

The American Journal of Drug and Alcohol Abuse, 31:471–490, 2005
Copyright © Taylor & Francis Inc.
ISSN: 0095-2990 print / 1097-9891 online
DOI: 10.1081/ADA-200056813

Preventing Alcohol and Drug Exposed Births in Washington State: Intervention Findings from Three Parent-Child Assistance Program Sites

**Therese M. Grant, Ph.D.,¹ Cara C. Ernst, M.A.,²
Ann Streissguth, Ph.D.,² and Kenneth Stark, M.Ed., M.B.A.³**

¹Department of Psychiatry and Behavioral Sciences and Department of Epidemiology, University of Washington, Seattle, Washington, USA

²Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle, Washington, USA

³Division of Alcohol and Substance Abuse, Washington State Department of Social and Health Services, Seattle, Washington, USA

Abstract: Home visitation interventions show promise for helping at-risk mothers, yet few programs have been developed and evaluated specifically for alcohol and drug-abusing pregnant women. This study examines outcomes among 216 women enrolled in the Washington State Parent-Child Assistance Program, a three-year intervention program for women who abuse alcohol and drugs during an index pregnancy. Pretest-posttest comparison was made across three sites: the original demonstration (1991–1995), and the Seattle and Tacoma replications (1996–2003). In the original demonstration, the client group performed significantly better than controls. Compared to the original demonstration, outcomes at replication sites were

Address correspondence to Therese M. Grant, Ph.D., Department of Psychiatry and Behavioral Sciences and Department of Epidemiology, University of Washington, 180 Nickerson, Suite 309, Seattle, WA 98109, USA; Fax: (206) 685-2903; E-mail: granttm@u.washington.edu

maintained (for regular use of contraception and use of reliable method; and number of subsequent deliveries), or improved (for alcohol/drug treatment completed; alcohol/drug abstinence; subsequent delivery unexposed to alcohol/drugs). Improved outcomes at replication sites are not attributable to enrolling lower-risk women. Public policies and programs initiated over the study period may have had a positive effect on outcomes. Study findings suggest that this community-based intervention model is effective over time and across venues.

Keywords: Prevention, intervention, prenatal substance abuse, home visitation, fetal alcohol syndrome

INTRODUCTION

Maternal alcohol and drug abuse during pregnancy remains a serious public health concern (1–7). Prenatal exposure incurs physical and neurodevelopmental risk for the child (8–10) and a birth mother with an untreated substance abuse problem is likely to provide a compromised home environment and continue to have repeat exposed pregnancies (11–13). Home visitation has emerged as a promising intervention for helping at-risk mothers improve parenting skills and become healthier and more self-sufficient, yet few programs have been developed and evaluated specifically for women who abuse alcohol and drugs during pregnancy (14–20).

The Parent–Child Assistance Program (PCAP, originally known as the Birth to 3 Project) is a three-year home visitation intervention that began in Seattle in 1991 as a federally-funded research demonstration with a primary aim of preventing subsequent alcohol and drug exposed births among mothers who abused alcohol and/or drugs during an index pregnancy. Research findings demonstrated the model's efficacy compared to controls, and in 1996 researchers obtained funding from the state of Washington and private philanthropy to replicate the intervention arm of the project at two sites, in Seattle (King County) and Tacoma (Pierce County), the two largest cities in Washington. The resources were targeted for direct intervention services in response to community need and for program evaluation; funding for comparison groups was not available. This article describes three-year intervention findings from the initial three PCAP sites: the original demonstration (1991–1995), the Seattle replication (1996–2003), and the Tacoma replication (1996–2003).

In 1999, two additional PCAP sites were funded through Washington State legislative appropriation. Sufficient data were not available from these sites to include in the present analysis. A dozen maternal intervention programs in the U.S. and Canada have been modeled on PCAP concepts (21).

METHODS

Participants

The original demonstration (OD) sample was recruited from July 1991 through December 1992 and exited the program between July 1994 and December 1995. The Seattle replication (SR) and Tacoma replication (TR) samples were recruited from January 1996 through October 2000 and exited between January 1999 and October 2003. Eligibility criteria included: 1) pregnant or postpartum; 2) self-report of heavy alcohol or illicit drug use during pregnancy (defined as drinking ≥ 5 alcoholic drinks/occasion \geq once/month and/or use of any illicit substance \geq once/week during pregnancy); and 3) ineffective or nonengagement with community social services. OD participants were enrolled within one month postpartum; SR and TR participants were enrolled during pregnancy (38%) or through six months postpartum (53% within three months postpartum).

OD subjects were identified and recruited through two sources: hospital postpartum screening by study researchers at two urban hospitals using a one-page, confidential self-report instrument (22); and referral from community providers (e.g., social workers, public health nurses). Eligible, consenting hospital-screened women were systematically assigned to either the intervention or control condition (every third woman as a control). SR and TR subjects were recruited solely through community referral to PCAP. All participants received an intake interview. Subjects were followed through the three-year intervention and completed an exit interview.

Human Subjects approvals were obtained from participating hospitals and the University of Washington, and informed consent was obtained from all subjects.

