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Implementation of the Integrated Management of Childhood Illnesses strategy in Northeastern Brazil

ABSTRACT

OBJECTIVE: The majority of child deaths are avoidable. The Integrated Management of Childhood Illnesses strategy, developed by the World Health Organization and the United Nations Children's Fund, aims to reduce child mortality by means of actions to improve performance of health professionals, the health system organization, and family and community practices. The article aimed to describe factors associated with the implementation of this strategy in three states of Northeastern Brazil.

METHODS: Ecological study conducted in 443 municipalities in the states of Northeastern Brazil – Ceará, Paraíba and Pernambuco, in 2006. The distribution of economic, geographic, environmental, nutritional, health service organization, and child mortality independent variables were compared between municipalities with and without the strategy. These factors were assessed by means of a hierarchical model, where Poisson regression was used to calculate the prevalence ratios, after adjustment of confounding factors.

RESULTS: A total of 54% of the municipalities studied had the strategy: in the state of Ceará, 65 had it and 43 did not have it; in the state of Paraíba, 27 had it and 21 did not have it; and in the state of Pernambuco, 147 had it and 140 did not have it. After controlling for confounding factors, the following variables were found to be significantly associated with the absence of the strategy: lower human development index, smaller population, and greater distance from the capital.

CONCLUSIONS: There was inequality in the development of the strategy, as municipalities with a higher risk to child health showed lower rates of implementation of actions. Health policies are necessary to help this strategy to be consolidated in the municipalities that are at a higher risk of child mortality.

DESCRIPTORS: Child Health (Public Health). Integrated Management of Childhood Illness. Child Health Services. Socioeconomic Factors. Health Inequalities. Ecological Studies.

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INTRODUCTION

Deaths of children under five years of age continue to occur on a large scale, especially in developing countries, despite the availability of effective health technologies.[a] On a global level, five diseases are responsible for over 70% of these deaths: pneumonia, diarrhea, malnourishment, measles and malaria.[6]

The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) developed a strategy entitled "Integrated Management of Childhood Illnesses" (IMCI) in 1993. The objective is to reduce mortality and morbidity associated with these diseases, as well as to contribute to children's healthy growth and development.[11] This strategy aims to improve three key components: performance of health professionals, the health system organization, and family and community practices.[20]

The first component involves the qualification of health professionals by means of standardized protocols. This enables early identification of severely ill children, and also guarantees the treatment of prevalent diseases and the adoption of preventive measures, such as immunizations and breastfeeding promotion. The second component aims to improve the health system organization by means of adequate support for the availability of equipment, medication, vaccines, educational materials, and supervision activities, in addition to a reference system for serious cases. The third component includes family and community activities based on health promotion practices.[25]

In Brazil, this strategy was launched in 1996 in the context of the *Programa Saúde da Família* – PSF (Family Health Program), initially in the Northern and Northeastern states, where the worst health indicators were found.[9] The Ministry of Health adopted the IMCI as a national health policy, and as part of the *Política de Saúde da Criança* (Child Health Policy), as this is a strategy designed to reduce child morbidity and mortality in higher-risk contexts, thus promoting health equality.[15,21] The expansion of the strategy occurred in 1998, so that all Brazilian states currently have qualified professionals. However, the strategy's consolidation has taken place unequally in distinct geographic areas.

The investigation of factors associated with the IMCI adoption could be viewed from different perspectives. The first approach would be to understand the characteristics of national, state and municipal health policies that are capable of promoting such adoption in a certain municipality, but not in others. These characteristics could include, for instance, the way through which the strategy is financed, and the incentives the municipality provides for its implementation, whether they are financial, logistic or technical in nature.

In terms of the municipality, the type of municipal health system management due to the introduction, the availability of own resources, the motivation and qualification of the local Secretary of Health, and the municipal government's ideology may affect the adoption of an innovative strategy. This type of analysis requires primary data collection on the municipal level, by means of quantitative and qualitative methods.

