CO-COVERAGE OF CHILD SURVIVAL INTERVENTIONS

IN TANZANIA, BANGLADESH AND BRAZIL

CG Victora, JRM Armstrong Schellenberg, SE Arifeen, JA Cesar, J Bryce

Universidade Federal de Pelotas, Pelotas, Brazil (Prof C Victora MD); London School of Hygiene and Tropical Medicine, London, UK (J A Schellenberg PhD); Ifakara Health Research and Development Centre, Ifakara, Tanzania (JRM Armstrong-Schellenberg, PhD); International Centre for Diarrheal Diseases Research, Dhaka, Bangladesh (SE Arifeen, DrPH); Universidade Federal do Rio Grande, Rio Grande, Brazil (J A Cesar, MD), Department of Child and Adolescent Health and Development, World Health Organization, Geneva, Switzerland (J Bryce, EdD).

WORK IN PROGRESS

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Introduction

In many developing country settings, coverage levels for child survival interventions are far from universal, and millions of children are dying every year from diseases against which effective interventions exist.[1] Furthermore, in many if not most countries there are important inequalities between different social groups[2 3], even within rural populations that may appear to be uniformly poor.[4] Children belonging to the poorest families are consistently less likely to receive preventive and curative interventions.[5]

In most, if not all, countries, several child survival interventions are being implemented simultaneously. These often include several vaccines, insecticide treated mosquito nets, and nutritional interventions including micronutrient supplementation, nutrition counseling (breastfeeding and complementary feeding) and growth monitoring. In addition to these preventive interventions, others are addressed at treating disease episodes; these include oral rehydration therapy, antibiotics and antimalarials.

The question we address in the present paper has not, to our knowledge, been addressed in the past. We refer to it as *co-coverage*. Using three cross-sectional datasets from Tanzania, Bangladesh and Northeast Brazil, we study the joint distribution of key preventive interventions in samples of under-five children, and investigate whether some of them are receiving several interventions simultaneously, while others are not receiving any. We also investigate the role of social inequalities in co-coverage, and we discuss whether a few interventions with high coverage might be a better goal than several interventions at low coverage levels.

Methods

In the mid-1990s, the World Health Organization and UNICEF launched the Integrated Management of Childhood Illness (IMCI) strategy aimed at reducing mortality associated with the five major killer diseases of young children in the world: pneumonia, diarrhoea, malaria, measles and malnutrition.[6] The Multi-Country Evaluation of IMCI (MCE) was designed to evaluate whether the IMCI strategy has an impact on improving child health and is cost-effective.[7] Typically, the MCE designs are based on a comparison over time of a limited number of geographical units (districts, municipalities or health facility catchment areas) *with* IMCI and similar units *without* IMCI. The results presented here are derived from baseline surveys of the MCE in Tanzania, Bangladesh and Northeast Brazil.

Study samples

The Tanzania survey was carried out in Kilombero, Morogoro Rural, Rufiji and Ulanga Districts (total population 1.2 million). The majority of people are subsistence farmers. The public health system has a network of hospitals, health centres and dispensaries, with 3,300 to 7,000 people served by each facility. Over 80% of health facilities are government-owned although mission facilities account for about half of the facilities in Kilombero and Ulanga. The underfive mortality rate is around 150 per thousand live births, and malaria is a major cause of death. In Kilombero and Ulanga the median value of monthly household consumption and expenditure in 1997 in a sample of local households was under $100 of which approximately 75% was for food.[4]

A representative cluster sample of 2,500 households was taken from the four districts in July-August 1999. 30 clusters were chosen from three of the four districts and 35 clusters were chosen from Kilombero District. Villages were selected with probability proportional to estimated population size, and one sub-village, with approximately 100 households, was chosen at random from each selected village. 20 households were chosen from each sub-village using a modified EPI-type scheme that ensured an equal probability of selection for every household in the sub-village. The town of Ifakara in Kilombero District is the largest peri-urban area in the survey: the ten clusters in Ifakara have been omitted from the analysis described here so that all results refer to rural areas. Further information is available elsewhere. [4]

In Bangladesh, the survey was carried out in Matlab sub-district which has a population of about 500,000. The Center for Health and Population Research (ICDDR,B) provides child and reproductive health services for a population of 105,000 inhabitants[8]. The remaining part of Matlab (. 400,000), which has an underfive mortality rate of approximately 90 per thousand, is serviced by government clinics and a referral hospital. This area formed the universe for this study. A census was performed in the first half of 2000 and an in-depth survey of child morbidity, nutrition, intervention coverage and care-seeking was carried out in a systematic sample of 6% of all households.

