Can the Community Health Workers Reduce the Utilization of Health Services for Children Under Five Years?

Juraci A. César[1]
Marcelo A. Cavaletti[2]
Gustavo S. de Lima[3]
Ricardo S. Houthausen[3]

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Takemi Program in International Health
Harvard School of Public Health
665 Huntington Avenue
Boston, MA 02115
(617) 432 0686

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1 Assistant Professor, Departamento Materno Infantil, Fundacao Universidade do Rio Grande, RS, Brazil and Takemi Fellow in International Health, Harvard School of Public Health, Boston, MA, USA.
2 Local Coordinator of Mainha Project, Prefeitura Municipal de Itapirapua Paulista, SP, Brazil.
3 Medical Students, Universidade Federal de Pelotas, RS, Brazil

Correspondence to: Juraci A. César
Rua Eng. Alfredo Huch, 475, Campus Cidade, Rio Grande, RS, Brazil, 96201.900

Summary

Severity of disease and easy access are the most important determinants of utilization of health services (UHS). A project with community health workers (CHWs) recently implemented in Vale do Ribeira, SP, Brazil, reduced drastically the occurrence of disease and deaths among children under five years. To evaluate whether these changes could have affected the pattern of utilization of medical consultation and hospitalization for children under five years, another area with characteristics similar to the area with intervention was chosen. Trained interviewers visited every home in each area and applied a standardized questionnaire to mothers or guardians about family and children. Eight hundred and one children were found - 403 in areas with CHWs and 398 without CHWs. Despite the majority of variables being favorable to area without CHWs, the utilization of health services among these children was 77 percent higher than the area with CHWs, 42.7 percent against 24.1 percent. After adjusting for many confounding factors, the most important determinants for the utilization of health service were: the absence of CHWs, children's ages, the distance to health service, and low birth weight. These results suggest that CHWs are able to reduce the number of medical consultations and hospitalizations for children under five years in areas with high levels of infant morbidity and mortality.

Keywords: Community health workers, evaluation of health service, maternal and child health, infant morbidity and mortality, children, developing countries.

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Introduction

Severity of disease and easy access are the main determinants of demand for health services. The first reason holds true for both poor and rich countries, while the second reason occurs in only developed areas. Many times in these areas, the health service is used when not necessarily required (Morley, 1973; Starfield, 1992).

These two scenarios occur in Brazil, with the first in the Northeast (Victora et all, 1995) and the second in the South (César et all, 1996). Sometimes, the two may occur together, as in Southeast region. In this region, there are rich and poor areas. In rich area, there is abundant availability of health services and low levels of morbidity and mortality. However, the opposite occurs in the poor area, with the availability of health services being low and the levels of morbidity and mortality rates being high.

Vale do Ribeira is located in Southeast region, in Sao Paulo State, the richest Brazilian state. It has approximately 30 counties and 300,00 residents, low availability of health service and one of the worst health indicators in Brazil.

Because of these factors and the absence of effective interventions by the Brazilian government in this region, a small county named Itapirapua Paulista implemented the Mainha Project in 1994. The goal of this project was to offer basic health care by community health workers (CHWs) to all children under five years of age living in this county.

After three years of intervention, the infant mortality rate was reduced 4.2 times from 65 in 1,000 to 15 in 1,000. The annual hospitalization rate decreased nearly six times, from 13 percent to 2 percent. The prevalence of the height-for-age deficit was diminished 22 percent, from 28 to 23 percent, and the use of oral rehydration therapy (ORT) during diarrhea episodes increased 2.4 times to 91 percent from 38 percent. Finally, basic immunization for children increased 31.5 percent during the three years, a change to 96 percent from 73 percent (César et all, 1998).

It is possible that these improvements could have affected the pattern of utilization of health service for under five years in this locale. To evaluate whether this occurred, another county with similar characteristics to Itapirapua Paulista was chosen. These characteristics included demographics, the socioeconomic level of the child's family, household conditions, and the availability of health service. This evaluation compares the utilization of health service for under five years between these two counties controlling for several confounding factors. The results are presented and discussed in this paper.

