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Maternal Age and Trajectories of Cannabis Use

Natacha M. De Genna^{a,*}, Marie D. Cornelius^b, Lidush Goldschmidt^c, and Nancy L. Day^d

^aDepartment of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA 15213 USA (degennan@pitt.edu)

^bDepartments of Psychiatry and Epidemiology, University of Pittsburgh School of Medicine, Pittsburgh, PA 15213 USA (mdc1@pitt.edu)

^cWestern Psychiatric Institute and Clinic (WPIC), University of Pittsburgh Medical Center, Pittsburgh, PA 15213 USA (lidush@pitt.edu)

^dDepartments of Psychiatry, Epidemiology, Pediatrics, and Occupational Therapy, University of Pittsburgh School of Medicine, Pittsburgh, PA 15213 USA (nday@pitt.edu)

Abstract

Background—Becoming a mother is a developmental transition that has been linked to desistance from substance use. However, timing of motherhood may be a key determinant of cannabis use in women, based on preliminary evidence from teenage mothers. The goal of this study was to identify trajectories of maternal cannabis use, and to determine if maternal age was associated with different trajectories of use.

Methods—This prospective study examined 456 pregnant women recruited at a prenatal clinic, ranging in age from 13–42 years old. The women were interviewed about their cannabis use one year prior to pregnancy and during each trimester of pregnancy, and at 6, 10, 14, and 16 years postpartum.

Results—A growth mixture model of cannabis use reported at each time point clearly delineated 4 groups: non/unlikely to use, decreasing likelihood of use, late desistance, and increasing likelihood/chronic use (Lo-Mendell-Rubin adjusted LRT test statistic = 35.7, $p < .001$). The youngest mothers were least likely to be in the “non/unlikely to use” group. Younger maternal age

*Corresponding Author at: Department of Psychiatry, 3811 O'Hara Street, Pittsburgh, PA 15213 USA Telephone: 412-246-6213 Fax: 412-246-6815 degennan@pitt.edu.

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Contributors

All authors have contributed materially to the preparation of this manuscript, and all authors have read and approved the final version. Natacha De Genna designed the study, prepared preliminary versions of the manuscript and revised the manuscript based on feedback from the other authors. Marie Cornelius oversaw data collection for the Teen Mother cohort, contributed to the conception and design of the secondary data analysis, and revised drafts of the manuscript. Lidush Goldschmidt conducted the data analysis and assisted with interpretation of the data and helped revise drafts of the manuscript. Nancy Day oversaw data collection for the Adult Mother cohorts, assisted with interpretation of the data, and revised drafts of the manuscript.

Conflict of Interest

The authors have no conflicts of interest to declare.

also differentiated between late desistance and increasing likelihood/chronic use, versus decreasing likelihood of use post-partum.

Conclusions—This is the first study to demonstrate that younger mothers are more likely to use cannabis across 17 years, including later desistance post-partum and increasing/chronic use. Other substance use and chronic depressive symptoms were also associated with more frequent use.

These findings have implications for both prevention and treatment of cannabis use in mothers.

Abstract

Keywords

cannabis; marijuana; maternal; mother; women; desistance

1. INTRODUCTION

Although the medical community is concerned with recreational cannabis use and uniformly opposed to legalization efforts (Hadland et al., 2015), more American women are finding cannabis use acceptable (Johnston et al., 2015; Pacek et al., 2015). For example, 70% of the women of reproductive age surveyed from 2007-2012 for the National Survey on Drug Use and Health (NSDUH) believed that there is either no or only slight risk associated with using cannabis once or twice a week. More than 10% of them had used cannabis in the past year, whether or not they were pregnant (Ko et al., 2015). These findings are disturbing because cannabis use is associated with numerous adverse outcomes including impaired memory and motor function, faulty judgment about health-risk behaviors such as unprotected sexual intercourse, increased mental health problems including paranoia, psychosis and addiction, and lower educational achievement and life satisfaction (Hall and Degenhardt, 2009; Volkow et al., 2014). These outcomes may directly impair parenting and result in fewer resources for children. Maternal cannabis use has also been associated with adverse outcomes in offspring, both prenatal (Day et al., 1994; 2006; Jaques et al., 2014; Sonon et al., 2015) and post-natal exposures (Merikangas et al., 2009).

