COMPARATIVE STUDIES 1

IMMUNIZATION

◉DHS **Demographic and Health Surveys**

Demographic and Health Surveys
Comparative Studies No. 1

Immunization: Levels, Trends and Differentials

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Preface

An important part of the DHS program is the comparative analysis of data obtained from DHS surveys. Standard recode files have been prepared for most surveys and researchers worldwide are encouraged to use the datasets available through the DHS Data Archive.

DHS staff in Columbia, Maryland are carrying out much of the analysis, particularly for major topics such as fertility, mortality, contraceptive use, and immunization. The results of these analyses will be published in the *DHS Comparative Studies* series.

The reports in this series are based on the standard recode files which were available in late 1989 or early 1990. These include datasets for approximately 25 standard DHS surveys carried out from 1985 to 1989.

Reports in the *DHS Comparative Studies* series provide detailed tables and graphs comparing the results of DHS surveys in four regions: sub-Saharan Africa, the Near East and North Africa, Asia, and Latin America and the Caribbean. The reports also discuss various issues such as questionnaire comparability, survey procedures, and data quality. Where appropriate, data from previous survey programs, primarily the World Fertility Survey (WFS), are used to evaluate trends over time.

The *DHS Comparative Studies* series is intended to provide analysts and policymakers with readily available comparisons of data from developing countries. They will also be an important source of information for many professionals in the fields of international population and health.

Martin Vaessen
Project Director

1 Introduction

Immunization is a major focus of child survival and development programs throughout the world. Since 1974, when the World Health Assembly initiated the Expanded Programme on Immunization (EPI), immunization services have been an important part of public health programs in developing countries (Henderson et al., 1988). In the second half of the 1980s, the expansion of immunization services became a major goal of international health organizations and governments throughout the world; the aim was to have at least 80 percent of the world's children fully immunized by 1990 (World Health Organization and UNICEF, 1985; UNICEF, 1985).

The immunization of children and pregnant women is one of the most powerful interventions to improve child survival and reduce childhood morbidity. In addition, immunization coverage is a good indicator of the degree of utilization of health services both at the aggregate (national/regional) level and at the individual level. Thus, monitoring and evaluating the performance of immunization programs (with regard to immunization coverage and disease surveillance) is particularly important.

Data from the Demographic and Health Surveys (DHS) program provide a new source of information on immunization coverage in Africa, Asia, Latin America, and the Caribbean. This report presents the results of a comparative analysis of immunization coverage (BCG, DPT, polio, and measles) in 21 developing countries: Africa (12), Asia (2), Latin America and the Caribbean (7). The analysis is based on the standard recode files which were available in 1989. Where possible, DHS data are compared with data from other national surveys and health information systems. Information on levels of tetanus toxoid immunization for pregnant women is also presented.

2 DHS Data on Immunization

Most DHS surveys include questions on the immunization status of children of respondents. This analysis covers immunization data collected in 21 countries between 1986 and 1989. The data were collected for (living) children under five years of age. The large size of DHS surveys—typically, 3,000 to 10,000 women of reproductive age—has produced a vast amount of information on immunization. This new database allows for extensive analysis of a range of variables.

The main source of information about childhood vaccinations is the immunization record (health card) filled out by health workers and kept by the mother. In DHS surveys, mothers were asked if their children under the age of five had a health card. If the mother was able to present the card, the interviewer recorded the vaccination dates. If she could not produce the card, the mother was asked whether the child had ever been vaccinated. In about one-third of the countries this question was followed by questions on specific vaccinations. In the other countries, the questionnaire did not allow for information on specific vaccinations based on mother's reports (maternal recall). In Mexico and Togo mothers were not asked to present child health cards to the interviewer. The Mexico survey includes only maternal recall for specific vaccinations, while the Togo survey includes only information on the proportion of children ever vaccinated. No information on immunization was collected in the DHS surveys in Ecuador and Indonesia, and none of the surveys collected data on the immunization status of children who died prior to the survey. Table 2.1 summarizes the available data by country.

Table 2.1 Summary of immunization data: Availability of information on immunization of children under 5 years from health cards and maternal recall, Demographic and Health Surveys, 1986-1989

Country	Country Code	Date of Fieldwork	Health Card Info.	Maternal Recall Specific Vaccinations	Maternal Recall Ever Vaccinated	No.of Respondents
SUB-SAHARAN AFRICA						
Botswana	BT	Aug-Dec 1988	yes	no	yes	4366
Burundi	BU	Apr-Jul 1987	yes	no	yes	3970
Ghana	GH	Feb-May 1988	yes	no	yes	4488
Kenya	KE	Dec-May 1988/89	yes	no	yes	7150
Liberia	LB	Feb-Jul 1986	yes	no	yes	5239
Mali	ML	Mar-Aug 1987	yes	no	yes	3200
Senegal	SN	Apr-Jul 1986	yes	no	yes	4415
Togo	TG	Jun-Nov 1988	no	no	yes	3360
Uganda	UG	Sep-Feb 1988/89	yes	BCG scar	yes	4730
Zimbabwe	ZW	Sep-Jan 1988/89	yes	no	yes	4201
NORTH AFRICA						
Egypt	EG	Oct-Jan 1988/89	yes	partly	yes	8911
Morocco	MA	May-Jul 1987	yes	yes	yes	5982
Tunisia	TN	Jun-Oct 1988	yes	yes	yes	4184
ASIA						
Indonesia	IN	Sep-Dec 1987	no	no	no	11884
Sri Lanka	LK	Jan-Mar 1987	yes	yes	yes	5865
Thailand	TH	Mar-Jun 1987	yes	no	yes	6775
LATIN AMERICA/CARIBBEAN						
Bolivia	BO	Mar-Jun 1989	yes	yes	yes	7923
Brazil	BR	May-Aug 1986	yes	no	yes	5892
Colombia	CO	Oct-Dec 1986	yes	no	yes	5329
Dominican Republic	DR	Sep-Dec 1986	yes	campaigns	no	7649
Ecuador	EC	Jan-Mar 1987	no	no	no	4713
Guatemala	GU	Oct-Dec 1987	yes	yes	yes	5160
Mexico	ME	Feb-May 1987	no	yes	yes	9308
Peru	PE	Sep-Dec 1986	yes	no	yes	4999
Trinidad & Tobago	TT	May-Aug 1987	yes	yes	yes	3806

Information on immunization was collected from child health cards in the Dominican Republic, but it has been excluded from the analysis of coverage in this report because the survey questions were different from those of the DHS core questionnaire. Instead of the question "Has your child ever received a vaccination?" the survey asked whether the child had ever received a vaccination in a "campaign" and followed-up with queries about specific campaigns in the last three years. At least 80 percent of all vaccinations to children 12-23 months in the Dominican Republic were given during mass immunization campaigns; 82 percent of all children with a health card had participated in at least one campaign. What is not clear, however, is what proportion of "campaign" vaccinations were recorded on the health cards, since cards are not generally used in campaigns.

The Egypt questionnaire also deviated from the DHS core questionnaire regarding immunization. In Egypt, vaccinations are recorded on birth certificates rather than on child health cards. Since these immunization records are not always complete, women in the Egypt DHS survey who had birth certificates for their children were asked about specific vaccinations. In addition, all mothers were asked about the number of times each child had received oral polio vaccine (OPV), and whether their child(ren) had ever received a vaccination by injection.

The analysis of vaccination dates from child health cards provides information about the timing of immunizations. According to the World Health Organization guidelines, the recommended immunization schedule is: BCG at birth, three doses of DPT and oral polio vaccine at 6, 10, and 14 weeks, and measles immunization at 9 months. Most countries follow this schedule, however, among the DHS countries analyzed here, there is some divergence from the WHO guidelines: Morocco uses injectable polio vaccine (IPV) given in the same injection as DPT, and Trinidad and Tobago operates under a different schedule.

The analysis of coverage levels and trends in this report focuses on children 12-23 months of age. This age group was selected because full immunization is recommended for all children by age one. In addition, most EPI cluster-sample surveys estimate coverage levels for children 12-23 months.

3

3 Methodology for Estimating Immunization Coverage

Estimates of immunization coverage based on health cards require careful consideration. Such estimates can understate the level of coverage if it is assumed that children whose mothers did not present a card during the interview were never vaccinated. It is possible that the health card may have been lost, or was inaccessible at the time of the interview, or the child may have been vaccinated in a campaign and never received a card. On the other hand, estimates can overstate the level of coverage if it is assumed that children without cards presented have the same vaccinations as those with cards presented.

The coverage estimates presented in this report take these problems into consideration. In addition to health card information, DHS estimates of immunization coverage incorporate information based on mother's recall of vaccinations. The addition of this information increases the accuracy and precision of overall estimates. The methodol-ogy for this procedure is described below in sections 3.3 and 3.4.

3.1 PRESENCE OF CHILD HEALTH CARDS

Immunization data were collected from child health cards in 21 DHS surveys. Table 3.1 indicates the proportion of children for whom a health card was presented during the interview. The highest proportion of children with cards was observed for age groups 6-11 months, 12-23 months, and 24-35 months. A large proportion of children 0-5 months had no health card, presumably because many infants had not yet been in contact with the health system. For older children (36-59 months) card levels were lower, either because the cards got lost (or were inaccessible due to being put away for a long time), or because fewer children had received cards.

Table 3.1 Health card levels: Percentage of children under five for whom a health card was presented, by age of child in months, Demographic and Health Surveys, 1986-1989

Country	Year of Survey	Age of Child (Months)					Total	No. of Children
		0-5	6-11	12-23	24-35	36-59		
SUB-SAHARAN AFRICA								
Botswana	1988	90	86	74	70	60	71	3031
Burundi	1987	44	59	64	51	31	46	3456
Ghana	1988	28	39	40	40	25	33	3646
Kenya	1988/89	52	68	61	50	40	51	6514
Liberia	1986	34	45	43	36	25	34	4227
Mali	1987	11	14	12	13	10	12	2858
Senegal	1986	14	28	30	25	19	24	3677
Uganda	1988/89	23	48	49	50	42	44	4330
Zimbabwe	1988/89	82	88	78	75	64	73	3140
NORTH AFRICA								
Egypt	1988/89	53	62	61	55	47	53	7912
Morocco	1987	52	61	50	39	31	42	5559
Tunisia	1988	69	80	77	71	64	70	4212
ASIA								
Sri Lanka	1987	78	87	82	79	70	76	3861
Thailand	1987	39	49	36	31	18	29	3499
LATIN AMERICA/CARIBBEAN								
Bolivia	1989	17	21	23	23	16	19	5192
Brazil	1986	46	70	74	70	63	66	3206
Colombia	1986	51	59	55	50	41	48	2584
Dominican Republic	1986	17	15	18	16	11	14	4066
Guatemala	1987	31	54	56	58	54	53	4184
Peru	1986	34	45	43	36	30	36	2814
Trinidad & Tobago	1987	24	81	79	78	71	72	1870

In Botswana, Brazil, Sri Lanka, Trinidad and Tobago, Tunisia, and Zimbabwe the proportion of children with a health card is high, with more than 60 percent of children under five having a card presented to the interviewer (more than 70 percent of children 12-23 months). A smaller proportion (40 to 60 percent) of the children in Burundi, Colombia, Egypt, Guatemala, Kenya, Morocco, and Uganda have a health card, and 20 to 40 percent of children in Ghana, Liberia, Peru, Senegal, and Thailand have a card. The lowest proportion was reported for Bolivia, the Dominican Republic, and Mali, where less than 20 percent of children under five have a health card.

Differentials in card levels for children 12-23 months are examined in Table 3.2. (The relative differentials are presented in Appendix A, Table A.1.) There are substantial differences according to place of residence, and in all but six countries—Botswana, Egypt, Guatemala, Kenya, Trinidad and Tobago, and Zimbabwe—health cards are more often presented for urban children than for rural. Large differences between urban and rural areas are reported for three West African countries (Ghana, Mali, and Senegal), the Dominican Republic, Morocco, and Thailand.

Table 3.2 Differentials in health card levels: Differentials in health card levels for children 12-23 months by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Birth Order		Mother's Age		Sex		Percentage With Card	No. of Children
	Urban	Rural	None	Pri	Sec+	1	6+	<20	>=35	M	F		
SUB-SAHARAN AFRICA													
Botswana	69	76	78	75	66	71	88	70	86	74	75	74	614
Burundi	a	64	63	68	a	65	65	a	67	66	62	64	663
Ghana	58	33	32	44	65	45	37	38	37	38	43	40	782
Kenya	50	63	53	66	57	58	53	71	50	63	59	61	1315
Liberia	43	39	36	48	52	36	39	38	38	38	44	43	817
Mali	30	5	10	23	a	20	7	19	7	12	12	12	554
Senegal	58	16	24	53	68	35	27	22	23	30	30	30	791
Uganda	56	49	45	51	60	50	47	42	52	51	48	49	946
Zimbabwe	72	80	83	80	67	71	78	71	75	77	78	78	629
NORTH AFRICA													
Egypt	61	61	57	64	61	59	56	60	59	61	61	61	1593
Morocco	69	40	48	73	52	54	46	56	45	52	49	50	1101
Tunisia	82	72	73	81	79	81	67	a	70	77	77	77	820
ASIA													
Sri Lanka	86	82	66	79	86	85	81	90	82	84	80	82	774
Thailand	55	32	16	34	58	41	16	23	23	38	34	36	759
LATIN AMERICA/CARIBBEAN													
Bolivia	28	19	15	21	32	32	19	17	18	23	23	23	1108
Brazil	76	69	65	74	77	82	65	74	69	72	76	74	578
Colombia	58	50	48	54	59	57	52	43	46	54	55	55	556
Dominican Republic	24	10	6	12	31	24	5	13	13	17	18	18	864
Guatemala	53	56	51	60	57	49	56	47	54	56	55	56	823
Peru	45	40	34	45	44	45	43	40	39	42	44	43	526
Trinidad & Tobago	77	81	a	77	82	83	66	79	74	78	81	79	380

Note: Relative differentials in health card levels are presented in Table A.1.

a Less than 20 cases

Card levels are lower than average for mothers with no education in all countries except Botswana and Zimbabwe. Generally, card levels increase with increases in the level of maternal education. In the three North African countries, especially Morocco, card levels are highest for children of mothers with primary education. Analysis by birth order shows that in 16 of the 21 countries card levels are lower than average for the sixth or later child. The differences are greatest in the Dominican Republic and Mali. First-born children appear to have higher card levels

in most countries. Card levels are generally lower for children of mothers who are under 20 years of age, or, are 35 and over. There were no significant differentials according to the sex of the child.

3.2 CARD INFORMATION VERSUS MATERNAL RECALL

The vaccination status of children was ascertained by examining the health cards presented by mothers. If no health card was presented, the mother was asked if the child had ever been vaccinated. Table 3.3 shows the vaccination status of children 12-23 months, including health card information and maternal recall.

Table 3.3 Children ever vaccinated: Percent distribution of children 12-23 months according to vaccination status, including health card information and maternal recall, Demographic and Health Surveys, 1986-1989

Country	Children Ever Vaccinated		Children Never Vaccinated	Total
	Health Card	Maternal Recall		
SUB-SAHARAN AFRICA				
Botswana	74	23	3	100
Burundi	63	17	20	100
Ghana	41	36	23	100
Kenya	61	35	4	100
Liberia	42	29	29	100
Mali	12	28	60	100
Senegal	30	34	36	100
Uganda	49	22	29	100
Zimbabwe	77	19	4	100
NORTH AFRICA				
Egypt	37	59	4	100
Morocco	50	36	14	100
Tunisia	77	20	3	100
ASIA				
Sri Lanka	82	17	1	100
Thailand	36	53	11	100
LATIN AMERICA/CARIBBEAN				
Bolivia	23	62	15	100
Brazil	74	21	5	100
Colombia	55	39	6	100
Dominican Republic	18	75	7	100
Guatemala	55	26	19	100
Peru	42	50	8	100
Trinidad & Tobago	79	14	7	100

In 7 of the 21 countries more children were classified as ever-vaccinated according to mother's reports than was indicated by health cards. In the remaining countries, maternal recall adds substantially to the estimated propor-

tion of children ever vaccinated. This suggests that the limited card information available gives an unreliable picture of overall coverage.

Table 3.3 also shows that, in 11 countries—after including information reported by the mother—less than 10 percent of children 12-23 months had never been immunized. In six countries, all in sub-Saharan Africa, 20 percent or more of children one year of age had never received a vaccination; the highest level was in Mali (60 percent).

Questionnaires in seven countries asked mothers to report information on specific vaccinations if they could not show the child's health card to the interviewer. In addition, all children in Uganda were checked for the presence of a BCG scar. Coverage estimates derived from maternal recall (recall coverage) were compared with coverage estimates based on health card information. To assess the extent to which the estimates differ, relative coverage levels among children without a card were compared with levels among children with a card (the latter standardized at 100; see Table 3.4). Recall coverage is based on children whose mothers said they had received at least one vaccination, thus, excluding children who were never vaccinated. For most vaccines, coverage for specific vaccines among children ever vaccinated according to the mother's report is 75 to 95 percent of card coverage. This result suggests that the absence of a card may be considered as an indicator of less concern about immunization or fewer opportunities for immunization and thus of lower coverage, even though the mother says the child has been immunized. The only exception is BCG, for which recall coverage was the same as, or higher than, card coverage in almost all countries. (It was particularly high in Guatemala.) On the basis of maternal recall, dropout rates between the first and third dose of DPT and polio vaccines are considerably higher than rates based on card information.

