reference	Reference
Poor Relationship with Father					
Yes	1.63 (1.15, 2.30)**	2.04 (1.41, 2.94)***	1.81 (1.28, 2.56)***	1.15 (0.81, 1.62)	1.73 (0.90, 3.32)
No	Reference	Reference	Reference	Reference	Reference

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001

childhood results in a 5.71 (95% CI: 3.90, 8.35) times increased odds of having a stepfather present or mother-only household in adolescence.

The third step of the staging method, displaying the other portion of the indirect effect and the relationship between the mediator and outcome, is shown in Table X. Adolescents who report having a poor relationship with their fathers have a 1.63 (95% CI: 1.15, 2.30;  $p < 0.01$ ) times increased odds of also report initiating smoking early and a 2.04 (95% CI: 1.41, 2.94;  $p < 0.001$ ) times increased odds of self-reporting current smoking. Adolescents who come from a mother-only household or a household with a stepfather present have a 1.50 (95% CI: 1.10, 2.04;  $p < 0.05$ ) times increased odds of reporting current cigarette use. Compared to middle or high SES, adolescents from low SES had decreased odds of reporting early drinking initiation (0.58 [95% CI: 0.38, 0.89]), yet those with a poor-quality relationship with their father had increased odds of early drinking. Though not significant, all the potential mediators resulted in increased odds of delinquency or arrest ( $> 1.5$  odds).

Backward and stepwise model selection resulted in the exposure being dropped from the model in all cases except for delinquency (results not shown). Table XI compares the unadjusted odds between separation from father in early childhood and the five outcome measures with the multivariable adjusted models (both with and without the potential mediators). There was an increased odds of early smoking initiation, current smoking, and delinquency among adolescents with absent fathers in early childhood compared to those whose fathers were not absent after adjusting for confounding and excluding mediators. After including the mediators in the multivariable models, the relationship between separation from father in early childhood and the odds of early smoking and current smoking crossed the null value. The adjusted odds of arrest or delinquency remained significant.

Table XII displays the results for the generalized structural equation modeling (GSEM) analysis, estimating the total effect between the exposure and outcomes, as mediated through SES in adolescence, father-child relationship quality, and household type. Compared to

individuals who were not separated from their fathers in early childhood, adolescents have increased odds of early smoking initiation and current smoking use (OR: 1.63 [95% CI: 1.07, 2.49] and 1.99 [95% CI: 1.25, 3.17], respectively). Adolescents whose fathers were absent during early childhood have a 2.47 (95% CI: 1.17, 5.22) increased odds of being arrested or having problems with the law by the ages of 15 to 18 years of age.

**TABLE XI UNADJUSTED ODDS OF THE FIVE SOCIO-BEHAVIORAL OUTCOMES AMONG FATHERS ABSENT VERSUS THOSE WITH FATHERS PRESENT IN EARLY CHILDHOOD COMPARED TO THE MULTIVARIABLE ADJUSTED MODELS WITH MEDIATORS AND WITHOUT MEDIATORS.**

Outcomes by father presence/absence in early childhood	OR (95% CI)		
	Unadjusted	Multivariable-Adjusted <sup>a</sup> Model, <i>without mediators</i>	Multivariable-Adjusted <sup>a</sup> Model, <i>with mediators modeled as confounders</i>
Early Smoking			
Father absent	1.84 (1.29, 2.64)***	1.75 (1.15, 2.67)**	1.46 (0.90, 2.38)
Father present	Reference	Reference	Reference
Current Smoking			
Father absent	2.24 (1.52, 3.31)***	2.03 (1.24, 3.31)**	1.55 (0.82, 2.96)
Father present	Reference	Reference	Reference
Early Drinking			
Father absent	1.51 (1.04, 2.19)*	1.28 (0.83, 1.97)	0.92 (0.52, 1.62)
Father present	Reference	Reference	Reference
Current Drinking			
Father absent	1.40 (0.97, 2.00)	1.43 (0.89, 2.30)	1.36 (0.79, 2.35)
Father present	Reference	Reference	Reference
Delinquency			
Father absent	3.16 (1.65, 6.05)***	3.88 (1.57, 9.62)**	3.24 (1.16, 9.04)*
Father present	Reference	Reference	Reference

