

# The Effect of Medicaid Managed Care on Prenatal Care: The Case of Puerto Rico

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**Abstract** *Objectives* From 1994 to the year 2000 the government of Puerto Rico implemented a health care reform which included the mandatory enrollment of the entire Medicaid eligible population under Medicaid managed care (MMC) plans. This study assessed the effect of MMC on the use, initiation, utilization, and adequacy of prenatal care services over the reform period. *Methods* Using the vital records of all infants born alive in Puerto Rico from the year 1995–2000, a series of bivariate and multivariate analyses were conducted to assess the effect of insurance status (traditional Medicaid, MMC, private insurance and uninsured) on prenatal care utilization patterns. In order to assess the potential influence of selection bias in generating the health insurance assignments, propensity scores (PS) were estimated and entered into the multivariate regressions. *Results* MMC had a generally positive effect on the frequency and adequacy of prenatal care when compared with the experience of women covered by traditional Medicaid. However, the PS analyses

suggested that self-selection may have generated part of the observed beneficial effects. Also, MMC reduced but did not eliminate the gap in the amount and adequacy of prenatal care received by pregnant women covered by Medicaid when compared to their counterparts covered by private insurance. *Conclusions* The Puerto Rico Health Reform to implement MMC for pregnant women was associated with a general improvement in prenatal care utilization. However, continued progress will be necessary for women covered by Medicaid to reach prenatal care utilization levels experienced by privately insured women.

**Keywords** Medicaid managed care · Health reform · Pregnant women · Prenatal care · Health insurance status · Adequacy of prenatal care

## Introduction

During the 1990s, many states embarked on changes and reforms directed at enrolling most of their Medicaid populations into managed care plans, better known as Medicaid managed care (MMC). As a result, the percentage of Medicaid enrollees in managed care plans increased from 9.5 percent in 1991 to 59.1 percent in 2003 [1]. From 1994 to 2000, the government of Puerto Rico, a territory and Commonwealth of the United States, implemented a health care reform program which included the mandatory enrollment of all the Medicaid beneficiaries into managed care plans. Prior to the reform, Medicaid enrollees received prenatal and post-partum care provided through public, primary care centers located in each municipality while labor and delivery services were provided in public hospitals. However, implementation of MMC was designed to shift these services to private physicians and hospitals

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contracted by private health insurance companies under the managed care system.

The impact of MMC on the utilization and quality of prenatal care services and indicators of infant health remains an important health policy concern. The available evidence from several evaluations of MMC in different states suggests somewhat contradictory findings. Some studies have reported that MMC had a negative effect on prenatal care utilization [2–5]. Specifically, these studies reported that MMC was associated with a higher probability of late or no prenatal care, fewer prenatal care visits, and reduced length of delivery hospital stay compared with a Medicaid fee-for-service population. However, one study reported no significant differences in prenatal care utilization between MMC and fee-for-service Medicaid systems [6], while others have reported beneficial effects [7–9]. Given this mixed evaluative record, the utility of MMC as a strategy to improve prenatal services remains unclear [5, 10–18]. Therefore, the objective of this study was to assess the effect of MMC on the initiation, utilization, and adequacy of prenatal care services during the implementation period of the health care reform initiative in Puerto Rico. The study population consists of all live births to women living in Puerto Rico during the period of 1995–2000, which covers the implementation of the health care reform through all the municipalities in Puerto Rico. Using data from computerized birth certificate files, we were able to compare prenatal care indicators among child-bearing women covered by traditional Medicaid, MMC, private health insurance, or without health insurance.

Although the effectiveness of prenatal care has been examined in a variety of settings, the evidence regarding its impact on birth outcomes remains complex particularly given the interactive pathways by which social forces, medical conditions, and maternal behaviors are ultimately expressed as prematurity, intrauterine growth retardation, or other perinatal complications [19–21]. However, despite this incomplete understanding of prenatal care's impact on birth outcomes, its documented benefits, particularly for ensuring women's health, has made the provision of high quality prenatal care an essential component of women's health care and a recognized goal for Healthy People 2010 (Objective 16–6) [22].

This article is the first in a series evaluating the impact of the health reform initiative in Puerto Rico. Given the accepted importance of prenatal care, the objective of this study is to assess the effect of MMC on the initiation, utilization, and adequacy of prenatal care services for pregnant women covered by traditional Medicaid, MMC, private insurance, or not insured during the reform's implementation period. A subsequent publication will examine the reform's impact on birth outcomes which, because of the complexity of the methods and findings inherent in evaluating birth outcomes, requires its own detailed presentation.

