

Healthy Families Massachusetts (HFM): Cost-Benefit Analysis

Report Prepared by Rebecca Fauth, Usman Naeem, and Danyel
Moosmann

Tufts Interdisciplinary Evaluation Research (TIER),
Tufts University

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Section 1. Massachusetts Healthy Families Evaluation—Phase 2 (MHFE-2)

Healthy Families Massachusetts (HFM), an affiliate of Healthy Families America (HFA), is an evidence-based home visiting program in Massachusetts. HFM is administered by the Children’s Trust of Massachusetts and provides services through a combination of state and federal funding. It serves all first-time parents aged 26 years and under (with some local implementing agencies serving older parents). HFM's stated goals are to: (1) prevent child abuse and neglect by supporting positive, effective parenting; (2) achieve optimal health, growth, and development in infancy and early childhood; (3) encourage educational attainment, job, and life skills among parents; (4) prevent repeat pregnancies during the teen years; and (5) promote parental health and well-being.

Tufts Interdisciplinary Evaluation Research (TIER) at Tufts University designed and conducted the Massachusetts Healthy Families Evaluation: Phase 2 (MHFE-2), a longitudinal randomized controlled trial of HFM. MHFE-2 followed a cohort of young first-time mothers for nearly a decade, documenting their—and their children’s—short- and long-term outcomes across HFM’s goal areas.

To date, MHFE-2 demonstrated favorable HFM program effects on mothers’ mental health, substance use, and housing stability, and children’s asthma.

MHFE-2 Methods Overview

MHFE-2 began in 2008. Data were first collected about one month following HFM enrollment (Time 1, [T1]), with follow-ups completed one (T2), two (T3), five (T4), six (T5), and eight (T6) years later. Data were collected from 704 young mothers (18.8 years at first birth, on average) at T1, with about 70% remaining in the later follow-up studies. Primary data sources included a phone survey, in-person interviews, and state administrative data from the Departments of Children and Families (DCF), Public Health (DPH), Transitional Assistance (DTA), and Elementary and Secondary Education (DESE).

MHFE-2 findings are presented in detail in three reports.¹⁻³ These data have been the source of more than 20 peer-reviewed journal articles. For MHFE-2 reports and publications, see: <https://sites.tufts.edu/tier/home/publications/>

In the final phase of the evaluation, TIER collaborated with an economist to conduct a cost-benefit analysis (CBA) to determine the return on investment for HFM.

In the following sections, we provide an overview of the approach and methods, followed by a description of the benefits.

Section 2. Approach

Outcomes

This economic analysis focuses on a subset of significant outcomes from the MHFE-2 evaluation. We used the following criteria to select outcomes for the economic analysis:

- Outcomes that were statistically significant^a
- Outcomes that were measured using well-validated tools or via administrative data

^a No negative program effects were observed. Thus, by omitting outcomes that were not statistically significant, we are not at risk of omitting outcomes for which a potential cost, not benefit, could incur. Null findings were interpreted to have a value of zero. Thus, if the core HFM costs are lower than total estimated benefits, omitted null findings should have no impact on our final estimates.

- Outcomes that could be reasonably and independently costed.^b

Using the selected outcomes, we estimated intent-to-treat (ITT) program effects, comparing outcomes between the HFM program group and the control group based on random assignment status. We regressed each outcome on an HFM program status indicator variable (1 = HFM program group, 0 = control group). We fitted ordinary least squares (OLS) regression models to continuous outcomes and logistic regression models to binary outcomes. All models controlled for maternal race and ethnicity (Hispanic, non-Hispanic Black, non-Hispanic other, non-Hispanic White), given known racial and ethnic inequities in Massachusetts. For outcomes measured at T4–T6, we incorporated inverse probability weights (IPW) to reweight the data to be representative of the original T1 sample and adjust for attrition over time. All models were run in Stata 17.0.

We used the effect size computation commands in R to calculate effect sizes (Hedge’s *g*) for each outcome.⁴ Significant outcomes were determined by examining the effect size 95% confidence intervals. Table 1 below summarizes the focal outcomes.