3.3 PROCEDURE FOR ESTIMATING IMMUNIZATION COVERAGE

In two-thirds of DHS surveys, mothers who did not have health cards for their children were not asked questions about specific immunizations; however, they were asked whether their children had ever received a vaccination. The responses given, in combination with the results shown in Table 3.4, make possible an estimate of national coverage. In addition to information on card levels, card coverage by vaccine, and the proportion of children ever vaccinated, a national estimate requires assumptions about immunization coverage among ever-vaccinated children without a card. Based on the median coverages for the countries included in Table 3.4 the following assumptions were made:

Table 3.4 Comparison of health card coverage and recall coverage: Immunization coverage for children under 5 years as a ratio of health card coverage and recall coverage for specific vaccines, full immunization, and dropout rates, Demographic and Health Surveys, 1986-1989

Country	BCG	DPT 1	DPT 2	DPT 3	Polio 1	Polio 2	Polio 3	Measles	Full Immun.[a]	Dropout Rate[b]
Uganda	78[c]									
Morocco	100	89	83	79	89	83	79	74	74	166
Tunisia	102	95	96	93	95	96	93	78	78	132
Sri Lanka	100	96	94	86	97	94	86	88	88	280
Bolivia	106	91	74	50	100	88	68	91	50	167
Brazil	99	69	65	65	88	82	71	104	70	135
Guatemala	167	95	90	73	98	90	75	95	73	123
Trinidad & Tobago	d	99	98	80	101	99	74	48	NA	189
Median	100	95	90	80	97	90	75	88	74	166

Note: Figures are the ratio of recall coverage/card coverage * 100.

NA = Not available

[a] Received BCG, measles and three doses of DPT and polio
[b] Dropout rate between DPT1 and DPT3 as a ratio of card and recall coverage
[c] BCG scar rate for children ever vaccinated and children with cards
[d] BCG not routinely administered

- BCG recall coverage is the same as BCG card coverage.
- DPT1 and polio1 recall coverages are 95 percent of the corresponding card coverages.
- DPT2, polio2, and measles recall coverages are 90 percent of the corresponding card coverage rates.
- DPT3 and polio3 recall coverage are 80 percent of the corresponding card coverages.
- Full coverage from maternal recall is 75 percent of full coverage from card information.

Coverage for each vaccination is then calculated as follows:

$P(vaccine,all) = [P(card) + K * P(ever)] * P(vaccine,card)$, where $P(vaccine,all)$ is specific vaccination coverage for all children, $P(vaccine,card)$ is coverage for that vaccine according to the child health card, $P(card)$ is the proportion of children with cards, $P(ever)$ is the proportion ever vaccinated among all children, and K is the vaccine-specific adjustment factor as outlined above.

In Table 3.5, coverages reported in the seven countries where mothers were asked for specific information (column A) are compared with estimates of coverage using the adjustment formula given above (column B). In addition, column C of the table shows overall coverage estimates based on the assumption that the proportion of children vaccinated for specific vaccinations among ever-vaccinated children without a card is similar to the proportion indicated according to the cards (that is, $K = 1.0$).

The adjusted estimates in column B are generally very close to the estimates based on health cards and maternal recall for specific vaccinations in column A, and are closer to (A) than are the unadjusted estimates in column C. For BCG in Guatemala and for third doses of DPT and polio in Bolivia, the difference between columns A and B are greater than 4 percent. BCG is exceptionally high among children without a card in Guatemala, which causes the discrepancy with the adjusted estimates. Among children ever vaccinated, Bolivia is one of seven countries where more information on immunization comes from maternal recall than from health cards (Bolivia, Dominican Republic, Egypt, Mali, Peru, Senegal, and Thailand). Immunization coverage is more difficult to estimate in these countries because information from mothers' reports is more prone to error than card information.

Overall, the seven countries used to test the validity of the proposed adjustment procedure (see Table 3.5) are fairly representative of the 21 countries included in this study. However, there are some differences: none of the sub-Saharan countries is represented, and the mean proportion of children ever vaccinated, based on recall information, is lower for the seven countries than for all countries combined.

Table 3.5 Comparison of different methods of coverage estimation: Estimates of immunization coverage for specific vaccines based on: (A) card information and maternal recall, (B) card information and proportion ever vaccinated, with adjustment factor, and (C) card information and proportion ever vaccinated, assuming same coverage level as card information, selected Demographic and Health Surveys, 1986-1989

Country	BCG			DPT3			Polio3			Measles			Full Immunization		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Morocco	83	83	83	63	63	69	63	63	69	58	62	65	53	54	60
Tunisia	95	95	95	88	86	90	88	86	90	84	86	88	78	78	82
Sri Lanka	98	98	98	91	90	93	91	89	93	67	67	68	65	64	67
Bolivia	55	53	53	28	38	45	38	42	49	58	57	61	18	23	28
Brazil	70	70	70	70	72	76	75	77	80	79	77	79	57	54	57
Guatemala	50	42	42	36	37	39	39	40	43	55	54	56	18	19	20
Trinidad & Tobago	a	a	a	74	74	66	73	74	67	33	35	31	NA	NA	NA

Note: Coverages are percentages.

NA = Not available
a BCG not routinely administered

3.4 REFINEMENTS TO THE ESTIMATION PROCEDURE FOR SPECIFIC COUNTRIES

The estimation procedure outlined above can be improved by taking into account the differentials. The characteristics of children who have a card are different from the characteristics of children without a card (see Table 3.2). In most countries, children without a card are more likely to live in urban areas and have mothers who are more educated. Levels of immunization coverage for children with cards also tend to differ according to residence and maternal education. In three countries, Ghana, Mali, and Senegal, there exist both large socioeconomic differentials in card presence and large differentials in vaccination coverage among those presenting cards. In these countries, the estimation procedure can be modified to take into account these differentials.

To illustrate the refinement based on differentials, Senegal can be used as an example. In the survey for this country 64 percent of the mothers who presented health cards for their children live in urban areas; among mothers unable to present a card but who reported that their children had received a vaccination, 29 percent live in urban areas. Health card information also indicates that coverage for specific vaccines differs greatly between these groups. For example, 49 percent of urban children with health cards received a third dose of DPT compared with only 8 percent of rural children. Estimates of DPT3 coverage should take into account these large differences.

A correction factor for large differentials may be calculated as follows:

$$k' = \frac{p(\text{vaccine,recall})}{p(\text{vaccine,card})} = \frac{e_r v_r + (1-e_r)v_u}{c_r v_r + (1-c_r)v_u}$$

where k' is the differential correction factor equal to the ratio of the estimated overall coverage for a specific vaccine for children ever vaccinated according to their mothers to overall coverage based on card information; e_r is the proportion of ever-vaccinated children according to recall that live in rural areas, c_r is the proportion of children with health cards that live in rural areas, v_r and v_u are the rates of specific vaccine coverage in rural and urban areas, respectively, derived from the health cards.

In the case of Senegal for DPT3:

P(DPT3,recall) = 0.71 * 0.08 + 0.29 * 0.49 = .199
P(DPT3,card) = 0.36 * 0.08 + 0.64 * 0.49 = .342

thus k' = .199 / .342 = .58

Therefore, to correct maternal recall of DPT3 coverage (necessary because coverage is lower in rural areas), the factor 0.58 should be applied to the DPT3 coverage estimate based on card information. Note, however, that this correction still does not adjust for lower coverage of ever-vaccinated children without cards (as described earlier) because it assumes no difference in the coverage for children whose mothers were not able to present cards. Therefore, the product of both the adjustment factor and the correction factor, K*k', should be used to produce national estimates where there are large differentials in both the presence of health cards and vaccine coverage based on health cards.

Differentials in card levels and recall information by residence, maternal education, and literacy were examined for all countries. The impact on recall coverage was negligible in most countries (less than 1 percent difference in coverage). The exceptions were Ghana, Mali and Senegal, where large differences exist between urban and rural areas. The correction factor described above was used to improve national coverage estimates in these countries.

A different procedure was used to estimate coverage in Egypt, since immunizations in that country are recorded on birth certificates rather than on health cards. In the DHS survey in Egypt, birth certificates were presented for 61 percent of children 12-23 months, but an additional 38 percent said they had birth certificates. Thus, the presence of a birth certificate does not appear to be a good indicator of coverage. For example, coverage for polio1 was 64 percent among children 12-23 months whose birth certifi-

cate was presented to the interviewer and 84 percent among all other children 12-23 months. This suggests that recording of immunizations on birth certificates is incomplete. Moreover, a large proportion of mothers reported polio vaccinations that had not been recorded on the birth certificate. Thus, *card coverage* cannot be used as the basis for coverage estimations in Egypt. All mothers were asked about the number of times their children received polio drops by mouth (OPV). This recall information was used to obtain estimates of polio1, polio2, and polio3 coverage; DPT coverage was assumed to be the same as that for polio vaccine. Since no specific questions were asked about BCG and measles vaccinations, BCG and measles coverages are assumed to be similar for all children as for children with at least one immunization recorded on their birth certificate. It is probably, however, that these estimates are too low.

4 Immunization of Children

4.1 IMMUNIZATION COVERAGE

Table 4.1 presents estimates of immunization coverage for children 12-23 months of age. The estimates are based on the combined information from health cards and mother's reports, using the assumptions made in the previous section. For seven countries—Bolivia, Brazil, Guatemala, Morocco, Sri Lanka, Trinidad and Tobago and Tuni-

sia—mother's reports on specific vaccinations were used together with card information to obtain overall estimates of coverage. Since no card information is available for Mexico, coverage for that country is based entirely on maternal recall.

Table 4.1 Immunization coverage for specific vaccines: Percentage of children 12-23 months immunized for specific vaccines, including health card information and maternal recall, Demographic and Health Surveys, 1986-1989

Country	BCG	DPT 1	DPT 2	DPT 3	Polio 1	Polio 2	Polio 3+	Measles	Full Immun.	Dropout Rate DPT 1-3	No. of Children
SUB-SAHARAN AFRICA											
Botswana	95	93	92	88	93	92	86	87	81	5	615
Burundi	77	76	65	55	77	67	57	59	44	28	663
Ghana	69	69	53	42	71	53	41	51	31	40	782
Kenya	93	92	89	82	92	88	82	72	63	11	1315
Liberia	60	61	32	20	58	30	18	47	14	67	817
Mali	38	32	17	8	20	11	6	27	4	76	554
Senegal	54	54	32	14	46	27	12	39	10	74	791
Uganda	70	67	53	38	67	54	38	49	31	43	946
Zimbabwe	94	94	91	86	94	91	86	88	79	8	630
NORTH AFRICA											
Egypt	70	91	80	66	91	80	66	76	54	24	1579
Morocco	83	77	69	63	77	69	63	58	53	18	1101
Tunisia	95	96	93	88	96	93	88	84	78	8	820
ASIA											
Sri Lanka	98	98	96	91	98	96	91	67	65	7	774
Thailand	83	86	79	66	85	78	66	45	37	23	759
LATIN AMERICA/CARIBBEAN											
Bolivia	55	70	51	28	79	61	38	58	18	60	1108
Brazil	70	85	77	70	91	85	75	79	57	17	578
Colombia	85	90	83	72	90	83	72	64	54	20	556
Guatemala	50	77	57	36	80	60	39	55	18	54	823
Mexico	73	77	60	34	94	87	57	59	21	56	1017
Peru	57	84	76	58	85	77	57	72	36	31	526
Trinidad & Tobago	a	93	88	74	93	88	73	33	NA	20	380

NA = Not available
a BCG not routinely administered

Figure 4.1 shows coverage levels for BCG, three doses of DPT, measles, and full immunization among children 12-23 months of age based on card information and based on maternal recall. Immunization coverage varies greatly among countries, with Botswana, Tunisia, and Zimbabwe having the highest levels, and Bolivia, Ghana, Guatemala, Liberia, Mali, and Senegal having the lowest levels.

Except for Latin America, coverage levels within countries are about the same for BCG, DPT1, and polio1 (see Table 4.1). In Latin America, BCG coverage is lower than DPT1 or polio1 coverage. Also, BCG is not routinely given in Trinidad and Tobago.

Figure 4.1 Immunization coverage among children 12-23 months, Demographic and Health Surveys, 1986-1989

BCG

MEASLES

DPT3

FULL IMMUNIZATION
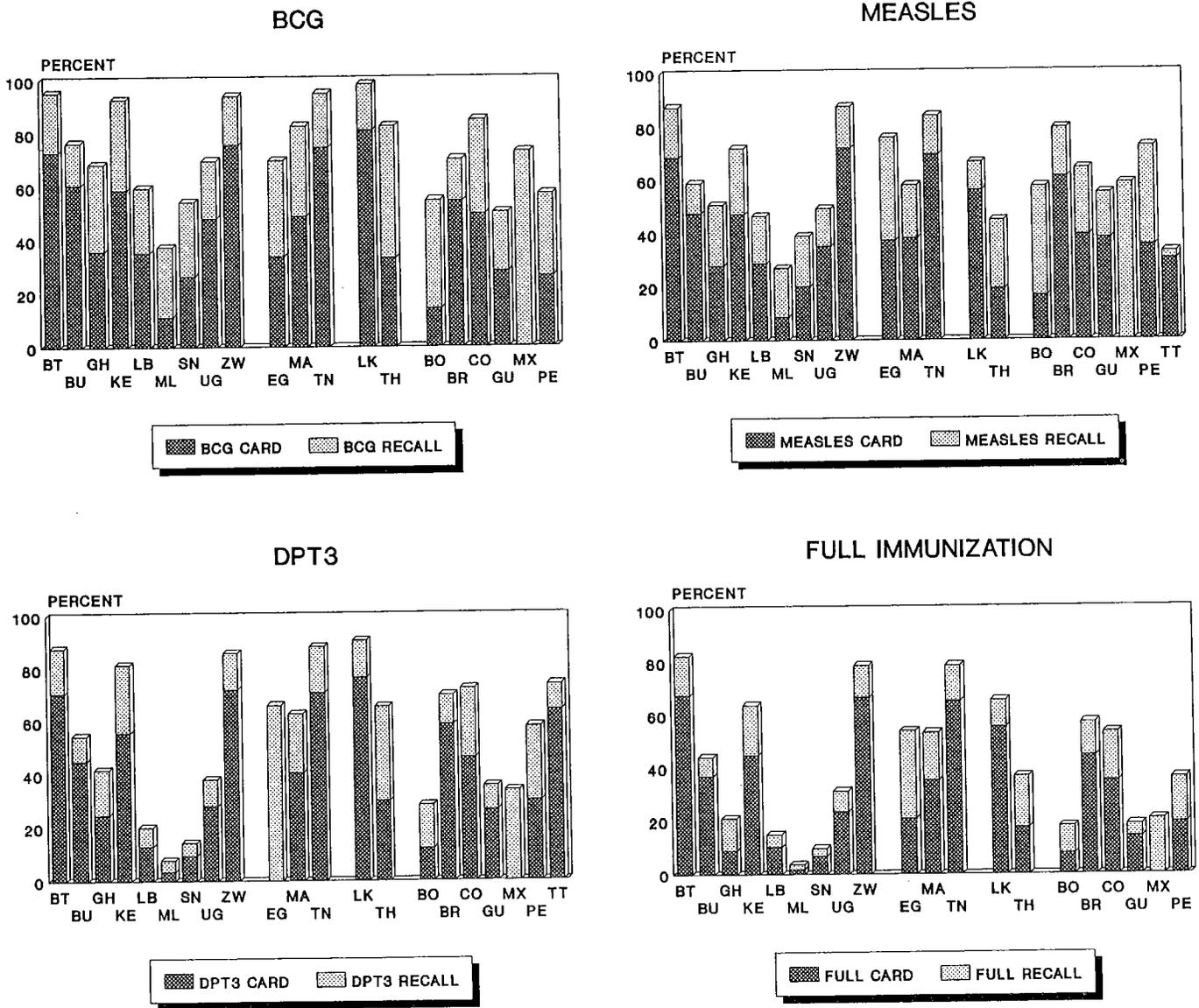
Since it is recommended that oral polio vaccine and DPT injections be given together at 6, 10, and 14 weeks, coverage levels for DPT and polio should be about the same. This was found to be the case in most countries—differences in coverage between DPT and polio for corresponding doses are small (less than 4 percent). In Bolivia, Brazil, and Mexico, however, polio coverage is higher than DPT coverage, probably as a result of campaigns specifically aimed at increasing polio immunizations. In Senegal and Mali polio coverage is significantly lower than DPT coverage. Comparing immunization dates on health cards in countries with high DPT3 coverage (Sri Lanka, Tunisia, and Zimbabwe), it was found that more than 95 percent of

children who received a DPT injection also received oral polio vaccine on the same day (see Figure 4.2). High percentages were also found in Colombia, Thailand, Trinidad and Tobago, and Uganda. Although Botswana is regarded as having one of the best immunization programs, DHS data indicate that 15 percent of DPT shots are given without accompanying polio vaccination. Despite this, DPT and polio coverage are about the same, suggesting that the vaccines are given on other occasions. In Kenya and Mali more than 25 percent of DPT immunizations are administered without polio vaccine (according to dates on health cards).

