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The Economic Impact of Untreated Maternal Mental Health Conditions in Texas

March 15, 2021

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Acknowledgements

The authors would like to thank all those who provided support, guidance, and time to this study. We thank St. David's Foundation for its financial support. We thank Ellie Haggerty Coplin and Lourdes Rodriguez at St. David's Foundation and Peter Clark, Stephanie Rubin, and Adriana Kohler at Texans Care for Children for their support and guidance throughout this study.

The views and opinions expressed in this paper are those of the authors and do not reflect the views of Mathematica, St. David's Foundation, or Texans Care for Children.

Contributors

C. Margiotta developed and implemented the model with input from S. O'Neil, K. Zivin, and D. Vohra. C. Margiotta and J. Gao conducted the literature review in consultation with K. Zivin and S. O'Neil. C. Margiotta wrote the paper and J. Gao created appendices with input from all authors. K. Zivin and S. O'Neil supervised the project.

We greatly appreciate the contributions of additional Mathematica staff to the success of the study. Jen de Richemond provided support on the literature review. Damion Mayne helped ensure that all Microsoft VBA macros in the main cost-of-illness model and subgroup analyses worked correctly, allowing users to update input values and easily recalculate costs. Donovan Griffin and Felita Buckner provided editorial and production support.

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Executive summary

Objectives. To estimate the economic impact of untreated maternal mental health conditions (MMHCs) among births in Texas in 2019.

Methods. We developed a mathematical cost-of-illness model to estimate the impact of exposure to untreated MMHCs on mothers and children in Texas. We estimated the costs incurred by mothers giving birth in 2019 and their babies, projected from conception through the first five years of the birth cohort's lives. In addition to the main model, we developed four subgroup models to estimate the economic impact of untreated MMHCs among non-Hispanic White, non-Hispanic Black, and Hispanic mothers in Texas as well as the costs to Texas Medicaid. We identified model inputs through secondary data collection and a literature review.

Results. We estimated that MMHCs affected 13.2% of women and that untreated MMHCs cost $2.2 billion among mothers and children born in Texas in 2019 when we followed the birth cohort from conception through five years postpartum. On average, this amounts to $44,460 per mother–child pair over the six-year period. In all, 55% of costs relate to maternal outcomes, and 45% relate to child outcomes. The largest costs included reduced economic productivity among mothers with MMHCs ($610 million), increased prevalence of child behavioral and developmental disorders ($556 million), increased maternal non-obstetric health expenditures ($445 million), and increased incidence of preterm birth ($372 million). We estimated that MMHCs affected 17.2% of mothers enrolled in Texas' Medicaid for Pregnant Women and that untreated MMHCs resulted in $962 million in costs among this population. Non-Hispanic White mothers had the lowest estimated prevalence of MMHCs (11.4%) and incurred $599 million in costs. Non-Hispanic Black mothers had the highest estimated prevalence of MMHCs (18.2%) and incurred $521 million in costs. Hispanic mothers had a high estimated prevalence of MMHCs (12.0%) and incurred $928 million in costs.

Conclusion. Employers and health insurers, including Medicaid, bore most of the substantial economic impact of untreated MMHCs. In addition, the prevalence of MMHCs and resulting costs vary considerably among women of different races and ethnicities, potentially driven by differences in access to screening and high-quality treatment. The Texas Health and Human Services Commission's (HHSC) strategic plan to increase awareness about MMHCs among providers and the public, establish referral networks, and increase access to care represents an important step toward improving the health of mothers and their children. However, further interventions, such as extending Medicaid benefits beyond 60 days postpartum and expanding Medicaid benefits to a wider pool of women, are necessary to maximize benefits to Texas HHSC, employers, and insurers.

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INTRODUCTION

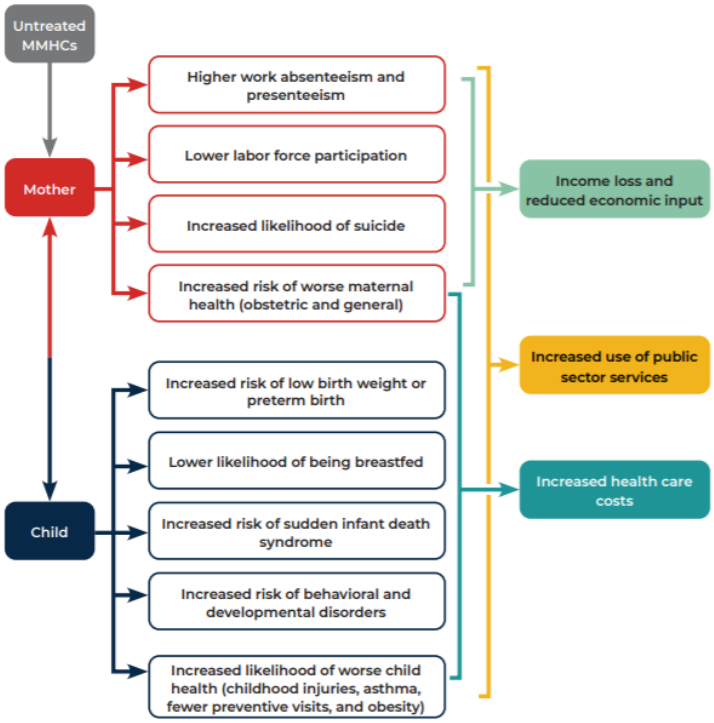
Maternal mental health conditions (MMHCs), which include depression and anxiety disorders during pregnancy and up to one year postpartum, affect at least 1 in 8 pregnant and postpartum women nationally and are among the most common obstetric complications in Texas.[1] Despite the existence of effective screening tools and treatments, these conditions often go undiagnosed and untreated.[2,3] In fact, 60% of perinatal women with MMHCs do not receive a clinical diagnosis, and half of those diagnosed do not receive treatment.[3] When left untreated, MMHCs can become a multigenerational issue affecting the mother and child's long-term physical and emotional health and overall well-being. MMHCs can lead to reduced maternal economic productivity due to an inability to work or adequately perform work duties, increased risk of suicide, increased use of public services such as Medicaid, and worse health for both mother and child.[4]

In Texas, legislators and health insurers have begun to pay more attention to MMHCs, as evidenced by the Texas Health and Human Services Commission's (HHSC) September 2020 release of a strategic plan to tackle postpartum depression by increasing awareness of MMHCs, establishing referral networks, and increasing access to care.[5] To support further efforts to increase screening and improve access to effective treatment, we generated detailed estimates of the economic impact of untreated MMHCs.

In Luca et al. (2020), we quantified the economic impact of untreated MMHCs in the United States.[6] To our knowledge, this study is the first to quantify the economic impact of untreated MMHCs in Texas and to examine the economic impact of untreated MMHCs among mothers enrolled in Texas Medicaid for Pregnant Women as well as mothers of different races and ethnicities.

In this study, we used the conceptual framework we developed in Luca et al. (2020), as well as recent data and estimates from peer-reviewed literature, to build a mathematical model that quantifies the societal costs of untreated MMHCs in Texas (Figure 1). We restricted our analysis to costs for the mother–child pair from conception through five years postpartum to highlight the immediate economic impacts most relevant to the public and policymakers. Although exposure to MMHCs during early childhood can have longer-term implications for a child's well-being, many effects do not appear until later in life. Thus, by limiting the model time frame to five years postpartum, we produced cost estimates that can inform decisions that will support immediate action to address maternal and child health.

Figure 1. Conceptual framework: Influence of untreated MMHCs on maternal and child outcomes



Notes: Mothers with MMHCs have a greater risk of presenteeism (reduced productivity and accuracy at work), absenteeism (regularly missing work), unemployment, and suicide. They are also more likely to experience preeclampsia or cesarean delivery, to have a long postpartum hospital stay, and to have high non-obstetric health care costs.

Children of mothers with MMHCs have a higher risk of being born preterm, not being breastfed, dying of sudden infant death syndrome, or having physical health issues. In addition, they are more likely to have a behavioral or developmental disorder, such as attention-deficit/hyperactivity disorder, depression, anxiety, and behavioral or conduct disorders such as oppositional defiant disorder, which can lead to reduced educational attainment in the longer term.

MMHCs = maternal mental health conditions.

METHODS

Our cost-of-illness model focused on Texas-specific maternal and child outcomes linked to MMHCs. We estimated the societal costs, including those to health care payers and employers, incurred by mothers and their children born in 2019 and projected from conception through the child's fifth birthday. Peer-reviewed literature and input from subject matter experts informed the outcomes we focused on, such as productivity losses and preterm birth. We accounted for direct and indirect costs in three domains: (1) maternal income loss through reduced labor force participation and productivity; (2) increased use of public-sector programs, such as Supplemental Nutrition Assistance Program (SNAP), Special Supplemental Nutrition Program for Women, Infants and Children (WIC), and Medicaid; and (3) higher health care costs, which result from poorer maternal and child health.

To build the model, we synthesized existing evidence from many data sources on the impact of untreated MMHCs on mother and child. We used data from peer-reviewed literature and secondary data sources to inform model inputs, including (1) impact estimates, which measure the incremental effects associated with exposure to untreated MMHCs relative to no exposure; (2) the prevalence of MMHCs in Texas; and (3) costs and baseline rates of each outcome.

Literature review

We extracted impact estimates from literature on the relationship between exposure to untreated MMHCs and maternal and child outcomes. We used the Ovid MEDLINE, CINAHL, Cochrane, APA PsycInfo, and Scopus databases and key search terms to identify articles published in peer-reviewed scientific journals. To ensure that we had the most current and relevant evidence, we restricted our search to articles published from 2008 to 2020. When possible, we prioritized articles with Texas-specific estimates. For outcomes with sparse Texas-specific evidence, we selected articles focusing on the United States or other high-income countries. We augmented these articles with (1) articles that we identified through our literature search for Luca et al. (2020), (2) references from articles we identified through our literature search for this study, (3) references from other publications focusing on the costs and impacts of untreated MMHCs, and (4) grey literature and reports that St. David's Foundation and Texans Care for Children recommended. Appendix A describes our literature review process and the search terms we used.

We reviewed article titles to ascertain relevance and exclude irrelevant articles and then reviewed abstracts and full-text articles to determine which articles contained estimates relevant for the model. We identified 75 candidate papers and selected articles using the following inclusion criteria. Each selected study (1) controlled for confounding variables or used a matched comparison group design, ensuring a credible estimated association between exposure to untreated MMHCs and the outcome of interest; (2) focused on outcomes relevant to the period between conception and the child's fifth birthday; and (3) quantified outcomes in monetary terms. In total, we identified 111 relevant articles for our literature review, including 29 relevant articles published after 2018 in addition to the 82 articles used in Luca et al. (2020).

We then extracted impact estimates for the maternal and child outcomes. These impact estimates measured the expected change in the likelihood of a particular outcome occurring as a result of exposure to untreated MMHCs. When possible, we used systematic reviews or meta-analyses to determine a range of estimates to include in the model. We prioritized articles focusing on women and children in Texas, and in cases with no available Texas-specific estimates, we extracted estimates from the United States or

other high-income countries such as Canada or the United Kingdom. Table 1 shows the impact estimates we extracted from our final set of 111 articles. Appendix C describes the articles containing the extracted impact estimates.

We also searched for articles and other publications estimating the prevalence of MMHCs in Texas, when possible, and in the United States. We included in our definition of MMHCs depression, anxiety, panic disorders, obsessive-compulsive disorders, mood disorders, post-traumatic stress disorders, and other psychiatric conditions (excluding bipolar disorder and psychosis) that occur prenatally or postpartum. For the main model, we used an estimate of 13.2% (95% confidence interval: 12.6% to 13.8%) from the Centers for Disease Control and Prevention's (CDC) Pregnancy Risk Assessment Monitoring System (PRAMS) survey, consistent with the range of estimates we used in Luca et al. (2020) (7 to 25% of new mothers).[1] Although the PRAMS estimate comes from a group of states that does not include Texas, this estimate is the most current and credible estimate available and also allowed us to look at racial and ethnic subgroups.

Cost estimates

To calculate the economic impact of MMHCs in Texas, we estimated the incremental costs of each outcome attributable to exposure to untreated MMHCs. We collected baseline cost estimates from peer-reviewed literature, the CDC, the U.S. Bureau of Labor Statistics (BLS), and other government publications and data sets. We collected direct and indirect cost estimates from the literature, standardized these costs to annual units, and accounted for immediate and downstream costs. To avoid double counting and therefore overstating costs, we extracted granular cost estimates from the literature and excluded any overlapping cost components. In particular, the estimated cost of suboptimal breastfeeding that we used in the model accounted for costs attributable to obesity, asthma, and sudden infant death syndrome (SIDS).[7] Although some evidence suggests that MMHCs influence these outcomes independently of suboptimal breastfeeding, we subtracted the costs of these outcomes from the total per capita cost of suboptimal breastfeeding because we accounted for the costs of these outcomes separately.

We converted all medical costs into 2019 dollars using the medical component of the consumer price index (CPI) and converted all nonmedical costs into 2019 dollars using the CPI for all urban consumers, less food and energy. Appendix D describes the studies and data sources from which we extracted cost estimates. Table E.1 shows the point estimates, sensitivity analyses ranges, and data sources we used in the model.

Baseline rates

We used CDC and other government data to estimate the rate of each outcome in the general population. In selecting estimates, we prioritized recency and relevance to the study population: pregnant and postpartum women and children ages 0 to 5. For example, the baseline rate estimates for productivity-related outcomes focus on reproductive-age women or women with young children. Appendix Table E.1 shows the point estimates, sensitivity analyses ranges, and data sources we used in the main model.

Modeling

For each impact estimate, we extracted a range of plausible estimates from the literature. When we identified multiple high-quality, rigorous studies containing impact estimates, we used the point estimates to inform the high and low values for the sensitivity analyses (described in Appendix F). In these cases,

the point estimates used in the main model represent the average of these high and low values. If only one study contained a credible impact estimate, we used the upper and lower bounds of the 95% confidence interval around that point estimate to inform the high and low values for the sensitivity analyses. If the study did not include a 95% confidence interval, we varied the point estimate by 25% to calculate high and low values. For certain outcomes not linked to MMHCs in the literature—including maternal suicide, absenteeism (inability to work), presenteeism (reduced productivity and increased likelihood of making mistakes at work), and unemployment—we used a range of estimates from studies examining depression among women or among all adults. We then converted each impact estimate to a percentage point change in the likelihood of an outcome due to exposure to untreated MMHCs.

To calculate the expected prevalence or incidence of each outcome among women with MMHCs and their children, we added the impact estimates to the baseline rates of each outcome in the general population. For example, the impact estimate for preeclampsia reflects the incremental risk of preeclampsia among women with untreated MMHCs relative to women without MMHCs. The sum of the impact estimate and baseline rate represents the incremental risk of preeclampsia among women with untreated MMHCs.

To calculate the annual incremental cost of each outcome because of untreated MMHCs, we multiplied the incremental risk of each outcome by the expected number of women with MMHCs, then multiplied that product by the per capita cost of each outcome. Depending on whether the outcome takes place during pregnancy or postpartum, the expected number of women with MMHCs either reflects the number of pregnancies among women with MMHCs or the number of births to women with MMHCs.

