Financial Toll of Untreated Perinatal Mood and Anxiety Disorders Among 2017 Births in the United States

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Objectives. To estimate the economic burden of untreated perinatal mood and anxiety disorders (PMADs) among 2017 births in the United States.

Methods. We developed a mathematical model based on a cost-of-illness approach to estimate the impacts of exposure to untreated PMADs on mothers and children. Our model estimated the costs incurred by mothers and their babies born in 2017, projected from conception through the first 5 years of the birth cohort's lives. We determined model inputs from secondary data sources and a literature review.

Results. We estimated PMADs to cost $14 billion for the 2017 birth cohort from conception to 5 years postpartum. The average cost per affected mother–child dyad was about $31 800. Mothers incurred 65% of the costs; children incurred 35%. The largest costs were attributable to reduced economic productivity among affected mothers, more preterm births, and increases in other maternal health expenditures.

Conclusions. The US economic burden of PMADs is high. Efforts to lower the prevalence of untreated PMADs could lead to substantial economic savings for employers, insurers, the government, and society. (*Am J Public Health.* 2020;110:888–896. doi: 10.2105/AJPH.2020.305619)

See also Ko and Haight, p. 765.

Perinatal mood and anxiety disorders (PMADs)—defined as mood and anxiety disorders during pregnancy and the year following birth—are common in the United States, affecting at least 1 in 7 pregnant and postpartum women,[1–12] yet they often go undiagnosed and untreated. Although screening tools and effective treatments exist, 60% of perinatal women with depressive symptoms do not receive a clinical diagnosis, and 50% with a diagnosis do not receive treatment.[13] If left untreated, PMADs can have serious health and social consequences for both mother and child, including lower productivity—defined as lost earnings because of the inability to work or suboptimal performance while at work—for the mother and worse health for both the mother and child.[14]

Policymakers and health care payers have paid scant attention to PMADs in the United States, in part because of the lack of published evidence on costs of untreated PMADs. Health insurers, employers, and policymakers need credible and transparent estimates of the economic burden of PMADs. Several studies have examined the costs of untreated PMADs in other countries, such as the United Kingdom and Australia,[15,16] but, to our knowledge, this study is the first to provide a comprehensive picture of the economic burden of PMADs in the United States.

We developed a mathematical model to quantify the societal costs of untreated PMADs and used recent data and estimates from peer-reviewed literature. We concentrated on the mother–child dyad's costs during the first several years of life (conception through age 5 years) to highlight the most pressing concerns relevant to the public and decision makers. Although other studies have documented long-term impacts of exposure to untreated PMADs on children, these effects do not manifest themselves for many years. Limiting the model timeframe to 6 years enabled us to generate more concrete estimates than would be possible over a longer period.

METHODS

Our model considered impacts of exposure to untreated PMADs on mother and child. It estimated societal costs, including health care payer and employer costs, incurred by mothers and their babies born in 2017, projected forward for 6 years. The model focused on outcomes shown in the literature and recognized by subject matter experts as linked to PMADs (e.g., preterm birth). We looked at direct and indirect costs of untreated PMADs in 3 key domains: (1) income loss because of reduced maternal productivity and labor force participation; (2) greater use of public sector services, including safety net programs and Medicaid; and (3) higher health care costs attributable to worse maternal and child health.

The model used a cost-of-illness approach to synthesize existing evidence from multiple

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data sources about the effects of untreated PMADs on mother and child. We relied on literature and secondary data sources to inform model inputs, including (1) impact estimates, which measure incremental effects associated with exposure to untreated PMADs (vs no exposure); (2) prevalence estimates of PMADs in the United States; and (3) associated costs and baseline rates of each outcome. We did not estimate costs of prenatal and postnatal PMADs separately, nor mood disorders versus anxiety disorders.