The second approach to examine associated factors concerns health needs. This type of approach is more suitable to analyze the statistical model for ecological studies, based on the existing secondary data, and taking into consideration hierarchy among possible implementation determinants.[17,23]

In this hierarchical model, according to epidemiological principles, IMCI must be first established in more impoverished areas.[18] In this sense, the hypothesis of this study was that IMCI adoption is higher in municipalities with worse socioeconomic, environmental, nutritional, and child health indicators, as well as in municipalities with poorer health systems. Thus, the objective of the present study was to describe factors associated with the implementation of this strategy in Northeastern Brazil.

METHODS

The study is part of a broader research project to assess IMCI in five countries – Bangladesh, Brazil, Peru, Tanzania, and Uganda.[8] A comparative analysis of some factors associated with IMCI implementation in Brazil, Peru and Tanzania was recently published,[22] and it led to studies on case management and strategy impact.[1,2]

The design of the study was ecological, where the distribution of a dependent variable (IMCI adoption) was compared to independent variables in three states of Northeastern Brazil (Ceará, Paraíba, and Pernambuco).

IMCI adoption was the dependent variable, defined by the presence of at least one health professional in the municipal health system who is qualified for the strategy, with a staff comprised of doctors, for the most part, or nurses. This information was obtained through direct contact with the state secretariats of health in 2002.

The following socioeconomic, demographic and nutri-

[a] World Health Organization. World Health Report 1999 - making a difference. Geneva; 1999. [cited 2006 May 12]. Available from: http://www.who.int/whr/1999/en/whr99_en.pdf

tional independent variables, as well as those related to health service infrastructure and morbidity and mortality indicators, were obtained from available official data in 2000, and measured before the IMCI adoption:

- human Development Index (HDI), calculated from information provided by the United Nations Children's Fund (UNICEF);[a]
- average income per person (in *reais*);[a]
- illiteracy rate: percentage of people over 15 years of age without education;[a]
- population living in the municipality;[b]
- distance between municipality and the state capital, in kilometers;[a]
- urbanization: rate of individuals living in urban areas;[b]
- water supply: percentage of households with plumbed water supply in at least one of the rooms;[b]
- sewage system: percentage of households connected to the sewage system;[b]
- infant mortality rate, based on an indirect mortality estimate from the United Nations Development Program (UNDP);[a]
- breastfeeding: percentage of mothers who breastfed until the baby's third month;
- malnourishment: weight-for-age child malnourishment rate;
- vaccination coverage for children between zero and one year of age.

As regards the three last indicators, the Ministry of Health's *Sistema de Informação em Atenção Básica* – SIAB (Primary Care Information System) databases were used.[b] The SIAB databases that were unavailable on the Internet were consulted at the state Departments of Health, when data had not been compiled on a national level. In the selected municipalities, SIAB coverage was high, thus reflecting the population data.

Only the municipalities with a population ranging between 5,000 and 50,000 inhabitants were included, according to the 2001 census, as it would be difficult to measure the IMCI impact on very small municipalities. In addition, higher mortality rates are observed in rural municipalities with up to 50,000 inhabitants. The other criteria to select municipalities were the following: presence of a suitable network of primary care units (one or more units per 10,000 inhabitants) and over 80% of the population covered by health community agents. All the municipalities had PSF units. Municipalities of comparison should have active PSF teams, but no IMCI-qualified professionals.

A total of 443 municipalities in three states were included: Ceará (65 with and 43 without IMCI), Paraíba (27 with and 21 without IMCI), and Pernambuco (147 with and 140 without IMCI). In all, the presence of IMCI was recorded in 54% of municipalities. A conceptual model that proposed a hierarchy among factors which were possibly associated with IMCI implementation was designed. This model was based on the theoretical presupposition that this strategy would have more impact in areas with a higher risk to child health (Figure).[3]

The geographic and socioeconomic factors were placed in groups A and B, including the HDI, per capita income, literacy rate, urbanization rate, population, and distance from capital. Group C included infrastructure factors that could be affected by the socioeconomic level, such as the sewage system and water supply rate. Two nutritional factors were included in group D: low-weight-for-age prevalence and exclusive-breastfeeding prevalence at three months of age. Factors related to healthcare, such as vaccination coverage, were also included on this level (group E). Group F included the child health situation prior to IMCI implementation, by means of the infant mortality rate, which can be influenced by all the variables included on the levels above. The analysis model was simplified into a hierarchical model with four levels: level 1 (groups A and B), level 2 (group C), level 3 (groups D and E), and level 4 (group F).