According to life course theory, there are age and social norms that determine substance use initiation and desistance (Elder, 1975). Cannabis use often begins in adolescence, with decreasing use reported by the mid-to-late 20s (Chen and Jacobson 2012; Chen and Kandel, 1995; Ellickson et al., 2004; Johnston et al., 2015; SAMHSA, 2014; Schulenberg et al.,

2005). Compared to tobacco and alcohol use, individuals are even more likely to “age out” of cannabis use (Nelson et al., 2015). Thus, desistance occurs at the same time the majority of American women first give birth (Martin et al., 2015). In life course theory, the birth of a child represents an important “turning point” in the life span that may shape patterns of substance use (Teruya and Hser, 2010).

In fact, pregnancy and parenting are important predictors of cessation in cannabis using women (Chen and Kandel, 1998; Hammer and Vaglum, 1990; Kandel and Reveis, 1989). According to life course theory, parenthood is an important turning point away from many risky behaviors including illicit drug use (Elder, 1975; Kreager et al., 2010) but, as with all major life transitions, timing is key (Elder, 1998). Becoming a mother *after* the age of 18 appears to reduce substance use and abuse (Christie-Mizell and Peralta, 2009; Fergusson et al., 2012; Staff et al., 2014). In contrast, earlier childbearing is associated with more substance use (Krohn et al., 1997; Oesterle et al., 2011). The impact of life transitions or events is contingent on the timing of that transition or event, and a transition to early motherhood is actually a process with several steps such as engaging in sex, engaging in unprotected sex, choosing to carry the child to term, and choosing to raise the child (Elder, 1998). According to problem behavior theory, another developmental theory that guides the current work, early transitions to more adult behaviors such as sexual intercourse and substance use often co-occur. The early or “off-time” initiation of these behaviors is predictive of less optimal paths of development across adolescence and during the transition to adulthood (Jessor et al., 1991).

Adolescent motherhood in one early life transition that has been specifically linked to cannabis use (Cavazos-Rehg et al., 2012; Chapman and Wu, 2013). Pregnant adolescents in the National Study on Drug Use and Health (NSDUH) were significantly more likely to experiment with cannabis and meet criteria for a drug use disorder than non-pregnant adolescents (Salas-Wright et al., 2015). However, initiation of cannabis use was not associated with parenthood by age 18 in the National Epidemiologic Study on Alcohol and Related Conditions (NESARC), after controlling for early tobacco use and behavior problems (Cavazos-Rehg et al., 2010). In one study of adolescent mothers from the Pacific Northwest, nearly 40% used cannabis prior to pregnancy, but only 10% of them reported use during pregnancy. Cannabis use increased in the postpartum but did not return to pre-pregnancy levels of use, with nearly 20% reporting cannabis use 18 months postpartum (Gilchrist et al., 1996). In another paper examining cannabis use over 8 years, over 20% of the young mothers reported past-month use; trend analyses showed no decrease in use over time. Cannabis use rates among these young mothers were twice the level seen in same-aged female youth from the Monitoring the Future study (Gillmore et al., 2006). In the only other prospective study of adolescent mothers, more than half reported using cannabis, although use declined between adolescence and young adulthood. Despite an overall decline in cannabis use, over a quarter of the young mothers were cannabis users in the year before their teen pregnancy as well as at 10 years postpartum (De Genna et al., 2009). Taken together, the results of these studies focusing on adolescent mothers suggest that they may not “age out” of cannabis use by their mid-twenties.

It is not known if there are similar patterns of cannabis use among young women who give birth after age 18, or in women who become mothers in their late twenties and thirties, after the developmental peak in substance use. Comparisons of mothers' substance use by age may be confounded by differences in socioeconomic status (SES) and other variables associated with early motherhood and cannabis use. For example, adolescent pregnancy (Boden et al., 2008; Fergusson and Woodward, 2000) and adolescent cannabis use (Horwood et al., 2010) are both negatively associated with educational attainment. White women become mothers at an older age, on average, compared to mothers of other race and ethnicities (Martin et al., 2015). White women use cannabis earlier than Black women, but they may also desist earlier (Chen and Jacobson, 2012; Evans-Polce et al., 2015). In one study that did not consider maternity, Black women used cannabis more frequently than White women at age 29 (Keyes et al., 2015). Similarly, in the Pittsburgh Teen Mother study, White adolescent mothers who used cannabis were more likely to have begun after their pregnancy, but they were also more likely to quit 10 years postpartum, compared to Black adolescent mothers (De Genna et al., 2009). Hence, analyses of cannabis use by maternal age should consider these important socio-demographic characteristics.

