SUPPLEMENT ARTICLE

# Measles Vaccination Coverage during Poliomyelitis National Immunization Days in Burkina Faso, 1999

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**In 1999, Burkina Faso added measles vaccine during the second round of its poliomyelitis national immunization days (NIDs). A cluster survey was conducted in each of the country's 53 health districts to assess vaccination coverage achieved by the campaign. Forty-four percent of children aged 9–59 months had a documented prior measles vaccination, and 88% were vaccinated during NIDs. Eighty-five percent of children not previously vaccinated received measles vaccine during the campaign. Although routine vaccination coverage varied substantially among children from various socioeconomic groups, the campaign appeared to almost equally reach all groups of children surveyed. Poliovirus vaccine coverage was 90% when measles vaccine was added to the campaign, compared with 88% during the first round. In Burkina Faso, the addition of measles vaccine to poliomyelitis NIDs achieved greater equity in measles vaccination coverage according to a number of socioeconomic factors without compromising the coverage of poliovirus vaccination.**

Measles is estimated to have been responsible for more than half a million deaths in Africa during 1999 [1]. The World Health Organization (WHO) set a goal of reducing by half the number of measles deaths by 2005 relative to 1999 estimates [2]. A three-component strategy relying on "catch-up" mass vaccination campaigns, "keep-up"-strengthened routine vaccination, and "follow-up" campaigns in high-risk areas resulted in a 99% reduction of measles morbidity and mortality among member countries of the American Region of WHO [3]. The use of catch-up campaigns since 1996 had a similar impact on measles epidemiology in seven southern African countries [4]. To reduce measles mortality in the most affected African countries, it has been suggested that measles vaccine could be added to poliomyelitis national immunization days (NIDs) [5].

In Burkina Faso, a survey conducted in 1998 revealed that 47% of children aged 12–23 months had received measles vaccine through routine services, with 9 of the 11 health regions having coverage lower than 50% [6]. In December 1998, a mass measles vaccination campaign was combined with the poliomyelitis NIDs in the cities of Ouagadougou and Bobo Dioulasso and in four smaller towns. About 10% of the country's 9- to 59-month-old children were offered measles vaccine. A survey conducted immediately after the campaign in the two main cities revealed that 79% of eligible children had been vaccinated during the campaign and that 91% of children had received at least one dose of measles vaccine either in the routine program or through the campaign [7]. In 1999, following these encouraging results, the Ministry of Health and its partners developed a 3-year plan of action. The plan combined a national measles vaccination campaign for children

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aged 9–59 months in conjunction with 1999 poliomyelitis NIDs, strengthening routine measles vaccination and enhancing surveillance for measles. Follow-up measles campaigns would be implemented in the subsequent years in high-risk areas, depending on epidemiologic findings (Ministère de la Santé du Burkina Faso, unpublished data).

In the days immediately following the campaign, we conducted an extensive national vaccination coverage survey modeled on the survey conducted in 1998 [7]. This report presents an analysis of measles vaccine coverage data, addressing five key issues: (1) routine and campaign coverage at district, regional, and national levels; (2) the percent of children not vaccinated through the routine program but reached through the campaign; (3) factors associated with vaccination coverage through routine or campaign; (4) characteristics of children who received no doses of vaccine; and (5) impact of inclusion of measles vaccine administration on oral poliovirus vaccine (OPV) coverage.

## METHODS

***Design of the national measles vaccination campaign.*** Combining the 1999 measles campaign with NIDs enabled a reduction in operation costs associated with measles vaccination. However, the measles campaign had to be restricted to age groups included in the poliomyelitis campaign (i.e., children <60 months of age). The design of the national campaign was similar to that of the limited 1998 campaign (all children 9- to 59-months old), with the exception of those areas included in 1998. In these cities and towns, the 1999 campaign offered measles vaccine only to children aged 9–23 months since most children ⩾24 months old had been vaccinated previously. The measles vaccination campaign took place 4–8 December 1999 simultaneously with the second round of NIDs. As was the case in 1998, measles vaccine was exclusively administered with auto-disable syringes [8].

***Sampling.*** We used a two-stage sampling approach, according to the sampling methodology used by the Expanded Program on Immunization [9, 10]. In each of the country's 53 health districts, 30 clusters were selected by using cumulative populations of village or city sectors. District survey coordinators drew sketches of administrative boundaries of the villages or sectors selected in the first stage and divided these sketches into 32 areas of comparable population size. They randomly selected the survey area of each cluster by drawing a number between 1 and 32. Survey agents identified 7 children who were 0–59 months old by visiting all consecutive households from a starting point in the selected area. They interviewed the principal caregiver of each child. If the principal caregiver was absent, agents had been instructed to revisit the household to complete the interview at a later time.

