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Economic Evaluation of a Comprehensive Teenage Pregnancy Prevention Program: Pilot Program

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Abstract

Background—Previous research has suggested that comprehensive teenage pregnancy prevention programs that address sexual education and life skills development and provide academic are effective in reducing births among enrolled teenagers. However, there have been limited data on costs and cost-effectiveness of such programs.

Objectives—To use a community-based participatory research approach, to develop estimates of the cost-benefit of the Pathways/Senderos Center, a comprehensive neighborhood-based program to prevent unintended pregnancies and promote positive development for adolescents.

Methods—Using data from 1997–2003, we conducted an in-time intervention analysis to determine program cost-benefit while teenagers were enrolled and then used an extrapolation analysis to estimate accyrred economibc benefits and cost-benefit up to age 30.

Results—The program operating costs totaled \$3,228,152.59 and reduced the teenage childbearing rate from 94.10 to 40.00 per 1000 teenage females, averting \$52,297.84 in total societal costs, with an economic benefit to society from program participation of \$2,673,153.11. Therefore, total costs to society exceeded economic benefits by \$559,677.05, or \$1,599.08 per adolescent per year. In an extrapolation analysis, benefits to society exceed costs by \$10,474.77 per adolescent per year by age 30 on average, with social benefits outweighing total social costs by age 20.1.

Conclusions—We estimate that this comprehensive teenage pregnancy prevention program would provide societal economic benefits once participants are young adults, suggesting the need to expand beyond pilot demonstrations and evaluate the long-range cost-effectiveness of similarly comprehensive programs when implemented more widely in high-risk neighborhoods.

Keywords

teenage pregnancy prevention; cost-benefit analysis

Introduction

Each year in the United States, more than 400,000 children are born to teenage mothers¹ are at high risk of preterm birth, low birth weight, child abuse, poverty, and death,²⁻⁶ and more likely to have educational underachievement and mental health problems.⁷ Teenage mothers are at high risk for dropping out of high school and for having low self-esteem and symptoms of depression.⁸⁻¹⁰ More than 75% of teenage mothers receive public assistance within five years of their child's birth.¹¹

A variety of programs¹²⁻¹⁶ are effective in reducing births among teenagers who participate. The most effective programs address a comprehensive range of social and behavioral issues in addition to providing sexual education,¹⁷ such as access to birth control, life skill development, academic support, and job training. Such comprehensive programs reduce participants' pregnancy rates,¹⁴ substance use/abuse, violent or criminal behavior, and poverty¹⁶ and increase use of primary health care¹⁴ and rates of graduating from high school.¹⁶

There is limited evidence of cost-effectiveness of such programs.¹⁸ Because these programs require substantial investment, understanding their cost-benefit is critical for informing policies to promote larger-scale implementation. In this study, we sought to estimate the cost-benefit of one comprehensive program, the Greater New Britain Teen Pregnancy Prevention's Pathways/Senderos Center. Our goal was to examine cost-effectiveness both during program participation and, using extrapolation, through early adulthood.

Methods

Program

The Pathways/Senderos Center is a comprehensive neighborhood-based program to prevent unintended pregnancies and promote positive youth development for middle school and high school students, operated by Greater New Britain Teen Pregnancy Prevention, Inc. The program, modeled after the Children's Aid Society-Carrera program in Harlem, NY,¹⁴ uses a case management and "parallel family-systems" approach, meaning that staff are available to the adolescents twenty-four hours a day and seven days a week.¹⁹ The program provides six integrated components to males and females: 1) education about family life, sex, and health; 2) academic support, including tutoring and weekly monitoring of progress; 3) career and vocational preparation; 4) artistic expression; 5) recreation; and 6) health and mental health care referrals. The program serves males and females from ages 11 to 18 from the Arch Street area, an impoverished, largely Latino neighborhood in New Britain, Connecticut. Students generally enroll at age 11 and participate daily until high school graduation, with infrequent contact thereafter.

Due to limited local public transportation youth are recruited by program outreach workers from as far away from the Center as they are willing to walk. All sixth-grade boys and girls are eligible for enrollment. The bilingual outreach workers obtain suggestions for possible participants from current program youth and families and advertise the after-school program and its job club stipends at school bus stops. The program also receives referrals from the schools where program staff make presentations to sixth-graders.