All the independent variables were classified in quartiles to assess dose-response effects. Bivariate and multivariate analyses were performed in the Stata software, version 8.0, where Poisson regression was used to calculate prevalence ratios.[5]

The factors associated with IMCI implementation considered were those with a test of heterogeneity or of significant linear tendency ($p<0.05$). Variables were progressively introduced in the model, according to the hierarchical level. Those with $p<0.20$ were maintained, as they can act as confounding factors, despite their not reaching statistical significance.[16]

RESULTS

The Table shows how the socioeconomic, geographic, infrastructure, nutritional, healthcare, and child health situation variables are related to the IMCI adoption.

[a] Programa das Nações Unidas para o Desenvolvimento Humano (PNUD). Atlas de Desenvolvimento Humano no Brasil. [Internet]. [cited 2006 Set 9]. Available from: http://www.pnud.org.br

[b] Ministério da Saúde. Sistema de Informação em Atenção Básica (SIAB) [Internet]. [cited 2006 Set 9] Available from: http://w3.datasus.gov.br/siab/siab.php

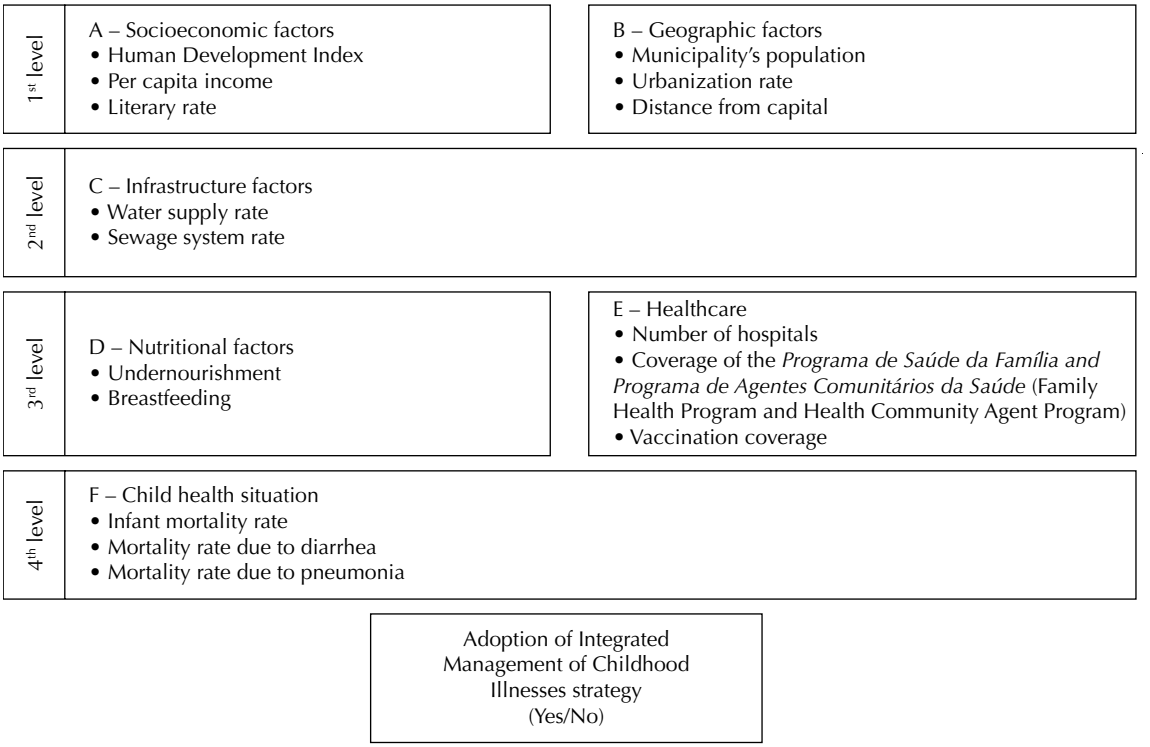

Figure. Theoretical model to analyze the Integrated Management of Childhood Illnesses strategy. States of Ceará, Paraíba and Pernambuco, Northeastern Brazil, 2000-2002.

Of all the socioeconomic variables, the HDI was the one that showed statistically significant linear relationship; that is, the lower the HDI, the more likely it is a municipality will not have IMCI. This variable continued to be in the model when adjusted for confounding factors, and thus remained for the analysis of the subsequent levels.

Per capita income, statistically significant in the crude analysis, lost its significance after adjustment for the remaining variables on level 1, but continued to be close to the significance level (p=0.09). On the other hand, illiteracy rate was not significant either in the crude analysis or in the adjusted one, even though its effect increased after adjustment. Both variables remained in the model for control of confounding factors on the subsequent levels as they showed $p<0.20$.