***Data collection.*** We used a survey questionnaire with closed entry fields in order to gather information on demographics, socioeconomic status, knowledge and attitudes toward vaccination, and routine and campaign vaccination data. We assigned a code number for each of the largest 24 ethnic groups in the country and left an open field for other groups that would be encountered. Data on routine measles vaccination were abstracted from the child's vaccination record; children without a record were considered not to have been vaccinated by the routine program. To assess campaign vaccination data, we used indirect questioning. Interviewers first verified if the caregiver was aware that a campaign had taken place. If yes, they then verified that the caregiver remembered the timing of the campaign and asked for a description of what the child had received. Clear drops given into the mouth from a plastic or glass vial were considered to correspond to vaccination with OPV, while an injection was considered to correspond to measles vaccination. The survey was conducted during 9–21 December 1999, that is, less than 2 weeks after the end of the campaign.

***Data analysis.*** Coordinators of regional health units entered information into an Epi Info database. Data files were transferred to the central level together with questionnaires for validation and correction of inconsistencies. We validated routine measles vaccinations if they had been administered when the child was ⩾255 days (8.5 months) of age and classified children as not vaccinated if the vaccine had been received at an earlier age. For the analysis of measles vaccine coverage, we restricted the data set to children ⩾255 days old. In the urban sectors of the 10 districts comprising Ouagadougou, Bobo-Dioulasso, and the four smaller cities included in the 1998 measles vaccination campaign, we also restricted measles vaccination analysis to children 9–23 months of age. This age group was the only one in these areas that should have received measles vaccine. We used the CSAMPLE module of Epi Info 6.04d [11] to calculate proportions, risk ratios, and confidence limits. We stratified the analysis by district, using the size of the district populations as weights and the clusters as principal sampling units. To calculate the coverage achieved by OPV during both rounds of NIDs, we used the whole sample of 0- to 59-month-old children in each district.

## RESULTS

Of a theoretical sample of 11,130 (53 health districts × 210) 0- to 59-month-old children, data were obtained on 11,026 (99%) and used to calculate OPV coverage during both rounds of NIDs. Of the 8641 (78%) children eligible for measles vac-

**Table 1. Demographic and socioeconomic characteristics for 8551 persons surveyed following a measles vaccination campaign during the 1999 poliovirus National Immunization Days in Burkina Faso.**

| Characteristic | No. | % |
|---|---|---|
| Age, months | | |
| 9–11 | 755 | 9 |
| 12–23 | 2871 | 34 |
| 24–35 | 2090 | 24 |
| 36–47 | 1495 | 17 |
| 48–59 | 1340 | 16 |
| Sex | | |
| Male | 4397 | 51 |
| Female | 4154 | 49 |
| Health region of residence | | |
| Banfora | 352 | 4 |
| Bobo Dioulasso | 749 | 9 |
| Dedougou | 997 | 12 |
| Dori | 519 | 6 |
| Fada Ngourma | 679 | 8 |
| Gaoua | 669 | 8 |
| Kaya | 711 | 8 |
| Koudougou | 954 | 11 |
| Ouagadougou | 1534 | 18 |
| Ouahigouya | 682 | 8 |
| Tenkodogo | 705 | 8 |
| Education level of principal caregiver | | |
| None | 7074 | 83 |
| Literate | 486 | 6 |
| School | 991 | 12 |
| Family's daily expenses | | |
| <500 FCFA | 6275 | 73 |
| ⩾500 FCFA | 2276 | 27 |
| Distance from health center, km | | |
| 0–4 | 4170 | 49 |
| 5–9 | 2240 | 26 |
| ⩾10 | 2141 | 25 |
| Country of birth | | |
| Burkina Faso | 8200 | 96 |
| Other | 351 | 4 |
| Ethnic group | | |
| Mossi | 3724 | 44 |
| Gourmantche | 554 | 6 |
| Gourounsi | 531 | 6 |
| Peul | 496 | 6 |
| Other | 3246 | 38 |
| Place of residence | | |
| Urban | 770 | 9 |
| Rural | 7781 | 91 |
| Possessed vaccination record | 5508 | 64 |

**NOTE.** FCFA, francs de la Communauté Financière d'Afrique.

cination, 8551 (99%) observations had complete information for the variables studied and were used for this analysis (table 1). There were more children aged 12–23 months than any other age group presented because children ⩾24 months old from the 10 districts that conducted a measles campaign in 1998 were excluded from analysis. Also, the proportion of children included in the analysis diminished with increasing age. Mossis, the country's largest ethnic group, accounted for 44% of the sample. Only 3 other ethnic groups accounted for >5% of all observations. A vaccination record was available for 64% of the children, and that proportion decreased from 69% among those aged 9–23 months to 58% among those aged 48–59 months.