To project costs through five years postpartum, we assumed that:

1. Increased rates of preeclampsia or cesarean delivery, long peripartum hospital stays, and increased rates of preterm birth, SIDS, and suboptimal breastfeeding occur only once, either in Year 0 or in the first year postpartum.
2. The costs of productivity loss, suicide, increased non-obstetric health expenditures, increased incidence of child injury or emergency department visits, and increased likelihood of missing annual well-child care visits occur annually until the mother achieves remission from MMHCs. When the mother achieves remission, costs of these outcomes due to untreated MMHCs fall to $0.
3. Roughly two-thirds of women achieve remission by the end of the first year postpartum (Year 0), even without treatment. Following the meta-analysis by Vliegen et al. (2014), we assumed that the proportion achieving remission by the end of each year remains constant across years.[8]
4. The impact of untreated MMHCs on other outcomes, such as child behavioral and developmental disorders, asthma, and obesity, remains constant over time. For example, we assumed that a child with a behavioral or developmental disorder would continue to have that disorder even if their mother recovers from an untreated MMHC within five years postpartum.

Based on a recommendation from the U.S. Preventive Services Task Force, we discounted costs at an annual rate of 3% to reflect the lower present economic value of an expense occurring in the future.[9] Finally, to project costs through five years postpartum, we adjusted for inflation using the medical component of the CPI. Based on the percentage change between the December 2018 medical CPI and the December 2019 medical CPI, we assumed that medical costs increased by 4.53% each year after Year 0.[10] We collated estimates and developed the model in Microsoft Excel, using Visual Basic to develop macros that update the model when inputs are changed (Office 365, Microsoft, Redmond, WA).

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RESULTS

All Texas mothers

We estimated that the total cost of exposure to untreated MMHCs reached $2.2 billion for the 2019 birth cohort, projected from conception through five years postpartum. Assuming that 13.2%, or 49,816, of the 377,397 Texas mothers who gave birth in 2019 had an untreated MMHC, this amounts to more than $44,000 per affected mother–child pair over the first five years of the birth cohort's lives.[1,11] Nearly half of these costs occur in Year 0 (the year of conception and birth), attributable to birth-related outcomes including obstetric complications, preterm birth, suboptimal breastfeeding, and SIDS. Mothers incurred 55% of total costs and their children incurred 45%. Table 1 shows detailed model results, Appendix Table E.1 shows model inputs and data sources, and Appendix Table F.1 shows the results of the sensitivity analyses we conducted for the main model.

Table 1. Model results for costs of untreated MMHCs (in millions of dollars) for the 2019 birth cohort: All Texas mothers

Outcomes	Total	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Maternal costs							
Productivity losses	610.2	222.7	77.5	81.0	84.7	88.5	92.5
Suicide	12.0	4.4	1.5	1.6	1.7	1.7	1.8
Preeclampsia[a]	36.8	36.8	0.0	0.0	0.0	0.0	0.0
Cesarean delivery[a]	55.2	55.2	0.0	0.0	0.0	0.0	0.0
Peripartum stay[a]	31.3	31.3	0.0	0.0	0.0	0.0	0.0
Non-obstetric health expenditures	445.1	162.4	56.5	59.1	61.8	64.6	67.5
Benefit receipt	22.2	3.5	3.7	3.9	4.1	4.3	4.5
Child costs							
Preterm birth[a]	371.8	371.8	0.0	0.0	0.0	0.0	0.0
Suboptimal breastfeeding[a]	5.7	5.7	0.0	0.0	0.0	0.0	0.0
SIDS	1.3	1.3	0.0	0.0	0.0	0.0	0.0
Behavioral and developmental disorders	555.7	89.3	93.3	97.5	101.9	106.5	111.3
Obesity	3.9	0.7	0.7	0.7	0.7	0.7	0.7
Asthma	32.8	5.3	5.5	5.7	6.0	6.3	6.6
Injury	26.3	9.6	3.3	3.5	3.7	3.8	4.0
Emergency department visits	15.7	5.7	2.0	2.1	2.2	2.3	2.4
Non-attendance of well-child care visits	-11.2	-4.1	-1.4	-1.5	-1.6	-1.6	-1.7
Total societal costs for one birth cohort (millions of $)	**2,215**	**1,002**	**243**	**254**	**265**	**277**	**290**
Cost per mother–child pair with an MMHC in the first year postpartum ($)	**20,106**						
Cost per mother–child pair with an MMHC in the first two years postpartum ($)	**24,976**						
Cost per mother–child pair with an MMHC, averaged over the first two years postpartum ($)	**12,488**						
Cost per mother–child pair with an MMHC in the first five years postpartum ($)	**44,460**						
Cost per mother–child pair with an MMHC, averaged over the six years from conception through the first five years postpartum ($)	**7,411**						

[a] Costs only apply to Year 0, the year of conception and birth. We assumed that other costs incur annually through Year 5.
MMHCs = maternal mental health conditions; SIDS = sudden infant death syndrome.

Maternal outcomes

- *Productivity.* The expected annual per capita costs of increased job absenteeism and presenteeism due to untreated MMHCs were $1,104 and $3,107, respectively. We estimated that untreated MMHCs could lead to an additional 433 unemployed women per year, with an excess cost of $40,144 per woman each year. In total, we estimated that productivity losses due to untreated MMHCs cost $222.7 million per year, or $610.2 million through five years postpartum.

- *Suicide.* Mothers with MMHCs experienced a 20-fold greater risk of suicide than the general population and a 27-fold greater risk than among women generally, leading to an estimated 102 excess deaths per year as a result of untreated MMHCs. Assuming an annual per capita cost of $43,550 per excess death by suicide, we estimated that the increased risk of suicide among mothers with untreated MMHCs costs $4.4 million per year, or $12 million through five years postpartum.
- *Maternal obstetric health expenditures.* We estimated that untreated MMHCs are associated with 2,042 additional cases of preeclampsia, 4,533 additional cases of delivery by cesarean section, and 12,952 additional peripartum inpatient days in the birth year. This amounted to additional costs of $36.8 million due to excess cases of preeclampsia, $55.2 million due to excess cases of cesarean delivery, and $31.3 million due to excess peripartum inpatient days in Year 0 (the year of conception and birth).
- *Maternal non-obstetric health expenditures.* We estimated that annual out-of-pocket non-obstetric health expenditures were $339 higher and annual insurer-paid non-obstetric health expenditures were $1,726 higher for mothers with MMHCs than for mothers without MMHCs. This amounted to an excess cost of $162.4 million in the birth year or an excess cost of $445.1 million through five years postpartum.
- *Benefit receipt.* Untreated MMHCs were associated with an annual increase of 157 mothers receiving SNAP benefits, 157 mothers receiving WIC benefits, 187 mothers receiving Medicaid benefits, and 157 mothers receiving Temporary Assistance for Needy Families (TANF) benefits. We estimated that untreated MMHCs are associated with a $22.2 million increase in public assistance costs through five years postpartum.

Child outcomes

- *Preterm birth.* Untreated MMHCs were associated with 7,472 additional cases of preterm birth, and an expected incremental per capita cost of $7,463. This amounted to $371.8 million in excess costs in the birth year.
- *Suboptimal breastfeeding.* Untreated MMHCs were associated with 2,890 additional cases of suboptimal breastfeeding, and an expected incremental per capita cost of $114 in the birth year. This amounted to a societal cost of $5.7 million in the birth year.
- *SIDS.* Untreated MMHCs were associated with 61 additional cases of SIDS, and an expected incremental per capita cost of $26. This amounted to a societal cost of $1.3 million in the birth year.
- *Behavioral and developmental disorders.* Untreated MMHCs were associated with an additional 6,874 children with a behavioral or developmental disorder each year, with an expected incremental per capita cost of $1,793 and a total societal cost of $89.3 million in the birth year, or $555.7 million through five years postpartum.
- *Obesity.* Untreated MMHCs were associated with 2,640 additional cases of child obesity each year, with an expected incremental per capita cost of $14 and a total societal cost of $0.7 million in the birth year, or $3.9 million through five years postpartum.
- *Asthma.* Untreated MMHCs were associated with 1,744 additional cases of child asthma each year, with an expected incremental per capita cost of $106 and a total societal cost of $5.3 million in the birth year, or $32.8 million through five years postpartum.

- *Injury.* Untreated MMHCs were associated with 1,195 additional child injuries each year, with an expected incremental per capita cost of $193 and a total societal cost of $9.6 million in the birth year, or $26.3 million through five years postpartum.
- *Emergency department visits.* Untreated MMHCs were associated with 8,021 additional emergency department visits each year, with an expected incremental per capita cost of $114 and a total societal cost of $5.7 million in the birth year, or $15.7 million through five years postpartum.
- *Missed well-child care visits.* Untreated MMHCs were associated with 8,070 missed well-child care visits each year, with an expected incremental per capita cost of $82 and a total societal cost reduction of $4.1 million in the birth year, or a reduction of $11.2 million through five years postpartum. Although reduced attendance at well-child care visits partially offsets the costs of child outcomes within the model time frame, reduced attendance could contribute to higher long-term health care costs through worse child health.

Mothers enrolled in Texas Medicaid for Pregnant Women

We estimated that the total cost of exposure to untreated MMHCs among mothers who enroll in Texas Medicaid for Pregnant Women and their children was $962 million for the 2019 birth cohort, projected from conception through five years postpartum. Assuming that 17.2%, or 30,833, of the 179,264 mothers enrolled in Texas Medicaid for Pregnant Women who gave birth in 2019 had an untreated MMHC, this amounts to more than $31,000 per affected mother–child pair over the first five years of the birth cohort's lives.[1,12]

Medicaid, which is separate from other public assistance programs such as SNAP, WIC, and TANF, does not pay for productivity losses, suicide, or SIDS, so we assumed that these costs were equal to 0 for this population. Because coverage through Texas Medicaid for Pregnant Women ends after 60 days postpartum, and because Medicaid income eligibility limits are very low, many of these costs are not paid for by Medicaid.[13,14] Mothers incurred 35% of total costs, and children incurred 65%. Most of the costs of maternal outcomes are borne by the health care system (for women who do not qualify for Medicaid for Parents and Caretakers but cannot afford to self-pay or purchase health insurance) or by insurers (for women who can purchase insurance in the Affordable Care Act Marketplace). Similar to maternal outcomes, most of the costs of child outcomes are borne by the health care system (for children whose parents no longer meet Medicaid or Children's Health Insurance Program income eligibility requirements) or by Medicaid (for children whose parents do meet these requirements). Table 2 shows detailed model results, and Appendix Table E.2 shows model inputs and data sources.

Table 2. Model results for costs of untreated MMHCs (in millions of dollars) for the 2019 birth cohort: Mothers enrolled in Texas Medicaid for Pregnant Women

Outcomes	Total	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Maternal costs							
Productivity losses	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Suicide	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Preeclampsia[a]	23.4	23.4	0.0	0.0	0.0	0.0	0.0
Cesarean delivery[a]	14.8	14.8	0.0	0.0	0.0	0.0	0.0
Peripartum stay[a]	17.0	17.0	0.0	0.0	0.0	0.0	0.0
Non-obstetric health expenditures	275.5	100.5	35.0	36.6	38.2	40.0	41.8
Benefit receipt	9.7	1.5	1.6	1.7	1.8	1.9	2.0
Child costs							
Preterm birth[a]	231.4	231.4	0.0	0.0	0.0	0.0	0.0
Suboptimal breastfeeding[a]	3.6	3.6	0.0	0.0	0.0	0.0	0.0
SIDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Behavioral and developmental disorders	344.8	55.4	57.9	60.5	63.2	66.1	69.1
Obesity	2.2	0.4	0.4	0.4	0.4	0.4	0.4
Asthma	20.6	3.3	3.4	3.6	3.8	4.0	4.2
Injury	16.1	5.9	2.1	2.1	2.2	2.3	2.5
Emergency department visits	5.3	1.9	0.7	0.7	0.7	0.8	0.8
Non-attendance of well-child care visits	-2.2	-0.8	-0.3	-0.3	-0.3	-0.3	-0.3
Total societal costs for one birth cohort (millions of $)	**962**	**458**	**101**	**105**	**110**	**115**	**121**
Cost per mother–child pair with an MMHC in the first year postpartum ($)	**14,864**						
Cost per mother–child pair with an MMHC in the first two years postpartum ($)	**18,133**						
Cost per mother–child pair with an MMHC, averaged over the first two years postpartum ($)	**9,067**						
Cost per mother–child pair with an MMHC in the first five years postpartum ($)	**31,200**						
Cost per mother–child pair with an MMHC, averaged over the six years from conception through the first five years postpartum ($)	**5,200**						

[a] Costs only apply to Year 0, the year of conception and birth. We assumed that other costs are incurred annually through Year 5.
MMHCs = maternal mental health conditions; SIDS = sudden infant death syndrome.

Maternal outcomes

- *Maternal obstetric health expenditures.* Among mothers enrolled in Texas Medicaid for Pregnant women, untreated MMHCs were associated with an additional 1,301 cases of preeclampsia, an additional 2,775 deliveries by cesarean section, and an additional 8,017 peripartum inpatient days. Since these outcomes occur within the Medicaid eligibility period, we estimated that the expected incremental per capita costs of increased risk of preeclampsia, cesarean section delivery, and long peripartum stay due to exposure to untreated MMHCs were $759, $480, and $551, respectively. In total, they amounted to $55.2 million in excess costs to Medicaid in the birth year.
- *Maternal non-obstetric health expenditures.* Untreated MMHCs were associated with an expected incremental per capita cost of $3,259 in non-obstetric health expenditures each year, which amounted to $100.5 million in the birth year or $275.5 million through five years postpartum. Most of these costs are borne by the health care system or by private insurers.
- *Benefit receipt.* Untreated MMHCs were associated with an annual increase of 189 mothers receiving benefits through regular Medicaid each year. We estimated that the expected incremental per capita cost of increased utilization of Medicaid benefits was $49 per year, which amounted to $1.5 million in excess costs in the birth year, or $9.7 million through five years postpartum.

Child outcomes

- *Preterm birth.* Untreated MMHCs were associated with 4,650 additional cases of preterm birth in this population, which have an expected incremental per capita cost of $7,505 in the birth year. This amounted to $231.4 million in excess costs borne by Medicaid in the birth year.
- *Suboptimal breastfeeding.* Untreated MMHCs were associated with 1,788 additional cases of suboptimal breastfeeding, with an expected incremental per capita cost of $117 in the birth year. This amounted to $3.6 million in excess costs, partially borne by Medicaid, in the birth year.
- *Behavioral and developmental disorders.* Untreated MMHCs among mothers enrolled in Texas Medicaid for Pregnant Women were associated with an additional 4,267 children diagnosed with a behavioral or developmental disorder each year, with an expected incremental per capita cost of $1,797. This amounted to a total societal cost of $55.4 million in the birth year, or $344.8 million through five years postpartum.
- *Obesity.* Untreated MMHCs were associated with 1,624 additional cases of child obesity each year, with an expected incremental per capita cost of $13. This amounted to a total societal cost of $0.4 million in the birth year, or $2.2 million through five years postpartum.
- *Asthma.* Untreated MMHCs were associated with 1,085 additional cases of child asthma each year, with an expected incremental per capita cost of $107. This amounted to a total societal cost of $3.3 million in the birth year, or $20.6 million through five years postpartum.
- *Injury.* Untreated MMHCs were associated with 733 additional child injuries each year, with an expected incremental per capita cost of $191. This amounted to a total societal cost of $5.9 million in the birth year, or $16.1 million through five years postpartum.
- *Emergency department visits.* Untreated MMHCs were associated with 4,964 additional emergency department visits each year, with an expected incremental per capita cost of $62. This amounted to a total societal cost of $1.9 million in the birth year, or $5.3 million through five years postpartum.