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001

<sup>a</sup> **Multivariable models adjusted for:**

Early Smoking: Separation from father in early childhood, sex, mother's opinion of smoking, mother's smoking status, mother's socialization at birth, father's education level, friend cigarette use, and friend alcohol use

Current Smoking: Separation from father in early childhood, sex, mother's opinion of smoking, mother's smoking status, mother's socialization at birth, father's education level, friend cigarette use, and friend alcohol use

Early Drinking: Separation from father in early childhood, mother drinks alcohol weekly, mother's opinion of drinking, mother's education level, friend cigarette use, and friend alcohol use

Current Drinking: Separation from father in early childhood, mother drinks alcohol weekly, partner drinks alcohol weekly, friend cigarette use, and friend alcohol use

Delinquency: Separation from father in early childhood, sex, mother's socialization at birth, alcohol use during pregnancy, mother's education level, partner's education level, mother's smoking status, partner's smoking status, partner drinks alcohol weekly, and mother's age at birth

**TABLE XII RESULTS OF MULTIPLE MEDIATION ANALYSIS, DISPLAY ODDS (TOTAL EFFECT) OF OUTCOME AMONG ADOLESCENTS WITH ABSENT FATHERS IN EARLY CHILDHOOD (18 MONTHS TO THREE YEARS OF AGE) COMPARED TO ADOLESCENTS WITH PRESENT FATHERS.**

	OR (95% CI)				
	Early Smoking	Current Smoking	Early Drinking	Current Drinking	Delinquency
Separated from father					
Yes	1.63 (1.07, 2.49)*	1.99 (1.25, 3.17)**	1.33 (0.86, 2.07)	1.28 (0.84, 1.96)	2.47 (1.17, 5.22)*
No	Reference	Reference	Reference	Reference	Reference

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001



#### IV. DISCUSSION

This study sought to evaluate the relationship between early childhood separation from father (18 months to three years of age) on negative socio-behavioral outcomes in adolescence. Among Ukrainian adolescents in Kamianske, separation from father in early childhood results in greater odds of smoking and delinquent behavior in adolescence that persists after controlling for confounders and modeling multiple mediators simultaneously. This is the first known study in a Ukrainian cohort to evaluate the effect of father separation in early childhood on negative socio-behavioral adolescent outcomes.

With growing single-mother households and father separation, it is important to understand the effect of mediators to target future interventions. Using a multiple mediation analysis allowed us to appropriately handle the correlation between variables that would otherwise result in inflated error and unstable confidence intervals. This is most apparent in the results for the multivariable adjusted model (without mediators) for delinquency versus the odds ratios for the mediator adjusted model (3.88 [95% CI: 1.57, 9.62] versus 2.47 [95% CI: 1.17, 5.22], respectively) (Table XII). In addition to appropriately modeling the error, the mediation analysis also allows us to conserve sample and improve power.

These findings are consistent with prior longitudinal studies that found a relationship between father absence and other early life stressors on early smoking initiation<sup>9-12</sup>. We did not find an association after adjusting for confounding and modeling for mediators between father separation in early childhood and drinking by age 12 or current drinking in adolescence. This is also consistent with other articles investigating the relationship between early life stressors and alcohol use in adolescence<sup>12</sup>. Lacey et al specifically addressed the type of parental absence on smoking and drinking behaviors in adolescence<sup>9</sup>. While the association between age of absence and later outcomes were not significant, there were increased odds of smoking and drinking in adolescence among those who experienced absence between the ages of three to five relative to other ages. Friend smoking and drinking behavior were both strongly associated

with early smoking initiation and current smoking in unadjusted analyses (Table IV). Also, having any friends that smoke or drink alcohol in adolescence is also associated with current drinking behavior among the adolescents in this study (Table V). Yet, only adolescents who reported having most or all of their friend's drink alcohol or smoke were more likely to report early drinking initiation (unadjusted OR 5.74 [95% CI: 3.22, 10.24] and 3.40 [95% CI: 1.95, 5.93], respectively) (Table V). However, these variables were not associated with separation from father (Table I), indicating an independent association with the two outcomes.