Methods

This study was carried out in Itapirapua Paulista and Bom Sucesso de Itarare, two small and poor counties in Vale de Ribeira, Sao Paulo state, Brazil. The Brazilian government gives $1 million per year to maintain the public services in each of these counties. Two-thirds of this money goes to the public employees' salaries. There is one public employee for every 20 residents.

When this evaluation was conducted in 1996, Itapirapua Paulista had 3,097 residents with two-thirds living in rural areas. More than 90 percent of the residents have eletricity and only two-thirds of the urban population has treated water and sewage disposal in their homes. The health system consists of one health center where one physician and three attendants work as a team. There are two other mini health centers in rural areas, where this team works one day a week. Also, 12 CHWs visit all resident children under age five weekly.

Bom Sucesso de Itarare had 2,763 inhabitants equally distributed between urban and rural areas. Eletricity was available in almost every home, while one-fifth of the urban population had treated water. Sewage disposal, however, did not exist in the homes. Four attendants and one nurse and two doctors were responsible for offering health care to this population at two locations. Each doctor worked two days per week at these health centers. The county did not have CHWs.

To conduct this study, eight interviewers and two supervisors were selected for each county. The teams were trained separately for one week by the coordinators of this evaluation (JAC and MAC). During this period, the 10 were taught how to use the questionnaires and how to assess the weight and height of the children. These interviewers were divided into pairs. There was one supervisor for two pairs. The supervisor was present to monitor the quality of the collected data and help the interviewer during the administration of the questionnaire and during measuring the children.

A pilot study was not conducted because all the resident children under age five were included in the initial study. To compensate for this limitation, each interview was followed up by the supervisors or coordinators during the first two weeks after the initial questionnaire and height and weight measurements of the children. Also, five percent of all interviews were repeated by coordinators to verify the information collected by interviewers. No important difference was found.

One pair of interviewers visited every home in these counties. These visits occurred between January and March 1996. When a child under age five was found, two questionnaires were distributed to the child's mother or guardian. The first concerned the family's socioeconomic level and household conditions. The second questionnaire addressed the issues of ante natal care, assistance during delivery, breast feeding and diet, the use of the curative and preventative services at the health center, the occurrences and treatment of diarrhea and acute respiratory disease, and evaluation of the nutritional status of the child. These questionnaires resulted in 105 queries or 135 variables for each child and its family.

These questionnaires were codified by interviewers and revised by a supervisor. Any problem was corrected and, when necessary, the interviewer and supervisor would go back to the home where the questionnaire was applied. This revisiting occurred less than 10 times in each county.

After these stages, two different persons typed the questionnaires in the Epi Info 6.02 software. Using the same software, all files were compared. One of these files was chosen and corrected. Afterwards, this data was transferred to make bivariate, crude and adjusted analyses.

The bivariate and crude analyses consisted of measuring the degree of association between independent variables (sex, age, the education levels of the child's parents, family income,

nutritional status, etc.) and dependent variable (utilization of health service). These associations were evaluated through the odds ratio (with a confidence interval of 95 percent) and the chi-square test. Adjusted analysis was carried out according to the hierarchical model previously determined. This model was made from variables associated (p-value up to 0.10) with outcome according to bivariate analysis.

Using this criterion and biological plausibility, only 10 variables were selected. These variables were distributed in five levels (Box). The first level contains the socioeconomic status (family income and the education levels of the child's mother and father). The second level includes household conditions (type of house, number of people sleeping in each room, overcrowding, availability of treated water and sewage disposal and use of household appliances). In the third was the distance from the health center. The fourth level contained variables related to ante natal and postnatal care (medical consultation during pregnancy, gestation age when consultation with a doctor began and method and location of delivery). Breastfeeding and diet comprise the fifth level. Birth weight also was included in this item.

The outcome consists of utilization of health service. The child who required medical consultations in the last three months or was hospitalized until 12 months before this interview was considered as having utilized the health services.

Also included in this model was an additional level. In this level are the following variables: county and locale of residence - urban or rural -, sex, and age. All variables that appear underlined in Box were associated with outcome with p-value equal or less than 0.10.