Intervention

Theoretical background and details of the PCAP model have been described in detail elsewhere (17, 23–26). In brief, the primary aim of the intervention is to prevent future alcohol and drug exposed births among high-risk mothers who have already delivered at least one exposed child. To achieve this aim, PCAP case managers assist women in obtaining alcohol and drug treatment and staying in recovery, and link them with comprehensive community resources that will help them build healthy, independent lives. They work individually with approximately 15 families, help mothers identify personal goals and steps necessary to achieve them, and monitor progress. They facilitate integrated service delivery among providers, offer regular home visitation, transport clients and children to important appointments, and work

actively within the context of the extended family. PCAP case managers are paraprofessionals not formally trained or credentialed in the helping professions (27). They share some life experiences with their clients but have overcome obstacles and achieved significant successes, enabling them to be credible role models with clients who have formerly had little reason to trust anyone. They receive initial and ongoing training and weekly individual supervision by a master's level professional (25).

Objectives

In this study comparing three-year findings from the OD, SR, and TR, three questions are addressed:

- Did baseline characteristics differ between subjects enrolled in the OD versus those enrolled at the later SR and TR sites?
- Were OD outcomes maintained or improved at the SR and TR sites?
- What factors explain differential outcomes at the replication sites?

Intake Measure

OD subjects and the first 100 enrolled in the SR and TR (50 at each) were interviewed by a trained researcher using a 50-minute structured instrument used by the authors in previous studies (17, 28, 29). Subjects enrolled after 1996 (n=84) were interviewed using the 5th edition Addiction Severity Index (ASI) with supplemental questions. The semistructured ASI assesses problems in six domains: medical, employment, legal, family/social, psychiatric/emotional, alcohol/drug use (30–32). PCAP supplemental questions included items on pregnancy substance use, contraception, and service utilization.

Exit Measure

At three-year exit, a researcher interviewed OD subjects using a structured instrument assessing areas measured in the intake interview. SR and TR subjects were interviewed at exit using the ASI 5th edition, with the PCAP supplemental questions including items on status of the index child and subsequent births.

PCAP data collection methods enhanced accuracy of self-report. Detailed instruction manuals and intensive training to establish inter-rater reliability insured standardized interview procedures. Exit interviews were

conducted by independent research staff at a University of Washington facility. Interviewers took time, asked subjects to think carefully and thanked them for their openness and honesty. They used calendar prompts to improve subject recall, and reminded subjects of previous responses to assist with present responses. The study obtained a Certificate of Confidentiality from the U.S. Department of Health and Human Services to safeguard client data.

Statistical Methods

This cohort study is a pretest–posttest comparison across three sites. Enrollment and exit characteristics between two groups (subjects retained versus those lost to follow-up) were compared by *t*-test or chi-square. Overall program efficacy was measured in the OD by creating a baseline (intake) summary variable (18 items) and an endpoint (three-year) summary variable (23 items) (17). Items reflected five domains expected to be most affected by the intervention (see Table 2) and were scored on a five-point scale from most negative (–2) to most positive (+2). Item scores were summed to compute individual domain scores and the total summary score. Cronbach’s alpha computed from the five component domain scores was .91 for the baseline score and .82 for the endpoint score, suggesting good item-to-scale reliability (33). In this analysis, we constructed SR and TR baseline and endpoint summary variables in the same manner. We compared the endpoint summary variables across the three sites, using three-group analysis of covariance adjusting for the baseline variable to test for differences. Also, to reflect our primary interest in alterations in actual behavior, we present descriptive statistics comparing clinically relevant outcomes across the three sites. Data were analyzed using S-Plus and SPSS.

RESULTS

Full findings from the OD are reported in Ernst et al. (17). In brief, of 2,244 postpartum women who completed the screening questionnaire, 131 met eligibility criteria: 28 were not asked to participate because of living out of area, twin birth, or neonatal death, 65 were enrolled as clients in the intervention, 31 were enrolled as controls, and 7 refused enrollment. Among the 65 clients, 5 (8%) were lost to follow-up. Sixty completed the three-year exit interview and are included in the main analysis for this report.

At the combined replication sites (SR and TR), a total of 683 women were referred to PCAP during the study period. Three hundred twenty (47%) were ineligible and referred to more appropriate programs; 13 (2%) had fetal alcohol spectrum disorders (FASD) and were enrolled in a separate pilot study;

349 (51%) met eligibility criteria. Among the eligible, 105 (30%) avoided contact after being referred or refused the intervention, 14 (4%) enrolled but declined services within a few months and did not receive the intended intervention, and 1 woman died during the program of assault injuries. Among the 229 who enrolled and participated in the intervention, 45 (13%) are excluded from this analysis because of lack of a valid interview or exit interview conducted more than 6 months after program completion. Among the remaining 184, 28 (15%) were lost to follow-up at 3 years (14 at each site); the 156 retained are included in the main analysis (n=76 at SR; n=80 at TR).

We compared baseline characteristics of subjects lost to follow-up with those retained. In the OD, the 5 lost to follow-up (8%) were approximately 3 years younger, with a year less education (17). At the combined SR and TR sites, subjects lost to follow-up were younger (27.1 vs. 28.6 years), with 3 or more children (75% vs. 60%), and at least one child removed from their custody (75% vs. 62%). Fewer were binge alcohol drinkers during the index pregnancy (25% vs. 50%, $p < .01$), and a higher proportion were methamphetamine users (43% vs. 24%, $p < .05$).