Geographic variables – population and distance from capital – showed linear association with IMCI implementation, that is, smaller and more distant municipalities were more likely not to have IMCI. These associations continued to be statistically significant after adjustment for confounding factors, and thus remained for the subsequent level analysis. The "urbanization rate" variable was excluded from the model as it did not reach significance ($p>0.20$).

The infrastructure variables – sewage system and water supply rate – were not significant either in the crude analysis or in the adjusted one. Nonetheless, both variables remained in the model for control of confounding factors on the subsequent levels ($p<0.20$).

The nutritional variables – breastfeeding and malnourishment – were excluded from the model, because they were not associated with IMCI implementation in the crude and adjusted analyses.

The variable related to healthcare – vaccination coverage prior to IMCI implementation – did not show statistically significant association in the bivariate model. When adjusted for other variables on the third level, there was an increase in association, though not significant. The "infant mortality rate prior to IMCI implementation" variable was not statistically significant, and was thus excluded from the model.

The following variables remained in the final model: HDI, population and distance from capital. The "per capita income" (p=0.09) and "water supply rate" (p=0.08) variables showed values close to significance.

DISCUSSION

Some methodological limitations must be pointed out. The first one refers to data collection. Secondary data from diverse sources were used, causing problems related to information quality, such as under-notification or incomplete data. However, it is possible that

Table. Distribution of municipalities without the Integrated Management of Childhood Illnesses strategy, according to socio-economic, geographic, infra-structure, and healthcare variables, previous to implementation. States of Ceará, Paraíba and Pernambuco, Northeastern Brazil, 2000-2002.