- *Missed well-child care visits.* Untreated MMHCs were associated with 4,995 missed well-child visits, with an expected reduction in the incremental per capita cost of $26. This amounted to a total societal cost reduction of $0.8 million in the birth year, or $2.2 million through five years postpartum.

Health disparities by race and ethnicity

To understand potential disparities in the impact of MMHCs on mothers and children of different races and ethnicities in Texas, we estimated costs for non-Hispanic White, non-Hispanic Black, and Hispanic mothers. These racial and ethnic groups had the most consistently available stratified estimates. We assumed no differential impacts of MMHCs on outcomes across racial and ethnic backgrounds and applied the impact estimates from the main model to these subgroup analyses (Appendix C). Accounting for differences in the prevalence of MMHCs, population size, and societal and health outcomes revealed that untreated MMHCs occur most often among non-Hispanic Black mothers (18.2%) followed by Hispanic mothers (12%) and non-Hispanic White mothers (11.4%).[1] Health disparities result in higher societal costs per non-Hispanic Black mother–child pair ($62,000) than for non-Hispanic White and Hispanic mother–child pairs ($43,000). This suggests that there is ample room for policy interventions to improve equity in screening for and treatment of MMHCs and to reduce societal costs. Tables 3 to 5 show detailed model results, and Appendix Table E.3 shows model inputs and data sources for the subgroup models.

Non-Hispanic White mothers

We estimated that the total cost of exposure to untreated MMHCs among non-Hispanic White mothers and their children was $599 million for the 2019 birth cohort, projected from conception through five years postpartum. Assuming that 11.4%, or 13,896, of the 121,899 Non-Hispanic White mothers who gave birth in 2019 had an untreated MMHC, this amounts to more than $43,000 per affected mother–child pair over the first five years of the birth cohort's lives.[1,11] Nearly half of these costs relate to birth-related outcomes and occur in Year 0. Mothers incurred 56% of total costs, and their children incurred 44%.

Table 3. Model results for costs of untreated MMHCs (in millions of dollars) for the 2019 birth cohort: Non-Hispanic White mothers

Outcomes	Total	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Maternal costs							
Productivity losses	169.5	61.9	21.5	22.5	23.5	24.6	25.7
Suicide	8.0	2.9	1.0	1.1	1.1	1.2	1.2
Preeclampsia[a]	8.8	8.8	0.0	0.0	0.0	0.0	0.0
Cesarean delivery[a]	14.7	14.7	0.0	0.0	0.0	0.0	0.0
Peripartum stay[a]	8.7	8.7	0.0	0.0	0.0	0.0	0.0
Non-obstetric health expenditures	122.7	44.8	15.6	16.3	17.0	17.8	18.6
Benefit receipt	5.6	1.0	1.0	1.0	1.0	1.0	1.0
Child costs							
Preterm birth[a]	89.2	89.2	0.0	0.0	0.0	0.0	0.0
Suboptimal breastfeeding[a]	1.6	1.6	0.0	0.0	0.0	0.0	0.0
SIDS	0.4	0.4	0.0	0.0	0.0	0.0	0.0
Behavioral and developmental disorders	154.9	24.9	26.0	27.2	28.4	29.7	31.0
Obesity	1.1	0.2	0.2	0.2	0.2	0.2	0.2
Asthma	4.5	0.8	0.8	0.8	0.8	0.8	0.8
Injury	7.1	2.6	0.9	0.9	1.0	1.0	1.1
Emergency department visits	5.3	1.9	0.7	0.7	0.7	0.8	0.8
Non-attendance of well-child care visits	-3.3	-1.2	-0.4	-0.4	-0.5	-0.5	-0.5
Total societal costs for one birth cohort (millions of $)	**599**	**263**	**67**	**70**	**73**	**77**	**80**
Cost per mother–child pair with an MMHC in the first year postpartum ($)	**18,941**						
Cost per mother–child pair with an MMHC in the first two years postpartum ($)	**23,784**						
Cost per mother–child pair with an MMHC, averaged over the first two years postpartum ($)	**11,892**						
Cost per mother–child pair with an MMHC in the first five years postpartum ($)	**43,106**						
Cost per mother–child pair with an MMHC, averaged over the six years from conception through the first five years postpartum ($)	**7,184**						

[a] Costs only apply to Year 0, the year of conception and birth. We assumed that other costs are incurred annually through Year 5.
MMHCs = maternal mental health conditions; SIDS = sudden infant death syndrome.

Maternal outcomes

- *Productivity.* Among non-Hispanic White mothers, the expected incremental per capita cost of increased job absenteeism, presenteeism, and unemployment due to untreated MMHCs was $4,455 in the birth year. In total, we estimated that productivity losses due to untreated MMHCs cost $61.9 million in the birth year or $169.5 million through five years postpartum.
- *Suicide.* Untreated MMHCs led to an estimated 53 excess deaths by suicide per year, with an expected incremental per capita cost of $209 in the birth year. In total, this increased risk of suicide cost $2.9 million in the birth year or $8 million through five years postpartum.
- *Maternal obstetric health expenditures.* Untreated MMHCs were associated with an additional 486 cases of preeclampsia, an additional 1,209 deliveries by cesarean section, and an additional 3,613 peripartum inpatient days in the birth year. The expected incremental per capita costs of the increased risk of preeclampsia, cesarean section delivery, and long peripartum stay due to exposure to untreated MMHCs were $633, $1,058, and $626, respectively. In total, they amounted to $32.2 million in excess costs in the birth year.
- *Maternal non-obstetric health expenditures.* Untreated MMHCs were associated with an additional $3,224 in per capita non-obstetric health expenditures each year, which amounted to $44.8 million in the birth year and $122.7 million through five years postpartum.
- *Benefit receipt.* Untreated MMHCs were associated with an annual increase of 44 mothers receiving SNAP benefits, 44 mothers receiving WIC benefits, 52 mothers receiving Medicaid benefits, and 43 mothers receiving TANF benefits each year. We estimated that the expected incremental per capita cost of increased use of public assistance was roughly $72 per year, which amounted to $1 million in excess costs in the birth year or $5.6 million through five years postpartum.

Child outcomes

- *Preterm birth.* Among children of non-Hispanic White mothers, untreated MMHCs were associated with 1,797 additional cases of preterm birth and an expected incremental per capita cost of $6,434 in the birth year. This amounted to $89.2 million in excess costs in the birth year.
- *Suboptimal breastfeeding.* Untreated MMHCs were associated with 863 additional cases of suboptimal breastfeeding and an expected incremental per capita cost of $115 in the birth year. This amounted to $1.6 million in excess costs in the birth year.
- *SIDS.* Untreated MMHCs were associated with 17 additional cases of SIDS and an expected incremental per capita cost of $29 in the birth year. This amounted to $0.4 million in excess costs in the birth year.
- *Behavioral and developmental disorders.* Untreated MMHCs were associated with an additional 1,923 children with a behavioral or developmental disorder each year, with an expected incremental per capita cost of $1,799 and total societal cost of $24.9 million in the birth year, or $154.9 million through five years postpartum.
- *Obesity.* Untreated MMHCs were associated with 820 additional cases of child obesity, with an expected incremental per capita cost of $14 and a total societal cost of $0.2 million in the birth year, or $1.1 million through five years postpartum.

- *Asthma.* Untreated MMHCs were associated with 267 additional cases of child asthma each year, with an expected incremental per capita cost of $58 and a total societal cost of $0.8 million in the birth year, or $4.5 million through five years postpartum.
- *Injury.* Untreated MMHCs were associated with 325 additional child injuries each year, with an expected incremental per capita cost of $187 and a total societal cost of $2.6 million in the birth year, or $7.1 million through five years postpartum.
- *Emergency department visits.* Untreated MMHCs were associated with 2,723 additional emergency department visits each year, with an expected incremental per capita cost of $137 and a total societal cost of $2 million in the birth year, or $5.3 million through five years postpartum.
- *Missed well-child care visits*. Untreated MMHCs were associated with 2,251 missed well-child visits each year, with an expected reduction in the incremental per capita cost of $88 and a total societal cost reduction of $1.2 million in the birth year, or $3.3 million through five years postpartum. As with the broader Texas population, missed well-child visits partially offset the total societal cost through five years postpartum, but they could result in higher long-term costs due to worse child health.

Non-Hispanic Black mothers

We estimated that the total cost of exposure to untreated MMHCs among non-Hispanic Black mothers and their children was $521 million for the 2019 birth cohort, projected from conception through five years postpartum. Assuming that 18.2%, or 8,448, of the 46,420 non-Hispanic Black mothers who gave birth in 2019 had an untreated MMHC, this amounts to nearly $62,000 per affected mother–child pair over the first five years of the birth cohort's lives.[1,11] Mothers incurred 65% of total costs, and their children incurred 35%.

Table 4. Model results for costs of untreated MMHCs (in millions of dollars) for the 2019 birth cohort: Non-Hispanic Black mothers

Outcome	Total	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Maternal costs							
Productivity losses	189.4	69.1	24.1	25.1	26.3	27.5	28.7
Suicide	2.4	0.9	0.3	0.3	0.3	0.4	0.4
Preeclampsia[a]	8.8	8.8	0.0	0.0	0.0	0.0	0.0
Cesarean delivery[a]	9.5	9.5	0.0	0.0	0.0	0.0	0.0
Peripartum stay[a]	5.3	5.3	0.0	0.0	0.0	0.0	0.0
Non-obstetric health expenditures	117.5	42.9	14.9	15.6	16.3	17.1	17.8
Benefit receipt	5.0	0.9	0.9	0.9	0.9	0.9	0.9
Child costs							
Preterm birth[a]	74.0	74.0	0.0	0.0	0.0	0.0	0.0
Suboptimal breastfeeding[a]	1.0	1.0	0.0	0.0	0.0	0.0	0.0
SIDS	0.5	0.5	0.0	0.0	0.0	0.0	0.0
Behavioral and developmental disorders	93.9	15.1	15.8	16.5	17.2	18.0	18.8
Obesity	0.6	0.1	0.1	0.1	0.1	0.1	0.1
Asthma	11.4	1.8	1.9	2.0	2.1	2.2	2.3
Injury	3.3	1.2	0.4	0.4	0.5	0.5	0.5
Emergency department visits	0.8	0.3	0.1	0.1	0.1	0.1	0.1
Non-attendance of well-child care visits	-2.0	-0.7	-0.2	-0.3	-0.3	-0.3	-0.3
Total societal costs for one birth cohort (millions of $)	**521**	**231**	**58**	**61**	**64**	**67**	**69**
Cost per mother–child pair with an MMHC in the first year postpartum ($)	**27,308**						
Cost per mother–child pair with an MMHC in the first two years postpartum ($)	**34,209**						
Cost per mother–child pair with an MMHC, averaged over the first two years postpartum ($)	**17,105**						
Cost per mother–child pair with an MMHC in the first five years postpartum ($)	**61,671**						
Cost per mother–child pair with an MMHC, averaged over the six years from conception through the first five years postpartum ($)	**10,279**						

[a] Costs only apply to Year 0, the year of conception and birth. We assumed that other costs are incurred annually through Year 5.
MMHCs = maternal mental health conditions; SIDS = sudden infant death syndrome.

Maternal outcomes

- *Productivity.* Among non-Hispanic Black mothers, the expected incremental per capita cost of increased job absenteeism, presenteeism, and unemployment due to untreated MMHCs was $8,179 in the birth year. In total, we estimated that productivity losses due to untreated MMHCs cost $69.1 million in the birth year, or $189.4 million through five years postpartum.
- *Suicide.* Untreated MMHCs led to an estimated 23 excess deaths by suicide per year, with an expected incremental per capita cost of $107 and a total societal cost of $0.9 million in the birth year. In total, this increased risk of suicide costs $2.4 million through five years postpartum.
- *Maternal obstetric health expenditures.* Untreated MMHCs were associated with an additional 490 cases of preeclampsia, an additional 777 deliveries by cesarean section, and an additional 2,196 peripartum inpatient days in the birth year. The expected incremental per capita costs of increased risk of preeclampsia, cesarean section delivery, and long peripartum stay due to exposure to untreated MMHCs were $1,042, $1,125, and $627, respectively, and in total, they amounted to $23.6 million in excess costs in the birth year.
- *Maternal non-obstetric health expenditures.* Untreated MMHCs were associated with an additional $5,078 in per capita non-obstetric health expenditures each year, which amounted to $42.9 million in the birth year or $117.5 million through five years postpartum.
- *Benefit receipt.* Untreated MMHCs were associated with an annual increase of 42 mothers receiving SNAP benefits, 42 mothers receiving WIC benefits, 50 mothers receiving Medicaid benefits, and 42 mothers receiving TANF benefits each year. We estimated that the expected incremental per capita cost of increased use of public assistance was $107 per year, which amounted to $0.9 million in excess costs in the birth year, or $5 million through five years postpartum.

Child outcomes

- *Preterm birth.* Among children of non-Hispanic Black mothers, untreated MMHCs were associated with 1,488 additional cases of preterm birth and an expected incremental per capita cost of $8,759 in the birth year. This amounted to $74 million in excess costs in the birth year.
- *Suboptimal breastfeeding.* Untreated MMHCs were associated with 482 additional cases of suboptimal breastfeeding and an expected incremental per capita cost of $118 in the birth year. This amounted to $1 million in excess costs in the birth year.
- *SIDS.* Untreated MMHCs were associated with 21 additional cases of SIDS and an expected incremental per capita cost of $59 in the birth year. This amounted to $0.5 million in excess costs in the birth year.
- *Behavioral and developmental disorders.* Untreated MMHCs were associated with an additional 1,165 children diagnosed with a behavioral or developmental disorder each year, with an expected incremental per capita cost of $1,787. This amounted to a total societal cost of $15.1 million in the birth year, or $93.9 million through five years postpartum.
- *Obesity.* Untreated MMHCs were associated with 515 additional cases of child obesity each year, with an expected incremental per capita cost of $12. This amounted to a total societal cost of $0.1 million in the birth year, or $0.6 million through five years postpartum.
- *Asthma.* Untreated MMHCs were also associated with 576 additional cases of child asthma each year, with an expected incremental per capita cost of $213. This amounted to a total societal cost of $1.8 million in the birth year, or $11.4 million through five years postpartum.