## Methods

### Description of the Health Reform Initiative

During the period of 1994–2000 the government of Puerto Rico implemented a health care reform initiative designed to eliminate the traditional dual structure of the health care delivery system which relied on both private and government-operated health sectors. The government-operated sector provided care to poor patients and was financed by a combination of Commonwealth funds and federal Medicaid contributions. The principal users of the private sector were those with private health insurance, including Medicare. The intention of the reform program was to abolish these distinctions and increase the quality of and access to health care services for Medicaid beneficiaries through three mechanisms: (1) the privatization of government-owned health care facilities and services; (2) offering a health insurance card to the Medicaid and medically indigent population through private insurance companies contracted by the government; and (3) requiring private insurance companies to contract health providers under the provisions of Medicaid managed care. Therefore, while a general model of MMC was implemented, some variation in performance may have occurred between the different contracted insurance companies or providers.

The Puerto Rico Health Insurance Administration (PRHIA), a public corporation charged with implementing Medicaid managed care, divided the island into different health regions covering all the 78 municipalities of the island. Each year, a group of regions were added to the program until July, 2000 when all the municipalities of the island were included. Prior to the reform, prenatal and post-partum care for Medicaid enrollees was mostly provided through public primary care centers located in each municipality while delivery services were provided in public hospitals. However, after the implementation of the reform, these services were provided through private physicians and hospitals. While community health centers and public hospitals continued to deliver care, they did so under the unified privatized system; the role of the federal funding mechanisms, including Title V support, and that of Puerto Rican health authorities shifted from operating clinical facilities to financing and monitoring care provided by private providers.

### Design

This study represents a quasi-experimental time series that examined retrospectively the effects of health insurance type on prenatal care. The dataset did not allow us to compare the same individuals across years but rather between individuals with different insurance type within

the same year. Therefore, for each particular year in our sample, we observed mothers who reported having MMC, traditional Medicaid (public health services available to the Medicaid population before MMC), private health insurance, or were uninsured. The primary comparison was made between the MMC and traditional Medicaid enrollees. However, the privately insured group was also included in the analysis since it served as a benchmark for access and quality of services for the reform program's designers. Although the uninsured group was not a specific focus of the Medicaid comparisons, it was also included in the analysis as it represented some 7,000 women and may include a pool of patients who interact with the Medicaid system as either former or potential recipients.

### Population, Data, and Variables

The study population consists of all live births to women living in Puerto Rico during the period of 1995–2000, which covers the implementation of the health care reform through all the municipalities in Puerto Rico. The total number of infants born during this period was 370,652. The primary source of data was birth and death certificates for the period of 1995–2000 maintained by the Puerto Rico Health Department. Socioeconomic characteristics of each municipality in Puerto Rico were determined from the 1990 and 2000 Decennial Census of Puerto Rico prepared by the United States Census Bureau. These characteristics were estimated for each study year by simple interpolation from the base census years. Finally, data were obtained from the Puerto Rico Health Department on the number of physicians available in each municipality in Puerto Rico during the period of 1995–2000.

The dependent variables in this study are use and nonuse of prenatal care (dichotomous: any visit (1), no visit (0)); when the initial care occurred (dichotomous: first trimester (1), other (0)); the number of visits for prenatal care (frequency); and the adequacy of care (adequate (1), inadequate (0)). Adequacy is defined using the Kotelchuck Index, also called the Adequacy of Prenatal Care Utilization Index [23]. This index uses two crucial elements obtained from birth certificate data: when prenatal care began (initiation) and the number of prenatal care visits from the moment the initial visit took place until delivery (received services). The Kotelchuck index classifies the adequacy of initiation as follows: pregnancy months 1 and 2, months 3 and 4, months 5 and 6, and months 7–9, with the underlying assumption that the earlier prenatal care begins the better. To classify the adequacy of received services, the number of prenatal visits is compared to the expected number of visits for the period between the first prenatal care visit and the delivery date. The expected number of visits is based on the American College of

Obstetricians and Gynecologists prenatal care standards for uncomplicated pregnancies and is adjusted for the gestational age when care began and for the gestational age at delivery. A ratio of observed to expected visits is calculated and grouped into four categories: Inadequate (received less than 50% of expected visits), Intermediate (50%–79%), Adequate (80%–109%), and Adequate Plus (110% or more). For analytical convenience and as in other previous studies [8, 19, 20] we decided to classify pregnant women in two groups: those with adequate care that includes the Adequate and Adequate Plus categories, and those with non-adequate care which includes the Inadequate and Intermediate categories.