This model admitted that some independent variables might indirectly or directly determine the utilization of health service among children under five years of age. In the direct determination, only one variable could lead a child to use the health service. The family's low income is an example. The indirect determination occurred when two or more variables were introduced. Low family income, plus low birth weight, for example, could lead the child to medical consultation or hospitalization (Victora et all, 1997).

In the adjusted analysis, the variable tested was controlled by all variables of same level and previous levels that were significantly associated to outcome. Because of this, in each level an equation was made. The statistical significance for these analyses was measured through likelihood ratio statistics (EGRET, 1997).

All interviews that were conducted were successful. Meanwhile, 11 children were not found. Eight were living in Itapirapua Paulista and three in Bom Sucesso de Itarare. Considering that 801 children were studied, the loss totaled 1.7 percent. This guarantees the internal validity of this study (Rothman and Greenland, 1998).

Results

Among the 801 children under age five who participated in this study, 403 lived in Itapirapua Paulista and 398 were residents of Bom Sucesso de Itarare.

The results of the study of these children and their families are presented in two parts. In the first part, table 1 to 5, are compared variables related to socioeconomic status, household conditions, ante natal and postnatal care, pattern of morbidity and utilization of health service. Table 6 resumes this comparison. In the second part, table 7, are showed the results of the crude and adjusted analysis according to hierarchical model previously determined.

Children in Bom Sucesso de Itarare demonstrated a clear advantage in the locale of residence and age. The percentage of children living in urban and older was higher in Bom Sucesso de Itarare than that in Itapirapua Paulista. The distribution of children by sex and the number of person by home were similar between counties (Table 1).

Families with children in Bom Sucesso de Itarare had better income and the mothers displayed a higher level of education as compared to those in Itapirapua Paulista. The education levels of the fathers were equivalent in the two counties (Table 2).

The percentage of mothers who received antenatal care, as well as the number of medical consultations during pregnancy was similar between the counties. Meanwhile, the number of children adequately immunized against neonatal tetanus and locale of delivery were favorable to Bom Sucesso de Itarare. The occurrence of cesarean section was fewer in Itapirapua Paulista. Finally, the median of breastfeeding was equally high in both counties. At least 50 percent of all children were breastfed until the end of first year of life (Table 3).

Table 4 shows that the occurrence of low birth weight was equally high in both counties as was the prevalence of deficit height for age and diarrhea. The usage of oral rehydration therapy during diarrhea episodes was significantly more elevated in Itapirapua Paulista. Children living in this county had fewer medical consultations in the last three months and were less frequently hospitalized in the last twelve months. The variable named utilization of health service (UHS), created from medical consultations plus hospitalization, shows that while 24.1 percent of children required medical assistance, the percentage in Bom Sucesso de Itarare reached 42.7 percent. This indicates that the UHS for under five years in the county without CHWs was 77 percent higher than county with CHWs. Practically all children living in Itapirapua Paulista were weighed in the last three months. This percentage reached a little more than 50 percent of the children in Bom Sucesso de Itarare. More than 90 percent of children aged 12-59 months in Itapirapua Paulista were completely immunized compared to 76 percent in Bom Sucesso de Itarare. The distance to the health service was shorter for children living in the county without CHWs.

Table 5 shows that type and number of rooms used to sleep in was similar between counties, while usage of household appliances, receiving treated water at home and toilet facility was substantially better in Bom Sucesso de Itarare.

Table 6 resumes this comparison. Variables related to utilization of health service - preventive or curative - was favorable in Itapirapua Paulista. Bom Sucesso de Itarare showed better socioeconomic level, household conditions, and assistance for pregnancy and delivery. In addition, their children were older, living mainly in urban areas and closer to the health service. There was absence of advantage between counties for important variables like antenatal care, incidence of low

birth weight, duration of breastfeeding and overcrowding. These differences were statistically significant (P<0.05).

Table 7 refers to the crude and adjusted analyses. According to crude analysis, children residents in urban areas, from families with low income, without treated water at home, living more than one kilometer from health service, whose mother did not use antenatal care and who were born at home, used health service commonly than the other children. carried out to health service. On the other hand, children living in a county without CHWs, with ages ranging from 12 to 23 months, who were born by caesarian section or had low birth weight, more frequently used the health service.

