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THREATENED CHILD HEALTH THROUGH LACK OF IMMUNIZATION - IDENTIFICATION OF RISK GROUPS IN UGANDA.

BY

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the School of Graduate Studies and Research
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ABSTRACT

Introduction. Despite the great success of the worldwide Expanded Programme on Immunization (EPI), there are still 2 million third world children who die every year from the vaccine-preventable diseases: measles, tuberculosis, tetanus, pertussis, and diphtheria. In addition about 200,000 children are yearly crippled by polio.

Throughout the 1980s, immunization rates have steadily kept rising. Now efforts are turning towards "reaching the un-reached".

While the great majority of children in Uganda and other third world countries receive vaccination against tuberculosis (BCG) and the first dose of oral polio vaccine, many do not complete the EPI vaccination series; and neonatal tetanus is still a major concern, since most fertile women in the third world are not covered with two doses of tetanus toxoid (TT).

Main objectives. Using data of the 1988-89 Uganda Demographic and Health Survey [UDHS]:

To assess risk factors for children not getting immunized against tuberculosis, diphtheria, tetanus, whooping cough, polio and measles.

To assess risk factors for not completing the EPI vaccination series (the "drop-out" problem).

To assess risk factors for pregnant women not receiving

tetanus toxoid for protection against neonatal tetanus;

and hence:

To identify high risk groups/populations where children are less likely to get immunized (partly thru fully).

To identify high risk groups of pregnant women in terms of not receiving tetanus toxoid during pregnancy.

Methods. The raw data of the UDHS were transformed and edited into two main SPSS system files.

1697 children aged 12 to 35 months and 1998 women aged 15 to 49 years were selected for the analysis. Only one child per mother was selected. Children who were claimed to have received some immunization(s) but could not produce a vaccination card, were regarded as (at least) partly immunized. However, these children were only included in the analysis for total lack of immunization. Separate analysis were done for the urban and the rural areas. Two rural areas were oversampled: the Luwero triangle by a factor of three and the South West region by a factor of two. Unweighted, weighted, and stratified (rural region) analysis were done. Since the results were almost identical, generally only the crude unweighted results were shown in the tables, while the weighted and the stratified results were shown in the appendix. In order to describe potential interaction (i.e. effect modification) by rural region, Woolf's test for heterogeneity of odds ratios across strata was performed on

every combination of predictor and outcome variable. The UDHS was a multi-stage cluster sample. Characteristics of the cluster sampling are discussed. Design effects [DEFF's] were calculated on the basis of the design effects presented in the UDHS report.

In the descriptive analysis crosstabulations between 40 predictor variables and 4 outcome variables were carried out and univariate statistics are presented taking into account the DEFF. If $P>0.10$ in Woolf's test, only the non-stratified rural results were shown. If $P<0.10$, the stratified results were presented. Logistic regression analysis was carried out for each outcome variable. Independent variables with $p<0.15$ in the univariate analysis were entered into a logistic model. For each of the four rural and four urban logistic models an average DEFF for the predictor variables included was used.

Results. In the univariate analysis the following general risk factors for lack of immunization were identified: low maternal or paternal education, not listening to radio, low housing standard, increasing distance to drinking water, and disapproval of contraception and family planning.

Particular risk factors for lack of child immunizations: the rural mother was not a member of an organisation (Mothers' Union, etc.), and the urban mother had lived with more than one man.

Some factors showed their main effect on completion of the

EPI-series: weekly immunization service in the rural community, migrancy, and urban mother's age between 20 and 30 years showed a positive effect, while bigamy, increasing number of children under five years in the household (urban sample), and death among siblings (rural sample) showed a negative effect.

Risk factors for children not receiving any vaccination were as follows: lack of professional pregnancy check or assistance at the delivery, mother did not receive TT while pregnant, and woman had more than four children (though in the rural sample there was a positive correlation between more than three children under five years in the household and receipt of at least one immunization).

Having a trained midwife in the subparish, and increasing number of children under five years in the household were factors with positive correlation to women's TT.

Muslim children and mothers had the same rate of vaccination as their Christian counterparts. No association with immunization coverage was found for the child's gender and size of the household. In the latter case there was a non-significant trend towards a higher immunization coverage in rural households of more than 10 persons.

Logistic regression. Best fit models for complete lack of child immunization included low level of maternal and paternal education, low housing standard, increasing distance to drinking water, the mother did not receive TT while she was

pregnant, and lack of weekly immunization possibility (rural sample), while low housing standard, mother has lived with more than one man, lack of pregnancy checks, and disapproval of contraception were included in the urban model.

Best fit models for lack of full vaccination included no formal maternal and/or paternal education, low housing standard, no radio in the household, bigamy, disapproval of contraception, vaccinations were not offered at least once a week in the community, and the mother did not receive TT while pregnant (rural sample), while increasing distance to drinking water, low housing standard, bigamy, disapproval of contraception, and the mother had lived with more than one man were included in the urban model.

Best fit models for describing "drop-outs" included: the mother was not a member of an organisation, low housing standard, bigamy, more than one sibling had died, and lack of weekly immunization possibility (rural sample), while low housing standard, bigamy, and disapproval of contraception were included in the urban model.

Best fit models for lack of women's TT included: (a) for the rural sample - woman was not a member of an organisation, low housing standard, household did not have a radio, never used contraception, more than four living children, lack of a trained midwife in the subparish, and increasing distance to drinking water ; (b) for the urban sample - low housing standard and disapproval of contraception.

Summary: High risk groups of children and women could be identified by combining risk factors and taking into account each factor's odds ratio and contribution to the logistic model. A simplified overview was presented in two tables. These rural and urban tables are intended for health authorities, scientists, doctors, etc. Four very simple models in point format are presented: one rural and one urban model for the child vaccinations as well as for women's TT. These simple "point models" of risk factors are intended for the local health workers.

Abbreviations

BCG = Tuberculosis vaccine.

Chisq = Chisquare.

CI = Confidence Interval.

DEFF = Design effect.

DF = Degrees of freedom.

DPT = Diphtheria, pertussis, tetanus vaccine (for children).

Drop-outs = Children (or women) who received the first vaccination in a vaccinations series, but who did not receive all vaccinations in the series.

EPI = Expanded Programme on Immunization.

FP = Family planning.

FP-info = Information about family planning.

Freq = Frequencies.

HC = Health Card (vaccination card).

MH = Mantel Hanzel's chisquare.

MHLA = Mantel Hanzel's test for linear association.

OPV = Oral polio vaccine.

RR = Relative risk.

SAQ = UDHS service availlability questionnaire.

TBC = tuberculosis.

TOPV = Trivalent oral polio vaccine.

TT = (Women's) tetanus toxoid.

TT2 = 2 doses of TT giving with 4-8 weeks interval.

UDHS = Uganda Demographic and Health Survey 1988-89.

UNEPI = Ugandan Expanded Programme on Immunization.

Vs. = Versus.

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1.1 INTRODUCTION

I selected my topic in 1990 when, according to UNICEF's late 1980ies estimate, 3 million children under 5 years died each year from easily immunizable diseases: measles, tetanus, tuberculosis, whooping cough and diphtheria.[1] In addition, two hundred thousand yearly were crippled by polio.[2]
Immunization against all these diseases costs approximately US$ 10 per child.
In the meantime progress has been made. Newer figures from WHO are 2.1 million deaths among children under 5 years in 1990 from vaccine-preventable diseases.[3] The WHO estimates for 1990 are shown in table 1. As shown, vaccine-preventable deaths are 16.7% of all under-five deaths. This figure was estimated to be 27.4% in 1985. The Expanded Programme on Immunization (EPI) has in fact turned out to be a success. Each year around 3 million deaths are being prevented by immunization in the third world.[4] However, there is still a long way to go to reach the WHO goals for the nineties: achieving and maintaining 90% full immunization coverage of one-year old children by year 2000 in all districts; 95% reduction in measles deaths; global eradication of polio by year 2000, and eradication of neonatal tetanus by year 1995.[5]
The 1990 goal of 80% worldwide immunization rate has almost been reached with regard to the child immunizations.
However, the estimated 1990 level of immunization of pregnant

TABLE 1: Estimated morbidity and mortality from vaccine-preventable diseases among children under 5 years of age in developing countries (1990 estimates): Sources WHO, UNICEF.

Disease	Incidence	deaths	% of total deaths
Measles	49,000,000	880,000	6.8%
Pertussis	45,800,000	360,000	2.8%
Neonatal Tetanus	700,000	560,000	4.3%
Tuberculosis	7,600,000*	300,000	2.3%
Diphteria		4,000	0.03%
Poliomyelitis	190,000		
Total vaccine-preventable		2,100,000	16.7%

* all age groups

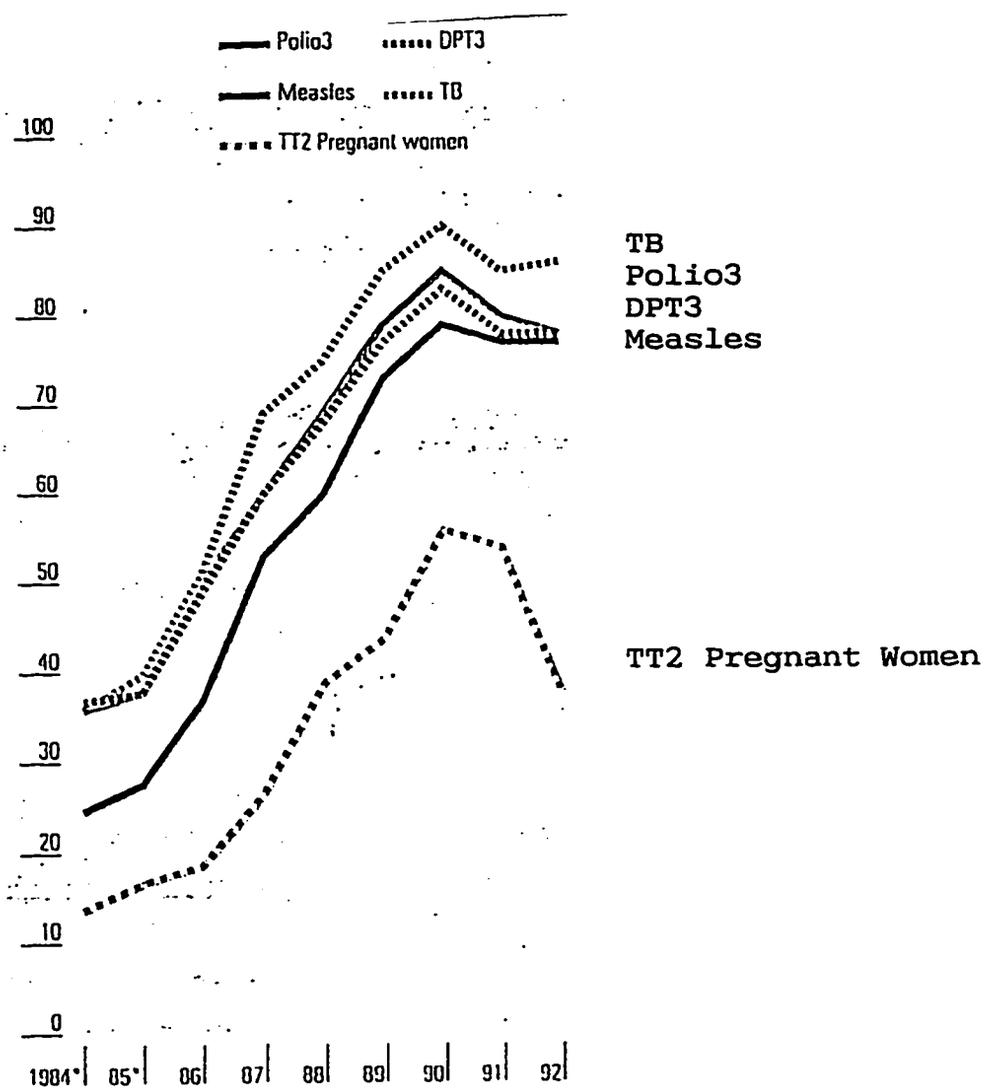
women against tetanus (two or more doses) is only 39% in the developing countries. These numbers hide big worldwide differences. China has achieved close to 100% coverage, while for the 41 least developed countries with a total population of 460 million the coverage for the child immunizations is no higher than 43%, while it is 37% for pregnant women's TT2.

The latest figures on immunization coverage in the developing world show a tendency towards stagnation and for TT2 there is a clear decline in coverage (fig. 1).

The latest message from the WHO's 47th World Health Congress is that the 1995 goals for measles will not be reached if the current slow downward trend in vaccination coverage continues.[6]

Fig. 1: Immunization coverage

Percentage of the developing world's one-year-olds protected against the major vaccine-preventable diseases.



* Ecluding China. **Source:** WHO and UNICEF, August 1993.

The immunization coverage in most African countries is still below world average and Uganda is no exception with regard to

full immunization coverage of one-year olds. However, recently the country has achieved a major increase in pregnant women's TT2. The reported vaccine coverage figures for Uganda are shown in table 2:

TABLE 2: Reported immunization coverage in Uganda. % of children under 12 months and pregnant women.

	Immuniz.Schedule	Year	1984*	1985	1988	1992
BCG	birth		5	37	79	98
Polio3 /DPT3	6,10,14 weeks		5	14	48	71
Measles	9 months		5	17	50	68
TT2			missing		14	83

* Estimates

UNICEF (which runs the UNEPI) suggests that the coverage in reality probably is 10-30% lower.[7] The coverage figures are based on quarterly reports on number of doses of vaccines given in each district. This is a very rough measure and several errors are likely: some of the vaccines might be given to older children or some children might receive more vaccines than necessary, just to name a few factors that would bias the figures towards an overestimation of the real coverage.

Uganda's history in recent decades of endless civil wars has had a negative impact on preventive health. However, since Yoweri Museveni's National Resistance Army came into power in

January 1986, things have begun changing towards the better. Regarding health, Ugandan policy is much in favour of preventive and educational measures; (i.e. as described in the 1990 edition of the State of the World's Children by UNICEF).[1] Child vaccinations and fertile women's tetanus toxoid are offered free of charge. Also the Ugandan government is very open about the country's health problems compared to many other countries in Africa (i.e. information about number of HIV-positives).

So far only a few African studies concerning risk factors for lack of immunization have been published. Studies have been carried out in Kenya, Mozambique, Gambia, South Africa, Nigeria, Senegal, and Cameroun. However, the latter three of them were restricted to the capitals of Lagos, Dakar and Yaounde, while the South African study was restricted to one township.

1.2 Relevance of the topic to health care.

Although most Ugandan children receive some immunization during their first year of life, many do not complete the EPI series. Neonatal tetanus is still a major concern, since many pregnant women do not receive tetanus toxoid.[8] My study tries to characterize children and pregnant women who lack

immunizations, and to identify relevant risk factors. It is certainly of benefit to know who the children/mothers who lack immunizations are, so special efforts can be implemented to reach these groups.

As the overall immunization rate goes up, the efforts turn more and more towards "reaching the unreached". Immunizing at every opportunity (i.e. using every contact with the health system to control for missing vaccinations for children and fertile women, and give the relevant vaccines at the same contact) has been strongly advocated for some years.[9] Fifty-nine missed opportunities studies were carried out between 1973 and 1991 in 41 developing countries.[10] All except for one study from Zimbabwe demonstrated missed opportunities for immunization during visits for curative health services. Among the 19 studies which assessed missed opportunities for both children and fertile women, 14 found that missed opportunities for women were several-fold higher than for children. This is no surprise considering that global immunization coverage is about twice as high for the child vaccinations than for TT2 for fertile women.

Immunizing at every opportunity is one way to improve coverage, especially for TT2, considering that women visit health services for many different reasons: child immunization or illness, adult illness, pregnancy check. However, at a cer-

tain point in a vaccination coverage, a "saturation" level for what can be achieved through the "every opportunity approach" will be reached. Subgroups lacking vaccination might pay fewer visits to health facilities than others do. It is not difficult to imagine that children lacking immunizations are less likely to pay visits to health facilities in the case of illness, than are children who already have established a contact with a health facility through vaccination. The reasons for not paying visits to a health centre or dispensary in the case of illness might be the same as the reasons for not having received immunization; (i.e. distance to health facility, caregivers do not have the amount of time needed to bring their child to a doctor/nurse, caregivers choose a traditional healer, etc.)

The Global Advisory Group (GAG) of the Expanded Programme on Immunization (EPI) speaks about high-risk subgroups in terms of lack of immunization and how important it is to reach these groups.[9],[11]

The 1990 GAG recommendations on neonatal tetanus are as follows:

- identify high-risk areas and population groups.
- prepare action plans which identify and prioritize efforts to reach high-risk areas and groups.
- screen and immunize every woman who brings a child to an immunization session.[11]

The questions arise: who are the "unreachable"? What are their characteristics?

The purpose of my study is to answer these questions.
I am looking at more than 40 variables including demographic characteristics, family characteristics, education, attitudes, socio-economic characteristics, communication, access to preventive health care, etc. These potential predictor variables are then compared to whether a child/mother is immunized or not - partly or fully. Finally, I hope to come up with models that characterize unimmunized and insufficiently immunized children and fertile women with regard to the EPI vaccines.

Once these children and fertile women are identified: how are they to be reached and vaccinated?

One of the ways is certainly through the improvement of infrastructure. Other efforts that have proved successful are: decentralization of vaccine administration, health education, community involvement, and trained midwives in the community.[3] In Gambia, reminder visits by health personnel the day before vaccination is due have proved to be effective.[12] Wright et al. recommend immunization on a house-to-house basis for children living in a zone that is epidemiologically at risk for poliomyelitis.[13]
This approach is of course imaginable for other vaccinations

as well. Other possible approaches will be cosidered later in the discussion section.

1.3 Vaccine availability in Uganda.

There is one question, which needs to be asked before doing the analysis that I have done: Are people insufficiently immunized because of lack of access to vaccination or are other factors of more importance? How is the availability of vaccines across the country of Uganda?

The availability of vaccines should be only a minor problem in the areas surveyed.[14] An international group which evaluated the Expanded Programme of Immunization and Primary Health Care in Uganda in July 1987, found most of the 114 UNEPI vehicles to be less than one year old, in a reasonably good condition, and suitable for Uganda's poor roads. The supply of vaccines to stationary immunization facilities overall was reported to be adequate, except for short temporary shortage of OPV and tetanus toxoid in a few ares. However, there appeared to be a shortage of transport with regard to outreach services.
The evaluation group visited five districts, namely Kampala, Tororo, Masindi, Mubende, and Rukungiri. They inspected 36 refrigerators, and concluded that the cold chain was maintained properly in the five districts. The peripheral health

units were able to store their vaccine stock properly and use ice-packs in outreach activities. No problem with vaccine supply was observed in the five districts.

2.1 LITERATURE REVIEW

Fassin and Jeannie studied sociocultural factors associated with immunization coverage among a random sample of 500 mothers in underprivileged suburbs of Dakar, Senegal.[15] The mothers were asked whether the youngest child between one and five years old had been immunized at least once and the response was verified with the vaccination card in her possession. Twenty-five out of 260 administrative districts in the suburbs were randomly selected for the study. In each district two blocks were randomly chosen, and interviews were conducted with the first 10 women who had at least one child under 5 years of age, starting from the eastern corner of the block.

The interviews were carried out in two stages, since in the first stage 8 women were absent twice and 41 women refused to answer. Hence 49 other women were selected and interviewed in the second stage.

175 (35,1%) of the children were not vaccinated at all. Factors strongly associated with lack of vaccination are shown in table 3.

The first four factors are socioeconomic and educational factors, while the next four relate to experience in town. Thus low socioeconomic standard, lack of maternal education, and migrancy are associated with higher rates of unimmunized

TABLE 3: Immunization Coverage and Sociocultural Variables of Children <5 years old in Urban Senegal.

Socio-cultural variables	n	not vac.	p*
Husband does not earn a regular salary	317	42.6%	<0.001
Not owning the house	165	41.2%	0.046
Not possessing a couch	328	40.8%	<0.001
Mother has no formal education	356	41.8%	<0.001
Mother's parents not living in town	285	42.1%	0.001
Spent <10 years in town	122	41.0%	0.09
Return to village in the past 5 years	285	41.0%	0.001
Mother >10 years at first arrival in town	244	40.6%	0.01
Participation in village associations	43	9.3%	<0.001

N=500 * Compar.group: Rest of sample excl.missing answers.

children, according to this study.

Participation in village associations was strongly associated with a high immunization rate. Of the 43 mothers participating in a village association, only 4 (9.3%) of them had not vaccinated their child. Participation in urban associations was not a significant factor.

It is interesting that while returning to the village is associated with a high proportion of unimmunized children, participation in village organisations was strongly protective. However, the authors did not comment on this.

Ethnicity, in terms of tribal belonging was not associated with vaccination after adjusting for education and low socio-economic group.

Cutts et al. evaluated factors influencing "vaccine uptake" [1] in Mozambique.[16] In 1987 they surveyed 30 urban and 32 rural clusters in two districts in the Inhambane province. Seven children aged 12 to 23 months were selected in each cluster using the EPI sampling method.[17]

Fifty-three percent of the children in the cities and 60% in the rural areas were fully vaccinated. A further 12% (urban and rural areas) of the children had a history of receiving all the vaccines but their vaccination cards were not available. These children were included in the analysis as "vaccinated". The "unvaccinated" group included incompletely immunized and never-vaccinated children.

Possible risk factors were divided into two groups: "personal" and "local" factors. The only local variable significantly associated with vaccine uptake in the urban areas was "number of days per week that the nearest health post offered vaccination" ($P<0.01$). "Distance to nearest the health post" showed a non-significant negative trend. In the rural sample only "inability of the community representative to speak Portuguese (the official language in Mozambique)" was significantly associated with lack of immunization.

Among the personal factors the following were significant (table 4):

---

[1] Whether a child has been immunized or not.

TABLE 4: Personal factors significantly associated with incomplete vaccination in Inhambane, Mozambique

Child born at home	Urban + rural	**
Five or more children in family	urban	**
Lack of knowledge of no. of vaccinations	rural	**
Can name <2 target diseases	rural	**
Recognizes <3 types of health education material	rural	*
Knowing child with post-vaccination abscess	urban	**
Non-Portuguese speaking	rural	**

* P<0.05. ** P<0.01.

Variables showing a strong (even if non-significant) association were included in multiple logistic regression analysis. These were done with separate models for "local" and "personal" factors; and also for a joint model.

The variable "family resident <1 year in the area" was highly significant in the separate model (OR = 4.7, P<0.01) for the urban sample, but was not significant in the joint model. The reason was that migrants to Inhambane had community support mechanisms (relatives in the area, etc.) and that one of the focal points of the health project was to refer new-comers to the health services. This seemed to work better in the countryside than in town.

Otherwise, all the above mentioned variables were significant in the separate models including "distance to health post" and "representative does not perceive EPI diseases as dangerous" in the urban sample (both P<0.05). In the joint model these two variables were not significant nor was "representative non-Portuguese speaking". Please see table 5 for more details.

TABLE 5: Logistic regression. Cutts et al. Mozambique study. Adjusted odds ratios for variables associated with increased risk of incomplete vaccination, in separate models for personal and local variables and in a joint model.

	levels	%	Sep.mod. OR	P	J.mod. adj.OR
URBAN SAMPLE					
Personal variables					
Knows of child with post-vaccination abscess		36	3.1	**	3.6
Child born at home		24	1.6	*	3.1
Five or more children in family		27	2.3	*	4.2
Family resident <1 year in area		17	4.7	**	n.s.
Local variables					
Number of days/week nearest health post offers vaccination	6	84	1.0	**	1.0
	3	3	1.7		0.8
	2	10	26.5		3.6
	1	3	16.8		8.5
Distance in km from nearest health post	<3	43	1.0	**	n.s.
	3-5	23	0.6		
	6-10	21	1.9		
	11-15	13	8.3		
Representative speaks Portuguese	Well	48	1.0	*	n.s.
	Little	39	2.0		
	None	13	3.8		
Representative does not perceive EPI-disease as dangerous		50	3.2	*	n.s.
RURAL SAMPLE					
Personal variables					
Child born at home		37	3.5	**	2.6
Mother non-Portuguese speaking		58	3.5	*	3.2
Mother can name <2 target diseases		52	4.1	**	3.7
Mother recognizes <3 types of health education material		39	3.6	*	n.s.
Local variables					
Representative non-portuguese speaking		29	2.6	**	n.s.

n.s. = not significant * P<0.05 ** P<0.01.
Sep.mod. = separate model. Joint m. = joint model.
Adjusted odds ratios only shown for significant associations in the joint model.

In Kenya in 1987, a countrywide survey on immunization was conducted using a stratified cluster sampling method modified from the stratified cluster sampling method recommended by WHO (please see chapter 4 on cluster sampling).[18,19] The country was divided into five ecological regions and from each of these regions two districts were randomly chosen. The clusters were defined as the smallest administrative units. In each of the districts, 30 clusters were randomly selected. A fixed number of households, usually 35 or 40 in each cluster were visited to give an average of seven children aged 12-23 months in each cluster.

The survey included a total of 2451 children: 40.2% were fully immunized according to a vaccination card, and another 10% only according to the mother's memory. However, there were pronounced regional differences which could not be explained by accessibility of vaccination facilities nor social factors. The geographical variation, however could be explained by ethnic-cultural differences.

The variable with the strongest negative association with full immunization was maternal education. Thus maternal education was controlled for in the stratified analysis.

Other variables associated with low immunization rate were: paternal education, ethnicity, low social group (subsistence farmers, casual labourers), polygamy, traditional religion, home delivery, and general health status of the family.

Maternal education was important in all social groups, but most pronounced in the lowest group. A high risk group was identified as children belonging to the lowest social group and to certain ethnic groups, living in rural areas, and whose mothers has no formal education.
On the other hand there was no effect of the child's gender in any of the 8 major ethnic groups. Distance to the immunization clinic was not significant (P=0.09).

Brown et al. tried to identify reasons for low immunization coverage in Yaounde, the capital of Cameroon.[20] They used the 1976 National Census, the 1978 National Nutrition Survey, as well as the annual citywide EPI immunization coverage survey. To the 1979 version of the latter, the researchers added two questions: Ethnic group and nutritional status. Large proportions of unimmunized children were found in certain neighbourhoods, among certain ethnic groups, in families at lower socio-economic levels, and in new arrivals (<3 months in town). Malnourished children were not less likely to be vaccinated than were well-nourished children.

The Health and Nutrition Baseline Survey 1983, which was carried out in the districts of BO and Pujehun in Sierra Leone, showed high differences in vaccination rates in favour of children living within 3 miles of the primary health centre compared to those living outside the three miles range.[21]

P. Hanlon et al. studied factors influencing vaccination compliance in two small peri-urban Gambian towns.[12] All children aged 12 - 18 months who were born locally were identified (251 children) and had their health cards examined. Two subgroups were identified: 23 children with less then five vaccinations and 42 children who were fully immunized (nine vaccinations). These two group were compared with regard to 29 socioeconomic and attitudinal variables in order to detect factors associated with poor vaccination compliance. Univariate analysis showed that the following factors were significantly associated with poor immunization: Lack of formal education, few assets and consumer goods, mother self-employed petty trader, little awareness and knowledge of immunizable diseases, superstitiousness, number of children, and mother had personally experienced a stillbirth. Also the fully immunized children visited the health centre significantly more for curative reasons than did the poorly immunized ones. There was no difference regarding mean family income, size of house, distance to health centre, and deaths among siblings.

