Fertility Rate Trends Among Adolescent Girls With Major Mental Illness: A Population-Based Study

OBJECTIVE: Fertility rates among adolescents have decreased substantially in recent years, yet fertility rates among adolescent girls with mental illness have not been studied. We examined temporal trends in fertility rates among adolescent girls with major mental illness.

METHODS: We conducted a repeated annual cross-sectional study of fertility rates among girls aged 15 to 19 years in Ontario, Canada (1999–2009). Girls with major mental illness were identified through administrative health data indicating the presence of a psychotic, bipolar, or major depressive disorder within 5 years preceding pregnancy (60,228 person-years). The remaining girls were classified into the comparison group (4,496,317 person-years). The age-specific fertility rate (number of live births per 1000 girls) was calculated annually and by using 3-year moving averages for both groups.

RESULTS: The incidence of births to girls with major mental illness was 1 in 25. The age-specific fertility rate for girls with major mental illness was 44.9 per 1000 (95% confidence interval [CI]: 43.3–46.7) compared with 15.2 per 1000 (95% CI: 15.1–15.3) in unaffected girls (rate ratio: 2.95; 95% CI: 2.84–3.07). Over time, girls with major mental illness had a smaller reduction in fertility rate (relative rate: 0.86; 95% CI: 0.78–0.96) than did unaffected girls (relative rate: 0.78; 95% CI: 0.76–0.79).

CONCLUSIONS: These results have key clinical and public policy implications. Our findings highlight the importance of considering major mental illness in the design and implementation of pregnancy prevention programs as well as in targeted antenatal and postnatal programs to ensure maternal and child well-being.
Adolescents comprise a vulnerable group with respect to pregnancy and parenting outcomes. They are at increased risk of multiple adverse outcomes, including preterm birth, poor fetal growth, stillbirth, postpartum depression, and psychosocial instability across the perinatal period. Public health and school- and community-based interventions to reduce pregnancies among adolescents have led to reductions of up to 35% in Canada, the United States, the United Kingdom, and in other developed countries over the past several years. However, certain groups of adolescents remain at higher risk of pregnancy, including minority groups and those with family and/or economic instability. Adolescent girls with major mental illnesses, including major depression, bipolar disorder, and psychotic disorders such as schizophrenia, have several risk factors associated with teenage pregnancy, including poverty and early childhood trauma, but trends in fertility rates among adolescent girls with mental illness diagnosed before pregnancy have not been documented.

Knowledge about the burden of preexisting serious mental illness among adolescent mothers is important because having a major mental illness is associated with a higher rate of adverse pregnancy outcomes among adult women such as preterm birth and poor fetal growth. Furthermore, the negative impact of maternal mental illness on child development and child psychopathology is substantial. Given that adolescents are at high risk of adverse pregnancy outcomes, children of adolescent mothers with mental illness may be “doubly” vulnerable due to the independent risks associated with both the child and the adult woman. Information about fertility rates among adolescents with major mental illness will have important implications for clinical care, research, and public policy. It will help inform the development of interventions targeting pregnancy prevention and optimization of outcomes for adolescent mothers and their children. Also, if fertility rates are high in this group, it will underscore the importance of future research to quantify the level of risk for these adolescent mothers’ children. To begin to address the knowledge gaps in this area, we undertook a population-based study among adolescents in Ontario, Canada. Our primary objective was to examine age-specific fertility rates (ASFRs; live births per 1000 girls ages 15–19 years) over a 10-year period, comparing adolescent girls with and without major mental illness diagnosed before pregnancy. Our secondary objective was to identify factors that could explain observed differences between groups.

METHODS

Study Design

We completed a repeated cross-sectional study of ASFRs for all adolescent girls aged 15 to 19 years in the province of Ontario, Canada over a 10-year study period (1999–2009). By using population-based health administrative data, we calculated annual ASFRs among adolescent girls with major mental illnesses diagnosed before pregnancy (psychotic disorders, bipolar disorder, and major depressive disorder) and compared these rates with those of adolescent girls without a previous major mental illness diagnosis.