Figure 4.2 Percentage of children who received a DPT vaccination with and without polio drops (OPV) on the same day,
Demographic and Health Surveys, 1986-1989
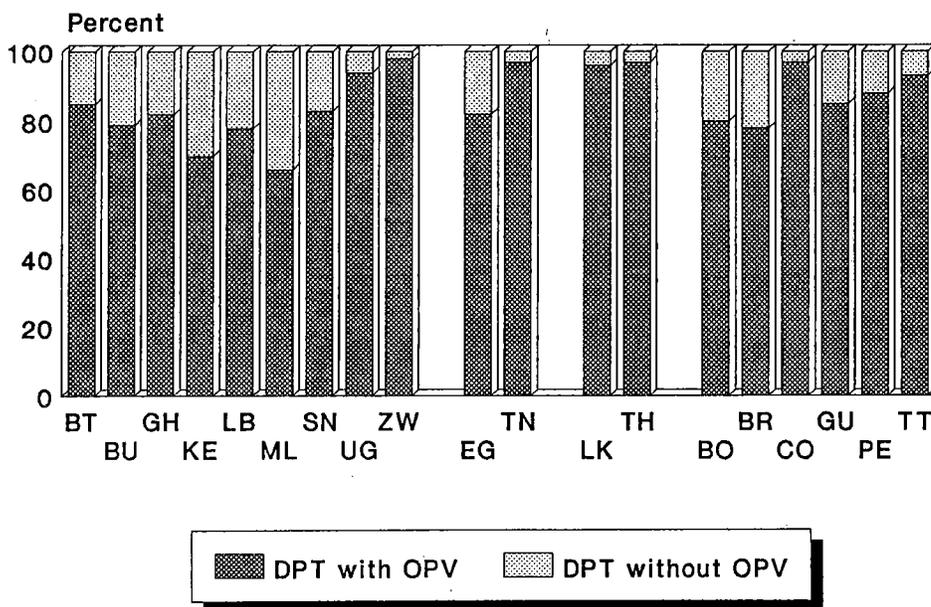
Note: Health card Information only.

Low dropout rates are typical of effective immunization programs. Table 4.1 shows the dropout rate between the first and the third dose of DPT for children 12-23 months. Four countries have dropout rates below 10 percent and six countries below 20 percent. Very high DPT dropout rates of 50 percent or more are reported for six countries: Bolivia, Guatemala, and Mexico in Latin America, and Liberia, Mali, and Senegal in West Africa.

Figure 4.3 shows a cross-tabulation of DPT3 and measles coverage for all countries. Twelve countries are clustered near the line representing equal coverage for both vaccinations. Six countries—Bolivia, Guatemala, Liberia, Mali, Mexico, and Senegal—have much higher coverage rates for measles than for DPT3. One explanation for this is that immunization programs in these countries lack the health infrastructure needed to complete the three-shot schedule and rely more on single-shot campaigns. Coverage for three doses of DPT is higher than measles coverage in the two Asian countries and Trinidad and Tobago. In the

Asian countries, this difference is probably due to the late inclusion of measles immunization in the national immunization programs.

Recording dates of immunization on health cards makes it possible to consider missed opportunities for immunization. Table 4.2 shows the number of children 12-23 months who received a DPT vaccination at 9-11 months, and the percentage of these who did not receive a measles immunization (even though they were eligible for one). In most countries, about one in five opportunities is missed, however, the two Asian countries surveyed show a much higher proportion of missed opportunities, probably because the programs were introduced only recently. In Sri Lanka and Thailand, more children receive DPT and polio vaccinations late in infancy because they follow a slower immunization schedule than that recommended by the World Health Organization. In Peru and Zimbabwe, almost all children who received DPT at 9-11 months also received a measles vaccination.

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Figure 4.3 Cross-tabulation of DPT and measles coverage among children 12-23 months by country, Demographic and
Health Surveys, 1986-1989
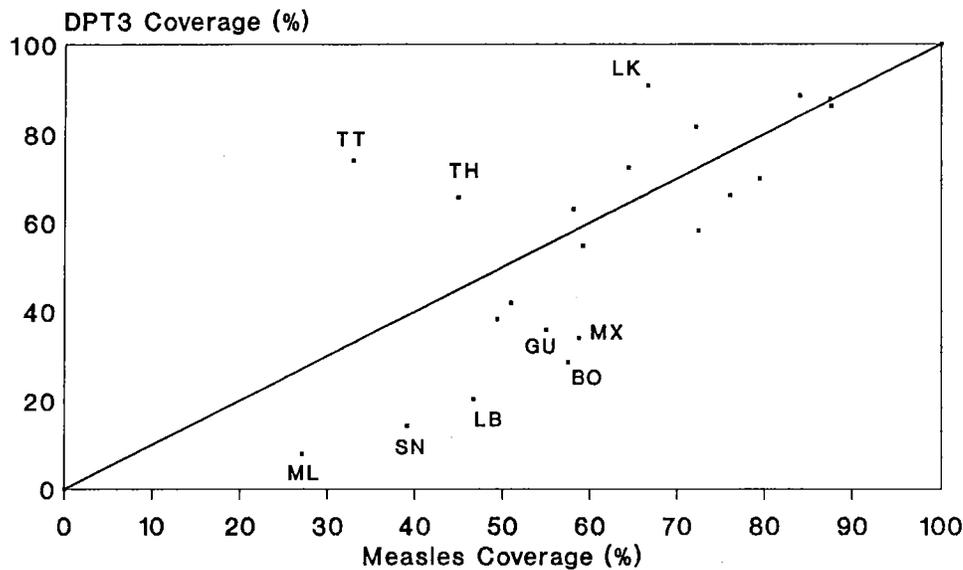
Note: Coverage includes health card
and recall information.

4.2 TIMELINESS OF IMMUNIZATIONS

Table 4.3 summarizes data on the age at which immuniza-
tions were given for all children under five at the time of
the survey. The analysis is limited to data from health
cards, since no attempt was made to obtain information on
immunization dates if the card was not shown.

MEASLES

The recommended age for measles immunization is 9
months, except in Trinidad and Tobago, where it is 12-15
months. A significant proportion of measles vaccinations
were given before 9 months, ranging from 3 percent in Sri
Lanka to 25 percent in Ghana. In Burundi, Ghana, Kenya,
Liberia, Senegal, and Uganda 10 percent or more of
immunizations for measles were given to children 8 months
or younger. It should be noted that a number of countries
changed the recommended age from 8 to 9 months early in
the five-year period preceding the survey.[1]

---

[1] The age at which measles vaccinations were administered to children 12-
17, 18-23, 24-35, and 36-59 months is discussed in section 4.3.

In eight countries more than half of the measles vaccina-
tions were given to children between the age of 9 and 11
months (see Figure 4.4), but in most countries, children are
immunized for measles in the second year (12-23 months).

DPT

The World Health Organization recommends that DPT
vaccine be given in three doses—at 6 weeks (DPT1), 10
weeks (DPT2), and 14 weeks (DPT3) of age. Since DHS
surveys collected data on year and month of birth only (not
day of birth), age at immunization is analyzed in terms of
months rather than weeks.

In 12 of the 20 countries surveyed with health card data,
more than half of the DPT1 doses were given at 2-4
months; in only four countries were more than half of the
DPT3 doses given at ages 4-6 months (see Figure 4.5).
The data from Mali indicate that DPT3 was given at the
recommended time more frequently than DPT1. This
seeming improvement is more apparent than real, and is
due to problems of data quality. The interval between DPT

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Table 4.2 Missed opportunities for measles immunization: Among children 12-23 months with a health card, the number who received a DPT vaccination at 9-11 months, and the percentage who did not receive a measles vaccination, Demographic and Health Surveys, 1986-1989

Country	No. of Children 12-23 Months With a Health Card	Children 12-23 Months With a Health Card, Who Receive DPT at 9-11 Months	
		Total Number	Percentage Who Did Not Receive Measles Vaccine
SUB-SAHARAN AFRICA			
Botswana	454	43	11
Burundi	423	78	24
Ghana	315	94	21
Kenya	802	64	23
Liberia	352	87	22
Mali	66	15	42
Senegal	247	68	22
Uganda	467	185	17
Zimbabwe	488	110	4
NORTH AFRICA			
Egypt	972	108	13
Morocco	556	98	20
Tunisia	631	116	14
ASIA			
Sri Lanka	636	194	41
Thailand	273	40	70
LATIN AMERICA/CARIBBEAN			
Bolivia	255	107	18
Brazil	426	103	13
Colombia	305	137	17
Guatemala	457	156	14
Peru	226	97	4

doses is too short, or more likely, it reflects that a certain proportion of the population—those who complete the three-dose schedule—are likely to get immunized at the proper ages, while those who do not complete the series are likely to begin later in life.

The mean interval between DPT1 and DPT3 is less than 3 months in Botswana, Burundi, Kenya, Mali, Morocco, and Tunisia; it is 3 months in Egypt, Ghana, Sri Lanka, Thailand, Trinidad and Tobago, Uganda, and Zimbabwe; and it is 4 months or more in Bolivia, Brazil, Colombia, Guatemala, Liberia and Peru.

BCG

BCG vaccinations are recommended at birth (or when a child first comes in contact with the health system). In seven countries, more than 80 percent of children with health cards were immunized by the age of 4 months. In contrast, less than 40 percent of the children who received BCG vaccine in Guatemala, Mali, Senegal, and Uganda were immunized at age 0-3 months.

Immunization status by 12 months of age is an indicator of both the level of immunization and the timeliness of vaccination programs, and is, therefore, the preferred indicator of the successfulness of immunization programs. Table 4.4 shows the percentage of children 12-23 months who were immunized by age 12 months. The proportion of children who were fully immunized at the time of the survey is slightly higher, particularly for measles (see Table 4.1).

Table 4.3 Distribution of vaccinations by age: Among children under 5 years with a health card, the percentage who were immunized at about the recommended age (in months) for measles, DPT1, DPT3, and BCG, Demographic and Health Surveys, 1986-1989

	Measles[a]			DPT1	DPT3	BCG
	<8	8	9-11	2-4	4-6	0-3
SUB-SAHARAN AFRICA						
Botswana	2	3	74	85	74	93
Burundi	10	7	42	44	38	54
Ghana	18	7	32	43	31	57
Kenya	10	11	58	63	59	79
Liberia	16	6	22	35	31	55
Mali	4	3	8	18	27	29
Senegal	11	5	34	43	19	39
Uganda	10	5	27	28	20	33
Zimbabwe	5	5	66	74	48	91
NORTH AFRICA						
Egypt	6	5	52	71	32	76
Morocco	5	5	62	74	55	87
Tunisia	8	9	55	71	50	87
ASIA						
Sri Lanka	1	2	32	75	8	93
Thailand	4	5	54	83	48	86
LATIN AMERICA/CARIBBEAN						
Bolivia	7	3	27	37	4	59
Brazil	14	7	52	73	36	56
Colombia	7	3	45	62	18	69
Dominican Republic	7	3	39	70	19	75
Guatemala	5	2	31	28	8	35
Peru	2	3	31	40	10	82
Trinidad & Tobago	2	0	1	64	25	b

[a] Percentages at <8 and 8 months are given in addition to the recommended age (9 months).

[b] BCG not routinely administered.

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Figure 4.4 Percentage of children immunized at 9 months and at 10-11 months among children under five with
measles vaccination, Demographic and Health Surveys, 1986-1989
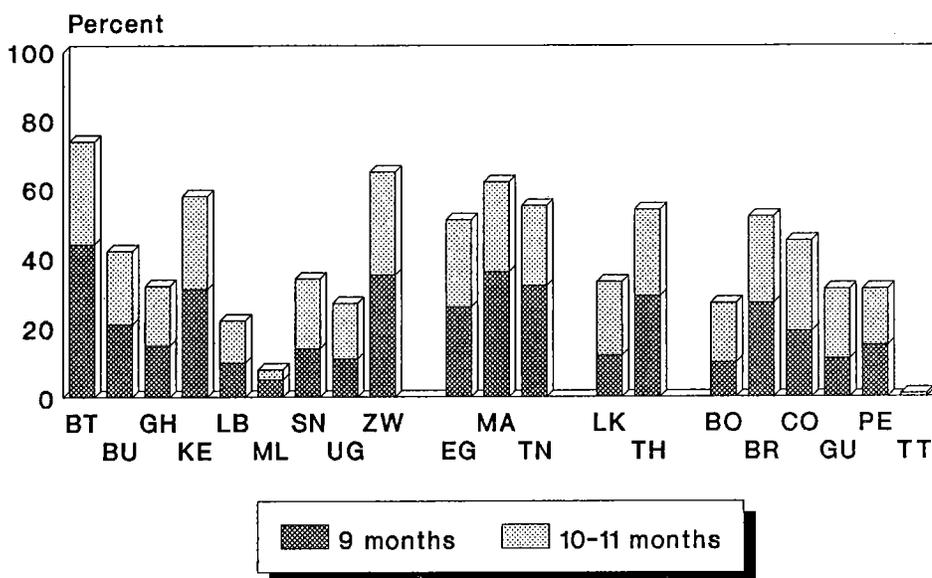
Note: Health card Information only.

4.3 TRENDS IN IMMUNIZATION COVERAGE

Trends in immunization coverage can be analyzed by comparing levels of coverage for different age groups. Since actual immunization dates are required for such an analysis, only health card information is used. This section examines trends in coverage for specific vaccines by age 12 months. Four age groups are included: 12-23 months, 24-35 months, 36-47 months, and 48-59 months. The findings provide insights into program performance during the five years preceding the survey.[2] Estimates of coverage are given for the whole population, using the procedure described in section 3.3 and 3.4.

Trends in BCG coverage by region are presented in Figure 4.6. Overall, BCG coverage is increasing, particularly in sub-Saharan Africa.

Polio coverage (that is, three doses of vaccine by age 12 months) is also increasing (see Figure 4.7). Large increases in the level of polio3 coverage were observed in East Africa and southern Africa from 1985 to 1989. In West Africa, with the exception of Ghana, there was little increase in the

level of polio3 coverage from 1984 to 1987. In Latin America, polio3 coverage is increasing, although there is considerable variation among the six countries.

Measles coverage is increasing, especially in North Africa, East Africa, southern Africa, and Asia (see Figure 4.8). Asian countries have only recently introduced measles vaccine to their immunization schedule, and a rapid increase in coverage was reported after 1985, particularly in Sri Lanka. In Latin America and West Africa the increase in measles coverage was moderate for the period 1983-1987. Figure 4.9 shows the proportion of children with a health card who received a measles vaccination at 9-11 months, by age group and region. The increasing proportion of children immunized on time (that is, according to the recommended schedule) indicates widespread improvements in immunization coverage.

4.4 COVERAGE DIFFERENTIALS

In this analysis of coverage differentials, data for children 12-23 months and 24-35 months were combined in order to increase the number of cases in different categories. (Card levels and coverage levels are fairly similar for both age groups.) Table 4.5 presents the differentials for ever-vaccinated children age 12-35 months, based on health card information and maternal recall. (The relative differentials are presented in Appendix A, Table A.2.)

[2] A simulation analysis of DHS immunization data showed that card loss can affect estimates of immunization coverage. Apparent increases in coverage over time may be due in part to loss of cards among children in older age groups, especially if the cards are discarded when children are fully immunized (see Rutstein et al., 1989).

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Figure 4.5 Percentage of children immunized at 2-4 months among children under five with DPT1 and percentage of children immunized at 4-6 months among children under five with DPT3, Demographic and Health Surveys, 1986-1989
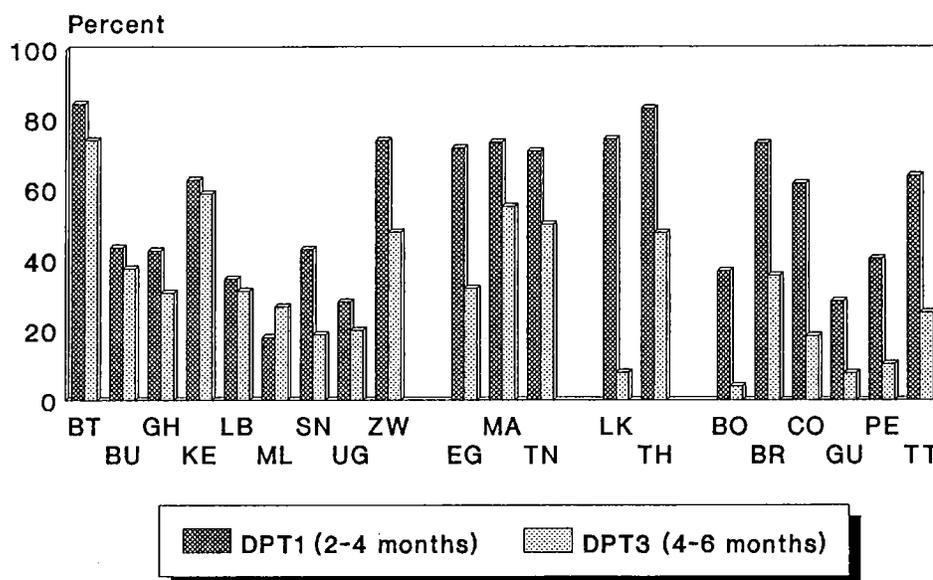
Note: Health card information only.