None of the mothers interviewed believed that vaccination could cause any harm to their child.

Logistic regression analysis produced a best fit model containing number of children born alive, number of assets, and attitudes (would attend for vaccination, or weighing, even if the child were not sick / belief in a scientific cause of

disease).

It is possible that the heavier workload of looking after many children and (as traders) having to spend a great deal of time on the markets, gave the mothers of poorly immunized children less time to visit the health centre for vaccination.

The authors concluded that since some characteristics of mothers of children with few vaccinations were a low level of formal education and less awareness of diseases and vaccine, it would seem logical to employ health education techniques to compensate for these disadvantages.

However, these mothers pay fewer visits to the health centre, which is the traditional site for most formal health education. Hence health workers would need to take health education messages to the homes.

An unpublished Gambian study has shown that vaccination compliance was measurably improved by paying reminder visits to the child's compound on the day before vaccinations were due.[12] Hence, the authors suggested that Community Health Nurses should make these reminder visits to "at-risk children" and combine them with health education activities.

Mothers attending infants' primary health care centres with children aged from 10 months to 5 years were studied at two clinics in Lagos, Nigeria.[22] One-hundred twenty mothers were randomly picked (60 in each clinic) and interviewed.

The author proposed criteria for the identification of at-risk

children: "Four or more children in the family", "father unskilled or unemployed and separated from the family", "mother 30 years or older and with no formal education", and "family often moving from one place to another". Size of income and house were the same for the group of non-immunized as for the group of immunized. However this study, where only descriptive statistics were computed, had several weaknesses. Firstly, only visitors of the health centres were interviewed. Hence mothers who did not bring their children to the health centres were left out. It is not hard to imagine that these children could be the "hard core" of the at-risk children. Also high users of health services were over-represented, since the more you visit the centre, the greater was the chance of being randomly selected for interview. Secondly, the number of children and the age of the mother are correlated as are the age of the child and the age of the mother. By having a wide age interval (4 years and 2 months), the study was affected by changes in immunization rates over time. Older children might on an average be more poor immunized than younger children, considering that the immunization rate has increased.

An immunization coverage survey was conducted in September 1988 in Alexandra Township in South Africa.[23] Alexandra is a poor urban township of around 200,000 inhabitants situated near Johannesburg. Forty-five clusters of 7 children aged 12 - 23 months were interviewed. Sixty-one percent of the children

were fully immunized (probably according to a vaccination card but this is not clear from the article). The influence of 13 sociodemographic variables, 3 immunization knowledge variables, and 5 health service access variables on immunization rates were analyzed. Children with caregivers who could not read, or had difficulties reading a simple message in English ($P<0.01$ and $P<0.05$, respectively) were the only ones to have significantly lower immunization rates by one year of age and by the time of the interview. Forty-seven percent of the population were so called "squatters". These "squatters" children and those living farthest away from the clinic were the only groups with a statistically significant lower "on time" immunization rates ($P<0.05$) (i.e these children were on an average vaccinated later than other children), but at the time of the interview there were no other statistically significant differences.

2.2 Summary of the results of previous studies

In general, rural areas in Sub-Saharan Africa have lower immunization rates than urban areas. Communities where immunizations are not offered on an almost daily basis have with a few exceptions lower immunization rates than other communities.

In all studies, "parents having no formal education and/or low

literacy" is an important risk factor. There is a tendency towards the mother's education being the most significant (e.g. the Kenyan study). Low socioeconomic status is also an important risk factor that all studies agree on. Likewise is the case with home delivery ($P<0.01$ in Kenya and Mozambique).

The following factors have only been studied once each. In these studies, they emerged as significant risk factors for lack of immunization:

"father living separated from rest of the family" (Nigeria)

"general health status of the family" (Kenya)

"mother has previously expierenced a stillbirth" (Gambia)

"mother does not participate in an organisation" (rural Senegal)

"traditional attitudes" (Gambia)

traditional religion and polygamy (Kenya)

"mother knows child with post-vaccination abscess" (urban Mozambique).

Some factors have been significantly associated with vaccination compliance in some studies but not in others:

"Parents' lack of knowledge on immunization and health"

ethnicity

immigration

distance to immunization service

"maternal age >30 years"

"mother has more than four children".

So far no significance have been found for the following factors:

gender

nutritional status

"mother received antenatal care"

death among siblings

(the latter two were only studied once).

2.3 THEORETICAL RELATIONSHIPS BETWEEN VARIABLES AND IMMUNIZATION

2.3.1 Demographic characteristics

Urban areas should have higher immunization rates because of the advantage of having immunization centres within the community, which often is not the case in the rural areas. Also, educational and socioeconomic standards tend to be higher in urban areas. These factors should both be related to above average vaccination coverage.

Theoretically there should be a negative relationship between vaccination coverage and restricted access to immunization centres in terms of bad roads, long distance, or lack of public transportation.

When moving to a new place, it can take some time to get settled and get accustomed to the services that the new place offers, including vaccination services. Hence, immigrants might tend to be vaccinated to a lesser degree than those who have lived longer in the particular place.
However, it might depend on where the immigrants are coming from. If a child is moving from a town (where the immunization rates in general are higher than in rural areas) to a village, one would expect that the child would be better vaccinated

than a local village child.

Since various tribes live at different overall distances to health facilities, have different ways of living (nomads, permanent settlers), have different attitudes towards modern medicine, etc. one would expect differences in vaccination coverage between various ethnic groups, as is the fact in Kenya.[18],[19] Nevertheless, in African cities, ethnicity has been modified by other social factors. In their Senegalese study, Fassin and Jeannee found no difference in immunization coverage between different ethnic groups who had similar socioeconomic levels, although their culture, history and urbanization were quite different.[15] Several authors have come to the same conclusion even when looking at other outcome variables; (i.e. the same findings were obtained for access to curative care.[24])

Muslim children and women are expected to have lower vaccination coverage than their Christian counterparts, since Muslim communities often have traditional (health) practices, which leave them less receptive to modern health programmes, especially those of a preventive nature.[25]

2.3.2 Socioeconomic characteristics

High socioeconomic status in terms of good housing standards

(building material, water supply, toilet, electricity, stove) should be associated with high immunization coverage. People of high socioeconomic status are in general better educated and informed about the benefits of immunization.

Households having soap should be associated with higher immunization coverage. Soap is a cheap product that most people (even in Uganda) can afford. It is associated with some standard of hygiene, (i.e. it is a preventive health measure) as is immunization.
However, in some remote areas soap might not always be available, and this could lead to bias. In such areas low immunization coverage might be due to remoteness, not soap.

Listening to the radio or owning a radio represent both access to information as well as socioeconomic status. Since one of the ways that the EPI message is spread to the people is through radio, listening to the radio should be associated with higher coverage.

At least in rural communities, owning a transportation vehicle should be of advantage for the access to immunization centres and hence should lead to above average immunization coverage. In addition, owning a car, bicycle, canoe, etc. is associated with a higher level of socioeconomic status, which as mentioned above should have a positive association with immunization.

2.3.3 Educational characteristics

All sorts of education and knowledge should be associated with higher vaccination coverage, because with education people tend to understand the benefits of having their children vaccinated. In previous studies education has turned out to be one of the strongest determinants for immunization.

2.3.4 Family characteristics

"Number of persons in the household" and "number of children under five years of age in the household": Traditional households consist of many people, including many children. Modern families are on an average smaller. Since traditionalism in general is thought to be associated with low immunization coverage, one could expect that the bigger the household, the lower is the likelihood that its children would get immunized.

Woman's age: More younger women than "older" women should have received formal education. Also "older" women should on an average be more traditionalistic than young women. Since low levels of education and traditionalism are associated with a lower level of immunization, older women should on an average be less well protected against tetanus and their children

should be less immunized.

Marriage (or stable partnership) is a sort of social insurance, which theoretically should provide the basis for a more stable social and familial foundation than should be the case for a single woman with children. Hence, the married woman should on an average have more energy to spend on her child's health, including taking the child to immunization sessions. In most cases when the father is living apart from the rest of the family, he does this for the sake of earning money, which eventually should be for the benefit of the whole family. The mother stays at the village with the children. Though an important participant in the social network (the father) is not around, the social network might still work, since there might be other members of the family/village, who compensate for the father being away. It is difficult to generalize as to how the father living apart from the rest of the family should influence the possibility that his child receives vaccination.

There are two different ways how bigamy might influence the likelihood of getting vaccinations. Firstly, to have more than one wife is a traditional custom in many parts of Africa. Traditionalism is expected to be associated with lower immunization coverage, since vaccination is a modern invention, and is not traditionally incorporated in a child's life. On the other hand, only wealthy men can afford to have more than one

wife. And wealth is generally associated with higher immunization coverage.

Death of siblings is an indicator of poor health (and poverty) in the family and subnormal contact with the health system. Children from such families are expected to be immunized to a lesser extend than children from other families. The same argument is valid for women's TT2.

2.3.5 Attitudes, etc.

Parents with "modern" attitudes towards family planning are expected to have better than average vaccination coverage for their children since a positive attitude towards family planning should be linked with a positive attitude towards other parts of modern primary health as well, including immunization. The same argument is valid for women's TT2.

Women who are member of an organisation that promotes vaccination would be expected to have high TT coverage and high immunization coverage for their children.

The child's gender could be of importance with regard to full immunization, since boys in some African countries are more likely to visit health centres for curative reasons than are

girls; (i.e. an effective "using every opportunity" vaccination policy might be of most benefit for the boys.)

2.3.6 Health system

If a mother has contact with the modern health system during pregnancy for preventive reasons (e.g. check-ups, tetanus vaccination), it is likely that her child subsequently will get vaccinated, since the contact for preventive health is already established. This contact is also established if a midwife or doctor assisted with the delivery, which also should ensure that the newborn child receives BCG at birth.

Since one of the tasks of a trained midwife is to promote tetanus vaccination for pregnant women, communities with a trained midwife should have higher TT-coverage than communities without. She might also have a positive effect on the child vaccinations.

Children and fertile women from communities that offer daily or weekly immunization service should be better covered with regard to the EPI vaccines, than children and women from other communities where immunization service is not available every week. In the latter communities, immunization is often provided as a so called out-reach service in contrast to stationary service at a permanent health centre.

Distance to stationary immunization centre should be inversely related to vaccination coverage in communities not served by out-reach service.

2.3.7 Summary

Many of the above mentioned predictor variables are inter-related, (e.g. education and socio-economic status).
The discussion above is only about theoretical univariate relationship. As described in the methods section, logistic regression was carried out to adjust for the correlation between various predictor variables.

3. UGANDA AND THE DEMOGRAPHIC AND HEALTH SURVEY 1988-89

3.1 Short description of the country

The republic of Uganda is located in Central-Eastern Africa and lies astride the equator. The country is landlocked, bordering Kenya in the east, Tanzania and Rwanda in the south, Zaire in the west, and Sudan in the north. The area is around 240,000 sq. km., which is approximately the size of the U.K. The population is 17.3 million (mid-1990 estimate). The languages are English (official), Swahili, Luganda, Lugbara, Runyankole-Rukiga, Runyoro-Rutoro, and numerous other local languages. There are four major ethnic groups: the Bantu, the Nilotic, the Nilo-Hamitic, and the tribes in the West Nile Province, which are of Sudanese origin. Pygmies in the south-west of the country are ethnically related to the Bantus, who are the biggest ethnic group on the country.

Much of the country forms a plateau at 900-1,500 meters above sealevel, with temperatures mostly between 15° and 26°C throughout the year.

Uganda is mainly an agricultural country. Its favorable climate and fertility saved people from starvation during the endless civil wars. Since farming has been able to feed the people, Uganda has never experienced the migration from country to towns as have other countries (i.e. their

neighbours to the east, Kenya).

More than 90% of the work force are employed in agriculture. Coffee, cotton, tea, tobacco, and sugar are the main export crops. The main food crops are plantains, sweet potatoes, millet, sorghum, pulses and beans, and groundnuts. The main trading partners are the EEC, Japan, U.S.A., and the neighbours Tanzania and Kenya. Uganda's GNP is around 300 US$ per capita.

Only about 10% of the population live in towns of more than 1000 inhabitants.

Kampala, the capital of 500,000, and the industrial town of Jinja, 60,000 are the biggest cities.[26] Other principal towns are Masaka, Mbale, Entebbe (the airport, some governmental institutions), Mbarara, and Gulu.[27]

Uganda was a British protectorate from 1893 until 1962, when it gained independence with Milton Obote as the first prime minister. Much of the time after independence has been characterized by political struggle and civil wars. However, things have slowly turned towards the better, since Yoweri Museweni's NRA came into power in January 1986; though it was not until 1991 that the government achieved a stable, full control situation in the Northern provinces. That is the reason why 9 northern provinces were not surveyed in the Uganda Demographic and Health survey (UDHS).

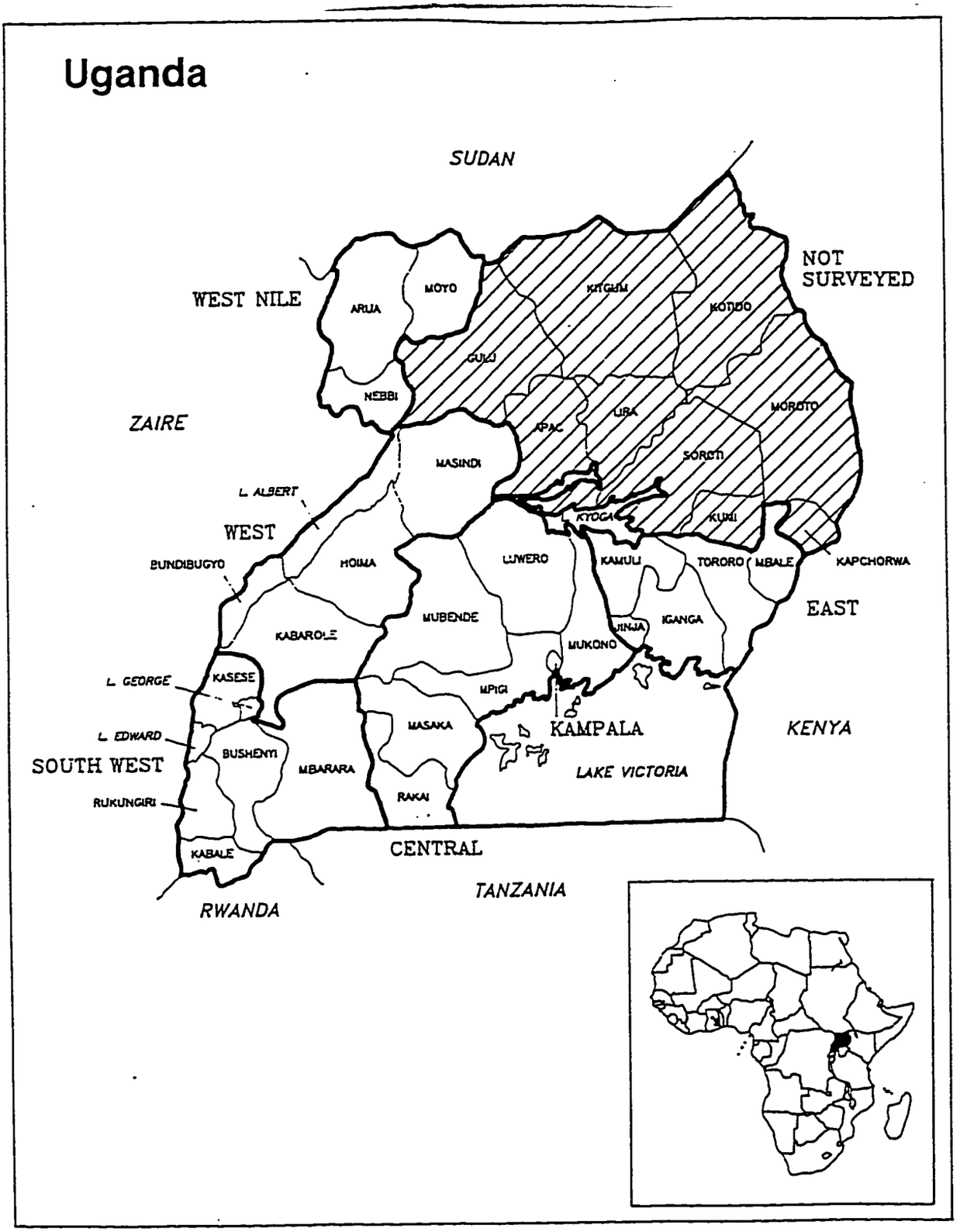
3.2 Short description of the Uganda Demographic and Health Survey 1988-89

The Uganda Demographic and Health Survey [UDHS] was conducted by the Ministry of Health in 24 districts between September 1988 and February 1989.[28] The sample covered 4730 women aged 15-49 years. Nine northern districts, containing an estimated 20% of the total Ugandan population were not surveyed due to security reasons at the time of sample selection (see map on next page).

The purpose of the survey was to provide baseline information regarding fertility, family planning, and maternal and child health for planning and implementing national and regional programmes.

The survey was conducted by the Ministry of Health in collaboration with the Ministry of Planning and Economic Development, The Institute of Statistics and Applied Economics, Makerere University, and the Department of Geography, Makerere University. Training and fieldwork was carried out with financial and technical assistance from the U.S. Agency for International Development [USAID]. The Institute for Resource Development, a US macro systems company, provided technical assistance.

FIGURE 2: Map of Uganda.



The sample used for the UDHS was a stratified, weighted probability sample of women aged 15-49 selected from 206 clusters. A general discussion of cluster surveys, the probability proportional to size [PPS] sampling, and its statistical implications are discussed in chapter 4.

Different survey designs were applied for the rural and the urban areas:

Primary sample units in the rural areas were sub-parishes, which (in the absence of a more reliable sampling frame) were selected with a probability proportional to the number of taxpayers. The South West region was over-sampled by a factor of two, and the central region known as Luwero Triangle was over-sampled by a factor of three to provide a sample with sufficient size to produce independent estimates for these two areas.

Ten percent of the subparishes were selected for the second stage in which teams visited each selected sub-parish and listed all households. Individual households were then selected for the interview by stopping at every tenth household.

The urban sector was over-sampled by a factor of three compared with a proportionate urban/rural sample in order to achieve a sufficient urban sample.In the urban areas the smallest administrative units known as Resistance Council Ones [RC1] were the primary sample units.

In the first stage, a sampling frame was created by

systematically selecting 200 of these units with equal probability for a complete household updating.

In the second stage, a subsample of 50 RC1s were selected with a probability proportional to size (size as reported in the household listing). Twenty households were then systematically selected in each of the 50 RC1s for a total of of 1,000 urban households. The survey design is explained further in Appendix A.

Three questionnaires were used: the household questionnaire, the individual woman's questionnaire, and the service availability questionnaire. All questions with relevance to my research are listed in Appendix B.

The questionnaires were translated into four languages: Luganda, Lugtbara, Runyankole-Rukiga, and Runyoro-Rutoro. A pretest of the translated questionnaires was conducted in October 1987. The questionnaire was interviewer administered.

The household questionnaire obtained a list of all the usual members of the household and their visitors, together with information on their sex, age, and fostering of children under 15. It was used to identify woman eligible for the individual questionnaire, namely those aged 15-49 who had slept in the household the night before the household interview. For women that were absent or could not be interviewed during the first visit, a minimum of three revisits were made before recording

no response.

The individual questionnaire contained questions on fertility, family planning, and maternal and child health.

The service availability questionnaire [SAQ] collected information on family planning, health services, and other socioeconomic characteristics of the selected rural and urban areas and was completed for 161 of the 206 clusters. The SA questionnaire was administered by a different team of interviewers. The results are not shown in the UDHS report.

The household response rate was 99.6%. On an average there were 0.95 women per household (i.e. some households had no women aged 15-49 years (and some had more than one)). The individual response rate was 97.4%. In no district was it lower than 95%. The urban response rate was 96.0% and the rural 97.7%. Please see appendix A for further details.

Completed questionnaires were sent to the data processing room at Makerere University where data entry proceeded concurrently with fieldwork.

3.3 Obtaining and transcription of data

The UDHS raw data for the **household** and **individual questionnaire** was obtained from the Institute of Resource Development [IRD]. The 19 Mbytes of data, which was provided on a magnetic mainframe tape as a 1600 bpi, unlabelled EBCDIC file, was translated into an SPSS-X system file, which, due to the size, was then translated into three SPSS-PC system files. These files were edited by removing variables not necessary for this study.

Data used to identify eligible women for the individual questionnaire were eliminated. All variables concerning children >3 years old were deleted as were most of the variables concerning contraception, feeding of the children, and marriage. Information about women without children under three years old was deleted. Hence the files were reduced from 4730 women to 2400 women, as well as by the deletion of many variables. The three files were then merged to one SPSS-PC system file.

The service availability questionnaire [SAQ], which I received a month later from the same source, was also available in a SPSS-PC version.

The individual data file and the SAQ file were translated into dBASE files and merged by matching clusters using the EPI INFO merge command. This means that all women in a cluster had equal values with regard to the variables from the SAQ (C2-

C31), while the values differ with regard to the variables from the individual questionnaire. Suppose the i'th cluster consisted of 20 women. Then there would be 20 different answers with regard to age. On the other hand the item "trained midwife in cluster" would produce the same answer for each of the 20 women.

Finally the combined file was translated back to SPSS-PC.

3.4 Transformation of variables.

UDHS-questions relevant for my study are shown in Appendix B. Many items had several alternatives, e.g. Q717 (roof material) and Q150 (membership of an organisation). In order to achieve a sufficient number in each cell for the statistical analysis related answers were grouped. Continuous variables such as age of the mother (15-49 years) and number of children per woman (0-19 children) were grouped in order to be able to do non-parametric statistics with a sufficient number in each cell. Other variables had to be combined for the cause of analysis, i.e. C30A (trad. birth attendant trained in modern methods) and C31 (trained midwife). The predictor variables are further presented in section 5.2, while a list of variable transformations is shown below (number of categories for analysis are shown in brackets):

Q101 **Number of people in household** (3) ≤5, 6-10, ≥11 - arbitrary gouping.

Q102 **Number of children <5 years in household.** (4) 1, 2, 3, >4.

Q105 **Length of residency** was arbitrarily dichotomized into <2 years, >2 years. The <2 years group were stratified with regard to previous residence: urban or rural.

Q107-8 **Women's age** was arbitrarily transformed into **five age groups:** 15-19, 20-24, 25-29, 30-34, 35-39, 40-49.

Q109-110 **Education:** Junior school was merged with primary school, since Junior school is the old name for grade 5 to 7 in the primary school. Secondary school and university were merged. Hence three categories remain: No school, primary school, secondary school (any attendance would do).

Q115 **Source of drinking water** was dichotomized into
1. higher standard (piped into yard, plot, residence; public tap, borehole at the residence).
2. lower standard (others).

115A **Distance to drinking water:** Since only 20 rural women had >3 miles to walk for drinking water, these were merged with

the 1-3 miles group. For the same reasons the urban subsample were dichotomized into <1/4 mile and >1/4 mile.

Q117 **Household has toilet** (any kind) was dichotomized into yes or no.

Q120G Charcoal or electric **stove in the household** (2): 1. yes 2. no.

Q121 **Household owns transportation vehicle** (2):
1. bicycle, motorcycle, motor vehicle, canoe, or boat;
2. no transportation vehicle.

Q122 **Main material of floor** (2): 1. earth/sand, cow dung;
2. cement/finer material.

Q150 **Woman member of an organisation** (2): 1. yes; 2. no.

Q206 **No. of children who have died** (3): 0. none; 1. one ;
2. two or more. Younger siblings who have died are not included. Children who died after the woman's youngest child was born were not counted as dead in the women's TT file.

Q208 **No. of children ever born** (2): 1. ≤ 4; 2. ≥ 5 (same cutpoint as in comparable studies described in the literature review. Younger siblings were not counted for the child

immunizations files. Youngest child were not counted in the women's TT file.

Q404 **Pregnancy check** (3): 1. doctor, trained nurse/midwife; 2. traditional birth attendant (left out of the analysis because of very small numbers); 3. no one.

Q405 **Assistance with the delivery** (4) Same as above except 3. relative, etc. or no one.

Q502 **Marital status** (2): 1. married/living together with a man; 2. single incl. widowed/divorced.

Q518 **Number of places** where the woman lived, since the first time she lived together with a man (3) : 1, 2, 3 or more.

Q610 **Ideal number of children** (2): 1. $\leq$6; 2. $\geq$7. The women's answers clustered around two intervals: 3-5 children and 8-10 children, while only a few women answered 6 or 7 children.

Q702-3 **Husband's/partner's education** (3): same as Q109-10.

Q717 **Material of the roof** (2): 1. papyrus/thatch; 2. better material (i.e. iron sheets, tiles, concrete).

Q718 **Material of the walls** (3): 1. thatch/mud and poles; 2. earth or clay bricks; 3. cement blocks/stones.

C31 **Midwife** was merged with **traditional birth attendant trained in modern methods.**

4.1 CHARACTERISTICS OF CLUSTER SURVEYS

In most developing countries, simple random sampling is not possible: accurate lists of the population do not exist, and travel between selected individuals, who might be widely scattered, can be both costly and time consuming.[29]

An alternative sampling strategy, with considerable operational advantages, is know as "probability proportional to size" (PPS) cluster sampling. The sampling area (e.g. a country) is divided into small units (clusters). The population of each cluster must be known or estimable from census or other figures. Rough statistical estimates are done in order to decide how many clusters are needed for the study. In the first stage of sampling the clusters are selected in such a way that large clusters have a higher probability of being selected that do small clusters. Large clusters might even be selected twice or thrice.

In the second stage of sampling a certain number of individuals (often 7) is selected within each cluster. Several methods of more or less random selection have been used depending on what is practically achievable.

In order to achieve the same precision with cluster sampling as would be possible with simple random sampling, the sample size required for simple random sampling is multiplied by a factor (called the design effect [DEFF]), to estimate the sample size required for cluster sampling. DEFF is the

variance of the estimated outcome under cluster sampling relative to the variance under simple random sampling:[30]

$$DEFF = sec^2/s^2,$$

where

s = standard error for simple random sample, and
sec = standard error for cluster sample.

The formulas are given below:

$$s = \sqrt{[p(1-p)/N]}$$
$$sec = [c/\Sigma x_i]\sqrt{\{[\Sigma y_i^2 - 2p\Sigma x_i y_i + p^2\Sigma x_i^2]/[c(c-1)]\}}$$

where

c = number of clusters surveyed
y_i = number with the observed variable in the i'th cluster.
x_i = number of sample units (i.e. people interviewed) in the i'th cluster.
$p = \Sigma y_i/\Sigma x_i$
N = total sample size.

It is often desirable to obtain separate estimates for, say, different regions (strata). The UDHS design is an example of

a stratified, weighted PPS sample design. The sample size for each stratum must be sufficient for carrying out appropiate statistical analysis for each strata, which means that some strata might have to be oversampled in order to achieve the desired power. A point estimate for each stratum may be calculated. A stratified estimate for the whole surveyed area may then be calculated by weighting the stratum estimates by the stratum population. The straight forward unweighted value would be a biased estimator of the true population value. The standard error of the stratified, weighted estimate will usually be slightly smaller compared to the standard error of an unweighted estimate.[31]

Compared to the formulas on page 45 we must replace x_i with $w_i x_i$ and y_i with $w_i y_i$, where w_i is the weight attached to the i'th cluster.[31] An unweighed cluster has $w_i=1$. Hence

$$p = \Sigma w_i y_i / \Sigma w_i x_i$$

and $$sec = [c/\Sigma w_i x_i]\sqrt{\{[\Sigma w_i^2 y_i^2 - 2p\Sigma w_i^2 x_i y_i + p^2 \Sigma w_i^2 x_i^2]/[c(c-1)]\}}$$

For a given cluster size and a given total sample size, a survey in which a large number of clusters is selected and a few households are visited in each, will give more precise results than a survey in which a larger number of households are visited in each of a smaller number of clusters.