Data Sources

We used multiple linked population health administrative databases from the Institute for Clinical and Evaluative Sciences in Toronto, Ontario, an independent nonprofit research organization that uses a variety of administrative databases to evaluate universally available health care services and their effectiveness in the province of Ontario. Patient-level records in these databases are anonymously linked through the use of a unique identifier (scrambled health care number). The data quality in these administrative databases has been examined and found to be complete, reliable, and accurate with respect to demographic information, primary diagnoses for inpatient services, and billing claims for physician services. We used the Registered Persons Database containing gender, age, and postal code for all Ontario residents eligible for health care services, to identify all adolescent girls aged 15 to 19 years in each fiscal year from 1999 to 2009. We used the Canadian Institute of Health Information–Discharge Abstract Database (CIHI-DAD) and the Ontario Mental Health Reporting System Database for hospitalization-related data and the Ontario Health Insurance Plan Database (OHIP) for physician billing data to identify girls with major mental illness. We also used the MOMBABY data file, an existing cumulative data set derived from the OHIP that provides linked maternal and newborn health records for all newborns delivered in hospital. Births are identified in the MOMBABY data file by using the main patient service code for “obstetric delivery” and/or hospital diagnostic codes indicating obstetric delivery, and the data file includes flags to identify live births. This data file has been used extensively in multiple publications examining population-based pregnancy outcomes in Ontario.

Cohort

For a previous study, we created annual samples of Ontario women aged 15 to 49 years at the midpoint of each 12-month period starting from April 1, 1999, until April 1, 2009. For this study, we restricted the cohort to adolescent girls aged 15 to 19 years. The number of adolescent girls in each fiscal year ranged from a minimum of 379,303 to...
a maximum of 457,534, resulting in a total of 4,556,545 person-years for the overall study period.

**Exposure**

For the primary analysis, we chose to combine girls with major depression, bipolar disorder, and psychotic disorders into 1 category of major mental illness because psychiatric diagnoses are very fluid between these categories for adolescents. For each 12-month period, an adolescent was assigned to the major mental illness group if: (1) she had been hospitalized with a discharge diagnosis of any psychotic disorder, bipolar disorder, or major depressive disorder on the basis of International Classification of Diseases, Ninth Revision (ICD-9), codes of 295 to 298 or the Canadian version of the International Classification of Diseases, 10th Revision (ICD-10-CA), codes of F20, F22 to F25, or F28 to F33; or (2) if she had ≥1 physician OHIP service claims for these disorders (OHIP codes 295–298, based on ICD-9 classification), any of which were within the 5-year period preceding the estimated date of conception of the index pregnancy. This mental illness classification was used by the Manitoba Centre for Health Policy to profile the treatment prevalence of mental health disorders in Manitoba, Canada, and has been used in previous Institute for Clinical and Evaluative Sciences studies. The remaining girls were classified into the comparison group. For a subgroup analysis, we identified girls within the major mental illness group who had any diagnosis of schizophrenia and/or another psychotic disorder (OHIP/ICD-9: 295, 297, 298; ICD-10-CA: F20, F22, F23, F24, F25, F28, F29) during the look-back period and classified them into a “primary psychotic disorder” subgroup. The remaining girls in the major mental illness group were classified into a “primary mood disorder” subgroup (OHIP/ICD-9: 296; ICD-10-CA: F30–F33).

**Outcomes**

We measured annual ASFRs in the 15- to 19-year age band among girls with major mental illness and a comparison group. The ASFR is a measure of the number of live births per unit of population. It is the measure used by the World Health Organization to take into account the age structure of the population and is globally used to measure fertility rates among adolescent girls. By definition, the ASFR includes only live births, such that it is not a perfect reflection of pregnancy rates. To address this issue, we also measured stillbirth rates separately in both groups to be compared in a secondary analysis.

**Covariates**

We measured parity, socioeconomic status, and place of residence (urban versus rural location). Parity was derived from the maternal health record in the CIHI-DAD. Socioeconomic status was approximated by using quintiles of neighborhood income derived from Ontario postal code data. Place of residence was defined by using postal code data where urban areas were those with an urban core of ≥10,000 individuals.

**Statistical Analyses**

We calculated the number of girls with and without major mental illness who delivered a live-born infant during the study period and described both groups in terms of the study covariates. We calculated overall and annual ASFRs for each group by dividing the number of live births to eligible adolescent girls in each fiscal year by the total number of eligible adolescent girls in that fiscal year; the data are presented in terms of the number of live births per 1000 eligible girls. To achieve the primary objective, we compared ASFRs between adolescents with and without major mental illness, creating an ASFR ratio and 95% confidence interval (CI) overall and for each fiscal year. To investigate change over time within each group, we used 3-year moving averages to reduce variability and calculated relative ASFR and 95% CIs comparing the final 3 years of the study (2007–2009) with the first 3 years of the study (1999–2001) for affected and unaffected adolescents separately. In secondary analyses, we compared ASFRs between girls with “primary psychotic disorders” and “primary mood disorders.” In addition, we compared stillbirth rates between girls with and without major mental illness.