- *Injury.* Untreated MMHCs were associated with 151 additional child injuries each year, with an expected incremental per capita cost of $142. This amounted to a total societal cost of $1.2 million in the birth year, or $3.3 million through five years postpartum.
- *Emergency department visits.* Untreated MMHCs were associated with 481 additional emergency department visits each year, with an expected incremental per capita cost of $36. This amounted to a total societal cost of $0.3 million in the birth year, or $0.8 million through five years postpartum.
- *Missed well-child care visits.* Untreated MMHCs were associated with 1,369 missed well-child visits, with an expected reduction in the incremental per capita cost of $68. This amounted to a total societal cost reduction of $0.7 million in the birth year, or $2 million through five years postpartum. As with the broader Texas population, missed well-child visits partially offset the total societal cost through five years postpartum, but they could result in higher long-term costs due to worse child health.

Hispanic mothers

We estimated that the total cost of exposure to untreated MMHCs among Hispanic mothers and their children was $928 million for the 2019 birth cohort, projected from conception through five years postpartum. Assuming that 12%, or 21,421, of the 178,509 Hispanic mothers who gave birth in 2019 had an untreated MMHC, this amounts to more than $43,000 per affected mother–child pair over the first five years of the birth cohort's lives.[1,11] Mothers incurred 55% of total costs, and their children incurred 45%.

Table 5. Model results for costs of untreated MMHCs (in millions of dollars) for the 2019 birth cohort: Hispanic mothers

Outcomes	Total	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Maternal costs							
Productivity losses	229.0	83.6	29.1	30.4	31.8	33.2	34.7
Suicide	3.6	1.3	0.5	0.5	0.5	0.5	0.5
Preeclampsia[a]	16.6	16.6	0.0	0.0	0.0	0.0	0.0
Cesarean delivery[a]	22.7	22.7	0.0	0.0	0.0	0.0	0.0
Peripartum stay[a]	13.5	13.5	0.0	0.0	0.0	0.0	0.0
Non-obstetric health expenditures	211.0	77.0	26.8	28.0	29.3	30.6	32.0
Benefit receipt	10.3	1.6	1.7	1.8	1.9	2.0	2.1
Child costs							
Preterm birth[a]	149.2	149.2	0.0	0.0	0.0	0.0	0.0
Suboptimal breastfeeding[a]	2.5	2.5	0.0	0.0	0.0	0.0	0.0
SIDS	0.5	0.5	0.0	0.0	0.0	0.0	0.0
Behavioral and developmental disorders	238.9	38.4	40.1	41.9	43.8	45.8	47.9
Obesity	2.2	0.4	0.4	0.4	0.4	0.4	0.4
Asthma	17.5	2.9	3.0	3.1	3.2	3.3	3.4
Injury	7.1	2.6	0.9	0.9	1.0	1.0	1.1
Emergency department visits	8.1	3.0	1.0	1.1	1.1	1.2	1.2
Non-attendance of well-child care visits	-4.9	-1.8	-0.6	-0.7	-0.7	-0.7	-0.7
Total societal costs for one birth cohort (millions of $)	**928**	**414**	**103**	**107**	**112**	**117**	**123**
Cost per mother–child pair with an MMHC in the first year postpartum ($)	**19,327**						
Cost per mother–child pair with an MMHC in the first two years postpartum ($)	**24,131**						
Cost per mother–child pair with an MMHC, averaged over the first two years postpartum ($)	**12,066**						
Cost per mother–child pair with an MMHC in the first five years postpartum ($)	**43,322**						
Cost per mother–child pair with an MMHC, averaged over the six years from conception through the first five years postpartum ($)	**7,220**						

[a] Costs only apply to Year 0, the year of conception and birth. We assumed that other costs are incurred annually through Year 5.
MMHCs = maternal mental health conditions; SIDS = sudden infant death syndrome.

Maternal outcomes

- *Productivity.* Among Hispanic mothers, the expected incremental per capita cost of increased job absenteeism, presenteeism, and unemployment due to untreated MMHCs was $3,903 in the birth year. In total, we estimated that productivity losses due to untreated MMHCs cost more than $83 million in the birth year, or $229 million through five years postpartum.
- *Suicide.* Untreated MMHCs led to an estimated 38 excess deaths by suicide per year, with an expected incremental per capita cost of suicide of $61 across all Hispanic mothers in the birth year. In total, this increased risk of suicide among Hispanic mothers costs $1.3 million per year, or $3.6 million through five years postpartum.
- *Maternal obstetric health expenditures.* Untreated MMHCs were associated with an additional 922 cases of preeclampsia, an additional 1,864 deliveries by cesarean section, and an additional 5,570 peripartum inpatient days, all of which occur in the birth year. The expected incremental per capita costs of increased risk of preeclampsia, cesarean section delivery, and long peripartum stay due to exposure to untreated MMHCs were $775, $1,060, and $630, respectively, and in total they amounted to $52.8 million in excess costs in the birth year.
- *Maternal non-obstetric health expenditures.* Untreated MMHCs were associated with $3,595 in excess per capita non-obstetric health expenditures each year, which amounted to $77 million in the birth year or $211 million through five years postpartum.
- *Benefit receipt.* Untreated MMHCs were associated with an annual increase of 74 mothers receiving SNAP benefits, 75 mothers receiving WIC benefits, 89 mothers receiving Medicaid benefits, and 74 mothers receiving TANF benefits each year. We estimated that the expected incremental per capita cost of increased use of public assistance was roughly $75 per year, which amounted to $1.6 million in excess costs in the birth year, or $10.3 million through five years postpartum.

Child outcomes

- *Preterm births.* Among children of Hispanic mothers, untreated MMHCs were associated with 2,999 additional cases of preterm birth and an expected incremental per capita cost of $6,965 in the birth year. This amounted to $149.2 million in excess costs in the birth year.
- *Suboptimal breastfeeding.* Untreated MMHCs were associated with 1,264 additional cases of suboptimal breastfeeding and an expected incremental per capita cost of $117 in the birth year. This amounted to $2.5 million in excess costs in the birth year.
- *SIDS.* Untreated MMHCs were associated with 21 additional cases of SIDS and an expected incremental per capita cost of $23 in the birth year. This amounted to $0.5 million in excess costs in the birth year.
- *Behavioral and developmental disorders.* Untreated MMHCs were associated with an additional 2,956 children diagnosed with a behavioral or developmental disorder each year, with an expected incremental per capita cost of $1,793. This amounted to a total societal cost of $38.4 million in the birth year, or $238.9 million through five years postpartum.
- *Obesity.* Untreated MMHCs were associated with 1,628 additional cases of child obesity each year, with an expected incremental per capita cost of $19. This amounted to a total societal cost of $0.4 million in the birth year, or $2.2 million through five years postpartum.

- *Asthma.* Untreated MMHCs were associated with 964 additional cases of child asthma each year, with an expected incremental per capita cost of $135. This amounted to a total societal cost of nearly $2.9 million in the birth year, or just over $17.5 million through five years postpartum.
- *Injury.* Untreated MMHCs were associated with 322 additional child injuries each year, with an expected incremental per capita cost of $121. This amounted to a total societal cost of $2.6 million in the birth year, or $7.1 million through five years postpartum.
- *Emergency department visits.* Untreated MMHCs were associated with 4,199 additional emergency department visits per year, with an expected incremental per capita cost of $140. This amounted to a total societal cost of $3 million in the birth year, or $8.1 million through five years postpartum.
- *Missed well-child care visits.* Untreated MMHCs were associated with 3,470 missed well-child visits each year, with an expected reduction in the incremental per capita cost of $84. This amounted to a total societal cost reduction of $1.8 million in the birth year, or $4.9 million through five years postpartum. As with the broader Texas population, missed well-child visits partially offset the total societal cost through five years postpartum, but they could result in higher long-term costs due to worse child health.

DISCUSSION

In this study, we estimated the total societal cost of untreated MMHCs in Texas to inform financial and policy perspectives on ways to improve screening for and treatment of MMHCs. We also quantified the variation in the economic impact of MMHCs among non-Hispanic White, non-Hispanic Black, and Hispanic mothers and their children. Finally, we quantified the total cost of MMHCs among mothers enrolled in Texas Medicaid for Pregnant Women and their children.

Using the framework we developed in Luca et al. (2020), we estimated that untreated MMHCs in Texas cost $2.2 billion for the 2019 birth cohort, which amounts to more than $44,000 per mother–child pair through five years postpartum.6 We found that nearly half of the total costs are incurred in the birth year and that, on average, untreated MMHCs cost $7,411 per pair per year. We also found that 55% of the costs of untreated MMHCs were attributable to maternal outcomes, and that 45% were attributable to child outcomes.

We estimated that the total cost of MMHCs for all births covered by Texas Medicaid for Pregnant Women was $962 million (or $31,071 per pair), excluding costs for productivity losses, maternal suicide, and SIDS. Among the Medicaid population, mothers incurred 35% of total costs, primarily driven by non-obstetric health expenditures ($276 million). Their children incurred 65% of total costs, which were primarily driven by child behavioral developmental disorders ($345 million) and preterm birth ($231 million). In Texas, coverage through Medicaid for Pregnant Women ends after 60 days postpartum, and 57% of costs occur beyond the birth year, so Medicaid does not directly bear many of these costs. If a mother cannot afford to self-pay or purchase health insurance, the health care system could bear the costs of maternal outcomes incurred beyond 60 days postpartum, whereas insurers might bear these costs for mothers who can purchase insurance through the Affordable Care Act Marketplace. Similarly, the health care system might bear the costs of child outcomes if parents do not meet the income eligibility requirements for Medicaid or the Children's Health Insurance Program. Medicaid could bear these costs if parents do meet the income eligibility requirements.

Finally, we found disparities in the economic impact of untreated MMHCs among women of different races and ethnicities. We estimated that the total cost of untreated MMHCs in Texas through five years postpartum was $599 million among non-Hispanic White mothers (or $43,106 per pair), $521 million among non-Hispanic Black mothers (or $61,671 per pair), and $928 million among Hispanic mothers (or $43,322 per pair). The distribution of costs for non-Hispanic White and Hispanic pairs was consistent with the distribution of costs among all Texas women, but among non-Hispanic Black pairs, mothers incurred 65% of total costs and their children incurred 35%.

Limitations

This study had several limitations similar to those of Luca et al. (2020).[6] First, we designed the model to focus on a six-year period spanning from conception through five years postpartum to highlight the immediate impacts of untreated MMHCs in Texas. We recognize, however, that MMHCs can have longer-term implications for mother and child, such as reduced educational attainment and worse health into adolescence and adulthood. Second, the estimated prevalence of MMHCs in Texas did not account for any increased prevalence of MMHCs resulting from the COVID-19 pandemic. Third, we did not account for the impact of MMHCs on others in the household besides the mother–child pair, including

fathers and other caregivers, though we recognize that nonmaternal caregivers can have mental health conditions as well. Fourth, most of the evidence on the relationship between untreated MMHCs and maternal and child outcomes focused on maternal depression, primarily in the postpartum period. If maternal anxiety affects outcomes independently of depression, and mothers who are both anxious and depressed have worse outcomes than mothers who have depression alone, the model might underestimate the cost of untreated MMHCs.[15] For these reasons, model results should be interpreted as conservative estimates of the total cost of untreated MMHCs in Texas.

In this study, we did not explore the economic case for treatment, examine the costs of treating MMHCs, or estimate potential cost savings that could result from treating MMHCs. Our model did not account for various treatment options and did not differentiate between untreated MMHCs and inadequately treated MMHCs. This study did not analyze primary data, such as medical records and administrative data. Rather, our model used inputs from peer-reviewed literature and publicly available secondary data sources.

Although disparities exist in how MMHCs affect mothers in many different racial and ethnic groups, we could only estimate costs for non-Hispanic White, non-Hispanic Black, and Hispanic mothers due to a lack of available data and consistency in the definitions of other racial and ethnic subgroups. Due to a lack of available data, we also based some estimates on national or state-level estimates that are not unique to non-Hispanic White, non-Hispanic Black, and Hispanic mothers. Finally, we could not parse out the effects of confounders such as socioeconomic status, systemic racism, and other unobserved confounders using available literature. For these reasons, we recommend interpreting results of the analysis of health disparities by race and ethnicity with caution.

Policy implications

Legislators and insurers have paid increased attention to the effects of MMHCs, as evidenced by Texas HHSC's strategic plan to address postpartum depression.[5] Continued efforts should ensure access to equitable and consistent screening for MMHCs as well as expansion of access to effective and affordable treatment options through at least the first year postpartum. Our model shows that the total societal cost of untreated MMHCs in Texas remains high ($2.2 billion through five years postpartum) and that employers (through reduced maternal productivity) and health insurers (through higher maternal and child health care costs) bear most of these costs. In addition, our model shows that there are substantial disparities in the impact of MMHCs on women of different races and ethnicities, suggesting a need for additional targeted intervention for women who are most affected by MMHCs: non-Hispanic Black and Hispanic women.

Improving access to screening and treatment for MMHCs among women of all races and ethnicities will help increase women's productivity, reduce the utilization of high-cost health care for mother and child, and decrease use of public assistance, which would ultimately save Texas HHSC, employers, insurers, and the health care system money and would bolster the health of generations to come.

Appendix A.

Description of Literature Review and Search Terms

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This appendix describes our literature review process, which focused on studies that address outcomes shown in the literature and recognized by subject experts as linked to MMHCs. We developed our search terms with the support of a reference librarian at Mathematica. We identified original articles published in peer-reviewed scientific journals by searching the following library databases: Ovid MEDLINE, CINAHL, Cochrane, APA PsycInfo, and Scopus. To identify papers specifically related to MMHCs, we performed the search in each database using the subject headings for "Affective Disorders," "Anxiety Disorders," "Postpartum Depression," "Major Depression," and "Post-Traumatic Stress" along with the subject headings for "Pregnancy" or "Mothers." In databases that do not use subject headings, we used keywords such as "pregnant," "antenatal," "perinatal," "prenatal," "prepartum," "postpartum," "maternal," and "mother," along with keywords for mood and anxiety disorders, such as "depression," "depressive," "post-traumatic stress," "PTSD," "anxiety," and "mood disorder." We used the search terms for MMHCs in conjunction with each set of search terms listed in Table A.1 to identify articles for each outcome. To ensure that we had the most current and relevant evidence, we searched for articles published between 2008 and 2020 for Texas-specific estimates. We also refreshed our prior 2008 to 2018 national searches to include articles published through 2020.

To augment our literature search, we reviewed supplementary studies from two other sources: (1) the references of articles found through our literature search and (2) the references of other reports and publications that examine the costs and effects of MMHCs, such as our previous study on the cost of MMHCs (Luca et al. 2020).[6] We also considered grey literature and reports recommended by the St. David's Foundation and Texans Care for Children.

