Measles vaccine coverage and immune response in children of Caiabi and Metuktire Indian tribes living in malarial endemic area: Parque Indígena do Xingu, Central Brazil

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SUMMARY Measles vaccination efficiency was evaluated in children from two Indian tribes – Caiabi and Metuktire – living in the Amazon region, in the Parque Indígena do Xingu (PIX). The population sample, selected at random, made up 37 Caiabi and 28 Metuktire children, aged from 20–75 months (40%). For operational and epidemiological reasons, measles vaccine is given from 6 months of age. The average age of children when they received the vaccine was 11.5 months for the first dose and 20 months for the second. The search for IgG antibodies against measles virus and *Plasmodium falciparum* was made through immunofluorescence assay (IFA). Measles vaccine coverage has reached 60% at 12 months of age and 92% at 18 months, whereas post-vaccine serum conversion was 95% in Caiabi children (geometric mean of titres (GMT) 126) and 89% in Metuktire (GMT 109). The difference in GMT is not statistically significant.

Seventy-three per cent of Caiabi children (GMT 101) and 100% of Metuktire children (GMT 135) were plasmodium antibody positive, showing they had been exposed to malarial infection. Despite the differences detected, the immune response to measles vaccine was satisfactory in both groups, with a positive percentage consistent with that achieved in non-malarial areas in Americas. The results show the efficiency of a vaccination programme in an indigenous area despite the difficulties in reaching the villages and maintaining the cold chain, and also despite the malaria endemicity.

Introduction

The goal of measles eradication from the Americas was established during the 1994 Pan American Conference[1]. Nevertheless, despite all efforts the measles virus continues to circulate in some countries and a measles outbreak occurred in 1997 in southern Brazil, with 52 284 notified cases, mainly in urban areas[2]. In general the vaccine coverage tends to be lower among the indigenous population due to their difficulties in accessing health services. There are about 340 000 Indians in Brazil, most of them living in remote areas of the Amazon region, with many villages accessible only after long boat journeys or by helicopter. The Parque Indígena do Xingu (PIX), in south Amazon, is one of the biggest indigenous areas in Brazil. There, since 1966, the Escola Paulista de Medicina (São Paulo Medical School) has been developing an immunization programme which was well accepted by the Indians because they have bad memories of the measles epidemic of 1954, which caused 114 deaths in a population of 600[3]. The programme includes BCG, polio, diptheria, tetanus and pertussus and measles vaccines. A semestral multivaccination schedule was adopted because of the difficulties in reaching the villages and the preservation of the vaccine. The measles vaccine was given at 6 months of age taking account of the local epidemiological characteristics and a second dose was given after an interval of at least 6 months. This study is designed to evaluate the measles vaccine coverage and immune response in children of the Caiabi and Metuktire tribes, in the PIX. As malaria is endemic in the area the study includes also the evaluation of the eventual interference of frequent plasmodium infections in the response to measles vaccine through immunodepression mechanisms. In fact, there is still some controversy about the possibility of malarial interference in some vaccines[4,5].

Materials and methods

Parque Indígena do Xingu

PIX is located in northern Mato Grosso State, in a 32 000-km^2 area extending along the Xingu River course from its headwaters, in the south, through von Martius Falls, in the north, near the Pará State border. The Xingu River is a right margin tributary of the Amazon River and the PIX is a transitory area from the scrub of Central Brazil to the Amazonic forest. The rainy season lasts from October to March and the dry season from April to September; the temperature ranges from 24°C to 34°C, with a distinct nocturnal low in July and August. At the time of this study the PIX had 3400 inhabitants, belonging to 17 tribes and four linguistic trunks, distributed in 28 villages and six vigilant posts in the borders. The Caiabi (Tupi language) and the Metuktire (Jê language) formed the largest tribes, with 538 and 480 people, respectively. The former are in the central area of the PIX and the latter in the north.