In Brazil, the study covered the state of Sergipe (population 1.5 million) in the Northeastern region. The infant mortality rate is 46 per thousand and life expectancy is 69 years for women and 63 years for men. Twenty four percent of adults over age 15 years are illiterate.[9] The local health system consists of 52 hospitals and 445 health centers scattered around the state. Most services are concentrated in the state's capital, Aracaju, and in the coastal areas, where health conditions are better than in the dry interior. Out of the 75 municipalities in the state, 21 were selected through 30 draws using probability proportionate to population size with replacement. Some of the largest municipalities were selected more than once. For each draw, six census tracts were randomly sampled from the corresponding municipality. In each tract, 22 consecutive households were selected, from a random starting point defined a priori. When a family was found with a child aged 0 to 4 years the mother or caretaker was interviewed using standard questionnaires.

Outcome variables

A modular questionnaire about the health of all children under five years was developed for use in the three sites and locally adapted. It included information on proxy markers of household socio-economic status (see below) and several variables on child health including coverage of preventive interventions. A generic version of the questionnaire is available from the authors on request.

To ensure sufficient sample sizes for the analyses, only preventive interventions aimed at reaching all children aged 12-59 months were included. Infants were not part of the analyses because some of the interventions (for example, a third dose of DPT vaccine) would not have been received by all of them. Curative interventions were not included because these are not aimed at all children, but only at those with a given disease. Only vaccine doses that were registered in a vaccine card were considered. In each study site, coverage with the following interventions was studied:

1. One dose of BCG vaccine – BCG is recommended to be delivered soon after birth in Brazil; soon after birth (but often given at age 6 weeks with DPT) in Bangladesh and soon after birth in Tanzania);
2. Three doses of DPT (diphtheria, pertussis, tetanus) vaccine – recommended to be delivered at 2, 4 and 6 months in Brazil; 6, 10 and 14 weeks in Bangladesh and 1, 2 and 3 months in Tanzania;
3. One dose of measles vaccine – the recommendation for Brazil, Bangladesh and Tanzania is to give this vaccine at 9 months;
4. Child slept under a mosquito net in the night preceding the survey – this variable was not available for Brazil;
5. One capsule of vitamin A in the preceding 6 months – a dose every 6 months is recommended in Brazil, Bangladesh and Tanzania.
6. Nutrition counseling or growth monitoring intervention; this varied by country – in Brazil this consisted of having a weight plotted in the weight chart within the last 3 months; in Tanzania, having been shown or given a mother's card with feeding recommendations in a health facility; in Bangladesh this consisted of

having a weight plotted in the weight chart within the last month, as part of large national nutrition program.

Assessment of socio-economic status

Relative indices of socio-economic status were constructed in each site using principal component analyses.[10] The first component was used to rank households and to divide them into quintiles. In Tanzania, the index included the following variables: ownership of chickens/ducks (54% of households had one or more); a radio (41%); a bicycle (35%); a tin roof (23%); and of other animals (11%); living in a rented house (7%) rather than owner-occupied; whether the household head had an income apart from farming (29%); and whether the mother had an income apart from farming (10%). In addition, education of the head of the household was measured on a scale ranging from 0 to 2 (22% 1-6 yrs; 57% 7 or more yrs).

In Bangladesh, the following variables were used: ownership of a radio (26%); a bicycle (10%); a boat (15%); a watch (55%); a television (6%); a cabinet (52%); a bed (92%); a table or a chair (61%); materials used in building walls (60% had tin wall) and roofs (99% had tin roof); and land ownership (mean of 0.08 acres with 38% HHs owning no land and 16% owning 0.16 acres or more). In addition, actual number of chickens/ducks (mean of 5); and cows/goats (mean of 1) was included in the index.