After conducting these searches, we reviewed the article titles to ascertain relevance, dropping any irrelevant articles. For example, our search returned many studies conducted in developing countries and studies on screening or treatment for MMHCs, rather than outcomes. We then reviewed the abstracts and full text of the remaining articles to determine which articles contained impact estimates that we could use in the model. We included original studies that analyzed MMHCs as the main exposure of interest, as well as systematic reviews. We developed inclusion criteria to guide our selection of articles during this review as follows:

The study should use adequate controls to strengthen the evidence that the reported effects were due to MMHC exposure rather than to potentially confounding factors. To ensure the high quality of the articles used to inform our model, we excluded studies if they did not control for confounders, such as demographic characteristics, or use a matched-comparison group design. Included studies do not need to demonstrate impacts of a certain magnitude or in a certain direction; they only need to meet high methodological standards, to ensure that the estimated impacts are credible.

Outcomes should be relevant to the six-year timeframe of the model. Some papers mentioned outcomes, such as those related to child education and cognitive development, which would not likely affect costs during the time frame of our model.[i] We therefore excluded papers that focused solely on longer term outcomes.

[i] For example, evidence suggests that untreated MMHC is linked to lower cognitive scores in children, which may lead to lower educational attainment and future earnings. However, these costs would not likely affect our model because we focused on cost effects within five years postpartum.

The study should quantify outcomes in monetary terms. For an outcome to be relevant for our model, we need to quantify its impact monetarily. Thus, we excluded outcomes such as mother-infant interactions that may not have significant impacts on societal costs within our study time frame.

Results

We identified 1,023 records through our database searches, 1,322 records through grey literature searches and snowballing, and two additional records based on the recommendation of the St. David's Foundation and its partners, which dropped to 1,927 articles after excluding duplicates. After title and abstract screening, we selected 75 articles and reports for full-text analysis. We subsequently excluded 46 articles and reports after additional review based on lack of rigor, inapplicability of timeframe, or the other exclusion criteria above.

After our review, we selected 29 new articles in addition to 82 articles used in our prior study to be included in the review, for a total of 111 articles. Figure A1 shows our Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart for this study.

Next, we extracted impact estimates for the relevant outcomes. If we identified systematic reviews or meta-analyses, we used those to inform a range of estimates. To ensure that we use the most recent estimates, we prioritized studies published after 2018 with a population in the United States and studies published after 2008 with a population in Texas. If we found multiple studies with high-quality estimates for an outcome, we prioritized those that focused on women and children in Texas or those that used data collected in the U.S. or other high-income countries after 2010. For a few outcomes that had limited evidence in the literature published over the past two years, we referred to the articles we used in Luca et al. 2020.

Figure A.1. Prisma flowchart of article selection

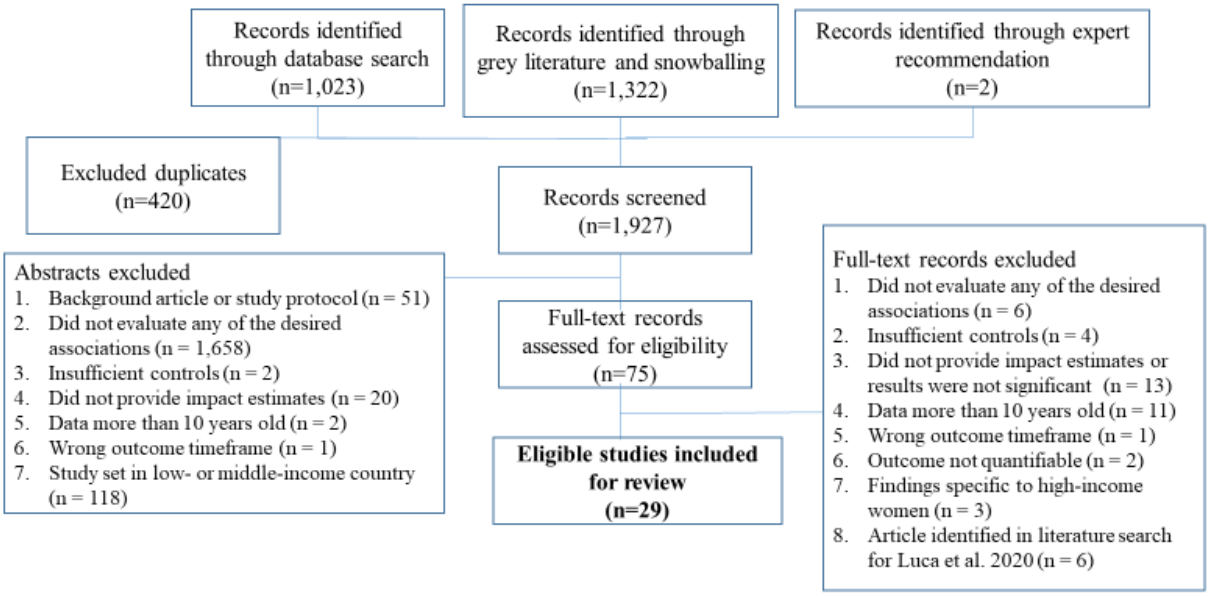

Table A.1. Search terms used in literature review

Outcomes	Search terms
Maternal outcomes	
Work	absentee* employ* productivity work
Health	caesarean “emergency care” “emergency department” “health care cost*” “health care expenditure*” “health services utilization" hospitalization* “length of stay” “maternal health” pre-eclampsia “primary care” psychiatric psychosis readmission*
Benefit Receipt	“Medicaid” “Temporary Assistance of Needy Families” “TANF” “Supplemental Assistance Nutrition Program” “SNAP” “Special Supplemental Nutrition Program for Women Infants and Children” “WIC”
Suicide	“self harm” “self-injurious behavior” suicid*

Outcomes	Search terms
Child outcomes	
Health	asthma “attention deficit/hyperactivity disorder” autism-spectrum-disorder behavioral-problem* breastfeeding child* n/3 health conduct-problem* conduct-disorder* depression-or-anxiety-problem” developmental-delay* “emergency care” “emergency department” “emergency hospital” feeding growth “health care cost*” “health care expenditure*” “health services utilization” height hospitalization* immunization* infant n/3 health intellectual-disabilit* learning-disabilit* “neonatal intensive care” “otitis media” “preterm birth” “preventive care” “preventive visit*” “primary care” readmission* “regular checkup*” size speech-problem* “sudden infant death” Tourette-syndrome underweight vaccination* weight “well baby care” “well baby visit*” “well care” “well child care” “wellbaby care” “wellbaby visit*” “wellchild care”

Outcomes	Search terms
Maltreatment/neglect	child* n/3 abuse “corporal punishment” maltreatment mistreatment neglect
Low birthweight/preterm birth	“fetal distress” “fetal growth” “low birthweight” “premature birth” “premature delivery” “preterm birth” “preterm birth” “preterm delivery” “preterm delivery”
Child development	“infant development”

Notes: We used these search terms, along with the search terms for MMHCs, including the following: “Affective Disorders,” “Anxiety Disorders,” “Postpartum Depression,” “Major Depression,” and “Post-Traumatic Stress” along with the subject headings for “Pregnancy” or “Mothers.” In databases that do not use subject headings, we used keywords such as “pregnant,” “antenatal,” “perinatal,” “prenatal,” “prepartum,” “postpartum,” “maternal,” and “mother,” along with keywords for mood and anxiety disorders, such as “depression,” “depressive,” “post-traumatic stress,” “PTSD,” “anxiety,” and “mood disorder.”

* is a truncation search feature that enables users to search for any words that begin with those letters.

“n/3” is a proximity search term that means “within three words of.”

Appendix B.

Prevalence of MMHCs

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Outcome	Data source	Study population	Data year	Subgroup	Point estimate (95% CI)	Source
Postpartum depression and postpartum depressive symptoms	Pregnancy Risk Assessment Monitoring System	Women across 31 states with a recent live birth (surveyed 2–6 months postpartum)	2018	National	13.2% (12.6%–13.8%)	1
				Non-Hispanic White	11.4% (10.7%–12.1%)	1
				Non-Hispanic Black	18.2% (16.5%–19.9%)	1
				Hispanic	12.0% (10.8%–13.2%)	1
				Medicaid	17.2% (16.3%–18.2%)	1

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Appendix C.

Effects of Exposure to MMHCs

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Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
Maternal outcomes								
Remission from MMHC without treatment	Postpartum depression	Multiple (Review)	Studies published from 1985 to 2012	23 studies in the final review	Around 30% of mothers with postpartum depression continued to have major depression during their child's first year of life, absent treatment.	Systematic review of screened longitudinal studies that have examined the course of postpartum depression following PRISMA guidelines. We used 30% for the main model and the range of estimates (20–60%) from the review to inform the sensitivity analyses.	Y*	8
Absenteeism	Clinically diagnosed depression (self-reported)	Workers in 8 countries, including the US	2012	n = 1,000 per country	Annual cost of absenteeism per worker with depression is $410 (adjusted to 2019 $).	Secondary analysis on data collected in the Global IDEA (Impact of Depression in the Workplace in Europe Audit) survey to examine the effects of depression on presenteeism and absenteeism across 8 countries, controlling for country-specific contextual factors and other factors associated with the outcomes. We used the US-specific estimates to inform the model.	Y	16
Absenteeism	Major depressive order	Low-income mothers ages 18–35 and being unmarried, receiving Medicaid, or having incomes less than 300% of the Federal Poverty Level	2006–2011	n = 20,531	Average annual cost of absenteeism per mother with depression is $619 (adjusted to 2019 $).	Analysis of the likelihood of employment and workdays missed due to major depressive disorder among mothers using data from the Medical Expenditure Panel Survey, using logistic models controlling for comorbidities, demographics, region, and year. Although their focus was on low-income mothers, they also projected cost estimates to the aggregate population, which are the estimates we use in our model.	Y	17

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
Absenteeism	Major depression (measured as reporting 5 or more of the 9 Diagnostic and Statistical Manual–III revised criteria for major depression in the past 2 weeks)	Depressed patients	1996–1997	n = 479	Average annual cost of absenteeism per mother with depression is $899 (adjusted to 2019 $).	Randomized trial examining the impact of improved primary care depression management on absenteeism and presenteeism. A total of 479 patients were recruited from 12 community primary care practices across the US, and depression was measured as reporting 5 or more of the 9 Diagnostic and Statistical Manual–III revised criteria for major depression in the past 2 weeks. Absenteeism was measured as the total number of work hours lost due to illness or doctor visits over the past 4 weeks.	Y	18
Absenteeism	Major depressive disorder (DSM-IV criteria and ICD-9 codes)	Individuals ages 16–64	2005 and 2010	n = 1,461,640	Average annual cost of absenteeism per person with depression is $1,792 (adjusted to 2019 $).	Case-control study where individuals were matched 1-1 with controls using propensity score matching methods and national survey and administrative claims data from 2005 and 2010 to estimate the incremental burden of individuals with major depressive disorder. We used the 2010 estimates to inform the model.	Y	19
Presenteeism	Depression	Workers in 8 countries, including the US	2012	n = 1,000 per country	Annual cost of absenteeism per worker with depression is $410 (adjusted to 2019 $).	Secondary analysis on data collected in the Global IDEA (Impact of Depression in the Workplace in Europe Audit) survey to examine the effects of depression on presenteeism and absenteeism across 8 countries, controlling for country-specific contextual factors and other factors associated with the outcomes. We used the US-specific estimates to inform the model.	Y	16

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
Presenteeism	Major depression (measured as reporting 5 or more of the 9 Diagnostic and Statistical Manual–III revised criteria for major depression in the past 2 weeks)	Depressed patients	1996–1997	n = 479	Average annual cost of presenteeism per mother with depression is $2,879 (adjusted to 2019 $).	Randomized trial examining the impact of improved primary care depression management on absenteeism and presenteeism. 479 patients were recruited from 12 community primary care practices across the US, and depression was measured as reporting 5 or more of the 9 Diagnostic and Statistical Manual–III revised criteria for major depression in the past 2 weeks. Productivity was self-rated by employee as "productivity as effectiveness at work over the past 2 weeks" on a scale of 0 (nothing at all accomplished) to 10 (best possible work performance).	Y	18
Presenteeism	Major depressive disorder (DSM-IV criteria and ICD-9 codes)	Individuals ages 16–64	2005 and 2010	n = 1,461,640	Average annual cost of presenteeism per person with depression is $5,804 (adjusted to 2019 $).	Case-control study where individuals were matched 1-1 with controls using propensity score matching methods and national survey and administrative claims data from 2005 and 2010 to estimate the incremental burden of individuals with major depressive disorder. We used the 2010 estimates to inform the model.	Y	19
Unemployment	Depression	Multiple (Review)	Studies published from 2002 to 2007	Number of studies not specified	Individuals with depression have a 20–40% greater likelihood of unemployment. We used the mean (30%) for the main model and the range for the sensitivity analyses.	A review of population-based, workplace, and clinical articles reporting on the magnitude and/or nature of depression's impact on work.	Y*	20
Suicide	Unipolar depression (hospital diagnoses)	Sweden psychiatric inpatient sample	1973–1995	n = 15,829 males and 23,353 females	The standardized mortality ratio for suicide for females with unipolar disorder was estimated to be 27.0.	Standardized mortality ratios by 5-year interval age at admission and time of follow-up were calculated using Poisson regression methods, controlling for calendar time of the first admission.	Y	21

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
Preeclampsia	Antenatal anxiety	Multiple (Review)	Studies published from 1979 to 2011	4 studies in the final review	OR = 3.30 (0.56 –19.37)	Systematic review of screened longitudinal studies that have examined associations with antenatal anxiety following PRISMA guidelines. DerSimonian and Laird random effects model were used to pool estimates of the odds ratios for binary outcomes and the weighted mean difference for continuous outcomes.	N	22
Preeclampsia	Maternal serious mental illness	Nationwide Inpatient Sample	2008-2014	n =5,518,766	Adjusted RR = 1.24 (1.21–1.28)	Multivariable logistic regressions adjusted for covariates: race, maternal age, insurance coverage (private insurance, Medicaid, or other), urban/rural hospital location, U.S. region, weekend, emergency department or elective admission, income, and admission year and other SMI diagnosis (MDD, BD, or schizophrenia).	Y	23
Preeclampsia	Perinatal mood and anxiety disorders	Nationwide Inpatient Sample	2006-2015	n = 7,906,820	The incidence of preterm birth was higher among women with perinatal mood and anxiety disorders (9.7 per 100 deliveries) than without (6.7 per 100 deliveries).	Adjusted multivariable logistic regression models estimated delivery-related outcomes with and without perinatal mood and anxiety disorders. Models included covariate adjustments for maternal age, payer, ZIP code income quartile, rural residence, and hospital region.	Y	24
Preeclampsia	Depression (clinically diagnosed based on ICD-9 codes) at time of delivery	Nationwide Inpatient Sample	1998–2005	n = 3,215,6438	OR = 1.57 (1.52–1.62)	Multivariate regression analysis examining delivery-related hospitalizations for select maternal and fetal outcomes by depression diagnosis, adjusting for age, insurance status, and hospital characteristics.	Y	25
Preeclampsia	Maternal mood and anxiety disorders diagnosed during first 20 weeks of pregnancy (self-reported and from clinical records)	Study sample recruited from women attending prenatal clinics at two hospitals in Seattle and Tacoma, WA	1996–2004	n = 2,601	Adjusted RR = 3.64 (1.13–11.68)	Generalized linear regression models were used to derive relative risk (RR) estimates, controlling for maternal age, maternal race/ethnicity, and pre-pregnancy body mass index. (Other confounders were evaluated and were excluded if they did not significantly alter model coefficients.)	Y	26