The primary independent variable in this study is the type of health insurance the mother had during pregnancy. This variable is divided into four categories: those who had private health insurance, those with traditional Medicaid, those with MMC, and those who were uninsured. This variable was added to the birth certificate in the year 1995, just after the beginning of the health care reform. The other independent variables considered possible confounders in our study fall into four groups: socio-demographic variables related to the parents, lifestyle risk factors and medical risk factors related to the mother, socioeconomic and health related characteristics of the municipality of residence of the mother, and factors related to the regional health care system where the mother resides.

The socio-demographic variables related to the parents are the following: mother's age, years of formal education for the infant's parents, and, marital status of the parents. Again, all the data needed for the creation of these variables came from the birth certificates. Mother's age was recoded in the following categories: 0–14, 15–19, 20–24, 25–29, 30–34, 35–39, and 40 and above. Parent's education was recoded using the number of years of formal education into the following levels: 0–6, 7–9, 10–12, 13–16, and 17 and above. For the variable of marital status, we classified the parents in three categories; legally married, consensual union, and disrupted (single, divorced, separated, or widow).

Birth certificates provided information on maternal medical conditions and behaviors during pregnancy. Tobacco use and alcohol consumption during pregnancy were coded as dichotomous, yes or no variables. Medical risk factors could be one or multiple in nature and included anemia, cardiac disease, acute or chronic lung disease, diabetes, genital herpes, hydramnios or oligohydramnios, hemoglobinopathy, chronic hypertension, hypertension due to pregnancy, eclampsia, incompetent cervix, previous infant with high weight, previous preterm or small for gestational age infant, renal disease, Rh sensitization factor, uterine bleeding, and other categories. An infant's mother may have one or many of these medical risk factors

because they are not exclusive. Each of them was coded as binary variable with one [1] implying the presence of the condition, and zero (0) meaning that the condition is absent. All births are included in the analysis but in the regression analysis a dummy variable representing singleton status was included to capture any differential effect on prenatal care related to multiple births.

The variables representing the socio-economic and health related characteristics for the municipality of residence of the mother were median family income, population density, and the number of physicians per 1,000 persons. Finally, the government divides the island into health regions to regulate and organize the provision of health services. Since this could have an important impact in the supply and type of health services provided in each region, we decided to use these health regions as a variable in our models. For this, each municipality of residence of the mother was assigned to its corresponding health region. Then, dummy variables representing each of the regions were created.

### Data Analysis

A series of bivariate and multivariate logistic and log-linear regressions were estimated by pooling data from all the years ranging from 1995 to 2000. The dependent variables in these regressions were the use of prenatal care, the initiation of prenatal care, the number of prenatal care visits, and the adequacy of prenatal care as the dependent variables. For use, initiation, and adequacy we used logistic regression models while for the frequency of visits, a log-linear regression was estimated to help normalize the skewed distribution of visitation data.

For the bivariate regressions, only the health insurance status of the mother was used as an independent variable. For the multivariate regressions, the independent variables representing the health insurance status of the mother, the characteristics of the parents, the lifestyle and medical risk factors of the mother, and the socioeconomic and health related characteristics of the municipality and the health region were included in a block step process. A set of dummy variables were used to represent the health insurance status of the pregnant mother, regardless of the year the infant's birth occurred. Since the private insurance group was chosen as the comparison group, only the dummy variables for Medicaid, MMC, and the uninsured were included in the regression. The estimated coefficients for these dummy variables represent the average effect of these groups on the prenatal care variables compared to the private group for the entire 1995–2000 period.

Comparisons between the insurance groups were made through unadjusted and adjusted odds-ratios calculated from the regression analyses using SPSS statistical software (Version 15; Chicago, IL:SPSS). In the case of the

number of prenatal care visits the log-linear regression coefficients represented the average percentage difference. Statistical significance between groups was determined by using the 95% confidence intervals of the calculated coefficients. The time progression through the study period was captured by including a series of dummy variables in the regression models representing each year of birth for the included population of births, with the year 1995 as the reference year.

To address potential selection bias in the compared groups, we utilized propensity scores (PS) as suggested by Rosenbaum and Rubin [24, 25] for use in program or treatment effectiveness evaluation. The PS is defined as the probability of receiving a particular treatment or program service for a particular subject conditional on a set of observed covariates that precede the occurrence of treatment or program service receipt. In our case, the intervention or “treatment” group is those subjects who had some form of public insurance, either traditional Medicaid or MMC. This methodology required a two step approach. First, a logistic regression was estimated in order to produce the probability of having public health insurance for a particular mother. The predicted probability for each individual is its PS, which is a function of all the independent variables included in the regression. The PS's were formed into quintiles. We repeated the original regressions for each of the prenatal care dependent variables, but stratified them by PS quintile strata. Thus, for each prenatal care dependent variable, five regressions were performed, one for each PS quintile stratum. Finally, we report the results for the fifth PS quintile with pregnant women within that group having the highest probability of having public health insurance.