In Brazil, the variables included in the assets index were: type of floor (26% with ceramic tiles), ownership of plot where the house was built (85%), persons per room (mean of 1.54), source of water (67% treated water from public system), flush toilet (57%), ownership of radio (75%), television set (77%), water filter (45%) and gas stove (91%).

Data analyses

A co-coverage score was calculated by adding the number of the above listed interventions received by each child, The score ranged from zero to six, except for Brazil where the upper limit was five due to lack of information on mosquito nets.

Associations between the socioeconomic status index and the number of interventions received by each child were tested by analysis of variance. In Tanzania, cluster sampling was taken into account in the data analysis by using the *svy* sets of commands in Stata.[11]

Results

The Tanzania survey included 2,246 households in 115 rural clusters; the response rate was 93%, and 2,006 underfive children were available for analysis. In Bangladesh, 2,289 households were visited and 2,066 children under five years were surveyed; the response rate was 93%. In Brazil, 1,785 children under five were identified in 3,086 households, with a response rate of 98%.

All analyses were restricted to children aged 12-59 months. The numbers of children available for analyses by sex, age and socioeconomic group are listed in Table 1.

Table 1: Distribution of the children studied by age, gender and socioeconomic status

Variable	Categories	Tanzania		Bangladesh		Brazil	
		Number	**%**	**Number**	**%**	**Number**	**%**
Sex	Boys	547	49%	897	53%	735	51%
Age	1 year	311	28%	435	26%	340	24%
	2 years	282	25%	452	27%	365	25%
	3 years	267	24%	434	25%	356	25%
	4 years	257	23%	382	22%	375	26%
Socio-economic status group	Most poor	209	19%	351	21%	289	20%
	Very poor	241	22%	343	20%	280	20%
	Poor	197	18%	336	20%	280	20%
	Less poor	222	20%	345	20%	289	20%
	Least poor	248	22%	328	19%	298	21%
Total		1117		1703			

Table 2 shows the coverage levels for each intervention studied. Brazil had the highest coverage levels of vaccines and of the nutritional intervention. Bangladesh had low levels of registered vaccine coverage. Vitamin A was lowest in Tanzania. Information on mosquito nets as not collected in Brazil.

Table 2. Coverage of child survival interventions in Tanzania, Bangladesh and Brazil.

Intervention	**Tanzania (4 districts)**	**Bangladesh (Matlab)**	**Brazil (Sergipe)**
BCG vaccine	71%	29%	88%
DPT vaccine (3 doses)	63%	25%	86%
Measles vaccine	55%	23%	86%
Mosquito nets	32%	85%	-
Vitamin A capsule	6%	83%	63%
Growth card and/or weighed last month*	28%	2%	54% *

Figure 1 shows how many interventions each individual child received. The percentages of all children who failed to receive any interventions were 13% in Tanzania and 2% in Bangladesh; in Brazil, every child received at least one intervention. On the other extreme, at least five interventions were received by 7% of children in Tanzania, 16% in Bangladesh and 13% in Brazil.

Figures 2-4 show how co-coverage varied according to socioeconomic groups. In Tanzania and Bangladesh, there were clear associations (both at P<0.001) between the number of interventions received and the family's socioeconomic status. In Brazil the associations were not so clear, probably because coverage levels for several interventions were close to 100%.

Figure 1. Distribution of children according to the number of child survival interventions received.