Our study did not find a strong association between early childhood separation from father and early or current drinking in adolescence. The strongest association between the covariates and drinking included contextual factors such as the number of friends who smoke or drink, SES, and child-father relationship quality in adolescence. Those of low SES were protected against early drinking, while those with a reported poor quality of relationship were more likely to drink alcohol by age 12. This indicates that the association between separation from father in early childhood and early drinking is mediated to some degree by both SES and father-child quality of relationship. It appears that contextual factors may play a stronger role in the development of drinking behavior than father separation in early childhood. This aligns with the findings from the Dunedin longitudinal study, where Moffit and Caspi<sup>16</sup> contended that adolescent-onset delinquency was largely influenced by contextual factors in adolescence. While it was not possible to measure delinquent or risk-behaviors between age 7 and adolescence in this analysis, our findings still support the importance of early childhood exposures that are mediated through adolescent contextual factors.

Delinquent adolescents tend to have a higher perception of stress compared to adolescents who do not display delinquent behavior<sup>17</sup>. Chronic stress in childhood has been associated with morphological changes within the brain, affected by alterations to hormone and gene-expression<sup>13</sup>. These changes are then linked to the development of addictive behaviors.

Yet as Enoch notes, not all children with early life stress develop later negative behaviors, indicating the likely mediation of adolescent socio-environmental factors<sup>13</sup>.

Much of the prior research from other countries that do evaluate the effects of father absence has been limited by the use of cross-sectional studies and inappropriately accounting for mediators as confounders<sup>5,14</sup>. Even when studies conduct a mediation analysis, many incorrectly use cross-sectional mediation methods in data that is either longitudinal or half-longitudinal<sup>21-23,29</sup>. The use of cross-sectional mediational methods in a longitudinal study design improperly manages the correlated error and results in unstable or biased estimates<sup>22,29</sup>. This helps explain conflicting results and identified risk factors. Past studies have also used inconsistent definitions of delinquency and father absence.

Few studies investigating the relationship between childhood family-stressors and adolescent outcomes have been conducted in countries undergoing economic change. Ukraine's independence from the Soviet Union and subsequent period of hyperinflation offered a unique insight into the socioeconomic and cultural factors that influence family life. This is important considering the economic drivers to a father being separated from the family (e.g., migrant work) and acute ramifications if a father permanently leaves the household (e.g., loss of a second income). These also contribute to early childhood stressors through potential instability in a child's home, which impact learned behaviors and later health outcomes. The Family Children of Ukraine (FCOU) birth cohort allowed us to prospectively capture these exposures and effects.

Though Iakunchykova et al did not find any association between individual stressors in early childhood and the early initiation of smoking and drinking within the FCOU birth cohort, there are key methodological differences between these two studies<sup>12</sup>. First, this study identified whether the exposure occurred instead of ranking the emotional toll on the child. While both studies did not find an association with early drinking initiation, both did find an association with early smoking. This analysis also investigated current smoking behaviors, within the last 30

days, and self-reported arrest, which were not included in Iakunchykova et al. Lastly, this study included a mediation analysis while Iakunchykova et al used multivariable logistic regression<sup>12</sup>.

#### **A. Limitations**

There are several potential limitations to this study. Early smoking and drinking initiation technically represent an outcome that temporally precedes the mediator, which does not “fit” a half-longitudinal model. However, these were measured in the adolescent questionnaire, which allows it to fit the analytical assumptions of a half-longitudinal design, yet may have also introduced recall bias. Furthermore, the mother, or primary caregiver, completed the questionnaires until adolescence. Though they are the best candidate to answer the questions, it is difficult for them to truly know the impact of stressors on their children’s lives. Therefore, this study analyzed whether the event occurred instead of perceived emotional impact.

This study made several assumptions regarding mother alcohol and cigarette use during pregnancy which may not have aligned with health recommendations at the time of pregnancy. For example, this analysis dichotomized any alcohol use during pregnancy, when obstetric recommendations at the time may have simply advised reduced alcohol intake. This analysis dichotomized parent alcohol use into at least one unit of alcohol weekly. Parent smoking was also recorded as at least one cigarette per week, which could be considered a “social smoker”. While these variables were dichotomized to retain cell sample size they may have misclassified risk.