In all, 44% (95% confidence interval [CI], 42%–46%) of children in the country had received measles vaccine in the routine program prior to the campaign (figure 1), and 88% (95% CI, 87%–89%) were vaccinated during NIDs. Among children with prior routine vaccination, 93% (95% CI, 92%–94%) were revaccinated during NIDs. Among children not vaccinated previously through routine services, 85% (95% CI, 83%–86%) were vaccinated during the campaign, leaving 9% (95% CI, 8%–10%) of children who had never received a dose of measles vaccine. Children whose principal caregiver was more educated, had a higher family budget, resided closer to a health center, lived in urban settings, or belonged to the Mossi group all had significantly higher routine measles vaccine coverage levels (table 2). None of these characteristics was significantly associated with higher coverage during NIDs. Children from urban areas had a lower coverage (82%; 95% CI, 78%–87%) from the campaign than children in rural areas (89%; 95% CI, 88%–90%). Peul children had the lowest routine vaccination coverage of all ethnic groups (24%). Peuls are predominantly nomadic, and only 27% of children in this group lived within 5 km of a health center (compared with 45%–54% among other groups). Peul children were less likely than Mossi children to be vaccinated by the routine program, regardless of the distance to the nearest health center: Peul and Mossi children within 5 km of a center had 26% and 51% (risk ratio [RR], 0.5; 95% CI, 0.2–0.7) coverage, respectively, those within 5–9 km had 14% and 52% (RR, 0.3; 95% CI, 0.2–0.4) coverage, respectively, and those ⩾10 km from a center had 26% and 41% (RR, 0.6; 95% CI, 0.4–0.9) coverage, respectively.

There was substantial variability in routine measles vaccine coverage at the district level (12%–76%). Of 53 districts, 17 (32%) had a point estimate of routine measles vaccine coverage of ⩾50%. NID coverage estimates were higher than routine coverage in all 53 districts. Six districts (11%) had NID measles coverage estimates of <80% (67%–79%), 21 districts (40%) had coverage estimates between 80% and 89%, and 26 districts (49%) had coverage estimates of ⩾90%. After the campaign, only one health district, Leo in the health region of Koudougou,

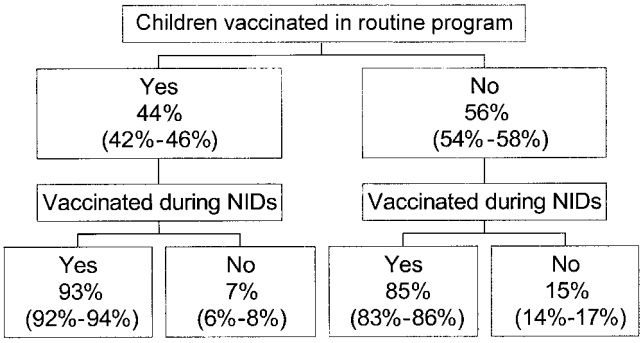


**Figure 1.** Percent of children vaccinated against measles during National Immunization Days (NIDs), according to their vaccination status in the routine vaccination program—Burkina Faso, 1999.

had a point estimate of <80% (79%; 95% CI, 66%–93%) for the proportion of children who had received at least one dose of measles vaccine through routine or campaign vaccination. Sixteen districts (30%) had point estimates ranging from 80% to 89%, and 36 districts (68%) had estimates of ⩾90%. After the campaign, only three regions had point estimates of >10% for children not vaccinated against measles: Banfora, Dori, and Tenkodogo. Eleven percent of 9- to 23-month-old children had not received measles vaccine in the routine program or in the campaign, compared with 7% of those aged 24–59 months (RR, 1.7; 95% CI, 1.4–2.0). Only 7% of Mossi children, compared with 10% of children from all other ethnic groups, remained unvaccinated (RR, 0.7; 95% CI, 0.5–0.8). Compared with all other children, those living ⩾10 km from a health center were 1.6 (95% CI, 1.2–2.0) times more likely to be unvaccinated.