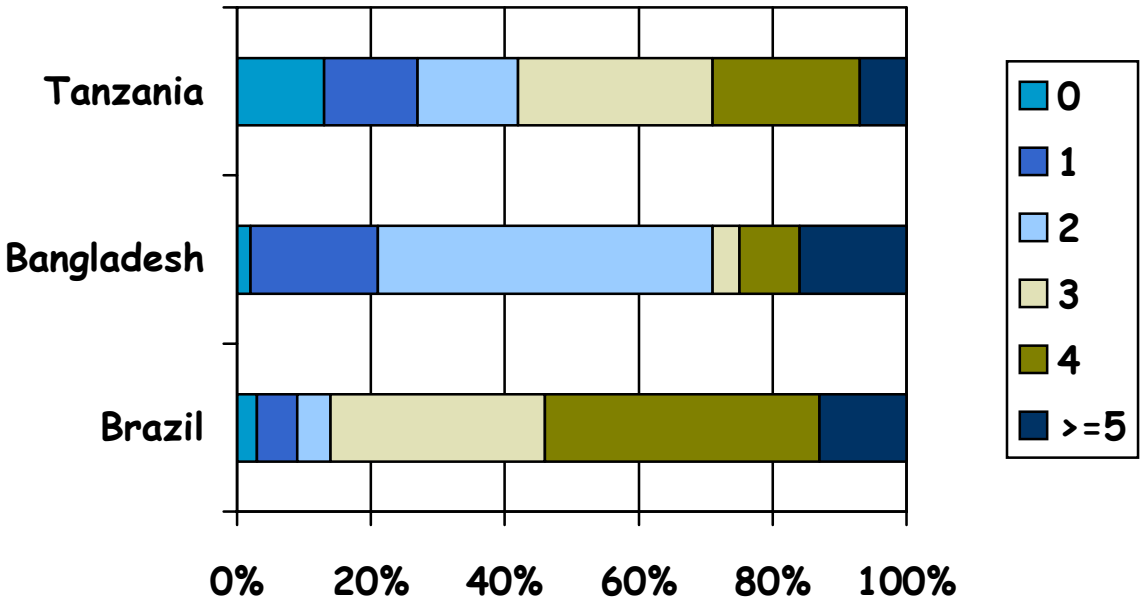


Figure 2. Distribution of children in the Tanzania (four districts) survey according to the number of child survival interventions received, by socioeconomic groups.

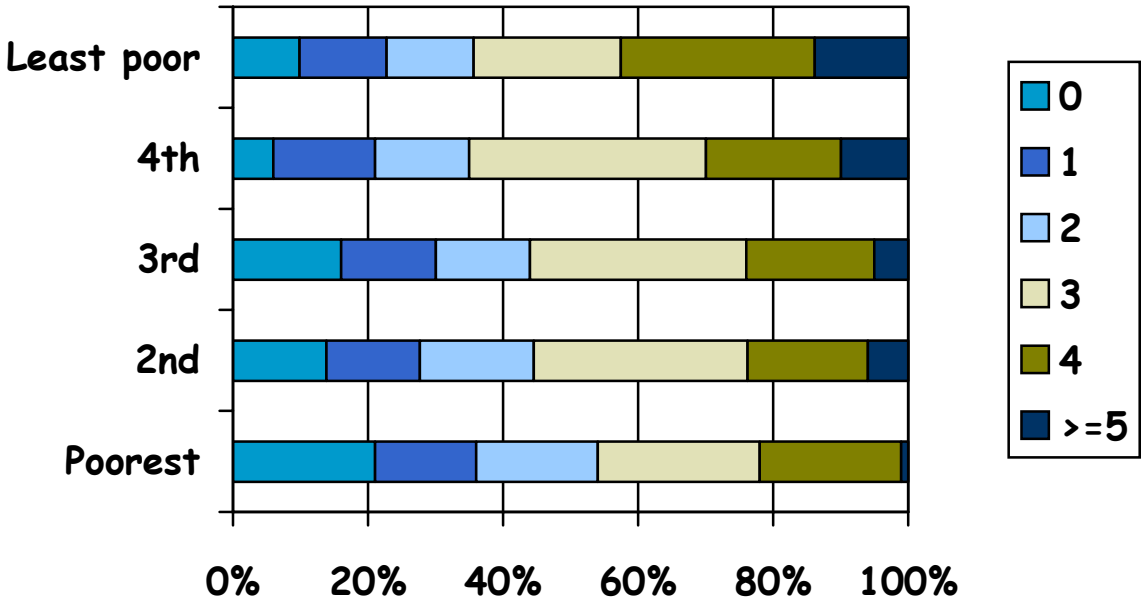


Figure 3. Distribution of children in the Bangladesh (Matlab) survey according to the number of child survival interventions received, by socioeconomic groups.