Analytic Framework for Economic Evaluation

We estimated total program costs and benefits from a societal perspective over the 7-year period for which adolescents are enrolled (Figure 1). Total societal costs were defined as the total operating costs of the program. Total societal benefits included the sum of 1) the total costs averted from prevention of births to teenage females that we estimated would have occurred without the program and 2) the additional economic benefits from participating independent from prevention of births. We assumed that the opportunity cost of participation was \$0; since there are otherwise few wage earning and enrichment activities available locally, the youth lost leisure time, only.

We used data are from the most recent 7 years of the program (1997-2003) for which teenage birth data were available on all participants. We used a community-based participatory approach (see on-line appendix); the academic partners proposed an in-time intervention analysis, calculating the cost-benefit of the period of the program (age 11 until high school graduation). and community partners proposed an extrapolation analysis to estimate program cost-benefit up to age 30. We discounted future benefits at 3%.²⁰ Specific analysis steps are described below. We performed sensitivity analyses on estimated net benefit to determine robustness of conclusions. All economic estimates were adjusted for inflation²¹ and stated in December 2006 dollars. The Yale University School of Medicine Institutional Review Board approved an exemption for our protocol.

Program Costs: Operating Costs

We calculated average annual operating costs of the program from 1997-2003, C_{program} . Operating costs included salaries and benefits for administrative and program staff, rent and utilities, maintenance, food, expenses for fundraising activities, the establishment and maintenance of the on-site work experience and training program, and other miscellaneous costs. Revenue generated from fundraisers was treated as an offset to program operating costs.

Program Benefits: Teenage Births Averted

To determine expected births among teenage females, we calculated an expected birth rate, q_{ij} (where i =race/ethnicity and j =age group), for each race/ethnicity-age group stratum in New Britain, Connecticut (i.e., white females age 10-14, Latina/Hispanic females age 15-19). This expected birth rate, q_{ij} , is the average number of births among each race/ethnicity-age group stratum, B_{ij} , divided by the average population of teenage females of each race/ethnicity-age stratum living in New Britain, Connecticut, P_{ij} . To calculate B_{ij} , we used 1997-2003 data from the Connecticut Department of Public Health,²² which provided annual birth data categorized by race/ethnicity (white, black, Latina/Hispanic, and other) and by age-group (10-14 years, 15-17 years, and 18-19 years). To calculate the average population of teenage females of each race/ethnicity-age stratum living in New Britain, Connecticut, P_{ij} , we used data from the 2000 U.S. Census²³ categorized by race/ethnicity (white, black, Latina/Hispanic, and other) and by age-group (10-14 years and 15-19 years). Race/ethnicity was determined by the participant at in-take.

To estimate the probability of teenage childbearing among females for each year of age rather than for the overall age group, q_{iy} (where y =year of age), we divided the expected birth rate for each race/ethnicity-age group stratum (q_{ij}) by the number of years included within the age group. For example, the probability of a 14-year old white female giving birth is the expected birth rate for her race/ethnicity-age group stratum (white, 10-14 years olds) divided by 5, as 5 years of ages are included in the age group:

$$q_{\text{white, age 14 year}} = (B_{\text{white, age 10-14 years}} / P_{\text{white, age 10-14 years}}) 5 \text{ years}$$

To calculate the race/ethnicity-specific probability of teenage childbearing between ages 11 to high school graduation, Q_i , we summed the probabilities of teenage childbearing for each specific year of age, y , so that $Q_i = \sum q_{iy}$ (where $y = 11, 12, \dots, 18$ years of age).

We applied these race/ethnicity-specific probabilities of teenage childbearing to the population of females enrolled in the Pathways/Senderos Center to calculate the estimated number of births that the enrollees would have had without the program. The estimated number of births was compared to the actual number for program participants in 1997-2003. The documentation of model parameters, sources and assumptions are provided in Tables 1 and 2.