Table 1. Description of Outcomes

Outcome	Time Measured	Description
Maternal		
Rapid repeat birth	T3	Repeat birth for mothers who identified as Hispanic/Latina and experienced psychological vulnerability (e.g., depressive symptoms, post-traumatic stress disorder, childhood history of child welfare involvement, and low social connection) ⁵
Substance use	T5	Mothers’ substance use past month ²
Asthma	T6	Mothers’ asthma treatment past year ³
Depressive symptoms	T2, T4	Mothers’ depressive symptoms past week ^{1,2}
Emergency department (ED) use	T4	Mothers’ ED use past year ²
Child		
Maltreatment recurrence	Birth–2016	Receipt of a second 51A report for children who had an initial 51A report ⁶
Asthma	T6	Children’s asthma diagnosis past year ³
Family		
Homelessness	T5	Family experienced homelessness since child’s birth ⁷

Calculating the Benefits of Participating in HFM

TIER conducted a literature review to estimate the monetary benefits or cost savings related to each of the focal outcomes attributed to reductions in health care, social services, legal system, and productivity loss costs.⁸⁻¹⁵

^b For example, parenting stress cost savings would incur via reductions in maltreatment reports or maternal depressive symptoms, each of which is already costed.

Using the estimated cost savings and effect sizes, we calculated the economic benefit for each outcome. Specifically, we used the following formula to calculate the net present value (NPV) for each outcome.

$$NPV = \sum_{t=0}^n [OutcomeCost * EffectSize_t - ProgramCost_0] / (1 + i)^t$$

Where:

t = time since enrollment in HFM

OutcomeCost = unit cost of outcome

EffectSize = treatment effect for outcome

ProgramCost = program cost of outcome

i = discount rate (3.5%)

We applied a discount rate of 3.5% for each year after enrollment an outcome occurred.

As seen in Table 2, for outcomes measured at T4, for example, benefits were discounted by 5 years. Discounting is done to account for time value of money, acknowledging that money earned today is worth more than money earned tomorrow, net of the initial investment. For programs like HFM where future benefits may be realized well after upfront costs are provided, it is important to account for this future investment.

Table 2. MHFE-2 Data Collection Schedule

Evaluation Time Point	Average Year of Data Collection	Time Since Enrollment
Time 1	2008	0 years
Time 2	2009	1 year
Time 3	2010	2 years
Time 4	2013	5 years
Time 5	2014	6 years
Time 6	2016	8 years

All monetary values were converted into 2008\$^c to align with the start of the study and were adjusted to reflect the cost of living in Massachusetts.^d Lifetime costs were converted to annual costs based on 79 years of life expectancy in Massachusetts.^e

Individual benefits were summed to get the total HFM benefits.

HFM Program Costs

The Children’s Trust of Massachusetts provided us with detailed HFM-related costs for the period of the evaluation, 2008 to 2016. Costs included staff salaries, fringe, training, travel, food, and participant allowances. To generate the average per family HFM program cost, we computed the average per family cost from 2008–

^c https://www.bls.gov/data/inflation_calculator.htm

^d <https://www.bankrate.com/real-estate/cost-of-living-calculator/>

^e <https://www.cdc.gov/nchs/pressroom/states/massachusetts/ma.htm>

2011, the years that the evaluation sample was enrolled in HFM. This average—\$2,863—was subtracted from the total benefits.

Section 3. The Benefits of HFM

In this section, we describe HFM impacts and provide details on how we derived the NPV for each of the focal outcomes.

Maternal Outcomes

Rapid Repeat Birth

Mothers were asked whether they experienced a repeat birth at T3 (when first-born children were approximately 2 years of age); data were validated using birth records. Subgroup analyses revealed that mothers in the HFM program group who identified as Hispanic/Latina and experienced psychological vulnerability (e.g., depressive symptoms, post-traumatic stress disorder, childhood history of child welfare involvement, and low social connection) had 81% lower odds of experiencing a rapid repeat birth than mothers in the control group.⁵ Table 3 presents the data used to calculate the NPV for rapid repeat birth.

Table 3. NPV for Rapid Repeat Birth

NPV Formula Component	Data	Comments
Time since enrollment in HFM	2 years	Outcome observed at T3
Effect size	0.78	
Annual outcome cost (MA 2008\$)	\$327	Average per person expenditure on unintended pregnancy ⁸
Effect size * outcome cost	\$254	
Discounted benefit per family	\$237	$(\text{Effect size} * \text{outcome cost}) / (1 + .035)^2$

\$ The discounted benefit for reduction in rapid repeat birth is \$237.

Substance Use

At T5, mothers reported on the frequency of binge drinking and marijuana and cocaine use in the past month. On average, mothers in the HFM group reported lower average frequency of substance use compared to mothers in the control group ($M = 0.14$ HFM, $M = 0.24$ control).² Table 4 presents the data used to calculate the NPV for maternal substance use.

