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# An exploratory study of the costs and consequences of prenatal care in the Family Health Program

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## ABSTRACT

**OBJECTIVE:** To assess costs and consequences of prenatal care on perinatal morbidity and mortality.

**METHODS:** Evaluation study using two types of analysis: implementation and efficiency analysis, carried out at 11 Family Health Units in the Recife, Northeastern Brazil, in 2006. The costs were calculated by means of the activity-based costing technique and the cost-effectiveness ratio was calculated for each consequence. Data sources were information systems of the Ministry of Health and worksheets of costs provided by the Health Department of Recife and Instituto de Medicina Integral Prof. Fernando Figueira. Healthcare units with implemented or partially implemented prenatal care were compared in terms of their cost-effectiveness and perinatal results.

**RESULTS:** In 64% of the units, prenatal care was implemented with a mean total cost of R\$ 39,226.88 and variation of R\$ 3,841.87 to R\$ 8,765.02 per healthcare unit. In the units with partially implemented prenatal care (36%), the mean total cost was R\$ 30,092.61 (R\$ 4,272.12 to R\$ 11,774.68). The mean cost per pregnant woman was R\$ 196.13 with implemented prenatal care and R\$ 150.46 with partially implemented prenatal care. A higher proportion of low birth weight, congenital syphilis, perinatal and fetal deaths was found in the partially implemented group.

**CONCLUSIONS:** Prenatal care is cost-effective for several studied consequences. The adverse effects measured by the health indicators were lower in the units with implemented prenatal care. The mean cost in the partially implemented group was higher, which suggests a possible waste of resources, as the teams' productivity is insufficient for the installed capacity.

**DESCRIPTORS:** Cost-Effectiveness Evaluation. Prenatal Care. Family Health Program. Evaluation Studies as Topic.

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## INTRODUCTION

Health economics evaluates the relationship between the costs and effects of different interventions to determine the most efficient, the one that offers the best yield and allocation of resources.<sup>4</sup>

This type of evaluation in the health area was criticized in the 1970s-1980s, being considered an artifice for rationing of expenditures. However, according to Hartz & Pouvourville,<sup>14</sup> the costs rationalization process has other applications and its results can avoid the sub-financing of some actions considering

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their effects. It is necessary that public resources efficiency is promoted, due to the principle of justice, and this does not exclude the possibility of reducing investments in interventions to which there is still no proof of effectiveness.

There are four techniques or types of health economics analysis, with similar procedures for cost calculation, but with different measures concerning consequences. In the cost-benefit analysis, costs and effects are measured in monetary units; in cost-utility analysis, the result is measured in utility units, like the quality-adjusted life year (QALY); in cost-effectiveness analysis, the single outcome is expressed in natural units (avoided cases); and in cost-minimization analysis, the cost of two interventions with similar results and different costs is compared.<sup>8</sup>

There is a variant of cost-effectiveness analysis that is called costs and consequences,<sup>4</sup> proposed by the Centers for Disease Control (CDC), in which the visualization of the intervention by the managers is more efficient and practical. The utilization of the results in planning aims to meet the needs of the population, considering its values and preferences.<sup>5</sup> Coast<sup>7</sup> considers it the best alternative for decision-making and its main advantage is that it provides a scenario of options, including employed resources and effects that are prevented by the intervention, and it also allows to add quantitative and qualitative information.

Prenatal care is a programmatic action that has been consolidated in Brazil since 1984. Assistance to low-risk pregnancy is provided by family health teams based on the technical manual of Programa Nacional de Humanização do Pré-Natal e Nascimento (PHPN – National Program for Prenatal and Birth Humanization),<sup>a</sup> which is part of the National Policy for Women's Health.<sup>b</sup>

Prenatal care was chosen to be studied due to the national challenge of reducing perinatal morbidity and mortality, which are still high in Brazil, and because maternal and child actions are cost-effective, as it has been shown in international studies.<sup>1,9</sup>

The present study aimed to evaluate the costs and consequences of prenatal care regarding perinatal morbidity and mortality.