Program Benefits: Costs Averted by Reducing Teenage Births

We calculated the total societal costs averted by reducing the number of teenage births through the program, C_{averted} , by multiplying the number of births averted using previously published estimates of the societal costs of teenage childbearing among females that are averted by delaying childbearing from age 18 until age 20 or 21.⁶ Previous research has estimated costs averted for two distinct kinds of teenage pregnancy prevention programs (Table 3): 1) programs that are narrowly focused on reducing teenage childbearing as the sole goal, and 2) programs that are focused not only on reducing teenage childbearing but also addressed educational, professional, and health issues.

The societal costs averted by a more narrowly focused program include earnings-related outcomes for teenage mothers (slightly increased productivity as a consequence of greater work effort); earnings-related outcomes for fathers of children born to teenage mothers (decreased productivity from lower educational and labor-skill attainment and subsequent decreased provision of resources to mothers and children); earnings-related outcomes for children born to teenage mothers (decreased productivity from lower educational attainment); public assistance (cash assistance, food stamp benefits, rent subsidies, medical assistance for parents and children, and the administrative costs of public assistance programs); administrative costs of foster care programs; and incarceration costs of male children born to teenage mothers.⁶ The societal costs averted by a more broadly focused program include the benefits of the narrowly focused program plus improvements in educational and employment opportunities, decreased social and economic support needs, improved personal motivation, and improved peer group influence.⁶ As the Pathways/Senderos Center is broadly focused, we used the latter estimates to calculate averted costs.

Program Benefits: Economic Value of Program Participation

We estimated the societal benefit of program participation, B_{program} , derived from teenagers' exposure to educational, professional, and health-related curriculum, for teenage males and for teenage females who did not bear children before high school graduation. Using previously published estimates,⁶ we calculated the difference per program participant between societal costs of teenage childbearing averted for comprehensive versus narrowly-focused programs.

Program Net Benefit

We calculated the net benefit of the program as the total societal benefit minus the total societal costs of the program. To calculate the total social benefit of the program, we summed the societal costs of teenage childbearing averted among females enrolled in the

program, C_{averted} , and the economic value of program participation among males and females, B_{program} . From this sum we subtracted the total program operating costs, C_{program} .

$$\text{Net Benefit}_{\text{program}} = (C_{\text{averted}} + B_{\text{program}}) - C_{\text{program}}$$

Sensitivity Analysis

To determine the robustness of findings, we performed sensitivity analyses to examine the time horizon for which the total social costs and benefits of the program are equivalent. For our in-time intervention analysis, we varied key variables (number of students, proportion female, expected pregnancy rates for non participants and participants, average age of childbearing, annual program costs, and discount rate for future benefits) over a reasonable range to determine at which point the program's economic benefit exceeded program costs. Data analysis was performed using Microsoft Office Excel 2003 (Microsoft Corporation, Redmond, WA).

Results

For the period from 1997-2003, the Pathways/Senderos Center enrolled 50 students per year in a year-round curriculum with expected daily participation for seven years. Each year, three to seven students graduate high school and leave the program, opening new spots. During the last decade, approximately half of enrollees were female, nearly 95% were Latino/Hispanic, and the remainder were black/African-American. From 1997-2003, all enrollees graduated high school on time, 57% matriculated at a 4 year college and, to date, 14% have graduated from a 4 year college.

Program Costs: Operating Costs

From 1997-2003, the total inflation-adjusted program operating costs averaged \$469,304.01 per year, or \$3,285,128.08 for seven years (C_{program}), for an cost per student per year of \$9,386.08 and seven-year total cost per student of \$65,702.56.

Program Benefits: Teenage Births Averted

We calculated an expected pre-high school graduation birth rate in New Britain, Connecticut of 50.33 per 1000 females (Table 2). Adjusting for the ethnic distribution of program participants who are predominantly Latino/Hispanic, we calculated an expected pre-high school graduation birth rate of 94.10 per 1000 females or 2.35 for the 25 females in a cohort of 50 students between enrollment at 11 and high school graduation.

In comparison, from 1997-2003, one female participant of 25 bore a child, for a teenage childbearing rate of 40.00 per 1000, an estimated reduction of 54.10 teenage births per 1000 females, or 1.35 teenage births averted among the 25 females.