Literature Review

We extracted effect sizes from literature on exposure to untreated PMADs on outcomes of interest. We identified original articles published in peer-reviewed scientific journals by using the MEDLINE, PsycINFO, CINAHL, and EconLit databases and key search terms. We augmented our literature search with (1) references from articles found through our literature search, (2) references from other publications that discuss costs and effects of PMADs, and (3) literature that subject matter experts in our advisory group recommended (Appendix A, Table A, available as a supplement to the online version of this article at http://www.ajph.org, lists the members of our advisory group). We focused on articles published over an approximately 10-year period: January 1, 2008, to August 22, 2018. For PMAD-related outcomes that had appeared in few articles, we conducted additional targeted searches to fill evidence gaps, including articles published before 2008. Appendix B (available as a supplement to the online version of this article at http://www.ajph.org) describes our literature review process and search terms used.

After excluding papers based on titles, we reviewed abstracts to determine each paper's relevance to our study. We identified 170 candidate papers and used the following inclusion criteria to assess each study and determine its appropriateness for use in the model. Each study (1) included controls for confounders or used a matched-comparison group design to strengthen the evidence of associations between PMAD exposure and the effects of interest, (2) used outcomes relevant to the 6-year timeframe of our model, and (3) quantified outcomes in monetary terms.

Next, we extracted impact estimates for relevant outcomes. Each impact estimate measures the expected change in a given outcome attributed to exposure to untreated PMADs. We used systematic reviews or meta-analyses to inform a range of estimates when possible. We prioritized studies conducted with a population in the United States. For the few outcomes that had limited evidence from US-based studies, we included evidence from studies conducted in other high-income countries, such as Canada. Table 1 shows the impact estimates from the final set of papers. Appendix C (available as a supplement to the online version of this article at http://www.ajph.org) describes the studies used to inform the impact estimates.

We also conducted a literature search on the prevalence of PMADs in the United States. We defined perinatal mood and anxiety disorders to include depression, anxiety, panic disorders, obsessive–compulsive disorders, mood disorders, posttraumatic stress disorders, and psychiatric disorders in pregnant and postpartum women during the prenatal, postnatal, and postpartum periods. For our main model, we chose to use a recent estimate of 11.5%, which we identified based on data from the Pregnancy Risk Assessment Monitoring System, a Centers for Disease Control and Prevention (CDC) surveillance project.[88] We used a range of prevalence estimates (7% to 25% of recent mothers) from literature in our sensitivity analyses.[2–12] Appendix D (available as a supplement to the online version of this article at http://www.ajph.org) describes the studies we included to inform the prevalence estimates. Altogether, we included 10 studies to inform the prevalence of PMADs and 34 studies to inform the impact estimates.

Cost Estimates

Calculating the economic burden of PMADs required us to estimate the incremental costs of each outcome attributable to exposure to untreated PMADs. We collected cost data from the CDC, peer-reviewed literature, and government reports. We made assumptions to standardize costs to annual units, distinguish between downstream and upfront costs, and include direct and indirect cost estimates from the literature. We sought to avoid double counting of costs by disaggregating cost estimates into their subcomponents and excluded overlapping subcomponents. For example, the costs of suboptimal breastfeeding from the literature included costs attributable to higher risks of obesity, asthma, and sudden infant death syndrome (SIDS; among other worse health outcomes). Because we separately examined the costs of obesity, asthma, and SIDS in our model, we subtracted the costs of these categories from the "unit" cost of suboptimal breastfeeding, even though there is evidence that PMADs influence these outcomes independently of suboptimal breastfeeding. We adjusted all cost estimates to 2017 dollars by using the medical care component of the consumer price index for year 0. Table 1 provides estimate values and sources. Appendix E (available as a supplement to the online version of this article at http://www.ajph.org) describes the studies and data sources used to inform the cost estimates.

Baseline Rates

We identified the baseline rate of each outcome—that is, the outcome rate in the general population—relying on data from the CDC and other government agencies. We used the most recent statistic available and, when available, focused on statistics for the most relevant population (such as the rates of labor force participation among women with young children). Table 1 provides estimate values and sources.