## Results

### Descriptive Statistics

In 1996, 30,402 women reported having Medicaid, only 6,365 reported having MMC, 25,528 had private insurance, and 1,223 were uninsured. As the implementation of the health care reform advanced throughout the Island, the number of women enrolled in MMC increased to 35,532 in the year 2000, with only 2,218 reporting having traditional Medicaid. This group of women that reported having traditional Medicaid in 2000 represented those who had not yet entered MMC before July of that year, the month in which all regions were included in the MMC program. Also, in the year 2000, 20,551 reported having private insurance and 1,158 were uninsured.

Table 1 presents the trends in prenatal care and health insurance variables for the period 1995–2000. The percentage

**Table 1** Descriptive statistics for prenatal care and health insurance status variables from 1995 to 2000 for all live births in Puerto Rico

Variables	1995		1996		1997		1998		1999		2000		
	n	%	n	%	n	%	n	%	n	%	n	%	
Prenatal Care (PNC)	Any PNC	62,437	98.2	62,329	98.5	63,474	98.8	59,792	98.7	58,880	98.6	58,692	98.6
	No PNC	768	1.2	758	1.2	605	0.9	582	1.0	559	0.9	555	0.9
	Total <sup>a</sup>	63,518	100.0	63,259	100.0	64,214	100.0	60,518	100.0	59,684	100.0	59,460	100.0
Initiation of PNC	I trimester	48,678	76.6	48,781	77.1	50,191	78.2%	47,552	78.6	46,179	77.4	46,238	77.8
	II trimester	12,224	19.2	12,112	19.1	12,072	18.8	10,976	18.1	11,081	18.6	11,001	18.5
	III trimester	1,535	2.4	1,436	2.3	1,211	1.9	1,264	2.1	1,620	2.7	1,453	2.4
No PNC		768	1.2	758	1.2	605	0.9	582	1.0	559	0.9	555	0.9
	Total <sup>a</sup>	63,518	100.0	63,259	100.0	64,214	100.0	60,518	100.0	59,684	100.0	59,460	100.0
	Adequate	43,730	68.8	44,674	70.6	46,499	72.4	44,706	73.9	45,821	76.8	47,129	79.3
Adequacy of PNC (Kotelchuck Index)	Inadequate	19,788	31.2	18,585	29.4	17,715	27.6	15,812	26.1	13,863	23.2	12,330	20.7
	Total <sup>a</sup>	63,518	100.0	63,259	100.0	64,214	100.0	60,518	100.0	59,684	100.0	59,460	100.0
	Medicaid	30,402	47.9	21,844	34.5	16,213	25.2	11,126	18.4	5,573	9.3	2,218	3.7
Type of health insurance	MMC	6,365	10.0	14,857	23.5	22,109	34.4	25,051	41.4	31,751	53.2	35,532	59.8
	Private	25,528	40.2	25,254	39.9	24,271	37.8	23,270	38.5	21,307	35.7	20,551	34.6
	Uninsured	1,223	1.9	1,304	2.1	1,171	1.8	1,071	1.8	1,053	1.8	1,158	1.9
PNC visits	Total <sup>a</sup>	63,518	100.0	63,259	100.0	64,214	100.0	60,518	100.0	59,684	100.0	59,460	100.0
	Mean		S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
	10.2	3.8	10.2	3.9	10.4	3.8	10.4	3.7	10.5	3.8	10.6	3.8	

<sup>a</sup> Sum of values and percentages for a particular year do not necessarily add up to the total due to missing values

of pregnant women that did not have any prenatal care was very low; 1.2% for the year 1996 and then decreased to 0.9% in the year 2000. The percentage of mothers who initiated care in the first trimester increased from 76.6% in 1995–78.6% in 1998 and then decreased to 77.8% in 2000. The percentage of mothers with adequate prenatal care (adequate plus and adequate within the Kotelchuck index) increased from 68.8% in 1995–79.3% in 2000. This improvement in adequacy of care is very closely related to the significant upward trend in the average number of prenatal care visits per women from 10.15 in 1995 to 10.64 in the year 2000.

## Bivariate Analyses

Table 2 presents the demographic and risk variables for the different health insurance groups. Pregnant women in the traditional Medicaid and MMC group were significantly younger, less educated, less likely to be married, and tended to use more alcohol and tobacco than the private insured group. The MMC group exhibited greater level of medical risks than the traditional Medicaid group.