Variable*	Number of municipalities	% Municipalities without IMCI	Crude PR (95% CI)	Adjusted PR (95% CI)
Human Development Index			p =0.01**	p =0.01**
> 0.64	106	40.6	1.0	1.0
> 0.61 – 0.64	114	42.1	1.04 (0.76; 1.42)	1.15 (0.84; 1.58)
> 0.58 – 0.61	110	43.6	1.08 (0.79; 1.47)	1.05 (0.74; 1.48)
0 – 0.58	113	57.5	1.42 (1.07; 1.88)	1.48 (1.00; 2.19)
Per capita income			p =0.03	p =0.09
> 90.7	111	33.3	1.0	1.0
> 78.1 – 90.7	111	47.8	1.43 (1.03; 1.99)	1.41 (1.02; 1.94)
> 66.7 – 78.1	111	53.2	1.59 (1.16; 2.19)	1.32 (0.93; 1.87)
0 – 66.7	110	50.0	1.50 (1.09; 2.07)	1.13 (0.77; 1.66)
Illiteracy rate			p =0.62	p =0.16
> 43.6	110	47.3	1.00 (0.76; 1.32)	0.77 (0.53; 1.11)
> 39.4 – 43.6	111	40.5	0.86 (0.64; 1.15)	0.73 (0.53; 1.01)
> 35.9 – 39.9	110	49.1	1.04 (0.79; 1.36)	0.88 (0.66; 1.16)
0 – 35.9	112	47.3	1.0	1.0
Population (inhabitants)			p < 0.01**	p <0.01**
> 25,000 – 50,000	106	29.3	1.0	1.0
> 15,000 – 25,000	111	37.8	1.29 (0.88; 1.89)	1.27 (0.88; 1.83)
> 10,000 – 15,000	111	47.8	1.63 (1.15; 2.33)	1.57 (1.11; 2.23)
> 5,000 – 10,000	109	68.8	2.35 (1.70; 3.25)	1.98 (1.42; 2.76)
Distance from capital (km)			p < 0.01**	p <0.01**
> 318.4	110	66.4	1.67 (1.28; 2.18)	1.72 (1.31; 2.26)
> 194.9 – 318.4	111	47.8	1.20 (0.89; 1.63)	1.31 (0.97; 1.77)
> 94.2 – 194.9	111	30.6	0.77 (0.54; 1.11)	0.82 (0.58; 1.17)
0 – 94.2	111	39.6	1.0	1.0
Urbanization			p =0.03**	p =0.57**
> 61.8	111	41.4	1.0	1.0
> 47.9 – 61.8	110	39.6	0.96 (0.70; 1.32)	0.82 (0.60; 1.13)
> 38.1 – 47.9	111	49.1	1.18 (0.88; 1.59)	1.01 (0.75; 1.35)
0 – 38.1	111	54.1	1.30 (0.99; 1.73)	1.00 (0.74; 1.36)
Water supply rate			p =0.11	p =0.08
> 46.5	110	41.8	1.0	1.0
> 35.8 – 46.5	112	42.0	1.00 (0.74; 1.37)	0.88 (0.66; 1.18)
> 25.5 – 35.8	110	55.5	1.33 (1.01; 1.75)	1.24 (0.93; 1.66)
0 – 25.5	111	45.1	1.08 (0.80; 1.46)	1.03 (0.75; 1.41)
Sewage system rate			p =0.11	p =0.17
> 20.6	110	41.0	1.0	1.0
> 5.9 – 20.6	112	44.6	1.09 (0.80; 1.48)	0.95 (0.71; 1.28)
> 0.7 – 5.9	111	43.2	1.06 (0.78; 1.44)	1.02 (0.75; 1.39)
0 – 0.7	112	55.5	1.36 (1.02; 1.79)	1.25 (0.94; 1.67)
Malnourishment (weight for age)			p =0.61	p =0.32
> 11.5	110	48.0	0.93 (0.70; 1.25)	0.89 (0.65; 1.22)
> 8.0 – 11.5	109	42.2	0.90 (0.67; 1.21)	0.97 (0.71; 1.32)
> 5.7 – 8.0	111	50.5	1.08 (0.82; 1.41)	1.14 (0.87; 1.50)
0 – 5.7	111	46.9	1.0	1.0