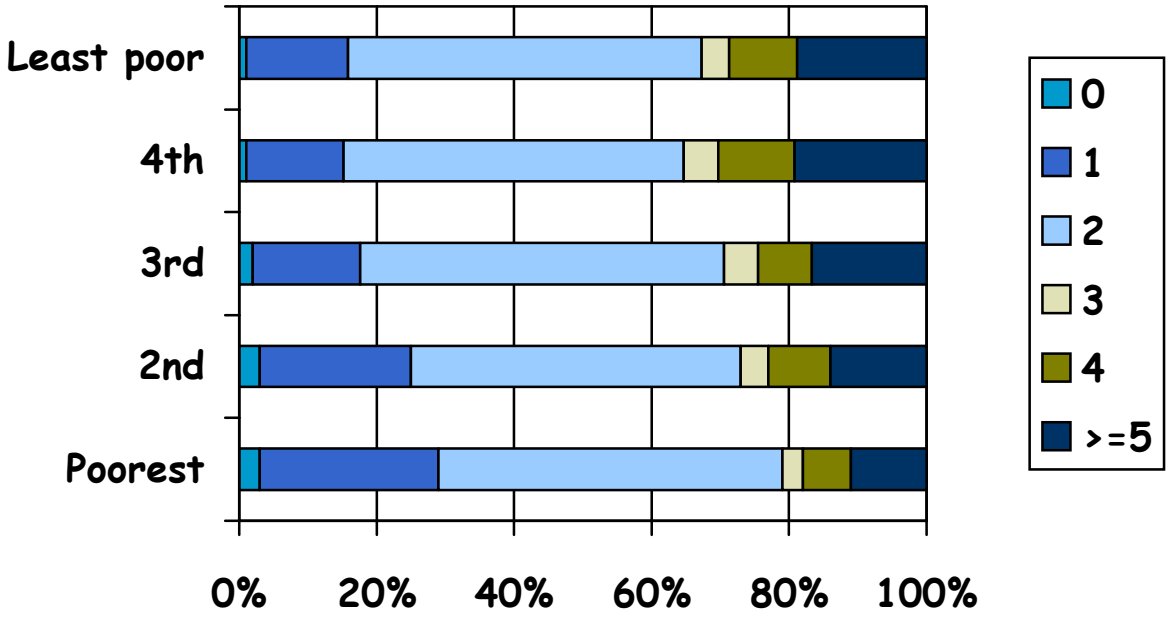
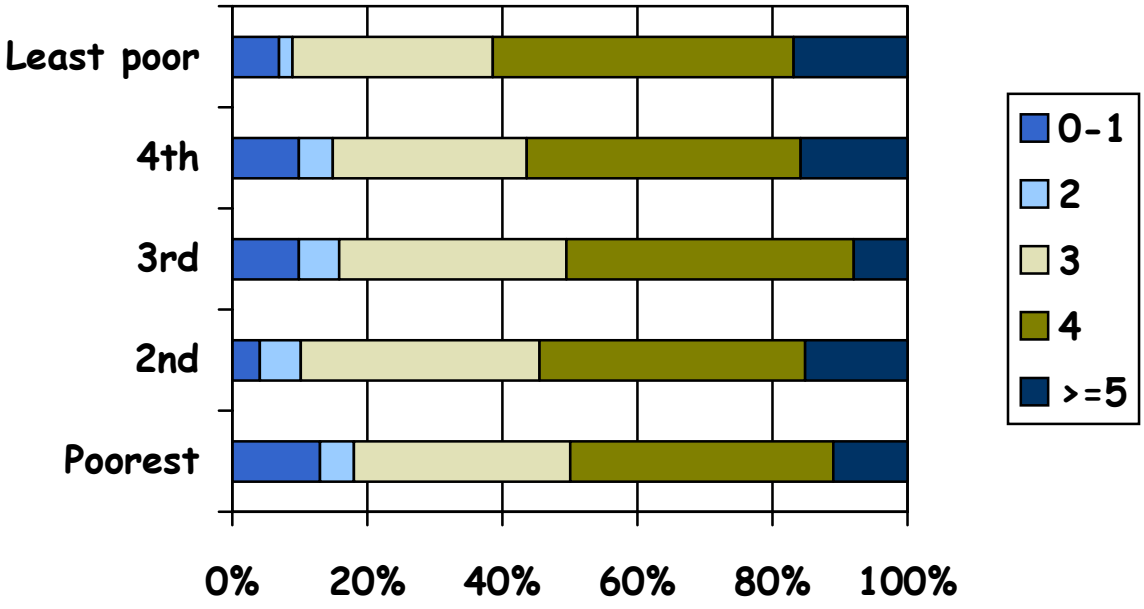


Figure 4. Distribution of children in the Brazil (Sergipe) survey according to the number of child survival interventions received, by socioeconomic groups.