The association between the prenatal care variables and health insurance status is shown in Table 3. The odd ratios (OR), percentage differences, and their corresponding 95%

**Table 2** Socio-demographic and risk factor characteristics for mothers according to health insurance status from 1995 to 2000 in Puerto Rico

Demographics characteristics	Health insurance status							
	Medicaid		MMC		Private		Uninsured	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
<b>Mother's age</b>								
<20	27,325*†	31.3	38,835*	28.6	7,586	5.4	949*	13.6
20–29	47,345	54.2	77,707	57.3	82,131	58.4	4,262	61.1
30–39	11,814	13.5	17,822	13.1	48,374	34.4	1,655	23.7
40+	846	1.0	1,224	0.9	2,517	1.8	105	1.5
Total	87,330	100.0	135,588	100.0	140,608	100.0	6,971	100.0
<b>Mother's years of education</b>								
<7	4,161*†	4.8	4,977*	3.7	670	0.5	481*	6.9
8–11	66,067	75.8	94,754	70.0	36,352	25.9	3,871	55.7
12+	16,887	19.4	35,577	26.3	103,308	73.6	2,594	37.3
Total	87,115	100.0	135,308	100.0	140,330	100.0	6,946	100.0
<b>Marital Status</b>								
Legally married	30,330*†	34.7	55,943*	41.2	109,675	78.0	3,506*	50.3
Consensual union	39,433	45.1	56,869	41.9	22,613	16.1	2,083	29.9
Alone	17,585	20.1	22,837	16.8	8,325	5.9	1,384	19.8
Total	87,348	100.0	135,649	100.0	140,613	100.0	6,973	100.0
<b>Alcohol use</b>								
No	87,158*	99.7	135,472*	99.8	140,583	99.9	6,948*	99.5
Yes	218	0.2	193	0.1	48	0.0	32	0.5
Total	87,376	100.0	135,665	100.0	140,631	100.0	6,980	100.0
<b>Tobacco Use</b>								
No	85,503*†	97.8	133,765*	98.6	140,358	99.8	6,814*	97.6
Yes	1,873	2.1	1,900	1.4	273	0.2	166	2.4
Total	87,376	100.0	135,665	100.0	140,631	100.0	6,980	100.0
<b>Medical risk factors</b>								
0	76,814*†	87.9	111,527*	82.3	113,686	80.8	5,656	81.0
1	9,802	11.2	21,768	16.0	23,820	16.9	1,158	16.6
2 or more	760	0.8	2,370	1.7	3,125	2.2	167	2.4
Total	87,376	100.0	135,665.0	100.0	140,631	100.0	6,981	100.0

*Notes:* \* Means that the column distribution for the specific variable is significantly different for the respective insurance group and the private insurance reference group at a *P* level of 0.05 or less

† Means that the column distribution was significantly different between the traditional Medicaid and MMC insurance groups. Chi-square statistical tests were used



**Table 3** Bivariate statistics for the association between prenatal care variables and health insurance status for the aggregate period of 1995–2000 in Puerto Rico  $N = 370,652$  (total number of pregnant women that gave birth to a live infant)

	Health insurance status				Total
	Private	Traditional medicaid	Medicaid managed care (MMC)	Uninsured	
Number of infant births	140,631	87,376	135,665	6,980	370,652
<b>Prenatal Care (PNC) Variables</b>					
<i>Access</i>					
No use of PNC	154	2,093	1,273	307	3,827
% of total within the group	0.1%	2.4%	0.9%	4.4%	1.0%
Odds Ratio [95% C.I.]	1.0 [reference group]	22.2** <sup>^</sup> [18.9,26.2]	8.5** <sup>^</sup> [7.2,10.1]	42.2* [34.7,51.3]	
<i>Initiation of PNC</i>					
During first trimester	122,237	59,930	100,608	4,843	287,618
% of total within the group	86.9%	68.5%	74.1%	69.3%	77.6%
Odds Ratio [95% C.I.]	1.0 [reference group]	0.327** <sup>^</sup> [0.320,0.334]	0.430** <sup>^</sup> [0.422,0.439]	0.341* [0.323,0.359]	
<i>Adequacy</i>					
Adequate PNC according to the Kotelchuck Index	116,927	39,177	86,640	4,102	246,846
% of total within the group	83.1%	44.8%	63.8%	58.7%	66.6%
Odds Ratio [95% C.I.]	1.0 [reference group]	0.164** <sup>^</sup> [0.161,0.167]	0.357** <sup>^</sup> [0.350,0.363]	0.290* [0.276,0.305]	
<i>Number of visits</i>					
Mean of PNC visits	12.1	8.4	9.8	9.5	10.3
Standard deviation (SD)	3.6	3.3	3.3	4.3	3.8
% Difference compare to private insurance [95% C.I.]	0.0% [reference group]	-38.8%** <sup>^</sup> [-39.2%, -38.5%]	-21.6%** <sup>^</sup> [-21.9%, -21.3%]	-31.3%** <sup>^</sup> [-32.3%, -30.4%]	