To achieve the secondary objective, we adjusted the overall ASFR ratio for the study covariates by using generalized estimating equations to account for clustering of participants, presenting each variable’s contribution to the model using rate ratios and 95% CIs.

Analysis was conducted by using SAS 9.2 for UNIX (SAS Institute, Cary, NC). Permission to complete this study was granted by the Sunnybrook Health Sciences Centre Research Ethics Board in Toronto, Ontario.

**RESULTS**

Adolescents with previously diagnosed major mental illness represented 60,228 person-years in the cohort (1.1% to 1.4% of the sample for any given fiscal year). Girls in the major mental illness group were more likely to be multiparous compared with unaffected girls (3.6% vs 1.4%), but the breakdown of socioeconomic status and place of residence was relatively similar; ~22% of girls in the major mental illness group were in the lowest neighborhood income quintile compared with 20% of unaffected girls, and almost all girls in both groups were living in urban areas (87.3% and 86.5% of affected and unaffected girls, respectively).
There were 71,098 births among adolescent girls in Ontario over the study period, and 2,707 (3.8%) were to girls in the major mental illness group. Of these births, 795 (29.3%) were to girls with a primary psychotic disorder and 1,912 (70.6%) were to girls with a primary mood disorder. The overall ASFR among adolescents with major mental illness was 44.9 per 1,000 (95% CI: 43.3–46.7) compared with 15.2 per 1,000 (95% CI: 15.1–15.3) among unaffected girls, resulting in a rate ratio of 2.95 (95% CI: 2.84–3.07) (Table 1). Over time, the ASFR among adolescents with major mental illness decreased, but not in a linear form (Table 1). Using 3-year moving averages to reduce annual variability in the data, a similar trend was observed (Fig 1), and the relative ASFR comparing fiscal years 2007–2009 with 1999–2001 was 0.86 (95% CI: 0.78–0.96). For unaffected girls, there was a consistent downward trend using 3-year moving averages (Fig 1), and the relative ASFR comparing fiscal years 2007–2009 with 1999–2001 was 0.78 (95% CI: 0.76–0.79). There was no difference in ASFRs between girls from the major mental illness group who had a diagnosis of a primary psychotic disorder (overall ASFR: 45.0; 95% CI: 41.9–48.3) and those with a primary mood disorder (overall ASFR: 44.9; 95% CI: 42.9–47.0) (ASFR ratio: 1.00; 95% CI: 0.92–1.09). The stillbirth rate was 7.04 per 1,000 births among girls with major mental illness (95% CI: 5.43–8.66) compared with 6.61 per 1,000 births (95% CI: 6.30–6.92) among unaffected girls, a nonsignificant difference.

Study covariates explained some of the difference in ASFRs between groups. Multiparity, low socioeconomic status, and rurality were all independently associated with increased birth rates, and inclusion of these covariates in the multivariable model reduced the ASFR ratio comparing girls in the major mental illness group with unaffected girls to 1.87 (95% CI: 1.77–1.96) (Table 2).

**DISCUSSION**

Adolescent girls with a major mental illness diagnosed before pregnancy accounted for almost 1 in 25 adolescent births, corresponding to an overall ASFR almost 3 times higher than the rate for adolescent girls without major mental illness. Although fertility rates in both affected and unaffected adolescent girls decreased over time, the gap between the groups appeared to be increasing slightly over our 10-year study period. The ASFR among adolescents with major mental illness decreased by only ~14% in comparison with a decrease of 22% among unaffected girls.

There has been minimal antecedent literature on this topic. Two clinical studies revealed high rates of teenage pregnancy among girls with bipolar disorder.54,55 To our knowledge, however, this is the first population-based study to show that adolescents with major mental illnesses are at higher risk than unaffected adolescents of becoming teenage parents. Although we could not explain all of the reasons for the observed increase in birth rate, multiparity, low socioeconomic status, and rural region of residence all independently increased the risk of adolescent birth in our study. This finding is consistent with the literature on known risk factors for adolescent pregnancy, including previous adolescent pregnancy, poverty, minority status (in the United States), and history of childhood trauma, including sexual abuse.10,13,14,36 As such, our findings add considerably to how we understand the clinical situation of adolescent pregnancy and have clear implications for public policy and program development.