As with all studies, there is a potential for unmeasured confounding and attrition. Though about half of the sample was lost to follow up over the 15 to 18 years of the study, previous analyses have found no significant differences between the portion of the original sample that remained in the study compared to the sample that no longer participated<sup>12</sup>. Children who were separated from their fathers or have the negative socio-behaviors that this study was measuring (i.e., delinquency) may have been more likely to have been lost to follow up. Furthermore, this

sample is from one geographically-defined area, limiting generalizability to a larger Ukrainian adolescent population.

## **B. Strengths**

Despite these limitations, there are many strengths to this study. The size of this birth cohort allowed us to analyze delinquency (or arrest), smoking, and drinking among adolescents in a largely understudied population using mediation methods. Longitudinal study designs allow us to have more confidence in results that we find and inferences. Since the exposure was measured relatively close to the time of event, the potential for recall bias was reduced considerably allowing for more confident inferences. Adolescent smoking and drinking measures are reported to be reliable<sup>12</sup>.

Though this study did contain broad definitions of delinquency (through self-reported arrest) and father separation (for “any reason”), this captured the actual events, regardless of underlying meaning which may differ between cultures and over time. Though “separation” and delinquency are vague terms, these may have captured the most severe or influential of cases and does not invalidate the findings. SES and father relationship quality are also best measured using self-report. The SES measure captures perceived wealth relative to others in the adolescent’s social sphere and the question regarding father relationship quality also reflects how the child personally perceives this relationship.

## **C. Conclusion**

This study is the first to use a Ukrainian birth cohort to analyze the effect of separation from father in early childhood on smoking, drinking, and delinquent behaviors in adolescence. This early-life stressor is mediated through SES during adolescence, family-type in adolescence, and the quality of the father-child relationship. These highlight areas where clinicians, policymakers, and researchers can focus future interventions to help mitigate antisocial and maladaptive behavior. For example, mentorship programs for children from low

SES with unstable households in adolescence may help mitigate the contextual factors and mediators within the pathway that contribute to delinquency. Public education of the importance of father presence in early childhood and relationship quality during adolescence is a potential low-cost intervention for families. These behaviors have long term impact on overall health and well-being, which affect both the individual and community. However, future research is needed to confirm these findings in other populations.

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**APPENDIX**

**TABLE XIII** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY AGE.

Outcome of Interest	Crude OR (95% CI)	Age (years)			P <sup>a</sup>	EM or C <sup>b</sup>
		15	16	17		
<i>Current Smoking</i>						
Father absent	2.11 (1.43, 3.10)	2.36 (1.21, 4.60)	2.13 (1.23, 3.70)	----	0.13	C
Father present	Reference	Reference	Reference			
<i>Early Smoking (≤13 years of age)</i>						
Father absent	1.79 (1.25, 2.55)	2.02 (1.14, 3.58)	1.89 (1.11, 3.23)	3.75 (0.14, 55.17)	0.96	C
Father present	Reference	Reference	Reference	Reference		
<i>Current Drinking</i>						
Father absent	1.39 (0.97, 1.99)	1.47 (0.81, 2.64)	1.43 (0.84, 2.42)	0.38 (0.04, 3.34)	0.48	C
Father present	Reference	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>						
Father absent	1.48 (1.02, 2.13)	1.79 (0.99, 2.19)	1.28 (0.74, 2.21)	0.56 (0.05, 6.77)	0.53	C
Father present	Reference	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>						
Father absent	2.87 (1.51, 5.43)	3.71 (1.15, 11.95)	2.78 (1.13, 6.84)	---	0.52	C
Father present	Reference	Reference	Reference			

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XIV** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY SEX.

Outcome of Interest	Crude OR (95% CI)	Sex		P <sup>a</sup>	EM or C <sup>b</sup>
		Boys	Girls		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	2.72 (1.59, 4.65)	1.97 (1.10, 3.55)	0.43	C
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	1.21 (0.71, 2.05)	2.91 (1.75, 4.82)	0.02	EM
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	1.50 (0.87, 2.57)	1.28 (0.78, 2.09)	0.67	
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	1.81 (1.05, 3.09)	1.30 (0.78, 2.16)	0.38	C
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	3.52 (1.61, 7.67)	3.74 (1.06, 13.23)	0.94	C
Father present	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XV** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY MOTHER SOCIALIZATION AT BIRTH.