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
Cesarean delivery	Maternal anxiety	Mother-newborn pairs with deliveries in the Beaumont Health System.	2013-2014	n = 15,492	Adjusted OR = 1.59 (1.04–2.42)	Multinomial logistic regression compared each psychiatric diagnosis group to the unaffected referent pregnancies to calculate adjusted odds ratios controlling for baseline differences.	Y	27
Cesarean delivery	Depression	Nationwide Inpatient Sample	1998–2005	n = 3,215,6438	OR = 1.34 (1.30–1.37)	Multivariable regression analysis examining delivery-related hospitalizations for select maternal and fetal outcomes by depression diagnosis.	Y	25
Cesarean delivery	Anxiety and depression (state anxiety scores >= 40 on the State Trait Anxiety Inventory (STAI) and depression scores >= 12 on the Edinburgh Postnatal Depression Survey (EPDS) were considered positive)	Mother-newborn pairs with deliveries at the Penn State Milton S. Hershey Medical Center in Hershey, PA	2006–2009	n = 1,154	OR = 1.46 (1.02–2.09)	Associations of positive anxiety and depression screens at baseline with each other, demographic, maternity nursery stay–related variables, and health care use were assessed by using Chi-squared tests. A multivariable regression model was built to determine independent association with a positive anxiety screen at baseline. The relationship between anxiety and depression screen findings at baseline with breastfeeding duration was analyzed by using Kaplan-Meier methods	Y	28
Peripartum stay	Elevated CES-D (>= 16 on the CES-D)	Pregnant women recruited from obstetrics clinics in Michigan	1999–2003	n = 867	An elevated CES-D was associated with a longer peripartum stay of 0.26 (0.04–0.48) days.	Multivariable Poisson regression models was used to evaluate predictors of length of stay, adjusting for sociodemographic, antepartum, and obstetric factors.	Y	29
Health expenditures	Major depressive order	Low-income mothers between ages 18–35 and being unmarried, receiving Medicaid, or having incomes less than 300% of the Federal Poverty Level	2006–2011	n = 20,531	Average incremental out-of-pocket health expenditures due to depression are $340 and average incremental insurer expenditures due to depression are $1,727 (in 2019 $)	Analysis of the likelihood of employment and work days missed due to major depressive disorder among mothers using data from the Medical Expenditure Panel Survey, using logistic models controlling for comorbidities, demographics, region, and year. Although their focus was on low-income mothers, they also projected cost estimates to the aggregate population, which are the estimates we use in our model.	Y	17

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
SNAP receipt	Maternal depression (CES-D >= 16 assessed at 9 months postpartum)	Early Childhood Longitudinal Survey	2001–2003	n = 7,900	Probit coefficient = 0.23 (0.14–0.32)	Analysis of effects of maternal depression (assessed when the child was 9 months old) on benefit receipt (measured when the child is 2), using multivariate probit models, controlling for age, race/ethnicity, educational attainment, prenatal health, and family history of depression.	Y	30
WIC receipt	Maternal depression (assessed at 9 months postpartum)	Early Childhood Longitudinal Survey	2001–2003	n = 7,900	Probit coefficient = 0.18 (0.09–0.26)	Analysis of effects of maternal depression (assessed when the child was 9 months old) on benefit receipt (measured when the child is 2), using multivariate probit models, controlling for age, race/ethnicity, educational attainment, prenatal health, and family history of depression.	Y	30
Medicaid receipt	Maternal depression (assessed at 9 months postpartum)	Early Childhood Longitudinal Survey	2001–2003	n = 7,900	Probit coefficient = 0.24 (0.15–0.34)	Analysis of effects of maternal depression (assessed when the child was 9 months old) on benefit receipt (measured when the child is 2), using multivariate probit models, controlling for age, race/ethnicity, educational attainment, prenatal health, and family history of depression.	Y	30
TANF receipt	Maternal depression (assessed at 9 months postpartum)	Early Childhood Longitudinal Survey	2001–2003	n = 7,900	Probit coefficient = 0.20 (0.09–0.31)	Analysis of effects of maternal depression (assessed when the child was 9 months old) on benefit receipt (measured when the child is 2), using multivariate probit models, controlling for age, race/ethnicity, educational attainment, prenatal health, and family history of depression.	Y	30

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
Child outcomes								
Preterm birth	Perinatal depression	Population-based administrative data holdings in Alberta, Canada, covering > 99.0% of the general province population	2012-2015	n = 158,486	Adjusted RR: 1.49 – (1.411.58)	Multivariable log-binomial regression models were used to assess the risk of adverse outcomes associated with depression alone (compared to without depression), adjusting for age and parity.	Y	31
Preterm birth	Maternal serious mental illness	Nationwide Inpatient Sample	2008-2014	n =5,518,766	Adjusted RR = 1.19 (1.16–1.22)	Multivariable logistic regressions adjusted for covariates: race, maternal age, insurance coverage (private insurance, Medicaid, or other), urban/rural hospital location, U.S. region, weekend, emergency department or elective admission, income, and admission year and other SMI diagnosis (MDD, BD, or schizophrenia).	Y	23
Preterm birth	Depression assessed using either a clinical interview/diagnosis or a screening tool or scale at any time during pregnancy	Varies (review)	No publication date restriction	23 studies included in the final review	Among high-quality US studies, ORs for preterm birth ranged from OR = 0.71 (0.47–1.07) to OR = 4.97 (1.54–16.05)	Systematic review examining randomized and nonrandomized studies reporting the risk of adverse neonatal outcomes in pregnant women with untreated depression compared with pregnant women without depression.	Y*	32
Suboptimal breastfeeding	Postpartum depression and anxiety (self-reported)	Pregnancy Risk Assessment Monitoring System	2010–2011	n = 55,987	Any breastfeeding at 3 months: OR = 0.79 (0.70–0.88) Exclusive breastfeeding at 3 months: OR = 0.58 (0.50–0.68) Anxiety: OR = 0.87 (0.70–1.08) (any breastfeeding) OR = 0.92 (0.68–1.24) exclusive	Multivariable logistic regression was used to explore the association between a pre-pregnancy mental health visit and subsequent breastfeeding initiation as well as PPD and 3-month any and exclusive breastfeeding, controlling for adjusted for maternal race/ethnicity, age, marital status, pre-pregnancy mental health visit, and prenatal morbidity, abuse during or in the 12 months before pregnancy, and delivery type.	Y	33

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
SIDS	Antenatal (a year before delivery) and postnatal depression (6 months postpartum) (clinical diagnoses ICD-10 codes F32–F38)	Female patients registered in the UK General Practice Research Database	1987–2000	n = 169 cases; n = 662 controls	OR = 4.93 (1.10–22.05)	Case-control study of women with a live birth and subsequent SIDS death, compared to women with a live birth born the same year as the matched SIDS death, with infant survival for the first year of life.	Y	34
SIDS	Depression (EPDS >= 12 at 1 month postpartum)	All births registered in Sheffield, UK	1988–1993	n = 32,984	OR = 3.20 (1.46–6.99)	Case-control study comparing the rate of SIDS among mothers who had a high EPDS score versus those who did not, controlling for mothers' smoking status, residence in an area of poverty, preterm birth, maternal age, number of previous pregnancies, birth weight, number born (multiple births), maternal psychiatric history, year of birth (within study), month or season of birth, number of health visitor visits, baby's sex, mother's feeding intention (breast or bottle), mode of feeding at 1 month (breast or bottle), or maternal satisfaction with the infant's feeding.	Y	35
Any behavioral and developmental disorders based on total SDQ scores	Elevated prenatal depression and anxiety at 32 weeks gestation (top 15%) (Crown–Crisp Experiential Index) (EPDS >= 13)	Pregnant women residing in the Avon area of southwest England	Women who had an estimated date of delivery between April 1, 1991, and December 31, 1992	n = 7,944	Probable child mental disorder: OR = 1.8 (1.62–1.98)	Longitudinal cohort study showing that maternal prenatal anxiety and depression at 32 weeks predicted greater child emotional and behavioral problems independent of a range of confounders (maternal age and education, crowding as index of socioeconomic status, birth weight and gestational age of the child, child sex, maternal prenatal smoking and substance use, maternal postnatal depression and anxiety, paternal pre- and postnatal anxiety, and a parenting index).	Y	36

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
Child obesity	Maternal depression	Fragile Families and Child Wellbeing Study	2009	n = 2,965	Adjusted OR: 1.35 (1.06–1.72)	Stepped multivariate analyses estimated the relationships between child obesity and maternal depression, adjusting for sociodemographic characteristics, child health and health behaviors, maternal health factors, and maternal–child relationship factors.	Y	37
Child obesity	Perinatal depression (CESD≥16 or EPDS≥13)	Latina mothers and their infants from 2 medical centers in San Francisco, CA (sample excluded women with drugs or alcohol abuse, diabetes, polycystic ovarian syndrome, eating disorders, or any health problems that would affect breastfeeding.)	2006–2007	n = 181	Decreased chance of overweight (OR = 0.28, 95%; CI = 0.03 –0.92)	Longitudinal cohort study examining association between exposure to perinatal maternal depression and child weight-for-length z-score at 6,12, and 24 months, controlling for infant birth weight, breastfeeding status, maternal postnatal BMI, maternal ethnicity, maternal age and gestational age.	Y	38
Child obesity	Maternal anxiety and depression	Various (Review)	Studies published between 2000 and 2014	2,033 records identified and 20 studies included in final review	OR ranges from 0.28 (0.03–0.92) to 2.62 (1.02–6.70)	Systematic review. Majority of studies showed positive associations between maternal depressive symptoms and increased risks for preschooler obesity. Effect sizes varied depending on the time at which depression was measured (i.e., antenatal, postnatal, in isolation, or longitudinally).	Y*	39

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
Asthma	Elevated prenatal depression and anxiety at 32 weeks gestation (top 15%); anxiety was assessed using anxiety subscale of the Crown-Crisp Experiential Index. Depression was assessed using the EPDS	Pregnant women residing in the Avon area of southwest England	1991–1999	n = 5,810	OR = 1.64 (1.25–2.17)	Longitudinal cohort study showing that maternal prenatal anxiety and depression at 32 weeks predicted greater child emotional and behavioral problems independent of a range of confounders (maternal age and education, crowding as index of socioeconomic status, birth weight and gestational age of the child, child sex, maternal prenatal smoking and substance use, maternal postnatal depression and anxiety, paternal pre- and postnatal anxiety, and a parenting index).	Y	40
Asthma	Depression (Kessler-6 >= 13)	Nationally representative cohort of Australian children	2004–2011	n = 4,164	OR = 2.36 (1.61–3.45)	Longitudinal cohort study using logistic regression analyses, controlling for risk factors, including child gender, maternal smoking during pregnancy, maternal use of asthma medication during pregnancy, instrumental delivery (cesarean, vacuum extraction, and/or forceps), preterm birth (< 37 weeks), low birth weight (< 2,500 grams), not being breastfed, attending a child care center within the first year of life, maternal age, number of children in the family, living in a metropolitan area, and socioeconomic status.	Y	41
Child injury	Depression (CESD >= 16)	Study of Early Child Care (sample from 10 US cities)	Not given	n = 1,364	Beta = 1.06 (0.58, 1.54)	Use Poisson models to assess maternal depression's effect on child injuries from birth to age 3, controlling for family socioeconomic background, child sex, child temperament and externalizing behavior, and parenting behaviors.	Y	42

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source
Child injury	Depression (EPDS >= 9)	Japanese mothers/children	2012	n = 9,707	OR = 1.59 (1.24–2.04)	Cross-sectional study using logistic multivariate regression to analyze the association between postpartum depression and experience of any unintentional injury, falls, and near drowning of infant children (4 months), adjusted for maternal characteristics (age, marital status, employment status, psychiatric history such as depression), paternal characteristics (age), infant characteristics (single or multiple birth, birth weight, gestational age, living with siblings), and household characteristics.	Y	43
ED visit	Depression (CES-D >= 16)	Women in pediatric ED of University of Michigan health system	Not given	n = 176	ER visits in past 6 months: OR = 2.90 (1.18–8.70) Missed pediatric outpatient visits in past year: OR = 2.91 (1.18–8.70)	Cross-sectional study using multivariate regression models to examine the association of maternal depression in mothers of young children and child health care use, controlling for the presence of child chronic illness, child age, maternal age, years of maternal education, insurance status.	Y	44
ED visit	Maternal depression (diagnoses based on medical and claim records that are identified with the ICD-9 depression codes)	Kaiser Permanente membership system	1997–2002	n = 69,665	Adjusted rate ratios for ED visits = 1.23 (children 3–11 months), 1.31 (children 1–2 years), and 1.15 (children 3–5 years)	Retrospective, matched-cohort design, examining associations between parental depression and child health care use, controlling for child's gender, number of parents, and a risk-adjustment variable to account for possible morbidity differences between exposed and unexposed children. We focus on adjusted rate ratios for children under 5.	Y	45
Well-child care visits	Maternal depression at 2–4 months postpartum	National Evaluation of Healthy Steps for Young Children (HS)	1996–1998	n = 4,896	Age-appropriate well-child visits at 12 months: OR = 0.80 (0.67–0.95)	Logistic regression for dichotomous outcomes and Poisson regression for count outcomes) were used to estimate the effect of maternal depressive symptoms on children's receipt of care. Models were adjusted for baseline demographic characteristics, child health status, and other potential confounders.	Y	46

Parameter	Measure of MMHCs	Study population	Sample years	Sample size	Estimate and comments	Methods	p < 0.05	Source

* indicates that the majority of papers in the systematic review demonstrated statistically significant effects.

CESD = Center for Epidemiologic Studies Depression Scale; DSM = Diagnostic and Statistical Manual; ED = emergency department; EPDS = Edinburgh Postnatal Depression Scale; ED = emergency department; ICD = International Classification of Diseases; NHANES = National Health and Nutrition Examination Survey; OR = odds ratio; PPD = postpartum depression; PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses; SDQ = Strengths and Difficulties Questionnaire; SNAP = Supplemental Nutrition Assistance Program; STAI = State Trait Anxiety Inventory; TANF = Temporary Assistance for Needy Families; WIC = Women, Infants, and Children Program

Appendix D.