First, despite outreach to reduce adolescent pregnancy rates, girls with major mental illness are a specific at-risk group. Preventive programs in most

**TABLE 1**

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Adolescent Girls With Major Mental Illnesses</th>
<th>Adolescent Girls Without Major Mental Illnesses</th>
<th>ASFR Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Number of Live Births</td>
<td>ASFR (95% CI)</td>
</tr>
<tr>
<td>1999</td>
<td>4252</td>
<td>228</td>
<td>53.6 (46.9–61.1)</td>
</tr>
<tr>
<td>2000</td>
<td>4584</td>
<td>245</td>
<td>53.4 (47.0–60.6)</td>
</tr>
<tr>
<td>2001</td>
<td>5041</td>
<td>241</td>
<td>47.8 (42.0–54.2)</td>
</tr>
<tr>
<td>2002</td>
<td>5244</td>
<td>249</td>
<td>47.5 (41.8–53.8)</td>
</tr>
<tr>
<td>2003</td>
<td>5371</td>
<td>219</td>
<td>40.8 (33.6–46.5)</td>
</tr>
<tr>
<td>2004</td>
<td>5565</td>
<td>227</td>
<td>40.8 (35.7–46.5)</td>
</tr>
<tr>
<td>2005</td>
<td>5780</td>
<td>223</td>
<td>38.6 (33.7–44.0)</td>
</tr>
<tr>
<td>2006</td>
<td>5965</td>
<td>243</td>
<td>40.7 (35.9–46.2)</td>
</tr>
<tr>
<td>2007</td>
<td>6012</td>
<td>283</td>
<td>47.1 (41.7–52.9)</td>
</tr>
<tr>
<td>2008</td>
<td>6146</td>
<td>272</td>
<td>44.3 (39.2–49.8)</td>
</tr>
<tr>
<td>2009</td>
<td>6266</td>
<td>277</td>
<td>44.2 (39.1–49.7)</td>
</tr>
</tbody>
</table>

All years 60,228 person-years 2007 4,498,317 person-years 68,391 15.2 (15.1–15.3) 2.95 (2.84–3.07)

* Major mental illnesses include psychotic disorders, bipolar disorder, or major depressive disorder.
* ASFR per 1,000 eligible girls.
* Compares girls with psychotic disorders, bipolar disorder, and major depressive disorder with girls without these major mental illnesses.
Adjustment might be beneficial in prevention programs for students identified as being at risk of engaging in impulsive behaviors such as substance misuse have shown benefit not only in preventing substance misuse but also in preventing emotional and behavioral problems. Such programs are mainly psychoeducational and use motivational strategies to focus on enhancing decision-making skills in situations involving impulsive behaviors. These types of programs could be modified for girls with major mental illness, or within adolescent mental health programs where these girls are being clinically treated. Services focused on counseling girls who already have delivered 1 child may also be important because the rates of multiple births are higher among those with major mental illness. A second major implication of our findings relates to antenatal and postnatal care programming. Whereas most adolescent pregnancy programs are equipped to help girls with complex social situations, the identification of such a high prevalence of pre-existing serious mental illness among adolescent mothers indicates that a more intensive level of mental health care may be needed during pregnancy and postpartum. Engaging adolescents in health services can be extremely challenging so antenatal mental health assessment and treatment would likely have optimal uptake at the point of care. In the postnatal period, many different public health and community-based programs exist for adolescent parenting and child care, but our findings suggest that there should be an increased focus on how to accommodate teens with significant mental health issues. Community programs (eg, breastfeeding, financial, parenting, and nutrition support) are often all run by different agencies, posing access challenges for any adolescent mother; those with major mental illnesses may have even greater difficulty navigating and engaging with these fragmented resources.

There are important strengths to this analysis. We were able to generate population-level fertility rate estimates for girls with and without major mental illness, and as such, our findings are likely to be widely generalizable. The adolescent fertility rate in Canada was last reported at 12.3 in 2010 according to a World Bank report published in 2012. This same report showed that this was a decrease from 14.7 per 1000 in January 2002. Our rates (for adolescents in the unaffected group) are remarkably consistent with these numbers, as is the observed downward trend in fertility rate. Population-based data are particularly appropriate for a study such as ours, where it is difficult to assemble a clinical cohort large enough to detect differences in birth rates. At the same time, administrative health data do not capture all pertinent variables, and as such, it is difficult to isolate major mental illness as a causal factor in teenage pregnancy.

For example, we could investigate the impact of parity, socioeconomic status, and region of residence but not rates of sexual abuse history, housing situation, substance use, behavioral disorders, and/or symptoms of other psychiatric disorders that did not result in presentation to the health care system.