## METHODS

Evaluation research with two types of analysis:<sup>8</sup> implementation (type two) and efficiency analysis.

The study was carried out in the city of Recife, State of Pernambuco, Northeastern Brazil, with 17 equipes de saúde da família (ESF – family health teams), allocated in 11 Unidades de Saúde da Família (USF – Family Health Units) of three sanitary districts. These USF integrate the Community Extension Program of Instituto de Medicina Integral Prof. Fernando Figueira – PEC/IMIP, and are administered in partnership with the Municipal Health Department. They provide health assistance for approximately 60,000 inhabitants.<sup>c</sup>

To evaluate the degree of implementation, Donabedian's systemic approach was adopted. This approach deals with three components: structure, process and result,<sup>15</sup> the last one as a proxy of effectiveness. Based on this approach, we initially performed a normative analysis taking as good practices standard the norms of the technical manual of PHPN.<sup>a</sup> This type of evaluation compares the empirical reality with the established norms and attributes the degree of adherence to the norms.<sup>11</sup>

A questionnaire was administered to the ESF in May and June 2007 with closed questions about material resources, inputs, personnel and training (structure) and about prenatal care practices (process). This normative stage was consolidated through the answers of the ESF. Weight five was attributed to the questions referring to structure and ten to the ones referring to the working process, totaling 100 points. The percentage of correct answers of each ESF was calculated. The ESF were classified as implemented prenatal care (76% to 100% compliance with the standards established in the technical manual); partially implemented prenatal care (between 51% and 75.9%); incipient (between 26% and 50.9%); or without implementation ( $\leq 25\%$ ).

The degree of implementation of prenatal care was related to perinatal results measured by health indicators. The explanatory power of this analysis was in the coherence of the relations between the effects that were found and the degree of adequacy of the program's structure and functioning.<sup>10</sup>

The indicators related to child health were: neonatal, fetal and perinatal deaths of the triennium 2004-2006 and tracer conditions, such as:<sup>13</sup> neonatal tetanus, congenital syphilis, low birth weight (below 2,500 g); live births with no prenatal assistance and with less than four prenatal consultations in the year of 2006. This information was provided by the Information Systems: on Live Births (SINASC), Mortality (SIM), Mandatory Reporting of Health Conditions (SINAN), supplied by the Health Department of Recife; and by Sistema de Informação Hospitalar (SIH – Hospital Information

<sup>a</sup> Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. Área Técnica de Saúde da Mulher. Pré-natal e puerpério: atenção qualificada e humanizada: manual técnico. 3.ed.rev. Brasília, DF; 2006. (Série A. Normas e Manuais Técnicos. Série Direitos Sexuais e Direitos Reprodutivos, 5).

<sup>b</sup> Ministério da Saúde. Secretaria de Políticas de Saúde. Programa de humanização no pré-natal e nascimento. Brasília, DF; 2000.

<sup>c</sup> Instituto de Medicina Integral Prof Fernando Figueira. Relatório interno do Programa de Extensão Comunitária do IMIP. Recife; 2006.

System) provided by the State Health Department. All the events were identified by the mother's name and her full address.

The efficiency analysis employed the costs and consequences<sup>4</sup> alternative of the cost-effectiveness type through the measure of outcomes in natural units.<sup>8</sup> We adopted the technique Basic Assessment Scheme for Intervention Costs and Consequences Methodology (BASICC), recommended by CDC, which incorporates the principles of evidence-based medicine for public health programs in the evaluation of prevention programs<sup>9</sup> and enables to evaluate adverse effects that are caused or prevented by the intervention.<sup>4</sup>

Costs were calculated according to the activity-based costing (ABC) technique in the perspective of the public sector, which was chosen due to the greater connection between costs and activities. It uses only the direct costs (fixed and variable) involved in the activity, calculated by means of specific drivers.<sup>2</sup>