Outcome of Interest	Crude OR (95% CI)	Mother Social at Birth		P <sup>a</sup>	EM or C <sup>b</sup>
		Yes	No		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	1.63 (1.02, 2.63)	5.03 (2.34, 10.80)	0.01	EM
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	1.69 (1.10, 2.59)	2.82 (1.37, 5.82)	0.23	C
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	1.08 (0.71, 1.66)	2.84 (1.36, 5.95)	0.03	EM
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	1.62 (1.05, 2.50)	1.52 (0.71, 3.24)	0.89	C
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	2.84 (1.24, 6.51)	3.75 (1.27, 11.13)	0.69	C
Father present	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XVI** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY MOTHER'S ALCOHOL USE DURING PREGNANCY.

Outcome of Interest	Crude OR (95% CI)	Alcohol Use During Pregnancy		P <sup>a</sup>	EM or C <sup>b</sup>
		Yes	No		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	2.46 (1.12, 5.43)	2.38 (1.41, 4.01)	0.94	C
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	2.07 (1.02, 4.23)	1.49 (0.91, 2.44)	0.45	C
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	1.47 (0.70, 3.08)	1.39 (0.85, 2.28)	0.90	
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	2.74 (1.31, 5.73)	0.86 (0.51, 1.46)	0.01	EM
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	1.23 (0.23, 6.61)	4.56 (2.06, 10.13)	0.15	C
Father present	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XVII** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY MOTHER'S OPINION OF SMOKING.

Outcome of Interest	Crude OR (95% CI)	Mother's Opinion of Smoking		P <sup>a</sup>	EM or C <sup>b</sup>
		Negative	Acceptable		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	1.86 (0.80, 4.33)	2.35 (1.50, 3.70)	0.63	C
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	1.03 (0.44, 2.43)	2.13 (1.42, 3.20)	0.13	C
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	1.03 (0.44, 2.42)	1.53 (1.02, 2.29)	0.42	C
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	0.82 (0.34, 1.97)	1.67 (1.10, 2.54)	0.15	C
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	3.89 (0.91, 16.56)	3.24 (1.50, 6.98)	0.83	C
Father present	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XVIII** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY FAMILY (HOUSEHOLD) TYPE IN ADOLESCENCE.

Outcome of Interest	Crude OR (95% CI)	Household Type at Teen			P <sup>a</sup>	EM or C <sup>b</sup>
		Two Parent (Biological)	Step-Father Present	Mother Only		
<i>Current Smoking</i>						
Father absent	2.11 (1.43, 3.10)	1.01 (0.43, 2.37)	2.21 (1.02, 4.79)	3.84 (1.88, 7.86)	0.06	EM
Father present	Reference	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>						
Father absent	1.79 (1.25, 2.55)	1.26 (0.63, 2.51)	2.03 (0.97, 4.22)	2.11 (1.14, 3.91)	0.50	C
Father present	Reference	Reference	Reference	Reference		
<i>Current Drinking</i>						
Father absent	1.39 (0.97, 1.99)	1.16 (0.58, 2.30)	1.17 (0.57, 2.44)	1.66 (0.89, 3.10)	0.68	C
Father present	Reference	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>						
Father absent	1.48 (1.02, 2.13)	1.26 (0.62, 2.56)	0.95 (0.44, 2.02)	2.11 (1.13, 3.93)	0.25	C
Father present	Reference	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>						
Father absent	2.87 (1.51, 5.43)	2.46 (0.67, 8.95)	3.58 (0.88, 14.61)	2.31 (0.77, 6.92)	0.88	C
Father present	Reference	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XIX** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY SELF-REPORTED SES IN ADOLESCENCE.