Coverage of the OPV vaccination campaign was high for both rounds (table 3). The percent of children vaccinated with OPV during the second round (90%) when measles vaccine was offered was slightly higher than that of the first round (88%; RR, 1.02; 95% CI, 1.01–1.03).

## DISCUSSION

Combining measles vaccination with the 1999 poliomyelitis NIDs increased coverage with at least one dose of measles vaccine from 44% to 91% in the study population. This increase was possible because 85% of children who had not been vaccinated through the routine program received a dose of measles vaccine during the campaign. While routine vaccination was strongly correlated with higher socioeconomic status, the likelihood of receiving measles vaccine during the campaign was similar for children of all socioeconomic groups, even among populations that appeared to have the least access to health services. The addition of measles vaccination to the second round of NIDs did not reduce coverage for OPV compared with that achieved during the first round.

The WHO and its partners have developed a global strategic plan for measles control [12]. Two of the key strategies proposed are to provide a first dose of measles vaccine to successive cohorts of infants through routine vaccination services and to ensure that all children have a second opportunity for measles vaccination. Data from this report reveal that in Burkina Faso, no health district achieved routine vaccination coverage of 90%, which is considered essential for achieving sustainable reduction in measles mortality [13]. By contrast, the national measles vaccination campaign allowed 89% of all children to be vaccinated. In addition, campaign vaccine coverage tended to be more homogeneous than routine coverage across health districts. Campaign coverage was also higher in rural than urban areas. Therefore, in Burkina Faso, mass campaigns have been effective in providing the second opportunity for measles vaccination among children <5 years of age. The main challenge rests, however, in strengthening the routine delivery system. In this respect, the routine vaccination coverage among 12- to 23-month-old children was not higher in December 1999 (45%) than it was in June 1998 (47%). As a result of this low routine coverage, only 41% of children actually had received two doses of measles vaccine after the campaign.

The mass campaign also provided homogeneous coverage across various socioeconomic categories. Low socioeconomic predictors are commonly associated with lower routine vaccine coverage, reflecting in part, lower accessibility to health services [14–16]. Of particular interest in this study was the finding that ethnicity was a strong predictor of routine coverage. Children of Peul ethnicity, many of whom are nomadic, had significantly lower routine measles vaccine coverage than Mossi children. In contrast, the campaign coverage was not significantly different between the 2 groups. Primary health care systems are not easily accessible to nomadic populations [17]. These populations present particular challenges to vaccine-preventable disease-control programs because of low vaccination coverage, as was the case with smallpox eradication [18]. An additional challenge specific to measles control may be related to the age distribution of measles susceptibility in these groups. A serologic survey among Tuaregs in Niger revealed that 15% of adults did not have IgG antibodies to measles. It is speculated that nomadic lifestyle may result in infrequent exposure to measles virus [19]. Vaccination strategies aimed at interrupting measles transmission should therefore address a wider age range in these populations [20].

In addition to poliovirus vaccination, NIDs in Burkina Faso have provided additional benefits to children <5 years of age. Since 1998, vitamin A supplements have been offered during the first round of NIDs to all children aged 6–59 months. Because of the necessity of injecting measles vaccine rather than giving it orally as is done with poliovirus vaccine, adding measles vaccination complicates the logistics of poliomyelitis NIDs

**Table 2. Routine and National Immunization Days (NIDs) measles vaccine coverage according to age, demographic characteristics, and socioeconomic indicators—Burkina Faso, 1999.**