Sample definition

The children between 20 and 75 months of age were defined as the target population and the sample comprised 65 children (37 Caiabi and 28 Metuktire) selected at random through the medical files used in the field work. These children represented 40% of the age group defined. The proceedings and the aim of the research were explained to the Indians through the leaders and indigenous health agents; nobody refused to have their children included or objected to the blood collection.

Measles vaccine

The children included in this research had been vaccinated against measles with BIOCAM-70, a vaccine produced by Instituto Manguinhos, Rio de Janeiro, Brazil.

Laboratory tests

Using disposable needles and syringes, 5–10 mL of blood were collected; after serum separation, they were stored at an average temperature of 4°C for 2–3 days – including a flight to São Paulo, where they were kept at −25°C until tested. The measles IgG antibodies were measured through indirect immunofluorescence assay (IFA); the serum samples were diluted in phosphate buffer saline (PBS) in multiples of two from 1/5 dilution, adopted as the cutoff point. IFA was also used through search and to quantify antibodies against *Plasmodium falciparum* erythrocytic forms. The assay was made according to the technique described by Ferreira Sanches[6].

Statistical technique

The following tests were employed in the statistical analyses: χ^2 to detect association between two variables measured nominally; Fisher's exact test when necessary and the T test for the averages found in reaction titres; 0.05 was adopted as the significant level. Pearson's correlation coefficient was employed to evaluate the existence, intensity and meaning of correlation between two continuous quantitative variables.

Results

Measles vaccine coverage after the first dose was 60% at 12 months of age, 92.3% at 18 months, 95.4% at 24 months and 100% at 36 months (Table 1). On average, when given the first dose, Caiabi children were 12.1 months old (standard deviation = 4.71) and Metuktire children were 11.2 months old (standard deviation = 4.69). Forty-two (64%) of 65 children received the second dose, with the same percentage in both groups. The average age of the children when they received the second dose was very similar in both groups: 20 months (standard deviation = 6.3).

Table 1 Measles vaccine coverage in Caiabi and Metuktire children according to the age group. Parque Indígena do Xingu, Central Brazil

Age (months)	*Caiabi N (%)*	*Metuktire N (%)*	*Total N (%)*
6–12	22 (59.5)	17 (60.7)	39 (60)
12–18	13 (94.6)	8 (89.3)	21 (92.3)
18–24	1 (97.3)	1 (92.9)	2 (95.4)
24–36	1 (100)	2 (100)	3 (100)
Total	37 (100)	28 (100)	65 (100)

Table 2 Positiveness percentage and geometric mean of titres (GMT) of antibodies (IgG) against measles and malaria through immunofluorescence assay among Caiabi and Metuktire children. Parque Indígena do Xingu, Central Brazil

	Caiabi	*Metuktire*	*P*
Measles			
Positiveness	95%	89%	0.64
GMT	126	109	0.68
Malaria			
Positiveness	73%	100%	0.002
GMT	101	135	0.115

The search for measles IgG antibodies through IFA was positive for 95% of Caiabi children and 89% of Metuktire children ($P = 0.64$). The geometric mean of titres (GMT) was 126 and 109 each ($P = 0.68$), as shown in Table 2. Five negative reactions occurred, three among children vaccinated between 3 and 9 months of age. The GMT of the 42 children who received two doses was 123; and the GMT of the 23 children who received only the first dose was 121 ($P = 0.096$). As for the time elapsed between the last dose and the collecting of blood to search specific antibodies, there was a decrease in GMT, which was 182 between the 12th and the 40th month and fell to 57 between the 40th and the 60th. Three children remained negative even after the second dose.

The presence of IgG antibodies against *P. falciparum* was detected through IFA in 73% of Caiabi children and 100% of Metuktire children ($P = 0.002$); the GMT of positive reactions was, respectively, 101 and 135 ($P = 0.115$) (Table 2).