Outcome of Interest	Crude OR (95% CI)	Socio-economic status			P <sup>a</sup>	EM or C <sup>b</sup>
		Low	Middle/High			
<i>Current Smoking</i>						
Father absent	2.11 (1.43, 3.10)	4.44 (1.94, 10.19)	1.67 (1.04, 2.66)	0.04	EM	
Father present	Reference	Reference	Reference			
<i>Early Smoking (≤13 years of age)</i>						
Father absent	1.79 (1.25, 2.55)	2.73 (1.22, 6.09)	1.59 (1.04, 2.41)	0.24	C	
Father present	Reference	Reference	Reference			
<i>Current Drinking</i>						
Father absent	1.39 (0.97, 1.99)	1.91 (0.83, 4.42)	1.30 (0.86, 1.96)	0.41	C	
Father present	Reference	Reference	Reference			
<i>Early Drinking (≤12 years of age)</i>						
Father absent	1.48 (1.02, 2.13)	3.65 (1.46, 9.10)	1.29 (0.85, 1.97)	0.04	EM	
Father present	Reference	Reference	Reference			
<i>Arrested/Legal Problems</i>						
Father absent	2.87 (1.51, 5.43)	36.00 (4.33, 299.37)	1.73 (0.75, 4.02)	0.002	EM	
Father present	Reference	Reference	Reference			

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XX** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY QUALITY OF FATHER-CHILD RELATIONSHIP IN ADOLESCENCE.

Outcome of Interest	Crude OR (95% CI)	Relationship with Father (teen)		P <sup>a</sup>	EM or C <sup>b</sup>
		Poor	Good or better		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	1.84 (0.88, 3.82)	1.99 (1.18, 3.34)	0.87	C
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	1.54 (0.76, 3.13)	1.78 (1.12, 2.83)	0.73	C
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	1.08 (0.53, 2.21)	1.34 (0.85, 2.13)	0.62	C
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	1.74 (0.85, 3.55)	1.16 (0.71, 1.90)	0.36	C
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	1.65 (0.51, 5.35)	3.63 (1.59, 8.29)	0.28	C
Father present	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XXI** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY MOTHER'S SMOKING STATUS DURING PREGNANCY.

Outcome of Interest	Crude OR (95% CI)	Mother Smoked During Pregnancy		P <sup>a</sup>	EM or C <sup>b</sup>
		Yes	No		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	2.01 (0.94, 4.28)	2.62 (1.60, 4.29)	0.56	
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	1.70 (0.86, 3.35)	1.91 (1.20, 3.03)	0.78	
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	1.51 (0.76, 3.00)	1.48 (0.92, 2.80)	0.96	
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	1.77 (0.90, 3.48)	1.19 (0.74, 1.90)	0.34	
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	2.42 (0.74, 7.91)	3.76 (1.68, 8.42)	0.54	
Father present	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XXII** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY MOTHER'S SMOKING STATUS DURING ADOLESCENCE.

Outcome of Interest	Crude OR (95% CI)	Current Smoker (Mother)		P <sup>a</sup>	EM or C <sup>b</sup>
		Yes	No		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	1.63 (0.86, 3.09)	2.47 (1.47, 4.16)	0.32	C
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	2.18 (1.19, 3.97)	1.62 (1.00, 2.62)	0.45	C
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	1.10 (0.59, 2.03)	1.49 (0.92, 2.39)	0.44	C
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	1.07 (0.56, 2.06)	1.59 (0.99, 2.56)	0.34	C
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	2.24 (0.79, 6.33)	4.84 (2.02, 11.61)	0.26	C
Father present	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XXIII** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY MOTHER'S PARTNER SMOKING STATUS.

Outcome of Interest	Crude OR (95% CI)	Current Smoker (Mother's Partner)		P <sup>a</sup>	EM or C <sup>b</sup>
		Yes	No		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	1.90 (1.09, 3.33)	1.97 (0.86, 4.54)	0.94	C
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	1.72 (1.03, 2.89)	1.45 (0.67, 3.13)	0.72	C
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	1.64 (0.96, 2.79)	1.11 (0.54, 2.28)	0.40	C
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	1.58 (0.91, 2.74)	0.68 (0.30, 1.57)	0.10	C
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	2.35 (0.99, 5.57)	6.75 (1.94, 23.52)	0.16	C
Father present	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XXIV** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY MOTHER'S ALCOHOL USE.