The precision of an estimate also depends on the item itself

and how evenly it is distributed across the population. For example, suppose the overall proportions of households with a toilet in the sampling area were 40%: if the proportions in each cluster varied little (say between 35% and 45%) a small number of clusters selected will give a reasonable precise estimate. If, on the other hand, the proportions in each cluster varied widely (say from 0% to 80%) one would need a larger sample to obtain the same precision. This inter-cluster variability is measured by the rate of homogeneity (roh).

It is given by the formula:[30,31]

$$roh = (DEFF-1)/(b-1),$$

where b is the average of responses to the item per cluster.

The sample designer can reduce roh by increasing the distance between study units[32] (i.e if the persons interviewed are widely and randomly scattered throughout the cluster), which makes roh lower, than if one house is chosen as the starting point for the interviews and subsequently the nearest neighbours are visited and interviewed.

A variable which is very homogeneously (randomly) distributed across the population will have roh close to zero, whereas one which is heterogeneously distributed, will have a higher value (up to one, which is the maximum value). Values of roh below

zero is usually considered as due to sampling error and treated as zero.

Demographic items such as "currently married" and measures of mortality (excluding epidemics) will be hardly more likely to produce the same answer from two respondents in the same cluster as from two respondents in different clusters, and will have a roh close to zero. For questions of health care practice and immunization coverage, responses will depend on the level of services locally and on local customs, and roh may be from 0.1 to 0.3 depending on the amount of variation between communities.[33]

In practice values of roh above 0.4 are uncommon, except for variables which are specific for a community rather than for a household (i.e. "health within the community").

If the design effect is more than one (which is usually the case), the variance of any estimated outcome will be larger for a clustered design than for a simple random sample design (i.e $sec^2 > s^2$). Given the previous mentioned formulas we have an increase in the standard error:

$$sec = s\sqrt{DEFF}$$

The square root of the design effect is called the design factor.

Conclusion: Analyzing a clustered study like a random sample study yields the same odds ratios, but the P-values are lower and the confidence intervals more narrow than they should be if the analysis is done properly taking the design effect (if >1) into account.

Analyzing a stratified, weighted study as an unweighted studies would result in biased point estimates and hence biased odds ratios. However, the experience from immunization coverage surveys is, that the unweighted estimates obtained by surveys which did not conform with the PPS sampling were similar to the weighted results.[17]

4.2 Logistic regression of clustered data

In the case of multivariate analysis the problem is much more complex than mentioned above. It is beyond the scope of this paper to go into a detailed discussion of this issue. However, let us have a short look at clustered data and logistic regression, since logistic regression was carried out in my study.

Ordinary logistic regression has the advantage of being computationally relatively simple, and can easy be carried on a micro computer. Using this method one must assume independence between sample points (i.e. roh=0 in each

cluster, which should rarely be the case). The problem with using ordinary logistic regression on clustered data is that the P-values usually are too low and some reportedly significant results are nonsignificant.[34] However, it is important to emphasize that it is the standard errors of the regression coefficients which are invalidated by the clustered sample, rather than the coefficients themselves.[35]

Several recent approaches for modelling clustered data have been proposed. Many of these approaches can be grouped into two classes: cluster-specific and population-averaged.[36]

With the cluster-specific approach, the probability distribution of the binary outcome Y_{ij} of the j'th subunit of the i'th cluster is modelled as a function of the covariates X_{ij} and parameters α_i specific to the i'th cluster. Examples of this approach include the mixed effects logistic regression model by Stiratelli et al.[37] as well as the logistic-normal mixture model formulated by Pierce and Sands in 1975 and extended by Hauck and Ober in 1987 to include subunit-specific covariates.[34] However, these models are computationally very complicated.

With the population-averaged approach, the marginal or population-averaged expectation of Y_{ij} over clusters is modelled as a function of the covariates X_{ij}. Examples of this approach include the quasi-likelihood approaches of Williams[38] and Liang and Zeger,[39] as well as the beta-

binomial model by Prentice.[40] Rosner proposed a polychotomous regression model to control for the effect of both cluster and individual-specific covariates while accounting for the correlation among units within a cluster.

This model reduces to a beta-binomial model in the absence of covariates (as does Prentice's model), and to an ordinary logistic model for clusters of size 1 and for large clusters when no correlation is present.[41]

One of the disadvantages with Prentice's model is that only unit-specific covariates are possible. Rosner's model has been strongly critized by Neuhaus and Jewell, because the effects of covariates on the binary outcome obtained by Rosner's model can be misleading, and not correspond to those measured by either of the two above mentioned standard procedures. Even Liang and Zeger's model, which leads to systematically smaller regression effects than those obtained by a cluster-specific model, has been the case of major criticism.[42]

There are advantages but also disadvantages with all the models presented. So far the experts have not been able to agree on a certain model for logistic regression of clustered data, and the search for such a model continues. In lack of a good model for logistic regression of clustered data, I used ordinary logistic regression analysis in my study to produce a best-fit model. Then I adjusted for the design effect as described in the methods section (chapter 6.2-4).

5.1 AIMS OF RESEARCH

Using data of the 1988-89 Uganda Demographic and Health Survey [UDHS]:

To assess risk factors for children not getting immunized against tuberculosis, diphtheria, tetanus, whooping cough, polio and measles.

To assess risk factors for not completing the EPI vaccination series.

To assess risk factors for pregnant women not receiving tetanus-toxoid for protection against neonatal tetanus.

and hence:
To identify high risk groups/populations were children are less likely to get immunized (partly thru fully).

To identify high risk groups of pregnant women in terms of not receiving tetanus toxoid during pregnancy.

To create a "baseline for comparison" for future achievements in immunization coverage.

5.2 Objectives

To test whether children or mothers with certain characteristics mentioned in table 6 are less likely to receive vaccination than are others.

TABLE 6: Variables tested for influence on immunization status:

Demographic variables:
- area - rural/urban
- migrants
- religion

Socio-economic variables:
- Drinking water: source and distance
- Toilet
- Soap
- Household owning a transportation vehicle
- House standard (roof,walls,floor)
- Household owning a radio
- Household owning a stove

Educational variables:
- Mother's education
- Mother's literacy
- Mother listens to radio
- Father's education
- Father's literacy

Attitudes, etc.
- Mother's attitudes towards contraception
- Mother's attitudes towards family planning
- Husband's attitudes towards contraception
- Husband's attitudes towards family planning
- Mother's ideal number of children
- Mother member of an organisation (Mother's Union, YWCA, Red Cross, a cooperative, Family Planning Association, others - see Appendix B for Q150 coding).
- Child's gender

TABLE 6 (cont.): Variables tested for influence on immunization status:

Family characteristics:
- Size of the household
- Number of children in the family
- Age of the mother
- Marital status of the mother (single, monogamous, polygamous)
- Father living apart from the rest of the family
- Sibling who has died

Health system:
* Mother's pregnancy check
* Mother's tetanus vaccination
* Assistance with the delivery
**Immunizations given on a daily/weekly basis
**Trained midwife in the community

---

* not applicable for women's TT.
**not applicable for the urban subsample.

The choice of independent variables depended, in the first place, on what was available from the UDHS in sufficient size for analysis. For example, the sample sizes of the SAQ-variables on distance to health centre and road standards were too small to be included in the analysis. In addition the variables should be easy to indentify and measure for the local health worker.

Secondly, variables were selected in order to be able to make comparisons with other similar studies.

Thirdly, variables that theoretically could be predictors of lack of immunization (please see section 2.3), e.g."source and distance to drinking water" (e.g. according to the authors of the Gambian study mothers might not have sufficient time and energy left to bring their children and themselves to immuniz-

ation sessions if they were to spend a great amount of time on other activities (trading at the market place, going for water, etc.)).[12]

Finally, some variables on primary health promotion were selected in order to see if health messages delivered on the radio, through a trained midwife or through an organisation had a positive impact on immunization coverage.

6. METHODS

6.1 Study population

The study population consisted of children identified in the UDHS who were aged 12 to 35 months. If a woman had more than one child in this age group, only one was randomly selected for my study. This was done in order to reduce roh and the risk of sampling bias. It is reasonable that women who do not use preventive methods and who have many children, are less likely to have their children immunized. If more than one child per woman were included there would be an over-representation of women who have children at close intervals. This measure reduces the original sample size from 1775 to 1697, (i.e. 78 (4.4%) of the children were excluded).
This is a small number which is unlikely to have any impact on the results.

At the time of the survey, the recommended ages for vaccination were as follow: BCG: 0 months; DTP and Polio: 6, 10, 14 weeks; measles: 9 months.
Since 1988 oral Polio was given at birth as well.
Children should have received all vaccinations before they become one year old. The last immunization - measles - is scheduled for age 9 months.

There are some advantages by only looking at children <3 years old:

a) The problem of missing health cards will be less, compared to having ages 3 and 4 in the study. The more time that has passed since vaccination, the more risk of a vaccination card getting lost.

b) The information will be more recent than if older children were included.

c) The acceleration of UNEPI began in January 1987 (i.e. 2 years before the UDHS).

For studying "receipt of tetanus toxoid during pregnancy", the study population is defined as women fulfilling the following criteria: child born within 2 years preceding the survey (1998 women).

6.2 Estimation of weighting effects and design effects

As previously mentioned the UDHS sample is a weighted PPS-cluster sample. Further the SAQ obtained the same answer within each cluster (i.e roh=1).

Some parts of the rural subsample were oversampled: the Luwero triangle was over-sampled by a factor 3 and the South West Region by a factor 2, compared to the rest of the rural

subsample. The problem is whether to analyze the rural subsample as one or three samples. If it is analyzed as one sample, the next problem is whether or not to count the cases according to weight (i.e. 0.34 for the Luwero triangle and 0.5 for the South West region). As previously mentioned (p.50) the unweighted estimates are unlikely to differ substantially from the weighted ones, and so was the case for my study. For the sake of simplicity, only the unweighted results are shown in the tables, while the weighted odds ratios are shown (for comparison) in Appendix D.

The question arises whether the results obtained for the predictor variables are influenced by "rural region" (i.e if "rural region" is a confounder or effect modifier (or both) for any of the predictor variables).

In the case of confounding, the observed association between a predictor variable and an outcome variable is due, totally or in part, to the effects of differences between the "rural regions". The confounding factor must be associated with the predictor variable and, independent of that variable, be a risk factor for the disease (read lack of immunization).[43]

In order to evaluate any possible confounding by "rural region", stratified analysis were done and Mantel-Haenzel's pooled estimates[44] were presented in Appendix D along with the crude odds ratios. The magnitude of confounding is the degree of discrepancy between the crude and the adjusted (Mantel-Haenzel) odds ratios. The crude and the adjusted odds

ratios presented in Appendix D are similar, which means that "rural region" is no important confounder for any combination of predictor and outcome variable in this study.

Another factor to consider is effect modification, i.e. if the magnitude of the association between the predictor variable and the outcome variable varies by levels of a third factor.[43] In order to describe any possible effect modification by "rural region", Woolf's test for heterogeneity across strata was performed. As mentioned above all predictor variables were stratified by "rural region", and Woolf's test was performed on every combination of predictor and outcome variables, using the EPI-info analysis program. The formula is taken from Sclesselman's book.[45] The P-value obtained provides some indication about whether the odds ratios (OR's) at different levels differ. If $P<0.05$ the odds ratios may be considered to differ, indicating interaction (read effect modification) between the analyzed predictor variable and "rural region". Woolf's test is considered to be safe with a minimum of five cases per cell, which is almost always the case here.

In the case of a Woolf's test where $P<0.10$,[1] the stratified tables are shown in the results section, and the potential reasons for confounding are discussed in the discussion section. Otherwise only the non-stratified results are shown

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[1] Since Woolf's test has lower power, it is custom to use $P<0.10$ as cutpoint in order to be able to identify any important effect modifier.

in the results section counting every case as one (1.0) case. All Woolf's test results are shown in Appendix E.

Some of the design effects [DEFF*] of the individual questionnaire listed in Appendix B of the UDHS report, are used to calculate DEFF's for the individual predictor variables in my study using the formula below:[30]

roh* = (DEFF* - 1) / (b* - 1)

roh = (DEFF - 1) / (b - 1)

where b* is the average number of units (women interviewed) per cluster,
and b is the average number of children aged 12-35 months included in my study.

Since roh* = roh we have:

(DEFF* - 1) / (b* -1) = (DEFF - 1) / (b - 1).

Let E* = DEFF* - 1, and E = DEFF - 1, we have

E = E* (b - 1) / (b* - 1), and

DEFF = 1 + E.

Since the average unit per cluster is lower in my study due to a smaller number of children aged 12-35 months than women, while the number of clusters is the same (except for some outcome variables where a few clusters have zero units), DEFF tends to be smaller than DEFF*.

The design effects of the SAQ variables are calculated as follows:

$$DEFF = 1 + (b - 1)\ roh,$$[31]

since roh=1 in the SAQ, we have

$$DEFF = 1 + (b - 1) = b$$

Hence the design effects of the SAQ variables equals the average number of units per cluster (with more than zero units).

95% confidence intervals adjusted for the design effects (CI*) are calculated using the formula below, which is a simple extention of a common formula for construction of confidence intervals around a relative risk or an odds ratio:[43]

$$CI^* = (OR)EXP[(\sqrt{DEFF})\ln(CI/OR)],$$

where

OR=odds ratio

CI=random sample confidence interval.

6.3 Sample size

The sample size was fixed due to logistic considerations: what was available from the UDHS. However, a brief statistical look is worthwhile:

Alpha = 0.05 (two-sided test); power = 80%.

Let us consider the following example with dichotomized exposure (formal education): p_0 = 0.4 (i.e. proportion of children immunized, whose mother has received no formal education). Let us consider a full immunization rate of 50% of the children who have at least one vaccination (i.e. the drop-out rate is also 100%-50%=50%). The rural sample size for this setting is 733 children (see later in this section). The design effect for education for this subsample is 1.11.
The smallest detectable relative risk (read odds ratio) can be calculated using Walter and Denman's formula [45]:

$$\text{Smallest RR} = 1 + \sqrt{A}\ \{B\sqrt{A} + \sqrt{[AB^2 + 4C]}\} / C$$

where

$A = (z_\alpha + z_\beta)^2$

$B = 1 + 2p_0$

$C = 2p_0 [cn(1-p_0)/DEFF - Ap_0]$,

where

n = number children, who are not fully immunized ("drop-outs"); i.e 733/2=366, and

c = no. of fully immunized children per drop-out = 367/366.

p_0 = the expected rate of "exposure" among immunized.

Hence

cn = (367/366)366 = 367.

Applying our data to this formula:

$A = (0.84 + 1.96)^2 = 7.84$

$B = 1 + 2x0.4 = 1.8$

$C = 2x0.4 [367(1-0.4)/1.11 - 7.84x0.4) = 156.19$

$OR = 1 + 2.8 \{1.8x2.8 + \sqrt{[7.84x3.24+4x156.19]}\} / 156.19 = 1.54$

(i.e a smallest detectable odds ratio of 1.54).

Considering the urban sub-sample where cn=123 and DEFF=1.09 (otherwise the same criteria as above), the smallest detectable OR = 2.10 using the formula above. Applying the same data to an immunization rate of 40% would yield a smaller detectable OR (1.97), since nc would be larger (cn=147).

The sample size required for the smallest detectable odds ratio varies very little inside a population exposed between 20% and 80% for OR $\geq$1.5.[45]

The SAQ-variables possess a potential sample size problem. Since roh=1, the design effects for the SAQ-variables are substantially higher than for the variables from the individual questionnaire. Let us consider an example of full immunization in the rural subsample, where p_0=0.4, cn=632 and DEFF=7.43. Applying the formula from above yields a smallest detectable odds ratio of 2.32.

If we apply the same formula to the urban subsample where cn=84, DEFF=4.73 and p_0=0.4 we get a smallest detectable odds ratio of 5.26. For all combinations of SAQ-variables and outcome variables in the urban subsample the smallest detectable odds ratio is more than five, and in some combination it even exceeds seven.

Another problem is that the SAQ was carried out in neither Kampala nor in the provincial capitals of Rukungiri and Kasese. Hence only slighly more than half of the urban subsample was included in the questionnaire. The fact that Kampala was not included also poses a risk that the SAQ-clusters are not representative for the urban subsample.

Based on the high smallest detectable odds ratio (i.e. low power to detect any real differences) and the risk that the

SAQ-clusters are not representive for the whole urban subsample, it was decided to exclude the SAQ-variables from the analysis of the urban subsample.

The "roh=1 approach" was selected since it was then straight forward to use the SAQ-variables in a logistic regression together with the variables from the individual questionnaire. Another aproach would be to do a t-test on the differences in immunization coverage rates between clusters (i.e. communities) with daily or weekly immunization sessions/ trained midwives and clusters without. The design effect of immunization (i.e. 1.26 for TT) would be considered. Also in this setting it would be necessary to rule out confounding by rural regions or to incorporate the weights in the analysis.
The differences between the two approaches are discussed in the discussion section (chapter 8).

There are methods of estimating sample size in logistic regression. These are, however, complicated, and do not necessarily give a perfect result. Another approach is based on the recomendation to have at least 10 cases per independent variable in a logistic regression. This approach is a rule of thumb and is used in this study. The smallest outcome file is the urban "drop-outs" file (198 cases). Applying the rule of thumb to this sample size allow 19 independent variables in a logistic regression.

6.4 Analysis

As already mentioned some transformations of variables were carried out for the analysis, which was carried out in two stages:

1) Descriptive analysis.

The urban and rural subsample were analyzed independently. Tables were produced showing absolute numbers and the distribution for each independent variable for the four different outcome variables shown below. The samples used for outcome variables 2 and 3 were subsamples of either the whole urban or the rural subsample, which were used for the first outcome variable.

1 Child immunized at least once vs. not immunized at all - 1687 children. Case definition: child was not vaccinated according to health card, had no BCG-scar, and mother did not claim the child has received at least one vaccination ("complete lack of vaccination").

Children with missing health cards were excluded from the analysis for outcome variables 2 and 3. Only children who could produce a HC proving receipt of all 8 EPI-vaccinations were counted as fully immunized (for further discussion see

section 6.5 below).

2 Full immunization vs. not (0 - 7 vaccinations) - 1314 children ("full vaccination"). Case definition: the child has not received all 8 EPI-vaccinations (according to HC).

3 Full immunization vs. some immunization (1-7 vacc.). All immunizations completed according to health card versus receipt of at least one vaccination - 931 children ("drop-outs"). Case definition: child has received at least one vaccination (according to HC, BCG-scar and/or mother's memory) but has not completed the EPI-vaccinations series.

4 Women claiming receipt of Tetanus toxoid during pregnancy versus those who don't - 1998 women ("TT"). Case definition: woman does not claim receipt of TT during one of her last three pregnancies.

Statistics: the P-value is shown for all n-by-2 tables. In most cases Pearson's Chi-square is used. If the expected value of any cell is <5 (which is rarely the case) Fisher's exact test is used. For ordinal variables, Mantel-Haenzel's test for linear association [MHLA] is shown.
When a two-by-two table is relevant, the odds ratio is shown. If P<0.05, confidence intervals adjusted for DEFF is shown as

well.

2) Logistic regression analysis.

For each dependent variable, those independent variables which had a univariate relationship with a significance of at least $P<0.15$ were entered into a logistic model using SPSS-PC version 4: Advanced Statistics.

The odds ratio was estimated for each independent variable by taking the antilogarithm of the coefficient for exposure.

For ordinal variables the so called partial or indicator "dummy" variable coding was used, since with this method it is straight forward to obtain estimated odds ratios and their associated confidence intervals [CI].[46] 95% CI were calculated from the coefficient and its related standard error. The confidence intervals were also adjusted for an average DEFF of the independent variables in the final model.

Conventional backward stepwise regression were done. No variable was forced into the model. At each step the least significant variable (or interaction term (i.e. product of original variables)) was deleted. Variables with $P\leq0.15$ were kept in the model until the final procedures for finding the best-fit model were carried out. The final model was often chosen among a few (two to five) candiate models.

The "goodness of fit" chi-square was used as a measure of the difference between the observed probabilities and those

predicted by the model (if P>0.05 the model did not differ significantly from the "perfect" model). However, in addition to "the goodness of fit" test, the modeling results were validated against the univariate results (in order to ensure similarities between the univariate results and the modeling results), and histograms of estimated probabilities were examined in order to find the best-fit model. For each of the eight dependent variables only the best-fit model is presented in the tables.

6.5 Discussion of coding for outcome variables

One important question was **whether to consider only children with health cards as immunized.** Of the eligible 1697 children for my study, 383 children claimed to have health cards, but their mothers could not produce them at the time of interview.

Experience from Kenya[19] showed that 15-20% of children under two years with BCG-scars could not produce health cards. Comparing UDHS children with lost health cards whose mothers claim they are vaccinated to children with health cards with respect to **BCG-scar** revealed no significant difference between the two groups (table 7):

TABLE 7: Comparison of children with health cards to children with missing health cards with regard to BCG-scars.

	BCG-scar visible	BCG-scar not visible
Produce HC:	755 91.0%	75 9.0%
Missing HC:	247 88.2%	33 11.8%

P = 0.18

There was a close relationship between BCG-scar and self-reported immunization status in children who reported never having a health card: 94.3% of the children who had a BCG-scar were claimed to have received at least one vaccination, while 97.1% of the children who did not have a BCG-scar were reported to have received no vaccination at all (table 8):

TABLE 8: Comparison of Q422 "Has the child received disease vaccine" to Q422A "BCG-scar <u>for children who were claimed never to have received a health card</u>".

	BCG-scar:	Yes	No
Claim some immunization:	Yes	33	11
	No	2	364

Sensitivity = 94.3% Specificity = 97.1%
Predictive value + = 75% Predictive value - = 99.4%.

There are two reasons that the positive predictive value is only 75%. Firstly, these 44 children were claimed to have received at least one vaccination, but not necessarily the BCG, even though the BCG is the vaccine with the highest coverage. Secondly, it is well known that 10-15% of children vaccinated against tuberculosis have no visible BCG-scar, since BCG vaccination does not always leave a visible scar or a scar might be difficult to identify as being a BCG-scar.[19]

A Sudanese study[47] tried to measure the accuracy of mother's report on their children's vaccination status. As a part of four immunization coverage surveys, illiterate women were asked about their children's vaccination status. Their answers were then compared with the information given on the health cards. Mother and card agreed in 81% of the cases concerning measles vaccination and in 61% concerning the DTP series. The sensitivity for measles vaccination was 87% and the specificity 79%. The study was based on the assumption that illiterate women can not understand the information given on the health card. A pre-test was done before the study to ensure that this assumption was right.

There are some weak points concerning this study:

1. Only mothers possessing vaccination cards could be included. However, the study was done in order to test whether one could rely on the reports of women with missing health cards for assessing coverage rates. The authors con-

cluded on the basis of their study, that this is possible, assuming that the group of mothers with health cards are similar to the ones without - at least regarding vaccine coverage.

2. Only children aged 11-16 months were included. Usually 12-23 months old children are surveyed for vaccination coverage. This means of course that the time difference to when the vaccines were given was shorter than usual.

From previous studies it is well known that low level of education, low socioeconomic status, and 'traditional' attitudes are important risk factors for lack of immunization. Hence I decided to compare different characteristics between UDHS children with HCs and with lost HCs (table 9).

I found no difference with respect to education, except for the fact that significantly more fathers in the missing HCs group went to secondary school.

There was no difference regarding soap, toilet, roof material, and possession of a bicycle. However, there were significant differences concerning direct water supply as well as the possession of a stove.

With regard to attitudes, etc. there was no difference on religion, acceptance of FP, use of contraception, size of household, number of children, and membership of mother's organisation. Significantly more women in the missing HC group were living with a bigamous husband.

TABLE 9: Comparison of 875 children who could produce HC to 383 children with missing HC with regard to socio-cultural, educational and demographic variables.

Predictor variable	HC: % Shown	Missing	Chisq	P
Household >10 persons	11.9	11.2	0.1	0.74
Mother >30 years old	33.6	27.4	4.7	0.03*
Mother has no formal education	33.9	29.2	2.7	0.10
Mother is completely ilitterate	45.1	45.0	0.0	0.91
Mother listens to radio	58.4	54.6	1.7	0.20
Drinking water piped into residence	16.6	23.5	8.4	<0.01*
Residence has no kind of toilet	10.6	12.0	0.5	0.47
No soap at the residence	11.8	13.6	0.8	0.37
Household owns a stove	25.3	34.2	10.6	<0.01*
Household owns a bicycle	37.3	37.3	0.0	0.98
Muslims	9.0	11.3	1.5	0.22
Mother member of women's organisat.	20.6	18.8	0.5	0.47
Had sibling who died	40.0	37.9	0.5	0.47
Mother gave birth to >4 children	41.5	37.3	1.9	0.17
Mother used contraception	28.7	32.1	1.5	0.22
Mother accepts family planning	76.2	77.6	0.3	0.60
Mother received TT	62.7	63.7	0.1	0.74
Father has >1 wife	26.8	35.3	7.3	<0.01*
Family always resided at same place	56.1	54.5	0.5	0.77
Father went to secondary school	22.3	30.8	9.7	<0.01*
Roof material: papyrus/thatch	46.2	40.5	3.5	0.06

* significant at P<0.05.

No difference was seen for "family always resided at the same place" (i.e. since the parents were living together).

No difference was seen for child mortally and TT while pregnant.

Conclusion: Overall there was not much difference between the two groups. Most of the variables tested were not significant. The significance obtained was mostly towards better socio-

economic status for the missing HC group. Since higher socio-economic status is generally associated with high immunization coverage, it could cause important bias if we were to regard the lost HCs group as not immunized. It might disguise or diminish the true differences between immunized and not immunized. Hence, children with lost HCs were not included in the analysis **except** for the first outcome variable: "receipt of any vaccine vs. no vaccination at all", where they were regarded as having received at least one vaccination.
It is interesting that significantly more children of the lost HC group were not at the residence at the time of the interview (24% vs. 5%). They might have brought their health cards with them wherever they might have been at the time of the interview.

The results of the Sudanese study as well as my analysis of the UDHS data indicate that mother's information about their children's vaccination status is reliable. If the mother claims that her child received at least one immunization, the child was analyzed as "partly immunized".

Since mother's information about their children's vaccination status looks reliable, one might assume that this is also the case for receipt of TT during pregnancy.
Unfortunately mothers were simply asked if they had received TT during pregnancy. They were not asked if they received one

or two doses, and when during pregnancy they received TT. However, this was only of minor interest, since the exact TT immunization rates among pregnant women were not essential for the study. The most important task was to identify woman at risk for not receiving TT at all while pregnant.