Baseline Characteristics

Among subjects enrolled at all three sites, most had been physically or sexually abused as children, had parents who abused alcohol/drugs, had been incarcerated as adults, and were currently receiving welfare; approximately half were not living in stable housing; on average, there were 2 prior children, most not in the mother's care (Table 1). More subjects in the replication samples were married compared to the OD (SR/TR=15% vs. OD=3%, $p < .002$) and had been victims of domestic violence (SR/TR=41% vs. OD=18%, $p < .001$). In Tacoma, a higher proportion were White, reflecting population demographics. Approximately half the subjects at the SR and TR had a diagnosed mental health disorder (not assessed in the OD).

All OD participants, and 81% of those in the combined replications, were polysubstance abusers (binge alcohol and cocaine was the most common combination). Substances used during the index pregnancy were strikingly different in Tacoma compared to the OD and SR (both conducted in Seattle). The TR had 11-fold greater use of methamphetamine, and more alcohol and binge alcohol use, but only half the rate of heroin use during the index pregnancy.

Summary Scores

Compared to the OD, baseline summary scores at the SR and TR were higher (means: OD=-20.7; SR=-10.5; TR=-11.5), as were scores on all five

Table 1. Baseline demographics and characteristics of participants in the original demonstration (1991–1995) and the Seattle and Tacoma PCAP replications (1996–2003)

	Original demonstration (n=60) mean or n (%)	Seattle replication (n=76) mean or n (%)	Tacoma replication (n=80) mean or n (%)	Replications combined (n=156) mean or n (%)
Age (mean yrs)	27.6	28.7	28.4	28.6
Education (mean yrs)	11.5	10.7	10.8	10.8
High school diploma/GED	31/60 (52)	32/75 (43)	38/80 (48)	70/155 (45)
Race				
White	18/60 (30)	29/76 (38)	45/80 (56)	74/156 (47)
African American	27/60 (45)	32/76 (42)	25/80 (31)	57/156 (37)
Native American	10/60 (17)	7/76 (9)	7/80 (9)	14/156 (9)
Other (Hispanic, Asian)	5/60 (8)	8/76 (11)	3/80 (4)	11/156 (7)
Married	2/60 (3)	12/76 (16)	11/80 (14)	23/156 (15)
Number prior children	2.1	2.1	2.3	2.2
None	10/60 (17)	15/76 (20)	13/80 (16)	28/156 (18)
Living with mother (mean)	0.8	0.5	0.8	0.7
Primary income source				
Public assistance	50/60 (83)	60/76 (79)	50/80 (63)	110/156 (71)
Employment	0/60 (0)	2/76 (3)	4/80 (5)	6/156 (4)

Stable housing	28/60 (47)	34/76 (45)	42/80 (53)	76/156 (49)
Childhood risk indicators				
Parent(s) abused alcohol/drugs	40/53 (75)	56/67 (84)	61/71 (86)	117/138 (85)
Physical/sexual abuse	40/62 (65)	61/76 (80)	59/79 (75)	120/155 (77)
Adult risk indicators				
Domestic violence, current partner ^a	10/57 (18)	29/54 (54)	22/70 (31)	51/124 (41)
Mental health disorder ^b	—	37/68 (54)	38/75 (51)	75/143 (52)
Ever incarcerated	47/59 (80)	62/75 (83)	66/79 (84)	128/154 (83)
Substance use during index pregnancy				
Alcohol	47/60 (78)	48/76 (63)	62/80 (78)	110/156 (71)
Binge alcohol	23/60 (38)	33/76 (43)	45/80 (56)	78/156 (50)
Heroin	13/60 (22)	18/76 (24)	10/80 (13)	28/156 (18)
Cocaine	53/60 (88)	62/76 (82)	46/80 (58)	108/156 (69)
Marijuana	28/60 (47)	38/76 (50)	49/80 (61)	87/156 (56)
Methamphetamine	0/60 (0)	3/76 (4)	35/80 (44)	38/156 (24)
Cigarettes	56/60 (93)	68/76 (89)	70/80 (88)	138/156 (88)

^aAscertained from the Difficult Life Circumstances Scale from Ref. (53).

^bInformation on mental health diagnosis was not collected for the original demonstration. Diagnoses for the replication samples include: mood disorders 38%; anxiety disorders 20%; personality disorders 3%; others $\leq 1\%$ each.