Discussion

Measles vaccination at 6 months of age has been recommended to people living in remote areas[7]. In the PIX, each village is visited twice a year by a health team to vaccinate the susceptible and take care of the population. The decision to give the measles vaccine from 6 months of age onwards was due either to the semestral schedule adopted or to the fact that children were at risk of acquiring the disease when taken to urban centres (for ambulatory care or hospitalization, or just to go with their parents, a common habit among the Indians). Because of the semestral vaccination scheme adopted, there has been a delay in measles vaccine coverage, which has achieved a satisfactory level (92.3%) at 18 months of age. The immune response to the vaccine was satisfactory (95% of Caiabi children and 89% of Metuktire children) considering that the efficacy of measles immunization in the Americas is around 90%[1]. Since the early 1980s up to the present time there has been no report of measles cases among the tribes living in the park.

As expected[8] seroconversion was lower in children vaccinated before 9 months of age (86%) than it was in those vaccinated after that age (95%). The average age of children when they received the second dose was 20 months, which can be considered appropriate taking into account the scheme and the schedule adopted. There has been no significant statistical difference in GMT when children who received one dose of the vaccine were compared to those who received two doses. The aim of the second dose was the serum conversion of the children who had not responded to the first dose, something that happens more frequently when this dose is given before 12 months of age. It is important to note that of the five children who did not respond to the vaccine, three had received two doses. There has been a remarkable decrease in titres 3 years after vaccination, a fact observed by other authors in researches carried out with several populations[9].

PIX is located between two regions of high malarial transmission, in areas recently settled, with intense migratory movements and mining sites – where housing and sanitary conditions are unreliable. The endemicity of malaria in the park is demonstrated in this research by the presence of IgG antibodies against *P. falciparum* in 73% of Caiabi children (GMT 101) and 100% of Metuktire children (GMT 135). The difference between the two groups, although statistically significant only as far as the

percentage of positive reactions to the plasmodium is concerned, occurs because Metuktire Indians live closer to the Amazon Forest, and therefore, they are more exposed to anopheles. Thanks to the maintenance of the traditional feeding pattern, Caiabi and Metuktire children were well nourished.

The results show that in the period covered by this research malaria was endemic among the two populations studied, affecting the Metuktire Indians more. Although the immune response had been slightly lower in Metuktire children, the efficiency of vaccination was satisfactory in both tribes.

Conclusion: despite the semestral schedule and the decision to give the vaccine at 6 months of age, the efficacy of measles vaccination in both tribes studied was proved, although malaria is endemic in the region.

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MOSHI: A culture-tailored management game for African hospital managers

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SUMMARY The computer-based management game MOSHI (management of small hospitals) was developed in Tanzania and became an integrated component of a training programme for East African hospital managers. Players are in charge of a 120-bed hospital in rural Tanzania and have to make strategic and tactical decisions according to their own traditions and values. Thus, it becomes possible that the cultural gap between western management philosophy and traditional African values is bridged.

Financial and managerial problems of African healthcare institutions and programmes are numerous and large. Amongst others there are problems of bad planning, embezzlement and lack of motivation[1–4]. There is a high demand for management training adapted to the specific culture of East Africa, however contents of training programmes are drawn from books written in Europe or in the USA as are case studies used in the classes. Aware that traditional classroom work will always incorporate this cultural bias, the Masoka Management Training Institute (Tanzania) with the assistance of the University of Erlangen-Nuernberg (Chair Professor M Meyer) developed a computer-based management game to support the training of East African hospital managers. The cultural gap between East-African tradition and western management philosophy can be bridged by this game because the players can develop group decision making and bargaining processes in accordance with their own tradition and cultural values[5]. They can also experiment with different goal systems, even those outwith European thinking.

The management game MOSHI

MOSHI is an acronym for management of small hospitals and it is also the name of the Tanzanian city where the game was developed. The players are in charge of a 120-bed rural hospital typically with a 50-bed maternity/gynaecology ward and a 70-bed general ward. Other departments and supporting units exist but they are not part of the decision-making process.

Only emergency patients are generated from the statistical distributions. This generative process gives a diagnosis and length of stay. The game administrator can initiate a cholera epidemic and the number of AIDS-patients relates to the decisions of the players. New patients may be rejected if they are unable to pay or the hospital is fully occupied. All major costs are calculated. The flow of patients through the MOSHI-hospital is shown in Figure 1.