7. RESULTS

7.1.1 Descriptive statistics on demographical characteristics

Descriptive statistics on selected demographical variables are shown in four tables (10-13), describing the child immunizations sample as well as the women's TT sample. Different tables were made for the rural and urban subsamples. Table 10 (child immunizations sample) reveals significant differences between the rural regions, except for the age and gender of the children as well as for the variable "toilet in household", though the latter nearly turned out significant. The mean age of the mothers in the South-West Region was higher then in the rest of the rural (and urban) parts of Uganda, which were surveyed. The South-West region, which is predominantly protestant, had the most stationary inhabitants (only 1.5% of the mothers were immigrants) and the highest percentage of mothers staying in a monogamous relationship. The Luwero Triangle, which is closest to Kampala had the highest percentage of immigrants and single mothers. On the other hand only 25% of the mothers in the Luwero Triangle had received no formal education compared to 53% in the South-West region and 45% in the rest of the rural sample.

TABLE 10: Descriptive statistics on selected demographic variables in various rural areas - child immunizations sample.

Variable	Total	Luwero	S-W	Rest	Chisq	P
N	1339	332	484	520		
Maternal immigration	12.2%	25.1%	1.5%	14.5%	102.2	<0.001
(missing cases	49	25	3	18)		
No maternal education	42.9%	25.3%	52.7%	44.9%	61.8	<0.001
No toilet in household	15.2%	14.8%	12.6%	18.0%	5.7	0.058
Religion:						
Catholic	44.7%	45.6%	40.6%	47.9%	55.2	<0.001
Protestant	44.5%	42.6%	52.4%	38.3%	DF=6	
Muslim	9.4%	11.2%	3.9%	13.5%		
Seventh Day Advent	1.4%	0.6%	3.1%	0.4%		
Marital status:						
Mother single	15.6%	21.1%	11.8%	15.7%	26.7	<0.001
Monogamy	58.7%	54.8%	66.5%	53.9%	DF=4	
Bigamy/polygamy	25.7%	24.1%	21.7%	30.4%		
Trad. roof material	57.1%	35.8%	65.9%	62.3%	82.4	<0.001
Child a boy	48.5%	47.0%	51.4%	46.8%	2.6	0.28
Mean age mothers(yrs)	27.6	27.1	28.5	27.0	8.3*	<0.01
Mean age of children (months)	22.7	22.7	22.6	22.8	0.1*	0.94

* F-value (One-way ANOVA)

The women's TT sample showed the same pattern as described above. Here, the variable "toilet in household" showed a significant difference between the rural regions, although the difference in percentage of the households which had no toilet was less than 6% (table 11).

TABLE 11: Descriptive statistics on selected demographic variables in various rural areas - women's TT file.

Variable	Total	Luwero	S-W	Rest	Chisq	P
N	1571	356	574	641		
Maternal immigration	15.2%	30.6%	3.7%	17.9%	120.6	<0.001
(missing cases	69	32	6	31)		
No maternal education	42.1%	23.0%	52.1%	43.8%	77.4	<0.001
No toilet in household	15.1%	15.2%	12.0%	17.9%	8.3	0.016
Religion:						
Catholic	42.6%	44.7%	38.4%	45.2%	64.8	<0.001
Protestant	45.1%	43.3%	52.9%	39.1%	DF=6	
Muslim	10.2%	11.5%	4.5%	14.5%		
Seventh Day Advent.	2.2%	0.6%	4.2%	1.3%		
Marital status:						
Mother is single	16.4%	22.8%	12.7%	16.1%	29.3	0.002
Monogamy	58.6%	51.4%	66.2%	55.9%	DF=4	
Bigamy/polygamy	25.0%	25.8%	21.1%	28.1%		
Trad. roof material	58.4	38.2%	66.6%	62.4%	79.7	<0.001
Mean age women (yrs)	27.1	26.6	27.8	26.8	4.5*	0.01
Mean # months since delivery	11.2	11.4	11.1	11.1	0.4*	0.68

* F-value (one-way ANOVA)

Significant differences between Kampala and the rest of the urban samples were seen for maternal education and housing standard. All households in the capital area had a toilet and only 1% of the houses in the province of Kampala had a traditional papyrus or thatch roof (tables 12 and 13).

TABLE 12: Descriptive statistics on selected demographic variables in urban areas - child immunizations file.

Variable	Total	Kampala	Rest	Chisq	P
N	358	152	206		
Maternal immigration	18.1%	16.2%	19.5%	0.6	0.43
(missing cases	16	10	6)		
No maternal education	15.4%	3.9%	23.8%	26.5	<0.001
No toilet in household	6.7%	0.0%	11.7%	19.0	<0.001
Religion:					
Catholic	43.7%	41.7%	45.1%	4.6	0.21
Protestant	41.5%	39.1%	43.2%	DF=3	
Muslim	12.3%	15.2%	10.2%		
Seventh Day Advent	2.5%	4.0%	1.5%		
Marital status:					
Mother is single	20.9%	25.7%	17.5%	5.6	0.061
Monogamy	54.2%	54.6%	53.9%	DF=2	
Bigamy/polygamy	24.9%	19.7%	28.6%		
Child is a boy	48.3%	49.3%	47.6%	0.1	0.74
Trad. roof material	19.6%	1.3%	33.0%	55.9	<0.001
Mean age of mothers	26.7	26.4	26.9	0.86*	0.39
Mean age of children	23.6	23.5	23.6	0.17*	0.87

* t-value (t-test)

No difference was seen for immigration, religion, women's age, or number of months since last delivery. A higher percentage of women in Kampala did not live together with a man, while a lower percentage of Kampala women lived with a man who had more than one wife. This difference was significant for the

TABLE 13: Descriptive statistics on selected demographic variables in urban areas - women's TT file.

Variable	Total	Kampala	Rest	Chisq	P
N	427	193	234		
Maternal immigration	21.6%	20.8%	22.2%	0.1	0.73
(missing cases	24	15	9)		
No maternal education	16.2%	5.2%	25.2%	31.3	<0.001
No toilet in household	7.3%	0.0%	13.2%	27.6	<0.001
Religion:					
Catholic	45.2%	46.9%	43.8%	0.6	0.89
Protestant	38.4%	36.5%	39.9%	DF=3	
Muslim	14.6%	14.6%	14.6%		
Seventh Day Advent.	1.9%	2.1%	1.7%		
Marital status					
Mother is single	22.0%	28.0%	17.1%	13.3	0.001
Monogamy	51.3%	52.8%	50.0%	DF=2	
Bigamy/polygamy	26.7%	19.2%	32.9%		
Trad. roof material	18.7%	1.0%	33.3%	72.5	<0.001
Mean age women (yrs)	25.6	25.5	25.7	0.36*	0.72
Mean # months since delivery	10.3	10.7	9.9	1.22*	0.23

* t-value (t-test).

women's TT sample, and nearly significant for the child immunizations sample (table 12 and 13).

7.1.2 Immunization coverage

As shown in table 14 there were significant differences between rural regions for three of the four outcome variables. The only outcome variable that was not significant was the one looking particularly at children without any vaccination.
A higher percentage of the children living in rural South-west Region or in the Luwero Triangle continued their immunization series and received full immunization than was the case in the rest of the rural sample.
The women's TT immunization rate was significantly lower in the South West region (table 14).

TABLE 14: Outcome file specific immunization and "drop-out" rates (%) and sample size in various rural areas.

Outcome	Total	Luwero	S-W	Rest	Chisq*	P
Any vaccination	74.9	77.4	75.0	73.2	1.9	0.39
N	1331	328	484	519		
Full vaccination	33.9	39.6	40.4	23.4	31.2	<0.001
N	1069	256	421	398		
"Drop-outs"	50.6	43.4	43.3	64.0	28.3	<0.001
N	733	175	300	258		
TT	63.9	66.6	59.2	66.6	8.6	0.014
N	1571	356	574	641		

* Degrees of Freedom [DF] = 2.

The same pattern as above is seen in table 15, which compares Kampala with the rest of the urban subsample. While there was no significant difference for receiving any vaccination, Kampala showed a significantly higher full immunization rate and women's TT rate (table 15).

TABLE 15: Outcome file specific immunization and "drop-out" rates (%) and sample size in Kampala and the rest of urban Uganda.

Outcome	Total	Kampala	Rest	Chisq*	P
Any vaccination	86.3	92.7	81.6	0.7	0.42
N	358	151	207		
Full vaccination	49.8	62.6	42.2	9.6	<0.001
N	245	91	154		
"Drop-outs"	38.4	28.7	44.9	5.3	0.022
N	198	80	118		
TT	81.3	88.6	75.2	12.5	<0.001
N	427	193	234		

* Degrees of Freedom [DF] = 1.

Comparing table 14 and 15, immunization coverage was higher in the urban sample than in rural sample. This difference was significant for all outcome variables. However, comparing rural South-West Region and Luwero Triangle with the urban sample outside Kampala, showed no difference for full vaccination and "drop-outs".

7.1.3 Results of Woolf's test

Woolf's test was done for 38 predictor variables in each of the three child immunizations outcome files and for 34 predictor variables in the women's TT file in order to test for potential interaction (read effect modification) by rural region. The test was significant at the 0.05 level only for 6 out of the 148 combinations which was tested for. Another 6 combinations had P-values between 0.05 and 0.10. Such a result could as well have occurred by chance suggesting that in general there was no efect modification by rural region.
However, one pattern emerged: 5 of 6 combinations with P<0.05 (and 1 of 6 with P=0.05-0.10) were variables on number of children per woman and woman specific child mortality. The sixth predictor variable with a significant Woolf's test (P=0.04) was found in the women's TT outcome file: "Is it acceptable to provide family planning information on radio or in newspapers?"
Stratified tables are shown in the results section for combinations with P<0.10.[1] The reasons for the stratified results and the limitations of the Woolf's test are discussed in the discussion section (chapter 8). All Woolf's test results are shown in Appendix E.

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[1] Tables 22,27,28,31,46-48,53,60,67,84,87.

7.1.4 Explanation of analytical statistics' tables

Univariate statistics tables: The odds ratio [OR] is shown whenever a two-by-two table is relevant. The OR is always shown on the same horizontal line as "the exposure", unless something else is indicated. In tables with more than two lines of "predictors", the OR is calculated for "the exposure" versus the sum of the rest of the "predictors" (unless otherwise indicated). A 95% confidence interval [CI] is shown in brackets after the OR. The first CI does not take the design effect [DEFF] into account. If $P<0.05$ when the data was analyzed without considering the DEFF, a second CI (taking DEFF into account) is shown right after the first. Unless DEFF=1.00, the second CI is wider. The DEFF which is shown at the upper right corner of the table is valid for all predictor variables in the table, unless a different DEFF is shown (at the lower right corner) for a particular predictor variable. When appropriate, Pearson's chisquare is shown (usually on the first line) for each predictor variable. Degrees of freedom [DF] is only shown when it differs from one. For ordinal variables, Mantel Hanzel's test of linear association chisquare [MHLA] is shown.

Logistic regression analysis tables: DEFF is not taken into account in the P value and the first CI. The second CI is calculated using an average DEFF for the predictor variables.

The rural results are always shown before the urban ones.

7.2 RESULTS - COMPLETE LACK OF VACCINATION

7.2.1 Demographic characteristics

There were 1339 children in the rural sample and 358 children in the urban sample. 25.1% of the rural children and 13.7% of the urban children had not received any of the EPI-vaccinations.

In the rural sample no significant association was seen for migrancy (table 16). Children of mothers who have moved from a village to an urban area within the last two years had a higher risk of staying unimmunized compared to other urban children (tables 17 and 18). However the numbers were small and the results were just around the significance level if children with missing health cards and fully immunized children were not included (table18) (otherwise the result was not significant (table 17)).

The variables "number of locations since marriage" and "religion" showed no significant value in any of the samples.

TABLE 16: Demographic characteristics by Complete lack of vaccination.

Rural sample:	**Any vacc.** No	Yes	OR	DEFF not presented in UDHS report chisq	P
Immigration (mother).					
A) <2 years from a village	32 26%	89 74%		1.5 (DF=2)	0.47
B) <2 years from an urban area	15 19%	62 81%	0.70* (0.38-1.29)	1.5	0.23
C) ≥2 years, always lived in community	278 26%	806 74%			
* B vs. C					
Number of localities after marriage					
One	194 26%	541 74%		1.3 (DF=2)	0.54
Two	99 23%	323 77%			
Three or more	30 26%	85 74%	1.04 (0.66-1.64)	0.0	0.86
Religion					
Catholic	142 24%	450 76%		0.9 (DF=3)	0.81
Protestant	152 26%	438 74%			
Seventh Day Adventist	6 32%	13 68%			
Muslim	31 25%	94 75%			

TABLE 17: Demographic characteristics by Complete lack of vaccination.

Urban sample:	**Any vacc.** No	Yes	OR	DEFF not presented in UDHS report chisq	P
Immigration (mother).					
A) <2 years from rural area	7 18%	31 82%	1.40* (0.50-3.73)	0.5	0.47
B) <2 years from another town	10 10%	91 90%	0.68** (0.29-1.54)	1.0	0.32
C) ≥2 years, always lived in community	28 14%	173 86%		2.0 (DF=2)	0.38
* A vs. C ** B vs. C					
Number of localities after marriage					
One	20 12%	147 88%		1.5 (MHLA)	0.22
Two	17 15%	95 85%			
Three or more	10 18%	45 82%	1.45 (0.63-3.31)	0.9	0.34
Religion					
Catholic	21 14%	134 86%		0.1 (DF=2)	0.97
Protestant, Seventh Day Adventist	20 13%	137 87%			
Muslim	6 14%	37 86%			

TABLE 18: Immigration by Complete lack of vaccination (children with missing HCs and fully immunized children not included).

Urban sample:	**Any vacc.** No	Yes	OR	chisq	P
Immigration (mother).					
A) <2 years from a rural area	7 64%	4 36%			
B) <2 years from another town	10 43%	13 57%			
C) ≥2 years, always lived in community	28 32%	59 68%		4.5 (MHLA)	0.035
A vs. C:			3.69 (0.87-16.59)	4.2	0.051 DEFF=1.00

7.2.2 Socioeconomic characteristics

Low housing standards were clearly related to total lack of immunization as shown in tables 19 and 20. However, the variables "wall material" and "floor material" showed non-significant values in the rural sample where more than 90% of the people lived in houses with cow dung as floor material and mud and poles as wall material. "Not having any kind of toilet" and "having traditional roof material (papyrus, thatch)" were both correlated to total lack of immunization in both samples. "Having no soap in the household" and increasing distance to drinking water were only associated with total lack of immunization in the rural sample (table 19).

Children who lived in households with stoves and radios had higher immunization coverage in both samples. No association was seen for "household has a transportation vehicle".

TABLE 19: Socioeconomic characteristics by Complete lack of vaccination.

Rural sample	**Any vacc.**				DEFF=1.22
	No	Yes	OR	Chisq	P
Distance to drinking water					
Piped into residence	20 18%	91 82%		15.4 (MHLA)	<0.001
Less than 0.25 mile	76 22%	276 78%			
Between 0.25 and 0.5 mile	95 25%	287 75%			
Between 0.5 and 1 mile	78 25%	240 75%			
More than 1 mile	65 39%	103 61%	2.10 (1.47-2.98) (1.41-3.12)	18.9	<0.001
Toilet in household					
No	73 36%	128 64%	1.90 (1.38-2.61) (1.33-2.71)	15.9	<0.001
Yes	261 23%	869 77%			
Wall material					
Mud & poles	348 30%	800 70%	1.46 (0.88-2.44)	2.4	0.12
Earth Bricks	12 19%	50 81%			
Cement blocks	9 19%	39 81%		4.8 (MHLA)	0.028

TABLE 19 (cont.): Socioeconomic characteristics by Complete lack of vaccination.

Rural sample	**Any vacc.**				DEFF=1.22
	No	Yes	OR	Chisq	P
Floor material					
Cow dung, etc.	317	915	1.65	3.4	0.065
	26%	74%	(0.96-2.83)		
Parquet, wood, cement	17	81			
	17%	83%			
Roof material					
Thatch, papyrus	226	534	1.81	20.3	<0.001
	30%	70%	(1.40-2.36)		
			(1.36-2.42)		
Tins, tiles	108	463			
	19%	81%			
Stove in household					
No	312	863	2.20	11.4	<0.001
	27%	73%	(1.38-3.52)		
			(1.31-3.70)		
Yes	22	134			
	14%	86%			
Household has a radio					
No	279	729	1.86	14.8	<0.001
	28%	72%	(1.35-2.57)		
			(1.31-2.66)		
Yes	55	268			
	17%	83%			

TABLE 19 (cont.): Socioeconomic characteristics by Complete lack of vaccination.

Rural sample	Any vacc.				DEFF=1.22
	No	Yes	OR	Chisq	P
Soap in household					
No	65 32%	141 68%	1.47 (1.06-2.04) (1.03-2.11)	5.5	0.019
Yes	268 24%	856 76%			
Transportation vehicle					
No	221 27%	612 73%	1.23 (0.95-1.60)	2.4	0.12
Yes	113 23%	385 77%			

TABLE 20: Socioeconomic characteristics by Complete lack of vaccination.

Urban sample	Any vacc.				DEFF=1.12
	No	Yes	OR	Chisq	P
Distance to drinking water					
Piped into residence	19 11%	151 89%		2.1 (MHLA)	0.15
Less than 0.25 mile	9 12%	68 88%			
More than 0.5 mile	19 17%	90 83%			

TABLE 20 (cont.): Socioeconomic characteristics by Complete lack of vaccination.

Urban sample	**Any vacc.**				DEFF=1.12
	No	Yes	OR	Chisq	P
Toilet in household					
No	8	16	3.76	9.1	0.003
	33%	67%	(1.51-9.35)		
			(1.43-9.88)		
Yes	39	293			
	12%	88%			
Wall material					
Mud & poles	35	102	5.51	25.8	<0.001
	26%	74%	(2.58-12.01)		
			(2.47-12.30)		
Earth Bricks	3	54			
	5%	95%			
Cement blocks	14	102			
	12%	88%			
Floor material					
Cow dung, etc.	32	112	3.75	17.2	<0.001
	22%	78%	(1.95-7.23)		
			(1.87-7.51)		
Parquet, wood, cement	15	197			
	7%	93%			
Roof material					
Thatch, papyrus	16	54	2.44	7.1	0.008
	23%	77%	(1.24-4.77)		
			(1.20-4.96)		
Tins, tiles	31	255			
	11%	89%			

TABLE 20 (cont.): Socioeconomic characteristics by Complete lack of vaccination.

Urban sample	Any vacc.				DEFF=1.12
	No	Yes	OR	Chisq	P
Stove in household					
No	23	83	2.61	9.5	0.002
	22%	78%	(1.40-4.88)		
			(1.35-5.06)		
Yes	24	226			
	10%	90%			
Household has a radio					
No	28	108	2.74	10.5	0.001
	21%	79%	(1.46-5.13)		
			(1.41-5.33)		
Yes	19	201			
	9%	91%			
Soap in household					
No	6	23	1.82	1.5	0.21
	21%	79%	(0.70-4.74)		
Yes	41	286			
	13%	87%			
Transportation vehicle					
No	33	179	1.71	2.6	0.11
	16%	84%	(0.88-3.33)		
Yes	14	130			
	10%	90%			

7.2.3 Educational characteristics

Statistical differences in immunization coverage were seen for maternal education, in terms of both school level and actual reading abilities: the more educated, the bigger the chance of vaccination (tables 21 and 24). Woolf's test was nearly significant (P=0.07) for maternal school attendance (table 22), due to differences in the magnitude of association in the three rural regions.

Children of women who listened to the radio were immunized to a higher degree than children of women who did not listen to the radio. This association was significant for both samples. (tables 21 and 24).

There was a strong association between increasing level of paternal education and immunization coverage in the rural areas (table 23), while no association was seen for the urban areas (table 25).

TABLE 21: Maternal educational characteristics by Complete lack of vaccination.

Rural sample:	**Any vacc.**				DEFF=1.22
	No	Yes	OR	chisq	P
Formal education					
None	182	389	1.87	24.4	<0.001
	32%	68%	(1.45-2.42)		
			(1.41-2.48)		
Primary school	146	553			
	21%	79%			
Secondary school	6	55		28.1	<0.001
	10%	90%		(MHLA)	
Reads Sentence?					
Not at all	200	453	1.69	16.2	<0.001
	31%	69%	(1.30-2.20)		
			(1.26-2.26)		
With difficulty	53	172			
	24%	76%			
Easily	74	314		17.5	<0.001
	19%	81%		(MHLA)	
Listens to radio?					
No	253	655	1.64	11.7	<0.001
	28%	72%	(1.23-2.18)		
			(1.19-2.26)		
Yes	80	339			
	19%	81%			

Table 22: "Maternal education" by Complete lack of immunization rate (%) in three rural regions.

Formal education	Luwero	S-W	Rest	Woolf's test Chisq	P
A) No	37%	32%	30%		
N	83	255	233		
B) Yes	18%	17%	24%		
N	245	229	286		
OR (A vs. B)	2.80	2.20	1.29	5.27	0.07

TABLE 23: Paternal educational characteristics by Complete lack of vaccination.

Rural sample:	Full vacc. No	Yes	OR	chisq	DEFF=1.22 P
Formal education					
None	81	151	1.78	13.8	0.001
	35%	65%	(1.30-2.44)		
			(1.25-2.52)		
Primary school	216	641			
	25%	75%			
Secondary school	23	152		25.0	<0.001
	13%	87%		(MHLA)	
Reads Letter?					
Not at all	79	119	2.02	18.6	<0.001
	40%	60%	(1.46-2.80)		
			(1.41-2.90)		
With difficulty	53	126			
	30%	70%			
Easily	161	526		21.3	<0.001
	23%	77%		(MHLA)	

TABLE 24: Maternal educational characteristics by Complete lack of vaccination.

Urban sample:	**Any vacc.**				DEFF=1.13
	No	Yes	OR	chisq	P
Formal education					
None	13	42	2.43	6.2	0.013
	24%	76%	(1.11-5.25)		
			(1.07-5.51)		
Primary school	26	161			
	14%	86%			
Secondary school	8	106		8.9	0.003
	7%	93%		(MHLA)	
Reads Sentence?					
Not at all	19	67	1.89	3.3	0.070
	22%	78%	(0.89-3.98)		
With difficulty	4	29			
	12%	88%			
Easily	16	104		2.6	0.10
	13%	87%		(MHLA)	
Listens to radio?					
No	25	94	2.60	9.5	0.002
	21%	79%	(1.39-4.83)		
			(1.34-5.04)		
Yes	22	215			
	9%	91%			

TABLE 25: Paternal educational characteristics by Complete lack of vaccination.

Urban sample	**Any vacc.**				DEFF=1.13
	No	Yes	OR	chisq	P
Formal education					
None	2	18		3.0	0.23
	10%	90%		(DF=2)	
Primary school	26	120			
	18%	82%			
Secondary school	19	148		0.9	0.33
	11%	89%		(MHLA)	
Reads Letter?					
Not at all	3	14		0.0	0.98
	18%	82%		(DF=2)	
With difficulty	3	17			
	15%	85%			
Easily	19	99			
	16%	84%			

7.2.4 Family characteristics

Rural children living in households of more than ten persons or four or more children under five years of age had a significantly lower risk of staying unimmunized (table 26). No association was found for the urban sample (table 29).

Maternal age showed no association with total lack of child immunization in the rural sample, while Pearsons chisquare was just significant (P=0.049) in the urban sample (table 29): mothers aged 20-24 years had the lowest rate of unimmunized children (7%), while the highest rate (24%) were seen for children of mothers aged 30-34 years.

There was a significant association between children's lack of any immunization and mothers who had had more than one husband. This association was stronger in the urban sample (OR=4.09).

No association with immunization status was observed for the other three marital variables in any of the samples.

Particularly urban children of mothers with many children had a higher risk of staying unimmunized (table 29). This item had significant Woolf's tests in the rural sample (tables 27 and 28). There was a clear association between increasing number of children per mother and total lack of immunization in the Luwero triangle. This association was not observed for the other rural regions. No association with total lack of

immunization was seen for sibling mortality in any of the samples.

TABLE 26: Family characteristics by Complete lack of vaccination.

Rural sample	**Any vacc.**				DEFF=1.00
	No	Yes	OR	Chisq	P
Size of household					
More than 10 persons	25 17%	121 83%	0.59 (0.37-0.92)	5.5	0.019
Less than 11 persons	309 26%	876 74%			
No. of children <5 years					
One	88 25%	258 75%		2.1 (MHLA)	0.15
Two	148 27%	395 73%			
Three	70 25%	205 75%			
Four or more	22 17%	106 83%	0.58 (0.35-0.96) (0.35-0.96)	5.0	0.025
Age of mother					
Age 15-19	29 22%	105 78%		3.2 (DF=4)	0.52
Age 20-24	88 24%	278 76%			
Age 25-29	88 24%	280 76%			
Age 30-34	60 18%	280 72%			
Thirtyfive or more	69 28%	176 82%			

TABLE 26 (cont.): Family characteristics by Complete lack of vaccination.

Rural sample	**Any vacc.**				DEFF=1.08
	No	Yes	OR	Chisq	P
Mother married /living with a man					
More than once	89 32%	191 68%	1.51 (1.12-2.02) (1.11-2.04)	7.7	0.006
Once	235 24%	760 76%			
Mother's current marital status					
Widowed, divorced, single	53 26%	153 74%	1.04 (0.74-1.46)	0.1	0.82
Married / living with a man	281 25%	844 75%			
Father living apart from the rest of the family?					
Yes	14 18%	63 82%	0.65 (0.34-1.21)	2.1	0.15
No	267 26%	777 74%			
Bigamy?					
Yes	92 27%	249 73%	1.17 (0.87-1.56) (1.26-2.44)	1.1	0.30
No	188 24%	594 76%			

TABLE 26 (cont.): Family characteristics by Complete lack of vaccination.

Rural sample	**Full vacc.**				DEFF=1.00
	No	Yes	OR	Chisq	P
No. of births					
More than four	163 28%	415 72%	1.34 (1.04-1.72) (1.04-1.72)	5.2	0.022
Less than five	171 23%	582 77%			
No. of living children					
More than four	125 28%	324 72%	1.24 (0.96-1.61)	2.7	0.099
Less than five	209 24%	673 76%			
No. of Children who have died					
A) Two or more	60 27%	160 73%	1.25* (0.97-1.61)	3.2	0.075
B) One	100 28%	262 72%			
C) None	174 23%	575 77%		0.0 (MHLA)	0.84

* A+B vs. C

Table 27: "Total no. of children born" by Complete lack of immunization rate (%) in three rural regions.

No. of children	Luwero	S-W	Rest	Woolf's test Chisq	P
A) More than four	31%	27%	27%		
N	140	230	208		
B) Less than five	16%	23%	26%		
N	188	254	311		
OR (A vs. B)	2.41	1.22	1.05	6.37	0.04

Table 28: "No. of living children" by Complete lack of immunization rate (%) in three rural regions.

No. of children	Luwero	S-W	Rest	Woolf's test Chisq	P
A) More than four	32%	28%	25%		
N	114	177	158		
B) Less than five	18%	23%	27%		
N	214	307	361		
OR (A vs. B)	2.14	1.25	0.90	6.29	0.04

TABLE 29: Family characteristics by Complete lack of vaccination.

Urban sample	**Any vacc.**				DEFF=1.00
	No	Yes	OR	Chisq	P
Size of household					
More than 10 persons	7	32	1.52	0.9	0.35
	18%	82%	(0.62-3.66)		
Less than 11 persons	40	277			
	13%	87%			
No. of children <5 years					
One	10	72		0.5	0.50
	12%	88%		(MHLA)	
Two	16	122			
	12%	88%			
Three	12	77			
	13%	87%			
Four or more	5	24	1.49	0.6	0.44
	17%	83%	(0.47-4.43)		
Age of mother					
Age 15-19	5	27		9.5	0.049
	16%	84%		(DF=4)	
Age 20-24	8	103			
	7%	93%			
Age 25-29	14	100			
	12%	88%			
Age 30-34	14	45			
	24%	76%			
Thirtyfive or more	6	34			
	15%	85%			

TABLE 29 (cont.): Family characteristics by Complete lack of vaccination.