Table 2. Baseline and endpoint summary scores and baseline summary domain scores of the original demonstration (1991 – 1995) and Seattle and Tacoma replication (1996–2003) samples

	Original demonstration (n=60) mean (SD)	Seattle replication (n=76) mean (SD)	Tacoma replication (n=80) mean (SD)	Replications combined (n=156) mean (SD)
Baseline score	-20.7 (6.1)	-10.5 (7.5)	-11.5 (7.8)	-11.0 (7.6)
Baseline domain scores:				
Alcohol/drug treatment	-2.5 (3.7)	1.7 (3.9)	0.7 (4.0)	1.2 (4.0)
Abstinence	-5.7 (1.0)	-5.4 (1.4)	-5.5 (1.4)	-5.4 (1.4)
Family planning	-5.0 (1.9)	-3.7 (2.6)	-3.6 (2.7)	-3.7 (2.6)
Index child	-2.2 (2.5)	-0.8 (2.6)	-0.6 (2.5)	-0.7 (2.5)
Connection with services	-5.4 (3.3)	-2.3 (3.2)	-2.5 (3.3)	-2.4 (3.3)
Endpoint Score	17.0 (13.2)	27.2 (11.3)	24.9 (13.9)	26.0 (12.8)

Table 3. Exit outcomes at three sites: Original demonstration (1991–1995) and the Seattle and Tacoma replication sites (1996–2003)

	Original demonstration (n=60) n (%)	Seattle replication (n=76) n (%)	Tacoma replication (n=80) n (%)	Replications combined (n=156) n (%)
Alcohol/drug treatment				
Inpatient or outpatient				
Inpatient	31/60 (52)	58/76 (76)	58/80 (73)	116/156 (74)
Outpatient	28/60 (47)	41/76 (54)	49/80 (61)	90/156 (58)
Other (e.g., AA, counseling)	21/60 (35)	45/76 (59)	34/80 (43)	79/156 (51)
Other	27/60 (45)	55/76 (72)	39/80 (49)	94/156 (60)
Abstinence from alcohol/drugs				
≥ 6 mo at program exit	17/60 (28)	33/76 (43)	31/80 (39)	64/156 (41)
≥ 1 year at program exit	10/60 (17)	26/76 (34)	26/80 (33)	52/156 (33)
Abstinence ≥ 1 yr during program	22/60 (37)	45/76 (59)	37/80 (46)	82/156 (53)
Family planning and subsequent birth				
Regular contraceptive use	44/60 (73)	56/76 (74)	57/80 (71)	113/156 (72)
Reliable method ^a	26/60 (43)	37/76 (49)	42/80 (53)	79/156 (51)
Subsequent pregnancy	31/60 (52)	38/76 (50)	30/80 (38)	68/156 (44)
Subsequent birth during program	17/60 (28)	22/76 (29)	20/80 (25)	42/156 (27)
Unexposed to alcohol/drugs	3/17 (18)	7/22 (32)	8/20 (40)	15/42 (36)

Primary income source						
Public assistance	30/60 (50)	20/76 (26)	21/80 (26)	41/156 (26)		
Employment	7/60 (12)	22/76 (29)	23/80 (29)	45/156 (29)		
Index child						
Custody at 3 years						
Biological mother	28/54 (52)	43/76 (57)	45/79 (57)	88/155 (57)		
Other family	10/54 (19)	10/76 (13)	16/79 (20)	26/155 (17)		
Adopted	2/54 (4)	10/76 (13)	11/79 (14)	21/155 (14)		
State foster care	14/54 (26)	13/76 (17)	7/79 (9)	20/155 (13)		
Regular well-child care ^b	35/38 (92)	51/53 (96)	58/61 (95)	109/114 (96)		
Connection with services						
Regular family healthcare	37/60 (62)	67/76 (88)	59/80 (74)	126/156 (81)		
Mental health ^c	7/10 (70)	29/37 (78)	34/43 (79)	63/80 (79)		
Completed education/training program	13/60 (22)	28/76 (37)	27/80 (34)	55/156 (35)		
Completed parenting class	22/60 (37)	54/76 (71)	50/80 (63)	104/156 (67)		
Permanent, stable housing	36/60 (60)	61/76 (80)	53/80 (66)	114/156 (73)		

^aIncludes tubal ligation, consistent Depo Provera injections, IUD, and Norplant implant.

^bAmong those in custody of biological mother or a family member at exit.

^cAmong clients who expressed a need for the service.

baselines (Table 2). Higher scores in two domains (“alcohol/drug treatment” and “connection with services” prior to program intake) accounted for 70% of the difference between OD and replication site baseline summary scores, reflecting increased availability of community services during more recent years.

In the OD, hospital-recruited clients scored significantly higher than controls on the endpoint summary score, adjusting for baseline summary score ($p < .02$). Three-group analysis of covariance (hospital-recruited clients, community referred clients, and controls) was also significant ($p < .05$) (17). Comparing data across the OD, SR, and TR, slopes for the regression of endpoint summary score on baseline score were similar across the groups. Each of the replication samples performed significantly better than the OD ($p < .02$), adjusting for baseline.

Three-Year Outcomes

Treatment and Abstinence

Compared to the OD, at exit from the intervention, a higher proportion of subjects in both replication samples completed inpatient (OD=45%; SR=54%; TR=61%), outpatient (OD=35%; SR=59%; TR=43%), and other forms of treatment (OD=45%; SR=72%; TR=49%) (Table 3). SR and TR subjects also accrued longer duration of abstinence from alcohol and drugs: for ≥ 6 months at exit (OD=28%; SR=43%; TR=39%); for ≥ 1 year at exit (OD=17%; SR=34%; TR=33%); for any period of abstinence ≥ 1 year while in the program (OD=37%; SR=59%; TR=46%).