Modeling

First, for each impact estimate, we defined a range of plausible values. If multiple high-quality, rigorous studies or sources examined the same outcome, we aggregated point estimates from these sources to define the range; we then used the mean value for the main model. However, if we had only a single study with an estimate, we used the confidence interval around the point estimate from that paper to define the range; if we could not locate a confidence interval, we varied the impact estimate by 25% in sensitivity analyses. If there were no rigorous studies for a given outcome, we estimated a range of values by using studies of depression among women broadly (rather than PMAD-specific studies). These outcomes included maternal suicide,

presenteeism (suboptimal performance at work), and unemployment.

We added the impact estimate (standardized to a percentage-point change)—which measures the expected change in the outcome attributable to exposure to PMADs—to the rate of the outcome among the general population. This approach enabled us to calculate the expected rate of the outcomes among women with PMADs. For example, the impact estimate for preterm birth would measure incremental risk of a preterm birth for a woman with untreated PMADs relative to a woman without PMADs. Adding this estimate to the baseline rate of preterm birth for the general population yields an approximate likelihood of preterm birth for women with untreated PMADs.

To calculate aggregate excess costs of PMADs in a year, we multiplied individual incremental risk of the outcome by expected number of women with PMADs, then multiplied the product by incremental unit cost. We treated each outcome as separate and costs as additive.

To extrapolate costs from 1 year to 5 years postpartum, we made several assumptions:

- We assumed that the following costs occurred only once during the model timeframe, either in year 0 or in the first year postpartum: increased rates of preeclampsia, increased rates of cesarean delivery, longer peripartum hospital stay, increased rates of preterm birth, increased rates of SIDS, and higher rates of suboptimal breastfeeding.
- We assumed that costs occurred annually for the following outcomes, as long as the mother had PMADs: productivity losses, economic losses from suicide, increased health expenditures, increased child injuries, increased emergency department visits, and reduced attendance at well-child care visits. For these outcomes, we assumed that once the mother achieved remission, the negative impact of exposure to PMADs would drop to zero.
- To calculate the number of mothers who recovered from untreated PMADs in the years following the birth, we assumed that about two thirds of women achieved remission by the end of the first year postpartum, even without treatment, and that

TABLE 1—Parameters and Costs Used in the Model of the Financial Toll of Untreated Perinatal Mood and Anxiety Disorders Among 2017 Births: United States

Parameter	Point Estimate (Range for Sensitivity Analysis)	Source
Baseline demographic characteristics		
No. of births	3 855 500	17
No. of pregnancies[a]	5 908 600	18
Prevalence of PMADs, %	11.50 (7.40–23.80)	2–12
Other inputs		
Medical care inflation, %	2.03	19
Discount rate, %	3.00	20
Women who do not achieve remission without treatment by end of first y postpartum, %	33.33 (20.00–60.00)	21
Maternal outcomes		
Maternal productivity		
Labor force participation among women with children aged younger than 6 y, %	62.20	22
Per-capita expected cost of job absenteeism, $	888 (397–1 715)	23–26
Per-capita expected cost of job presenteeism, $	2 871 (392–5 554)	24-26
Baseline rate of unemployment, %	4.90	27
Likelihood of unemployment among women with PMADs, %	6.37 (5.88–6.86)	28
Cost per unemployed woman, $	40 478	29
Suicide		
Baseline incidence among women, %	0.01	30
Likelihood among women with depression, %	0.16 (0.14–0.19)	31
Annual cost per case, $	74 666	32,33
Maternal obstetric health		
Baseline incidence of preeclampsia, %	3.80	34
Likelihood of preeclampsia among women with PMADs, %	7.32 (6.08–8.53)	35,36
Annual cost per case of preeclampsia, $	1 285	37
Baseline incidence of cesarean delivery, %	31.90	38
Likelihood of cesarean delivery among women with PMADs, %	39.61 (38.56–40.61)	35,39
Incremental cost per case of cesarean delivery, $	11 693	40
Average peripartum stay, d	2.60	41
Average peripartum stay for women with PMADs, d	2.86 (2.64–3.08)	42
Daily cost per inpatient stay, $	2 340	43
Maternal health expenditures		
Individual out-of-pocket expenditures for women without PMADs, $	616 (392–654)	23
Individual out-of-pocket expenditures for women with PMADs, $	934 (596–993)	23
Individual insurer expenditures for women without PMADs, $	3 615 (2 304–3 840)	23
Individual insurer expenditures for women with PMADs, $	5 234 (3 336–5 560)	23
Benefit receipt		
SNAP receipt among families with children aged younger than 18 y, %	50.10	44
Likelihood of SNAP receipt among women with PMADs, %	50.33 (50.24–50.42)	45
Cost per person on SNAP, $	1 599	46
WIC receipt among women with children aged 5 y and younger, %	27.30	47
Likelihood of WIC receipt among women with PMADs, %	27.48 (27.39–27.56)	45
Cost per WIC case, $	767	48
Medicaid receipt among women aged 15–44 y, %	18.20	49
Likelihood of Medicaid among women with PMADs, %	18.44 (18.35–18.54)	45
Cost per case of Medicaid, $	6 747	50,51