*Notes:* Odds ratios and percentage differences were generated by the bivariate logistic and log-linear regressions

An asterisk (\*) on top of the estimate means that it is significantly different from the private insurance group at a  $P$  level of 0.05 or less

A hat (^) on top of the estimates for the traditional Medicaid and MMC groups means that both estimates are statistically different at a  $P$  level of 0.05 or less

confidence intervals were generated using bivariate logistic and log-linear regressions. In these regressions the dummy variable for the private insured group was left out because it is the reference group. For all the prenatal care variables, the MMC group had relatively better utilization than the traditional Medicaid group. In addition, the confidence intervals for the corresponding coefficients showed that all these differences are statistically significant. For example, 0.9% of women under MMC (unadjusted OR = 22.2; 95% CI 18.9, 26.2) had no use of prenatal care compared to 2.4% of those under traditional Medicaid (unadjusted OR = 8.5; 95% CI 7.2, 10.1). The group with highest percentage of no use was the uninsured group with 4.4% (unadjusted OR = 42.2; 95% CI 34.7, 51.3) and the group with the lowest percent was the private insurance group with 0.1% (unadjusted OR = 1, reference group).

For the initiation of the prenatal care variable, 74.2% of women under MMC (unadjusted OR = .430; 95% CI .422, .439) initiated care during the first trimester compared with 68.6% under traditional Medicaid (unadjusted OR = .327; 95% CI .320, .334). Uninsured mothers had 69.3% (unadjusted OR = .341; 95% CI .323, .359) and privately insured mothers had 86.9% (unadjusted OR = 1, reference group). Also, women under MMC had an average of 9.8 (SD = 3.3) prenatal care visits, the traditional Medicaid group had 8.4 (SD = 3.3) visits, the uninsured group had 9.5 (SD = 4.3) visits, compared to 12.1 (SD = 3.6) for the private insurance group. The percentage differences in average visits compared to the private insurance group were: 21.6% (95% CI -39.2%, -38.5%) fewer visits for the MMC group, 31.3% (95% CI -32.3%, -30.4%) fewer visits for the uninsured group, and 38.8% (95% CI -39.2%, -38.5%) fewer visits for the traditional Medicaid group.

With respect to the adequacy of prenatal care, the percentage of women under MMC with adequate care was 63.9% (unadjusted OR = .357; 95% CI .350, .363) and those under traditional Medicaid were 44.8% (unadjusted OR = .164; 95% CI .164, .167). For women without health insurance, 58.7% (unadjusted OR = .290; 95% CI .276, .305) had adequate prenatal care versus 83.1% (unadjusted OR = 1; reference group) for those with private health insurance.

### Multivariate Analyses

Table 4 presents the results of the regression models for each of the studied prenatal care variables. After adjustment for confounders, women in the uninsured group had the highest likelihood of having no prenatal care visit during pregnancy (adjusted OR = 32.7; 95% CI 26.8, 39.9). The traditional Medicaid group (adjusted OR = 13.3; 95% CI 11.2, 15.9) had a significantly higher likelihood on no prenatal care visit

than the MMC group (adjusted OR = 4.9; 95% CI 4.1, 5.8), while the reference category, the privately insured group, had the lowest of the compared groups.

The multivariate models resulted in generally similar patterns for the initiation of care, the frequency of prenatal care visits, and the adequacy of prenatal care. The privately insured group had the highest likelihood of initiating care during the first trimester. The MMC group (adjusted OR = .621; 95% CI .607, .636) had significantly better first trimester initiation than the traditional Medicaid group (adjusted OR = .452; 95% CI .441, .463), while the uninsured group (adjusted OR = .393; 95% CI .373, .415) had lower likelihoods in comparison. The MMC group had 12.8% (95% CI -13.1%, -12.4%) fewer visits than the private insurance group although this was significantly better than the traditional Medicaid group's 31.1% (95% CI -31.4%, -30.7%) fewer and the uninsured group's 27.9% (95% CI -28.8%, -26.9%) fewer visits than the private insurance group (all at  $P < 0.01$ ). The adjusted estimates also suggested that the referent privately insured group had the highest likelihood of adequate care while the traditional Medicaid group (adjusted OR = .232; 95% CI .227, .237) had significantly less adequate care than the MMC group ( $P < 0.01$ ).