Table 4.4 Immunization coverage by 12 months: Percentage of children 12-23 months immunized by age 12 months, Demographic and Health Surveys, 1986-1989

Country	BCG	DPT3	Polio3	Measles	No. of Children
SUB-SAHARAN AFRICA					
Botswana	95	85	83	77	615
Burundi	70	48	51	43	663
Ghana	64	33	32	35	782
Kenya	84	73	75	60	1315
Liberia	47	15	13	27	817
Mali	19	8	6	7	554
Senegal	49	14	12	24	791
Uganda	59	28	28	34	946
Zimbabwe	91	76	76	75	630
NORTH AFRICA					
Morocco	77	54	54	45	1101
Tunisia	93	81	81	71	820
ASIA					
Sri Lanka	97	81	81	46	774
Thailand	81	54	57	34	759
LATIN AMERICA/CARIBBEAN					
Bolivia	37	13	20	33	1108
Brazil	65	60	64	64	578
Colombia	76	58	57	45	556
Guatemala	29	25	29	32	823
Peru	52	36	35	38	526
Trinidad & Tobago	a	60	58	1	380

Note: Egypt could not be included because recording of vaccination dates on birth certificates was incomplete.

a BCG not routinely administered

The largest differentials for children ever vaccinated are by place of residence, level of maternal education, and presence of a radio in the household (taken as an indicator of economic status). Urban coverage is higher than rural coverage in virtually all countries; likewise, households that have a radio show a higher level of coverage than those without a radio. The mother's level of education is a significant factor: children of mothers who have no formal education have the lowest level of coverage, while children of mothers with secondary education have the highest coverage. Generally, differentials based on fertility variables are smaller than those based on socioeconomic variables. However, in 12 countries, children of older mothers have lower coverage, and in 19 countries, children who are higher birth order are associated with lower coverage. There are no significant differentials according to the sex of the child. The coverage differentials for DPT1, DPT3, and measles are presented in tables 4.6-4.8. (The relative differentials are presented in Appendix A, tables A.3-A.5.) Differentials for the median coverage level of DPT3 (for all countries combined) are shown in Figure 4.10.

As a summary measure of differentials across countries, the medians of the relative coverage levels are presented in Table 4.9. The same procedure is used in Appendix A, tables A.3 (DPT1), A.4 (DPT3), and A.5 (measles).

It is important to be aware, as explained in section 3, that maternal recall data are not available for most countries, and therefore, this analysis of coverage differentials is based

Figure 4.6 Percentage of children who received a BCG immunization by age 12 months by region, Demographic and Health Surveys, 1983-1989
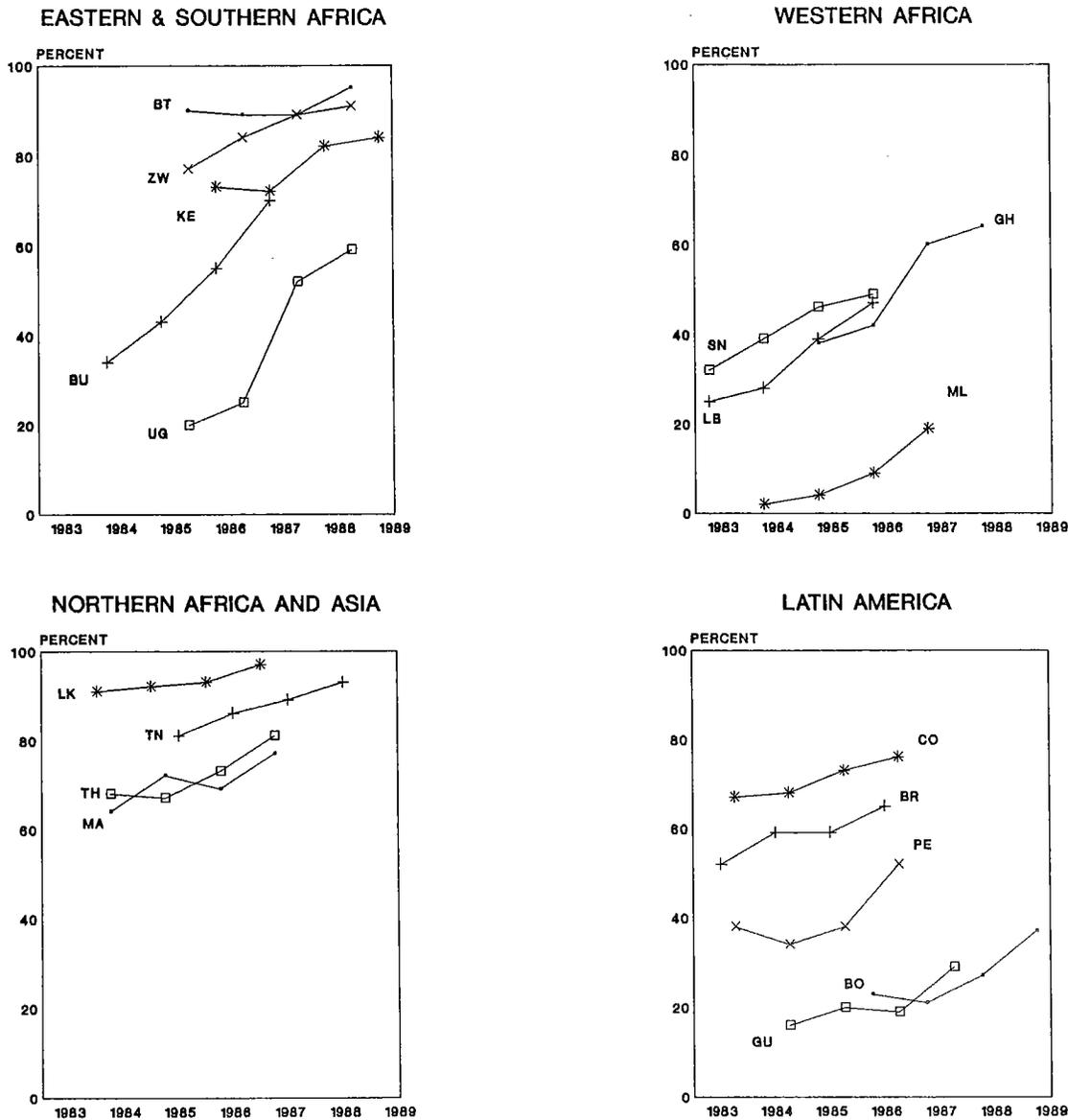
entirely on health card data. Coverage differentials based on health card data for DPT1, DPT3, and measles are consistent with differentials for ever-vaccinated children (see Table 4.9), however, since there are differences between children who have a health card and children who do not (see Table 3.2), the results of this analysis (of card data) should be interpreted with care.

children in households where a radio is not present. Coverage differentials are largest for Egypt, which may be related to the use of birth certificates to record immunizations rather than health cards. In all other countries the presence of a health card is correlated with receiving a first immunization (generally DPT1, polio1, or BCG), and differentials are small.

DPT1

Differences in coverage levels for DPT1 are small (see Table 4.6). Slightly lower levels are observed for rural children, children of mothers with no education, and

DPT3

Large differences in coverage are indicated for DPT3 (see Table 4.7 and Table 4.9). Coverage levels among rural children are lower in almost all countries; DPT3 coverage

Figure 4.7 Percentage of children who received a polio3 immunization by age 12 months by region, Demographic and Health Surveys, 1983-1989

EASTERN & SOUTHERN AFRICA

WESTERN AFRICA

NORTHERN AFRICA AND ASIA

LATIN AMERICA
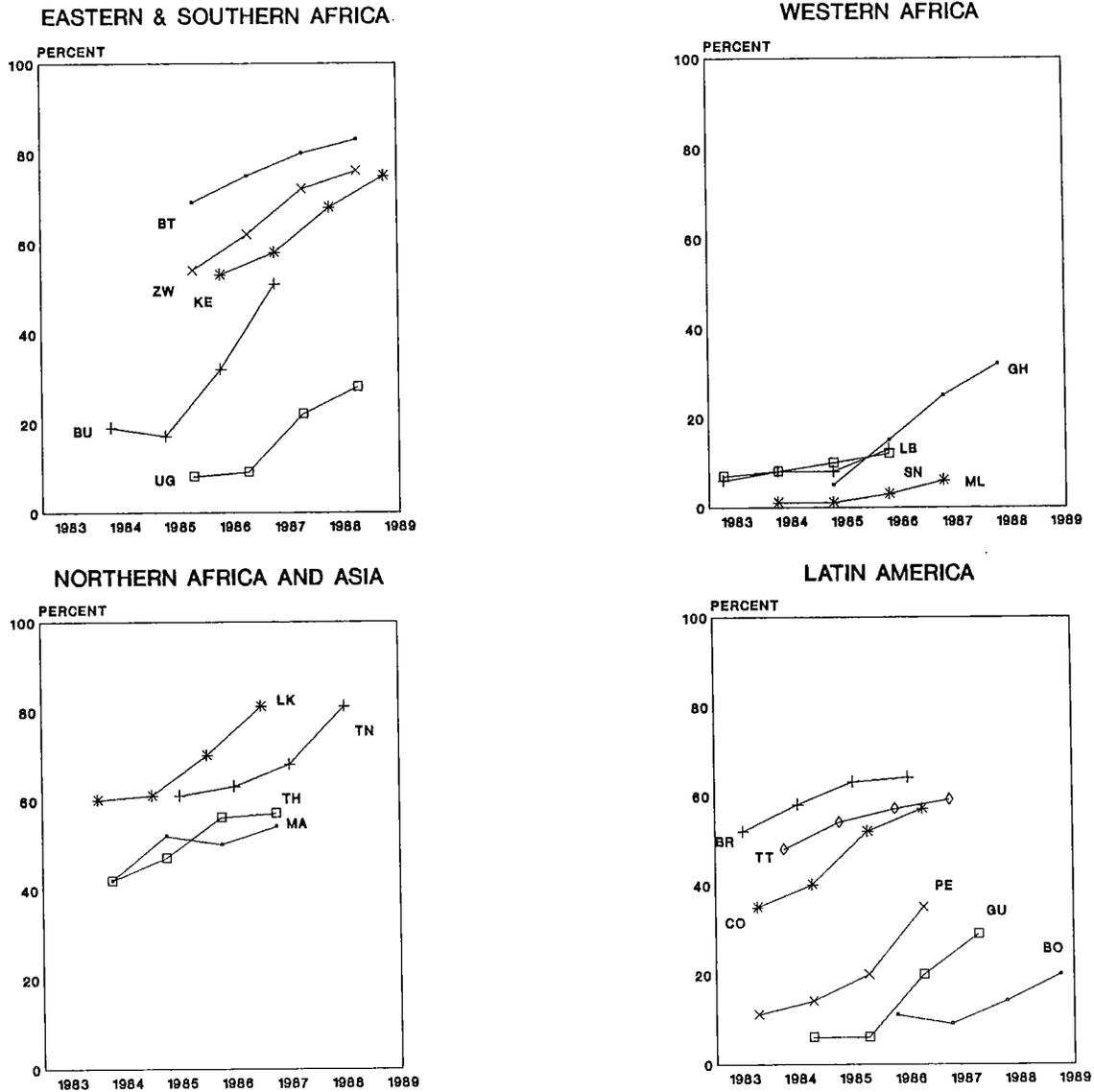
in nine countries is at least 15 percent below urban coverage. For all countries, coverage in households where there is no radio is lower than in households where a radio is present; in four countries the difference is more than 15 percent.

Differences according to education are large in most countries, particularly between children of mothers without education and children of mothers with secondary education: eleven DHS countries have differentials greater than 20 percent. In seven countries, however, the differentials were small.

Children of birth order six or higher have low levels of DPT3 coverage, whereas, first-born children have high levels

of coverage. If all countries are combined, older maternal age has no effect, but children of mothers under 20 have lower coverage levels. Length of the preceding birth interval and sex of the child have little effect in most countries, except in Mali, where coverage for girls is much lower (see Table 4.7).

MEASLES

Differences in levels of coverage for measles vaccine are shown in Tables 4.8 and 4.9. Generally, the differentials are similar to those for DPT3, but smaller in magnitude. Coverage levels for children of older mothers are lower than those for children of younger mothers.

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Figure 4.8 Percentage of children who received a measles immunization by age 12 months by region, Demographic and Health Surveys, 1983-1989

EASTERN & SOUTHERN AFRICA

WESTERN AFRICA

NORTHERN AFRICA AND ASIA

LATIN AMERICA
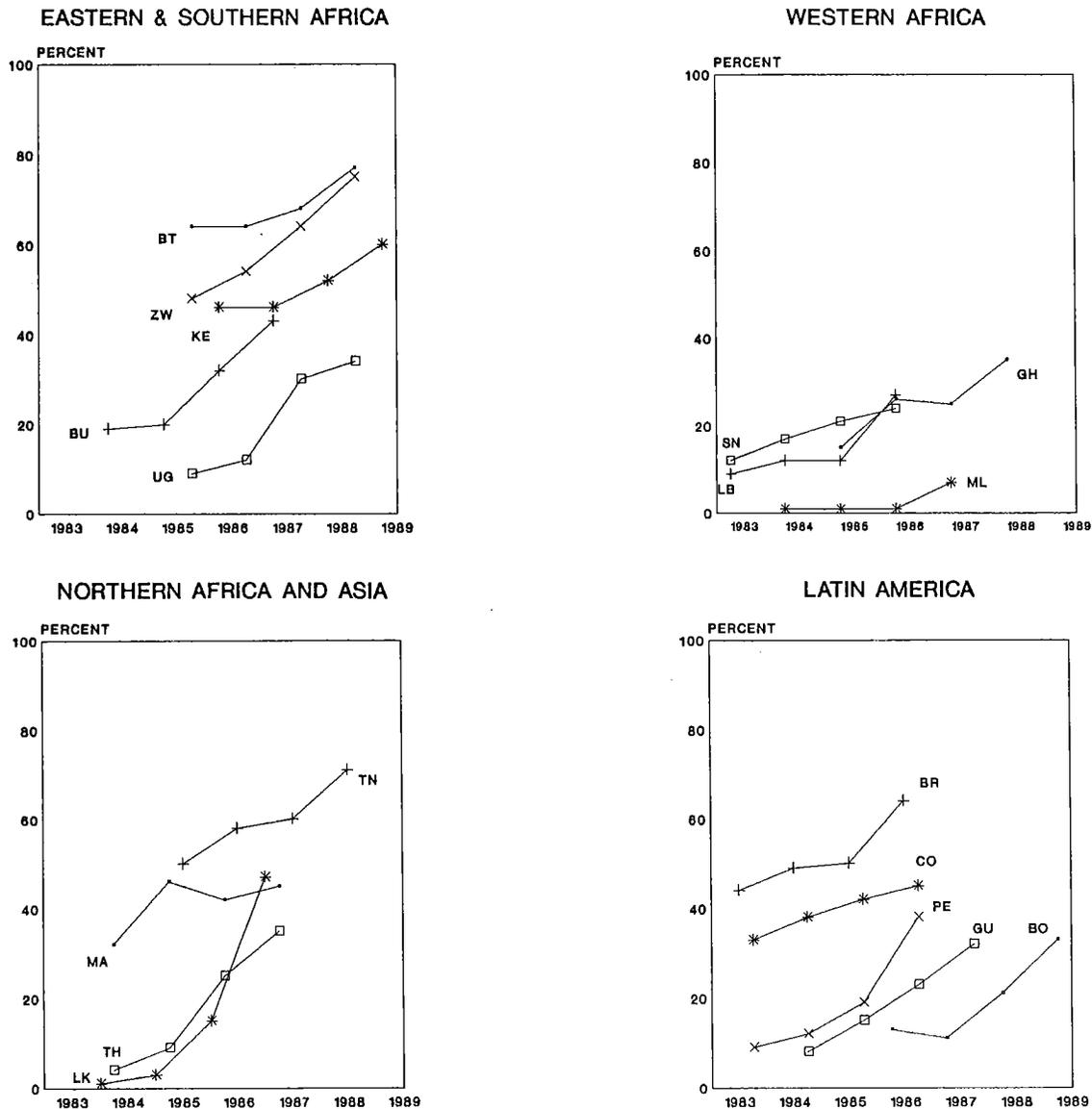
In addition to *whether* a child ever received a specific immunization, it is important to ascertain *when* the vaccination was received. Table 4.10 shows differentials in the timing of the measles immunization. (The relative differentials are presented in Appendix A, Table A.6.) The analysis is based on children 12-35 months with a health card, who received a measles vaccination at age 8-11 months.[3] (Table 4.9 summarizes the results for all surveyed countries.) The data indicate that, in general, the same differentials exist for timing of measles immunizations as for measles coverage; however, the timing differentials are larger than those for measles coverage, particularly regarding residence, maternal education, and higher birth order.

This analysis of coverage differentials has been limited to univariate analysis. Multivariate analysis would be useful for identifying the specific effects of residence, maternal education, and presence of a radio. The addition of country-specific variables (not possible here) would add greatly to the analysis and to the overall interpretation of findings.