To be continued

Continuation of Table

Variable*	Numberof municipalities	% municipalities without IMCI	Crude PR (95% CI)	Adjusted PR (95% CI)
Breastfeeding			p=0.99	p=0.34
> 61.1	107	44.9	1.0	1.0
> 54.7 – 61.1	106	45.3	1.00 (0.75; 1.36)	1.23 (0.90; 1.67)
> 46.4 – 54.7	108	46.3	1.03 (0.77; 1.38)	1.28 (0.96; 1.70)
0 – 46.4	106	45.3	1.00 (0.75; 1.36)	1.26 (0.94; 1.70)
Vaccination coverage (0 to 1 year of age)			p=0.48**	p=0.16**
> 92.0	109	47.7	1.0	1.0
> 88.2 – 92.0	109	37.6	0.79 (0.58; 1.08)	0.85 (0.63; 1.14)
> 81.4 – 88.2	111	46.0	0.96 (0.73; 1.28)	1.07 (0.81; 1.41)
0 – 81.4	93	50.5	1.06 (0.80; 1.40)	1.21 (0.90; 1.62)
UNDP Infant Mortality			p=0.99	p=0.27
> 67.5	110	46.4	1.03 (0.77; 1.37)	0.66 (0.42; 1.02)
> 54.4 – 67.5	111	46.9	1.04 (0.78; 1.38)	0.74 (0.51; 1.08)
> 44.1 – 54.4	111	46.0	1.02 (0.76; 1.36)	0.86 (0.63; 1.19)
0 – 44.1	111	45.1	1.0	1.0

* in quartiles
1st level: HDI. per capita income, illiteracy, population, distance from capital, urbanization.
2nd level: water supply rate, sewage system rate.
3rd level: malnourishment, breastfeeding, vaccination coverage.
4th level: infant mortality rate.
Final model: HDI, population, distance from capital.
** linear tendency p value
IMCI: Integrated Management of Childhood Illness
UNDP: United Nations Development Programme

these problems affected both municipalities with and without IMCI equally. Another limitation has to do with the fact that health programs could interfere with the results (such as confounding factors not measured), but, again, this would only distort the results if these programs were more common in the municipalities with IMCI or vice-versa.

The present analysis enabled the identification of municipal characteristics that increased the likelihood of IMCI implementation. This explanatory approach had not yet been applied to the adoption of health programs in Brazil, and this study was directed towards assessing its suitability. Studies on suitability such as these are performed in order to assess to what degree changes were due to the program.[12]

The hierarchical relationship enabled the identification of possible determinants of IMCI implementation. This hierarchical model also proved useful in other studies related to risk factors for child diseases in individual level analysis.[10]

For adequate result interpretation, it is necessary to know the IMCI adoption process in Brazil. After the introduction of the strategy to technicians from the Ministry of Health, *Sociedade de Pediatria* (Pediatric Society), public universities, and technicians from municipal and state Departments of Health in 1996, the translation and adaptation of the material produced by the WHO were made.

The infant mortality rate (IMR) in Brazil in 1997 was 33 per 1,000 live births (LB).[a] Qualification of *PSF* professionals according to this strategy began at that time in the following four states: Ceará, Pernambuco and Sergipe (IMR of 45, 54 and 49 per 1,000 LB, respectively), and Pará (IMR of 32/1,000 LB)[b]. Therefore, three of these four states where IMCI was introduced showed significantly higher IMR than the national average. These states were recognized by the strong consolidation of child health vertical programs, including the *Programa de Controle das Doenças Diarréicas e Infecções Respiratórias Agudas* (Control Program of Diarrhea-related Diseases and Acute Respiratory Infections).

[a] Instituto Brasileiro de Geografia e Estatística. Censo Demográfico 2000 – Fecundidade e mortalidade infantil (Resultados preliminares da amostra). Rio de Janeiro: 2002.
[b] Personal communication by Celso Simões, of Instituto Brasileiro de Geografia e Estatística, in June 2006.

Qualification courses were subsequently expanded to other states, including the Southern and Southeastern regions, where IMRs were lower than 20/1,000 LB. Even though there are no data on qualification coverage in each state, this seems to have been low, probably below 10% in the great majority of states.

Even though the IMCI had been initially prioritized in some of the poorest Brazilian states, this logic was not followed in their municipalities. The state secretariats of health seem not to have taken equality into consideration when introducing the strategy on the municipal level. The results from the present study showed that the lower the municipality's HDI, the smaller its population, the greater the distance from the capital, and, consequently, the lower the IMCI introduction.