Program Benefits: Costs Averted by Reducing Teenage Births

The societal costs of teenage childbearing averted by a broadly focused teenage pregnancy prevention program are estimated to be \$15,978.32 per teenage mother per year (Table 3). Using Connecticut Department of Public Health data,²² we determined that the average age of teenage childbearing among teenage mothers was 16.24 years, 2.42 years before high school graduation and 3.76 years before age 20. We estimated that by averting 1.35 teenage births for 2.42 years, the Pathways/Senderos Center averted \$52,297.84 in societal costs (C_{averted}) during program years; and using the extrapolation analysis, \$81,256.15 in societal costs was averted by averting 1.35 teenage births for 3.76 years.

Program Benefits: Economic Value of Program Participation

The added benefit of participating during program years, B_{program} , is estimated at \$7,793.45 per teenager per year, or \$54,554.15 per teenager for total benefit of \$2,673,153.11 among a cohort of 50 students. In the extrapolation analysis, this cohort benefit was \$3,165,815.23 by age 20, \$5,017,928.45 by age 25, and \$6,870,041.68 by age 30.

Program Net Benefit

Considering total program operating costs, societal costs averted by reducing teenage births and economic benefits of participation, the total operating costs exceeded economic benefits by \$559,677.05 during the program years, or \$1,599.08 per teenager (Table 4). In the extrapolation analysis program net benefits were \$10,474.77 per program participant by the time they would reach age 30. In sensitivity analysis, total social benefits would outweigh total social costs by reaching age 20.10.(Table 4).

Sensitivity Analysis

Sensitivity analyses suggested the net societal cost of the program during program years would be less than \$0.00 (cost saving) per teenager per year if the number of students exceeded 60 or annual program operating costs were reduced by at least 17.00%. The net societal costs of the program never exceeded \$50,000 per teenager per year when varying any given variable value.

Discussion

Our analysis suggests that from a societal perspective, the total benefits from participation in the Pathways/Senderos Center would exceed the total costs of the program once enrollees reach age 20.1 months while costs modestly exceed benefits by about \$1,600 per teen per year during participation. This suggests that investments in such programs may yield longer-term net societal gains. Our estimated program costs were somewhat higher than would be the case for ongoing programs because they included the start-up costs for the work-experience program. In particular, program costs per person per year decreased from 2003 to 2007 from \$9,386 to \$8,025. Calculated expected birth rates for non-program participants are conservative, as they are based on city-wide estimates rather than limited to this impoverished neighborhood. Our estimate of long-range benefits are conservative because they account only for the economic gain from high school graduation, not higher educational attainment.²⁴ More than half of participants have entered 4-year colleges, compared to an expected matriculation rate among poor teenagers of 35%.²⁵ Further, our estimates of costs averted do not include future savings in costs of special education for children born to teenage mothers.⁷ We also did not estimate the economic impact of teenage childbearing on the parental household.

Our findings suggest that the long-run net economic benefit from the Pathways/Senderos program is largely due to the program's success in addressing decision-making and overall life skills, and promotion of an adolescent's sense of responsibility, fulfilling important unmet needs of teenagers in a high-risk neighborhood, beyond the value of a pregnancy prevention program. Children from impoverished families are less likely to start school ready to learn,²⁶ are more likely to attend poorly functioning schools,²⁷ and are less likely to graduate high school.²⁵ Programs like the Pathways/Senderos Center that are broadly focused on improving the lives of impoverished youth, and not just on pregnancy prevention, can be an important resource for teens in the most at-risk neighborhoods, supplementing their education and creating greater occupational opportunities.

Despite the potential economic benefits of a comprehensive model of teenage pregnancy prevention, such programs are limited in number across the country. Previous literature¹⁴⁻¹⁶ has shown that teenage pregnancy prevention programs featuring comprehensive curricula are most successful in reducing pregnancy rates. Our study extends the literature by evaluating the costs and benefits to society of such a comprehensive program. Such programs require greater up-front investment than do narrower pregnancy prevention programs, and their net economic benefits occur in the future and do not address immediate fiscal concerns of policymakers. Supporting these programs requires policy and funding leadership that understands the value of investing in the future for underserved youth and families, and of budget neutrality or even net-gain in the long run.