When this analyses was adjusted for variables of the same level and previous levels, only the presence of CHWs, age of children, distance to health service and low birth weight were significantly associated with utilization of health service. Children living in the county without CHWs showed risks of 2.47 times more than another needing medical consultation or hospitalization. The risk among children 12-23 months using the health service increased to 2.53 from 2.27 crude analysis when compared with older children. Children living less than one kilometer distance to the health service continued using it more frequently than others. Finally, the risk for utilization of health service was 67 percent higher among children who were born with low birth weight (less than 2.5 kg) (Table 7).

When the adjusted analysis was restricted to county, age and distance to the health service were significantly associated with the outcome in both counties. These odds ratios were similar when all children were analyzed together, except for one age group in Bom Sucesso de Itarare. In this county, children of ages 12 to 23 months showed risks that contributed to the substantially higher usage of the health service. This odds ratio changed to 3.43 (1.60-7.42) from 2.53 (1.51-4.24) in the joint analysis. In Itapirapua Paulista, low birth weight was significantly associated with outcome after the control of the confounding factors. This odds ratio reached 2.46 (1.16-5.19) from 1.67 (1.04-.68) in the joint analysis.

Discussion

This study has at least two important limitations. First, it is a small experiment. Because of this, the extrapolation of these results for larger counties must not be done. Second, the cross sectional study is not the leading choice to evaluate health programs because it measures exposure and disease at the same time. On the other hand, there are two important reasons to use this epidemiological design in this situation. First, it is cheap, fast, easy to carryout and to analyze (Rothman and Greenland, 1998). Second, the experimental methods, the best choice in this situation, may be unnecessary, inappropriate, impossible or inadequate (Black, 1996).

This study showed a population under five years living in an area with low socioeconomic level, inappropriate household conditions, and inadequate assistance to mothers during pregnancy and delivery. These conditions are responsible both for the occurrence and maintenance of high indices of disease among these children, mainly infectious disease and malnutrition (Victora et all, 1988).

The utilization of health service (UHS) for children under five years living in Bom Sucesso de Itarare was 77 per cent higher than in Itapirapua Paulista. In terms of odds ratio, this represent a risk of 2.47 to require medical consultation or hospitalization.

Considering that the populations studied have similar demographic characteristic, household conditions, socioeconomic level, availability of health service, and pattern of morbidity, it is possible to suggest that the fewer UHS in Itapirapua Paulista occur because of the interventions performed by CHWs. There are two reasons to support this hypothesis. First, the presence of CHWs in Itapirapua Paulista was, in fact, the only important difference between these counties. Second, the main causes of medical consultation and hospitalizations in Bom Sucesso de Itarare were diarrhea and respiratory disease. Many studies in different settings show that the CHWs are able to diagnose, treat, and handle these diseases with success (Walt et all, 1990; Victora et all, 1991; Arole and Arole, 1994; Heggenhoughen K, 1987; McAuliffe et all, 1995; César et all, 1998).

Adjusted analysis showed that family income and the education level of the mother were not associated with UHS. This analysis reveals also that children born with low birth weight and living near health service required medical consultation and hospitalization more frequently than others.

Family income and the education level of the mother have been identified as two of the most important determinants of child health in the first years of life (Victora et all, 1988). In this study, these variables were not significantly associated with UHS even when this analysis was stratified by county. Another two studies carried out in two counties in Maranhao State, Brazil using analogous epidemiological design also showed similar results (Victora et all, 1991; César et all; 1992). However, there are two important differences between these studies. First, the Maranhao's studies considered only hospitalization as UHS. Second, the data analysis in these studies was not adjusted for confounders. Two other evaluations, one in Brazil (McAuliffe et all, 1995) and another in India (Arole and Arole, 1994) did not use community control neor the confounding factors were controlled. Basically, these studies were limited to comparison of the same population in different moments of time.