Discussion

To our knowledge, this is the first analysis of how child survival interventions are clustered at the individual level.

Information on vaccine coverage was obtained by inspecting vaccination cards. When no card was available, the caretaker provided information on the number of doses received by each child. The present analyses are based on registered doses only, but they were repeated by also taking informed doses into account. These results are presented below in the Annex. Inclusion of informed doses, as expected, led to substantial increases in vaccine coverage levels, particularly for Bangladesh. Results on co-coverage (see Annex), however, remained similar to those presented above.

We have shown that, while some children fail to receive any interventions, others receive several of them at the same time. In most countries, several different interventions are being promoted simultaneously, and less than half of all children tend to be reached by any given intervention.[12] New interventions are also on the horizon for widespread dissemination, including zinc supplementation and vaccines against pneumococci and rotavirus.[12] Before these interventions are made widely available, however, it would be worth considering whether they will tend to reach the same children who are already being reached by existing interventions, while leaving out those who are already under-served. Efforts aimed at improving equity may be preferable to the introduction of new technologies that will tend to sharpen inequalities, at least in the short term.[5]

To reduce costs, interventions are often delivered simultaneously, for example adding vitamin A distribution to national immunization days. While this approach has obvious advantages from the economic perspective, it should be noted that it will also contribute to concentrating coverage on a subset of children. Achieving universal or near universal coverage should be an essential pre-requisite for campaigns in which several interventions are jointly delivered. Mediocre coverage levels with bundled interventions may result in increasing inequalities.

These analyses were limited to three datasets collected as part of the Multi-Country Evaluation of IMCI, in relatively small geographical areas within which inequalities may be relatively restricted. Due to the nature of the child health program being evaluated, the number of interventions for which data were collected was limited. For example, no information was gathered on coverage of antenatal and delivery interventions. Analysis of existing national datasets – such as DHS[13] or MICS[14] – may well show a greater degree of inequality in the concentration of interventions at the child level.

Annex

The following table and figures show the same analyses presented above, but incorporating reported as well as confirmed vaccine doses.

Table 2A. Coverage of child survival interventions in Tanzania, Bangladesh and Brazil (using either registered or informed vaccine doses)

Intervention	**Tanzania (4 districts)**	**Bangladesh (Matlab)**	**Brazil (Sergipe)**
BCG vaccine	96%	94%	98%
DPT vaccine (3 doses)	83%	58%	93%
Measles vaccine	90%	77%	94%
Mosquito nets	32%	85%	-
Vitamin A capsule	6%	83%	63%
Growth card and/or weighed last month*	28%	2%	54% *

Figure 1A. ***Distribution of children according to the number of child survival interventions received (using either registered or informed vaccine doses)***