Mental health is also associated with early motherhood and cannabis use. For example, prospective studies of adolescent mothers have revealed that many suffer from mental health problems including anxiety and depression (Oxford et al., 2005; Noria et al., 2007). Consistent with problem behavior theory, adolescent mothers also score higher on measures of aggression and delinquency than other girls (Miller-Johnson et al., 1999; Woodward et al., 2001). Internalizing problems such as anxiety and depression and externalizing problems such as hostility have also been linked to chronic use of cannabis (Bácskai et al., 2011; Brook et al., 2011; De Genna et al., 2009). Therefore, mental health characteristics should also be considered as covariates in investigations of maternal age and patterns of cannabis use.

In life course theory, trajectories are patterns of behavior that are inter-dependent across domains of an individual's life, determined in large part by relationships and available resources (Sampson and Laub, 1996; Teruya and Hser, 2010). Thus far, no study has examined trajectories of cannabis use as a function of the timing of motherhood, while considering a range of demographic and psychological factors that may be associated with early motherhood in addition to cannabis use. This study includes mothers aged 13-42 from two birth cohorts, with substance use data gathered prospectively from gestation and 6, 10, 14, and 16 years postpartum. We hypothesize that there will be distinct patterns of maternal cannabis use spanning the year before pregnancy to 16 years post-partum, and that maternal age will predict trajectory group membership. Based on life course and problem behavior theories, as well as the literature on adolescent mothers, we expect that the youngest mothers will be less likely to be abstinent or to decrease their cannabis use during pregnancy and in the postpartum.

2. METHOD

2.1. Participants

Data for this study are from three birth cohorts that are part of a consortium of studies on the effects of substance use on offspring physical and neurobehavioral development. These data were collected as part of three NIH-funded studies: the Teen Mother Cohort and two Adult Mother Cohorts. The two adult mother cohorts were combined. Teen Cohort mothers were 13-18 years old and Adult Cohort mothers were 18-42 years old at the beginning of the studies, providing a wide spectrum of maternal ages to answer the research questions. A new dataset was created by combining the Adult and Teen Mother Cohorts for an integrative data analysis (Curran and Hussong, 2009). We avoid most of the potential sources of between-subject heterogeneity common to integrative data analysis because 1) all participants were drawn from the same prenatal clinic, 2) the same measures and personnel were used in all birth cohorts, 3) we had the same follow-up time periods, and 4) we used the same instruments and assessments.

2.1.1. Teen Mother Cohort—Pregnant adolescents were recruited and interviewed from 1990-1994, during a prenatal visit in the first half of pregnancy, and again at delivery (DA09275: PI M. Cornelius). Follow-up visits were conducted with mothers and their children in our laboratory when offspring were ages 6 (1995-2000), 10 (2000-2005), 14, and 16 (2005-2011). All adolescents attending the prenatal clinic who were under 19 years were eligible. By the 16-year follow-up phase, a total of 326 women were assessed: 79% of the delivery cohort.

2.1.2. Adult Mother Cohort—Participants were from two studies of adult women who attended the prenatal clinic from 1982-1985. Women who were at least 18 years of age were enrolled at their 4th prenatal month clinic visit. Eighty-five percent of the women agreed to participate. There were no differences in age, income, or race between those who participated and those who refused. Two cohorts were selected from the initial sample. The first Adult Mother birth cohort included a sample of pregnant adult women who were selected because they drank 3 or more alcoholic drinks per week, and a comparison sample comprised of pregnant women who were selected because they drank less often or not at all (AA06390: PI N. Day). The second Adult Mother birth cohort included pregnant adult women who used marijuana at the rate of 2 or more joints per month, and a comparison sample of women who used cannabis less often or not at all (DA03874: PI N. Day). For this study, only women from the two comparison samples were included ($n = 355$). We excluded the adult women who were selected for the original project due to their higher levels of prenatal alcohol or cannabis use. At the 16-year follow-up phase, 270 of the selected women from the adult mother cohorts were assessed, 76% of the delivery cohorts.