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[3] Although measles vaccinations before 9 months of age is generally considered too early, the data are included here. First, the number of children immunized at 8 months is substantial (see Table 4.3), and including these children increases the number of cases available for analysis in Table 4.6. Second, children who are immunized against measles at age 9-11 months have characteristics similar to children immunized at 8 months.

Figure 4.9   Percentage of children with a health card who received a measles vaccination at 9-11 months by age group and region, Demographic and Health Surveys, 1986-1989

SUB-SAHARAN AFRICA

Legend: 36-59 months, 24-35 months, 18-23 months, 12-17 months

ASIA/NORTH AFRICA

Legend: 36-59 months, 24-35 months, 18-23 months, 12-17 months

LATIN AMERICA

Legend: 36-59 months, 24-35 months, 18-23 months, 12-17 months
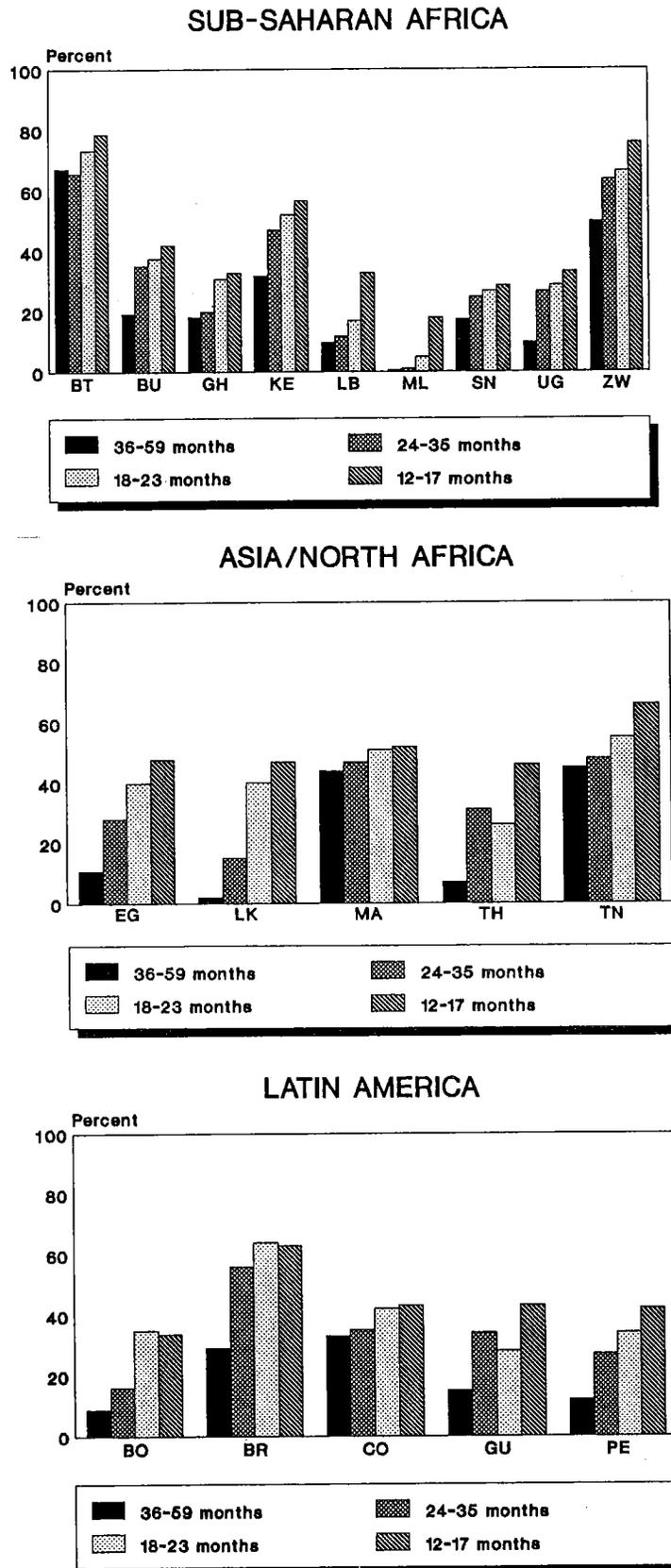
Table 4.5 Immunization coverage differentials: Percentage of children 12-35 months ever vaccinated, including health card information and maternal recall, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Age			Birth Order				Sex		Birth Interval (Months)				Radio		No. Children
	Urban	Rural	None	Pri	Sec+	<20	20-34	35+	1	2-3	4-5	6+	M	F	<24	24-35	36-47	48+	No	Yes	
SUB-SAHARAN AFRICA																					
Botswana	98	96	94	98	98	94	96	99	97	95	98	97	97	97	95	97	98	96	95	98	1195
Burundi	88	78	77	85	91	a	79	76	80	81	79	75	80	78	81	79	76	76	78	83	1431
Ghana	88	74	70	84	92	82	79	73	84	79	78	72	78	78	74	76	77	80	74	85	1534
Kenya	97	96	91	97	98	99	97	92	97	97	98	92	95	96	95	97	93	96	93	98	2694
Liberia	79	65	64	78	88	70	73	64	68	78	69	65	70	72	69	72	73	73	64	76	1577
Mali	76	30	37	66	a	42	45	34	42	41	45	42	41	43	41	46	39	39	31	52	1070
Senegal	87	57	64	85	97	64	69	65	74	69	69	63	71	65	68	67	65	68	57	71	1491
Togo	97	93	92	97	100	95	95	91	97	96	93	90	95	93	94	95	91	93	92	96	1128
Uganda	89	74	68	78	88	75	75	73	78	76	77	71	76	74	76	75	70	75	71	84	1784
Zimbabwe	98	95	96	95	98	98	96	95	96	96	97	95	96	96	94	95	97	97	95	97	1299
NORTH AFRICA																					
Egypt	98	92	91	97	99	90	95	94	96	96	94	91	96	93	92	95	94	95	†	†	3197
Morocco	97	77	82	98	99	80	85	83	86	87	83	82	85	84	85	82	83	87	77	86	2171
Tunisia	100	95	95	100	100	a	97	96	99	98	96	94	96	98	95	97	97	98	93	99	1244
ASIA																					
Sri Lanka	99	99	94	98	100	100	99	98	100	99	97	96	98	99	99	98	97	98	97	99	1550
Thailand	95	84	70	86	98	72	89	78	91	89	74	61	86	87	77	78	87	90	81	88	1448
LATIN AMERICA/CARIBBEAN																					
Bolivia	92	81	71	88	95	84	89	81	88	89	86	82	86	87	86	87	85	87	†	†	1227
Brazil	97	91	89	95	100	97	95	94	98	96	92	90	95	96	92	96	97	94	95	96	1192
Colombi	96	93	92	94	97	88	96	92	97	96	93	91	96	95	94	94	91	97	91	96	1063
Dominican Rep.	92	94	81	94	95	95	93	96	93	93	93	94	92	94	93	95	92	93	90	95	1635
Guatemala	90	84	79	92	97	87	87	81	89	87	84	83	86	85	84	84	82	92	81	89	1664
Mexico	99	96	94	98	100	97	98	98	98	97	99	98	99	97	98	96	97	100	†	†	2132
Peru	99	90	89	92	99	95	95	94	97	95	95	91	96	93	94	92	95	96	90	96	1092
Trinidad & Tob.	95	95	a	93	97	95	96	92	99	97	90	87	94	96	93	95	94	95	87	96	759

Note: Relative coverage levels are presented in Table A.2.

† Question not asked
a Less than 20 cases

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Table 4.6   Immunization coverage differentials for DPT1: Percentage of children 12-35 months with a health card who were immunized for DPT1, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Age			Birth Order				Sex		Birth Interval				Radio		No. of Children
	Urban	Rural	None	Pri	Sec+	<20	20-34	35+	1	2-3	4-5	6+	M	F	<24	24-35	36-47	48+	No	Yes	
SUB-SAHARAN AFRICA																					
Botswana	98	98	97	98	99	98	98	98	98	98	98	96	98	98	96	97	99	98	96	99	860
Burundi	97	95	96	93	89	a	94	96	95	94	94	97	94	96	93	95	96	95	95	96	814
Ghana	93	93	90	94	100	90	93	94	91	94	92	95	91	94	92	95	96	90	91	95	617
Kenya	98	98	97	99	97	98	98	100	99	98	99	98	98	99	97	98	98	99	98	99	1487
Liberia	87	84	68	62	91	91	85	82	83	87	89	81	86	85	88	81	87	86	85	86	624
Mali	92	86	91	96	a	a	91	98	88	86	92	93	92	88	94	89	84	91	86	92	134
Senegal	90	83	83	96	98	82	91	78	85	90	94	81	89	87	94	87	84	90	85	88	425
Uganda	98	96	96	96	100	96	96	97	95	97	96	96	95	97	96	96	99	95	96	96	887
Zimbabwe	99	97	98	98	98	98	98	97	96	99	98	97	98	98	98	97	99	99	97	99	990
NORTH AFRICA																					
Egypt	93	73	76	86	90	78	83	78	88	84	81	73	82	82	78	80	77	87	†	†	1843
Morocco	98	91	93	99	100	96	96	91	96	95	95	93	95	95	93	93	96	97	91	95	826
Tunisia	100	99	99	99	100	100	99	99	100	99	99	99	99	99	99	99	99	100	99	94	1244
ASIA																					
Sri Lanka	97	99	98	98	99	100	99	99	99	99	97	100	99	99	99	98	99	99	99	99	1245
Thailand	98	99	96	99	97	a	99	98	98	98	100	a	99	98	94	98	100	100	97	99	486
LATIN AMERICA/CARIBBEAN																					
Bolivia	91	91	82	92	93	86	91	95	91	90	92	92	91	91	88	91	88	97	†	†	490
Brazil	97	90	88	95	92	94	95	92	96	98	92	87	97	93	92	91	97	98	90	96	857
Colombia	100	98	95	99	100	100	99	100	100	99	99	99	99	99	99	98	100	100	99	99	560
Guatemala	96	97	96	97	95	95	97	95	97	97	96	97	97	97	98	96	96	97	95	97	942
Peru	95	89	92	90	96	77	94	93	94	91	95	92	92	94	92	89	93	96	94	92	433
Trinidad & Tob.	98	100	a	99	99	100	99	99	99	99	99	96	99	99	98	99	98	99	97	99	601

Note: Relative coverage levels are presented in Table A.3.

† Question not asked
a Less than 20 cases

Table 4.7 Immunization coverage differentials for DPT3: Percentage of children 12-35 months with a health card who were immunized for DPT3, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Age			Birth Order				Sex		Birth Interval (Months)				Radio		No. of Children
	Urban	Rural	None	Pri	Sec+	<20	20-34	35+	1	2-3	4-5	6+	M	F	<24	24-35	36-47	48+	No	Yes	
SUB-SAHARAN AFRICA																					
Botswana	97	96	94	98	97	98	96	96	97	95	99	95	97	96	93	97	96	97	93	98	860
Burundi	83	74	73	78	71	a	74	75	75	77	72	73	75	73	72	79	71	65	72	83	814
Ghana	73	57	56	64	91	55	62	69	65	62	64	63	63	64	56	62	66	63	61	67	617
Kenya	93	89	80	92	97	95	89	90	94	91	92	84	91	89	89	89	87	89	88	91	1487
Liberia	36	23	24	19	52	23	33	18	32	36	26	19	29	30	32	29	30	23	21	34	624
Mali	43	0	22	42	a	a	29	34	24	35	29	27	33	25	31	35	12	35	11	36	134
Senegal	49	8	26	51	63	18	37	34	33	38	41	30	36	35	35	35	37	44	17	39	425
Uganda	84	56	49	60	88	51	61	51	59	64	62	49	60	57	61	60	56	56	53	69	887
Zimbabwe	98	92	92	94	95	97	93	93	93	94	95	92	94	93	91	94	95	94	92	96	990
NORTH AFRICA																					
Egypt	86	62	63	79	84	58	74	70	80	75	69	64	73	72	69	67	70	79	†	†	1843
Morocco	95	71	79	96	99	79	85	77	84	87	85	77	82	84	83	79	82	91	79	84	826
Tunisia	97	88	89	97	98	a	93	93	97	93	93	89	95	91	91	92	92	95	90	94	1244
ASIA																					
Sri Lanka	90	95	91	89	97	95	94	93	97	93	93	86	94	94	93	91	92	94	90	96	1245
Thailand	89	85	88	86	87	a	85	94	90	82	87	a	84	88	71	92	85	83	77	89	486
LATIN AMERICA/CARIBBEAN																					
Bolivia	64	46	43	48	70	54	57	57	62	59	53	50	54	59	61	52	50	57	†	†	490
Brazil	88	70	65	82	95	77	83	77	89	86	79	59	85	79	74	76	82	86	67	87	857
Colombia	89	84	68	87	91	71	88	88	89	91	83	75	90	84	84	86	86	91	84	88	560
Guatemala	70	59	58	65	70	51	62	66	67	62	58	62	60	64	60	63	55	63	56	66	942
Peru	80	62	60	64	84	73	74	64	76	79	62	67	71	73	71	69	71	75	63	74	433
Trinidad & Tob.	84	87	a	85	86	84	85	89	87	87	85	78	85	86	85	84	90	84	79	86	601

Note: Relative coverage levels are presented in Table A.4.

† Question not asked
a Less than 20 cases

Table 4.8 Immunization coverage differentials for measles: Percentage of children 12-35 months with a health card and who were immunized for measles, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Age			Birth Order				Sex		Birth Interval (Months)				Radio		No. of Children
	Urban	Rural	None	Pri	Sec+	<20	20-34	35+	1	2-3	4-5	6+	M	F	<24	24-35	36-47	48+	No	Yes	
SUB-SAHARAN AFRICA																					
Botswana	95	94	91	96	96	95	95	93	95	95	95	92	95	94	88	96	94	95	91	96	860
Burundi	74	79	77	85	80	a	77	82	79	76	77	83	79	78	78	79	80	75	78	82	814
Ghana	73	69	68	69	93	65	71	69	71	71	72	68	68	72	68	67	72	72	68	74	617
Kenya	84	79	66	81	91	80	79	78	86	82	80	72	80	78	79	77	77	79	76	81	1487
Liberia	69	69	68	62	78	66	70	65	71	70	69	66	68	71	66	61	75	77	69	69	624
Mali	73	85	77	76	a	a	80	79	76	70	80	80	76	78	78	79	72	75	88	72	134
Senegal	68	61	62	70	78	64	66	64	61	69	75	57	65	66	70	62	73	73	66	59	425
Uganda	85	74	73	73	93	69	76	71	75	79	75	70	76	74	75	74	72	80	73	78	887
Zimbabwe	96	92	92	93	95	100	92	94	94	92	96	92	93	93	92	93	93	95	92	95	990
NORTH AFRICA																					
Egypt	88	63	65	80	87	60	75	71	80	77	71	65	74	74	70	70	70	82	†	†	1843
Morocco	87	71	76	85	95	71	81	72	84	79	81	74	79	79	77	79	76	80	73	81	826
Tunisia	94	89	89	94	98	83	92	92	93	92	93	88	93	91	90	91	94	94	90	93	1244
ASIA																					
Sri Lanka	63	70	58	62	73	74	70	64	77	67	63	50	69	68	61	61	66	73	60	72	1245
Thailand	61	52	73	52	63	a	54	57	64	49	42	a	52	57	34	43	56	50	51	56	486
LATIN AMERICA/CARIBBEAN																					
Bolivia	77	77	69	70	87	79	79	67	79	79	80	67	76	78	81	74	76	75	†	†	490
Brazil	87	77	76	85	88	84	84	83	88	87	83	71	86	82	79	80	84	89	90	96	857
Colombia	82	73	72	77	83	57	80	79	84	81	70	71	80	78	76	69	85	81	66	81	560
Guatemala	82	77	76	81	73	78	78	78	85	77	75	78	81	76	76	80	74	74	74	81	942
Peru	89	79	77	83	89	64	86	84	87	85	80	85	85	85	75	87	88	88	82	85	433
Trinidad and Tob.	52	41	a	46	45	61	45	45	55	43	42	35	42	49	42	41	48	41	36	47	601

Note: Rlative coverage levels are presented in Table A.5.

† Question not asked
a Less than 20 cases

Figure 4.10 Differentials for median coverage of DPT3, children 12-35 months with health cards, selected DHS surveys (combined), 1986-1989
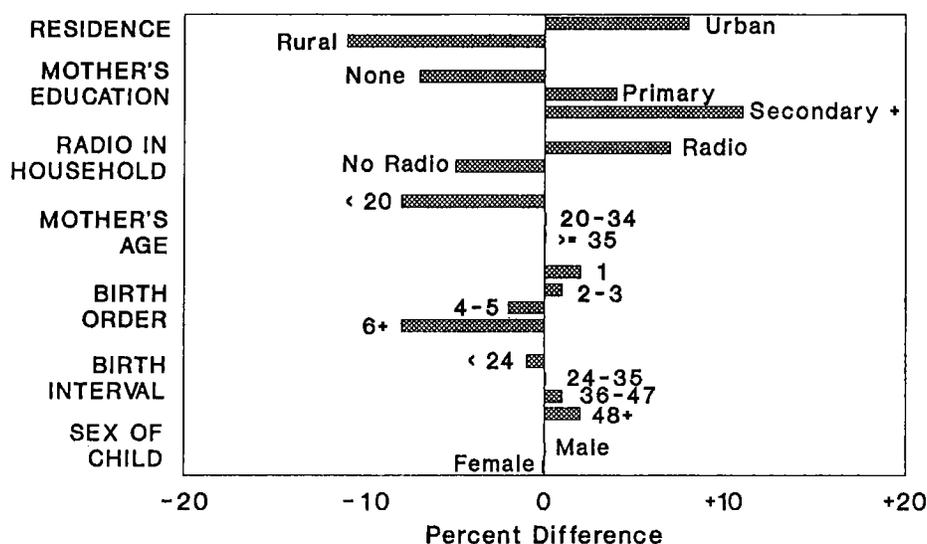
Note: Overall DPT3 coverage Is 78 percent.