Family Planning and Subsequent Birth

Outcomes were sustained or improved at the SR and TR for regular use of a contraceptive at program exit (OD=73%; SR=74%; TR=71%), and use of a more reliable method (tubal ligation, IUD, Norplant, or consistent Depo Provera injections) (OD=43%; SR=49%; TR=53%). The rate of subsequent pregnancy during the three-year intervention was notably lower at the TR (OD=52%; SR=50%; TR=38%), although the subsequent birth rate was similar (OD=28%; SR=29%; TR=25%), suggesting a higher rate of spontaneous or therapeutic abortions among Seattle subjects (OD and SR). Among those who had a subsequent birth during the intervention, the proportion unexposed to alcohol or drugs throughout the pregnancy doubled at the SR and TR compared to the OD (OD=18%; SR=32%; TR=40%). At all three sites, on program exit most subjects were no longer at present risk of having another alcohol or drug exposed pregnancy, either because they were

using a reliable contraceptive method or had been abstinent from alcohol/drugs for at least six months, or both (OD=60%; SR=67%; TR=74%).

Primary Income Source

In the OD, public assistance as the primary source of income dropped by 40% from program enrollment to exit (83% to 50%) compared to a 63% reduction at the combined replication sites (71% at enrollment to 26% at exit). In both replication sites, employment as primary source of income at program exit was nearly 2.5 times greater than in the OD (OD=12%; SR=29%; TR=29%). Employment replaced public assistance as primary income source among 35 women (32%) at the replication sites.

Index Child

The percentage of index children in custody of their mothers or other family members at program exit was similar across sites (OD=71%; SR=70%; TR=77%). Among those in custody of their families, over 90% at all three sites were receiving well-child care. Overall, fewer of those at the replication sites were in the state foster care system (OR=26%; SR=17%; TR=9%). Over three times as many SR and TR children were adopted compared to the OD (SR=13%; TR=14%; OD=4%).

DISCUSSION

Future alcohol and drug exposed births can be prevented in one of two ways: by helping women avoid alcohol and drug use during pregnancy, or by helping them avoid becoming pregnant if they are using alcohol or drugs. This study demonstrates that PCAP community-based intervention has been effective in achieving these ends over time and across venues. Compared to the original demonstration, outcomes at the replication sites were either improved (alcohol/drug treatment completed; abstinence from alcohol/drugs; subsequent delivery unexposed to alcohol or drugs) or maintained (regular use of contraception and use of a reliable method; number of subsequent deliveries during the program). Other findings included increased maternal employment, more permanent child custody placements, and increased connection with services. These are clinically relevant outcomes that help mothers build healthy and productive lives, improve the quality of the home environment for the children, and reduce the burden on community social and economic systems.

A number of factors account for our findings. PCAP maintained strong administrative and quality control protocols. Community recognition grew as PCAP staff participated in service delivery networks and assured that clients followed through with recommendations. Some study posttest change could be attributed to the process of maturation as case managers continued to receive training and became more experienced.

Over the study period (1991–2003) a number of public policies and programs aimed at the population served by PCAP were initiated in Washington State. Study outcomes were subject to multiple influences because of increased services made available. For example, Washington's "WorkFirst" welfare-to-work program was initiated in 1997. Between 1997 and June 2004 the number of families receiving any welfare income in Washington dropped by 41% (personal communication: Debra Came, Washington State Office of Financial Management, July 16, 2004, Debra.Came@OFM.wa.gov). We observed a similar 42% reduction among PCAP participants between 1996 and 2003 (76% received any welfare income at enrollment vs. 44% at program exit, data not shown on table), although PCAP women were at higher risk for unemployment than the general welfare population because all were substance abusers and fewer were white (47% vs. 63%).

The Washington State Division of Alcohol and Substance Abuse (DASA) nearly tripled the number of gender-specific inpatient residential treatment beds for pregnant and postpartum women from 55 to 149 between 1991 and 2003. The availability of these specialized treatment facilities undoubtedly had a positive impact on PCAP's treatment and abstinence outcomes.

Washington State DSHS initiated First Steps in 1989 to help low-income pregnant women obtain health and social services including family planning. In 1993 coverage was extended statewide and to one year postpartum; in 2001 no-cost family planning services became available to individuals with incomes up to 200% of the federal poverty level. State data indicate that from 1994 to 2000 the birth rate among welfare recipients dropped by 29% (34). Further, from 1991 to 2000, the percent of women identified as substance abusers who gave birth and had a subsequent birth within two years, dropped from 18.7% to 16.5% (personal communication: Laurie Cawthon, M.D., May 11, 2004, cawthml@dshs.wa.gov). The PCAP two-year subsequent birth rate has remained consistently lower than the state rate: 13% at the OD (1991–1996); and 13% at the combined SR and TR (1996–2003) (data not shown on table).

The Washington Permanency Framework was a five-year plan begun in 1998 to improve the lives of children in the foster care system by increasing rates of permanent placements in a timely manner; parental substance abuse is cited as a common reason for children entering the system. State data indicate nearly twice as many children were adopted in 2003 as in 1995 (35).

PCAP child placement outcomes improved during the period corresponding with implementation of the Framework: children not with family were three times more likely to be adopted at program exit, and only half as likely to be in the state foster care system.