Continued

TABLE 1—*Continued*

Parameter	Point Estimate (Range for Sensitivity Analysis)	Source
TANF receipt among families with children aged younger than 18 y, %	3.20	52,53
Likelihood of TANF receipt among women with PMADs, %	3.40 (3.29–3.51)	45
Cost per TANF case, $	10 146	54,55
Child outcomes		
Preterm birth		
Baseline incidence, %	9.80	56
Probability among infants born to women with PMADs, %	23.58 (7.16–35.06)	57
Incremental cost per infant with preterm birth, $	48 118	58
Suboptimal breastfeeding		
Baseline prevalence, %	72.10	59
Likelihood among women with PMADs, %	67.12 (64.40–69.46)	60
Incremental cost per infant, $	1 864	61
SIDS		
Baseline incidence, %	0.04	62
Probability among babies born to mothers with PMADs, %	0.15 (0.12–0.19)	63,64
Annual cost per case, $	21 066	65
Child behavioral and developmental disorders		
Baseline prevalence among children aged 2–8 y, %	6.83	66
Likelihood among children born to women with PMADs, %	12.31 (11.06–13.52)	67
Incremental annual cost per child, $	10 892	68
Childhood obesity		
Baseline prevalence among children aged 2–5 y, %	13.90	69
Likelihood among children born to women with PMADs, %	18.97 (4.32–29.72)	70,71
Incremental annual cost per child, $	233	72
Child asthma		
Baseline prevalence among children aged 0–4 y, %	3.80	73
Likelihood among children born to women with PMADs, %	7.32 (6.08–8.53)	74,75
Incremental annual cost per child, $	2 867	76
Child nonfatal injury		
Baseline incidence among children aged 0–4 y, %	12.90	77
Likelihood among children born to women with PMADs, %	16.37 (13.54–19.02)	78,79
Annual cost per injury, $	7 522	80
Child emergency department visits		
Baseline incidence among children aged 1–4 y, %	46.20	81
Likelihood among children born to women with PMADs, %	65.54 (51.37–73.32)	82,83
Cost per visit for child, $	875	84
Nonattendance of well-child care visits		
Baseline likelihood among children aged 0–6 y, %	35.00	85
Likelihood among children born to women with PMADs, %	51.22 (35.00–60.96)	86
Cost per visit, $	525	87

Note. PMAD = perinatal mood and anxiety disorder; 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]The estimate applies to intended and unintended pregnancies in US women aged 15–44 y that resulted in abortion, fetal loss, or live birth in 2014.

this proportion remained constant in subsequent years, based on a meta-analysis by Vliegen et al.[21]

- For the remaining outcomes, including child behavioral and developmental disorders and asthma, we assumed that the impact of exposure to untreated PMADs remained constant throughout the model timeframe. For example, we did not expect the child to recover from asthma, even if the mother recovered from PMADs.