Probably, the absence of independent effect of mother schooling and family income verified in this study is casual. There are two reasons to believe in this assumption. First, there is no biologic plausibility in it. Mother with better instruction is in a better condition to identify problems and to offer adequate care for child. Family income is the main factor responsible for household conditions, acquisition of food and clotes, etc (Morley, 1973; Victora et all, 1988). As a last resort, these aspects determine the health conditions of the children. Second, when this analysis was restricted by county, in Bom Sucesso de Itarare, where CHWs does not exist, the same result was observed. In spite of this, we suggest that this association should be evaluated in other studies controlling for confounding factors.

There are many studies showing that birth weight is, individually, the most important factor for infant's survival (WHO, 1980). The risk of death among children who are born weighing less than 2.5 kg is 11 time higher than other children during the first year of life (Victora et all, 1988). In this study, children who born with low birth weight required 67 percent more medical consultations and hospitalizations than others. For children with low birth weight living in Itapirapua Paulista, the

odds ratio to UHS reached 2.46. This increase may be attributed to special attention that CHWs must give to these children according to instruction guide of the CHWs.

Children living more than one kilometer from health service required medical consultation and hospitalization less frequently than others. This occur because the proximity to health service facilitate the access to it, having or not having necessity (Morley, 1973). In addition, children living far way were carried to the health service mainly when they manifested serious problems. Another limitation is the difficulty of transportation. Adequate transportation does not exist in many communities. These aspects reduce the UHS among these children (Morley, 1973).

There are many studies showing that the UHS in first years of life decreases with the increase of age. In this study, children with age between 12 and 23 months showed odds ratio substantially higher than other age groups who demanded medical consultation and hospitalization. One possible explanation for this result is related to a short birth interval. Many children were born with birth intervals between 12 and 23 months. When this occurs, the mother gives more attention to younger child. The reduction of care for older children frequently results in higher occurrence of disease in this age group and, consequently, higher UHS (UNICEF, 1997).

To verify whether this had happened in this study, a separated analysis was conducted. This investigation showed that the UHS was very similar in different birth intervals. When this analysis was restricted by county, the UHS in Itapirapua for children who were born with birth interval less than 24 months was 37 percent higher than in Bom Sucesso de Itarare. This occurred because the CHWs are instructed to direct these children to the health service when there was evidence of important disease, mainly pneumonia and dehydration. These diseases have continued to be the principal causes of death among under children five years in this locale (César et all, 1998).

This study gave two important contributions to understanding the activities performed by community health workers. First, from the point of view of results, it shows that the CHWs were able to reduce substantially the rate of medical consultation and hospitalization for children under five years. In addition, it has demonstrated that the age of the child, the distance to health service and birth weight act independently in determination of the UHS. Second, from the viewpoint of methods, according to literature revised, this study is the first to use, concurrently, a community control, a hierarchical model, and controlling of confounders in the evaluation of interventions performed by CHWs. Until now, these studies were frequently based only in the comparison of frequencies in the same population at different times. Finally, other studies are necessary to clarify many results found in this evaluation. It is important because the community health workers continue to be one of the most important means of offering basic health care for all, mainly in developing countries.

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Hierarchical model for utilization of health services for under five in two small Brazilian counties♣♦.
Level 1: Socioeconomic status Family income, schooling of father and mother **Level 2: Household conditions** Type of house, people by room to sleep, crowding, Treated water, toilet facility, household appliances **Level 3: Distance to health service** Medical consultation, kind and location of delivery **Level 4: Assistance to pregnancy and delivery** Low birth weight, deficits height for age, height for weight, weight for age **Level 5: Breastfeeding and diet** **Outcome:UHS** Medical consultation and hospitalization ♣ All these levels were controlled by county and locale of residence, children's age and skin color. ♦ Variables underlined were included in the final model because the p-value was equal or less than 0.10.

Table 1. Comparison of demographic variables among children under five years in two Brazilian counties, 1996.