Urban sample	**Any vacc.**				DEFF=1.13
	No	Yes	OR	Chisq	P
Mother married /living with a man					
More than once	20 31%	44 69%	4.09 (2.11-7.93) (2.02-8.27)	19.3	<0.001
Once	27 10%	243 90%			
Mother's current marital status					
Widowed, divorced, single	9 12%	66 88%	0.87 (0.40-1.90)	0.1	0.73
Married / living with a man	38 14%	243 86%			
Father living apart from the rest of the family?					
No	5 17%	24 83%	1.38 (0.43-4.18)	0.4	0.57
Yes	33 13%	219 87%			
Bigamy?					
Yes	12 14%	76 86%	1.01 (0.48-2.12)	0.0	0.97
No	26 13%	167 87%			

TABLE 29 (cont.): Family characteristics by Complete lack of vaccination.

Urban sample	**Any vacc.**				DEFF=1.11
	No	Yes	OR	Chisq	P
No. of births					
More than four	24 19%	105 81%	2.03 (1.09-3.76) (1.04-3.94)	5.2	0.023
Less than five	23 10%	204 90%			DEFF=1.15
No. of living children					
More than four	22 23%	73 77%	2 84 (1.51-5.34) (1.46-5.54)	11.2	<0.001
Less than five	25 10%	236 90%			
No. of Children who have died					
Two or more	3 10%	26 90%			
One	13 16%	67 84%			
None	31 13%	216 87%		0.0 (MHLA)	0.84

7.2.5 Attitudes, etc.

No association with immunization status was observed for the child's gender in any of the samples.

Rural children of mothers who were members of an organisation which promoted primary health had significantly lower risk of staying unimmunized (table 30). No association was found for the urban sample (table 32).

Children of women who had used contraceptives were at lower risk of staying unimmunized. This association was at the level of significance in both samples, but was clearly significant in a combined rural-urban sample.

In the rural sample, children of mothers who had an "ideal of more than six children" and rural children of mothers who disapproved of family planning being taught in school and promoted over the radio had a significantly higher risk of not receiving immunization. No association was observed for the urban sample.

Parents' disapproval of contraception was associated with a higher rate of unimmunized children in both samples, though the difference was not significant for the father's attitude in the rural sample. For maternal approval of contraception the association was strongest in the Luwero triangle (OR=2.61) followed by the South-West region (OR=1.76) and the rest of the rural sample (OR=1.15) (table 31). No association between

the parents approval or disapproval of contraception and their child's immunization status was observed for the urban sample.

TABLE 30: Attitudes, etc. by Complete lack of vaccination.

Rural sample:	**Any vacc.**				
	No	Yes	OR	chisq	P
Child's gender					
Female	176 26%	510 74%	1.06 (0.83-1.37)	0.2	0.63
Male	158 24%	487 76%			DEFF=1.00
Mother member of organisation?					
No	294 26%	821 74%	1.58 (1.09-2.28) (1.02-2.44)	5.9	0.015
Yes	40 19%	176 81%			DEFF=1.38
Ever used contracept.					
No	277 26%	777 74%	1.38 (0.99-1.90)	3.8	0.051
Yes	57 21%	220 79%			DEFF=1.36
Acceptable FP info on radio?					
No	107 29%	265 71%	1.36 (1.03-1.79) (0.99-1.87)	4.9	0.027
Yes	208 23%	700 73%			DEFF=1.38

TABLE 30 (cont.): Attitudes, etc. by Complete lack of vaccination.

Rural sample:	Any vacc.				
	No	Yes	OR	chisq	P
Acceptable FP taught in school?					
No	133	263	1.38	6.1	0.014
	34%	64%	(1.07-1.79)		
			(1.02-1.87)		
Yes	223	610			
	27%	73%			DEFF=1.38
Ideal no. of children					
More than six	185	452	1.50	10.1	0.001
	29%	71%	(1.17-1.92)		
			(1.16-1.94)		
Less than seven	149	545			
	21%	79%			DEFF=1.03
Mother approves contraceptive method					
No	121	261	1.61	12.5	<0.001
	32%	68%	(1.23-2.10)		
			(1.17-2.21)		
Yes	211	732			
	22%	78%			DEFF=1.38
Father approves contraception					
No	218	607	1.35	3.5	0.063
	26%	74%	(0.98-1.86)		
Yes	63	237			
	21%	79%			DEFF=1.38

Table 31: "Maternal approval of contraception" by Complete lack of immunization rate (%) in three rural regions.

Approve contraception	Luwero	S-W	Rest	Woolf's test Chisq	P
A) No	36%	34%	28%		
N	89	110	183		
B) Yes	18%	22%	26%		
N	237	371	335		
OR (A vs. B)	2.61	1.76	1.15	5.13	0.08

TABLE 32: Attitudes, etc. by Complete lack of vaccination.

Urban sample:	**Any vacc.**				
	No	Yes	OR	chisq	P
Child's gender					
Female	25	159	1.07	0.0	0.82
	14%	86%	(0.58-1.99)		
Male	22	150			
	13%	87%			DEFF=1.00
Mother member of organisation?					
No	34	224	0.98	0.0	0.98
	13%	87%	(0.50-1.97)		
Yes	13	85			
	13%	87%			DEFF=1.05
Ever used contracept.					
No	29	139	1.97	4.6	0.032
	17%	83%	(1.05-3.70)		
			(0.99-3.92)		
Yes	18	170			
	10%	90%			DEFF=1.19
Acceptable FP info on radio?					
No	5	39	0.81	0.2	0.67
	11%	89%	(0.30-2.17)		
Yes	42	265			
	14%	86%			DEFF=1.05

TABLE 32 (cont.): Attitudes, etc. by Complete lack of vaccination.

Urban sample:	**Any vacc.**				
	No	Yes	OR	chisq	P
Acceptable FP taught in school?					
No	6	70	0.49	2.6	0.11
	8%	92%	(0.20-1.20)		
Yes	41	233			
	15%	85%			DEFF=1.05
Ideal no. of children					
More than six	14	69	1.48	1.3	0.26
	17%	83%	(0.75-2.91)		
Less than seven	33	240			
	12%	88%			
Mother approves contraceptive method					
No	13	49	2.02	3.9	0.048
	21%	79%	(1.00-4.10)		
			(0.98-4.17)		
Yes	34	259			
	12%	88%			DEFF=1.05
Father approves contraception					
No	31	123	4.28	12.5	<0.001
	20%	80%	(1.81-10.11)		
			(1.77-10.35)		
Yes	7	119			
	6%	94%			DEFF=1.05

7.2.6 Health system

Children of mothers who were vaccinated against tetanus while they were pregnant had a significant lower risk of not getting any immunization (tables 33 and 34).

Children of mothers who visited a doctor, a nurse, or a trained midwife for pregnancy checks had a lower risk of staying unimunized.

If a doctor, a nurse, or a trained midwife assisted with the delivery the child had a significant lower risk of staying unimmunized.

Rural children living in communities where immunizations were offered regularly at least once a week showed a 6% higher immunization rate. Rural children living in communities where there was a trained midwife had 3% higher immunization rates.

TABLE 33: Health system by Complete lack of vaccination.

Rural sample:	**Any vacc.**				
	No	Yes	OR	chisq	P
Mother received TT when pregnant					
No	183	400	1.81	21.9	<0.001
	31%	69%	(1.41-2.32)		
			(1.38-2.38)		
Yes	151	594			
	20%	80%			DEFF=1.18
Pregnancy checks					
No	65	104	2.07	18.2	<0.001
	38%	62%	(1.47-2.91)		
			(1.44-2.98)		
Yes	267	884			
	23%	77%			DEFF=1.15
Assistant with delivery					
No one, person without formal education	264	640	2.10	25.1	<0.001
	29%	71%	(1.56-2.82)		
			(1.54-2.87)		
Nurse, midwife, doctor	70	356			
	16%	84%			DEFF=1.12
Vaccination offered at least once a week					
No	114	273	1.40	5.7	0.017
	29%	71%	(1.06-1.84)		
			(0.61-3.18)		
Yes	177	592			
	23%	77%			DEFF=8.96
Trained midwife in community?					
No	190	577	1.14	0.6	0.43
	25%	75%	(0.82-1.58)		
Yes	62	215			
	22%	78%			DEFF=8.96

TABLE 34: Health system by Complete lack of vaccination.

Urban sample:	**Any vacc.**				
	No	Yes	OR	chisq	P
Mother received TT when pregnant					
No	20	77	2.23	6.4	0.011
	21%	79%	(1.13-4.40)		
			(1.13-4.40)		
Yes	27	232			DEFF=1.00
	10%	90%			
Pregnancy checks					
No	6	17	2.51	3.6	0.059
	26%	74%	(0.94-6.74)		
Yes	41	292			DEFF=1.04
	12%	88%			
Assistant with delivery					
Person without formal health education, no one	22	78	2.61	9.4	0.002
	22%	78%	(1.39-4.88)		
			(1.35-5.03)		
Nurse, midwife, doctor	25	231			
	10%	90%			DEFF=1.08

7.2.7 Logistic regression.

The best fit model for the rural sample is presented in table 35. It contained maternal education as well as paternal reading ability. Two socioeconomic variables found their way into the model: "increasing distance to drinking water" and "toilet in household?". The last two variables were health sytem variables: "maternal receptance of TT while pregnant" and "vaccination offered at least once a week".

The best fit urban model is shown in table 36. Besides "toilet in household?" and "pregnancy checks", it included "paternal disapproval of contraception". If this variable had been forced out the model, "maternal disapproval of contraception would have been included". The last variable in the urban model was "mother had had more than one husband", which was a variable of importance only in the urban regions.

TABLE 35: Logistic regression - dependent variable Complete lack of vaccination - rural sample.

DEFF=2.50

Predictor variables	P	OR	95% CI
Q109 Woman ever attended school	0.018	1.45	(1.06-1.98)
			(0.89-2.38)
Q706(1) Husband's reading ability	<0.001	2.04	(1.51-2.98)
			(1.27-3.30)
Q706(2)	0.132	1.44	(0.90-2.30)
			(0.68-3.02)
Q115A(1) Distance to drinking water	0.389	1.43	(0.63-3.20)
			(0.40-5.11)
Q115A(2)	0.024	1.74	(1.07-2.91)
			(0.81-3.73)
Q115A(3)	<0.001	1.88	(1.16-3.03)
			(0.88-3.99)
Q115A(4)	0.031	1.71	(1.05-2.78)
			(0.79-3.70)
Q117 Toilet in household	0.005	1.75	(1.18-2.58)
			(0.95-3.23)
Q403 TT when pregnant	<0.001	1.75	(1.29-2.37)
			(1.08-2.82)
C10 Vaccination daily/weekly	0.026	1.43	(1.04-1.97)
			(0.87-2.37)

Goodness of Fit chisquare 927.0 (DF=928) P=0.50.

Coding of nominal variables:	0	1
Received any vaccination	No	Yes
Q109, Q117, Q403, C10	No	Yes

Coding of categorical variables:

Q706	Value	Freq	Coding (1)	Coding (2)
Husband can read letter				
Easily	1	602	1	0
With Difficulty	2	159	0	1
Not at all	3	178	0	0

Q115A	Value	Freq	Coding (1)	Coding (2)	Coding (3)	Coding (4)
Drinking water - distance						
In residence	0	41	1	0	0	0
< 0.25 Mile	1	259	0	1	0	0
0.25 - 0.5 Mile	2	281	0	0	1	0
0.5 - 1 Mile	3	240	0	0	0	1
> 1 Mile	4	118	0	0	0	0

TABLE 36: Logistic regression - dependent variable Complete lack of vaccination - urban sample.

DEFF=1.09

Predictor variables		P	OR	95% CI
Q117	Toilet	0.006	4.83	(1.57-14.85)
				(1.49-15.61)
Q404	Pregnancy checks	0.049	3.22	(1.00-10.32)
				(0.95-10.86)
Q507	Different husbands?	0.007	3.00	(1.35-6.66)
				(1.30-6.89)
Q607	Father approves contraception	0.007	3.41	(1.40-8.27)
				(1.35-8.60)

Goodness of Fit chisquare 291.0 (DF=274) P=0.23.

Coding of nominal variables:	0	1
Received any vaccination	No	Yes
Q117, Q404, Q507, Q607	No	Yes

7.3 RESULTS: FULL IMMUNIZATION

7.3.1 Demographic characteristics

There were 1069 children in the rural sample and 245 children in the urban sample. 33.9% of the rural children and 38.4% of the urban children were fully immunized against the EPI-diseases.

Immigrants from a town had significant higher full immunization coverage in both the rural and the urban sample. The full immunization coverage of children of immigrants from rural areas did not differ from the coverage of children of mothers who lived for more than two years in the community, regardless whether it was a rural or an urban community (tables 37 and 38).

No association was found between children's full immunization and the number of localities where the parents lived after their marriage.

No asociation was found between full immunization and religion in any of the samples.

TABLE 37: Demographic characteristics by Full vaccination.

Rural sample:	Full vacc. No	Yes	OR	DEFF not presented in UDHS report chisq	P
Immigration (mother)					
A) <2 years from a village	58 70%	25 30%	1.16* (0.69-1.95)	0.4	0.55
B) <2 years from an urban area	29 48%	32 52%	0.45** (0.26-0.79)	9.3	0.002
C) ≥2 years, always lived in community	604 67%	302 33%		10.0 (DF=2)	0.007
* A vs. C ** B vs. C					
Number of localities after marriage					
One	388 66%	204 34%		2.6 (DF=2)	0.27
Two	229 67%	113 33%		2.0 (MHLA)	0.16
Three or more	66 74%	23 26%	1.47 (0.88-2.49)	2.4	0.12
Religion					
Catholic	327 67%	158 33%		1.1 (DF=3)	0.79
Protestant	304 65%	164 35%			
Seventh Day Adventist	10 59%	7 41%			
Muslim	63 66%	32 34%			

TABLE 38: Demographic characteristics by Full vaccination.

Urban sample:	Full vacc. No	Full vacc. Yes	OR	DEFF not presented in UDHS report chisq	P
Immigration (mother)					
A) <2 years from rural area	11 50%	11 50%	0.68* (0.25-1.82)	0.7	0.40
B) <2 years from another town	23 32%	49 68%	0.32** (0.17-0.60)		
C) ≥2 years, always lived in the town	87 60%	59 40%		14.7 (DF=2)	<0.001
* A vs. C ** B vs. C					
Number of localities after marriage					
One	58 51%	56 49%		0.7 (DF=2)	0.69
Two	37 49%	38 51%			
Three or more	23 58%	17 43%	1.34 (0.64-2.82)	0.7	0.41
Religion					
Catholic	66 56%	51 44%	1.51 (0.89-2.56)	2.6	0.11
Protestant, Seventh Day Adventist	42 44%	54 56%			
Muslim	15 47%	17 53%		3.5 (DF=2)	0.17

7.3.2 Socioeconomic characteristics

In the urban sample all four variables describing housing standards were significant associated with full immunization coverage as shown in table 40. In the rural sample there was only a significant association for "toilet in household" and for "roof material", while the results comparing "floor material" and "wall material" with full immunization were non-significant (table 39).

In both sample there was a significant association between "long distance to the source of drinking water" and lack of full vaccination. Rural and urban children of parents who owned a radio showed significant higher full immunization rates. The same was seen for "stove in household", though the results were only around the level of significance in the rural sample. While slightly significant in the rural sample no significance association with full immunization was found for "soap in the household" in the urban sample.

TABLE 39: Socioeconomic characteristics by Full vaccination.

Rural sample	Full vacc.				DEFF=1.17
	No	Yes	OR	Chisq	P
Distance to drinking water					
Piped into residence	55 65%	30 35%		5.3 (MHLA)	0.021
Less than 0.25 mile	175 63%	101 37%			
Between 0.25 and 0.5 mile	201 64%	115 36%			
Between 0.5 and 1 mile	169 67%	83 33%			
More than 1 mile	107 76%	33 24%	1.78 (1.16-2.75) (1.12-2.83)	7.6	0.006
Toilet in household					
No	132 81%	30 19%	2.54 (1.67-3.86) (1.61-4.00)	20.1	<0.001
Yes	575 63%	332 37%			
Wall material					
Mud & poles	653 66%	331 34%		0.6	0.74
Earth Bricks	28 61%	18 39%			
Cement blocks	25 66%	13 34%		0.1 (MHLA)	0.76

TABLE 39 (cont.): Socioeconomic characteristics by Full vacc.

Rural sample	Full vacc.				DEFF=1.17
	No	Yes	OR	Chisq	P
Floor material					
Cow dung, etc.	665	333	1.41	1.9	0.17
	67%	33%	(0.86-2.42)		
Parquet, wood, cement	41	29			
	59%	41%			
Roof material					
Thatch, papyrus	448	178	1.79	19.9	<0.001
	72%	28%	(1.38-2.31)		
			(1.35-2.36)		
Tins, tiles	259	184			
	58%	42%			
Stove in household					
No	641	314	1.48	3.9	0.049
	67%	33%	(1.00-2.21)		
			(0.97-2.28)		
Yes	66	48			
	58%	42%			
Household has a radio					
No	571	244	2.03	23.6	<0.001
	70%	30%	(1.52-2.71)		
			(1.48-2.77)		
Yes	136	118			
	54%	46%			

TABLE 39 (cont.): Socioeconomic characteristics by Full vacc.

Rural sample	Full vacc.				DEFF=1.17
	No	Yes	OR	Chisq	P
Soap in household					
No	121	41	1.62	6.3	0.012
	75%	25%	(1.11-2.36)		
			(1.07-2.44)		
Yes	585	321			
	65%	35%			
Household owns a transportation vehicle					
No	456	220	1.17	1.4	0.23
	67%	33%	(0.90-1.52)		
Yes	251	142			
	64%	36%			

TABLE 40: Socioeconomic characteristics by Full vaccination.

Urban sample	Full vacc.				DEFF=1.10
	No	Yes	OR	Chisq	P
Distance to drinking water					
Piped into residence	39	69		25.9	<0.001
	36%	64%		(MHLA)	
Less than 0.25 mile	25	33			
	43%	57%			
More than 0.25 mile	59	20	4.70	28.0	<0.001
	75%	25%	(2.49-8.95)		
			(2.41-9.15)		

TABLE 40(cont.): Socioeconomic characteristics by Full vacc.

Urban sample	**Full vacc.**				DEFF=1.10
	No	Yes	OR	Chisq	P
Toilet in household					
No	16	4	4.41	7.7	0.005
	80%	20%	(1.43-13.61)		
			(1.35-14.37)		
Yes	107	118			
	48%	52%			
Wall material					
Mud & poles	79	37	4.17	28.4	<0.001
	68%	32%	(2.36-7.40)		
			(2.29-7.58)		
Earth Bricks	19	25			
	43%	57%			
Cement blocks	24	59		28.6	<0.001
	39%	71%		(MHLA)	
Floor material					
Cow dung, etc.	79	34	4.65	32.6	<0.001
	70%	30%	(2.70-8.00)		
			(2.63-8.23)		
Parquet, wood, cement	44	88			
	33%	67%			
Roof material					
Thatch, papyrus	42	11	5.23	22.8	<0.001
	79%	21%	(2.54-10.78)		
			(2.45-11.17)		
Tins, tiles	81	111			
	42%	58%			

TABLE 40 (cont.): Socioeconomic characteristics by Full vacc.

Urban sample	**Full vacc.**				DEFF=1.10
	No	Yes	OR	Chisq	P
Stove in household					
No	61	21	4.73	28.8	<0.001
	74%	26%	(2.63-8.52)		
			(2.57-8.70)		
Yes	62	101			
	38%	62%			
Household has a radio					
No	64	31	3.18	18.3	<0.001
	67%	33%	(1.85-5.47)		
			(1.81-5.60)		
Yes	59	91			
	39%	61%			
Soap in household					
No	15	6	2.69	4.1	0.042
	71%	29%	(1.005-7.17)		
			(0.96-7.56)		
Yes	108	116			
	48%	52%			
Household owns a transportation vehicle					
No	80	70	1.38	1.5	0.22
	53%	47%	(0.82-2.32)		
Yes	43	52			
	45%	55%			

7.3.3 Educational characteristics

Clear cut statistical differences in full immunization coverage were seen for maternal education, in terms of both school level and actual reading abilities: the more educated the mother, the higher the chance of full immunization for her child (tables 41 and 43). Children of women who listen to the radio are immunized to a significant higher degree, than are children of women who do not listen to the radio.

For the rural sample, the same pattern as for maternal educational characteristics was found: there was a linear association between level of education and full immunization (table 42). In the urban sample, no association was found between the reported reading ability of the father and his child's immunization (table 44).

Urban children of fathers who did not go to secondary school were at higher risk of not receiving full immunization (table 44).

TABLE 41: Maternal educational characteristics by Full vacc.

Rural sample:	**Full vacc.**				DEFF=1.17
	No	Yes	OR	chisq	P
Formal education					
none	346	127	1.77	18.6	<0.001
	73%	27%	(1.36-2.30)		
			(1.34-2.35)		
primary school	346	202			
	63%	37%			
secondary school	15	33		31.6	<0.001
	31%	69%		(MHLA)	
Reads Sentence?					
Not at all	392	138	1.82	19.6	<0.001
	74%	26%	(1.38-2.39)		
			(1.35-2.44)		
With difficulty	119	64			
	65%	35%			
Easily	178	126		21.6	<0.001
	59%	41%		(MHLA)	
Listens to radio?					
No	516	224	1.64	12.8	<0.001
	70%	30%	(1.25-2.15)		
			(1.23-2.19)		
Yes	190	135			
	58%	42%			

TABLE 42: Paternal educational characteristics by Full vacc.

Rural sample:	**Full vacc.**			DEFF=1.17	
	No	Yes	OR	chisq	P
Formal education					
none	151	47	1.78	10.2	0.001
	76%	24%	(1.25-2.55)		
			(1.21-2.61)		
primary school	463	225			
	67%	33%			
secondary school	63	68		26.0	<0.001
	48%	52%		(MHLA)	
Reads Letter?					
Not at all	138	36	1.88	9.8	0.002
	79%	21%	(1.24-2.86)		
			(1.21-2.93)		
With difficulty	104	38			
	73%	27%			
Easily	359	189		12.9	<0.001
	66%	34%		(MHLA)	

TABLE 43: Maternal educational characteristics by Full vacc.

Urban sample:	**Full vacc.**				DEFF=1.10
	No	Yes	OR	chisq	P
Formal education					
None	33	11	3.70	13.2	<0.001
	75%	25%	(1.77-7.73)		
			(1.71-7.99)		
Primary school	72	55			
	57%	43%			
Secondary school	18	56		31.5	<0.001
	24%	76%		(MHLA)	
Reads Sentence?					
Not at all	50	15	3.15	11.0	<0.001
	77%	23%	(1.50-6.69)		
			(1.44-6.86)		
With difficulty	10	6			
	63%	38%			
Easily	44	45		11.9	<0.001
	49%	51%		(MHLA)	
Listens to radio?					
No	58	27	3.14	16.9	<0.001
	68%	32%	(1.80-5.47)		
			(1.75-5.63)		
Yes	65	95			
	41%	59%			

TABLE 44: Paternal educational characteristics by Full vacc.

Urban sample:	**Full vacc.**			DEFF=1.10	
	No	Yes	OR	chisq	P
Formal education					
A) None	8 62%	5 38%			
B) Primary school	71 62%	43 38%			
C) Secondary school	39 38%	63 62%		10.9 (MHLA)	<0.001
OR: (A+B vs. C) 2.66 (1.50-4.72)			(1.46-4.85)	13.0	<0.001
Reads Letter?					
Not at all	7 64%	4 36%		2.3 (DF=2)	0.31
With difficulty	7 47%	8 53%			
Easily	61 67%	30 33%		0.7 (MHLA)	0.41

7.3.4 Family characteristics

The variable "no. of persons in household" showed no statistically significant results. However, a non-significant trend towards a higher chance of receiving all EPI-vaccinations in households with more than 10 persons was seen for the rural sample (table 45).

Different trends appeared for the rural and the urban sample for the variable "number of children under five years in the household". While there was a significant linear associaciation between increasing number children and lack of immunization in the urban sample (table 49), the trend (though non-significant) was exactly the opposite in the rural sample. Urban children with mothers aged 20-29 years at the time of the survey had a significant higher full immunization coverage than other children (table 49). No association was found in the rural sample.

If the mother had lived with more than one man, her child had less chance of having received all the EPI vaccinations. This association was most significant in the urban sample. Bigamy was associated with lower full immunization coverage mainly in the rural areas, while this association was not significant in the urban areas. "Mother's current marital status" and "father living a part from the rest of the family" showed no association with full immunization coverage. However, "mother's current marital status" had a Woolf's test of P=0.07

(table 46). None of the reported odds ratios in table 46 were significant.

In the urban sample there was a slightly significant association with lower full immunization coverage for children of mothers with more than four children (table 49). Though the tendency was in the same direction in the rural sample, no significance was found for the whole rural subsample, due to different results in the South-West region compared with the other rural regions (table 47). Woolf's test was significant for this variable (P=0.03).

The survival experience of older siblings was significantly associated with full immunization in both samples (tables 45 and 49). Here the variable had a Woolf's test of P=0.08 (table 48), which was due to a higher association in the Luwero triangle (OR=1.85) and the "rest" of the rural sample (OR=3.55).

TABLE 46: Family characteristics by Full vaccination.

Rural sample	**Full vacc.**				DEFF=1.00
	No	Yes	OR	Chisq	P
Size of household					
More than 10 persons	69 59%	47 41%	0.72 (0.48-1.10)	2.6	0.11
Less than 11 persons	638 67%	315 33%			
No. of children <5 years					
One	185 67%	90 33%		1.8 (MHLA)	0.19
Two	300 67%	150 33%			
Three	149 66%	78 34%			
Four or more	60 59%	42 41%	0.72 (0.46-1.11)	2.5	0.12
Age of mother					
Between 15 and 19	68 69%	31 31%		2.8 (DF=4)	0.59
Between 20 and 24	184 63%	110 37%			
Between 25 and 29	189 66%	98 34%			
Between 30 and 34	127 68%	59 32%			
Thirtyfive or more	139 68%	64 32%			

TABLE 46 (cont.): Family characteristics by Full vaccination.

Rural sample	**Full vacc.**				DEFF=1.07
	No	Yes	OR	Chisq	P
Mother married /living with a man					
More than once	156 74%	55 26%	1.53 (1.09-2.15) (1.08-2.17)	6.0	0.014
Once	529 65%	285 35%			
Mother's current marital status					
Widowed,divorced, single	97 66%	49 34%	1.02 (0.69-1.50)	0.0	0.93
Married / living with a man	610 66%	313 34%			
Father living a part from the rest of the family?					
Yes	38 62%	23 38%	0.84 (0.48-1.48)	0.4	0.52
No	570 51%	289 49%			
Bigamy?					
Yes	199 75%	68 25%	1.75 (1.27-2.41) (1.26-2.44)	12.2	<0.001
No	409 63%	245 37%			DEFF=1.04

TABLE 46 (cont.): Family characteristics by Full vaccination.