Finally, following a US Public Health Service Task Force recommendation, we discounted costs at an annual rate of 3% to reflect the lower economic value of a delayed expense.[20] We adjusted for inflation in costs when extrapolating beyond year 0 to 5 years postpartum, assuming that medical costs increased by 2.03% each year after year 0, based on the annual change in the medical care component of the consumer price index from 2017 to 2018. We organized the data and programmed the model in Microsoft Excel by using Visual Basic (Office 365, Microsoft, Redmond, WA).

RESULTS

The model estimated that the cost of untreated PMADs for the 2017 birth cohort, projected from conception to 5 years postpartum, was about $14.0 billion. There were 3 855 500 US births in 2017,[17] which suggests that, among mothers who gave birth in 2017, about 443 383 mothers had PMADs (3 855 500 * 11.5% = 443 383). The average cost per affected woman was roughly $32 300. Slightly more than half of the costs occurred in year 0, the year of conception through birth, because there were several outcomes relevant in the first year only (e.g., obstetric expenditures). The mother incurred about 65% of the total costs and the child incurred 35%. Table 2 shows these model results.

Maternal Outcomes

The expected annual costs per person with untreated PMADs attributable to absenteeism (inability to work while employed) and presenteeism (suboptimal performance while at work) were about $888 and $2871, respectively. The expected loss in

TABLE 2—Model Results for Costs of Untreated Perinatal Mood and Anxiety Disorder for the 2017 Birth Cohort, by Year (in Millions of Dollars): United States

Outcomes	Total	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Maternal costs							
Productivity losses	4635	1769	602	614	626	639	652
Suicide	200	76	26	26	27	28	28
Preeclampsia[a]	20	20	0	0	0	0	0
Cesarean delivery[a]	400	400	0	0	0	0	0
Peripartum stay[a]	270	270	0	0	0	0	0
Health expenditures	3449	1316	448	457	466	475	485
Benefit receipt	166	28	29	30	30	31	31
Child costs							
Preterm birth[a]	2 940	2 940	0	0	0	0	0
Suboptimal breastfeeding[a]	41	41	0	0	0	0	0
SIDS[a]	11	11	0	0	0	0	0
Behavioral and developmental disorders	1 551	265	270	276	281	287	293
Obesity	31	5	5	5	6	6	6
Asthma	262	45	46	47	48	49	50
Injury	18	7	2	2	2	2	2
Emergency department visits	197	75	26	26	27	27	28
Nonattendance of well-child care visits	−99	−38	−13	−13	−13	−14	−14
Total societal costs for 1 birth cohort	14 090	7 230	1 440	1 469	1 499	1 530	1 561
Cost per mother–child dyad with PMAD, over 0–5 y postpartum	31 778						
Cost per mother–child dyad with PMAD, per y, averaged over 0–5 y postpartum	5 296						

Note. PMAD = perinatal mood and anxiety disorder; SIDS = sudden infant death syndrome.
[a]Costs are assessed only once in the year of conception and birth. We assumed the other costs incurred annually for the 6 y of the model.

economic output attributable to increased unemployment among mothers with untreated PMADs was about $40 478. Estimated productivity losses amounted to increased societal costs of $4.6 billion over the 6 years from the cohort's birth to age 5 years.

Untreated PMADs increased suicide risk more than 20-fold, as the model estimated an excess of 1049 suicides among mothers of the birth cohort associated with PMADs. This estimate led to an increase of $200 million in societal costs over the 6 model years. Untreated PMADs were associated with an additional 15 615 women developing preeclampsia,[34–36] 34 168 women having cesarean deliveries, and 115 280 additional hospital days during delivery among mothers of the birth cohort, together amounting to an increase of $689 million in costs incurred during the birth year.