Variables	With CHWs (IP)	Without CHWs (BSI)	Advantage
Locale of residence**			
Urban	36.2%	48.7%	BSI
Rural	63.8%	51.3%	
Sex			
Male	47.6%	51.0%	AA
Female	52.4%	49.0%	
Age in months**			
0 - 11	21.3%	23.8%	
12 - 23	22.9%	14.9%	
24 - 35	21.1%	23.0%	BSI
36 - 47	16.1%	23.8%	
48 - 59	18.6%	14.4%	
Mean and SD	28.4 (17.0)	28.6 (16.8)]	
Overcrowding:			
Mean and SD	4.5 (2.3)	4.5 (2.2)	AA

Level of significance: *P<0,05; **P<0,01; ***P<0,001
IP: Itapirapua Paulista; BSI: Bom Sucesso de Itarare;
AA: Absence advantage

Table 2. Comparison of socioeconomic variables between children under five years in two Brazilian counties, 1996.

Variables	With CHWs (IP)	Without CHWs (BSI)	Advantage
Family income in minimal wages*:			
Less than 1	22.0%	14.6%	
1 - 1.9	41.3%	38.1%	BSI
2 - 2.9	14.9%	21.7%	
3 or more	21.7%	25.7%	
Mean and SD	2.1 (2.6)	2.4 (2.6)	
			AA
Father schooling in years:			
None	15.4%	13.4%	
1 - 4	59.6%	62.8%	
5 - 8	19.0%	19.3%	
9 or more	5.9%	4.5%	
Mean and SD	3.4 (2.8)	3.7 (2.6)	
Mother schooling in years*			BSI
None	18.6%	12.9%	
1 - 4	63.3%	58.1%	
5 - 8	12.4%	23.5%	
9 or more	5.7%	5.6%	
Mean and SD	3.1 (2.8)	3.7 (2.6)	

Level of significance: *P<0,05; **P<0,01; ***P<0,001;
IP: Itapirapua Paulista; BSI: Bom Sucesso de Itarare;
AA: Absence advantage

Table 3. Comparison of variables related to antenatal care and breastfeeding among children under five years in two Brazilian counties, 1996.

Variables	With CHWs (IP)	Without CHWs (BSI)	Advantage
Consultation with doctor during pregnancy	77.3%	75.8%	AA
Number of consultations performed Mean and SD	5.4 (2.4)	6.2 (2.4)	AA
Complete immunization against neonatal tetanus**	50.4%	63.8%	BSI
Birth in hospital**	73.9%	88.2%	BSI
Kind of delivery*			
Normal	82.6%	75.4%	IP
Cesarean	17.4%	24.6%	
Median of duration of breastfeeding (in months)	13.4	12.6	AA

Level of significance: *P<0,05; **P<0,01; ***P<0,001
IP: Itapirapua Paulista; BSI: Bom Sucesso de Itarare;
AA: Absence advantage.

Table 4. Comparison of variables related to morbidity and utilization of health service for children under five years in two Brazilian counties, 1996.

Variables	With CHWs (IP)	Without CHWs (BSI)	Advantage
Incidence of LBW	10.9%	13.7%	AA
Severe deficit H/A*	24.3%	19.8%	BSI
Prevalence of diarrhea: last 15 days	18.4%	22.4%	AA
Received ORT during diarrhea episodes*	85.7%	69.6%	IP
Children that required medical consultation: last 3 months***	24.6%	41.1%	IP
Main causes (N=263):			
Respiratory infection**	56.6%	30.1%	IP
Diarrhea	14.1%	22.7%	
Children hospitalized last 12 months***	3.2%	10.8%	IP
Main causes (N=56):			
Pneumonia	53.2%	46.3%	
Diarrhea/Dehydration	22.7%	30.5%	IP
Growth monitoring: last three months***	98.0%	51.6%	IP
Complete immunization☺**	91.3%	75.7%	IP
Distance health service*			
Less than 1 km	43.9%	48.5%	BSI
1 km or more	56.2%	51.5%	
Mean and SD	6.1 (8.0)	5.9 (7.3)	

Level of significance: *P<0,05; **P<0,01; ***P<0,001;
☺ Only for children aged 12-59 months;
IP: Itapirapua Paulista; BSI: Bom Sucesso de Itarare;
AA: Absence advantage

Table 5. Comparison of variables related to household conditions among children under five years in two Brazilian counties, 1996.