Table 4. NPV for Maternal Substance Use

NPV Formula Component	Data	Comments
Time since enrollment in HFM	6 years	Outcome observed at T5
Effect size	0.24	
Annual outcome cost (MA 2008\$)	\$839	Per capita cost of excessive drinking ⁹
Effect size * outcome cost	\$201	
Discounted benefit per family	\$164	$(\text{Effect size} * \text{outcome cost}) / (1 + .035)^6$

\$ The discounted benefit for reduction in maternal substance use is \$164.

Asthma

At T6, mothers in the HFM program group were less likely to report being treated for asthma in the past year relative to the control group (11.3% HFM, 18.8% control).³ Table 5 presents the data used to calculate the NPV for maternal asthma.

Table 5. NPV for Maternal Asthma Treatment

NPV Formula Component	Data	Comments
Time since enrollment in HFM	8 years	Outcome observed at T6
Effect size	0.35	
Annual outcome cost (MA 2008\$) ^f	\$632	Asthma-related lifetime healthcare costs and productivity loss for asthma onset 10–19 years ¹⁰
Effect size * outcome cost	\$219	
Discounted benefit per family	\$166	$(\text{Effect size} * \text{outcome cost}) / (1 + .035)^8$

\$ The discounted benefit for reduction in maternal asthma treatment is \$166.

Depressive Symptoms

Mothers were screened for depressive symptoms using the Center for Epidemiological Studies Depression Scale (CES-D) at each time point. At T2 and T4, mothers in the HFM program group reported fewer depressive symptoms than mothers in the control group.^{1,2} Table 6 presents the data used to calculate the NPV for maternal depressive symptoms.

Table 6. NPV for Maternal Depressive Symptoms

NPV Formula Component	Data	Comments
Time since enrollment in HFM	1 year & 5 years	Outcome observed at T2 and T4
Effect size	0.21	
Annual outcome cost (MA 2008\$)	\$4,158	Annual societal cost (productivity losses, maternal health expenditures, and obstetric-specific health expenditures) per mother with perinatal mood and anxiety disorders ^{11,12}
Effect size * outcome cost	\$1,722	
Discounted benefit per family	\$1,556	$[(\text{Effect size} * \text{outcome cost}) / (1 + .035)] + [(\text{Effect size} * \text{outcome cost}) / (1 + .035)^5]$

^f Lifetime costs were converted to annual costs based on 79 years of life expectancy in Massachusetts.

\$ The discounted benefit for reduction in maternal depressive symptoms is \$1,556.

ED Use

At T4, mothers in the HFM program group were less likely to report ED visits relative to the control group (66.4% HFM, 78.5% control).² Table 7 presents the data used to calculate the NPV for ED use.

Table 7. NPV for Maternal ED Use

NPV Formula Component	Data	Comments
Time since enrollment in HFM	5 years	Outcome observed at T4
Effect size	0.35	
Annual outcome cost (MA 2008\$)	\$688	Average cost of ED visit ¹³
Effect size * outcome cost	\$240	
Discounted benefit per family	\$202	$(\text{Effect size} * \text{outcome cost}) / (1 + .035)^5$

\$ The discounted benefit for reduction in maternal ED use is \$202.

Child Outcomes

Maltreatment Recurrence

Maltreatment recurrence was proxied using 51A reports from DCF. Recurrence was operationalized as having a second report. Using records from the time of children’s birth through August 2016, analyses revealed that 51.7% of children had an initial report, with 53.4% of these families experiencing report recurrence.⁶ Children in the HFM program group had a lower risk of recurrence than children in the control group (49.1% HFM, 60.4% control), and had a longer duration between the first and second reports. Table 8 presents the data used to calculate the NPV for children’s maltreatment recurrence.

Table 8. NPV for Children’s Maltreatment Recurrence

NPV Formula Component	Data	Comments
Time since enrollment in HFM	4 years	51A data were available from 2008–2016; 4 years (2012) is the median number of years from enrollment when recurrence was measured
Effect size	0.25	
Annual outcome cost (MA 2008\$)[§]	\$14,582	Non-fatal child maltreatment per-victim lifetime cost ¹⁴
Effect size * outcome cost	\$3,696	
Discounted benefit per family	\$3,221	$(\text{Effect size} * \text{outcome cost}) / (1 + .035)^4$

[§] Lifetime costs were converted to annual costs based on 79 years of life expectancy in Massachusetts.