Individual out-of-pocket expenditures for health care (excluding obstetric care) were $318 higher per year for women with untreated PMADs, and insurer-paid expenditures were $1619 higher for each woman with untreated PMADs,[23] leading to a $3.4 billion increase in societal health expenditures over the 6 years. Untreated PMADs were associated with an annual increase of 1651 women enrolled in Medicaid, 1570 women enrolled in the Supplemental Nutrition Assistance Program, 1359 women enrolled in Temporary Assistance for Needy Families, and 1196 women enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children, leading to a total increase in public assistance costs of $166 million over the 6 model years.

Child Outcomes

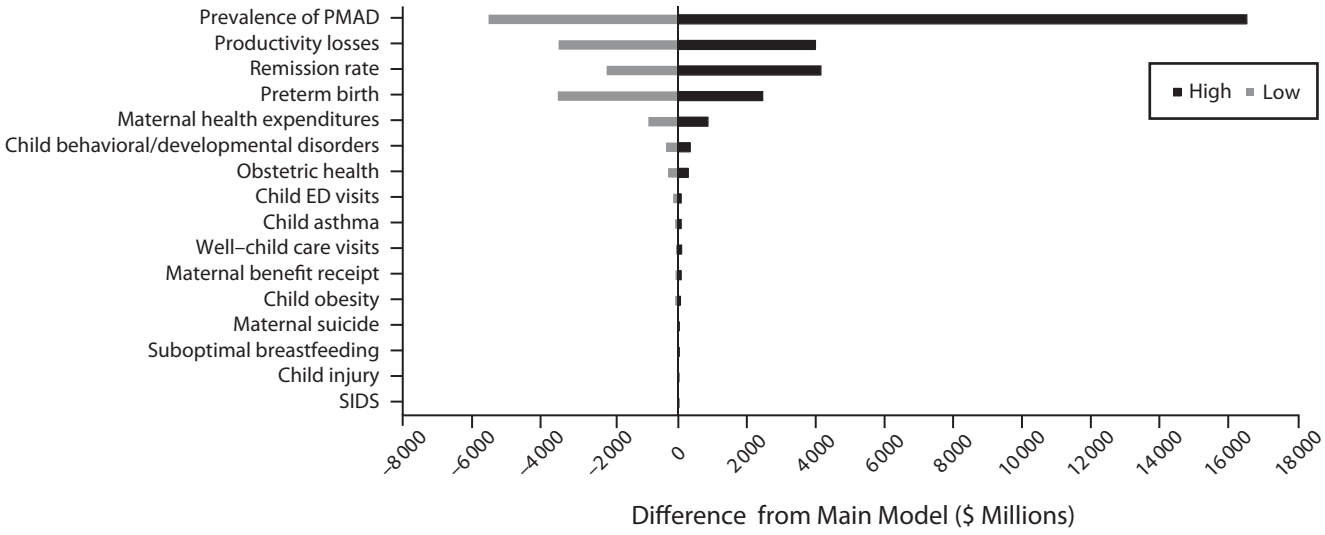
An additional 61 098 preterm births in the birth cohort were associated with untreated PMADs, leading to an increase in total societal costs of $2.9 billion incurred in the birth year. Untreated PMADs were associated with an additional 22 072 women per year not breastfeeding or breastfeeding suboptimally, leading to an increase of $41 million in total societal costs in the birth year. The cost associated with suboptimal breastfeeding is primarily attributable to higher incidence of preventable infant diseases and deaths.[89] An estimated 516 additional infant deaths attributable to SIDS were associated with untreated PMADs in the birth cohort, which increased societal costs by $11 million in the birth year.