Table 4.9 Medians of the relative coverage levels for all countries combined: Among all children 12-35 months, the relative level of the median proportion ever vaccinated, and among children 12-35 months with health cards, the median of the coverage levels for DPT1, DPT3, measles, and measles at <12 months of age, Demographic and Health Surveys, 1986-1989

Variable	Category	Ever Vaccinated	DPT1	DPT3	Measles	Measles <12 Months
Residence	Urban	100	100	100	100	100
	Rural	94	98	82	94	90
Female	None	92	99	90	94	86
Education	Primary	100	100	100	100	100
	Secondary +	104	101	107	109	120
Mother's Age	<20	99	100	92	98	101
	20-34	100	100	100	100	100
	35+	96	100	100	98	94
Birth Order	1	100	100	100	100	100
	2-3	99	100	100	97	92
	4-5	98	100	96	96	91
	6+	94	99	90	92	81
Birth Interval	<24 Months	98	100	98	99	99
	24-35	100	100	100	100	100
	36-47	99	101	101	102	101
	40+	100	102	102	106	104
Sex	Male	100	100	100	100	100
	Female	100	100	100	100	98
Radio Present	Yes	100	100	100	100	100
	No	94	98	89	94	94

Note: For each variable, the relative coverage level is given as a ratio of the level of coverage for one category of the variable.

Table 4.10 Differentials in the timing of measles immunization: Percentage of children 12-35 months with a health card who were immunized for measles at age 8-11 months, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Age			Birth Order				Sex		Birth Interval (Months)				Radio		No. of Children
	Urban	Rural	None	Pri	Sect+	<20	20-34	35+	1	2-3	4-5	6+	M	F	<24	24-35	36-47	48+	No	Yes	
SUB-SAHARAN AFRICA																					
Botswana	84	79	69	83	90	81	81	75	84	82	76	77	81	79	78	79	81	77	75	83	812
Burundi	ª	55	55	56	ª	71	57	52	59	55	55	55	55	57	58	57	53	46	52	67	639
Ghana	44	42	37	44	59	60	41	44	49	40	46	37	42	44	42	43	41	37	43	43	434
Kenya	75	71	65	71	78	82	72	68	75	74	70	67	73	70	72	73	62	71	70	73	1176
Liberia	35	32	28	32	48	28	33	35	35	28	33	40	37	30	38	35	29	30	32	34	431
Mali	16	2	8	17	ª	ª	11	ª	ª	10	30	31	14	8	ª	10	ª	ª	8	12	103
Senegal	53	28	44	32	70	39	45	51	48	47	40	47	46	45	37	45	41	63	26	49	279
Uganda	61	43	44	44	56	47	46	41	48	45	48	40	46	44	46	45	47	36	43	48	663
Zimbabwe	83	74	65	78	84	86	76	76	85	77	73	72	77	76	69	70	80	83	75	79	922
NORTH AFRICA																					
Egypt	73	66	62	69	84	69	71	65	75	73	67	58	70	70	66	66	72	72	†	†	1056
Morocco	78	53	63	77	81	ª	67	65	72	68	68	61	69	65	67	63	63	72	69	67	769
Tunisia	74	60	61	74	79	ª	69	65	77	70	62	58	67	69	63	66	63	71	63	70	1143
ASIA																					
Sri Lanka	53	46	35	45	48	62	47	40	53	44	43	30	45	48	40	41	51	44	45	47	856
Thailand	56	73	ª	71	59	ª	67	64	72	64	ª	ª	73	63	ª	65	65	67	70	67	265
LATIN AMERICA/CARIBBEAN																					
Bolivia	39	28	37	30	38	30	37	23	47	25	36	34	35	34	36	27	30	26	†	†	378
Brazil	75	67	69	70	84	57	74	71	75	75	69	61	73	72	63	67	77	80	59	76	721
Colombia	56	55	53	50	64	68	56	54	65	51	61	37	55	56	53	52	61	45	55	56	441
Guatemala	50	44	42	51	44	39	49	38	45	54	44	37	45	47	45	46	44	51	43	48	737
Peru	50	31	26	38	51	ª	43	39	57	45	33	30	42	42	32	30	37	56	30	45	366

Note: Only children who have a health card on which the measles vaccination date is recorded are included. Relative coverage levels are presented in Table A.6.

† Question not asked
ª Less than 20 cases

4.5 COMPARISON OF DHS AND OTHER COVERAGE DATA

Both the World Health Organization (WHO) and UNICEF regularly publish national statistics on immunization coverage (see for example, World Health Organization, 1989; UNICEF, 1989). These statistics are based on coverage surveys and data from health facilities where vaccinations are given. The coverage surveys are carried out using the survey methodology recommended by WHO (Henderson and Sundaresan, 1982). The survey sample consists of 30 clusters selected with probability proportional to the population size. In each cluster the first household is randomly chosen and, to reduce survey costs, all subsequent households are selected from neighboring households until at least seven children in a selected age group are identified. With this method, the level of immunization coverage can be estimated +/- 10 percentage points (Lemeshow et al., 1985).

This type of survey is carried out in many countries, although critics consider the resulting estimates to be too high. Their main argument is that the sample is biased by the overrepresentation of households located near health (or immunizing) facilities. Also, interviews are often conducted by health workers, which may introduce an additional bias into the survey.

In the absence of sample surveys, information from immunizing clinics is used to estimate coverage levels. Data from health information systems, however—including reports of numbers of vaccinations given at health facilities—are rarely complete, and assumptions have to be made in order to estimate national coverage levels from such data.

Since DHS surveys are based on nationally-representative samples, they can be used to validate official estimates of coverage. For this comparison, only recent DHS surveys are used, and the period covered by the survey is either during or after the period referred to by official estimates.

Ideally, the comparison should be limited to immunization status by age 12 months. Data from health facilities are classified by age and allow for estimates of coverage by 12 months of age. However, most coverage surveys report coverage for children 12-23 months, and do not consider age at immunization. Table 4.11 shows coverage at 12-23 months.

For most countries, although the periods covered by the surveys are sometimes different, there is close agreement between the DHS survey data and data from the cluster-sample surveys. This suggests that the cluster-sample surveys are effective in providing accurate estimates of coverage levels. This is not the case regarding data from the health facilities in these countries. When compared with coverage estimates from DHS surveys, national estimates based on statistics from health facilities are consistently higher, suggesting that estimates based on such statistics produce overestimates of national coverage. In the case of Egypt, the large discrepancy between the DHS coverage estimate and the estimate based on the national health information system may be due to inaccuracies in both estimates.

Table 4.11 Comparison of DHS and WHO coverage data: Percentage of children 12-23 months who received specific vaccina-
tions, according to DHS survey data and World Health Organization national statistics, selected countries,
1987-1989

Country	Data Source	Source and Year	BCG	DPT3	OPV3	Measles	No. of Children
Bolivia	DHS Feb-Jul 1988		55	28	38	58	1108
	WHO 1988	R	27	39	40	44	NA
Botswana	DHS Aug-Dec 1988		95	88	86	87	615
	WHO 1988	S 87	99	86	88	91	425
Burundi	DHS Apr-Jul 1987		77	55	57	59	663
	WHO 1987	R	84	69	45	55	NA
Egypt	DHS Oct-Jan 1989		70	66	66	76	1593
	WHO 1988	R	80	87	87	84	NA
Ghana	DHS Feb-May 1988		69	42	41	51	782
	WHO 1988	S 87	71	37	34	40	209
Kenya	DHS Dec-May 1989		93	82	82	72	1315
	WHO 1988	S 87	86	75	75	60	2451
Tunisia	DHS Jun-Oct 1988		95	88	88	78	759
	WHO 1988	R	85	91	91	83	NA
Uganda	DHS Sep-Feb 1989		70	38	38	49	946
	WHO 1988	S 87 +R	74	40	40	48	NA
Zimbabwe	DHS Sep-Jan 1989		94	86	86	79	630
	WHO 1988	S 88	97	79	78	83	NA

S = Survey data
R = Reported data
NA = Not available

5 Tetanus Toxoid Immunization

The goal of most countries is to give two doses of tetanus toxoid (TT) during pregnancy to protect the newborn against tetanus. After the first two doses only one booster is required during subsequent pregnancies, and five TT vaccinations are thought to give lifetime protection. In the DHS surveys, mothers were asked, for each child born in the last five years, if they received an injection to prevent tetanus (prior to the birth). No documentary evidence was required (such as an antenatal card), and no information was collected on the number of doses.

Tetanus toxoid coverage is presented in Table 5.1. In five countries—Botswana, the Dominican Republic, Kenya, Sri Lanka, and Zimbabwe—more than 75 percent of the births in the preceding five years were to women who had received at least one dose of tetanus toxoid. Coverage levels are below 50 percent in twelve countries, nine of which are in Latin America and the Caribbean.

The immunization of pregnant women with tetanus toxoid vaccine is a basic component of good antenatal care. Thus, whether a women received at least one tetanus toxoid injection generally depends on whether she received antenatal care and the level (or quality) of the care given. Table 5.2 shows, however, that many women reported that they had received a TT vaccination but had not received antenatal care. In Bolivia, Guatemala, Mali, and Senegal more than one-quarter of the women who reported receiving a TT injection for a pregnancy in the last five years had not seen anyone for antenatal care during the same pregnancy. In some instances, the TT immunizations may have been given during immunization campaigns; however, the discrepancy may also reflect problems of data quality. Women may have misunderstood the questions on TT injections and antenatal care, or, they may have reported other types of injections received during pregnancy—such as antibiotics, chloroquine, or iron—as TT injections.

The differentials for tetanus toxoid coverage are presented in Table 5.2. (The relative differentials are presented in Appendix A, Table A.7.) As with children's vaccinations, the level of TT coverage is lower in rural areas, lower for births to mothers without formal education, and lower in families where a radio is not present. The differentials are large, particularly in regard to maternal education, but there is considerable variation between countries.

Tetanus toxoid coverage is higher among younger mothers (15-19) than older mothers, but again, this varies greatly (see Table 5.2). In all but five countries, TT coverage is higher for first births than for higher order births. Finally, the length of the preceding birth interval appears to have an effect. With the exception of Latin America, TT coverage is usually lower if the birth interval is less than 18 months.

In most countries, tetanus toxoid coverage has increased moderately in the last five years. Table 5.3 shows the level of TT coverage for births that took place 0-11 months, 12-23 months, 24-35 months, 36-47 months, and 48-59 months before the survey. Substantial increases occurred in Colombia, Tunisia, and Uganda. Slight increases (less than 5 percent in five years) or actual declines in TT coverage took place in ten countries.

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Table 5.1 Tetanus toxoid coverage: Percentage of births to women in the last five years who received a tetanus toxoid (TT) vaccination, and TT coverage differentials, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Percentage of Births to Women Who Received TT	Residence		Education			Radio		Mother's Age							Birth Order				Birth Interval (Months)					No. of Births
		Urban	Rural	None	Pri.	Sec+	No	Yes	15-19	20-24	25-29	30-34	35-39	40-44	45-49	1	2-3	4-5	6+	<18	18-23	24-35	36-47	48+	
AFRICA																									
Botswana	85	79	85	76	87	91	81	87	83	85	86	84	83	88	77	84	85	86	82	87	82	82	84	88	3177
Burundi	59	91	58	57	67	84	57	69	75	66	64	57	50	57	52	68	58	55	57	55	57	58	58	53	3841
Ghana	70	81	65	60	77	84	65	77	67	72	70	69	72	65	60	73	69	69	68	56	64	68	71	74	4089
Kenya	89	92	88	85	89	93	86	91	85	90	89	90	89	83	85	90	89	90	87	90	87	88	88	89	7050
Liberia	71	77	68	67	75	84	64	76	71	75	74	69	66	64	60	73	75	68	67	68	77	71	68	70	3080
Mali	18	52	7	14	41	82	7	28	21	17	20	20	17	14	8	20	19	17	18	14	16	21	16	17	3390
Senegal	31	54	19	27	48	62	22	34	22	31	34	33	29	27	33	32	34	31	26	30	28	33	27	33	4253
Togo	70	88	64	64	82	87	62	80	68	74	70	70	72	66	57	75	72	69	65	65	61	70	69	72	3098
Uganda	56	75	54	50	58	72	52	65	61	58	56	53	51	51	65	60	57	54	51	47	52	56	55	55	5004
Zimbabwe	79	81	78	74	80	80	76	82	81	83	80	77	76	73	68	81	81	78	74	72	73	79	80	78	3334
NORTH AFRICA																									
Egypt	11	11	13	9	13	15	†	†	17	12	12	11	10	9	6	14	11	10	10	8	8	11	11	12	8624
Tunisia	33	31	35	28	41	35	29	35	48	40	36	32	28	25	17	40	33	32	22	26	29	30	30	32	4435
ASIA																									
Sri Lanka	86	87	86	76	85	89	85	87	83	86	85	87	88	87	84	87	86	86	83	75	81	87	84	90	3965
Thailand	65	66	63	47	67	72	60	68	66	70	70	64	53	46	59	71	66	53	38	43	58	48	64	69	3631
LATIN AMERICA/CARIBBEAN																									
Bolivia	20	26	15	9	19	30	†	†	22	22	22	20	16	16	13	23	20	19	17	18	16	18	21	21	5764
Brazil	41	43	36	33	41	43	40	41	44	39	39	40	46	42	a	42	39	38	43	37	39	43	42	37	3463
Colombia	39	38	41	40	37	42	39	39	49	40	40	39	35	31	14	42	39	34	33	34	34	32	33	44	2671
Dominican Republic	87	88	86	76	87	92	85	89	86	89	88	86	84	86	77	89	89	83	82	84	86	84	87	88	4401
Ecuaor	38	43	34	22	37	47	39	38	42	44	37	39	36	25	29	40	42	36	32	43	36	37	32	39	3031
Guatemala	14	16	13	10	18	12	13	14	20	14	14	13	12	11	a	15	14	13	12	14	14	13	13	15	4581
Peru	15	22	8	7	13	22	13	16	22	20	16	14	11	11	12	19	18	11	12	13	15	12	11	19	3106
Trinidad & Tobago	31	29	32	58	32	29	27	31	34	26	36	29	32	26	25	28	31	34	39	35	34	31	31	33	1929

Note: Relative coverage levels are presented in Table A.7.

† Question not asked
a Less than 20 cases

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Table 5.2 Tetanus toxoid coverage and antenatal care: Among women who gave birth in the last five years, the number of births whose mothers received a tetanus toxoid (TT) vaccination, and the precentage of births whose mothers received a TT vaccination with and without antenatal care (ANC), Demographic and Health Surveys, 1986-1989

Country	Number of Births With TT	Among Births with TT, the Percentage: With ANC	Without ANC
SUB-SAHARAN AFRICA			
Botswana	2700	98	2
Burundi	2266	99	1
Ghana	2862	97	3
Kenya	6275	83	17
Liberia	2187	96	4
Mali	610	63	37
Senegal	1318	53	47
Togo	2169	78	22
Uganda	2802	90	10
Zimbabwe	2634	100	0
NORTH AFRICA			
Egypt	949	93	7
Tunisia	1464	83	17
ASIA			
Sri Lanka	3410	99	1
Thailand	2360	95	5
LATIN AMERICA/CARIBBEAN			
Bolivia	1153	72	28
Brazil	1420	90	10
Colombia	1042	87	13
Dominican Republic	3829	98	2
Ecuador	1152	90	10
Guatemala	641	70	30
Peru	466	89	11
Trinidad & Tobago	598	98	2

Table 5.3 Trends in tetanus toxoid vaccination: Percentage of births one to five years prior to the survey, for whom women received a TT vaccination, and percentage of change during that period, Demographic and Health Surveys, 1986-1989

	Year of Survey	Years Prior to the Survey					% of Change
		1	2	3	4	5	
SUB-SAHARAN AFRICA							
Botswana	1988	86	85	84	84	82	+ 4
Burundi	1987	68	66	59	51	51	+17
Ghana	1988	73	70	70	69	66	+ 7
Kenya	1988/89	89	90	89	88	87	+ 2
Liberia	1986	71	72	68	69	79	- 8
Mali	1987	18	20	17	19	18	0
Senegal	1986	31	33	32	28	31	0
Togo	1988	72	74	69	69	67	+ 5
Uganda	1988/89	68	64	51	49	44	+24
Zimbabwe	1988/89	80	82	80	77	76	+ 4
NORTH AFRICA							
Egypt	1988/89	16	14	10	9	9	+ 7
Tunisia	1988	46	39	32	27	23	+23
ASIA							
Sri Lanka	1987	82	86	86	87	90	- 8
Thailand	1987	70	69	32	27	23	+12
LATIN AMERICA/CARIBBEAN							
Bolivia	1989	31	21	18	16	14	+17
Brazil	1986	38	40	44	38	42	- 4
Colombia	1986	48	46	36	37	27	+21
Dominican Republic	1986	85	88	87	86	90	- 5
Ecuador	1987	39	43	40	36	34	+ 5
Guatemala	1987	22	14	14	10	9	+13
Peru	1986	20	16	16	13	13	+ 7
Trinidad & Tobago	1987	28	31	31	31	33	- 5

6 Summary and Conclusions

The DHS surveys provide a new source of information on immunization coverage in developing countries. In these surveys mothers were asked to show the health (vaccination) cards for their children under five; the interviewer copied the vaccination dates for BCG, DPT, polio, and measles directly onto the questionnaire. Using this information, supplemented by maternal recall (mothers' reports for children whose health cards were not presented), it is possible to estimate levels of immunization coverage, trends, and differentials in a manner comparable across countries.