Variables	With CHWs (IP)	Without CHWs (BSI)	Advantage
Type of House			
Concrete	22.8%	19.8%	
Wood	70.0%	78.4%	AA
Others	7.2%	1.8%	
Number of rooms used to sleep (Mean and SD)	1.8 (0.8)	1.8 (0.9)	AA
Household appliances***	35.3%	56.3%	BSI
Treated water at home**	36.7%	46.2%	BSI
Toilet facility**	70.0%	90.5%	BSI

Level of significance: *P<0,05; **P<0,01; ***P<0,001
IP: Itapirapua Paulista; BSI: Bom Sucesso de Itarare;
AA: Absence advantage

Table 6. Summary of comparability for under five years in two Brazilian counties, 1996.

☞Advantage* to Itapirapua Paulista (With CHWs):

- Kind of delivery
- Medical consultation last three months
- Hospitalization last twelve months
- Use of oral rehydration therapy
- Growth monitoring
- Complete immunization

☞Advantage* to Bom Sucesso de Itarare (With CHWs):

- Locale of residence
- Age
- Mother schooling
- Family income
- Immunization against neonatal tetanus
- Locale of birth
- Prevalence of deficit height-for-age
- Distance to health service
- Receive treated water at home
- Toilet facility
- Household conditions
-

☞ Absence of Advantage:

- Sex
- Overcrowding
- Father schooling
- Antenatal care
- Incidence of low birth weight
- Duration of breastfeeding
- Type of house construction
- Number of people sleeping per room

* These differences were statistically significant ($P<0.05$)

Table 7. Logistic regression according to hierarchical model for utilization of health services for children under five years in two Brazilian counties, 1996.

Variables	Crude analysis OR with CI 95%	Adjusted analysis OR with CI 95%
Area [a]	P<0.05	P=0.11
Urban	1.00	1.00
Rural	0.70 (0.52 - 0.94)	0.75 (0.55 - 1.22)
County [b]	P<0.001	P<0.001
With CHWs	1.00	1.00
Without CHWs	2.35 (1.74 - 3.18)	2.47 (1.80 - 3.38)
Age in months [c]	P<0.05	P<0.01
0 - 11	1.22 (0.73 - 2.01)	1.16 (0.70 - 1.95)
12 - 23	2.27 (1.37 - 3.75)	2.53 (1.51 - 4.24)
24 - 35	1.29 (0.79 - 2.13)	1.21 (0.73 - 2.03)
36 - 47	1.35 (0.81 - 2.24)	1.19 (0.71 - 2.01)
48 - 59	1.00	1.00
Family income in minimal wages [a]	P<0.04	P=0.17
Less than 1	0.46 (0.29 - 0.86)	0.52 (0.27 - 0.99)
1 - 2.9	0.57 (0.33 - 0.97)	0.53 (0.30 - 0.94)
3 - 5.9	0.55 (0.29 - 1.04)	0.53 (0.27 - 1.02)
6 or more	1.00	1.00
Treated water at home [a]	P<0.05	P=0.13
Yes	1.00	1.00
No	0.70 (0.49 - 0.96)	0.76 (0.54 - 1.08)
Distance to health service [a]	P<0.001	P<0.001
Less than 1 km	1.00	1.00
1 km or more	0.60 (0.44 - 0.80)	0.60 (0.44 - 0.81)
Kind of delivery [d]	P<0.01	P=0.06
Normal	1.00	1.00
Caesarian	1.73 (1.22 - 2.45)	1.43 (0.98 - 2.08)
Antenatal care [e]	P=0.05	P=0.38
Yes	1.00	1.00
No	0.71 (0.48 - 1.00)	0.85 (0.56 - .128)
Locale of birth [f]	P<0.001	P=0.08
Hospital	1.00	1.00
Home	0.45 (0.29 - 0.69)	0.66 (0.42 - 1.06)

Models used in hierarchical analysis adjusted (Table 7):

Equation a:	age + county
Equation b:	area + age
Equation c:	area + county
Equation d:	Equation a + distance to health service + antenatal care + locale of birth
Equation e:	Equation a + distance to health service + kind of delivery + locale of birth
Equation f:	Equation a + distance to health service + kind of delivery + antenatal care
Equation g:	Equation a + distance to health service