The assistance drivers that were analyzed were prenatal consultations and number of pregnant women. In addition to assistance provided by a doctor and/or nurse, we included tests request, weight and blood pressure measurement through the nursing technique, educational activities and home visits performed by health agents. To calculate the fraction of other direct costs concerning prenatal care related to rent payment, water supply, electricity, telephone, maintenance, cleaning and conservation, and the hiring of employees, the driver "prenatal assistance shifts" of each ESF was selected. Neither the cost of units implementation, nor the cost of personnel training and the depreciation rate were considered, because we were dealing with a short period, equivalent to a gestation.

The worksheets of costs with monetary values spent per USF were obtained at the Health Department of Recife<sup>d</sup> and at Instituto de Medicina Integral Prof. Fernando Figueira,<sup>e</sup> referring to the last quarter of 2006 and first quarter of 2007.

Assistance-related information was extracted from the reports from Sistema de Informação da Atenção Básica (Primary Care Information System), which provides data disaggregated by ESF: "Historical Series of Health Information (SSA2)" and "Historical Series of Production (PMA2)", year 2006, issued by the Health Department of Recife.

The consequences (effects) used in the efficiency analysis were the same indicators and tracer conditions selected in the implementation analysis, except for "absence of prenatal care and number of live births with less than four prenatal consultations".

For the analysis of costs and consequences, the USF were grouped according to the degree of implementation, and the same procedure was employed with costs and indicators, aggregating them per group. The cost-effectiveness ratio was calculated dividing the difference of costs by the difference of each consequence between the groups with the best and worst degree of implementation.

## RESULTS

Table 1 presents the degree (%) of implementation of structure and process and the indicators of effects, except for the numbers of deaths in absolute figures. The USF were classified in two groups: with implemented prenatal care, called GI (in Portuguese, Grupo Implantado), with seven USF (64% of the total), and the four remaining ones (36%) were classified as "partially implemented group" (GPI – Grupo Parcialmente Implantado).

The number of live births registered at SINASC in the catchment area was 440 in the GI group and 344 in the GPI. Approximately 5% of the mothers of the live-born babies did not have prenatal care. The majority of them belonged to the GPI.

Eight cases of congenital syphilis were reported to SINAN, and one case was recovered from SIH, the majority in GPI areas. There was no register of neonatal tetanus cases in the period (Table 1).

The monthly mean costs with professionals in the ESF, proportional to the prenatal assistances, varied from R\$ 381.45 (Sanitary District I) to R\$ 1,287.72 (District IV, data not presented on a table).

In the cost composition (Table 2), the values directly related to pregnant woman assistance had greater participation (R\$ 63,433.47; 92.1%). The mean fraction attributed to prenatal care related to costs with rent payment, water supply, electricity, telephone, equipment maintenance, cleaning and conservation, and hiring of employees was R\$ 5,482.85 in the analyzed period.

The total mean cost of prenatal care in the perspective of Sistema Único de Saúde (SUS – National Health System) was R\$ 39,226.88 in GI, with variation of R\$ 3,841.87 to R\$ 8,765.02, and in GPI, R\$ 30,092.61 (R\$ 4,272.12 to R\$ 11,774.68) (Table 2). To SUS, the mean cost of prenatal care per pregnant woman of GI was R\$196.13 and in GPI, R\$150.46 (data not presented on a table).

The neonatal and perinatal mortality coefficients, the proportion of low birth weight and the incidence of congenital syphilis were higher in the GPI USF, which also presented higher mean costs. The prenatal care per USF cost, on average, R\$ 5,603.84 in the GI group and R\$ 7,523.15 in the GPI group (Table 3).

<sup>d</sup> Secretaria de Saúde do Recife. Relatório do CC/DAS, issued on 10 May 2007.

<sup>e</sup> Instituto de Medicina Integral Prof. Fernando Figueira. Relatório do Setor de Controladoria do IMIP, issued on May 2007.