The number of children in the birth cohort who had behavioral and developmental disorders increased by an estimated 24 297 attributable to untreated PMADs, raising societal costs by $1.6 billion over 6 model years. An estimated 22 473 additional children in the cohort developed obesity attributable to untreated PMADs, costing society $31 million over 6 model years. Another 15 615 children in the cohort were estimated to develop asthma attributable to untreated PMADs, costing society $262 million over the 6 model years. Untreated PMADs led to an estimated 15 513 additional child injuries per year, costing society $18 million over the 6 model years.

Untreated PMADs increased emergency department visits by children aged 5 years and younger by an estimated 85 760 each year—an increase of $197 million in societal costs over the 6 model years. Because children of mothers with PMADs are more likely to miss well-child care visits than children of mothers without PMADs, untreated PMADs contributed to 71 914 fewer well-child visits each year, reducing total societal costs by $99 million. Moreover, this outcome most likely resulted in worse overall child health, as reflected in higher costs in other child health categories.

Sensitivity Analyses

We conducted deterministic 1-way sensitivity analyses to examine which model parameters were most sensitive. These analyses varied impact estimates, prevalence of PMADs, and rate of remission from untreated PMADs, as they had a higher degree of uncertainty than other parameters (e.g., in the literature, the estimates of the prevalence of



Note. ED = emergency department; PMAD = perinatal mood and anxiety disorder; SIDS = sudden infant death syndrome.

FIGURE 1—Tornado Diagram From 1-Way Sensitivity Analysis of the Financial Toll of Untreated Perinatal Mood and Anxiety Disorders Among 2017 Births: United States

PMADs in the United States range from 7% to 25%).[2–12] We did not test model sensitivity to parameters such as baseline rates of outcomes because there is more certainty about those outcomes in the literature. Table 1 presents the range of input parameters we tested.

The tornado diagram (Figure 1) summarizes results of our 1-way sensitivity analysis. It shows the difference in costs (in dollars) from the main model as we varied each parameter, from lowest to highest value. The prevalence of PMADs had the strongest influence on model results ($8.6 to $30.5 billion) because we incorporated PMAD prevalence into almost all parts of the model. Furthermore, estimates of PMAD prevalence among US women varied substantially. The impact estimate on maternal productivity was the second most influential parameter, followed by the impact estimate on preterm birth and the remission rate from untreated PMADs. Not only did these parameters have large ranges in the literature, but also the associated costs of these outcomes were high, and therefore they caused large fluctuations in the model results.

The remainder of impact parameters did not appear to have a substantial effect on the results. This lack of impact was because the baseline rate of the outcome was low (e.g., suicide), the associated costs incurred during the model timeframe were low (e.g., child obesity), or the range of impact estimates was narrow (e.g., benefit receipt).

When we varied all model estimates from the low to the high end of the estimate ranges simultaneously, we found that costs of untreated PMADs for the 2017 birth cohort could range from $2.5 to $63.4 billion.

DISCUSSION

This study produced estimates of the economic burden of PMADs in the United States to inform the financial and public policy rationale for treatment. Our model estimated that the societal cost of untreated PMADs from conception through 5 years postpartum was $14 billion for the 2017 birth cohort. The cost per affected mother–child dyad over the 6 years of the model timeframe was close to $31 800, and the average annual cost of a mother–child dyad with PMADs was $5300. Approximately half of these costs occurred in the year of conception through birth. About two thirds of the costs of untreated PMADs from birth through the first 5 years of a child's life were attributable to maternal outcomes, whereas one third were attributable to child outcomes.

We identified few other studies that focused on costs of untreated PMADs. One peer-reviewed study from the United Kingdom concluded that the lifetime cost of perinatal depression for 1 birth cohort was around £75 728 (or $95 000) per affected woman.[16] This study used lifetime costs—whereas we focused on conception to 5 years postpartum—so its final cost estimates are not directly comparable with ours. An Australian study estimated the cost for the 2012 birth cohort over a 20-year period of untreated perinatal depression and anxiety to be $518 million in US dollars, which would be about $11 000 per affected woman.[15] A report on the costs of untreated maternal depression in Minnesota estimated that the 2-generational annual economic cost of not treating 1 mother with maternal depression is $22 647, but the authors did not describe their methodology or sources.[90]