2.1.3. Combined Sample—At birth, the combined sample size was 768 mothers. By 16 years postpartum, a total of 85 mothers were lost to follow up, 38 refused participation, 9 children had died, 7 were adopted or in foster care, and 33 mothers had moved out of the area. The focus of the parent studies was the effect of prenatal exposures to substance use on offspring, so mothers were not re-assessed if their children died or were removed from

custody. One hundred and forty mothers from the combined sample were excluded from the analyses because they had 2 or more postpartum drug and alcohol assessments missing. This resulted in a sample of 456 mothers for the current analyses. We conservatively did not impute for more than one missing phase since this would be an indication that it was not missing intermittently and hence not randomly missing. Out of 3,192 data points (7×456), 39 points were imputed using adjacent phases of assessment. There were no significant differences in prenatal cannabis use, maternal age, or education between subjects included in the analyses ($N=456$) and those who did not participate or were not included ($N=312$). Sample characteristics are presented in Table 1.

2.2. Procedure

Participants were recruited during the fourth or fifth month prenatal visit and interviewed about tobacco, alcohol, cannabis, and other drug use prior to becoming pregnant and during the first trimester. The mothers were seen again 24–36 hours after delivery, when they were interviewed about their substance use during the third trimester. At the 6-, 10-, 14- and 16-year follow-up visits, mothers provided information about their substance use (current and past year) and demographic and psychological status. The Institutional Review Board of the Magee-Womens Hospital approved the prenatal and delivery phases of the cohort studies, and the University IRB approved all later phases. A federal Certificate of Confidentiality was also obtained to protect participant confidentiality. Reports on maternal substance use, growth and behavioral outcomes of the offspring have been provided elsewhere (e.g. Cornelius et al., 1995; 2002; 2011; 2012; Day et al. 1994; 2006; Goldschmidt et al., 2004; 2008; 2012; Leech et al., 1999; Sonon et al., 2015).

2.3. Measures

2.3.1. Maternal cannabis use—Mothers were interviewed in a private setting by interviewers who were comfortable discussing alcohol and drug use, trained to use the instruments reliably, accurately identify the drugs used, and assess the amount of use. At the first visit, the mothers reported on cannabis used in the past year, as well as any cannabis use during the first trimester of pregnancy. At delivery, the mothers reported on use during the third trimester of pregnancy. At the 6, 10, 14 and 16-year follow-up visits, mothers reported on past year use. For this study, cannabis use was dichotomized to use/no use.

2.3.2. Demographic characteristics—During the first prenatal visit, mothers reported their date of birth, their age at the birth of their first child if they were not primiparous, and their race. For SES, a summary variable capturing maternal economic hardship was constructed from monthly family income, mothers' ability to handle bills, and financial strain 16 years postpartum (Hardaway and Cornelius, 2014). Financial strain was measured with three questions in the maternal interview: how often the mother was short of money at the end of the month, how often the mother could not buy essential things for her child, and how often the mother could not do extra things for her child ($\alpha = .73$). Maternal educational attainment reported by the 16-year post-partum assessment was used.

2.3.3. Maternal psychological status—Maternal levels of depression and hostility status were measured at all phases. Maternal depression was assessed using the Center for

Epidemiological Studies Depression scale (CES-D; Radloff, 1977). This measure of depression has been widely used in large cohort studies (Eaton and Kessler, 1981; Murphy, 2002; Radloff and Locke, 1986). A summary score capturing chronicity of depression was created by adding a point for each wave of testing that the mothers scored higher than or equal to 21 on the CES-D, indicating a clinically significant depressive episode in the past year (Radloff, 1977). Maternal dispositional (trait) anxiety and hostility were assessed using the State Trait Anxiety Index (STAI). This instrument assesses maternal experiences, expressions, and control of anger. The psychometric properties of the STAI have been demonstrated in a variety of populations (Spielberger et al., 1970). A summary score capturing chronicity of hostility was created by adding a point for each wave of testing that the mothers scored higher than or equal to 18 on the hostility subscale of the STAI, placing them in the top quartile.

2.3.4. Other substance use—Mothers self-reported all substance use for the year prior to testing, twice during pregnancy, and postnatal years 6, 10, 14 and 16. A summary score was created for tobacco use, with a point for any use at each wave of testing. Heavy alcohol use was defined as 7+ drinks per week, which is higher than the moderate level of use recommended for women by the National Institute on Alcoholism and Alcohol Abuse. A summary score was also created for heavy alcohol use, with a point for heavy alcohol use at each wave of testing.