The report includes a description of the methodology used for estimating national levels of immunization coverage. For these estimates certain assumptions were required regarding coverage levels among ever-vaccinated children who did not have a health card. The use of tetanus toxoid vaccine for pregnant mothers was also ascertained in the DHS surveys.

Levels of coverage vary substantially in the 21 countries included in this analysis. Countries which have a strong national immunization program typically have high measles coverage and low dropout rates (between the first and third dose) for DPT and oral polio vaccine. Measles coverage among children 12-23 months varies greatly, from less than 30 percent in Mali to more than 80 percent in Botswana and Zimbabwe. Dropout rates for DPT range from more than 50 percent in Guatemala, Liberia, Mali, and Senegal to less than 10 percent in Botswana, Sri Lanka, Tunisia, and Zimbabwe.

In all 21 countries surveyed, the trend is toward increasing levels of immunization coverage. Most vaccines showed an increase for the period 1985-1988. The increase appears to be larger in Africa than in Latin America; however, the surveys in Latin America were implemented a year earlier (1986-1987) than those in Africa (1987-1988).

Coverage differentials are present in all countries, but are larger in countries with low overall coverage. Coverage is substantially lower in rural areas, among children of mothers with no education, and in households that do not have a radio (an indicator of socioeconomic status). Children of birth order 6 or higher also have lower levels of coverage. Differentials are most pronounced for the three-dose vaccines, due to the high dropout rate. Differentials in the time at which immunizations are given indicate that by the age of 12 months, urban children, children of mothers with formal education, and first-born children are likely to have received measles immunization; however, rural children, children of mothers with no education, and children of higher birth orders who receive a measles vaccination, are more likely to obtain it after 12 months of age.

The target of 80 percent immunization coverage by 1990, for all children at their first birthday, will be reached by only a few of the countries included in this report. Those most likely to attain this level of coverage are Botswana, Brazil, Colombia, Kenya, Peru, Sri Lanka, Tunisia, and Zimbabwe.

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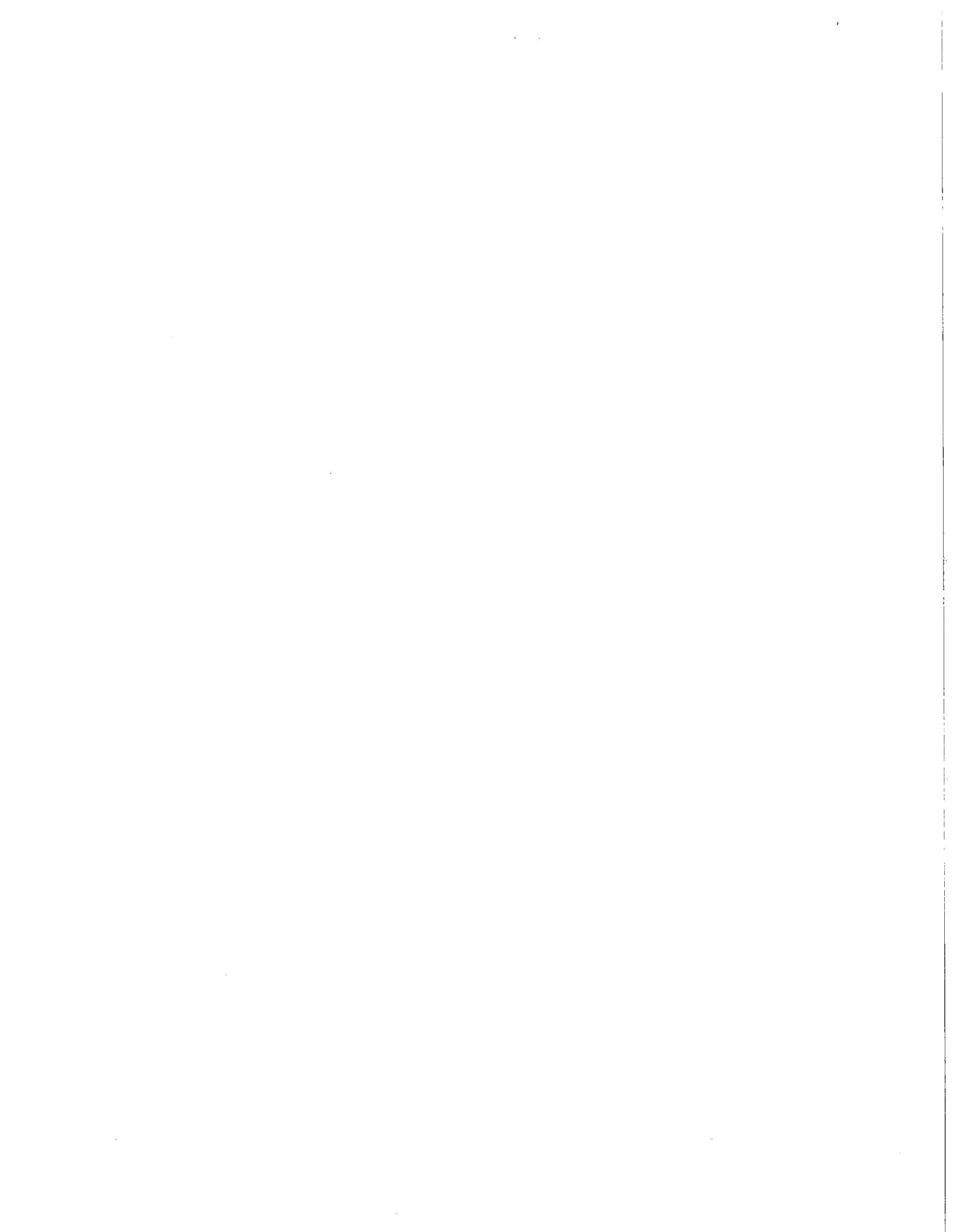
Appendix A

Relative Differentials in Immunization Coverage

Appendix A presents the relative differentials in immunization coverage for selected sociodemographic characteristics. Coverage levels have been standardized in all tables in order to facilitate assessment of the differences in immunization coverage.

In Table A.1, the overall health card level for each country (i.e., mothers were able to present child health cards to the interviewer) is set at 100 and subgroup levels are expressed relative to the overall level (e.g., the health card level for urban Botswana is 94 percent of the overall national level). In the rest of the tables (A.2-A.7) one of the subgroups is designated as the reference category and set at 100 (e.g., in Table A.3, DPT1 coverage for rural Botswana is 99 percent of coverage for urban Botswana).

Table A.1 Differentials in relative health card levels: Relative health card levels for children 12-23 months by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence Urban	Residence Rural	Education None	Education Pri	Education Sec+	Birth Order 1	Birth Order 6+	Mother's Age <20	Mother's Age >=35	Sex M	Sex F	% of Children With a Card	No. of Children
SUB-SAHARAN AFRICA													
Botswana	94	102	104	102	90	96	119	95	116	99	101	74	614
Burundi	a	100	98	107	a	102	102	a	104	103	97	64	663
Ghana	145	83	80	110	163	110	91	91	89	95	105	40	782
Kenya	80	103	86	108	93	95	86	115	82	103	96	61	1315
Liberia	106	96	88	117	126	89	96	93	93	93	108	43	817
Mali	253	42	82	190	a	168	56	155	55	102	98	12	554
Senegal	187	53	79	176	228	116	89	74	77	101	99	30	791
Uganda	115	99	90	104	122	102	94	85	107	104	97	49	946
Zimbabwe	92	103	107	103	86	91	100	93	98	99	101	78	629
NORTH AFRICA													
Egypt	100	100	94	105	100	97	92	99	96	100	100	61	1593
Morocco	136	80	94	145	102	107	91	111	90	102	98	50	1101
Tunisia	106	94	95	105	103	105	88	a	92	100	100	77	820
ASIA													
Sri Lanka	104	100	80	96	105	104	99	110	101	102	98	82	774
Thailand	152	89	45	94	160	104	95	64	64	104	95	36	759
LATIN AMERICA/CARIBBEAN													
Bolivia	121	81	65	90	141	138	80	76	78	102	99	23	1108
Brazil	104	92	87	101	105	112	88	100	90	97	103	74	578
Colombia	105	90	87	97	107	104	94	79	83	99	101	55	556
Dominican Republic	133	56	33	70	176	135	28	72	72	95	105	18	864
Guatemala	95	102	92	109	104	87	101	81	102	101	99	56	823
Peru	106	93	80	104	103	99	101	86	91	99	101	43	526
Trinidad & Tobago	96	103	a	96	104	105	84	100	94	98	102	79	380

Note: Health card level refers to the percentage of children for whom a health card was presented at the time of the interview. The card level for all children 12-23 months in each country is set at 100.

a Less than 20 cases

Table A.2 Immunization coverage differentials: Relative levels of immunization coverage for ever-vaccinated children 12-35 months, including health card information and maternal recall, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Age			Birth Order				Sex		Birth Interval (Months)				Radio		No. of Children
	Urban	Rural	None	Pri	Sec+	<20	20-34	35+	1	2-3	4-5	6+	M	F	<24	24-35	36-47	48+	No	Yes	
SUB-SAHARAN AFRICA																					
Botswana	100	98	96	100	101	97	100	102	100	99	102	100	100	100	98	100	102	99	97	100	1195
Burundi	100	89	90	100	106	a	100	96	100	100	99	93	100	97	102	100	95	96	93	100	1431
Ghana	100	84	83	100	110	104	100	92	100	94	93	86	100	100	97	100	102	105	87	100	1534
Kenya	100	99	93	100	101	102	100	95	100	101	102	96	100	101	97	100	96	99	95	100	2694
Liberia	100	81	82	100	112	96	100	88	100	114	102	96	100	103	97	100	102	102	84	100	1577
Mali	100	39	56	100	a	93	100	75	100	98	106	99	100	104	88	100	83	85	59	100	1070
Senegal	100	65	75	100	114	92	100	94	100	93	93	84	100	93	102	100	97	101	80	100	1491
Togo	100	96	94	100	103	100	100	96	100	100	96	94	100	98	99	100	97	98	97	100	1128
Uganda	100	83	87	100	112	99	100	97	100	98	100	91	100	98	101	100	93	100	85	100	1784
Zimbabwe	100	97	102	100	104	102	100	100	100	101	101	99	100	100	98	100	102	102	97	100	1299
NORTH AFRICA																					
Egypt	100	94	94	100	102	95	100	99	100	100	98	95	100	97	97	100	99	100	†	†	3197
Morocco	100	80	84	100	101	94	100	97	100	100	96	94	100	99	104	100	101	106	90	100	2171
Tunisia	100	95	95	100	100	a	100	98	100	99	97	95	100	101	98	100	100	101	95	100	1244
ASIA																					
Sri Lanka	100	100	96	100	102	101	100	100	100	99	97	96	100	102	100	100	99	99	98	100	1550
Thailand	100	88	81	100	114	81	100	88	100	97	81	67	100	102	98	100	111	115	92	100	1448
LATIN AMERICA/CARIBBEAN																					
Bolivia	100	88	80	100	107	95	100	92	100	101	98	94	100	101	98	100	98	99	†	†	2127
Brazil	100	94	93	100	105	102	100	98	100	98	93	92	100	101	96	100	102	98	99	100	1192
Colombia	100	96	97	100	103	91	100	96	100	100	96	94	100	99	99	100	97	103	94	100	1063
Dominican Rep.	100	102	86	100	101	102	100	103	100	99	99	101	100	102	98	100	98	99	94	100	1635
Guatemala	100	94	86	100	106	100	100	93	100	98	95	93	100	99	99	100	97	109	92	100	1664
Mexico	100	97	96	100	102	99	100	100	100	98	101	100	100	99	102	100	100	104			2132
Peru	100	91	96	100	107	100	100	99	100	98	98	93	100	97	102	100	103	104	94	100	1092
Trinidad & Tob.	100	101	a	100	104	99	100	96	100	98	92	88	100	101	98	100	99	100	90	100	759

Note: For each variable, the relative coverage level is given as a ratio of the level of coverage for one category of the variable.

† Question not asked
a Less than 20 cases

Table A.3 Immunization coverage differentials for DPT1: Relative levels of DPT1 coverage for ever-vaccinated children 12-35 months, including health card information, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Age			Birth Order				Sex		Birth Interval (Months)				Radio		No. of Children
	Urban	Rural	None	Pri	Sec+	<20	20-34	35+	1	2-3	4-5	6+	M	F	<24	24-35	36-47	48+	No	Yes	
SUB-SAHARAN AFRICA																					
Botswana	100	99	99	100	100	100	100	101	100	100	100	98	100	100	99	100	101	101	97	100	860
Burundi	100	98	103	100	96	a	100	102	100	99	100	103	100	102	98	100	101	100	99	100	814
Ghana	100	100	96	100	107	97	100	101	100	104	101	104	100	104	97	100	102	95	96	100	617
Kenya	100	101	98	100	98	100	100	102	100	100	100	99	100	100	99	100	100	101	99	100	1487
Liberia	100	97	110	100	146	107	100	96	100	105	107	98	100	99	109	100	108	106	110	100	624
Mali	100	94	95	100	a	a	100	107	100	98	105	106	100	96	106	100	100	102	94	100	134
Senegal	100	91	86	100	102	91	100	86	100	106	110	95	100	98	108	100	96	103	96	100	425
Uganda	100	98	100	100	104	101	100	101	100	102	101	101	100	102	100	100	102	99	100	100	887
Zimbabwe	100	98	100	100	100	101	100	99	100	103	102	101	100	100	101	100	102	101	98	100	990
NORTH AFRICA																					
Egypt	100	78	88	100	105	94	100	94	100	95	92	83	100	100	98	100	97	109	†	†	1843
Morocco	100	92	95	100	101	100	100	96	100	99	99	97	100	100	100	100	103	105	95	100	826
Tunisia	100	99	99	100	101	a	100	100	100	99	99	99	100	100	99	100	99	101	105	100	1244
ASIA																					
Sri Lanka	100	103	100	100	101	101	100	101	100	100	98	101	100	100	100	100	101	101	99	100	1245
Thailand	100	100	98	100	98	a	100	99	100	100	102	a	100	99	97	100	102	102	98	100	486
LATIN AMERICA/CARIBBEAN																					
Bolivia	100	100	90	100	102	94	100	105	100	100	102	102	100	99	97	100	97	107	†	†	490
Brazil	100	92	92	100	97	98	100	97	100	102	96	90	100	96	101	100	106	108	94	100	857
Colombia	100	98	96	100	101	101	100	101	100	100	99	99	100	100	101	100	102	102	100	100	560
Guatemala	100	101	99	100	98	98	100	98	100	100	99	100	100	100	103	100	100	101	98	100	942
Peru	100	94	102	100	107	83	100	99	100	96	101	97	100	102	104	100	104	107	102	100	433
Trinidad & Tob.	100	102	a	100	101	101	100	100	100	99	100	97	100	100	99	100	98	100	97	100	601

Note: For each variable, the relative coverage level is given as a ratio of the level of coverage for one category of the variable.