**Table 1.** Implementation analysis per Sanitary Districts, family health units and teams, according to the dimensions of structure, process and results. Recife, Northeastern Brazil, 2006.

Levels	Structure / Process		Dimensions								
			Results / USF				Live births (2006)				
SD	USF	ESF	Degree of implementation per team (%)	Degree of implementation per USF (%)	NB without PN (%) <sup>a</sup>	< 4 PN consultations (%)		Congenital syphilis (%)	Neonatal death <sup>b</sup> (no.)	Fetal death <sup>b</sup> (no.)	Low birth weight (%)
I	1	1.1 <sup>c</sup>	95	95	2.3	11.5	2.3	4	3	6.9	87
		1.2	95								
	2	2.1	58.5	64	3.6	20.5	6.0	3	5	13.3	83
		2.2	69.5								
	3	3.1 <sup>c</sup>	84	84	4.2	15.5	0	1	1	4.2	71
		3.2	84								
II	4	4.1	80.5	87	3.5	12.9	0	2	3	8.2	85
		4.2	94								
	5	5 <sup>c</sup>	93	93	0	7.5	0	2	0	12.5	40
	6	6 <sup>c</sup>	90.5	91	0	4.5	2.3	2	2	15.9	44
	7	7 <sup>c</sup>	89.5	90	0	1.6	1.6	0	3	4.9	61
	8	8.1	70	71	3.8	10.7	0.8	2	3	15.9	131
IV		8.2	71.5								
	9	9	72.5	73	3.4	12.1	0	6	0	15.5	58
	10	10 <sup>c</sup>	82.5	83	0	13.5	0	2	2	7.7	52
	11	11.1	73	75	4.2	12.5	0	1	3	8.3	72
	11.2	74									
Total of USF with implemented prenatal care (7)					1.8	10.2	0.9	13	14	7.9	440
Total of USF with partially implemented prenatal care (4)					3.8	13.7	1.7	12	11	10.2	344
TOTAL PEC					2.7	11.7	1.3	25	25	8.9	784

Sources: Information Systems about Live Births, Mortality and Mandatory Reporting of Health Conditions

SD: Sanitary District

USF: *Unidade de Saúde da Família* (Family Health Unit)

NB: Newborn

PN: Prenatal care

PEC: *Programa de Extensão Comunitária* (Community Extension Program)

<sup>a</sup> The amount of NB without PN is included in NB with less than four prenatal consultations (< 4 PN consultations).

<sup>b</sup> Deaths presented in absolute figures (triennium 2004-2006). Deaths caused by congenital malformations were excluded.

<sup>c</sup> Health care units with implemented prenatal care.

To prevent low birth weight, an investment of R\$ 3,761.58, on average, is necessary in the USF of the GPI group; and to reduce congenital syphilis, R\$ 2,283.57 (Table 3). For perinatal mortality, the cost-effectiveness ratio showed that four events might be avoided with an investment of R\$ 2,455.45 in the GPI.

## DISCUSSION

The results show that prenatal care is cost-effective for several studied consequences. The adverse effects measured by the health indicators were lower in the group of units with implemented prenatal care. The mean cost in the partially implemented group was higher, which suggests waste of resources, as the teams' productivity is insufficient for the installed capacity.

The choice of the costs and consequences approach using the BASICC methodology of CDC was based on the easiness of application to decision-making and on the criticism of the cost-effectiveness and cost-utility analyses. In the first case, the manager needs to analyze and appraise many effects instead of only one, and in the second, there is difficulty in fully understanding the measure "cost per earned QALY". Besides, the understanding of the economic theory that supports the comparison of costs and effects is not easy for those who are not economists.<sup>7</sup>

The implementation analysis was carried out before the efficiency one because, firstly, effectiveness needed to be proved in the economic evaluations so that a relationship could be established between costs and

**Table 2.** Drivers and direct mean costs related to the action of prenatal care per family health unit in 2006/2007. Recife, Northeastern Brazil, 2010.