2.4. Statistical analysis

A growth mixture model (GMM) was applied to maternal cannabis use measured at all seven phases to explore different trajectories of use over time. GMM is based on random coefficients growth curve models. GMM allows variation in growth across individuals, and at the same time, estimates mean growth curves for each trajectory (Muthén and Muthén, 2000). Cubic growth curves were fitted, creating trajectory classes of maternal cannabis use. The number of classes that best fit the data was determined using the Lo-Mendell-Rubin likelihood ratio test (Lo et al., 2001). This statistic tests whether a smaller number of classes better fits the data. The individual posterior probabilities for each class were also screened, to ascertain lack of ambiguity in assigning individuals to different classes.

Polytomous logistic regression was used to test the association between maternal age and maternal cannabis use trajectories. The regression was conducted in a stepwise manner to avoid saturation of the model by inclusion of non-statistically significant covariates. Demographic characteristics (maternal age, race, education and economic hardship) were entered into the model first. Maternal depression and hostility scores were entered in the second step. Maternal use of other substances was entered in the third step.

3. RESULTS

3.1. Trajectories of maternal cannabis use

The GMM indicated four patterns of maternal cannabis use over time best fit the data (entropy = 0.83). The Lo-Mendell-Rubin adjusted LRT test statistics for 5 and 4 classes of maternal cannabis use classes were 28.5 ($p = .04$) and 35.7 ($p = .00$), respectively. These 4

patterns included: non/unlikely to use at any time point (61%), this class was least likely to use during pregnancy and in later phases; late desistance (15%), this class did not use during pregnancy but reported use 6 and 10 years post-partum; decreasing likelihood of use (11%), this class used in the year prior to pregnancy and then had a steady decline in likelihood of use over the postpartum; and increasing likelihood/chronic users (14%), this class used cannabis across most of the time points, with an increasing likelihood of use over time. The mean posterior probabilities for the four classes were 0.92, 0.92, 0.97, and 0.97, respectively. The probabilities for classification of participants into their respective classes were all above 0.55, showing no ambiguity in delineation of classes.

The trajectories identified in the GMM are depicted in Figure 1, with the observed frequencies of maternal cannabis use at each time point in the study. Mothers in the “non/unlikely to use” group did not report any use during pregnancy, and were extremely unlikely to report use in the postpartum. Only a few in this group used the year prior to pregnancy (15%), at 14 (2%) or 16 years (2%) years postpartum. The “late desistance” group consisted of women who used cannabis the year prior to pregnancy (44%), 6 (78%), and 10 (41%) years postpartum. None of the “late desistance” used cannabis 14 or 16 years postpartum. All of the women in the “decreasing likelihood of use” group used cannabis prior to the pregnancy and during their first trimester. However, they had a steeply decreased likelihood of use during the third trimester onward, with most reporting abstinence by 14 years postpartum (90%) and none reporting any use at 16 years postpartum. Most of the women in the “increasing likelihood/chronic users” group used marijuana in the year prior to pregnancy (58%), decreased use during the pregnancy (28% in the first trimester; 10% by the third trimester) and then increased cannabis use postpartum, with 72%, 75%, 90% and 75% reporting cannabis use 6, 10, 14 and 16 years post-partum, respectively.

3.2 Bivariate analyses comparing maternal cannabis use trajectory groups

The mothers in the four cannabis user trajectory groups differed across several domains, including sociodemographic factors, psychological status, and other substance use (Table 2). The mothers in the non/unlikely to use group were more likely to be older, White, and higher income. They were less likely to smoke or use alcohol during pregnancy, and had lower depression and hostility scores postpartum. The increasing likelihood/chronic use mothers were the opposite in every way from the non/unlikely to use group mothers. Compared to the decreasing likelihood of use group, the late desistance mothers were younger, more likely to be Black, used tobacco or alcohol during pregnancy, and had lower hostility scores postpartum.