Improved findings observed at the replication sites do not appear to be attributable to enrollment of less afflicted women, as the groups did not systematically differ from the OD on background characteristics.

At the replication sites, 78 women drank alcohol in a binge pattern (≥ 5 drinks per occasion) during the index pregnancy. Alcohol is a known teratogen (36, 37) whose neurobehavioral effects have been found to be more injurious than cocaine and other drugs abused prenatally (38–41). Prenatal alcohol exposure puts fetuses at risk for fetal alcohol syndrome (FAS), a permanent birth defect and a leading preventable cause of mental retardation and neurodevelopmental disorders in the United States (42, 43). The estimated average lifetime cost for an individual with FAS is \$1.5 million (44, 45).

We found that 51 of the 78 PCAP heavy drinkers (65%) were no longer at present risk of having an alcohol exposed pregnancy at PCAP program exit: 24 (31%) were using a reliable contraceptive method (tubal ligation, IUD, or consistent Depo Provera injections); 18 (23%) had been abstinent from alcohol (and drugs) for at least six months; and 9 (12%) were both using a reliable contraceptive and were abstinent. Without PCAP intervention, we assume about 30% (or 23) of these 78 drinking mothers would have delivered another highly exposed child. Instead, the number was reduced by 65%, preventing approximately 15 exposed births. The incidence of FAS is estimated at 4.7% to 21% among heavy drinkers (46–48), therefore, we estimate that PCAP prevented at least one and up to three new cases of FAS. The cost of the PCAP program is approximately \$14,760 per client for the three-year program including intervention, administration and evaluation. If PCAP prevented the occurrence of just one new case of FAS, the estimated lifetime cost savings is equivalent to the cost of the PCAP intervention for 102 women.

Of related note, a 2004 independent economic analysis by the Washington State Institute for Public Policy found an average net benefit of \$6197 per client among selected well researched home visiting programs, including PCAP, for at-risk families in the U.S. (49).

Our study was subject to several limitations. Because data were obtained from personal interviews, they were subject to self-report biases (50). Positive study outcomes may reflect some spurious improvement due to the fact that we selected subjects with extremely poor social behavior history (statistical regression toward the mean) (51). The PCAP model might not affect the same degree of change among mothers whose baseline profile is not as severe.

Public health researchers have argued that when evaluation resources are limited, sound decisions may be made on the basis of adequacy or plausibility

evaluations conducted under routine conditions (as opposed to randomized controlled trials) (52). Our quasi-experimental study does not allow us to draw confident causal conclusions because it is not a randomized design and we cannot rule out the possibility that historical events operated to improve PCAP outcomes. We have, however, demonstrated: 1) compared to control subjects, clients in the original sample had significantly better endpoint summary scores, and both replication sites scored significantly better than the original sample; 2) improved outcomes are not attributable to enrollment of less impaired women; 3) there was sustained or improved impact over time and across settings; and 4) for most outcomes that may have been associated with state programs implemented, PCAP has improved women's status over and above what state data bases demonstrate.

The social and economic costs of prenatal substance abuse are high, and the toll on each new generation of exposed and affected children is profound. What is heartening is that the problem is preventable. The PCAP intervention strategy offers hope to high-risk families and has proven to be a cost-effective investment for the state.

ACKNOWLEDGMENTS

This research was supported in part by the U.S. Department of Health and Human Services Center for Substance Abuse Prevention under grant H865SPO2897-01-06, and by the State of Washington Department of Social and Health Services Division of Alcohol and Substance Abuse, under contracts #7141-1 and #6376-0.

An earlier version of this article was presented at the 27th Annual Meeting of the Research Society on Alcoholism, June 2004. We thank Dr. Paul Sampson (Department of Statistics, University of Washington) and Dr. Fred Bookstein (Institute of Gerontology, University of Michigan, and Institute of Anthropology, University of Vienna, Austria) for their constructive comments and suggestions and technical assistance.

REFERENCES

1. American College of Obstetricians and Gynecologists (ACOG) Committee on Ethics. ACOG committee opinion #294: at-risk drinking and illicit drug use: ethical issues in obstetric and gynecologic practice. *Obstet Gynecol* 2004; 103(5):1021–1031.
2. Ebrahim SH, Gfroerer J. Pregnancy-related substance use in the United States during 1996–1998. *Obstet Gynecol* 2003; 101(2):374–379.
3. Ebrahim SH, Luman ET, Floyd RL, Murphy CC, Bennett EM, Boyle