The results related to the HDI contradict literature data that propose that the strategy be preferably introduced in areas with the lowest socioeconomic level.[17] According to Hart's "inverse care law", populations that need quality medical care the most are those to which it is least provided.[13] Lower-quality health services are offered to the population groups that need it the most, an aspect routinely found in many developing countries nowadays.

The results from the present study confirm the "inverse equality hypothesis", in other words, that new health interventions (such as the IMCI) tend to be initially adopted by those who need it the least.[24] In the case of Brazil, this has already been observed in other interventions, such as the fluoridation of water.[4]

The availability of water supply and sewage system are indirect poverty and risk indicators for communicable diseases. Even though studies have shown an association between lack of piped water at home and incidence and mortality by infectious diseases, the IMCI strategy was preferably introduced in municipalities with higher piped water coverage.[19] On the other hand, association between sewage system rate and IMCI implementation was not observed.

Malnourishment is one of the diseases especially dealt with by the IMCI strategy, which includes a strong breastfeeding counseling component.[14] Thus, it was expected that municipalities with high malnourishment rates and low breastfeeding prevalence would be prioritized. This, however, did not occur.

Likewise, municipalities with smaller vaccination coverage were not included in the strategy. In the last years, vaccination activities have been emphasized by the *Programa Nacional de Imunização* – PNI (National Immunization Program) in all municipalities, a fact that may justify the lack of statistically significant difference.

Finally, not even the areas with high infant mortality were benefited by the strategy, thus contradicting the epidemiological reasoning, as the IMCI strategy was originally designed for areas with higher mortality rates.[7]

In a recent study, IMCI implementation was analyzed in three countries (Brazil, Peru and Tanzania), in relation to some variables previously mentioned (socioeconomic, geographic, infrastructure, infant mortality rate).[22] Data from the present study complement this study, suggesting that among the countries analyzed, Brazil is the one that has most evidence that the IMCI has prioritized less impoverished areas.

In conclusion, the findings from the present study reveal inequality in the IMCI implementation: municipalities with higher risk to child health showed lower IMCI adoption rates. Thus, it is necessary to define health policies in each state that promote the strategy in higher-risk municipalities.