3.3. Multivariate analyses predicting maternal cannabis use trajectories

Maternal age was regressed on maternal cannabis trajectory group membership, controlling for maternal race, age at first birth, maternal education, economic hardship, depression, hostility, tobacco use, and heavy drinking. Maternal age was a significant predictor of trajectory group membership in this model. Depression scores, tobacco and heavy alcohol use were also correlates of trajectory group membership. Younger mothers, mothers who were depressed across more waves of testing as reflected in the depression summary score, and mothers who used tobacco and alcohol across more waves were all significantly less

likely to be in the non/unlikely to use group. Maternal race did not predict maternal cannabis trajectory group membership. Table 3 depicts the simultaneous comparison of the non/unlikely to use class to the other three maternal cannabis user classes.

Another polytomous regression analysis was used to compare the “decreasing likelihood of use” to the “late desistance” and “increasing likelihood/chronic user” groups. Younger mothers and mothers who were heavy drinkers were less likely to be in the “decreasing likelihood” of cannabis use group, and more likely to be in the “late desistance” and “increasing likelihood/chronic user” groups. Mothers with chronically higher depression scores were also more likely to be in the “increasing likelihood/chronic users” trajectory vs. “decreasing likelihood of use” trajectory, but not in the “late desistance” and “decreasing likelihood of use” trajectories.

4. DISCUSSION

This is the first study to examine trajectories of cannabis use in mothers spanning a wide range of reproductive ages. We identified four distinct patterns of maternal cannabis use, spanning the year before pregnancy to 16 years post-partum. Consistent with our hypotheses, maternal age predicted trajectory group membership, with the older mothers most likely to be classified as “non/unlikely to use” (trajectory group mean maternal age = 20.6). As predicted by life course theory, the women who made the transition to motherhood at an older (more normative) age were the least likely to use cannabis while pregnant or raising children. Younger mothers were also more likely to be classified in the “late desistance” group (mean maternal age = 17.0) or “increasing likelihood/chronic use” group (mean maternal age = 17.2) and less likely to be in the “decreasing likelihood of use” group (mean maternal age = 18.7). In other words, adolescent mothers were significantly more likely to be using cannabis while raising children. Mothers in the “increasing likelihood/chronic users” group continued to use cannabis when their children were at risk of initiating cannabis use themselves as adolescents. This has implications for inter-generational transmission of cannabis use.

Other substance use was also associated with maternal cannabis use patterns, consistent with problem behavior theory. Mothers who used other substances were more likely to be in one of the cannabis user groups and less likely to be in the non/unlikely to use group. Other investigators have shown that tobacco use is associated with cannabis use among adolescents and young adults (Badiani et al., 2015; Nelson et al., 2015; Passarotti et al., 2015) and a systematic review of the literature confirms the prevalence of co-use among male and female adolescents and young adults (Ramo et al., 2012). In our study, chronic tobacco use differed between “non/unlikely to use” and the other cannabis use trajectories, but the more problematic trajectory groups did not differ by tobacco use. Chronic heavier use of alcohol, however, did distinguish among these problematic cannabis user groups: heavier drinkers were less likely to be in the “decreasing likelihood of use” category. These results on mothers converge with results from studies of young adults finding overlap between heavier alcohol use and cannabis use (Nelson et al., 2015) and data associating recent, binge, and heavy alcohol use with cannabis use in pregnant and non-pregnant women of reproductive age in the NSDUH (Ko et al., 2015). Taken together, these results suggest

that the children of cannabis-using mothers are also more likely to be exposed to maternal tobacco and alcohol use.

The finding that depressive symptoms differentiated the maternal cannabis user groups in our analysis is consistent with other reports of co-occurring cannabis use and depression in the general population (Chen et al., 2002; Grant, 1995; Lev-Ran et al., 2014). For the mothers in our study, those who were more likely to be depressed at multiple time points were more likely to use cannabis than to abstain. Chronic depressive symptoms were also related to increasing/chronic cannabis use compared to mothers who initially used cannabis, but then desisted 10 or 14 years postpartum (late desistance). Thus, women who are increasing or chronic users of cannabis are also more likely to expose their offspring to the effects of maternal depressive symptoms. The association between chronic depression and maternal trajectories of cannabis use remained significant in models including maternal age, suggesting that depressive symptoms contribute to the risk of maternal cannabis use above and beyond the contribution of younger maternal age. These findings have connotations for the treatment of cannabis use and depressive symptoms in mothers of all ages.