Limitations

Our model was subject to several limitations. First, although we conducted a systematic literature search, it was not feasible to include every possible outcome or cost in our review. Our cost results may therefore be downward biased. Second, although we designed inclusion criteria to include methodologically sound papers with adequate controls, the included studies may still not fully isolate the impact of PMADs because of

unobserved confounders. Third, most of the existing evidence on the relationship between PMADs and the studied outcomes focused on perinatal depression rather than anxiety, with the majority of papers focusing on postpartum depression. To the extent that anxiety may predict the outcomes examined independently of depression, and women with both anxiety and depression may have even worse outcomes,[91] our model estimates could be considered conservative. Furthermore, there are more studies on certain outcomes than others, so our confidence in each outcome is not uniform. Our limited use of literature from other countries with similar populations but different health care systems and care-seeking behaviors may introduce bias into the cost estimates. Fourth, although we worked to limit cost double-counting, we acknowledge that aggregate costs may still be overestimated because of remaining overlap of costs between outcomes. Fifth, model results are sensitive to the prevalence estimate of PMADs, which reflects the uncertainty in the prevalence of PMADs in the literature. When we varied the prevalence estimate to the lowest end of the range (7%) to the highest (25%), aggregate costs varied from $8.6 to $30.6 billion.

In addition, our model examined conception to 5 years postpartum, as this timeframe may be most relevant to policymakers. It may not capture other child outcomes outside that timeframe. For example, the effect of toxic stress on early childhood delinquency might not lead to costs captured during the model timeframe, although it may lead to higher costs in the future, such as reduced educational attainment or worse long-term health. Lifetime costs of PMADs are undoubtedly higher than the costs we found over a 6-year period.

Nonmaternal caregivers may also experience PMAD outcomes similar to those for mothers and children, such as paternal depression and absenteeism.[92,93] We recognize that such outcomes have important societal costs, but our model focused only on the mother–child dyad. Had we included these other costs in our model, the overall burden on society would likely have been higher, so our results may underestimate the true societal burden of PMADs.

Finally, our model estimated the economic burden of untreated PMADs but did not explore the economic case for or costs of intervention. We did not incorporate treatment options, nor did we differentiate between no treatment and inadequate treatment of PMADs. Furthermore, we did not explore variations in treatment of PMADs or the impacts of treatment type on costs. These important areas for future research were beyond the scope of this study.

Public Health Implications

Untreated PMADs represent a heavy economic burden in the United States. Given that the United States underdiagnoses and undertreats these conditions, we sought to highlight the importance of addressing PMADs as a public health concern. Several medical societies—including the American College of Obstetricians and Gynecologists; the American Academy of Pediatrics; the Association of Women's Health, Obstetric, and Neonatal Nurses; and the American Psychiatric Association[94–97]—recommend consistently screening perinatal women in obstetric or pediatric clinical settings and providing comprehensive treatment of PMADs, if indicated. Furthermore, the US Preventive Services Task Force recommends primary care screening for depression during pregnancy and postpartum[98] and counseling interventions to prevent perinatal depression.[99]

Efforts to curb PMADs would not only benefit women's and children's health but would also improve women's productivity and decrease their use of social services. This improvement would in turn benefit governments, employers, and health insurance payers. Stakeholders should support consistent screening during pregnancy through the first year postpartum and facilitate access to effective and affordable treatments. AJPH

CONTRIBUTORS

D. L. Luca developed and implemented the model with input from K. Zivin. C. Staatz and C. Margiotta conducted the literature review in consultation with D. L. Luca and K. Zivin. D. L. Luca wrote the article with input from all authors. K. Zivin supervised the project.

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CONFLICTS OF INTEREST

The authors have no conflicts to report.

HUMAN PARTICIPANT PROTECTION

Institutional board review was not required because there were no human participants involved in this study.

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