Rural sample	**Full vacc.**				DEFF=1.00
	No	Yes	OR	Chisq	P
No. of births					
More than four	329 69%	146 31%	1.29 (0.99-1.67)	3.7	0.053
Less than five	378 64%	216 36%			
No. of living children					
More than four	250 68%	116 32%	1.16 (0.88-1.52)	1.2	0.28
Less than five	457 65%	246 35%			
No. of children who have died					
Two or more	137 75%	46 25%	1.65 (1.15-2.37) (1.15-2.37)	7.5	0.006
One	193 65%	102 35%			
None	377 64%	214 36%			

Table 46: "Mother's current marital status" by Full vaccination coverage (%) in three rural regions.

Marital status	Luwero	S-W	Rest	Woolf's test Chisq	P
A) Widowed,divorced, single	27% 44	50% 46	25% 56		
B) Married/living with a man	42% 206	39% 375	23% 342		
OR (B vs. A)	1.95	0.64	0.89	5.37	0.07

Table 47: "Total no. of children born" by Full vaccination coverage (%) in three rural regions.

No. of children	Luwero	S-W	Rest	Woolf's test Chisq	P
A) More than four N	32% 113	42% 197	17% 165		
B) Less than five N	46% 137	39% 224	28% 233		
OR (B vs. A)	1.82	0.91	1.89	7.03	0.03

Table 48: "No. of children who have died" by Full vaccination coverage (%) in three rural regions.

Dead children	Luwero	S-W	Rest	Woolf's test Chisq	P
A) Two or more N	28% 46	38% 71	9% 66		
B) None or one N	42% 204	41% 350	26% 332		
OR (B vs. A)	1.85	1.13	3.55	5.08	0.08

TABLE 49: Family characteristics by Full vaccination.

Urban sample	**Full vacc.**				DEFF=1.10
	No	Yes	OR	Chisq	P
Size of household					
More than 10 persons	13 50%	13 50%	0.99 (0.41-2.40)	0.0	0.98
Less than 11 persons	110 50%	109 50%			
No. of children <5 years in the household					
One	21 37%	36 63%			
Two	45 48%	49 52%			
Three	37 55%	30 45%			
Four or more	14 67%	7 33%		7.0 (MHLA)	0.008
Age of mother					
A) 15-19	14 67%	7 33%		9.6 (DF=4)	0.048
B) 20-24	35 49%	36 51%			
C) 25-29	31 38%	50 62%			
D) 30-34	25 61%	16 39%			
E) ≥35	18 58%	13 42%			
ADE vs BC:			OR=2.06 (1.18-3.62) (1.18-3.62)	7.4	0.007 DEFF=1.00

TABLE 49 (cont.): Family characteristics by Full vaccination.

Urban sample	**Full vacc.**				DEFF=1.08
	No	Yes	OR	Chisq	P
Mother's current marital status					
Widowed, divorced, single	22 50%	22 50%	0.99 (0.49-2.00)	0.0	0.98
Married / living with a man	101 50%	100 50%			
Father living a part from the rest of the family?					
Yes	9 50%	9 50%	0.99 (0.37-2.61)	0.0	0.98
No	92 50%	91 50%			
Bigamy?					
Yes	40 63%	24 38%	2.22 (0.72-6.77)	2.0	0.16
No	61 45%	76 55%			
Mother married /living with a man					
More than once	35 76%	11 24%	3.84 (1.83-8.02) (1.78-8.30)	13.9	<0.001
Once	83 45%	100 55%			

TABLE 49 (cont.): Family characteristics by Full vaccination.

Urban sample	**Full vacc.**				DEFF=1.07
	No	Yes	OR	Chisq	P
No. of births					
More than four	55 59%	39 41%	1.72 (1.02-2.90) (0.998-2.97)	4.2	0.040
Less than five	68 45%	83 55%		DEFF=1.10	
No. of living children					
More than four	45 61%	29 39%	1.85 (1.06-3.23) (1.04-3.30)	4.8	0.029
Less than five	78 46%	93 54%			
No. of children who have died					
Two or more	8 44%	10 56%		2.8 (DF=2)	0.25
One	33 60%	22 40%			
None	82 48%	90 52%			

7.3.5 Attitudes, etc.

No association was found between gender and full immunization coverage. Children of mothers who were members of a mother's organisation, showed higher full immunization coverage. This difference, however, was only significant for the rural sample (tables 50 and 51).

The variables "ideal number of children", "mother finds FP-info in schools acceptable", and "mother approves contraception" were significantly associated with child vaccination in both samples: children of mothers who were in favour of family planning and contraception and who did not want to have more than six children themselves, had higher full immunization coverage than other children.

"Mother approves FP-info in schools" was significantly associated with higher full immunization coverage only in the rural sample (table 50). Urban children of fathers who were positive towards contraception and children of mothers who had used contraceptives had significant higher full immunization coverage (table 51).

TABLE 50: Attitudes, etc. by Full vaccination.

Rural sample:	Full vacc.				DEFF=1.29
	No	Yes	OR	chisq	P
Child's gender					
Female	368	185	1.04	0.1	0.77
	67%	33%	(0.80-1.34)		
Male	339	177			
	66%	34%			DEFF=1.00
Mother member of organisation?					
No	615	282	1.90	14.4	<0.001
	69%	31%	(1.36-2.64)		
			(1.30-2.76)		
Yes	92	80			
	53%	47%			
Acceptable FP info on radio?					
No	226	83	1.67	11.8	<0.001
	73%	27%	(1.24-2.23)		
			(1.19-2.33)		
Yes	448	274			
	62%	38%			
Acceptable FP taught in school?					
No	243	99	1.45	6.8	0.009
	71%	29%	(1.09-1.92)		
			(1.05-1.98)		
Yes	439	259			
	63%	37%			

TABLE 50 (cont.): Attitudes, etc. by Full vaccination.

Rural sample:	**Full vacc.**				DEFF=1.29
	No	Yes	OR	chisq	P
Ideal no. of children					
More than six	371	145	1.65	14.8	<0.001
	72%	28%	(1.28-2.14)		
			(1.27-2.16)		
Less than seven	336	217			
	61%	39%			DEFF=1.03
Mother approves contraceptive method					
No	235	73	1.97	20.0	<0.001
	76%	24%	(1.46-2.67)		
			(1.40-2.77)		
Yes	468	287			
	62%	38%			
Father approves contraception					
No	453	214	1.33	3.6	0.058
	68%	32%	(0.99-1.80)		
Yes	157	99			
	61%	39%			
Ever used contraception					
No	574	279	1.28	2.5	0.11
	67%	33%	(0.94-1.76)		
Yes	133	83			
	62%	38%			DEFF=1.28

TABLE 51: Attitudes, etc. by Full vaccination.

Urban sample:	Full vacc. No	Full vacc. Yes	OR	chisq	P
Child's gender					DEFF=1.03
Female	65 53%	57 47%	1.28 (0.77-2.11)	0.9	0.34
Male	58 47%	65 53%			DEFF=1.00
Mother member of organisation?					
No	94 54%	81 46%	1.64 (0.93-2.88)	3.0	0.082
Yes	29 41%	41 59%			
Acceptable FP info on radio?					
No	20 69%	9 31%	2.44 (1.06-5.60) (1.05-5.67)	4.6	0.031
Yes	102 48%	112 52%			
Acceptable FP taught in school?					
No	25 49%	26 51%	0.95 (0.51-1.77)	0.2	0.87
Yes	96 50%	95 50%			

TABLE 51 (cont.): Attitudes, etc. by Full vaccinations.

Urban sample:	**Full vacc.**				DEFF=1.03
	No	Yes	OR	chisq	P
Ideal no. of children					
More than six	42	22	2.36	8.2	0.004
	66%	34%	(1.30-4.27)		
			(1.30-4.27)		
Less than seven	81	100			
	45%	55%			DEFF=1.00
Mother approves contraceptive method					
No	29	12	2.86	8.5	0.004
	71%	29%	(1.38-5.92)		
			(1.36-5.99)		
Yes	93	110			
	46%	54%			
Father approves contraception					
No	71	42	3.27	16.3	<0.001
	63%	37%	(1.82-5.86)		
			(1.81-5.91)		
Yes	30	58			
	34%	66%			
Ever used contracept.					
No	73	44	2.59	13.3	<0.001
	62%	38%	(1.55-4.35)		
			(1.50-4.46)		
Yes	50	78			
	39%	61%			DEFF=1.12

7.3.6 Health system

Children of mothers who received TT while pregnant had significantly higher full immunization rates in both samples (tables 52 and 54). The same tendency was seen for pregnancy checks, though the association was not statistically significant (small numbers in the urban sample). However, in the rural sample this variable had a Woolf's test of P=0.07, which was due to a higher association (which was just at the level of significance) for the rural Luwero triangle, (table 53).

If a nurse, midwife or doctor assisted with the delivery, the child had a higher chance of receiving full immunization, although the difference was only at the 0.05 significance level in the rural sample.

Children in rural communities where vaccinations were offered on a regular daily or weekly basis had a 14% higher full immunization rate than other children. Children from communities with a trained midwife showed only a 3% higher full immunization rate (table 52).

TABLE 52: Health system by Full vaccination.

Rural sample:	Full vacc.				
	No	Yes	OR	chisq	P
Mother received TT when pregnant					
No	336	140	1.44	7.6	0.006
	71%	29%	(1.11-1.86)		
			(1.09-1.90)		
Yes	371	222			
	63%	37%			DEFF=1.14
Pregnancy checks					
No	117	45	1.40	3.3	0.071
	72%	28%	(0.96-2.07)		
Yes	587	317			
	65%	35%			DEFF=1.12
Assistant with delivery					
No one, person without formal education	516	243	1.33	4.1	0.042
	68%	32%	(1.00-1.77)		
			(0.98-1.80)		
Nurse, midwife, doctor	190	119			
	61%	39%			DEFF=1.10
Vaccination offered at least once a week					
No	228	76	1.92	18.0	<0.001
	75%	25%	(1.42-2.61)		
			(0.84-4.39)		
Yes	385	247			
	61%	39%			DEFF=7.31

TABLE 52 (cont.): Health system by Full vaccination.

Rural sample:	Full vacc. No	Yes	OR	chisq	P
Trained midwife in community?					
No	413 66%	217 34%	1.13 (0.82-1.55)	0.5	0.47
Yes	137 63%	81 37%			DEFF=7.31

Table 53: "Mothers' pregnancy checks" by Children's full vaccination coverage (%) in three rural regions.

Pregnancy checks	Luwero	S-W	Rest	Woolf's test Chisq	P
A) No	18%	32%	27%		
N	22	76	64		
B) Yes	42%	42%	23%		
N	228	342	334		
OR (B vs. A)	3.21	1.59	0.81	5.32	0.07

Luwero: P=0.031, 95% CI: 1.05-9.80 (0.99-10.46 (DEFF=1.12))

TABLE 54: Health system by Full vaccination.

Urban sample:	Full vacc. No	Yes	OR	chisq	P
Mother received TT when pregnant					
No	42 61%	27 39%	1.82 (1.03-3.23)	4.4	0.037
Yes	81 46%	95 54%			DEFF=1.00
Pregnancy checks					
No	9 56%	7 44%	1.30 (0.47-3.60)	0.3	0.62
Yes	114 50%	115 50%			DEFF=1.02
Assistant with delivery					
No one, person without formal education	51 70%	22 30%	3.22 (1.73-6.03) (1.70-6.09)	16.0	<0.001
Nurse, midwife, doctor	72 42%	100 58%			DEFF=1.05

7.3.7 Logistic regression

The best fit logistic model for the rural sample is shown in table 55. It included three socioeconomic variables. Though none of them were significant at the 0.05-level when the design effect was taken into account, leaving out any of the three, rendered the remaining two significant.

A combined variable on maternal and paternal education was also included ("educ"): none of the parents went to secondary school and at least one of the parents did not receive any formal education.

Additional risk factors for lack of full immunization for rural children were a bigamous father, a mother disapproved contraception and who did not receive TT.

"Vaccinations offered on a regular daily or weekly basis" provided the strongest contribution to the model.

In the urban model (table 56) increasing distance to drinking water, traditional roof material, bigamy and disapproval of contraception were risk factors included in the logistic model. In addition, children of mothers who had had more than one husband were at higher risk of not receiving full immunization.

TABLE 55: Logistic regression - dependent variable Full vaccination - rural sample

DEFF=1.89

Predictor variables		P	OR	95% CI
Educ	No formal maternal and/or paternal education	0.001	1.69	(1.22-2.34) (1.08-2.64)
Q117	Toilet in household	0.034	1.74	(1.04-2.90) (0.86-3.53)
Q717	Roof material	0.015	1.54	(1.09-2.19) (0.96-2.48)
Q120B	Household owns no radio	0.039	1.49	(1.02-2.18) (0.88-2.51)
Q403	TT when pregnant	0.023	1.44	(1.05-1.98) (0.93-2.23)
Q504	Bigamy	<0.001	2.08	(1.43-3.02) (1.24-3.49)
Q609	Mother approves contraception	0.024	1.53	(1.06-2.22) (0.92-2.54)
C10	Vaccination daily/weekly	<0.001	2.29	(1.61-3.26) (1.41-3.72)

Goodness of Fit chisquare: 793.3 (DF=796) P=0.52.

Coding of nominal variables:	0	1
Full immunization	No	Yes
Q117, Q120B, Q403, Q609, C10	No	Yes
Q504	Yes	No
Q717	thatch, papyrus	better mat.
Educ	None of the parents went to sec. school and at least one of the parents received no formal education	Both parents went to school

TABLE 56: Logistic regression - dependent variable Full vaccination - urban sample.

DEFF=1.08

Predictor variables	P	OR	95% CI
Q115A(1) Distance to drinking water	<0.001	3.97	(1.81-8.70)
			(1.75-8.98)
Q115A(2)	0.028	2.69	(1.12-6.48)
			(1.08-6.68)
Q717 Roof material	0.005	3.49	(1.45-8.37)
			(1.41-8.65)
Q504 Bigamy	0.006	2.78	(1.36-5.67)
			(1.33-5.83)
Q507 Different husbands?	0.019	2.78	(1.18-6.56)
			(1.14-6.78)
Q607 Father approves contraception	0.011	2.38	(1.22-4.63)
			(1.19-4.75)

Goodness of Fit chisquare 201.1 (DF=193) P=0.33.

Coding of nominal variables:	0	1
Received full vaccination	No	Yes
Q507, Q607	No	Yes
Q504	Yes	No
Q717	thatch, papyrus	better mat

Coding of categorical variables:

Q115A	Value	Freq	Coding	
Drinking water - distance			(1)	(2)
In residence	0	86	1	0
< 0.25 Mile	1	48	0	1
> 0.25 Mile	2	66	0	0

7.4 RESULTS - "DROP-OUTS"

7.4.1 Demographic characteristics

"Drop-outs" are children who have begun but not completed the EPI-vaccination series: (e.g. incompletely immunized children who have received at least one EPI-vaccination.)

There were 733 children in the rural sample and 198 children in the urban sample. The "drop-out" rates were 50.6% in the rural sample and 38.4% in the urban sample.

Children of mothers who immigrated to a village had significantly lower "drop-out" rates than children of mother's who have lived two years or more in the community (table 57). Urban children of immigrants from rural areas did not differ in "drop-out" rates from children of mothers who had lived for more then two years in the town, while children of immigrants from another town had the lowest "drop-out" rates (table 58). No significant association was found between children's "drop-out" rates and the number of localities where the parents had lived after their marriage.

The variable "religion" showed only one significant value: urban catholic children were more likely not to complete their vaccination series (table 58). However, no design effect for religion was shown in the UDHS report. If the design effect for religion in the urban subsample was more than 1.26, the result in table 58 would be non-significant.

TABLE 57: Demographic characteristics by "Drop-outs".

Rural sample:	**Full vacc.** No	Yes	OR	chisq	DEFF: no information in UDHS report P
Immigration (mother).					
A) <2 years from a village	26 51%	25 49%	0.97* (0.53-1.77)	0.0	0.91
B) <2 years from an urban area	13 29%	32 71%	0.38** (0.18-0.76)	8.8	0.003
C) ≥2 years, always lived in community	325 52%	302 48%			
* A vs. C ** B vs. C					
Number of localities after marriage					
One	194 49%	204 51%		3.4 (MHLA)	0.064
Two	128 53%	113 47%			
Three or more	36 61%	23 39%	1.54 (0.87-2.76)	2.4	0.12
Religion					
Catholic	184 54%	158 46%	1.26 (0.94-1.71)	2.5	0.11
Protestant	152 48%	164 52%			
Seventh Day Adventist	4 36%	7 64%			
Muslim	31 49%	32 51%		3.1 (DF=3)	0.37

TABLE 58: Demographic characteristics by "Drop-outs".

Urban sample:	**Full vacc.**			DEFF not presented in UDHS report	
	No	Yes	OR	chisq	P
Immigration (mother).					
A) <2 years from a rural area	4 27%	11 73%		15.4 (DF=2)	<0.001
B) <2 years from another town	13 21%	49 79%			
C) ≥2 years, always lived in town	59 50%	59 50%	3.53 (1.76-7.12)	15.3	<0.001
Number of localities after marriage					
One	38 40%	56 60%		0.8 (DF=2)	0.67
Two	20 34%	38 66%			
Three or more	13 43%	17 57%			
Religion					
Catholic	45 47%	51 53%	2.02 (1.08-3.77)	5.7	0.017
Protestant, Seventh Day Adventist	22 29%	54 71%			
Muslim	9 35%	17 65%		5.9 (DF=2)	0.051

7.4.2 Socioeconomic characteristics

In the rural sample, significant associations were found for "toilet in household" and for "roof material", while the results comparing "floor material" and "wall material" with "dropping-out" were non-significant (table 59). In the urban sample, all four variables describing housing standards were significantly associated with "dropping-out" of the EPI-series (table 61).

In the urban sample, there was a significant association between "increasing distance to drinking water" and a higher "drop-out" rate: children living more than 0.25 mile from their source of drinking water had a "drop-out" rate of 67% (table 61). No significance was found for the rural sample. Rural and urban children living in households which had a radio, and urban children living in a household which had a stove had significantly lower risk of incomplete vaccination. No association was found for "household has a transportation vehicle" and for "soap in the household". However, in the Luwero triangle, children who lived in a household with no soap had a much higher risk of "dropping-out" than other Luwero children (OR=3.81) as shown in the table 60.

TABLE 59: Socioeconomic Characteristics by "Drop-outs".

Rural sample	**Full vacc.**			DEFF=1.11	
	No	Yes	OR	Chisq	P
Distance to drinking water					
Piped into residence	35 54%	30 46%		0.4 (MHLA)	0.53
Less than 0.25 mile	98 49%	101 51%			
Between 0.25 and 0.5 mile	105 48%	115 52%			
Between 0.5 and 1 mile	91 52%	83 48%			
More than 1 mile	42 56%	33 44%	1,28 (0.77-2.13)	1.0	0.31
Toilet in household					
No	58 66%	30 34%	2.05 (1.28-3.27) (1.25-3.35)	9.4	0.002
Yes	313 49%	332 51%			
Soap in household					
No	56 58%	41 42%	1.39 (0.90-2.15)	2.3	0.13
Yes	315 50%	325 50%			
Household has a radio					
No	290 54%	244 46%	1.73 (1.24-2.41) (1.22-2.45)	10.7	0.001
Yes	81 41%	118 59%			

TABLE 59 (cont.): Socioecon. characteristics by "Drop-outs".

Rural sample	Full vacc.				DEFF=1.11
	No	Yes	OR	Chisq	P
Stove in household					
No	327 51%	314 49%	1.14 (0.73-1.76)	0.3	0.57
Yes	44 48%	48 52%			
Floor material					
Cow dung, etc.	346 51%	333 49%	1.26 (0.71-2.20)	0.6	0.43
Parquet, wood, cement	24 45%	29 55%			
Roof material					
Thatch, papyrus	221 55%	178 45%	1.52 (1.13-2.04) (1.12-2.07)	8.0	0.005
Tins, tiles	150 45%	184 55%			
Wall material					
Mud & poles	340 51%	331 49%	1.03 (0.59-1.78)	0.0	0.92
Earth Bricks	15 45%	18 55%		0.6 (DF=2)	0.74
Cement blocks	16 55%	13 45%		0.1 (MHLA)	0.78

TABLE 59 (cont.): Socioecon. characteristics by "Drop-outs".

Rural sample	Full vacc.			DEFF=1.11	
	No	Yes	OR	Chisq	P
Household owns a transportation vehicle					
No	233 51%	220 49%	1.09 (0.81-1.47)	0.3	0.57
Yes	138 49%	142 51%			

Table 60: "Soap in household" by "drop-out" rate (%) in three rural regions.

Soap in household	Luwero	S-W	Rest	Woolf's test Chisq	P
A) No	71%	46%	62%		
N	21	37	39		
B) Yes	40%	43%	64%		
N	154	263	219		
OR (A vs. B)	3.81	1.13	0.89	5.08	0.08

TABLE 61: Socioeconomic Characteristics by "Drop-outs".

Urban sample	**Full vacc.**			DEFF=1.07	
	No	Yes	OR	Chisq	P
Distance to drinking water					
Piped into residence	20	69		28.2	<0.001
	22%	78%		(MHLA)	
Less than 0.25 mile	16	33			
	33%	67%			
More than 0.25 mile	40	20	5.67	29.1	<0.001
	67%	33%	(2.80-11.57)		
			(2.73-11.77)		
Toilet in household					
No	8	4	3.47	4.3	0.038
	67%	33%	(1.01-11.96)		
			(0.99-12.48)		
Yes	68	118			
	37%	63%			
Soap in household					
No	9	6	2.60	3.2	0.073
	60%	40%	(0.88-7.62)		
Yes	67	116			
	37%	63%			
Wall material					
Mud & poles	43	37	3.05	13.7	<0.001
	54%	46%	(1.61-5.82)		
			(1.57-5.91)		
Earth Bricks	17	25			
	40%	60%			
Cement blocks	15	59		18.2	<0.001
	20%	80%		(MHLA)	

TABLE 61 (cont.): Socioecon. characteristics by "Drop-outs".

Urban sample	Full vacc.				DEFF=1.10
	No	Yes	OR	Chisq	P
Floor material					
Cow dung, etc.	47	34	4.19	22.4	<0.001
	58%	42%	(2.28-7.71)		
			(2.23-7.86)		
Parquet, wood, cement	29	88			
	25%	75%			
Roof material					
Thatch, papyrus	26	11	5.25	19.6	<0.001
	79%	21%	(2.40-11.45)		
			(2.33-11.80)		
Tins, tiles	50	111			
	31%	69%			
Household has a radio					
No	36	31	2.64	10.1	0.001
	54%	46%	(1.44-4.85)		
			(1.41-4.94)		
Yes	40	91			
	31%	69%			
Stove in household					
No	38	21	4.81	24.1	<0.001
	64%	36%	(2.51-9.22)		
			(2.45-9.43)		
Yes	38	101			
	27%	73%			
Transportation vehicle					
No	47	70	1.20	0.4	0.53
	40%	60%	(0.67-2.16)		
Yes	29	52			
	36%	64%			

7.4.3 Educational characteristics

There was a significant association between increasing maternal education and decreasing "drop-out" rates for both samples (tables 62 and 64).

Children of mothers, who listened to the radio were less likely to "drop-out" the EPI-series (tables 62 and 64).

As with maternal education, there was a significant association between increasing formal paternal education and decreasing "drop-out" rate in both samples (tables 63 and 65).

Rural children of fathers who could read a letter had slightly lower "drop-out" rates than children of fathers, who read with difficulties. They in turn had a 6% lower "drop-out rate" than children of fathers who could not read at all. This association was just around the 5%-level of significance (table 63).

No association was found between the reported paternal reading ability and children's "drop-out" rate in the urban sample (table 65). However, the numbers were small.

TABLE 62: Maternal educational characteristics by "Drop-outs".

Rural sample:	**Full vacc.**				DEFF=1.11
	No	Yes	OR	chisq	P
Formal education					
none	163 56%	127 44%	1.45 (1.08-1.95) (1.05-1.99)	6.0	<0.001
primary school	199 50%	202 50%			
secondary school	9 21%	33 79%		13.1 (MHLA)	<0.001
Reads Sentence?					
Not at all	191 58%	138 42%	1.56 (1.14-2.13) (1.12-2.17)	8.3	0.004
With difficulty	65 50%	64 50%			
Easily	104 45%	126 55%		9.1 (MHLA)	0.003
Listens to radio?					
No	261 54%	224 46%	1.43 (1.05-1.95) (1.03-1.98)	5.2	0.023
Yes	110 45%	135 55%			

TABLE 63: Paternal educational characteristics by "Drop-outs".

Rural sample:	**Full vacc.**				DEFF=1.11
	No	Yes	OR	chisq	P
School attendance					
None	69 59%	47 41%	1.50 (1.00-2.25) (0.98-2.30)	3.9	0.049
Primary school	246 52%	225 48%			
Secondary school	40 37%	68 63%		11.1 (MHLA)	<0.001
Reads Letter?					
Not at all	58 62%	36 38%	1.47 (0.92-2.38)	2.8	0.09
With difficulty	51 57%	38 43%			
Easily	197 51%	189 49%		4.0 (MHLA)	0.047

TABLE 64: Maternal educational characteristics by "Drop-outs"

Urban sample:	**Full vacc.**				DEFF=1.07
	No	Yes	OR	chisq	P
Formal education					
None	20 65%	11 35%	3.60 (1.61-8.04) (1.57-8.26)	10.6	0.001
Primary school	46 46%	55 54%			
Secondary school	10 15%	56 85%		25.4 (MHLA)	<0.001
Reads Sentence?					
Not at all	31 67%	15 33%	3.10 (1.37-7.08) (1.32-7.29)	9.0	0.003
With difficulty	6 50%	6 50%			
Easily	28 38%	45 62%		9.4 (MHLA)	0.002
Listens to radio?					
No	33 55%	27 45%	2.70 (1.45-5.04) (1.42-5.15)	10.0	0.002
Yes	43 31%	95 69%			

TABLE 65: Paternal educational characteristics by "Drop-outs".

Urban sample:	**Full vacc.**			DEFF=1.07	
	No	Yes	OR	chisq	P
Formal education					
A) None	6 55%	5 45%			
B) Primary school	45 51%	43 49%			
C) Secondary school	20 24%	63 76%		12.7 (MHLA)	<0.001
OR: (A+B vs. C)	3.35	(1.69-6.68)	(1.65-6.80)	13.0	<0.001
Reads Letter?					
Not at all	4 50%	4 50%		2.7 (DF=2)	0.26
With difficulty	4 33%	8 67%			
Easily	42 58%	30 42%		1.2 (MHLA)	0.28

7.4.4 Family characteristics

No statistically significant association was found between the size of the household and the children's "drop-out" rate. There was an association between increasing number of children under 5 years in a household and increasing "drop-out" rate for the urban sample (table 68), while no such association was found for the rural areas (table 66).

No association was found between maternal age and the children's "drop-out" rate in any of the samples.

If a rural mother had lived with more than one man her child had a higher risk of "dropping-out" of the EPI-series, while no such association was seen for the rural sample. Bigamy was associated with higher "drop-out" rates in both samples, while no association was seen for "mother's current marital status" and "father living a part from the rest of the family.

Rural children who had two or more siblings who had died, had a higher risk of "dropping-out" the EPI-series. No such association was seen for the urban sample. No association was found between number of children per mother and the child's risk of "dropping-out" the vaccination series. However, Woolf's test was significant for "total number of children born" (table 67).