Studies and Data Sources Used to Inform the Cost Estimates Used in the Main Model

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Parameter	Sample Years	Estimate (in 2019 $)	Methodology	Citation/Data Source
Maternal outcomes				
Cost per unemployed woman	2019	40,144	To calculate the cost per unemployed woman, we assumed that women are paid for working 52 weeks per year. We multiplied 52 weeks by the median weekly earnings data from the Bureau of Labor Statistics (BLS).	47
Annual cost per case of suicide	2013	43,550	We obtained the direct costs of suicide, including ambulance transport, a coroner or medical examination, an emergency department visit, inpatient hospitalization, and nursing home care from Shepard et al (2017). We calculated the indirect costs of suicide by estimating the annual salary of women with children under age 6, based on data from BLS.	47, 48
Annual cost per case of preeclampsia	2011-2015	18,016	We calculated the cost of pre-eclampsia for mothers and their infants combined, where the infant is born full-term (37 weeks or greater), to avoid overlap in costs with preterm birth. The individual maternal and infant costs were obtained from Hao et al (2019), which used a matched control cost-of-illness methodology to estimate the direct health care cost burden of pre-eclampsia, controlling for maternal age, parity, obesity status, and mean Charlson Comorbidity Index scores.	49
Incremental cost per case of cesarean delivery	2010	12,179	We calculated the incremental cost of delivery via cesarean section as the additional medical cost of a cesarean delivery beyond that for a vaginal delivery.	50
Daily cost per inpatient stay	2017	2,416	We used the daily cost of an inpatient stay as a proxy for the cost of an additional day of a peripartum stay.	51
Cost per SNAP recipient	2016	1,720	We calculated the cost per person on SNAP from the Texas-specific estimate of monthly administrative costs, multiplied by 12 to get an estimate of annual per capita administrative costs. We added this to the total per capita annual benefit cost to obtain an estimate of the total annual cost.	52
Cost per WIC recipient	2019	605	We calculated the cost per person on WIC from the total issuance and administrative costs of WIC, divided by the total number of participants.	53, 54, 55
Cost per Medicaid beneficiary	2014	7,766	This estimate represents personal health care spending among all full- or partial-benefit Medicaid beneficiaries in 2014. The estimate reflects all health care goods and services consumed by Medicaid beneficiaries but excludes government administrative costs and the costs of government public health activities and investment.	56, 57

Parameter	Sample Years	Estimate (in 2019 $)	Methodology	Citation/Data Source
Cost per TANF recipient	2016	10,374	We calculated the cost per TANF case by dividing total federal TANF and state maintenance-of-effort expenditures, including both services and administrative costs, by the average number of TANF recipients in federal fiscal year 2016.	58, 59
Child outcomes				
Incremental cost per infant with preterm birth	2016	49,758	We based the incremental cost per infant born pre-term on Waitzman & Jalali (2019). Their report considered medical care for the affected child, maternal delivery costs, early intervention services, special education services, devices, and lost labor market productivity. To avoid double-counting costs and to adhere to our model timeframe (from conception to age 5 of the cohort), we included only medical care costs and early intervention costs incurred by the child from birth to age 5. These costs are counted only once in the model.	60
Incremental cost per infant due to suboptimal breastfeeding	2007	1,987	We based the incremental cost due to suboptimal breastfeeding on Bartick & Reinhold (2010), which estimated the excess cost of suboptimal breastfeeding, relative to the costs if 80% of US families could comply with the recommendation to exclusively breastfeed for 6 months. Excess costs included necrotizing enterocolitis, otitis media, gastroenteritis, hospitalization for lower respiratory tract infections, atopic dermatitis, SIDs, childhood asthma, childhood leukemia, type 1 diabetes mellitus, and childhood obesity. To avoid double-counting, we excluded the costs due to SIDS, asthma, and childhood obesity.	7
Annual cost per case of SIDS	2010	22,014	We used Fox et al's estimate of the economic costs associated with child death. Cost components include funeral expenditures, the value of outside help over the course of 6 months, out-of-pocket prescription costs, and the costs of absenteeism and presenteeism due to parental bereavement.	61
Incremental annual cost per child with behavioral and developmental disorders	2005–2006	12,990	We based our estimate on Beecham et al (2014), who examined the costs of child mental illness among young children. Incremental costs include health and mental health care, education, social care, parents' out-of-pocket expenses, parents' absence from work, and accommodation (excluding parental home).	62
Incremental annual cost per child with obesity	2012	248	We used Finkelstein et al's (2014) estimate of the incremental lifetime medical cost of an obese child relative to a normal weight child who maintains normal weight through adulthood, divided by an average life expectancy of 78.2 years.	63

Parameter	Sample Years	Estimate (in 2019 $)	Methodology	Citation/Data Source
Incremental annual cost per child with asthma	2010	3,056	We based the cost of asthma on Sullivan et al 2017, which presented a cross-sectional retrospective analysis of school-aged children (ages 6–17 years) in the nationally representative 2007–2013 Medical Expenditure Panel Survey. All-cause health care expenditures of school-aged children with asthma were compared with school-aged children without asthma, controlling for sociodemographic characteristics and comorbidities. Expenditures included medical, ED, inpatient, outpatient, and pharmacy costs. We excluded the cost of ED visits to avoid double-counting.	64
Annual cost per child injury	2010	8,018	We averaged the lifetime cost of a nonfatal injury that resulted in a hospitalization to children ages 0 through 5 who were hospitalized by an average life expectancy of 78.2 years to estimate the annual cost per child injury. Hospitalization costs are considered separately in the CDC database we used (Web-based Injury Statistics Query and Reporting System [WISQARS]).	65
Cost per ED visit for child	2014	714	We used an estimate of the average expenses per child under age 5 living in Census Region 3 (South). Expenses include both the ER facility fee and separately-billed doctor expenditures. To obtain a reasonable estimate of mean ED expenditures and remove noise created by surveyed patients who did not visit the ED, we restricted the data to expenditures of at least $100.	66
Cost per well-child care visit	2015	514	We used an estimate of the median expenses for an office-based provider visit for a child ages 0 through 5 with a perceived health status of Excellent, Very Good, Good, or Fair.	67

ED = emergency department; SNAP = Supplemental Nutrition Assistance Program; TANF = Temporary Assistance for Needy Families; WIC = Women, Infants, and Children Program

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Appendix E.

Model Inputs: Parameters and Costs Used to Estimate the Economic Impact of Untreated MMHCs Among 2019 Births

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In Table E.1, we show the specific point estimates we used in the main model and the ranges of estimates we used for sensitivity analyses. In Table E.2, we show the specific point estimates we used in subgroup analyses by maternal race and ethnicity. Finally, in Table E.3, we show the specific point estimates we used in the subgroup analysis by Medicaid enrollment.

Table E.1. Parameters and costs: All Texas births

Parameter	Point estimate (Range for sensitivity analyses)	Source
Baseline demographic characteristics		
Number of births[a,c]	377,397	11
Number of pregnancies[a,b,c]	595,881	68, 69
Prevalence of MMHCs (%)[b]	13.2 (12.6-13.8)	1
Other inputs		
Medical care inflation (%)[b]	4.53	10
Discount rate (%)[b]	3.00	9
Women who do not achieve remission without treatment by the end of the first year postpartum (%)[b,c]	33.3 (20.0-60.0)	8
Maternal outcomes		
Maternal productivity		
Labor force participation among women with children aged younger than 6 years (%)[b,c]	62.0	70
Per capita expected cost of job absenteeism ($)[b,c]	1,104 (415-1,792)	16,17,18,19
Per capita expected cost of job presenteeism ($)[b,c]	3,107 (410-5,804)	16,18,19
Baseline rate of unemployment (%)[b,c]	4.6	70
Likelihood of unemployment among women with MMHCs (%)	6.0 (5.5-6.4)	20
Cost per unemployed woman ($)[a,c]	40,144	47
Suicide		
Baseline incidence among women (%)[a,c]	0.0058	71
Likelihood of suicide among women with depression (%)[b,c]	0.136 (0.116-0.157)	21
Annual cost per case of suicide ($)[a,c]	43,550	47, 48
Maternal obstetric health		
Baseline incidence of pre-eclampsia (%)[b,c]	4.7	72
Likelihood of pre-eclampsia among women with MMHCs (%)[b,c]	8.8 (6.9-10.6)	22, 23, 24, 25, 26
Annual cost per case of pre-eclampsia ($)[b,c]	18,016	49
Baseline incidence of cesarean delivery (%)[a,c]	34.8	11
Likelihood of cesarean delivery among women with MMHCs (%)[b,c]	43.9 (41.7-45.9)	25, 27, 28
Incremental cost per case of cesarean delivery ($)[b,c]	12,179	50
Average peripartum stay (days)[b,c]	2.6	73
Average peripartum stay for women with MMHCs (days) [b,c]	2.86 (2.64-3.08)	29
Daily cost per inpatient stay ($)[b,c]	2,416	51
Maternal health expenditures		
Individual out-of-pocket expenditures for women without MMHCs ($)[b,c]	657 (418-697)	17

Parameter	Point estimate (Range for sensitivity analyses)	Source
Individual out-of-pocket expenditures for women with MMHCs ($)[b,c]	996 (635-1,058)	17
Individual insurer expenditures for women without MMHCs ($)[b,c]	3,853 (2,456-4,093)	17
Individual insurer expenditures for women with MMHCs ($)[b,c]	5,579 (3,556-5,926)	17
Benefit receipt		
SNAP receipt among families with children aged younger than 18 years (%)[a,c]	59.9	74
Likelihood of SNAP receipt among women with MMHCs (%)[a,c]	60.1 (60.0-60.2)	30
Cost per person receiving SNAP benefits ($)[a,c]	1,720	52
WIC receipt among women with children under age 5 (%)[a,c]	29.4	75
Likelihood of WIC receipt among women with MMHCs (%)[a,c]	29.6 (29.5-29.7)	30
Cost per person receiving WIC benefits ($)[a,c]	605	53, 54, 55
Medicaid receipt among women aged 15–44 years (%)[a,c]	47.5	12
Likelihood of Medicaid receipt among women with MMHCs (%)[a,c]	47.75 (47.65-47.84)	30
Cost per person receiving Medicaid benefits ($)[a,c]	7,766	56, 57
TANF receipt among families with children aged younger than 18 years (%)[a,c]	0.7	76, 77
Likelihood of TANF receipt among women with MMHCs (%)[a,c]	0.9 (0.8-1.0)	30
Cost per person receiving TANF benefits ($)[a,c]	10,374	58, 59
Child outcomes		
Preterm birth		
Baseline incidence (%)[a,c]	11.0	11
Likelihood among infants born to women with MMHCs (%)[a,c]	26.0 (8.1-38.1)	23, 31, 32
Incremental cost per infant with preterm birth ($)[b,c]	49,758	60
Suboptimal breastfeeding		
Baseline prevalence of exclusive breastfeeding through 3 months postpartum (%)[a,c]	45.8	78
Likelihood among women with MMHCs (%)[a,c]	40.0 (37.2-42.6)	33
Incremental cost per infant ($)[b,c]	1,987	7
SIDS		
Baseline incidence (%)[a,c]	0.038	79
Likelihood among babies born to mothers with MMHCs (%)[a,c]	0.16 (0.1-0.2)	34, 35
Annual cost per case ($)[b,c]	22,014	61
Child behavioral and developmental disorders		
Baseline prevalence among children (%)[a,c]	17.3	80

Parameter	Point estimate (Range for sensitivity analyses)	Source
Likelihood among children born to women with MMHCs (%)[a,c]	31.1 (28.0-34.3)	36
Incremental annual cost per child ($)[b,c]	12,990	62
Childhood obesity		
Baseline prevalence among children aged 2–4 years (%)[a,c]	14.6	81
Likelihood among children born to women with MMHCs (%)[a,c]	19.9 (4.6-30.9)	39, 38, 39
Incremental annual cost per child ($)[b,c]	248	63
Child asthma		
Baseline prevalence among children aged 0–4 years (%)[b,c]	3.8	82
Likelihood among children born to women with MMHCs (%)[b,c]	7.3 (6.1-8.5)	40, 41
Incremental annual cost per child ($)[b,c]	3,056	64
Child nonfatal injury		
Baseline incidence of nonfatal injury among children aged 0–4 years (%)[b,c]	8.2	83
Likelihood of injury among children born to women with MMHCs (%)[b,c]	10.6 (8.7-12.4)	42, 43
Annual cost per childhood injury ($)[b,c]	8,018	65
Child emergency department visits		
Baseline incidence among children aged 1–4 years (%)[b,c]	62.8	84
Likelihood among children born to women with MMHCs (%)[b,c]	78.9 (67.5-84.4)	44, 45
Cost per visit for child ($)[a,c]	714	66
Nonattendance of well-child care visits		
Baseline likelihood among children aged 0–6 years (%)[b,c]	35.0	85
Likelihood among children born to women with MMHCs (%)[b,c]	51.2 (35.0-61.0)	46
Cost per visit ($)[a,c]	514	67

Notes: MMHCs = maternal mental health conditions; SIDS = sudden infant death syndrome; SNAP = Supplemental Nutrition Assistance Program; TANF = Temporary Assistance for Needy Families; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

[a] Texas-specific estimate

[b] National estimate

[c] Estimate for all races, ethnicities, origins, and payers

Table E.2. Parameters and costs: Subgroup analysis for women enrolled in Texas Medicaid for Pregnant Women

Parameter	Point estimate	Source
Baseline demographic characteristics		
Number of births[a]	179,264	12
Number of pregnancies[a]	283,043	12, 68, 69
Prevalence of MMHCs (%)[a]	17.2	1
Other inputs		
Medical care inflation (%)	4.53	10
Discount rate (%)	3.00	9
Women who do not achieve remission without treatment by the end of the first year postpartum (%)	33.3	8
Maternal outcomes		
Maternal obstetric health		
Baseline incidence of pre-eclampsia (%)[b,c]	4.9	72
Likelihood of pre-eclampsia among women with MMHCs (%)	9.12	22, 23, 24, 25, 26
Annual cost per case of pre-eclampsia ($)[b]	18,016	49
Baseline incidence of cesarean delivery (%)[a,c]	34.2	12
Likelihood of cesarean delivery among women with MMHCs (%)	43.2	25, 27, 28
Incremental cost per case of cesarean delivery ($)	5,339	50
Average peripartum stay (days) [b,c]	2.6	73
Average peripartum stay for women with MMHCs (days)	2.86	29
Daily cost per inpatient stay ($)	2,119	51
Maternal health expenditures		
Individual out-of-pocket expenditures for women without MMHCs ($)	657	17
Individual out-of-pocket expenditures for women with MMHCs ($)	996	17
Individual insurer expenditures for women without MMHCs ($)	3,853	17
Individual insurer expenditures for women with MMHCs ($)	5,579	17
Benefit receipt		
Medicaid receipt among women aged 15–44 years (%)	47.5	12
Likelihood of Medicaid among women with MMHCs (%)	47.74	30
Cost per case of Medicaid ($)	7,766	56, 57
Child outcomes		
Preterm birth		
Baseline incidence (%)[a]	11.1	12
Likelihood among infants born to women with MMHCs (%)[a]	26.18	23, 31, 32
Incremental cost per infant with preterm birth ($)[a,c]	49,758	60
Suboptimal breastfeeding		
Baseline prevalence (%)[a,c]	45.8	78
Likelihood among women with MMHCs (%)[b,c]	40.0	33
Incremental cost per infant ($)[b,c]	1,987	7