- CA. Alcohol consumption by pregnant women in the United States during 1988–1995. *Obstet Gynecol* 1998; 92(2):187–192.
4. CDC. Alcohol use among women of childbearing age—United States, 1991–1999. *MMWR* 2002; 51:273–276. Reprinted.
 5. CDC. Alcohol use among women of childbearing age—United States, 1991–1999. *JAMA* 2002; 287(16):2069–2071.
 6. U.S. Department of Health and Human Services. Summary of Findings from the 1999 National Household Survey on Drug Abuse. Washington, DC: Department of Health and Human Services, 2000. <http://media.shs.net/prevline/pdfs/2kNHSDA.pdf> (accessed June 2004).
 7. U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration (SAMHSA), Office of Applied Studies. National Household Survey on Drug Abuse. Pregnancy and Illicit Drug Use. July 2001. <http://oas.samhsa.gov/2k2/pregDU/pregDU.cfm> (accessed June 2004).
 8. Mattson SN, Riley EP. A review of the neurobehavioral deficits in children with fetal alcohol syndrome or prenatal exposure to alcohol. *Alcohol Clin Exp Res* 1998; 22(2):279–294.
 9. Singer LT, Arendt R, Minnes S, Farkas K, Salvator A, Kirchner HL, Kliegman R. Cognitive and motor outcomes of cocaine-exposed infants. *JAMA* 2002; 287(15):1952–1960.
 10. Frank D, Augustyn M, Grant-Knight W, Pell T, Zucherman B. Growth, development, and behavior in early childhood following prenatal cocaine exposure: a systematic review. *JAMA* 2001; 285(12):1613–1625.
 11. Lustbader AS, Mayes LC, McGee BA, Jatlow P, Roberts WL. Incidence of passive exposure to crack/cocaine and clinical findings in infants seen in an outpatient service. *Pediatrics* 1998; 102(1):e5.
 12. Ornoy A, Michailevskaya V, Lukashov I, Bar-Hamburger R, Harel S. The developmental outcome of children born to heroin-dependent mothers, raised at home or adopted. *Child Abuse Negl* 1996; 20(5):385–396.
 13. Connors NA, Bradley RH, Mansell LW, Liu JY, Roberts TJ, Burgdorf K, Herrell JM. Children of mothers with serious substance abuse problems: an accumulation of risks. *Am J Drug Alcohol Abuse* 2004; 30(1):85–100.
 14. Black MM, Nair P, Harrington D. Maternal HIV infection: parenting and early child development. *J Pediatr Psychol* 1994; 19(5):595–615.
 15. Black MM, Nair P, Kight C, Wachtel R, Roby P, Schuler M. Parenting and early development among children of drug-abusing women: effects of home intervention. *Pediatrics* 1994; 94(4 Pt. 1):440–448.
 16. Black MM, Dubowitz H, Hutcheson J, Berenson-Howard J, Starr RH Jr.

- A randomized clinical trial of home intervention for children with failure to thrive. *Pediatrics* 1995; 95(6):807–814.
17. Ernst CC, Grant TM, Streissguth AP, Sampson PD. Intervention with high-risk alcohol and drug-abusing mothers: II. 3-year findings from the Seattle model of paraprofessional advocacy. *J Commun Psychol* 1999; 27(1):19–38.
 18. Laken MP, Ager JW. Effects of case management on retention in prenatal substance abuse treatment. *Am J Drug Alcohol Abuse* 1996; 22(3):439–448.
 19. Loman LA, Sherburne D. *Intensive Home Visitation for Mothers of Drug-Exposed Infants: An Evaluation of the St. Louis Linkages Program*. St. Louis, MO, USA: Institute of Applied Research, April 2000.
 20. Navaie-Waliser M, Martin SL, Campbell MK, Tessaro I, Kotelchuck M, Cross AW. Factors predicting completion of a home visitation program by high-risk pregnant women: the North Carolina maternal outreach worker program. *Am J Public Health* 2000; 90(1):121–124.
 21. Umlah C, Grant T. Intervening to prevent prenatal alcohol and drug exposure: the Manitoba experience in replicating a paraprofessional model. *Manit J Child Welf* 2003; 2(1):1–12. <http://www.envisionjournal.com/application/Articles/48.pdf> (accessed August 2004).
 22. Streissguth AP, Grant TM, Barr HM, Brown ZA, Martin JC, Mayock DE, Ramey SL, Moore L. Cocaine and the use of alcohol and other drugs during pregnancy. *J Obstet Gynecol* 1991; 164(5 Pt. 1):1239–1243.
 23. Grant TM, Ernst CC, Streissguth AP, Phipps P, Gendler B. When case management isn't enough: a model of paraprofessional advocacy for drug- and alcohol-abusing mothers. *J Case Manag* 1996; 5(1):3–11.
 24. Grant TM, Ernst CC, Streissguth AP. An intervention with high-risk mothers who abuse alcohol and drugs: the Seattle advocacy model. *Am J Publ Health* 1996; 86(12):1816–1817.
 25. Grant TM, Ernst CC, Streissguth AP. Intervention with high-risk alcohol and drug-abusing mothers: I. Administrative strategies of the Seattle model of paraprofessional advocacy. *J Commun Psychol* 1999; 27(1):1–18.
 26. Grant T, Streissguth A, Ernst C. Benefits and challenges of paraprofessional advocacy with mothers who abuse alcohol and drugs and their children. *Zero Three* 2002; 23(2):14–20.
 27. Olds DL, Robinson J, O'Brien R, Luckey DW, Pettitt LM, Henderson CR Jr., Ng RK, Sheff KL, Korfmacher J, Hiatt S, Talmi A. Home visiting by paraprofessionals and by nurses: a randomized, controlled trial. *Pediatrics* 2002; 110(3):486–496.