| Socioeconomic indicator | Routine vaccination program | | NIDs | |
|---|---|---|---|---|
| | % vaccinated | 95% CI | % vaccinated | 95% CI |
| Age, months | | | | |
| 9–11 | 13 | 11–16 | 79 | 75–82 |
| 12–23 | 45 | 43–48 | 87 | 85–88 |
| 24–35 | 50 | 47–52 | 91 | 89–93 |
| 36–47 | 45 | 42–48 | 90 | 88–92 |
| 48–59 | 47 | 44–50 | 91 | 89–93 |
| Education level of principal caregiver | | | | |
| None | 42 | 41–44 | 88 | 87–89 |
| Literate | 47 | 41–52 | 90 | 86–94 |
| School | 53 | 49–57 | 89 | 86–92 |
| Family's daily expenses | | | | |
| <500 FCFA | 42 | 41–44 | 88 | 87–89 |
| ⩾500 FCFA | 48 | 45–51 | 88 | 86–90 |
| Distance from health center, km | | | | |
| 0–4 | 48 | 46–51 | 88 | 87–90 |
| 5–9 | 43 | 39–46 | 91 | 89–93 |
| ⩾10 | 35 | 32–39 | 85 | 82–88 |
| Ethnic group | | | | |
| Mossi | 50 | 48–53 | 90 | 88–91 |
| Gourmantche | 36 | 30–42 | 89 | 85–94 |
| Gourounsi | 39 | 33–45 | 85 | 79–90 |
| Peul | 23 | 17–29 | 86 | 80–91 |
| Other | 41 | 38–44 | 87 | 85–89 |
| Place of residence | | | | |
| Urban | 54 | 50–58 | 82 | 78–87 |
| Rural | 43 | 41–44 | 89 | 88–90 |

**NOTE.** CI, confidence interval; FCFA, francs de la Communauté Financière d'Afrique.

and can potentially reduce OPV coverage. Results from this report suggest that coverage during the second round of the poliomyelitis campaign, when measles vaccine was added, was as good as coverage during the first round. For many parents, availability of measles vaccine might even have increased their willingness to have their children vaccinated during NIDs. The marginal cost of the measles campaign corresponded to the cost of vaccine and injection materials, operational costs for 5 rather than 3 campaign days, and the recruitment of additional health care workers trained to administer injections to complement vaccination teams.

The main limitation of this study is related to the sampling scheme. Burkina Faso comprises areas with low population density as well as a substantial number of nomadic populations. The list of village and large city sectors maintained by the Ministry of Health may reflect areas that are actually identified by health services. It is possible that some segments of population would not have been included in the campaign or the survey. The large numbers of children not vaccinated through the routine program who were vaccinated during NIDs confirm that the mass strategy was very effective in reaching previously unvaccinated children. On the other hand, the homogeneous campaign coverage estimates found in all sub-groups studied might reflect, in part, some overlap between campaign and survey populations. Another limitation is related to the calculation of routine vaccination coverage. Our choice to count only vaccine doses that were documented on a vaccination record leads to some underestimation of the true coverage. In particular, the decreasing proportions of children who possess such a record with increasing age reflect the loss of these documents with time.

The measles mass vaccination campaign appears to have offered an effective strategy to rapidly increase one-dose measles vaccine coverage and access previously unreached children.

**Table 3. Oral poliovirus vaccine coverage during first- and second-round National Immunization Days, by location—Burkina Faso, 1999.**

| Health region | Estimated % coverage, mean (range) | |
|---|---|---|
| | First round | Second round |
| Banfora | 87 (82–92) | 89 (83–94) |
| Bobo Dioulasso | 89 (87–91) | 88 (85–91) |
| Dedougou | 91 (88–93) | 93 (91–95) |
| Dori | 86 (81–91) | 88 (84–93) |
| Fada Ngourma | 86 (82–91) | 91 (88–94) |
| Gaoua | 92 (89–94) | 93 (89–97) |
| Kaya | 92 (90–95) | 95 (93–97) |
| Koudougou | 90 (87–93) | 92 (89–94) |
| Ouagadougou | 89 (87–91) | 90 (88–92) |
| Ouahigouya | 89 (85–92) | 90 (87–94) |
| Tenkodogo | 80 (75–86) | 83 (78–88) |
| Burkina Faso | 88 (87–89) | 90 (89–91) |

Populations that were hardest to reach by the routine program benefited the most from the campaign. After the campaign, only 9% of the children studied had never received measles vaccine. Younger children, those of ethnicity other than Mossi, and those most distant from health facilities remained slightly, but significantly, less vaccinated. The distribution of zero-dose children was not statistically different between urban or rural places of residence, family budget, and education levels.

Findings from this report suggest that adding measles vaccine to poliomyelitis NIDs can effectively and substantially increase one-dose measles vaccine coverage among those who are most vulnerable to measles and, thus, on the basis of a number of socioeconomic measures, achieve greater access and equity in vaccination coverage than with routine vaccination alone. In 1999, only 5 of 21 West and Central African countries reported routine measles vaccination coverage of >60% [21]. As these countries are currently conducting large-scale poliomyelitis NIDs every year [22], this experience from Burkina Faso offers a unique opportunity to protect millions of children at risk of dying from measles at little additional cost.

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