\$ The discounted benefit for reduction in children’s maltreatment recurrence is \$3,221.

Asthma

At T6, when children were about 8 years of age, mothers in the HFM program group were less likely to report an asthma diagnosis for their child in the past year relative to the control group (7.2% HFM, 14.3% control).³ Table 9 presents the data used to calculate the NPV for children’s asthma.

Table 9. NPV for Children’s Asthma Diagnosis

NPV Formula Component	Data	Comments
Time since enrollment in HFM	8 years	Outcome observed at T6
Effect size	0.43	
Annual outcome cost (MA 2008\$)	\$761	Asthma-related lifetime healthcare costs and productivity loss for asthma onset 6–9 years ^{10h}
Effect size * outcome cost	\$326	
Discounted benefit per family	\$247	$(\text{Effect size} * \text{outcome cost}) / (1+.035)^8$

\$ The discounted benefit for reduction in children’s asthma diagnosis is \$247.

Family Outcome

Homelessness

At T5, mothers were asked to report any experiences of homelessness since the birth of their child. Homelessness was defined by any of the following: not having a place to live; living in a temporary, transitional, or homeless shelter; living in a motel; living on the streets; or temporarily living with others. Families in the HFM program group were less likely to experience homelessness than families in the control group (28.6% HFM, 39.2% control).⁷ Table 10 presents the data used to calculate the NPV for family homelessness.

Table 10. NPV for Family Homelessness

NPV Formula Component	Data	Comments
Time since enrollment in HFM	6 years	Outcome observed at T5
Effect size	0.30	
Annual outcome cost (MA 2008\$)	\$12,731	Homelessness per-case average annual cost ¹⁵
Effect size * outcome cost	\$3,838	
Discounted benefit per family	\$3,122	$(\text{Effect size} * \text{outcome cost}) / (1+.035)^6$

^h Lifetime costs were converted to annual costs based on 79 years of life expectancy in Massachusetts.

\$ The discounted benefit for reduction in family homelessness is \$3,122.

Total Benefits

Table 11 below summarizes the total per family HFM benefits relative to the cost per family.

Table 11. HFM Benefits, Costs, and NPV

HFM Outcome	Benefit per Family (2008\$)
Maternal	
Rapid repeat birth	\$237
Substance use	\$164
Asthma	\$166
Depressive symptoms	\$1,556
ED use	\$202
Child	
Maltreatment recurrence	\$3,221
Asthma	\$247
Family	
Homelessness	\$3,122
Total benefits	\$8,915
HFM program cost	\$2,863
NPV (benefits - cost)	\$6,052
Benefit to cost ratio	\$3.11 to \$1

\$ Overall, for each dollar invested in HFM, there is a return of \$3.11.

Sensitivity Analyses

We conducted a series of sensitivity analyses to validate the results. Each is described below.

1. Adjusting Average Cost Per Family

The average HFM cost per family figure does not account for the fact that some families assigned to the HFM program group did not receive any home visits and some families received many home visits. Thus, we calculated a per home visit cost to adjust overall costs by the number of home visits each family participating in the evaluation. We outline our approach below:

- Among families assigned to the HFM program group, the average number of home visits received per family was 24.
- Using the average cost per family of \$2,863, we calculated the average cost per family per visit, which was \$119.

- Multiplying the average cost per family per visit with the actual number of visits each family received, we calculated the adjusted average cost per family.
- We then added the average cost per family across the 433 program participants and divided it by 372, the number of families that had at least one home visit (i.e., 61 families did not receive any home visits), resulting in an adjusted average cost per family of \$3,332.

Table 12 presents the revised NPV calculation using the adjusted average cost per family.

Table 12. NPV using Adjusted Costs

	Per Family (2008\$)
Total benefits	\$8,915
Adjusted HFM program cost	\$3,332
NPV (benefits - cost)	\$5,583
Benefit to cost ratio	\$2.68 to \$1

\$ Using adjusted costs, for each dollar invested in HFM, there is a return of \$2.68.

2. Adjusting Total Benefits and Average Cost Per Family

While the effect size calculations accounted for sample sizes, we implemented a further adjustment here to explicitly weigh benefits by HFM program group sample sizes for each outcome to account for missing data and sample attrition.¹⁶⁻¹⁹ We summarize our approach below:

- We start with the eight average discounted benefits per family described in Section 3.
- We then multiplied each of these benefits by the HFM program group sample for each outcome and compute the sum to get the total benefits across families, \$2,073,871.
- We then divided the total benefits by 433, which is the full program group sample. This resulted in an adjusted per family average discounted benefit of \$4,790.