28. Grant T, Brown Z, Callahan C, Barr H, Streissguth AP. Cocaine exposure during pregnancy: improving assessment with radioimmunoassay of maternal hair. *Obstet Gynecol* 1994; 83(4):524–531.
29. Streissguth AP, Martin DC, Martin JC, Barr HM. The Seattle longitudinal prospective study on alcohol and pregnancy. *Neurobehav Toxicol Teratol* 1981; 3(2):223–233.
30. McLellan AT, Kushner H, Metzger D, Peters R, Smith I, Grissom G, Pettinati H, Argeriou M. The fifth edition of the addiction severity index. *J Subst Abuse Treat* 1992; 9(3):199–213.
31. McLellan AT, Luborsky L, Cacciola J, Evans F, Barr HL, O'Brien CP. New data from the addiction severity index. Reliability and validity in three centers. *J Nerv Ment Dis* 1985; 173(7):412–423.
32. Zanis DA, McLellan AT, Cnaan RA, Randall M. Reliability and validity of the Addiction Severity Index with a homeless sample. *J Subst Abuse Treat* 1994; 11(6):541–548.
33. Cronbach LJ. Coefficient alpha and the internal structure of tests. *Psychometrika* 1951; 16:297–334.
34. Cawthon L. Birth Rates After Welfare Reform. Washington State Department of Social and Health Services Research & Data Analysis Division. Report No. 9.61. November 2001. Available at: <http://www1.dshs.wa.gov/rda/research/9/61.shtm> (accessed July 2004).
35. Washington Permanency Report 1998–2003. Families for Kids Partnership, Seattle, WA. Data Compilation and Analysis by Evaluation Services, NW Institute for Children and Families, University of Washington. Available at: http://www.childrenshomesociety.org/2_cfkreportsDataPerm.htm (accessed June 2004).
36. Schenker S, Becker HC, Randall CL, Phillips DK, Baskin GS, Henderson GI. Fetal alcohol syndrome: current status of pathogenesis. *Alcohol Clin Exp Res* 1990; 14(5):635–647.
37. Randall CL. Alcohol as a teratogen: a decade of research in review. *Alcohol Alcohol* 1987; suppl 1:125–132.
38. Jacobsen JL, Jacobson SW, Sokol RJ. Effects of prenatal exposure to alcohol, smoking and illicit drugs on postpartum somatic growth. *Alcohol Clin Exp Res* 1994; 18(2):317–323.
39. Jacobson SW, Jacobsen JL, Sokol RJ. Effects of fetal alcohol exposure on infant reaction time. *Alcohol Clin Exp Res* 1994; 18(5):1125–1132.
40. Coles CD, Platzman KA, Smith I, James ME, Falek A. Effects of cocaine and alcohol use in pregnancy on neonatal growth and neurobehavioral status. *Neurotoxicol Teratol* 1992; 14(1):22–33.
41. Institute of Medicine [IOM]. In: Stratton KR, Howe CJ, Battaglia FC, eds. *Fetal Alcohol Syndrome: Diagnosis, Epidemiology, Prevention, and Treatment*, Washington, DC: National Academy Press, 1996:21.
42. Abel EL, Sokol RJ. Incidence of fetal alcohol syndrome and economic

- impact of FAS related anomalies. *Drug Alcohol Depend* 1987; 19(1):51–70.
43. American Academy of Pediatrics, Committee on Substance Abuse and Committee on Children with Disabilities. Fetal alcohol syndrome and alcohol-related neurodevelopmental disorders. *Pediatrics* 2000; 106(2): 358–361.
 44. Harwood H, Fountain D, Livermore G. *The Economic Costs of Alcohol and Drug Abuse in the United States, 1992*. Washington, DC: National Institute on Drug Abuse and National Institute on Alcohol Abuse and Alcoholism, 1998.
 45. Rice DP. The economic costs of alcohol abuse and dependence: 1990. *Alcohol Health Res World* 1993; 17(1):10–11.
 46. Abel EL. An update on incidence of FAS: FAS is not an equal opportunity birth defect (Review). *Neurotoxicol Teratol* 1995; 17(4):437–443.
 47. Barr HM, Streissguth AP. Identifying maternal self-reported alcohol use associated with fetal alcohol spectrum disorders. *Alcohol Clin Exp Res* 2001; 25(2):283–287.
 48. Majewski F. Alcohol embryopathy: experience in 200 patients. *Dev Brain Dysfunct* 1993; 6:248–265.
 49. Aos S, Lieb R, Mayfield J, Miller M, Pennucci A. *Benefits and Costs of Prevention and Early Intervention Programs for Youth*. Olympia, WA: Washington State Institute for Public Policy, July 6 2004:1–20.
 50. Rothman KJ. *Modern Epidemiology*. Boston: Little Brown, 1986:84–89.
 51. Cook TD, Campbell DT. *Quasi-Experimentation: Design & Analysis Issues for Field Settings*. Boston: Houghton Mifflin Company, 1979:100.
 52. Victora CG, Habicht JP, Bryce J. Evidence based public health: moving beyond randomized trials. *Am J Public Health* 2004; 94(3):400–405.
 53. Barnard KE. *Difficult Life Circumstances (DLC)*. Seattle, WA: University of Washington School of Nursing NCAST Publications, 1989.