SD	USF	Driver –Pregnant woman mean (n) <sup>a</sup>	Prenatal consultation (n) <sup>a</sup>	Mean cost of assistance (R\$) <sup>a</sup>	Driver-Shifts/month <sup>b</sup>	Other direct mean costs (R\$) <sup>b</sup>	Total of costs per USF (R\$)
I	1 <sup>c</sup>	47	58	8,266.56 (94.3%)	4.5	498.46 (5.7%)	8,765.02 (100%)
	2	37	47	6,640.95 (95.5%)	4.5	302.14 (4.5%)	6,943.09 (100%)
	3 <sup>c</sup>	30	33	5,594.77 (91.3%)	4.5	531.93 (8.7%)	6,126.70 (100%)
II	4 <sup>c</sup>	37	52	6,802.29 (89.7%)	11.25	778.64 (10.3%)	7,580.93 (100%)
	5 <sup>c</sup>	18	26	3,135.32 (81.1%)	9	732.14 (18.9%)	3,867.46 (100%)
	6 <sup>c</sup>	20	25	3,527.74 (91.8%)	4.5	314.13 (8.2%)	3,841.87 (100%)
IV	7 <sup>c</sup>	26	31	4,480.03 (94.3%)	4.5	272.59 (5.7%)	4,752.62 (100%)
	8	56	59	10,537.23 (89.5%)	11.25	1,237.45 (10.5%)	11,774.68 (100%)
	9	23	29	3,974.38 (93.0%)	4.5	297.74 (7.0%)	4,272.12 (100%)
	10	22	31	3,809.78 (88.8%)	4.5	482.49 (11.2%)	4,292.27 (100%)
	11	36	45	6,664.42 (93.8%)	4.5	438.30 (6.2%)	7,102.72 (100%)
Total PEC		352	436	63,433.47 (92.1%)	-	5,482.85 (7.9%)	6,9319.48 (100%)

SD: Sanitary district

USF: *Unidade de Saúde da Família* (Family Health Unit)<sup>a</sup> Pregnant woman mean and prenatal consultation mean are drivers of the cost of assistance.<sup>b</sup> Prenatal shifts are drivers of the other costs (water supply, electricity, telephone, rent, equipment maintenance, cleaning and conservation, and hiring of personnel) to which fractions corresponding to prenatal care were calculated.<sup>c</sup> USF with implemented prenatal care.

effects.<sup>6</sup> Likewise, the intervention must be undoubtedly implemented, because, with no knowledge of the degree of implementation, the evaluation may be

innocuous or lead to an erroneous interpretation of its effectiveness, which was called by Contandriopoulos et al<sup>8</sup> type two mistake.

**Table 3.** Costs and consequences according to the degree of implementation of prenatal care and the cost-effectiveness ratio of each consequence in the set of family health units of the Community Extension Program of IMIP in 2006. Recife, Northeastern Brazil, 2010.

Variables related to costs and consequences	Degree of implementation		Cost-effectiveness ratio (R\$)
	Implemented	Partially implemented	
Costs (R\$)			
Total mean cost	39,226.88	30,092.61	-
Mean cost per unit	5,603.84	7,523.15	-
Live births			
Live births (2006) <sup>a</sup>	440	344	-
Live births (2004-2006) <sup>b</sup>	1253	938	-
Consequences			
Congenital syphilis <sup>a</sup>	4 (0.7%)	6 (1.7%)	- 2,283.57
Low birth weight <sup>a</sup>	35 (7.9%)	35 (10.2%)	- 3,761.58
Early neonatal death (ENNM <sup>c</sup> ) <sup>b</sup>	12 (9.58‰ nv)	12 (12.79‰ nv)	- 2,845.57
Neonatal death (NNMC <sup>b</sup> )	13 (10.38‰ nv)	12 (12.79‰ nv)	- 3,790.25
Fetal death (FMC <sup>b</sup> )	14 (9.58‰ nascimentos)	11 (10.66‰ nascimentos)	- 8,457.66
Perinatal death (PMC <sup>b</sup> )	26 (20.52‰ nascimentos)	23 (24.24‰ nascimentos)	- 2,455.45