TABLE 66: Family characteristics by "Drop-outs".

Rural sample	**Full vacc.**				DEFF=1.00
	No	Yes	OR	Chisq	P
Size of household					
More than 10 persons	44 48%	47 52%	0.91 (0.58-1.41)	0.2	0.64
Less than 11 persons	327 51%	315 49%			
No. of children <5 years					
One	95 51%	90 49%		0.3 (MHLA)	0.61
Two	152 50%	150 50%			
Three	79 50%	78 49%			
Four or more	38 48%	42 53%	0.88 (0.54-1.44)	0.3	0.60
Age of mother					
Age 15 - 19	38 55%	31 45%		2.3 (DF=4)	0.67
Age 20 - 24	96 47%	110 53%			
Age 25 - 29	100 51%	98 49%			
Age 30 - 34	67 53%	59 47%			
Thirtyfive or more	70 52%	64 48%			

TABLE 66 (cont.): Family characteristics by "Drop-outs".

Rural sample	Full vacc.				DEFF=1.04
	No	Yes	OR	Chisq	P
Mother married /living with a man					
More than once	67 55%	55 45%	1.19 (0.80-1.76)	0.7	0.39
Once	218 50%	222 50%			
Mother's current marital status					
Widowed,divorced, single	43 47%	49 53%	0.84 (0.53-1.33)	0.6	0.43
Married / living with a man	328 51%	313 49%			
Father living a part from the rest of the family?					
Yes	24 51%	23 49%	1.00 (0.55-1.82)	0.0	1.00
No	302 51%	289 49%			
Bigamy?					
Yes	106 61%	68 39%	1.73 (1.21-2.47) (1.20-2.49)	9.2	0.002
No	221 47%	245 53%			

TABLE 66 (cont.): Family characteristics by "Drop-outs".

Rural sample	**Full vacc.**				DEFF=1.00
	No	Yes	OR	Chisq	P
No. of births					
More than four	165 53%	146 47%	1.19 (0.88-1.59)	1.3	0.26
Less than five	206 49%	216 51%			
No. of living children					
More than four	125 52%	116 48%	1.08 (0.79-1.47)	0.2	0.64
Less than five	246 50%	246 50%			
No. of Children who have died					
Two or more	76 62%	46 38%	1.77 (1.19-2.64) (1.19-2.64)	8.0	0.005
One	93 48%	102 52%			
None	202 49%	214 51%		4.9 (MHLA)	0.026

Table 67: "Total no. of children born" by "drop-out" rate (%) in three rural regions.

No. of children	Luwero	S-W	Rest	Woolf's test Chisq	P
A) More than four	48%	39%	74%		
N	69	135	107		
B) Less than five	41%	47%	57%		
N	106	165	151		
OR (A vs. B)	1.34	0.74	2.13	8.76	0.01

TABLE 68: Family characteristics by "Drop-outs".

Urban sample	**Full vacc.**				DEFF=1.00
	No	Yes	OR	Chisq	P
Size of household					
More than 10 persons	6 32%	13 68%	0.72 (0.26-1.98)	0.4	0.52
Less than 11 persons	70 39%	109 61%			
No. of children <5 years					
One	11 23%	36 77%			
Two	29 37%	49 63%			
Three	25 45%	30 55%			
Four or more	9 56%	7 44%		7.7 (MHLA)	0.006
Age of mother					
A) 15-19	9 56%	7 44%		8.5 (DF=4)	0.074
B) 20-24	27 43%	36 57%			
C) 25-29	17 25%	50 75%			
D) 30-34	11 41%	16 59%			
E) >35	12 48%	13 52%			
OR: (A+D+E vs. B+C)			1.74 (0.91-3.31)	3.3	0.07

TABLE 68 (cont.): Family characteristics by "Drop-outs".

Urban sample	**Full vacc.**				DEFF=1.07
	No	Yes	OR	Chisq	P
Mother married /living with a man					
More than once	15 58%	11 42%	2.44 (1.05-5.66) (1.02-5.83)	4.4	0.035
Once	56 36%	100 64%			
Mother's current marital status					
Single, widowed, divorced	13 37%	22 63%	0.94 (0.44-2.00)	0.0	0.87
Married/living with a man	63 39%	100 61%			
Father living a part from the rest of the family?					
Yes	4 31%	9 69%	0.69 (0.20-2.33)	0.4	0.54
No	59 39%	91 61%			
Bigamy?					
Yes	28 54%	24 46%	2.53 (1.29-4.98)	7.4	0.006
No	35 32%	76 69%			

TABLE 68 (cont): Family characteristics by "Drop-outs".

Urban sample	**Full vacc.**				DEFF=1.06
	No	Yes	OR	Chisq	P
No. of births					
More than four	165 53%	146 47%	1.19 (0.88-1.59)	1.3	0.26
Less than five	206 49%	216 51%			
No. of living children					
More than four	23 44%	29 56%	1.39 (0.73-2.65)	1.0	0.31
Less than five	53 36%	93 64%			
No. of Children who have died					
None	51 36%	90 64%		2.0	0.37
One	20 48%	22 52%			
Two or more	5 33%	10 67%		0.3 (MHLA)	0.58

7.4.5 Attitudes, etc.

No association was found between a child's gender and the risk of not completing the EPI-series.

Children of mothers, who were members of a mother's organisation had lower "drop-out" rates (tables 69 and 70).

Urban children of mothers who had used contraceptives had a significantly higher possibility of completing the EPI-series, while the difference (4%) was not significant for the rural sample. The variables "ideal number of children", "mother finds FP-info on the radio acceptable", and "mother approves contraception" were significantly associated with completion of the EPI-series in both samples: children of mothers who were in favour of family planning and contraception, and who did not want to have more than six children themselves, showed lower "drop-out" rates than other children.

"Mother approves FP-info in schools" was significantly associated with a lower "drop-out" rate only in the rural areas (table 69), while "father approves contraception" was significantly associated with a lower "drop-out" rate only in the urban areas (table 70).

TABLE 69: Attitudes, etc. by "Drop-outs".

Rural sample:	**Full vacc.**				DEFF=1.19
	No	Yes	OR	chisq	P
Child's gender					
Female	191 51%	185 49%	1.02 (0.76-1.36)	0.0	0.92
Male	180 50%	177 50%			DEFF=1.00
Mother member of organisation?					
No	319 53%	282 47%	1.74 (1.18-2.56) (1.14-2.65)	8.1	0.004
Yes	52 39%	80 61%			
Acceptable FP info on radio?					
No	118 59%	83 41%	1.63 (1.17-2.27) (1.13-2.34)	8.5	0.004
Yes	239 47%	274 53%			
Acceptable FP taught in school?					
No	127 56%	99 44%	1.42 (1.03-1.95) (1.004-2.01)	4.7	0.030
Yes	234 47%	259 53%			

TABLE 69 (cont). Attitudes, etc. by "Drop-outs".

Rural sample:	**Full vacc.**				DEFF=1.19
	No	Yes	OR	chisq	P
Ever used contracept.					
No	296	279	1.17	0.8	0.37
	51%	49%	(0.82-1.67)		
Yes	75	83			
	47%	53%			DEFF=1.28
Ideal no. of children					
More than six	184	145	1.47	6.7	0.009
	56%	44%	(1.10-1.97)		
			(1.09-1.99)		
Less than seven	187	217			
	46%	54%			DEFF=1.02
Mother approves contraceptive method					
No	113	73	1.74	10.3	0.001
	61%	39%	(1.23-2.44)		
			(1.20-2.52)		
Yes	256	287			
	47%	53%			
Father approves contraception					
No	234	214	1.15	0.7	0.41
	52%	48%	(0.82-1.62)		
Yes	94	99			
	49%	51%			

TABLE 70: Attitudes, etc. by "Drop-outs".

Urban sample:	**Full vacc.**				DEFF=1.02
	No	Yes	OR	chisq	P
Child's gender					
Female	40 41%	57 59%	1.27 (0.69-2.34)	0.7	0.42
Male	36 36%	65 64%			DEFF=1.00
Mother member of organisation?					
No	60 43%	81 57%	1.90 (0.97-3.70)	3.6	0.058
Yes	16 28%	41 72%			
Acceptable FP info on radio?					
No	15 63%	9 38%	3.11 (1.28-7.53) (1.27-7.61)	6.8	0.009
Yes	60 35%	112 65%			
Acceptable FP taught in school?					
No	19 42%	26 58%	1.26 (0.64-2.49)	0.5	0.50
Yes	55 37%	95 63%			

TABLE 70 (cont.): Attitudes, etc. by "Drop-outs".

Urban sample:	**Full vacc.**				DEFF=1.02
	No	Yes	OR	chisq	P
Ever used contracept.					
No	44	44	2.44	9.0	0.003
	50%	50%	(1.35-4.38)		
Yes	32	78			
	29%	71%			DEFF=1.10
Ideal no. of children					
More than four	28	22	2.65	8.8	0.003
	56%	44%	(1.37-5.11)		
			(1.37-5.11)		
Less than five	48	100			
	32%	68%			DEFF=1.00
Mother approves contraceptive method					
No	16	12	2.49	5.0	0.025
	57%	43%	(1.10-5.60)		
			(1.09-5.69)		
Yes	59	110			
	35%	65%			
Father approves contraception					
No	40	42	2.40	7.1	0.008
	49%	51%	(1.25-4.60)		
			(1.24-4.63)		
Yes	23	58			
	28%	72%			

7.4.6 Health system

There were no significant differences in "drop-out" rates between children whose mothers went to pregnancy checks and/or received TT immunization while pregnant and other children in any of the samples (tables 71 and 72). Urban children who were born without assistance from a nurse, a trained midwife or a doctor had more than twice the risk of "dropping-out" of the EPI-series compared to other children (table 72). No such association was found for rural children.

The "drop-out" rate was 14% lower in rural communities where vaccinations were offered daily or weekly and 3% lower in rural communities having a trained midwife (table 71).

TABLE 71: Health system by "Drop-outs".

Rural sample:	**Full vacc.**				
	No	Yes	OR	chisq	P
Mother received TT when pregnant					
No	153	140	1.11	0.5	0.48
	52%	48%	(0.83-1.50)		
Yes	218	222			
	50%	50%			DEFF=1.09
Pregnancy checks					
No	49	45	1.07	0.1	0.75
	52%	48%	(0.68-1.69)		
Yes	322	317			
	50%	50%			DEFF=1.08
Assistant with delivery					
No one, person without formal education	250	243	1.02	0.0	0.90
	51%	49%	(0.75-1.39)		
Nurse, midwife, doctor	120	119			
	50%	50%			DEFF=1.06
Vaccination offered at least once a week					
No	113	76	1.77	10.8	0.001
	60%	40%	(1.26-2.51)		
			(0.82-3.84)		
Yes	207	247			
	46%	54%			DEFF=5.02

TABLE 71 (cont.): Health system by "Drop-outs".

Rural sample:	Full vacc. No	Yes	OR	chisq	P
Trained midwife in community?					
No	222 51%	217 49%	1.12 (0.77-1.62)	0.4	0.55
Yes	74 48%	81 52%			DEFF=5.02

TABLE 72: Health system by "Drop-outs".

Urban sample:	Full vacc. No	Yes	OR	chisq	P
Mother received TT when pregnant					
No	22 45%	27 55%	1.43 (0.74-2.76)	0.7	0.28
Yes	54 36%	95 64%			DEFF=1.00
Pregnancy checks					
No	3 30%	7 70%	0.68 (0.17-2.70)	0.3	0.58
Yes	73 39%	115 61%			DEFF=1.02
Assistant with delivery					
No one, person without formal education	29 72%	22 28%	2.80 (1.46-5.39) (1.44-5.44)	9.9	0.002
Nurse, midwife, doctor	47 32%	100 68%			DEFF=1.04

7.4.7 Logistic regression

In the rural model, the following risk factors for "drop-out" were included: traditional roof material, bigamy, two or more sibling who had died, and immunizations were not offered at least once a week in the community. These variables had odds ratios around two and they were significant even when the combined design effect was taken into account (table 73).
The last variable included in the rural model was "mother is a member of an organisation" which was associated with a lower risk for her child of "dropping-out" the EPI-series.
This association, however, was not significant when the design effect was taken into account. The next best model included the variable "household has a radio" instead of "mother is a member of an organisation".
The urban model included only three risk factors which had odds ratios between 4 and 6.5: bigamy, traditional roof material, and maternal dissaproval of contraception (table 74).

TABLE 73: Logistic regression - dependent variable "Drop-outs".

Rural sample DEFF=1.87

Predictor variables		P	OR	95% CI
Q150	Member of mother's organis.	0.034	1.62	(1.04-2.52)
				(0.88-2.97)
Q717	Roof material	<0.001	1.93	(1.33-2.80)
				(1.15-3.22)
Q504	Bigamy	<0.001	2.10	(1.39-3.17)
				(1.19-3.68)
Q206	Siblings died	0.002	2.08	(1.30-3.32)
				(1.09-3.95)
C10	Vaccination daily/weekly	<0.001	1.95	(1.33-2.87)
				(1.15-3.31)

Goodness of Fit chisquare: 559.5 (DF=555) P=0.44.

Coding of nominal variables:	0	1
Completed EPI immunization series	No	Yes
Q150, C10	No	Yes
Q504	Yes	No
Q717	thatch, papyrus	better mat
Q206	≥2	≤1

TABLE 74: Logistic regression - dependent variable "Drop-outs".

Urban sample DEFF=1.05

Predictor variables		P	OR	95% CI
Q504	Bigamy	<0.001	4.08	(1.88-8.82)
				(1.85-8.99)
Q717	Roof material	<0.001	6.46	(2.55-16.38)
				(2.49-16.77)
Q609	Mother approves contracept.	0.006	4.36	(1.53-12.44)
				(1.49-12.76)

Goodness of Fit chisquare: 161.1 (DF=158) P=0.42.

Coding of variables:	0	1
Completed EPI vaccination series	No	Yes
Q609	No	Yes
Q504	Yes	No
Q717	thatch, papyrus	better mat

7.5 RESULTS: WOMEN'S TETANUS TOXOID

7.5.1 Demographic characteristics

There were 1571 women in the rural sample and 427 women in the urban sample. 63.9% of the rural women and 81.3% of the urban women claimed receipt of tetanus toxoid during pregnancy.
As shown in tables 75 and 76, none of the demographic variables showed a significant association with women's TT. The same results were obtained for both the rural and the urban sample. Looking at religion, Muslim women had a higher (although far from significant) TT coverage than Protestant and Catholic women.
The P-values change only little if the Seventh Day Adventists are merged with the Protestants.

TABLE 75: Demographic characteristics by Women's TT.

Rural sample:	**TT**			DEFF: no information in UDHS report	
	No	Yes	OR	chisq	P
Immigration (mother).					
A) <2 years from a rural area	71 38%	118 62%		1.6 (DF=2)	0.45
B) <2 years from a town	29 30%	67 70%			
C) lived ≥2 years in the community	440 36%	777 64%			
A vs. C: OR = 1.06 (0.76-1.48)				0.1	0.71
A vs. B+C: OR=1.08 (0.78-1.50)				0.2	0.62
Number of localities since married					
One	306 36%	548 64%		0.5 (MHLA)	0.49
Two	178 36%	318 64%			
Three or more	54 40%	81 60%	1.19 (0.82-1.74)	0.9	0.34
Religion					
Catholic	233 35%	435 65%		2.1 (DF=3)	0.56
Protestant	268 38%	439 62%			
Muslim	53 33%	107 67%			
Seventh day adventist	12 35%	22 65%			

TABLE 76: Demographic characteristics by Women's TT.

Urban sample:	**TT**		DEFF: no information in UDHS report		
	No	Yes	OR	chisq	P
Immigration (mother)					
A) <2 years from a rural area	8 17%	39 83%		0.7 (DF=2)	0.71
B) <2 years from a town	19 16%	98 84%			
C) Lived >2 years in the community	47 20%	192 80%			
Number of localities after marriage					
One	39 20%	160 80%			
Two	22 17%	106 83%			
Three or more	12 20%	49 80%		0.0 (MHLA)	0.86
Religion					
Catholic	38 20%	154 80%		1.8 (DF=3)	0.61
Protestant	32 20%	131 80%			
Muslim	8 13%	54 87%			
Seventh day adventist	1 13%	7 88%			

7.5.2 Socioeconomic characteristics

In the rural sample, there was a significant association between low socioeconomic status and low TT coverage for all variables. While women who had drinking water piped into their residence showed 86% TT coverage, women who lived more than one mile from their source of drinking water only had a TT coverage of 51%. This difference was also significant compared to the women who had to walk less than one mile to get to their source of drinking water (table 77). In the urban sample, the "cut-point" was at 0.25 mile as shown in table 78. The variables "floor, wall and roof material" as well as "toilet, radio, stove in the household" were significant in both the rural and the urban sample. While significant in the rural sample, no significant associations with TT-coverage were found for "soap in household" and "household owns a transportation vehicle" in the urban sample.

TABLE 77: Socioeconomic characteristics by TT.

Rural sample	TT				DEFF=1.26
	No	Yes	OR	Chisq	P
Distance to drinking water					
A) Piped into residence	17	105	0.25	28.2	<0.001
	14%	86%	(0.15-0.45)		
			(0.14-0.48)		
B) Less than 0.25 mile	163	286			
	36%	64%			
C) Between 0.25 and	165	286		21.7	<0.001
0.5 mile	37%	63%		(MHLA)	
D) Between 0.5 and 1 mile	125	225			
	36%	64%			
E) More than 1 mile	97	102	1.83	15.8	<0.001
	49%	51%	(1.34-2.49)		
			(1.29-2.59)		
OR: (E vs. B+C+D)	1.67 (1.22-2.29)		(1.17-2.38)	11.4	<0.001
Toilet in household					
No	106	132	1.52	8.7	0.003
	45%	55%	(1.15-2.01)		
			(1.11-2.08)		
Yes	461	872			
	35%	65%			
Wall material					
Mud & poles	535	902	1.89	9.3	0.002
	37%	63%	(1.23-2.94)		
			(1.15-3.10)		
Earth Bricks	21	53			
	28%	72%			
Cement blocks	10	46		10.6	0.001
	18%	82%		(MHLA)	

TABLE 77 (cont.): Socioeconomic characteristics by TT.

Rural sample	**TT**				DEFF=1.26
	No	Yes	OR	Chisq	P
Floor material					
Cow dung, etc.	541	913	2.25	12.3	<0.001
	37%	62%	(1.41-3.57)		
			(1.33-3.80)		
Parquet, wood, cement	24	91			
	21%	79%			
Roof material					
Thatch, papyrus	372	546	1.60	18.8	<0.001
	41%	59%	(1.29-1.98)		
			(1.26-2.03)		
Tins, tiles, etc.	195	458			
	30%	70%			
Stove in household					
No	524	861	2.07	16.2	<0.001
	38%	62%	(1.44-2.97)		
			(1.38-3.11)		
Yes	42	143			
	23%	77%			
Household owns a radio					
No	470	725	1.88	23.3	<0.001
	39%	61%	(1.45-2.44)		
			(1.40-2.52)		
Yes	96	279			
	26%	74%			

TABLE 77 (cont.): Socioeconomic characteristics by TT.

Rural sample	TT				DEFF=1.26
	No	Yes	OR	Chisq	P
Soap in household					
No	98 43%	128 57%	1.43 (1.07-1.91) (1.04-1.97)	6.1	0.014
Yes	468 35%	875 65%			
Household owns a transportation vehicle					
No	393 39%	606 61%	1.48 (1.19-1.85) (1.16-1.89)	12.5	<0.001
Yes	174 30%	394 70%			

TABLE 78: Socioeconomic characteristics by TT.

Urban sample	TT				DEFF=1.16
	No	Yes	OR	Chisq	P
Distance to drinking water					
More than 0.25 mile	36 29%	88 71%	2.41 (1.41-4.10) (1.35-4.29)	12.2	<0.001
Less than 0.25 mile	12 12%	86 88%			
Piped into residence	32 16%	173 84%		7.7 (MHLA)	0.006

TABLE 78 (cont.): Socioeconomic characteristics by TT.

Urban sample	**TT**				DEFF=1.16
	No	Yes	OR	Chisq	P
Toilet in household					
No	11	20	2.61	6.2	0.013
	35%	65%	(1.19-5.69)		
			(1.12-6.01)		
Yes	69	327			
	17%	83%			
Wall material					
Mud & poles	44	144	1.75	5.1	0.024
	23%	77%	(1.04-2.96)		
			(0.99-3.08)		
Earth Bricks	14	60			
	19%	81%			
Cement blocks, bricks	21	141		6.2 (MHLA)	0.013
	13%	87%			
Floor material					
Cow dung, etc.	48	128	2.55	14.0	<0.001
	27%	73%	(1.54-4.19)		
			(1.48-4.35)		
Parquet, wood, cement	32	217			
	13%	87%			
Roof material					
Thatch, papyrus	29	51	3.30	19.8	<0.001
	36%	64%	(1.91-5.69)		
			(1.83-5.95)		
Tins, tiles	51	296			
	15%	85%			

TABLE 78 (cont.): Socioeconomic characteristics by TT.

Urban sample	TT				DEFF=1.16
	No	Yes	OR	Chisq	P
Stove in household					
No	33	94	1.89	6.2	0.013
	26%	74%	(1.14-3.13)		
			(1.09-3.26)		
Yes	47	253			
	16%	84%			
Household has a radio					
No	44	130	2.04	8.3	0.004
	25%	75%	(1.25-3.34)		
			(1.20-3.46)		
Yes	36	217			
	14%	86%			
Soap in household					
No	7	24	1.29	0.3	0.57
	23%	77%	(0.53-3.11)		
Yes	73	323			
	18%	82%			
Transportation vehicle					
No	51	215	1.08	0.1	0.77
	19%	81%	(0.65-1.79)		
Yes	29	132			
	18%	82%			

7.5.3 Educational characteristics

In the rural sample, clear-cut statistical differences were seen for maternal education, in terms of both school level and actual reading abilities: The more educated, the higher the chance of receiving TT (table 79). In the urban sample, these differences were not significant with one exception: women who went to secondary school had a significant higher TT immunization rate (table 81).

Women who listened to the radio were immunized to a higher degree, than were women who did not listen to the radio. This difference was significant in both samples.

Also paternal education was significantly associated with TT coverage in the rural sample, but failed to show significance in the urban sample (tables 80 and 82).

TABLE 79: Maternal educational characteristics by TT.

Rural sample:	**TT**				DEFF=1.26
	No	Yes	OR	chisq	P
School attendance					
None	276	386	1.52	15.6	<0.001
	42%	58%	(1.23-1.88)		
			(1.20-1.92)		
Primary school	272	551			
	33%	67%			
Secondary school	19	67		19.5	<0.001
	22%	78%		(MHLA)	
Reads Sentence?					
Not at all	316	432	1.60	19.0	<0.001
	42%	58%	(1.29-1.99)		
			(1.25-2.04)		
With difficulty	83	182			
	31%	69%			
Easily	147	322		16.2	<0.001
	31%	69%		(MHLA)	
Listens to radio?					
No	415	656	1.46	10.8	0.001
	39%	61%	(1.17-1.84)		
			(1.13-1.89)		
Yes	149	345			
	39%	70%			

TABLE 80: Paternal educational characteristics by TT.

Rural sample:	**TT**				DEFF=1.26
	No	Yes	OR	chisq	P
School attendance					
None	123	160	1.47	8.2	0.004
	43%	57%	(1.13-1.91)		
			(1.09-1.97)		
Primary school	354	620			
	36%	64%			
Secondary school	54	163		17.8	<0.001
	25%	75%		(MHLA)	
Reads Letter?					
A) Not at all	105	148			
	42%	58%			
B) With difficulty	92	111	1.38*	7.2	0.007
	45%	55%	(1.08-1.76)		
			(1.05-1.82)		
C) Easily	275	500			
	35%	65%			

* A+B vs. C

TABLE 81: Maternal educational characteristics by TT.

Urban sample:	**TT**				DEFF=1.16
	No	Yes	OR	chisq	P
School attendance					
None	16 23%	53 77%	1.39 (0.71-2.68)	1.1	0.30
primary school	49 21%	185 79%		4.5 (MHLA)	0.034
secondary school	15 12%	109 88%	0.50 (0.27-0.92) (0.26-0.97)	5.1	0.025
Reads Sentence?					
A) Not at all	26 25%	78 75%			
B) With difficulty	13 25%	39 75%	1.53* (0.84-2.77)	2.2	0.14
C) Easily	26 18%	119 82%		1.9 (MHLA)	0.17
Listens to radio?					
No	36 25%	110 75%	1.76 (1.07-2.89) (1.03-3.01)	5.1	0.024
Yes	44 16%	237 84%			

* A+B vs. C

TABLE 82: Paternal educational characteristics by TT.

Urban sample:	TT				DEFF=1.16
	No	Yes	OR	chisq	P
School attendance					
None	7 23%	23 77%	1.37 (0.51-3.48)	0.5	0.49
Primary school	33 20%	129 80%			
Secondary school	31 16%	159 84%		1.4 (MHLA)	0.23
Reads Letter?					
A) Not at all	9 32%	19 68%	2.37* (0.86-6.46)	3.5	0.060
B) With difficulty	7 27%	19 73%	2.11** (0.94-4.71)	3.0	0.085
C) Easily	22 17%	110 83%		4.1 (MHLA)	0.043

* A vs. C ** A+B vs. C

7.5.4 Family Characteristics

No significance was found for the size of household and the number of children under 5 years in the household. In the rural sample, there was a slightly significant association (P=0.045) between increasing age of the women and lower TT-coverage (table 83). This association was not found in the urban sample.

No association was found for any of the marriage variables. "More than four living children per woman" was slightly correlated to a lower possibility of the mother receiving TT at the subsequent pregnancy (P=0.035) in the rural sample (table 83). The same tendency was found in the urban sample though it was not significant (P=0.074 - table 85). The same trend was observed for "total number of births per woman" though it was not significant.

No significance was found for "number of children who have died". However, this variable had a significant Woolf's test (P=0.015), due to different results for the Luwero triangle and the South West region (table 84).

TABLE 83: Family characteristics by Womens TT.

Rural sample	**TT**				DEFF=1.00
	No	Yes	OR	Chisq	P
Size of household					
More than 10 persons	59 32%	125 68%	0.82 (0.59-1.14)	1.5	0.23
Less than 11 persons	508 37%	879 63%			
No. of children <5 years					
One	152 39%	241 61%		4.2 (MHLA)	0.041
Two	211 36%	380 64%			
Three	135 36%	237 64%			
More than three	39 27%	106 73%	0.63 (0.42-0.94)	4.4	0.019
Woman's age					
Age 15-19	74 32%	155 68%			
Age 20-24	138 34%	273 66%			
Age 25-29	158 38%	257 62%			
Age 30-34	90 36%	160 64%			
Age ≥35	107 40%	159 60%		4.0 (MHLA)	0.045

TABLE 83 (cont.): Family characteristics by Women's TT.

Rural sample	**TT**				DEFF=1.10
	No	Yes	OR	Chisq	P
Mother married /living with a man					
More than once	120 38%	193 62%	1.13 (0.87-1.46)	0.8	0.36
Once	417 36%	756 64%			
Mother's current marital status					
Single, widowed, divorced	90 35%	167 65%	0.95 (0.71-1.25)	0.2	0.70
Married / living with a man	477 36%	837 64%			
Father living a part from the rest of the family?					
Yes	32 36%	58 64%	0.97 (0.62-1.52)	0.2	0.88
No	443 36%	776 64%			
Bigamy?					
Yes	138 35%	255 65%	0.93 (0.72-1.19)	0.3	0.56
No	339 37%	582 63%			

TABLE 83 (cont.): Family characteristics by Women's TT.