This was the first study to prospectively examine maternal substance use in women of different races across a wide spectrum of maternal ages, so there were no *a priori* hypotheses about racial differences. Maternal race was examined as a covariate because it has been associated with both the independent (maternal age) and dependent variables (cannabis use) in this study. In the literature, White women use cannabis earlier than Black women, but they may also desist earlier (Chen and Jacobson, 2012; Evans-Polce et al., 2015) and tend to delay motherhood (Martin et al., 2015). In the current study, race was only linked to maternal cannabis use trajectory group membership in the bivariate analyses. Race was no longer significant after including maternal age in multivariate analysis. Thus, from an identification, prevention and intervention stand point, race is not as important as maternal age, other substance use, and chronic depression for patterns of maternal cannabis use over time.

Life history theory reminds us to consider the historical time and place of development (Elder, 1998). The legal status of cannabis use in the US remains in flux, and the public health implications of increasing legalization remain unclear. Large professional medical organizations have released statements voicing concerns about cannabis use as well as opposition towards legalization efforts (Hadland et al., 2015). Nonetheless, American women of all ages and ethnicities perceive cannabis use as less risky than in previous years (Johnston et al., 2015; Pacek et al., 2015) in spite of the fact that current cannabis has much higher THC content than the cannabis that was available in earlier years (Mehmedic et al., 2010). Early analysis of national survey data indicated that legalization of medical marijuana increases recreational use (Cerdeira et al., 2012), although results of more recent studies have been mixed (Lynne-Landsman et al., 2013; Pacula et al., 2015). Given the current climate, cannabis use among women is not expected to decline (Volkow et al., 2014). Accordingly, the results of this study are an important first step in determining which women will abstain, desist, increase or chronically use cannabis use after becoming mothers.

This is the first study to prospectively examine cannabis use across nearly two decades in mothers from a wide range of ages. However, the results should be interpreted with caution. These results may not generalize to mothers from other regions of the country, to mothers of other racial and ethnic backgrounds, or to mothers from more advantaged backgrounds who do not give birth in an urban, university teaching hospital. This study provides no data on cannabis use in mothers of Hispanic or Asian-American descent. The racial distributions of the sample represent the prenatal clinic population in Allegheny County, which is overwhelmingly Black and White. Moreover, attrition varied by race: more White mothers had missing substance use data and were not assessed. Nonetheless, cannabis use did not differ as a function of race, and there was no difference in prenatal marijuana use for the mothers who were and were not included in the present analysis.

Another limitation of the current study is the reliance on self-report for cannabis use. Nevertheless, every effort was made to increase the reliability of this self-report, including asking detailed questions, pilot testing the assessments before each wave of testing, carefully selecting and training interviewers in standardized and non-judgmental interview techniques, and obtaining a federal Certificate of Confidentiality. In addition, biological measures only capture use for a short window of time, whereas questionnaire data can elicit patterns of cannabis use over time such as any use in the past year. A final potential source of bias was the compensation for the mothers' time provided at each phase of assessment, which may have influenced retention rates by providing additional incentive to participate for the most economically disadvantaged mothers. In these birth cohorts, the youngest mothers were generally more disadvantaged. However, rates of retention did not vary significantly between the adult and teen cohorts.

In conclusion, this study provides the first empirical evidence that age does matter for trajectories of maternal cannabis use. Consistent with life course theory, motherhood is not a turning point away from cannabis use for all young women, and the timing of motherhood can help us predict patterns and progression of cannabis use across two decades. A minority of mothers are much more likely to use marijuana after pregnancy, and these mothers are much younger than mothers who do not use cannabis or are increasingly less likely to use cannabis over time. These results have important implications for the physical and mental health of our youngest mothers, given the effects of cannabis use on the still-developing adolescent brain (Lubman et al., 2015). These findings also have implications for their children, who are being raised by mothers whose brain development may be compromised, and who are also engaging in what remains an illicit activity. Younger mothers have more childbearing years ahead of them and become pregnant multiple times after their first birth. Therefore, they are more likely to expose future offspring through gestational exposures, with potential adverse outcomes in offspring neurobehavioral outcomes. The results of this study suggest that the youngest mothers should be targeted for preventative efforts, along with any mothers who screen positive for depression and other substance use in the presence of cannabis use.

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Highlights

- This is the first study of maternal cannabis use spanning 17 years.
- Growth mixture modeling revealed 4 distinct maternal cannabis user groups.
- Younger mothers were less likely to be in the non/unlikely to use group.
- Younger mothers were more likely to be in the late desistance or increasingly likely/chronic user groups.
- Depressive symptoms also predicted increasingly likely/chronic maternal cannabis use.