Parameter	Point estimate	Source
Child behavioral and developmental disorders		
Baseline prevalence among children aged 2–8 years (%)[a,c]	17.3	86
Likelihood among children born to women with MMHCs (%)	31.1	36
Incremental annual cost per child ($)	12,990	62
Childhood obesity		
Baseline prevalence among children aged 2–5 years (%)[b,c]	14.6	81
Likelihood among children born to women with MMHCs (%)	19.9	39, 38, 39
Incremental annual cost per child ($)	248	63
Child asthma		
Baseline prevalence among children aged 0–4 years (%)[b,c]	3.8	82
Likelihood among children born to women with MMHCs (%)	7.32	42, 43
Incremental annual cost per child ($)	3,056	64
Child nonfatal injury		
Baseline incidence of nonfatal injury among children aged 0–4 years (%)[b,c]	8.2	83
Likelihood of injury among children born to women with MMHCs (%)	10.58	42, 43
Annual cost per childhood injury ($)	8,018	65
Child emergency department visits		
Baseline incidence among children aged 1–4 years (%)[b,c]	62.8	84
Likelihood among children born to women with MMHCs (%)	78.90	44, 45
Cost per child emergency department visit ($)[a]	383	66
Nonattendance of well-child care visits		
Baseline likelihood among children aged 0–6 years (%)[b,c]	35.0	87
Likelihood among children born to women with MMHCs (%)	51.2	46
Cost per visit ($)[a]	156	67

Notes: MMHCs = maternal mental health conditions; SIDS = sudden infant death syndrome; SNAP = Supplemental Nutrition Assistance Program; TANF = Temporary Assistance for Needy Families; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

[a] Texas-specific estimate

[b] National estimate

[c] Estimate for all races, ethnicities, origins, and payers

Table E.3. Parameters and costs: Subgroup analysis by maternal race and ethnicity

Parameters	Point Estimates			Source
	Non-Hispanic White Mothers	Non-Hispanic Black Mothers	Hispanic Mothers	
Baseline demographic characteristics				
Number of births[a]	121,899	46,420	178,509	11, 88
Number of pregnancies[a]	190,384	114,062	310,530	68, 89
Prevalence of MMHCs (%)[a]	11.4	18.2	12.0	1
Other inputs				
Medical care inflation (%)[b,c]	4.53	4.53	4.53	10
Discount rate (%)[b,c]	3.00	3.00	3.00	9
Women who do not achieve remission without treatment by the end of the first year postpartum (%)[b,c]	33.3	33.3	33.3	8
Maternal outcomes				
Maternal productivity				
Labor force participation among women with children aged younger than 6 years (%)	62.0	71.0	49.0	70
Per capita expected cost of job absenteeism ($)[b,c]	1,104	1,104	1,104	16,17,18,19
Per capita expected cost of job presenteeism ($)[b,c]	3,107	3,107	3,107	16,18,19
Baseline rate of unemployment (%)[b]	4.0	10.0	7.0	70
Likelihood of unemployment among women with MMHCs (%)[a]	5.2	13.0	9.1	20
Cost per unemployed woman ($)[a]	50,555	38,891	30,685	47
Suicide				
Baseline incidence among women (%)[a]	0.0109	0.0046	0.0045	71
Likelihood of suicide among women with depression (%)[a]	0.256	0.108	0.106	21
Annual cost per case of suicide ($)[a]	53,961	42,297	34,091	47, 48
Maternal obstetric health				
Baseline incidence of pre-eclampsia (%)[b]	4.0	7.0	5.0	72
Likelihood of pre-eclampsia among women with MMHCs (%)	7.5	12.8	9.3	22, 23, 24, 25, 26
Annual cost per case of pre-eclampsia ($)[b,c]	18,016	18,016	18,016	49
Baseline incidence of cesarean delivery (%)[b]	30.7	36.0	31.3	11
Likelihood of cesarean delivery among women with MMHCs (%)	39.7	45.2	39.7	25, 27, 28
Incremental cost per case of cesarean delivery ($)[b,c]	12,179	12,179	12,179	50
Average peripartum stay (days)[b,c]	2.6	2.6	2.6	73
Average peripartum stay for women with MMHCs (days)[b,c]	2.86	2.86	2.86	29
Daily cost per inpatient stay ($)[b,c]	2,416	2,416	2,416	51
Maternal health expenditures				
Individual out-of-pocket expenditures for women without MMHCs ($)[b,c]	657	657	657	17

Parameters	Point Estimates			Source
	Non-Hispanic White Mothers	Non-Hispanic Black Mothers	Hispanic Mothers	
Individual out-of-pocket expenditures for women with MMHCs ($)[b,c]	996	996	996	17
Individual insurer expenditures for women without MMHCs ($)[b,c]	3,853	3,853	3,853	17
Individual insurer expenditures for women with MMHCs ($)[b,c]	5,579	5,579	5,579	17
Benefit receipt				
SNAP receipt among families with children aged younger than 18 years (%)[a]	24.0	23.0	49.0	74
Likelihood of SNAP receipt among women with MMHCs (%)[a]	24.0	23.0	49.0	30
Cost per person receiving SNAP benefits ($)[a,c]	1,720	1,720	1,720	52
WIC receipt among women with children under age 5 (%)[b]	17.0	39.0	41.0	75
Likelihood of WIC receipt among women with MMHCs (%)[b]	17.2	39.2	41.2	30
Cost per person receiving WIC benefits ($)[a,c]	605	605	605	53, 54, 55
Medicaid receipt among women aged 15–44 years (%)[b]	29.0	65.0	59.0	90
Likelihood of Medicaid receipt among women with MMHCs (%)[b]	29.2	65.2	59.2	30
Cost per person receiving Medicaid benefits ($)[b,c]	7,766	7,766	7,766	56, 57
TANF receipt among families with children aged younger than 18 years (%)[b]	0.7	0.2	0.4	76, 77
Likelihood of TANF receipt among women with MMHCs (%)[b]	0.9	0.4	0.6	30
Cost per person receiving TANF benefits ($)[a,c]	10,374	10,374	10,374	58, 59
Child outcomes				
Preterm birth				
Baseline incidence (%)[a]	9.0	14.0	10.0	11
Probability among infants born to women with MMHCs (%)	21.9	31.6	24.0	23, 31, 32
Incremental cost per infant with preterm birth ($)[b,c]	49,758	49,758	49,758	60
Suboptimal breastfeeding				
Baseline prevalence of exclusive breastfeeding through 3 months postpartum (%)[a]	54.0	43.0	50.0	91
Likelihood among women with MMHCs (%)	48.1	37.3	44.1	33
Incremental cost per infant ($)[b,c]	1,987	1,987	1,987	7
SIDS				
Baseline incidence (%)[a]	0.042	0.077	0.026	79
Probability among babies born to mothers with MMHCs (%)	0.17	0.31	0.11	34, 35
Annual cost per case ($)[b,c]	22,014	22,014	22,014	61
Child behavioral and developmental disorders				

Parameters	Point Estimates			Source
	Non-Hispanic White Mothers	Non-Hispanic Black Mothers	Hispanic Mothers	
Baseline prevalence among children aged 2–8 years (%)[a,c]	17.3	17.3	17.3	80
Likelihood among children born to women with MMHCs (%)	31.1	31.1	31.1	36
Incremental annual cost per child ($)[b,c]	12,990	12,990	12,990	62
Childhood obesity				
Baseline prevalence among children aged 2–5 years (%)[a]	17.0	18.0	25.0	92
Likelihood among children born to women with MMHCs (%)	22.9	24.1	32.6	39, 38, 39
Incremental annual cost per child ($)[b,c]	248	248	248	63
Child asthma				
Baseline prevalence among children aged 0–4 years (%)[b]	2.0	8.0	5.0	82
Likelihood among children born to women with MMHCs (%)	3.9	14.8	9.5	40, 41
Incremental annual cost per child ($)[b,c]	3,056	3,056	3,056	64
Child nonfatal injury				
Baseline incidence of nonfatal injury among children aged 0–4 years (%)[b]	8.0	6.0	5.0	65
Likelihood of injury among children born to women with MMHCs (%)	10.3	7.8	6.5	42, 43
Annual cost per childhood injury ($)[b,c]	8,018	8,018	8,018	64
Child emergency department visits				
Baseline incidence among children aged 1–4 years (%)	42.0	89.0	38.0	65
Likelihood among children born to women with MMHCs (%)	61.6	94.7	57.6	44, 45
Cost per visit for child ($)[a,c]	714	714	714	66
Nonattendance of well-child care visits				
Baseline likelihood among children aged 0–6 years (%)[b,c]	35.0	35.0	35.0	85
Likelihood among children born to women with MMHCs (%)[b,c]	51.2	51.2	51.2	46
Cost per visit ($)[a,c]	514	514	514	67

Notes: MMHCs = maternal mental health conditions; SIDS = sudden infant death syndrome; SNAP = Supplemental Nutrition Assistance Program; TANF = Temporary Assistance for Needy Families; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

[a] Texas-specific estimate

[b] National estimate

[c] Estimate for all races, ethnicities, origins, and payers

Appendix F.

Sensitivity Analyses: All Texas Births

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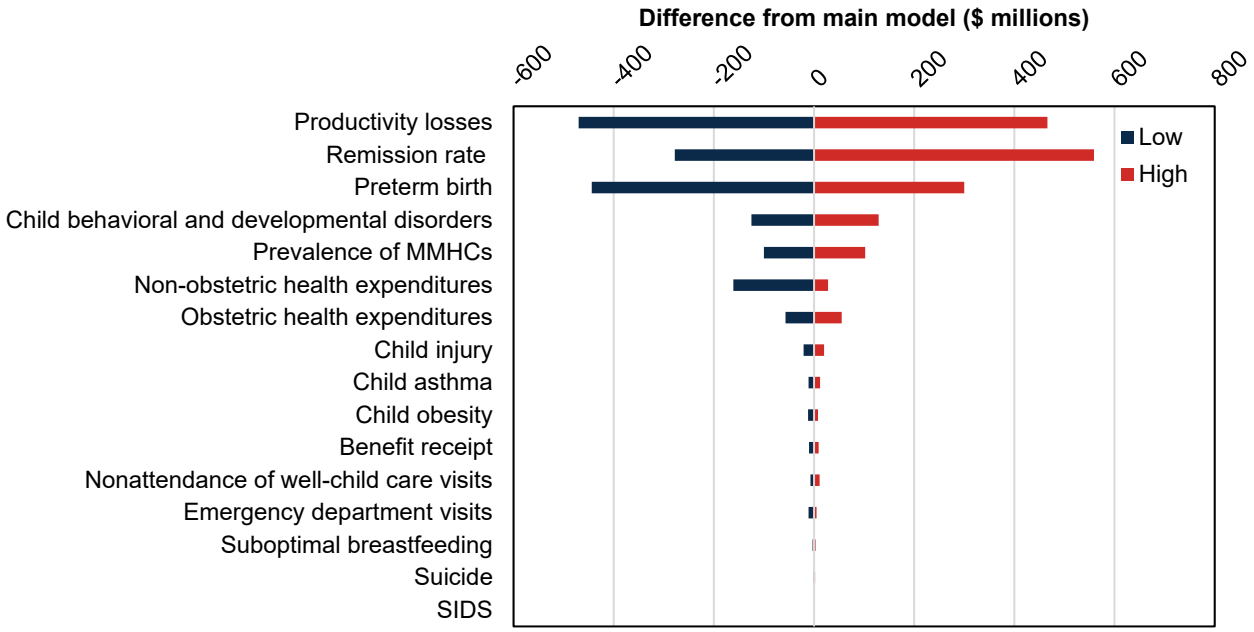
To determine which model parameters had the greatest impact on costs, we conducted deterministic one-way sensitivity analyses. We varied impact estimates, the prevalence of MMHCs, and the rate of remission from MMHCs because these parameters had a higher degree of uncertainty than others. For example, in the literature, the rate of remission from MMHCs after the first year postpartum ranges from 20% to 60%.[8] We did not vary baseline rates of outcomes because there is more certainty about these rates in the literature. Appendix Table E.1 shows the range of input parameters we used in our sensitivity analyses.

Figure F.1. Tornado diagram from one-way sensitivity analyses of the economic impact of untreated MMHCs among 2019 births: All Texas mothers



MMHCs = maternal mental health conditions; SIDS = sudden infant death syndrome.

The tornado diagram above (Figure F.1) shows the results of our sensitivity analyses, including the difference in costs, in millions of dollars, from the main model as we varied each parameter from its lowest to its highest value. The impact estimate of exposure to MMHCs on productivity losses had the greatest impact on estimated costs ($1.7 billion to $2.7 billion), followed by the remission rate ($1.9 billion to $2.8 billion) and the impact estimate on preterm birth ($1.8 billion to $2.3 billion). These parameters had large ranges in the literature and the costs of these outcomes were very high, so varying these parameters led to substantial variation in model results.

Other impact parameters had a more modest impact on model results because the baseline rate of the outcome was low (for example, SIDS, suicide, or TANF receipt). This is because the costs incurred through five years postpartum were low (for example, child obesity) or because the range of impact estimates was small (for example, benefit receipt). By varying all parameters at once, we found that total societal cost of untreated MMHCs in Texas could range from $739 million to $4.3 billion for the 2019 birth cohort.

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Appendix G.

Glossary

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Absenteeism. An inability to work.

Maternal mental health conditions. Conditions that occur in the perinatal period, between conception and five years postpartum. Depression is the most common condition, but mothers may also develop anxiety disorders, which include generalized anxiety disorder, panic disorder, obsessive-compulsive disorder, or birth-related PTSD.

Preeclampsia. A potentially dangerous pregnancy complication involving high blood pressure, swelling of hands and feet, and protein in urine. If left untreated, pre-eclampsia can lead to eclampsia, which poses severe health risks for mother and child and may lead to death.

Presenteeism. Reduced productivity and an increased likelihood of making mistakes at work.

Non-obstetric health care expenditures. Direct health care expenditures unrelated to labor and delivery which are paid for out-of-pocket by the patient and by insurers, if the patient is insured. These expenditures come from AHRQ's Medical Expenditure Panel Survey and include spending on physicians, hospital and outpatient services, medication, diagnostic testing, and other services.

Obstetric health expenditures. Medical expenditures related to labor and delivery. In our model, we consider health care costs of pre-eclampsia, cesarean section, and longer-than-average peripartum stay.

Benefit receipt. Public assistance funding provided through the Supplemental Nutrition Assistance Program (SNAP), Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), Medicaid, and Temporary Assistance for Needy Families (TANF).

Behavioral and developmental disorders. A series of disorders, such as attention-deficit/hyperactivity disorder, depression, anxiety, and behavioral or conduct disorders such as oppositional defiant disorder, which occur in children and can lead to reduced educational attainment in the longer term.

Suboptimal breastfeeding. Not breastfeeding at all, or not exclusively breastfeeding through 3 months postpartum.

Racial and ethnic backgrounds. These are defined according to the 1997 Office of Management and Budget (OMB) standards on race and ethnicity, which are used by the U.S. Census Bureau.

- **Hispanic.** A mother of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish heritage. They may be of any race.
- **Non-Hispanic White.** A non-Hispanic mother of European, Middle Eastern, or North African heritage.
- **Non-Hispanic Black.** A non-Hispanic mother of Black African heritage.

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