Outcome of Interest	Crude OR (95% CI)	Alcohol Use (Mother)		P <sup>a</sup>	EM or C <sup>b</sup>
		Weekly	Less than weekly		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	2.14 (0.88, 5.20)	1.89 (1.19, 3.00)	0.81	C
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	2.30 (1.02, 5.19)	1.49 (0.98, 2.27)	0.35	C
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	1.55 (0.66, 3.64)	1.29 (0.84, 1.96)	0.70	C
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	2.46 (1.08, 5.61)	1.14 (0.73, 1.79)	0.11	C
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	6.72 (1.76, 25.60)	1.48 (0.61, 3.60)	0.06	
Father present	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).



**TABLE XXV** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY MOTHER'S PARTNER ALCOHOL USE.

Outcome of Interest	Crude OR (95% CI)	Alcohol Use (Mother's Partner)		P <sup>a</sup>	EM or C <sup>b</sup>
		Weekly	Less than weekly		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	2.32 (1.20, 4.47)	1.47 (0.77, 2.80)	0.33	C
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	1.78 (0.95, 3.34)	1.52 (0.86, 2.68)	0.71	C
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	2.14 (1.10, 4.17)	1.12 (0.64, 1.96)	0.14	C
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	1.35 (0.70, 2.60)	0.83 (0.45, 1.55)	0.30	C
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	4.25 (1.58, 11.47)	2.16 (0.73, 6.36)	0.36	C
Father present	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XXVI** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY MOTHER'S EDUCATION ATTAINMENT AT BIRTH.

Outcome of Interest	Crude OR (95% CI)	Mother's Educational Attainment (at birth)			P <sup>a</sup>	EM or C <sup>b</sup>
		< Secondary	Secondary	> Secondary		
<i>Current Smoking</i>						
Father absent	2.11 (1.43, 3.10)	2.22 (0.80, 6.16)	2.29 (1.42, 3.70)	1.71 (0.61, 4.83)	0.88	
Father present	Reference	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>						
Father absent	1.79 (1.25, 2.55)	1.35 (0.56, 3.27)	2.53 (1.62, 3.97)	1.08 (0.41, 2.83)	0.18	C
Father present	Reference	Reference	Reference	Reference		
<i>Current Drinking</i>						
Father absent	1.39 (0.97, 1.99)	2.04 (0.84, 4.93)	1.20 (0.76, 1.89)	1.79 (0.72, 4.47)	0.49	C?
Father present	Reference	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>						
Father absent	1.48 (1.02, 2.13)	1.52 (0.59, 3.88)	1.30 (0.81, 2.09)	3.50 (1.41, 8.69)	0.16	C
Father present	Reference	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>						
Father absent	2.87 (1.51, 5.43)	3.00 (0.70, 12.89)	3.94 (1.68, 9.24)	1.53 (0.30, 7.71)	0.59	C
Father present	Reference	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XXVII** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY FATHER'S EDUCATIONAL ATTAINMENT AT BIRTH.

Outcome of Interest	Crude OR (95% CI)	Father's Educational Attainment (at birth)			P <sup>a</sup>	EM or C <sup>b</sup>
		< Secondary	Secondary	> Secondary		
<i>Current Smoking</i>						
Father absent	2.11 (1.43, 3.10)	3.26 (1.05, 10.07)	1.91 (1.15, 3.16)	2.73 (1.11, 6.70)	0.61	C
Father present	Reference	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>						
Father absent	1.79 (1.25, 2.55)	2.57 (0.94, 7.06)	1.60 (1.00, 2.56)	2.43 (1.06, 5.54)	0.55	C
Father present	Reference	Reference	Reference	Reference		
<i>Current Drinking</i>						
Father absent	1.39 (0.97, 1.99)	1.00 (0.37, 2.73)	1.41 (0.89, 2.26)	1.49 (0.65, 3.42)	0.80	
Father present	Reference	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>						
Father absent	1.48 (1.02, 2.13)	1.06 (0.36, 3.07)	1.34 (0.83, 2.18)	2.11 (0.92, 4.85)	0.54	C
Father present	Reference	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>						
Father absent	2.87 (1.51, 5.43)	3.53 (0.81, 15.44)	2.98 (1.29, 6.87)	0.94 (0.11, 8.37)	0.56	
Father present	Reference	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XXVIII** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY MOTHER'S AGE AT BIRTH.