ENNM: Early Neonatal Mortality Coefficient (&lt; 7 days)

NNMC: Neonatal Mortality Coefficient (&lt; 28 days)

FMC: Fetal Mortality Coefficient

PMC: Perinatal Mortality Coefficient

l b: live births

<sup>a</sup> Refers to the year of 2006.<sup>b</sup> Refers to the triennium 2004-2006

The use of the ABC technique allows greater connection between costs and activities, calculated by means of specific drivers. Thus, it identifies items that consume more financial resources; in the present study, teams and actions. This becomes particularly important in the public sector, considering Complementary Law 101,<sup>f</sup> which regulates norms related to control of costs and evaluation of results of programs financed by public budget resources. But the use of this technique is possible only in places with a structured cost calculation system, like the studied municipality.

There are few studies in the area of health economics in Brazil. Its results are not much used, and even in the international level, it is rarely employed to subsidize planning<sup>21</sup> and decision-making. Coast<sup>7</sup> justifies this assertion through the insufficient knowledge about the methods, and it is possible to add the incipient degree of institutionalization of the evaluative culture of public policies in the Brazilian reality. We have not identified, up to the present moment, in the electronic databases that we searched (SciELO, Lilacs, PubMed), a Brazilian economic study that compared the same intervention with different degrees of implementation, like the present study.

The implementation of basic child healthcare actions in Pernambuco was analyzed in previous studies, such as the one by Bezerra et al.<sup>3</sup> Also, studies were conducted on the effectiveness of the family health strategy over infant mortality<sup>16</sup> and over the efficiency of the family health model in relation to the traditional one. In this last study, some indicators were better, like offer of services, measured by the number of assistances or of access/utilization, judged by vaccinal coverage.<sup>8</sup>

To Darmstadt et al,<sup>9</sup> interventions to improve maternal health include the effectiveness of anti-tetanus vaccination, of detection and treatment of syphilis and asymptomatic bacteriuria during the prenatal period. According to the World Health Organization, almost ¾ of the maternal deaths that occur in poor countries can be avoided, 26% with prenatal care and 48% with the amplification of access to high-quality obstetric care. These aspects consumed 30% and 26% of the financial resources of the Safe Maternity Program, respectively.<sup>15</sup>

Adam et al<sup>1</sup> evaluated the cost-effectiveness of prenatal activities in the poor countries of the Sub-Saharan Africa and of the Southeast of Asia. They identified that the most cost-effective in primary care are: anti-tetanus vaccination; screening for and treatment of asymptomatic bacteriuria and syphilis; screening for pre-eclampsia, by means of blood pressure measurement,

detection of proteinuria, and existence of reference service for treatment. However, to avoid approximately 50% of neonatal and maternal deaths, it would be necessary that, apart from these activities, others related to childbirth, puerperium and to immediate neonatal assistance had 95% of population coverage. It should be noted that all these activities are incorporated into prenatal care in Brazil and are included in the technical manual of the Ministry of Health.<sup>a</sup>

Prenatal coverage in Recife for four or more consultations reached 88.3%.<sup>c</sup> In the catchment areas of the researched USF, even in the worst scenario (GPI), the prenatal coverage was similar to Recife's mean. This suggests that the ESF need to follow the assistance norms with the involvement of the whole team, perform active searches for absent pregnant women and follow them up with home visits.

Another indication of flaws in prenatal care is the occurrence of congenital syphilis, more frequent in the GPI group, a result that is coherent with the implementation degree. This result signals the need of greater efforts on the part of the ESF in the follow-up of pregnant women suffering from this sexually transmitted infection to ensure the complete treatment provided by the SUS for the couple. This treatment has low cost and good cost-effectiveness relationship per avoided case.