† Question not asked
a Less than 20 cases

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Table A.4 Immunization coverage differentials for DPT3: Relative levels of DPT3 coverage for ever-vaccinated children 12-35 months, including health card information, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Age			Birth Order				Sex		Birth Interval (Months)				Radio		No. of Children
	Urban	Rural	None	Pri	Sec+	<20	20-34	35+	1	2-3	4-5	6+	M	F	<24	24-35	36-47	48+	No	Yes	
SUB-SAHARAN AFRICA																						
Botswana	100	99	96	100	99	102	100	100	100	98	102	98	100	100	96	100	98	100	95	100	860
Burundi	100	89	94	100	91	a	100	102	100	102	96	97	100	98	92	100	90	82	86	100	814
Ghana	100	77	87	100	141	88	100	110	100	95	98	96	100	102	91	100	108	101	91	100	617
Kenya	100	95	87	100	105	107	100	102	100	97	98	90	100	98	100	100	98	100	97	100	1487
Liberia	100	64	126	100	271	72	100	55	100	112	82	59	100	103	112	100	107	79	60	100	624
Mali	100	0	52	100	a	a	100	119	100	143	120	110	100	75	89	100	33	99	29	100	134
Senegal	100	16	51	100	124	48	100	91	100	115	123	92	100	95	100	100	105	126	43	100	425
Uganda	100	66	81	100	146	84	100	84	100	109	105	84	100	95	102	100	94	93	78	100	887
Zimbabwe	100	94	98	100	101	104	100	100	100	101	102	98	100	99	97	100	102	100	96	100	990
NORTH AFRICA																						
Egypt	100	72	80	100	107	78	100	95	100	93	86	80	100	99	104	100	105	119	t	t	1843
Morocco	100	74	83	100	103	93	100	91	100	104	101	91	100	103	105	100	103	115	94	100	826
Tunisia	100	91	92	100	101	a	100	100	100	95	95	92	100	97	99	100	101	104	96	100	1244
ASIA																						
Sri Lanka	100	106	103	100	109	100	100	98	100	96	95	89	100	100	102	100	101	103	94	100	1245
Thailand	100	96	102	100	102	a	100	110	100	91	97	a	100	105	77	100	93	90	87	100	486
LATIN AMERICA/CARIBBEAN																						
Bolivia	100	71	90	100	147	96	100	100	100	95	85	80	100	109	118	100	96	110	t	t	490
Brazil	100	80	79	100	116	92	100	93	100	97	89	67	100	94	97	100	108	113	77	100	857
Colombia	100	95	78	100	104	81	100	100	100	103	94	84	100	94	98	100	101	106	96	100	560
Guatemala	100	84	90	100	108	82	100	106	100	93	87	92	100	105	94	100	87	100	85	100	942
Peru	100	78	93	100	131	98	100	86	100	105	82	89	100	102	102	100	102	108	85	100	433
Trinidad & Tob.	100	103	a	100	102	98	100	104	100	100	98	90	100	101	101	100	107	100	92	100	601

Note: For each variable, the relative coverage level is given as a ratio of the level of coverage for one category of the variable.

t Question not asked
a Less than 20 cases

Table A.5 Immunization coverage differentials for measles: Relative levels of measles coverage for ever-vaccinated children age 12-35 months, including health card information, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Age			Birth Order				Sex		Birth Interval (Months)				Radio		No. of Children
	Urban	Rural	None	Pri	Sec+	<20	20-34	35+	1	2-3	4-5	6+	M	F	<24	24-35	36-47	48+	No	Yes	
SUB-SAHARAN AFRICA																					
Botswana	100	99	95	100	100	100	100	99	100	101	100	97	100	99	92	100	98	100	95	100	860
Burundi	100	106	91	100	95	a	100	107	100	96	97	105	100	98	99	100	102	95	94	100	814
Ghana	100	95	100	100	135	91	100	98	100	100	101	96	100	106	102	100	107	108	92	100	617
Kenya	100	93	81	100	112	101	100	98	100	95	93	84	100	98	103	100	100	102	94	100	1487
Liberia	100	101	110	100	125	94	100	92	100	99	97	93	100	104	107	100	122	125	100	100	624
Mali	100	116	102	100	a	a	100	98	100	93	106	105	100	103	98	100	91	95	122	100	134
Senegal	100	89	88	100	111	97	100	98	100	113	123	94	100	101	113	100	119	119	113	100	425
Uganda	100	87	101	100	128	90	100	92	100	105	101	93	100	98	101	100	97	108	93	100	887
Zimbabwe	100	96	99	100	103	108	100	101	100	98	102	98	100	100	99	100	101	103	97	100	990
NORTH AFRICA																					
Egypt	100	71	81	100	109	79	100	94	100	97	89	82	100	101	100	100	100	117	t	t	1843
Morocco	100	81	90	100	112	87	100	89	100	94	96	88	100	100	97	100	96	102	91	100	826
Tunisia	100	95	95	100	104	a	100	100	100	99	100	95	100	98	99	100	103	103	97	100	1244
ASIA																					
Sri Lanka	100	110	94	100	118	106	100	92	100	87	81	65	100	99	99	100	108	118	83	100	1245
Thailand	100	85	142	100	122	a	100	105	100	76	67	63	100	110	79	100	129	116	92	100	486
LATIN AMERICA/CARIBBEAN																					
Bolivia	100	100	98	100	124	100	100	84	100	100	101	84	100	103	110	100	102	102	t	t	490
Brazil	100	89	89	100	104	100	100	99	100	99	94	80	100	96	99	100	105	111	94	100	857
Colombia	100	88	94	100	109	71	100	98	100	97	83	85	100	98	110	100	123	117	82	100	560
Guatemala	100	94	94	100	90	99	100	99	100	91	89	92	100	94	95	100	92	93	91	100	942
Peru	100	89	93	100	108	74	100	98	100	97	91	97	100	100	86	100	101	101	96	100	433
Trinidad & Tob.	100	80	a	100	100	137	100	100	100	79	76	64	100	115	104	100	117	100	77	100	601

Note: For each variable, the relative coverage level is given as a ratio of the level of coverage for one category of the variable.

t Question not asked
a Less than 20 cases

Table A.6 Differentials in the timing of measles immunization: Relative levels of measles coverage for ever-vaccinated children 12-35 months with a health card who were immunized for measles at age 8-11 months, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Age			Birth Order				Sex		Birth Interval (Months)				Radio		No. of Children
	Urban	Rural	None	Pri	Sec+	<20	20-34	35+	1	2-3	4-5	6+	M	F	<24	24-35	36-47	48+	No	Yes	
SUB-SAHARAN AFRICA																					
Botswana	100	93	84	100	109	100	100	92	100	98	90	92	100	98	99	100	103	98	90	100	812
Burundi	100	a	97	100	a	126	100	93	100	92	92	92	100	104	102	100	93	80	78	100	639
Ghana	100	96	85	100	134	145	100	107	100	82	93	76	100	104	98	100	96	86	102	100	434
Kenya	100	95	91	100	110	115	100	95	100	99	93	90	100	96	98	100	85	97	96	100	1176
Liberia	100	90	87	100	154	86	100	105	100	82	96	115	100	82	108	100	84	86	94	100	431
Mali	100	15	46	100	a	a	100	a	100	a	a	a	100	61	a	100	a	a	62	100	103
Senegal	100	52	139	100	220	87	100	114	100	99	84	98	100	100	82	100	91	140	52	100	279
Uganda	100	70	100	100	129	102	100	89	100	94	101	85	100	94	101	100	103	79	90	100	663
Zimbabwe	100	90	83	100	107	114	100	100	100	91	87	85	100	98	98	100	114	119	95	100	922
NORTH AFRICA																					
Egypt	100	90	90	100	123	97	100	92	100	96	89	77	100	100	100	100	108	108	t		1056
Morocco	100	67	82	100	105	a	100	96	100	94	94	84	100	94	106	100	99	115	104	100	769
Tunisia	100	81	82	100	107	a	100	95	100	92	81	76	100	103	96	100	96	108	89	100	1143
ASIA																					
Sri Lanka	100	86	78	100	108	131	100	84	100	83	81	56	100	106	96	100	123	106	97	100	856
Thailand	100	131	a	100	83	a	100	94	100	89	a	a	100	87	a	100	99	103	105	100	265
LATIN AMERICA/CARIBBEAN																					
Bolivia	100	73	125	100	128	82	100	63	100	52	76	72	100	96	131	100	110	96	t		378
Brazil	100	89	98	100	120	77	100	96	100	100	91	81	100	98	93	100	115	119	78	100	721
Colombia	100	99	104	100	127	123	100	97	100	79	95	56	100	101	102	100	118	86	98	100	441
Guatemala	100	88	82	100	86	80	100	78	100	119	98	81	100	103	97	100	96	109	91	100	737
Peru	100	63	69	100	133	a	100	90	100	79	57	52	100	100	107	100	126	189	68	100	366

Note: Only children who have a health card on which the measles vaccination date is recorded are included. For each variable, the relative coverage level is given as a ratio of the level of coverage for one category of the variable.

t Question not asked
a Less than 20 cases

Table A.7 Immunization coverage differentials for tetanus toxoid: Relative levels of tetanus toxoid (TT) coverage for women of reproductive age, by selected background characteristics, Demographic and Health Surveys, 1986-1989

Country	Residence		Education			Radio		Mother's Age							Birth Order				Birth Interval (Months)					No. of Births
	Urban	Rural	None	Pri.	Sec.+	No	Yes	15-19	20-24	25-29	30-34	35-39	40-44	45-49	1	2-3	4-5	6+	<18	18-23	24-35	36-47	48+	
SUB-SAHARAN AFRICA																								
Botswana	100	108	88	100	104	93	100	97	100	100	98	97	103	90	100	101	102	97	105	99	100	102	106	3177
Burundi	100	64	85	100	125	82	100	117	103	100	88	77	89	80	100	86	81	83	94	98	100	98	91	3841
Ghana	100	80	78	100	109	85	100	96	103	100	100	103	93	86	100	95	95	93	83	94	100	104	110	4089
Kenya	100	96	95	100	104	94	100	95	101	100	100	100	92	95	100	99	100	97	102	99	100	100	101	7050
Liberia	100	88	89	100	112	84	100	96	102	100	93	89	86	81	100	103	94	92	95	108	100	95	98	3080
Mali	100	14	34	100	197	25	100	105	84	100	104	88	69	40	100	93	82	89	65	77	100	76	79	3390
Senegal	100	35	56	100	129	64	100	65	91	100	96	86	78	96	100	106	98	83	89	83	100	80	101	4253
Togo	100	73	78	100	106	78	100	96	106	100	100	102	94	81	100	96	92	86	92	87	100	98	102	3098
Uganda	100	71	86	100	125	80	100	110	104	100	95	92	92	117	100	95	90	85	83	92	100	98	97	5004
Zimbabwe	100	97	93	100	101	93	100	102	105	100	97	96	91	86	100	99	96	91	91	92	100	101	98	3334
NORTH AFRICA																								
Egypt	100	84	72	100	119	t	t	138	98	100	93	86	72	47	100	78	76	72	69	73	100	98	105	8624
Tunisia	100	87	69	100	86	84	100	136	112	100	90	79	71	47	100	81	79	55	89	98	100	100	109	4435
ASIA																								
Sri Lanka	100	99	90	100	105	97	100	97	100	100	102	104	102	98	100	99	99	95	86	93	100	96	103	3965
Thailand	100	105	71	100	108	88	100	95	100	100	91	76	66	85	100	94	74	54	88	119	100	133	144	3631
LATIN AMERICA/CARIBBEAN																								
Bolivia	100	58	49	100	159	t	t	99	96	100	91	72	70	56	100	90	84	76	97	91	100	117	118	5764
Brazil	100	85	81	100	105	99	100	112	99	100	103	119	107	a	100	94	89	102	87	90	100	99	87	3463
Colombia	100	107	109	100	113	101	100	123	102	100	98	88	78	34	100	93	81	79	104	104	100	101	135	2671
Dominican Republic	100	97	88	100	106	95	100	98	101	100	97	96	97	88	100	99	93	92	100	102	100	103	105	4401
Ecuador	100	79	60	100	126	101	100	115	119	100	107	97	67	80	a	a	a	a	a	a	a	a	a	3031
Guatemala	100	82	55	100	68	90	100	139	97	100	94	82	77	a	100	91	86	82	107	107	100	100	115	4581
Peru	100	37	51	100	166	84	100	133	122	100	85	69	65	73	100	96	58	62	105	121	100	90	150	3106
Trinidad & Tobago	100	112	182	100	92	87	100	96	74	100	81	90	73	70	100	110	122	140	113	110	100	99	107	1929

Note: For each variable, the relative coverage level is given as a ratio of the level of coverage for one category of the variable.

t Question not asked
a Less than 20 cases

Appendix B

Summary of DHS-I surveys, 1985-1990

Region and Country	Date of Fieldwork	Implementing Organization	Respondents	Sample Size	Supplemental Studies, Modules, and Additional Questions
AFRICA					
Botswana	Aug-Dec 1988	Central Statistics Office	All women 15-49	4,368	AIDS, PC, adolescent fertility
Burundi	Apr-Jul 1987	Département de la Population, Ministère de l'Intérieur	All women 15-49	3,970	AM, SAI, adult mortality
Burundi (Husband Survey)	Apr-Jul 1987	Département de la Population, Ministère de l'Intérieur	Husbands	542	KAP study
Ghana*	Feb-May 1988	Ghana Statistical Service	All women 15-49	4,488	AM, SM, WE
Kenya**	Dec-May 1988/89	National Council for Population and Development	All women 15-49	7,150	H
Liberia	Feb-Jul 1986	Bureau of Statistics, Ministry of Planning and Economic Affairs	All women 15-49	5,239	H, TBH, employment status
Mali	Mar-Aug 1987	Institut du Sahel, USED/CERPOD	All women 15-49	3,200	AM, VC, childhood physical handicaps
Mali (Male Survey)	Mar-Aug 1987	Institut du Sahel, USED/CERPOD	Men 20-55	970	KAP study
Ondo State, Nigeria	Sep-Jan 1986/87	Ministry of Health, Ondo State	All women 15-49	4,213	AM, H, TBH
Senegal	Apr-Jul 1986	Direction de la Statistique Ministère de l'Economie et des Finances	All women 15-49	4,415	AM, CD
Sudan	Nov-May 1989/90	Department of Statistics Ministry of Economic and National Planning	EMW 15-49	5,860	H, M, MM, female circumcision, family planning services
Togo	Jun-Nov 1988	Unité de Recherche Démographique Université du Benin	All women 15-49	3,360	AM, H, SAI, marriage history
Uganda	Sep-Feb 1988/89	Ministry of Health	All women 15-49	4,730	AM, H, SAI
Zimbabwe	Sep-Jan 1988/89	Central Statistical Office	All women 15-49	4,201	AIDS, AM, H, PC, SAI, WE
ASIA/NEAR EAST/NORTH AFRICA					
Egypt	Oct-Jan 1988/89	National Population Council	EMW 15-49	8,911	AM, CD, H, MM, PC, SAI, WE, women's status
Indonesia	Sep-Dec 1987	Central Bureau of Statistics National Family Planning Coordinating Board	EMW 15-49	11,844	PC, SM
Morocco	May-Jul 1987	Ministère de la Santé Publique	EMW 15-49	5,982	AM, CD, H, S
Nepal (In-depth)	Feb-Apr 1987	New Era	CMW 15-49	1,623	KAP–gap survey
Sri Lanka	Jan-Mar 1987	Dept. of Census and Statistics Ministry of Plan Implementation	EMW 15-49	5,865	AM, H, NFP
Thailand	Mar-Jun 1987	Institute of Population Studies Chulalongkorn University	EMW 15-49	6,775	AM, S, SAI
Tunisia	Jun-Oct 1988	Office National de la Famille et de la Population	EMW 15-49	4,184	AM, CD, H, S, SAI

Region and Country	Date of Fieldwork	Implementing Organization	Respondents	Sample Size	Supplemental Studies, Modules, and Additional Questions
LATIN AMERICA & CARIBBEAN					
Bolivia	Mar-Jun 1989	Instituto Nacional de Estadística	All women 15-49	7,923	AM, CD, H, MM, PC, S, WE
Bolivia (In-depth)	Mar-Jun 1989	Instituto Nacional de Estadística	All women 15-49	7,923	Health
Brazil	May-Aug 1986	Sociedade Civil Bem-Estar Familiar no Brasil	All women 15-44	5,892	AM, H, PC, SM, abortion, young adult use of contraception
Colombia	Oct-Dec 1986	Corporación Centro Regional de Población Ministerio de Salud	All women 15-49	5,329	AM, PC, SAI, SM
Dominican Republic	Sep-Dec 1986	Consejo Nacional de Población y Familia	All women 15-49	7,649	NFP, S, SAI, SM family planning communication
Dominican Rep. (Experimental)	Sep-Dec 1986	Consejo Nacional de Población y Familia	All women 15-49	3,885	
Ecuador	Jan-Mar 1987	Centro de Estudios de Población y Paternidad Responsable	All women 15-49	4,713	SAI, CD, H, employment
El Salvador	May-Jun 1985	Asociación Demográfica Salvadoreña	All women 15-49	5,207	S, TBH
Guatemala	Oct-Dec 1987	Instituto de Nutrición de Centro América y Panamá	All women 15-44	5,160	H, S, SAI
Mexico	Feb-May 1987	Dirección General de Planificación Familiar Secretaría de Salud	All women 15-49	9,310	H, NFP, S, employment
Peru	Sep-Dec 1986	Instituto Nacional de Estadística	All women 15-49	4,999	H, NFP, employment, cost of family planning
Peru (Experimental)	Sep-Dec 1986	Instituto Nacional de Estadística	All women 15-49	2,534	
Trinidad and Tobago	May-Aug 1987	Family Planning Association of Trinidad and Tobago	All women 15-49	3,806	AM, NFP, breastfeeding

CMW = currently married women
EMW = ever-married women

AIDS = acquired immune deficiency syndrome
  AM = anthropometric measurements
  CD = causes of death (verbal reports of symptoms)
   H = additional health questions
   M = migration
  MM = maternal mortality
  NFP = natural family planning

PC = pill compliance
  S = sterilization
SAI = service availability information
SM = social marketing
TBH = truncated birth history
VC = value of children
WE = women's employment

*   Data available for 943 husbands interviewed with a husband's questionnaire
** Data available for 1,133 husbands interviewed with a husband's questionnaire