Outcome of Interest	Crude OR (95% CI)	Mother's Age (at birth)			P <sup>a</sup>	EM or C <sup>b</sup>
		< 20	20 – 29	30 – 39		
<i>Current Smoking</i>						
Father absent	2.11 (1.43, 3.10)	1.49 (0.60, 3.69)	2.41 (1.49, 3.89)	---	0.43	C
Father present	Reference	Reference	Reference			
<i>Early Smoking (≤13 years of age)</i>						
Father absent	1.79 (1.25, 2.55)	1.44 (0.63, 3.27)	1.99 (1.27, 3.10)	2.77 (0.87, 8.82)	0.64	C
Father present	Reference	Reference	Reference	Reference		
<i>Current Drinking</i>						
Father absent	1.39 (0.97, 1.99)	1.06 (0.47, 2.39)	1.45 (0.93, 2.28)	3.18 (0.92, 10.95)	0.34	C
Father present	Reference	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>						
Father absent	1.48 (1.02, 2.13)	1.90 (0.80, 4.50)	1.19 (0.75, 1.89)	5.54 (1.68, 18.29)	0.04	EM
Father present	Reference	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>						
Father absent	2.87 (1.51, 5.43)	3.68 (0.64, 21.02)	2.08 (0.92, 4.73)	25.00 (4.18, 161.72)	0.02	EM
Father present	Reference	Reference	Reference	Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XXIX** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY PREMATURE BIRTH.

Outcome of Interest	Crude OR (95% CI)	Gestation		P <sup>a</sup>	EM or C <sup>b</sup>
		< 38 weeks	≥ 38 weeks		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	4.38 (0.89, 21.61)	2.13 (1.42, 3.20)	0.39	C
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	2.64 (0.59, 11.83)	1.81 (1.25, 2.63)	0.63	
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	0.97 (0.22, 4.26)	1.42 (0.98, 2.07)	0.62	
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	3.29 (0.65, 16.67)	1.46 (1.00, 2.14)	0.34	C
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	---	3.05 (1.57, 5.91)	0.36	
Father present	Reference		Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

**TABLE XXX** ASSOCIATION BETWEEN FATHER SEPARATION IN EARLY CHILDHOOD ON NEGATIVE SOCIO-BEHAVIORAL OUTCOMES IN ADOLESCENCE, STRATIFIED BY LOW BIRTH WEIGHT.

Outcome of Interest	Crude OR (95% CI)	Low Birthweight (<2,500 grams)		P <sup>a</sup>	EM or C <sup>b</sup>
		Yes	No		
<i>Current Smoking</i>					
Father absent	2.11 (1.43, 3.10)	2.44 (0.27, 22.02)	2.23 (1.50, 3.33)	0.94	C
Father present	Reference	Reference	Reference		
<i>Early Smoking (≤13 years of age)</i>					
Father absent	1.79 (1.25, 2.55)	3.75 (0.44, 31.62)	1.81 (1.26, 2.62)	0.51	
Father present	Reference	Reference	Reference		
<i>Current Drinking</i>					
Father absent	1.39 (0.97, 1.99)	1.67 (0.18, 15.13)	1.38 (0.96, 2.00)	0.87	
Father present	Reference	Reference	Reference		
<i>Early Drinking (≤12 years of age)</i>					
Father absent	1.48 (1.02, 2.13)	1.75 (0.12, 24.65)	1.51 (1.04, 2.20)	0.92	
Father present	Reference	Reference	Reference		
<i>Arrested/Legal Problems</i>					
Father absent	2.87 (1.51, 5.43)	---	2.87 (1.51, 5.43)	---	
Father present	Reference		Reference		

<sup>a</sup> P-value = Breslow-Day test  
<sup>b</sup> Potential effect modification (EM); potential confounding indicated (C).

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