Figure 1.
Observed frequencies of maternal cannabis use by trajectory group membership

Table 1

Sample Characteristics (N=456)

	Mean (SD)	Range	Percentage
Baseline assessments (1st trimester)			
Age	19.6 (4.7)	13-42	
White			35.7%
Married			19.0%
Tobacco user			39.9%
Alcohol user			44.1%
Cannabis user			14.3%
16 years post-partum			
Educational attainment (years)	12.6 (1.9)	6-18	
Family income (monthly)	\$2255 (1816)	\$0-18,000	
Married			33.2%
Depression score ^a	38.7 (10.5)	20-75	
Hostility score ^b	15.6 (4.3)	10-40	
Tobacco user			48.5%
Heavy alcohol user			16%
Cannabis user			11%

^aDepression score from Center for Epidemiological Studies Depression scale (CES-D)^bHostility score from the State Trait Anxiety Index (STAI)

Table 2

Characteristics Associated with Maternal Cannabis Use Trajectory Groups

	Non/Unlikely Use	Late Desistance	Increasing Likelihood/ Chronic Use	Decreasing Likelihood of Use	<i>p</i>
(N = 456)	(n = 300)	(n = 49)	(n = 59)	(n = 48)	
Maternal age	20.6	17.0	17.2	18.7	.000
Maternal age at first birth	18.9	16.4	16.8	17.8	.000
Cannabis use					N/A
Pre-pregnancy	15%	44%	58%	100%	
1 st trimester	0	0	23%	100%	
3 rd trimester	0	6%	10%	19%	
6 years post-partum	0	78%	72%	33%	
10 years post-partum	0	40%	75%	29%	
14 years post-partum	2%	0	90%	10%	
16 years post-partum	2%	0	75%	0	
White	40%	18%	27%	35%	.010
Employed 16 years post-partum	77%	80%	58%	75%	.010
Income 16 years post-partum	\$2401	\$2238	\$1566	\$2210	.010
1 st trimester tobacco user	33%	38%	54%	67%	.000
1st trimester alcohol user	39%	47%	49%	67%	.003
3 rd trimester tobacco user	38%	49%	63%	75%	.000
3 rd trimester alcohol user	12%	10%	15%	21%	.360
Depression 6 years post-partum ^a	51%	57%	80%	56%	.001
Depression 10 years post-partum ^a	52%	61%	80%	63%	.000
Depression 14 years post-partum ^a	58%	53%	81%	54%	.004
Depression 16 years post-partum ^a	56%	55%	80%	52%	.005
Hostility 6 years post-partum ^b	15.31	15.25	18.48	17.15	.000
Hostility 10 years post-partum ^b	15.12	15.83	18.12	16.45	.000
Hostility 14 years post-partum ^b	15.15	15.92	18.15	16.22	.000
Hostility 16 years post-partum ^b	14.91	16.42	17.49	17.06	.000

^aDepression score > 35 on the Center for Epidemiological Studies Depression scale (CES-D)^bHostility score from the State Trait Anxiety Index (STAI)

Table 3

Predictors remaining in the Polytomous Logistic Regression Model comparing Non/Infrequent Users (reference group) to the other Maternal Cannabis User Trajectory groups

	Coefficient	p	Odds Ratio	Confidence Interval
<i>Decreasing Likelihood of Use</i>				
Maternal age	-0.87	<.05	0.85	0.85-0.99
Depression	0.13	ns	1.1	0.92-1.4
Tobacco use	0.25	<.001	1.3	1.1-1.5
Alcohol use	0.33	<.05	1.4	1.05-1.8
<i>Increasing Likelihood/Chronic Use</i>				
Maternal age	-0.24	<.001	0.79	0.70-0.88
Depression	0.53	<.001	1.7	1.4-2.2
Tobacco use	0.26	<.001	1.3	1.1-1.5
Alcohol use	0.75	<.001	2.1	1.6-2.7
<i>Late Desistance</i>				
Maternal age	-0.26	<.001	0.77	0.68-0.87
Depression	0.11	ns	1.1	0.88-1.4
Tobacco use	0.00	ns	1.1	0.94-1.2
Alcohol use	0.68	<.001	2.0	1.5-2.5