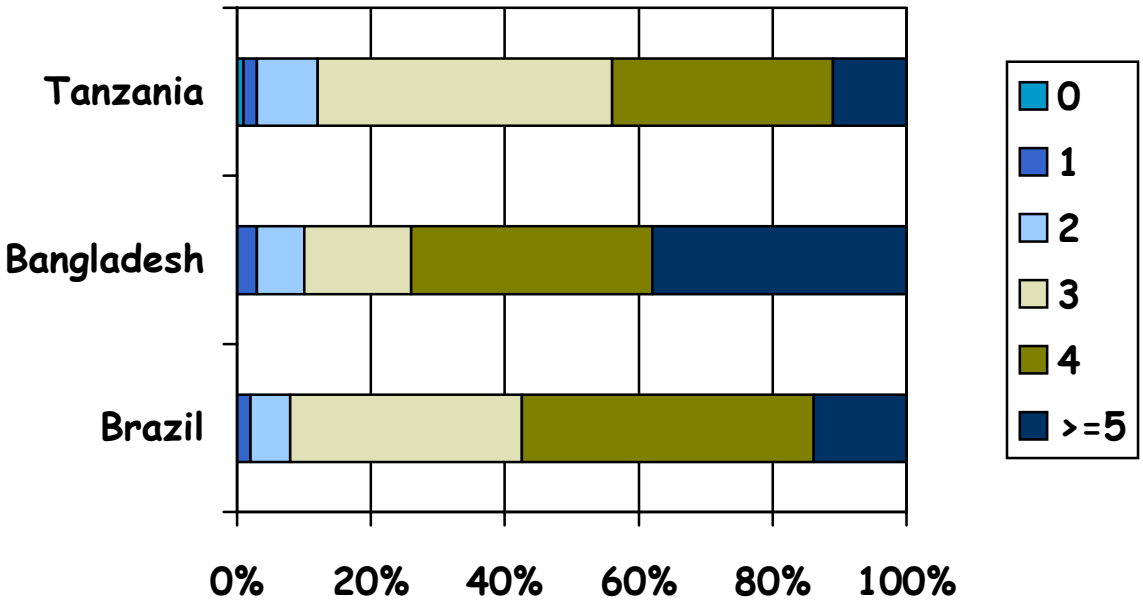


Figure 2A. ***Distribution of children in the Tanzania (four districts) survey according to the number of child survival interventions received, by socioeconomic groups (using either registered or informed vaccine doses)***

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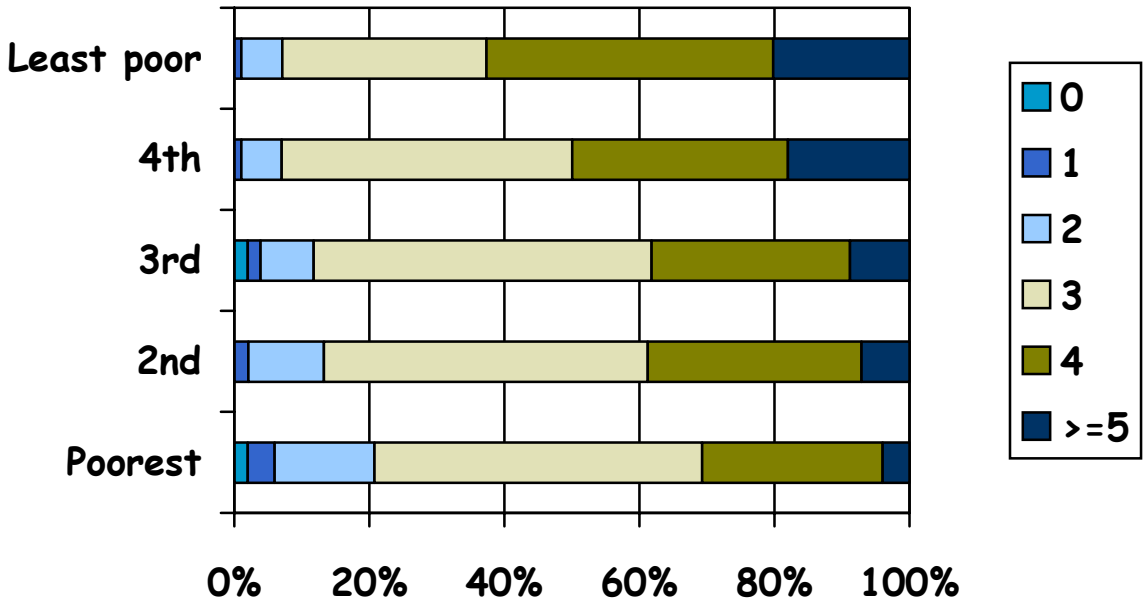

Figure 3A. Distribution of children in the Bangladesh (Matlab) survey according to the number of child survival interventions received, by socioeconomic groups (using either registered or informed vaccine doses)