### Propensity Score Analyses

Table 4 also presents the estimates adjusting for selection bias using propensity scores (PS). The PS analyses suggest that selection bias may have occurred in that results differed from the bivariate and multivariate results in three areas. First, in the PS analyses, there were no significant differences in the likelihood of not using any prenatal care services between traditional Medicaid and MMC. Second, the PS estimates reversed the previous finding that women in MMC were more likely to initiate care in the first trimester than those in the traditional Medicaid group. The PS estimates suggested that, under traditional Medicaid, women initiated care earlier in their pregnancy than under MMC. Third, the PS analyses also suggested that women under traditional Medicaid received more adequate and more frequent prenatal care than uninsured women. However, the PS analyses did not alter the findings for the frequency of visits and the adequacy of care variables. As noted in the bivariate and multivariate results, these indices of prenatal care utilization remained higher for women covered under MMC than those insured under traditional Medicaid.

### Discussion

Beginning in 1994, the government of Puerto Rico initiated an historic health care reform program which had as one of its central elements the enrollment of the entire Medicaid



**Table 4** Multivariate regressions results for the average effect of health insurance status on access, initiation, frequency, and adequacy of prenatal care compared to the privately insured mothers for the 1995–2000 period in Puerto Rico

Prenatal care variables (dependent variables)	Health insurance status (independent variable)	Regression models	
		Multivariate regressions adjusting for covariates N = 369,958 OR or % difference [95% C.I.]	Multivariate regressions adjusting for covariates and for selection bias using propensity scores (PS) N = 74,006 (Fifth PS Quintile) OR or % difference [95% C.I.]
No use of PNC (logistic regression)	Private	1.0 [reference group]	1.0 [reference group]
	Medicaid	13.3 <sup>∗∗</sup> [11.2,15.9]	2.6 <sup>∗</sup> [1.7,4.2]
	MMC	4.9 <sup>∗∗</sup> [4.1,5.8]	1.8 <sup>∗</sup> [1.1,2.8]
	Uninsured	32.7 <sup>∗</sup> [26.8,39.9]	13.1 <sup>∗</sup> [7.9,21.7]
Timely initiation of PNC (logistic regression)	Private	1.0 [reference group]	1.0 [reference group]
	Medicaid	0.452 <sup>∗∗</sup> [0.441,0.463]	0.894 <sup>∗∗</sup> [0.822,0.972]
	MMC	0.621 <sup>∗∗</sup> [0.607,0.636]	0.788 <sup>∗∗</sup> [0.727,0.853]
	Uninsured	0.393 <sup>∗</sup> [0.373,0.415]	0.541 <sup>∗</sup> [0.454,0.644]
Number of PNC Visits (log-linear regression)	Private	0.0% [reference group]	0.0% [reference group]
	Medicaid	-31.1% <sup>∗∗</sup> [-31.4%, -30.7%]	-14.4% <sup>∗∗</sup> [-16.0%, -12.8%]
	MMC	-12.8% <sup>∗∗</sup> [-13.1%, -12.4%]	-7.8% <sup>∗∗</sup> [-9.3%, -6.2%]
	Uninsured	-27.9% <sup>∗</sup> [-28.9%, -26.9%]	-34.7% <sup>∗</sup> [-38.4%, -30.9%]
Adequacy of PNC (logistic regression)	Private	1.000 [reference group]	1.000 [reference group]
	Medicaid	0.232 <sup>∗∗</sup> [0.227,0.237]	0.530 <sup>∗∗</sup> [0.490,0.573]
	MMC	0.534 <sup>∗∗</sup> [0.523,0.545]	0.747 <sup>∗∗</sup> [0.694,0.804]
	Uninsured	0.338 <sup>∗</sup> [0.321,0.355]	0.474 <sup>∗</sup> [0.398,0.565]

Notes: An asterisk (\*) on top of the estimate means that it is significantly different from the private insurance group at a P level of 0.05 or less

A hat (^) on top of the estimates for the traditional Medicaid and MMC groups means that both estimates are statistically different at a P level of 0.05 or less