REFERENCES

1. Amaral J, Gouws E, Bryce J, Leite AJ, Cunha AL, Victora CG. Effect of Integrated Management of Childhood Illness (IMCI) on health worker performance in Northeast-Brazil. *Cad Saude Publica*. 2004;20(Supl 2): S209-19.
2. Amaral J, Leite AJM, Cunha AJL, Victora CG. Impact of IMCI health worker training on routinely collected child health indicators in Northeast Brazil. *Health Policy Plan*. 2005;20(Supl 1):i42-8.
3. Armstrong-Schellenberg JA, Victora CG, Mushi A, Savigny D, Schellenberg D, Mshinda H, et al. Inequities among the very poor: health care for children in rural southern Tanzania. *Lancet*. 361(9357):561-6. doi:10.1016/S0140-6736(03)12515-9
4. Aurelio Peres M, Simara Fernandes L, Glazer Peres K. Inequality of water fluoridation in Southern Brazil- the inverse equity hypothesis revisited. *Soc Sci Med*. 2004;58(6):1181-9. doi:10.1016/S0277-9536(03)00289-2
5. Barros AJD, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol*. 2003;3:21. doi:10.1186/1471-2288-3-21
6. Black RE, Morris SS, Bryce J. Where and why are 10 million children dying every year? *Lancet*. 2003;361(9376):2226-34. doi:10.1016/S0140-6736(03)13779-8
7. Bryce J, el Arifeen S, Pariyo G, Lanata C, Gwatkin D, Habicht JP, et al. Reducing child mortality: can public health deliver? *Lancet*. 2003;362(9378):159-64. doi:10.1016/S0140-6736(03)13870-6
8. Bryce J, Victora CG, Habicht JP, Vaughan JP, Black RE. The multi-country evaluation of the Integrated Management of Childhood Illness strategy: lessons for the evaluation of public health interventions. *Am J Public Health*. 2004;94(3):406-15.
9. Cunha ALA, Silva MAF, Amaral J. A estratégia de "Atenção Integrada às Doenças Prevalentes na Infância – AIDPI" e sua implantação no Brasil. *Rev Pediatr Ceara*. 2001;2(1):33-8.
10. Fuchs SC, Victora CG, Martines JC, BLACK RE. Risk factors for dehydrating diarrhea among Brazilian infants: a case-control study. *BMC Gastroenterol*. 1998;36(2):46-53.
11. Gove S. Integrated Management of Childhood Illness by outpatient health workers: technical basis and overview. The WHO Working Group on Guidelines for Integrated Management of the Sick Child. *Bull World Health Organ*. 1997;75(Supl 1):7-24.
12. Habicht JP, Victora CG, Vaughan JP. Evaluation designs for adequacy, plausibility and probability of public health programme performance and impact. *International Journal of Epidemiology,* 1999 Feb;28(1):10-18. doi:10.1093/ije/28.1.10
13. Hart JT. The inverse care law. *Lancet*. 1971;1(7696):405-12.
14. Lopez-Flores F, Barquera-Cervera S, Kageyama-Escobar ML. Evaluación de una atención integrada contra la desnutrición infantil en áreas urbanas de Nayarit, México. *Salud Publica Mex*. 2004;46(2):158-63. doi:10.1590/S0036-36342004000200010
15. Lucchese PTR. Eqüidade na gestão descentralizada do SUS: desafios para a redução de desigualdades em saúde. *Cienc Saude Coletiva*. 2003;8(2):439-48. doi:10.1590/S1413-81232003000200009
16. Maldonado G, Greenland S. Simulation study of confounder-selection strategies. *Am J Epidemiol*. 1993;138(11):923-36.
17. Mosley WH, Chen LC. An analytical framework for the study of child survival in developing countries. *Popul Devel Rev*. 1984;10(Supl):25-44.
18. Nicoll A. Integrated Management of Childhood Illness in resource-poor countries: an initiative from the World Health Organization. *Trans R Soc Trop Med Hyg*. 2000;94(1):9-11. doi:10.1016/S0035-9203(00)90418-8
19. Schellenberg JA, Bryce J, Savigny D, Lambrechts T, Mbuya C, Mgalula L, et al. The effect of Integrated Management of Childhood Illness on observed quality of care of under-fives in rural Tanzania. *Health Policy Plan*. 204;19(1):1-10.
20. Tulloch J. Integrated approach to child health in developing countries. *Lancet*. 1999;354(Supl 2):SII16-20. doi:10.1590/S0102-88392003000100007
21. Viana ALA, Fausto MCR, Lima LD. Política de saúde e eqüidade. *Sao Paulo Perspec*. 2003;17(1):58-68.
22. Victora CG, Huicho L, Amaral JJ, Armstrong-Schellenberg J, Manzi F, Mason E, et al. Are health interventions implemented where they are most needed? District uptake of the IMCI strategy in Brazil, Peru and the United Republic of Tanzania. *Bull World Health Organ*. 2006;84(10):792-801. doi:10.2471/BLT.06.030502
23. Victora CG, Huttly SR, Fuchs SC, Olinto MTA. The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. *Int J Epidemiol*. 1997;26(1):224-7. doi:10.1093/ije/26.1.224
24. Victora CG, Vaughan JP, Barros FC, Silva AC, Tomasi E. Explaining trends in inequities: evidence from Brazilian child health studies. *Lancet*. 2000;356(9235):1093-8. doi:10.1016/S0140-6736(00)02741-0
25. Vidal AS, Silva EV, Oliveira MG, Siqueira AM, Felisberto E, Samico I, Cavalcante MGS. Avaliação da aplicação da estratégia da Atenção Integrada às Doenças Prevalentes da Infância (AIDPI) por Agentes Comunitários de Saúde. *Rev Bras Saude Matern Infant*. 2003;3(2):205-13. doi:10.1590/S1519-38292003000200011

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