In 2006, 8.2% of the live births in Brazil were low weight newborns, including preterm babies and newborns who were small for the gestational age.<sup>c</sup> This occurrence is associated with absent and/or inadequate prenatal assistance,<sup>18,19</sup> and was more frequent (10.2%) in the areas with GPI, above the national mean.<sup>c</sup> To reduce the proportion of low weight in this group and in the country's mean, it would be necessary to invest more in the ESF, according to the cost-effectiveness ratio.

Low birth weight children are more vulnerable to diseases and death; in addition, hospitalization cost varies inversely with birth weight.<sup>12,20</sup> In 2001, a study carried out in the United States compared the mean cost of the hospitalization of preterm/low birth weight children with normal weight newborns, which corresponded to US\$15,800 and US\$600, respectively.<sup>20</sup> Another research conducted in Greece in 2004 verified that the mean cost for the government with newborns weighing between 1001 and 1500g in intensive neonatal care public units was US\$10,438.<sup>12</sup>

It is not our intention to debate the need of these units, but rather, what could be done at lower costs to avoid the excessive demand of these services. Apart from the higher financial cost, there are intangible costs,

<sup>f</sup> Brasil. Presidência da República. Lei Complementar 101, de 4 de maio de 2000. Capítulo II, Seção II Lei de diretrizes orçamentárias, Art. 4 [Internet]. [Cited July 2010]. Available from: [http://www.planalto.gov.br/ccivil\\_03/Leis/LCP/Lcp101.htm](http://www.planalto.gov.br/ccivil_03/Leis/LCP/Lcp101.htm)

<sup>8</sup> Castro JD. A utilização do sistema de custeio por absorção para avaliar os custos da atenção básica de saúde: reformulações e aprimoramentos metodológicos [Doctoral thesis]. Campinas: Faculdade de Ciências Médicas da Universidade Estadual de Campinas; 2000.

as low weight babies present higher risk of avoidable neonatal death, according to the classification of Malta et al,<sup>17</sup> related to failures in prenatal assistance and to the handling of childbirth and of the neonatal period.<sup>19</sup>

The failure in the prenatal assistance also influenced the perinatal and neonatal mortality rates, which were higher in the GPI group. The similar rates between groups can be explained by the small difference in score for the classification of the implementation degree of prenatal care in the units, which, in general, had a good score, except for one.

It was not possible to establish prenatal effects on women's health with the selected indicators, because there was no maternal death in the areas under analysis in the triennium 2004-2006. On the other hand, there were problems in the identification of hospitalizations due to pregnancy complications in the SIH, such as arterial hypertension (first cause of maternal death), gestational diabetes and urinary tract infection. There is the possibility of an important under-record, since three hospitalizations due to severe pre-eclampsia (USF 8, 9 and 10) were located, and also one childbirth with eclampsia (USF 1) due to failure in filling in the pregnant woman's address.

The lack of availability of these women's health indicators and deriving costs is perhaps the greatest limitation of this work, probably, with underestimation bias of the

magnitude of the effectiveness differentials between GI and GPI. Uncertainties about the information systems' reliability may have increased the prenatal costs in those units that registered less, which is another limitation of the study.

It is possible that there are potential selection and information biases, based on the form of identification of the effects, through the addresses of the coverage areas of the USF provided by the health agents which, involuntarily, may have been suppressed or may be incomplete.

The constructed model can be applied to the universe of family health teams of Recife or be adapted to other actions and contexts, according to the stages recommended in the BASICC model.

As for generalization, the results cannot be extrapolated to other places, due to the different characteristics of the communities, of the productivity of the teams' professionals, as well as of the organization of the healthcare system and input prices, including salaries.

Also relevant are the factors related to the cost unit associated with a resource and with the effectiveness measure, and all these characteristics have a temporal relationship. However, to the municipality of Recife, the results can represent a good estimate to the public sector, concerning the programmatic action conducted by the ESF, and be useful to guide decisions.

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