Due to the long list of covariates used in the regression analysis we decided only to show the estimates for the health insurance status groups since this is the most important independent variable in this study. The list of covariate variables used in the regression models is the following: socio-demographic variables related to the parents (age, years of formal education, and marital status), mother's lifestyle risk factors (tobacco and alcohol use during pregnancy), medical risk factors (anemia, cardiac disease, acute or chronic lung disease, diabetes, genital herpes, hydramnios or oligohydramnios, hemoglobinopathy, chronic hypertension, hypertension due to pregnancy, eclampsia, incompetent cervix, previous infant with high weight, previous preterm or small for gestational age infant, renal disease, Rh sensitization factor, uterine bleeding, and singleton or multiple births), socio-economic and health services characteristics for the municipality of residence of the mother (median family income, population density, rate of physicians per thousand persons, and the infant mortality rate from the previous year), and health region to which the municipality belongs. The regression coefficients and statistics for these variables are available upon request

population into managed care programs. This study is the first to evaluate the impact of the reform initiative on maternal and child health services in the Commonwealth. The results of our analyses suggest that by the end of the study period more than 60% of all births in Puerto Rico occurred to women enrolled in the Medicaid managed care program. Moreover, the findings of this study suggest that the Medicaid managed care program in Puerto Rico was associated with generally improved provision of prenatal care to pregnant women enrolled in Medicaid who delivered a live birth. However, despite these accomplishments, patterns of prenatal care provision for women enrolled in MMC remained significantly worse than those found for women covered by private insurance.

Both the bivariate and multivariate analyses suggested that women enrolled in MMC had better indicators of prenatal care utilization than those under traditional Medicaid. Women in the MMC program were more likely than those in traditional Medicaid to initiate prenatal care during the first trimester, have a greater number of prenatal care visits, and have higher levels of adequate prenatal care. The finding that MMC was associated with improved levels of prenatal care utilization is generally consistent with reports from other jurisdictions. Similar to our findings from Puerto Rico, evaluations from Wisconsin [7] and Rhode Island [8] suggested that pregnant women enrolled in MMC received more adequate prenatal care. An experience in Ohio (Cuyahoga County) [9] generally agreed with our findings that the number of prenatal care visits also increased with the introduction of MMC. However, the finding related to the initiation of prenatal care under MMC is contrary to other experiences [2–5].

Our results are also consistent with prior studies in finding that Medicaid managed care was not able to fully close the gap between Medicaid prenatal care services and private insurance health services. In the case of Puerto Rico, possible explanations for this finding may be related to problems with the supply of prenatal care services, including physician recruitment limitations for the MMC program, or other structural health care system factors not considered in this study. Future research initiatives should address these issues.

Like most evaluations of large MMC programs, the present study of the Puerto Rican experience may have been affected by selection bias, as there were significant differences in the characteristics of women in the compared insurance groups, including differences between the traditional Medicaid and MMC categories. In response, we employed propensity scores which attempted to adjust the multivariate models for these selection effects. Although this approach can be useful in evaluating quasi-experimental, programmatic initiatives, it may not have captured some population characteristics that could have affected

program enrollment. Moreover, the PS methodology is merely a statistical attempt to simulate a hypothetical scenario in which study subjects are randomly assigned to each of the examined groups. While caution is therefore warranted in interpreting the PS analyses [24, 25], the resulting estimates did not effectively alter the general findings that MMC was associated with improved use, prenatal care visitation, and the adequacy of prenatal care. However, they did suggest that after adjusting for possible selection bias, women covered by MMC initiated care later than their traditional Medicaid counterparts, a finding consistent with prior studies [2, 4, 6].

It is also important to recognize other limitations to this study. A potential threat to the internal validity of the design was that resources may have been shifted from traditional Medicaid regions to those implementing MMC. This implies that each region's prenatal care performance may not have been independent from another and that prenatal care patterns of the traditional Medicaid group may have worsened from prior levels during the reform implementation process. Even though the use of a time variable in the analytic models would help adjust for these potential influences, the gradual implementation of the program could still bias the estimates in favor of MMC. The inability to identify specific women over different years implies that some women may have had more than one birth over the study period. However, the analyses did capture maternal risk parameters and insurance status which would modulate somewhat the potential impact of this issue. Some caution should also be exercised when drawing general lessons from our findings from Puerto Rico. The public and private structure of the Puerto Rican health system prior to the reform, the nature and cadence of the health reform initiative and a variety of sociocultural characteristics of the affected communities [5] should be considered when applying our findings to other settings. Finally, this study reports on prenatal care utilization effects and not on actual outcomes, such as low birth weight or mortality. Although enhanced prenatal care utilization has generally been tied to improved outcomes, this relationship is sufficiently complex to warrant further research on relevant outcomes, an objective to be addressed in subsequent analyses.

In sum, our findings suggest that the Puerto Rico health care reform initiative's effort to enroll pregnant women in Medicaid Managed Care was associated with a general improvement in prenatal care utilization in comparison with women covered by traditional fee-for-service Medicaid. However, these improvements were not sufficient to reach the levels of utilization observed for privately insured women. Therefore, policies that facilitate Medicaid managed care should be coupled with broader efforts to ensure the equitable provision of prenatal care services to all women in need.

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