Table 13 presents the NPV calculation using the adjusted average cost per family and the adjusted average discounted benefit per family.

Table 13. NPV using Adjusted Costs and Adjusted Benefits

	Per Family (2008\$)
Adjusted benefits	\$4,790
Adjusted HFM program cost	\$3,332
NPV (benefits - cost)	\$1,458
Benefit to cost ratio	\$1.44 to \$1

\$ Using adjusted costs and benefits, for each dollar invested in HFM, there is a return of \$1.44.

3. Using Different Discount Rates

CBA studies use different discount rates. For example, the Washington State Institute for Public Policy (WSIPP) Benefit-Cost Model used a range of discount rates to calculate NPV: 2%, 3.5%, and 5%.²⁰ The Congressional Budget Office used 3% in the analyses of Social Security,²¹ and the Council of Economic Advisors recommended using 2%.²² While we chose to use a 3.5% discount rate for our main analyses, Table 14 presents NPV calculations for a variety of discount rates: 5%, 3%, and 2%.

Table 14. NPV using Discount Rates of 5%, 3%, and 2%.

HFM Outcome	Benefit per Family (2008\$)		
	Discount Rate of 5%	Discount Rate of 3%	Discount Rate of 2%
Maternal			
Rapid repeat birth	\$231	\$240	\$244
Substance use	\$150	\$168	\$179
Asthma	\$148	\$173	\$187
Depressive symptoms	\$1,493	\$1,578	\$1,623
ED use	\$188	\$207	\$217
Child			
Maltreatment recurrence	\$3,041	\$3,284	\$3,415
Asthma	\$221	\$257	\$278
Family			
Homelessness	\$2,864	\$3,214	\$3,408
Total benefits	\$8,336	\$9,121	\$9,551
HFM program cost	\$2,863	\$2,863	\$2,863
NPV (benefits - cost)	\$5,473	\$6,258	\$6,688
Benefit to cost ratio	\$2.91 to \$1	\$3.19 to \$1	\$3.34 to \$1

\$ For each dollar invested in HFM, there is a return of:

- \$2.91 when using a 5% discount rate,
- \$3.19 when using a 3% discount rate, and
- \$3.34 when using a 2% discount rate.

Summary of CBA

Table 15 presents the total benefits, costs, NPV, and benefit-cost ratios from the main NPV and sensitivity analyses calculations.

Table 15. Summary of HFM Benefits, Costs, and NPV

	Per Family (2008\$)					
	Main NPV	Adj. Cost	Adj. Cost & Benefits	Main + Discount Rate 5%	Main + Discount Rate 3%	Main + Discount Rate 2%
Total benefits	\$8,915	\$8,915	\$4,790	\$8,336	\$9,121	\$9,551
HFM program cost	\$2,863	\$3,332	\$3,332	\$2,863	\$2,863	\$2,863
NPV (benefits - cost)	\$6,052	\$5,583	\$1,458	\$5,473	\$6,258	\$6,688
Benefit to cost ratio	\$3.11 to \$1	\$2.68 to \$1	\$1.44 to \$1	\$2.91 to \$1	\$3.19 to \$1	\$3.34 to \$1

Section 4. Conclusion

This report presented findings from an economic analysis of HFM based on data from TIER’s MHFE-2 study. Focusing on core impacts from the evaluation including maltreatment recurrence for children; maternal depressive symptoms, substance use, and emergency department visits; asthma for children and mothers, families’ experience of homelessness, the return on investment for HFM was estimated at \$3.11. Sensitivity analyses using adjusted costs, adjusted benefits, and different discount rates indicated the lower bound return on investment was \$1.44 and the upper bound, \$3.34.

To put these figures into perspective, estimates from the WSIPP meta-analyses indicated a benefit to cost ratio of \$1.81 for HFAⁱ and \$1.47 for Nurse-Family Partnership (NFP).^j Another analysis of NFP reported a higher ratio at \$4.24.¹⁶ Our reported estimates, ranging from \$1.44 to \$3.34 are in line with these other studies.

HFM is a cost-effective home visiting program serving young parents across Massachusetts.

ⁱ <https://www.wsipp.wa.gov/BenefitCost/Program/119>

^j <https://www.wsipp.wa.gov/BenefitCost/Program/35>

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