Community-Academic Partnership

Community partners suggested the need for this analysis and provided key additions to its scope, potential program impact, and meaning of findings.

A common issue in CBPR, apparent throughout this project, was the tension between the academic and community partners regarding the framing and dissemination of the findings.²⁸ The academic partners focused on how the research would be viewed by peer-reviewed journals and research experts, and the community partners focused on how the research would be viewed by potential funders and Board members. A sustained period of engagement facilitated sharing of perspectives and development of an integrated set of objectives and analysis. Our experience suggests that an engaged partnership can initiate and conduct a rigorous cost-effectiveness analysis that is useful to both local program planning and to the academia.

Limitations of our community-academic approach and our economic analysis are in the on-line appendix.

Implications—This is a pilot and a first effort to apply cost-benefit analysis; even given these caveats, the outcomes appear promising and support investment, through larger demonstrations that can address remaining technical and partnership challenges. Comprehensive teenage pregnancy prevention programs reflect the philosophy that altering the factors that lead to teenage pregnancy and adolescent childbearing requires tremendous effort. An adolescent makes a myriad of decisions over many years that ultimately determine whether or not she/he avoids adolescent parenting. If an intervention is to succeed, it must be sustained year-round, throughout adolescence, and, like Carrera's "parallel family-system,"¹⁹ staff members must be available to program participants even during non-program hours; such commitment and attendant costs may make more comprehensive programs less appealing for policy makers who focus on demonstration of immediate cost neutrality or savings. This partnered study offers a perspective to policy makers, program planners, and communities to consider longer-term goals when investing in programs that address such challenging problems such as teenage pregnancy in underserved youth.

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1. Calculated: Operating costs of the program (C_{oper})
 2. Calculated: Number of teenage births averted by the program
 3. Calculated: Social costs averted due to the program's prevention of teenage births (C_{social})
 4. Additional monetary benefits derived from participating in the program (B_{add})
 5. Calculated: net social benefit of the program for teenagers (B_{net})
- $$B_{\text{net}} = B_{\text{add}} - C_{\text{oper}} - C_{\text{social}}$$

Figure 1. Five Steps of the Analysis

Table 1

Data Used to Calculate Teenage Births Averted

Data Used (Variable)	Reference	Value *
Average annual population of females aged 10-14 (P_{10-14})	2000 U.S. Census ²³	Overall [†] 2418 White 881 Black 307 Latina/Hispanic 1103
Average annual population of females aged 15-19 (P_{15-19})	2000 U.S. Census ²³	Overall [†] 2648 White 1243 Black 307 Latina/Hispanic 973
Average annual number of teenage births among females aged <15 (B_{10-14})	Connecticut Department of Public Health ²²	Overall [†] 3.43 White 0.43 Black 0.14 Latina/Hispanic 2.86
Average annual number of teenage births among females aged 15-17 (B_{15-17})	Connecticut Department of Public Health ²²	Overall [†] 70.00 White 6.86 Black 4.71 Latina/Hispanic 54.57
Average annual number of teenage births among females aged 18-19 in community (B_{18-19})	Connecticut Department of Public Health ²²	Overall [†] 108.29 White 19.29 Black 10.43 Latina/Hispanic 72.00
Race/ethnicity of enrolled students, %	Pathways/Senderos Center [‡]	White 0% (0-10%)* Black 5% (0-10%)* Latina/Hispanic 95% (80-100%)*
Number of females enrolled	Pathways/Senderos Center [‡]	Total 25 (10-40)*

Data Used (Variable)	Reference	Value*
Average number of years prior to age 18 of teenage childbearing, among teenage mothers	Connecticut Department of Public Health ²²	Total 2.42 (0.50-6.00) [*]

* Values in parentheses were used for sensitivity analyses.

[†] The sum of the rows for White, Black, and Latina/Hispanic does not equal the Overall row because other races and ethnicities were also accounted by both the 2000 U.S. Census and the Connecticut Department of Public Health.

[‡] Average number/proportion enrolled in the Pathways/Senderos Center from 1997-2003.