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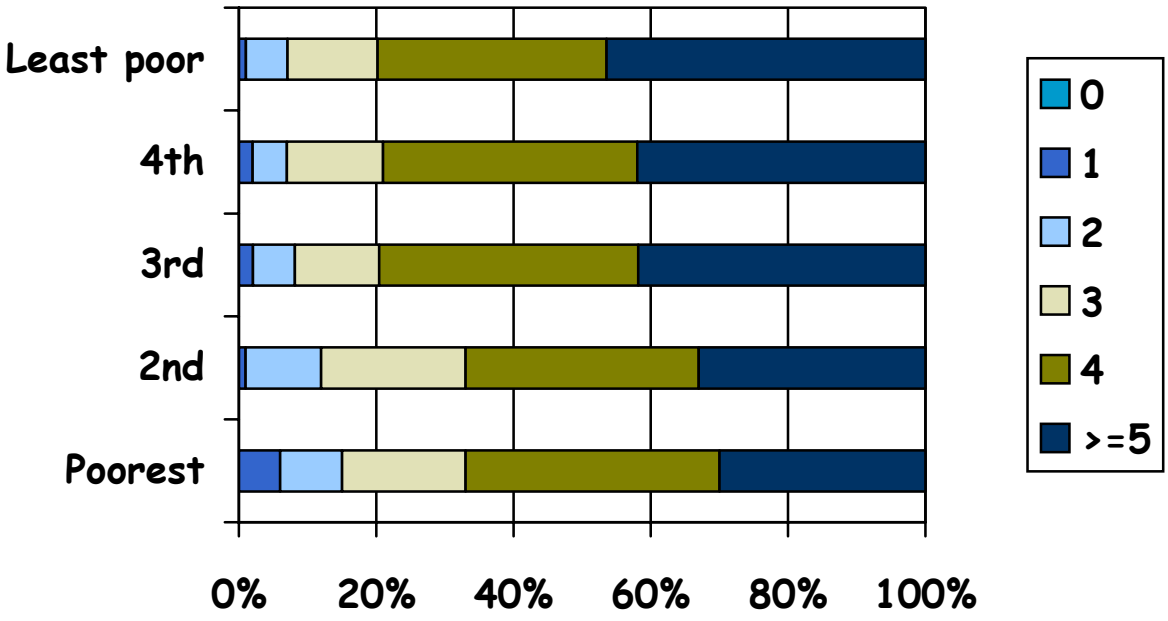

Figure 4A. Distribution of children in the Brazil (Sergipe) survey according to the number of child survival interventions received, by socioeconomic groups (using either registered or informed vaccine doses)

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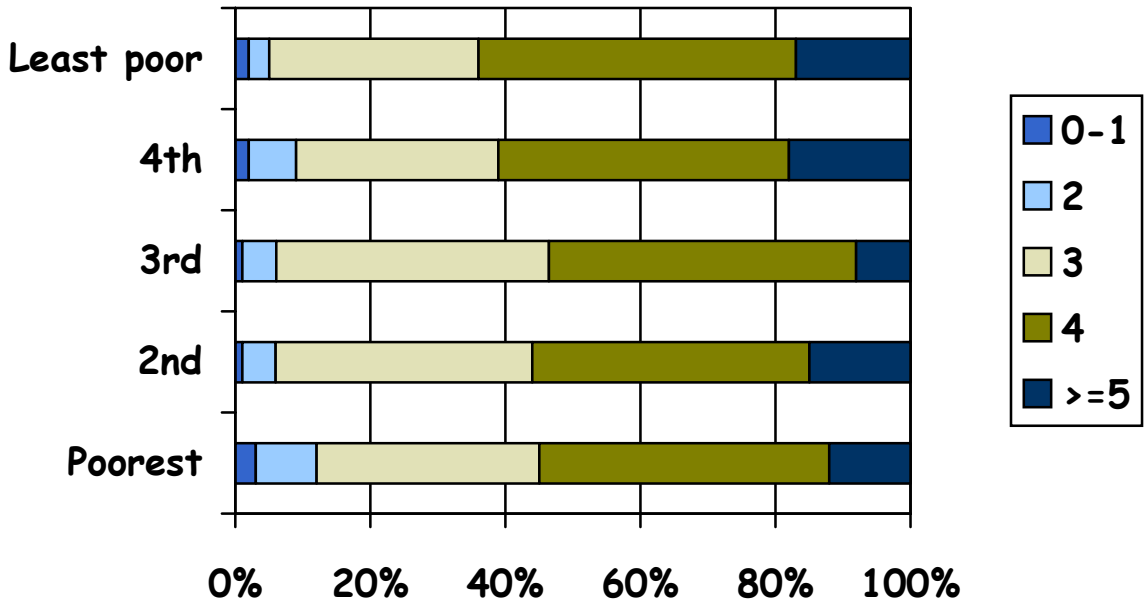

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