### TABLE 2 Comparison Between Girls With and Without Major Mental Illness

<table>
<thead>
<tr>
<th>Variable</th>
<th>ASFR Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unadjusted</strong></td>
<td></td>
</tr>
<tr>
<td>Mental health group</td>
<td></td>
</tr>
<tr>
<td>Major mental illness</td>
<td>2.95 (2.84–3.07)</td>
</tr>
<tr>
<td>No major mental illness</td>
<td>Ref</td>
</tr>
<tr>
<td>Adjusted*</td>
<td></td>
</tr>
<tr>
<td>Mental health group</td>
<td></td>
</tr>
<tr>
<td>Major mental illness</td>
<td>1.87 (1.77–1.96)</td>
</tr>
<tr>
<td>No major mental illness</td>
<td>Ref</td>
</tr>
<tr>
<td>Parity</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Ref</td>
</tr>
<tr>
<td>1</td>
<td>13.5 (12.9–14.1)</td>
</tr>
<tr>
<td>2</td>
<td>15.8 (15.4–16.2)</td>
</tr>
<tr>
<td>Neighborhood income quintile</td>
<td></td>
</tr>
<tr>
<td>Highest</td>
<td>Ref</td>
</tr>
<tr>
<td>4</td>
<td>1.33 (1.28–1.38)</td>
</tr>
<tr>
<td>3</td>
<td>1.81 (1.75–1.88)</td>
</tr>
<tr>
<td>2</td>
<td>2.27 (2.19–2.36)</td>
</tr>
<tr>
<td>Lowest</td>
<td>3.04 (2.95–3.15)</td>
</tr>
<tr>
<td>Region of residence</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>1.42 (1.39–1.46)</td>
</tr>
</tbody>
</table>

Data are presented for models unadjusted and adjusted for study covariates. Ref, referent group.

*All variables were adjusted for all other variables in the model.

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developed countries have not focused explicitly on mental health as a risk factor, which may partly explain why fertility rates are not decreasing as rapidly in this group. Improved consideration of mental health issues in prevention programs might be beneficial, and there are some intervention models that might be adapted for this purpose. For example, several school-based targeted prevention programs for students identified as being at risk of engaging in impulsive behaviors such as substance misuse have shown benefit not only in preventing substance misuse but also in preventing emotional and behavioral problems. Such programs are mainly psychoeducational and use motivational strategies to focus on enhancing decision-making skills in situations involving impulsive behaviors. These types of programs could be modified for girls with major mental illness, or within adolescent mental health programs where these girls are being clinically treated. Services focused on counseling girls who already have delivered 1 child may also be important because the rates of multiple births are higher among those with major mental illness. A second major implication of our findings relates to antenatal and postnatal care programming. Whereas most adolescent pregnancy programs are equipped to help girls with complex social situations, the identification of such a high prevalence of pre-existing serious mental illness among adolescent mothers indicates that a more intensive level of mental health care may be needed during pregnancy and postpartum. Engaging adolescents in health services can be extremely challenging so antenatal mental health...
REFERENCES


Given that the adjusted ASFR ratio for differences between groups was <2.0, residual confounding might explain the association between major mental illness and the risk of adolescent pregnancy. There are other minor limitations relevant to the outcome variable. Data on births in Ontario have excellent validity; however, we missed births occurring outside of the hospital (<0.01% in Ontario).27 Because the ASFR includes only live births, it is not intended to be a measure of pregnancy rates. We compared stillbirth rates between our 2 groups, and there was no significant difference. However, we do not know whether adolescents with mental illness are more or less likely to terminate a pregnancy or have a miscarriage. Also, consistent with global estimates of the adolescent fertility rate, we did not count births to girls aged 13 or 14 years.22 The latter limitation is unlikely to be significant given that the vast majority of adolescent pregnancies occur among older teens.24

CONCLUSIONS

Almost 1 in every 25 adolescent births in Ontario, Canada, is to a girl diagnosed before pregnancy with major depression, bipolar disorder, or a psychotic disorder. This situation raises issues of broad societal concern because of the potential negative impacts both for the adolescent mothers and for their children. Our results suggest that interventions targeting reproductive health and decision-making for adolescent girls with mental illness, as well as targeted antenatal and postnatal programs to ensure maternal and child well-being, are needed. Interventions that systematically integrate adolescent mental health and reproductive health care may help reduce adolescent fertility rates as well as optimize pregnancy and child development outcomes in this group. At present, there is very little information on the combined impact of having both a major mental illness and being an adolescent on pregnancy outcomes, nor how this might affect child developmental outcomes. Future research will be required to highlight specific health disparities for programs and interventions to target.

ACKNOWLEDGMENT

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DOI: 10.1542/peds.2013-1761

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