Table 2

Variables Calculated to Estimate Expected Teenage Births*

Data Used (Variable) with Formula		Average annual number of teenage births among females	Average annual female population	Calculation	Result
Teenage birth rate per 1000 females, Age 10-14	Overall	3.43	2418	$[(3.43/2418) * 1000]/5$	0.28
	White	0.43	881	$[(0.43/881) * 1000]/5$	0.10
	Black	0.14	307	$[(0.14/307) * 1000]/5$	0.09
	Latina/Hispanic	2.86	1103	$[(2.86/1103) * 1000]/5$	.52
Teenage birth rate per 1000 females, Age 15-18	Overall	70.00+108.29	2648	$[(70.00+108.29)/2648] * 1000/4$	13.47
	White	6.86+19.29	1243	$[(6.86+19.29)/1243] * 1000/4$	4.21
	Black	4.71+10.43	307	$[(4.71+10.43)/307] * 1000/4$	9.86
	Latina/Hispanic	54.57+72.00	973	$[(54.57+72.00)/973] * 1000/4$	26.02
Teenage birth rate per 1000 females until high school graduation in community ($Q = \sum q_i$) [†]	Overall			$((3.33) * (0.28)) + (3.67) * (13.47)$	50.33
	White			$((3.33) * (0.10)) + (3.67) * (4.21)$	15.75
	Black			$((3.33) * (0.09)) + (3.67) * (9.86)$	36.46
Teenage birth rate per 1000 females until high school graduation in community reflecting Pathways/Senderos Center enrollment (Q_{Black})	Latina/Hispanic			$((3.33) * (0.52)) + (3.67) * (26.02)$	97.14
	Reflecting Pathways/Senderos Center enrollment			$((0.95) * (97.14)) + ((0.05) * (36.46))$	94.10

* Calculations may not result in calculated values because of rounding.

[†] Formula for high school graduation: $((0.33) * (q_{11})) + q_{12} + q_{13} + q_{14} + q_{15} + q_{16} + q_{17} + ((0.67) * (q_{18}))$; to account for most teenagers reaching age 12 during their first year of middle school as well as reaching age 18 during the final year of high school.

Table 3

Estimated Annual Societal Costs Averted by Delaying Teenage Childbearing until Age 20 per Teenage Mother (December 2006 US Dollars).*

Outcome Measure	Societal Costs Averted*	
	Addressing <i>Only</i> Teenage Childbearing (N_{costs})	Addressing Maximum Set of Related Factors (M_{costs})
Earnings-Related Outcomes (\$ Billion)	\$8.30	\$24.76
Mother's earnings	(\$1.30)	\$12.70
Father's earnings	\$9.59	\$12.05
Public Assistance (\$ Billion)	\$2.33	\$2.20
Medical assistance for children	\$2.20	\$1.68
Administrative costs	\$0.13	\$0.52
Other Consequences (\$ Billion)	\$9.07	\$11.54
Out-of-pocket costs of children's health care	(\$0.65)	(\$0.65)
Foster care	\$1.81	\$2.07
Incarceration of male children	\$1.30	\$3.11
Productivity of adult children	\$6.61	\$7.00
Total per Year (\$ Billion)	\$19.70	\$38.36
Average per Teen Parent per Year (C_{averted})	\$8,184.87	\$15,978.32

* Values may not sum to column total because of rounding.

Source: Maynard RA.⁶

Table 4

Net societal benefit of the Pathways/Senderos Center.

Assumption: 50 teenagers (25 females, 25 males) enrolled in Pathways/Senderos Center for 7 years from age 11 to high school graduation	
Total operating costs (C_{program})	\$3,285,128.08
Societal costs averted by reducing teenage births (C_{averted})	\$52,297.84
Economic benefits of participation (B_{program})	\$2,673,153.11
Net societal benefit, per teenager per year of participation ($((C_{\text{averted}} + B_{\text{program}}) - C_{\text{program}})/50/7$)	
Through program completion (high school graduation)	(\$1,599.08)
Through age 20	(\$108.73)
Through age 20.10	\$0.00
Through age 25	\$5,183.02
Through age 30	\$10,474.77