Rural sample	TT				DEFF=1.00
	No	Yes	OR	Chisq	P
No. of births					
More than four	260	417	1.19	2.8	0.10
	38%	62%	(0.97-1.47)		
Less than five	307	587			
	34%	66%			
No. of living children					
More than four	214	326	1.26	4.5	0.035
	40%	60%	(1.02-1.56)		
			(1.02-1.56)		
Less than five	353	678			
	34%	66%			
No. of children who have died					
Two or more	108	175	1.11	0.6	0.42
	38%	62%	(0.85-1.45)		
One	164	300			
	35%	65%			
None	295	529			
	36%	64%			

Table 84: No. of children who have died by mother's TT coverage (%) in three rural regions.

Dead children	Luwero	S-W	Rest	Woolf's test Chisq	P
A) Two or more	53%	66%	63%		
N	64	105	114		
B) None or one	70%	58%	67%		
N	292	469	527		
OR (B vs. A)	2.01	0.71	1.20	8.44	0.015

TABLE 85: Family characteristics by Womens TT.

Urban sample	TT				
	No	Yes	OR	Chisq	P
Size of household					
More than 10 persons	12	43	1.25	0.4	0.53
	22%	78%	(0.62-2.49)		
Less than 11 persons	68	304			
	18%	82%			
No. of children <5 years in household					
One	24	93			
	21%	79%			
Two	23	111			
	17%	83%			
Three	18	87			
	17%	83%			
Four or more	5	37		1.4	0.24
	12%	88%		(MHLA)	
Age of woman					
Age 15-19	15	57		3.9	0.42
	21%	79%			
Age 20-24	27	111			
	20%	80%			
Age 25-29	16	102			
	14%	86%			
Age 30-34	11	46			
	19%	81%			
More than 35 years	11	31			
	26%	74%			

TABLE 85 (cont.): Family characteristics by Women's TT.

Urban sample	**TT**				DEFF=1.16
	No	Yes	OR	Chisq	P
Mother married/living with a man					
More than once	16	61	1.16	0.2	0.63
	21%	79%	(0.62-2.17)		
Once	57	253			
	18%	82%			
Mother's current marital status					
Single, widowed, divorced	17	77	0.95	0.0	0.85
	18%	82%	(0.52-1.71)		
Married / living with a man	63	270			
	19%	81%			
Father living a part from the rest of the family?					
Yes	5	25	0.85	0.1	0.74
	17%	83%	(0.31-2.33)		
No	58	245			
	19%	81%			
Bigamy?					
Yes	17	97	0.66	1.8	0.18
	15%	85%	(0.36-1.21)		
No	46	173			
	21%	79%			

TABLE 85 (cont.): Family characteristics by Women's TT.

Urban sample	**TT**				DEFF=1.14
	No	Yes	OR	Chisq	P
No. of births					
More than four	28	104	1.26	0.8	0.38
	21%	79%	(0.75-2.10)		
Less than five	52	243			
	18%	82%			DEFF=1.18
No. of living children					
More than four	28	87	1.61	3.3	0.071
	24%	76%	(0.96-2.71)		
Less than five	52	260			
	17%	83%			
No. of children who have died					
A) Two or more	11	39			
	22%	78%			
B) One	23	78	1.45*	2.2	0.14
	23%	77%	(0.88-2.39)		
C) None	46	230			
	17%	83%			

* A+B vs. C

7.5.5 Attitudes, etc.

Rural women who were members of a mothers' organisation had a 7% higher TT coverage, but this difference was not significant taking into account the design effect (table 86). Likewise, in the urban sample no significant association was found between women being members of a mothers' organisation and TT-coverage (table 88).

"Ideal number of children" was the only variable with a significant association with TT coverage in both samples: women, who had an ideal of more than six children were vaccinated to a lesser extend than other women (tables 86 and 88).

Women who had used contraceptives showed higher TT coverage than other women. The difference was significant for the rural sample and nearly significant for the urban sample.

Rural women who approved with FP being taught in school and urban women who approved contraceptives showed a significant higher TT coverage than other women (tables 86 & 88). Otherwise, none of the four variables about attitudes towards contraception and family planning information showed significant associations with TT coverage in any of the two samples. The Woolf's test was significant for the variable "FP info on radio acceptable" (P=0.04) as shown in table 87. In the rural sample outside the Luwero Triangle and the South West Region women who did not find FP info on radio acceptable

had lower TT coverage than other women (P<0.001).

TABLE 86: Attitudes, etc. by Women's TT.

Rural sample:	TT				DEFF=1.45
	No	Yes	OR	chisq	P
Mother member of organisation?					
No	485	816	1.36	4.6	0.03
	37%	63%	(1.03-1.81)		
			(0.97-1.90)		
Yes	82	188			
	30%	70%			
Ever used contracept.					
No	480	774	1.64	12.9	<0.001
	38%	62%	(1.25-2.15)		
			(1.18-2.28)		
Yes	87	230			
	27%	73%			DEFF=1.43
Acceptable FP info on radio?					
No	197	289	1.30	5.3	0.021
	41%	59%	(1.03-1.64)		
			(0.98-1.66)		
Yes	343	654			
	34%	66%			
Acceptable FP taught in school?					
No	199	293	1.31	5.8	0.016
	40%	60%	(1.05-1.65)		
			(1.01-1.73)		
Yes	348	673			
	34%	66%			

TABLE 86 (cont.): Attitudes, etc. by Women's TT.

Rural sample:	TT				DEFF=1.45
	No	Yes	OR	chisq	P
Ideal no. of children					
More than six	296	456	1.31	6.7	0.001
	39%	61%	(1.07-1.61)		
			(1.06-1.62)		
Less than seven	271	548			
	33%	67%			DEFF=1.04
Mother approves contraceptive method					
No	165	274	1.08	0.5	0.49
	38%	62%	(0.86-1.36)		
Yes	401	722			
	36%	64%			
Father approves contraception					
No	358	621	1.05	0.1	0.73
	37%	63%	(0.81-1.36)		
Yes	119	216			
	36%	64%			

Table 87: "Woman finds FP info on radio acceptable" by Women's TT coverage (%) in three rural regions.

FP info on radio	Luwero	S-W	Rest	Woolf's test Chisq	P
A) Not acceptable	66%	59%	58%		
N	92	175	219		
B) Acceptable	67%	59%	71%		
N	176	399	422		
OR (B vs. A)	1.02	1.02	1.84	6.55	0.038

TABLE 88: Attitudes, etc. by Women's TT.

Urban sample:	**TT**				DEFF=1.06
	No	Yes	OR	chisq	P
Mother member of organisation?					
No	59 18%	269 82%	0.81 (0.46-1.43)	0.5	0.47
Yes	21 21%	78 79%			
Ever used contracept.					
No	47 22%	162 78%	1.63 (0.99-2.66)	3.8	0.052
Yes	33 15%	185 85%			DEFF=1.19
Acceptable FP info on radio?					
No	12 21%	46 79%	1.23 (0.62-2.46)	0.4	0.55
Yes	63 17%	298 83%			
Acceptable FP taught in school?					
No	17 19%	73 81%	1.02 (0.56-1.86)	0.0	0.94
Yes	61 19%	268 81%			

TABLE 88 (cont.): Attitudes, etc. by Women's TT.

Urban sample:	**TT**				DEFF=1.06
	No	Yes	OR	chisq	P
Ideal no. of children					
More than six	26	71	1.87	5.4	0.021
	27%	73%	(1.09-3.20)		
			(1.09-3.20)		
Less than seven	54	276			
	16%	84%			DEFF=1.00
Mother approves contraceptive method					
No	22	60	1.81	4.3	0.038
	27%	73%	(1.03-3.18)		
			(1.01-3.23)		
Yes	58	286			
	17%	83%			
Father approves contraception					
No	40	155	1.28	0.7	0.39
	21%	79%	(0.74-2.26)		
Yes	23	114			
	17%	83%			

7.5.6 Health system

Only two health system variables are relevant for the TT file. The results of these rural SAQ variables are shown in table 89. Unlike the child immunization files the variable "trained midwife in community" (i.e. sub-parish) showed the strongest association with women's TT immunization. Because of the high DEFF (as a result of roh=1) with the SAQ variables, the association did not prove significant when taking the high DEFF into account.

TABLE 89: Health system by Women's TT.

Rural sample:	TT				DEFF=10.54
	No	Yes	OR	chisq	P
Vaccination offered at least once a week					
No	189 42%	266 58%	1.31 (1.04-1.64) (0.62-2.77)	5.2	0.02
Yes	325 35%	597 65%			
Trained midwife in community?					
No	370 41%	534 59%	1.87 (1.42-2.47) (0.76-4.57)	19.9	<0.001
Yes	89 27%	240 73%			

7.5.7 Logistic regression

The best fit model for the rural sample is presented in table 90. The model contained the variable "woman member of an organisation", which was not significant at the 0.05 level in the univariate analysis. No educational variable was included. However, one of the variables in the model was "household has a radio", which was closely associated with the educational variable "woman listens to radio".

Otherwise one family characteristic, two attitudinal characteristics, another socioeconomic characteristic, as well as the SAQ variable "trained midwife in cluster" were included in the rural logistic model.

The best fit model (table 91) included only two independent variables: one about housing standards and one about attitudes to contraception, though the latter was not significant at the $P<0.05$ level. The next best model included both roof and floor material in the housing standard besides "woman approves contraception". No other variable came close to be included in the final model.

TABLE 90: Logistic regression - dependent var. Women's TT.

Rural sample DEFF=2.82

Predictor variables	P	OR	95% CI
Q150 Mother member of organisation	0.013	1.51	(1.09-2.10)
			(0.87-2.63)
Q120B Household has a radio	0.002	1.62	(1.19-2.20)
			(0.96-2.71)
Q307 Ever used contraception	0.036	1.40	(1.02-1.91)
			(0.82-2.38)
LIVCHILD No. of living children	0.015	1.37	(1.06-1.76)
			(0.89-2.10)
C31 Trained midwife in subparish	<0.001	1.97	(1.48-2.63)
			(1.22-3.19)
Q115A(1) Distance to drinking water	<0.001	10.66	(3.98-28.6)
			(2.04-55.8)
Q115A(2)	0.003	1.82	(1.28-2.69)
			(0.94-3.52)
Q115A(3)	0.004	1.79	(1.21-2.63)
			(0.94-3.38)
Q115A(4)	0.003	1.83	(1.22-2.74)
			(0.92-3.62)

Goodness of Fit: Chisq 1244.7 (DF=1222) P=0.32.

Coding of nominal variables:	0	1
TT	No	Yes
Q150, Q120B, Q307, C31	No	Yes
No. of living children	≥5	≤4

Coding of categorical variables:

Q115A Drinking water - distance	Value	Freq	Coding (1)	(2)	(3)	(4)
In residence	0	50	1	0	0	0
< 0.25 Mile	1	370	0	1	0	0
0.25 - 0.5 Mile	2	361	0	0	1	0
0.5 - 1 Mile	3	297	0	0	0	1
> 1 Mile	4	154	0	0	0	0

TABLE 91: Logistic regression - dependent var. Women's TT.

Urban sample DEFF=1.11

Predictor variables		P	OR	95% CI
Q717	Roof material	<0.001	3.22	(1.86-5.58)
				(1.80-5.74)
Q609	Approve contraception	0.107	1.62	(0.90-2.89)
				(0.87-2.99)

Goodness of Fit Chisq 427.6 (DF=423) P=0.43.

Coding of variables:	0	1
TT	No	Yes
Q609	No	Yes
Q717	thatch, papyrus	better mat

7.6 SUMMARY OF THE RESULTS OF LOGISTIC REGRESSION

Simplified tables to summarize the results of logistic regression analysis are shown in tables 92 and 93.
"Education", "housing standards", "radio", "disapproval of contraception", and "pre/perinatal care" are "conglomerates" of two or more predictor variables. The rest of the variables shown in tables 92 and 93 are the original variables.

Socioeconomic variables contributed to all the logistic models: "housing standards" contributed to all of the four models in both samples except for the rural model on "women's TT"; and "distance to drinking water" was included in the "full vaccination model" in both samples as well as in the "complete lack of immunization model" and the "drop-out model" on the rural sample.
"Household has a radio" was included in the rural model on "women's TT".
Parental education contributed only to two rural models: the models on "full vaccination" and on "complete lack of vaccination", while "woman is a member of an organisation" was included in the other two rural models on "drop-outs" and "women's TT".
Maternal or paternal disapproval of contraception was included in all models except for the rural models on "drop-outs" and "complete lack of immunization".

"Woman has more than four living children" contributed to the rural model on "women's TT", while "sibling mortality" was included in the rural "drop-out model".

"Bigamy" contributed to the models on "full vaccination" and "drop-outs" in both samples. The variable "woman has lived with more than one husband" was included in the urban models on "complete lack of vaccination" and "full vaccination".

Pre/perinatal care, (i.e. TT while pregnant, pregnancy checks, and assistance with the delivery), contributed to the "complete lack of immunization model" in both samples and to the rural model on "full vaccination".

The SAQ-variables, (which were only applied in the rural sample), were both included in logistic models: "weekly immunization service" contributed to the models on child vaccination while "trained midwife in the community" was included in the model on "women's TT".

No interaction form made it into a final model.

TABLE 92: Simplified overview on logistic models.

Rural sample

	Total lack of imm.	Full vacc.	Drop out	TT
Education	x	x		
Radio[1]				x
Housing standards[2]	x	x	x	
Distance to drinking water	x	x		x
Member of org.			x	x
Dissapprove contraception		x		x
>4 living children				x
Sibling mortality			x	
Bigamy		x	x	
Pre/perinatal care[3]	x	x		na
Weekly imm. serv.	x	x	x	
Trained midwife				x

na = non applicable.

[1] Listen to radio or radio in household.

[2] Household has a toilet and/or roof material contribute to the logistic model.

[3] Mother received TT while pregnant and/or went to pregnancy checks, and/or had profesional assistance with the delivery.

TABLE 93: Simplified overview on logistic models.

Urban sample

	Total lack of imm.	Full vacc.	Drop out	TT
Housing standards[1]	x	x	x	x
Distance to drinking water		x		
Dissaprove contraception	x	x	x	x
Bigamy		x	x	
Lived with >1 husband	x	x		
Pre/perinatal care[2]	x			na

na = non applicable.

[1] Household has a toilet and/or roof material contribute to the logistic model.

[2] Mother received TT while pregnant, and/or went to pregnancy checks, and/or had professional assistance with the delivery.

8. DISCUSSION

8.1 Interpretation of results

All health services run by the Ugandan government (including immunizations, pregnancy control, and delivery) are offered free of charge. There are no direct costs involved in attending immunization sessions. Hence, differences in immunization coverage cannot be explained as an effect of some people having no money to pay for immunizations. However, there might be indirect costs (i.e. transportation costs, costs as a result of the time spend for the vaccination session, etc.).

That urban areas had higher immunization rates is no surprise. The reasons are discussed in an earlier chapter (2.3.1). The differences in immunization coverage between various rural regions as well as between Kampala and the rest of urban Uganda were consistent with the results of the Ugandan EPI-reports, which are released every three month.

It is not surprising that children of mothers who have moved from a village to an urban area within the last two years had a higher risk of staying unimmunized compared to other urban children (who were not fully immunized). However the numbers were small and the results were just around the significance

level. On the other hand, migrants from villages were more likely to complete the vaccination series than children who had always lived in the community (regardless of being urban or rural). The latter result was not expected. The results indicate that migrants from villages could be divided into two subgroups: one, small high risk subgroup, where children were lacking all immunizations, and one subgroup that had completed the vaccination series.

The results showed no significant differences between Muslim children/women and their Christian counterparts with regard to immunization coverage, despite official Ugandan sources which hypothesized that this would be the case.[25] The only significant result concerning religion was that urban Catholic children had a higher "drop-out" rate (47%) than children of other religions (30%). Catholics were not underrepresented in Kampala (table 12), (i.e. the result cannot be regarded as an effect of regional differences in religious belonging). As already mentioned in the results section, the UDHS report did not provide design effects for demographical variables like religion. If the design effect is greater than 1.26, then the result would not have been significant.

The same sources as above claimed that the nomadic tribe of Karamojong was a high risk group and difficult to reach for immunization. Unfortunately only four Karamojong children were

represented in the sample and these children might have differed from the rest of the children in the tribe, (i.e. the numbers are much too small for making any conclusion). However, two Karamojong children were fully immunized, while the other two were partly immunized. This was far better than for most other tribes. Of five Karamojong women, three claimed receipt of TT (this was average for the study).

Since most of the Nilotic tribes live in the nine northern provinces that were not surveyed, no calculations for ethnic groups are shown in this paper. It is possible that the differences in immunization coverage between ethnic groups, which surely exist, are partly due to local factors other than ethnicity.

It was not surprising that low socioeconomic status was strongly associated with lack of immunization. This was the only characteristic which contributed to all logistic models.

Based on the results of the logistic regression analysis, low maternal and paternal educational level was strongly and approximately equally related to total lack of immunization in the rural subsample, while only the mother's education was of significant importance for whether a child completed the EPI-series. This relation was less significant in the urban subsample, where the formal education of the parents did not

contribute to any of the logistic model.

It is interesting that listening to radio was so clearly correlated to high immunization in both samples, since the radio is a major source of information about Preventive Health in Uganda. This is an indicator (for the health authorities and others) that health measures provided through the radio can be effective.

That children and women who lived in households with more than ten persons showed higher immunization rates (though not always statistically significant) is an indication, that social support - in this case a large household - has a positive effect on vaccination coverage. The positive association between increasing number of children under five years in the household and women's TT coverage, can be seen as a effect of more potential contacts with the health system as a result of more pregnancies and deliveries. The same tendency was seen for the child immunizations in the rural sample, although the results were only statistically significant for total lack of immunization. On the other hand, in the urban areas the trend for child immunizations was the opposite: there was a negative association between increasing number of children under five years of age in the household and the immunization coverage of the children. This can be regarded as the effect of less social support in town. These urban results

are more like the results found in both samples for the number of children of any age per woman: there was a negative (though not always significant) association between the individual woman having more than four children and women's TT and children's immunization coverage.

One pattern emerged from the Woolf's tests: 4 of 6 combinations with $P<0.05$ and one combination with $P=0.07$ were variables on number of children per woman, mainly due to different results in the South-West region, compared to the other regions. In the South-West region there was no trend towards higher immunization coverage for children, who had <4 siblings. A possible (part of the) explanation could be, that even educated and socioeconomically well-situated parents in the South-West region still have many children, (i.e. many children are still the "norm"). In fact, more women in the rural South-West region had more than four children (47.5%) than in the Luwero triangle (42.7%) and in the rest of the rural sample (40%).

Children of single women did as well as other children with regard to immunization. This is rather surprising, but can partly be explained by the fact that the outcome was measured before exposure (i.e. (some of) the women might have lived with a husband at the time their children received immunizations (0-36 months before the survey)).

There was no association between child gender and immunization in my study. Although boys and girls are traditionally treated differently, no African study has so far been able to show differences in immunization coverage between boys and girls.

As expected positive attitudes towards contraception and family planning was associated with high immunization coverage, though this association were not significant for all combinations of predictor and outcome variables. In the rural sample, children of mothers, who were members of organisations like the Red Cross, Mother's union, etc. were more likely to complete the EPI immunization series. The same tendency was seen in the urban sample, though it was not significant probably due to the smaller urban sample size.

Contacts with the health system during pregnancy and at delivery were mostly of importance in terms of the child receiving its first immunization, but has less impact later in the vaccination series.

On the other hand, immunization availability in terms of daily/weekly service in the community, which was studied for the rural subsample, was most strongly correlated to whether the children finished the EPI-series. The strong influence of having a trained midwife in a rural community was observed for women's TT, while daily/weekly immunization service was of

less importance.

In general the results of this study are similar to the results obtained in other studies on Sub-Saharan children. However, some differences were found:

1 Maternal education, which was described as the single most important factor in the Kenyan study,[19] contributed only to two logistic models in my study.

2 "Father living separated from the rest of the family" was a risk factor in the Nigerian study.[22] In my study this variable showed no association at all with immunization coverage in any of the outcome files.

3 Sibling mortality was associated with non-completion of the EPI-series in my study, while no such association was found in the Gambian study.[12]

4 Pre/perinatal care was related to a higher rate of full child immunization in my study, while no such relationship was found in the South-African study.[23]

8.2 Using the results in everyday Preventive Health.

The most important question is whether one can use the results of this study in the everyday situation at health centres and dispensaries.
As discussed in the beginning of this thesis, there are two main strategies in trying to achieve the best possible immunization coverage:
1) Using every opportunity to give missing vaccinations.
2) Identification of high risk individuals and groups.

Let us first look at the missed opportunities part.
In the UDHS the mothers were asked whether each of their children had had a fever within the last four weeks (Q430), and whether it had suffered from difficult or rapid breathing, or severe cough within the last four weeks (Q433). In addition they were asked if the child was taken to a doctor/clinic for curative reasons. Combining the two variables into one variable gave the results shown in table 94 on the next page.

Table 94 shows that 61% of the children, who were not fully immunized, had had fever, cough or breathing problems within four weeks prior to the interview. According to table 94, 45% (222/486) of these children were taken to a doctor or a medical assistant at a dispensary for the problem. This means, that at least 27.6% (222/803) of not fully immunized children

TABLE 94: Immunization status by Fever, cough, dyspnea and curative health visits.

	Illness last 4 weeks			
Full immunization	No	Yes	Chisq	P
Yes	231 49%	245 51%	11.1	<0.001
No	313 39%	490 61%		
	Taken to doctor <4 weeks ago			
Full immunization	No	Yes		
Yes	112 46%	133 54%	5.3	0.02
No	268 55%	222 45%		

were taken to a doctor or dispensary in the last four weeks. Thus a substantial proportion of incompletely immunized children visit governmental hospitals, clinics and dispensaries, and to lesser extent private doctors for curative reasons. In general, these visits should be used to give missing immunizations. Even if in some cases it might be contraindicated to immunize in conjunction with the curative visit, the health professional in charge should write down the name and address of the children and arrange a visit for vaccination in near future. Children who fail to show up at the vaccination session should receive reminder visits by a health worker wherever this is practically achievable.

Curative visits for children might even be used to determine whether the mother has received TT2 - and if she has not - provide her with an immunization opportunity.

However, as seen in table 94, a significantly lower proportion of incompletely immunized children seek curative health for fever, dyspnea and cough compared to children who have completed the EPI-vaccination series. This is likely to be the case for other symptoms as well.

Children who lack immunization(s) must be identified, and the results of studies like mine could be a useful tool for such an identification, as well as for identification of fertile women who lack TT2.

The logistic models could be useful even to the local health authorities. The sort of simple presentations shown in tables 92 and 93 give a fast overview.

Certainly a logistic model must be used with some flexibility. For instance, if a model includes disapproval of contraception, and a particular woman's attitude is not known, but she has 8 children, this should be an indicator of her attitudes towards contraception, and the model can still be used as is. Even if one or two characteristics are unknown, it is still useful, if the other risk factors included in the model are present.

For the health authorities it is important to know that child

immunization coverage is strongly associated with how immunizations are offered. Thus immunization coverage is higher if immunizations are offered daily (or at least weekly) at the local health centre or dispensary. It is also important to know the positive impact a local trained midwife (through pregnancy controls, assistance with the delivery, etc.) should have on children's immunization coverage and in particular on women's TT coverage. Health authorities should also be aware of the positive effect of mother's organisations with regard to the immunization status of the members and their children and encourage membership of such organisations.

The local health workers need a much simpler model for identifying of high risk children and fertile women in terms of immunization coverage. Based on the results of this study, simple models in point format are presented below:

Urban areas - child immunizations.

1. Bad housing standards or >0.25 mile to drinking water.
2. Mother has had >1 husband

or traditional attitudes in the family.

Urban areas - women's TT.

1. Bad housing standards.
2. Disapproval of family planning.

Rural areas - child immunizations.

1. Bad housing standard or >1 mile to drinking water.
2. Low level of maternal and paternal education
or high siblings mortality/bad health status in the family.
3. Traditional attitudes in the family.

Rural areas - women's TT.

1. Bad housing standard or >1 mile to drinking water.
2. Woman has many children / disapproves family planning.

These models are extremely simple. Though there are differences in the predictors for total lack of immunization, lack of some immunization(s), and for "dropping-out" the EPI-series, these differences are ignored in the simple models since simplicity is of most importance.
This is no obstacle: the local health workers could use a more

nuanced approach if this is feasible.

Community action should be promoted to help identify all children and fertile women eligible for immunization and direct them to the appropriate services. In communities with very low coverage, door to door vaccination sessions are recommended. Reminder visits to "no show-ups" are always to be recommended wherever it is feasible.

8.3 Validity issues

The Uganda Demographic and Health Survey was carried out through oral interviews of the individuals selected. Considering that many women read badly or did not read at all, an interviewer administered questionnaire was surely the best method of obtaining reliable data.

The UDHS was a cross-sectional survey. In such a survey it is often not possible to determine whether or not exposure preceded disease, since exposure and disease are assessed at a single point of time.[43] Applying this to my study: disease = lack of immunization. Exposure were all other variables, i.e. education, socio-economic variables, etc.

The time-span from vaccination to survey was from 0 to 3 years. It is not likely that basic variables like education, socio-economic status, and religion, have changed much in this time span. If attitudes towards the modern health system have changed, these changes are likely to have occurred before vaccination, since attitudes is a determinant of whether a person will be immunized and if the attitude had not changed towards a positive attitude towards preventive health the person would probably not have been immunized.

I have controlled for changes in family size between the time of immunization and the time of interview (please see chapter 3.4 on transformation of variables).

On the other hand, variables like marital status and health services might have changed during the time span from vaccination to survey. It is likely that the effect of improved health services will show less significance in the results of this study than in reality.

The UDHS interviewers were carefully selected and went through an intensive three-week training course in 1987. A pretest of the questionnaire was conducted in October 1987 by the interviewers who had completed the three-week course. The experience from the pretest was used in the final questionnaire, in which several "check-up questions" were built in to verify that the information given in previous questions were right. The interviewers had another three-week training course in September 1988.

The questionnaire was translated into four local languages. The completed questionnaires were sent Makerere University, where data entry proceeded concurrently with the field work.[28]

In general the questions (Appendix B) were easy to understand and the answer categories well defined, so that interviewer bias should be low. The risk of interviewer bias should also have been reduced through the extensive training and the local language skills.

In two of the four outcome files the information for the

dependent variable (e.g. immunization) was directly recorded from the children's health cards. In the other two outcome files the information for the dependent variable was based upon the women's memory of immunization. Please see chapter 6 for discussion of the validity of women's memory of immunization and potential misclassification of outcome variables.

The high response rate minimized selection bias. On the other hand, the oversampling of certain areas means a risk of selection bias.

In order to evaluate any possible confounding by "rural region", Mantel-Hanzel's pooled estimates were calculated and presented in Apendix D. Since the crude and the adjusted (Mantel-Hanzel) odds ratios are similar, "rural region" was no important confounder for any combination of predictor and outcome variable in this study.

Woolf's tests were carried out to describe potential effect modification by the regions which were oversampled (Appendix E). Woolf's test, however, has lower power and it is only an indicator of effect modification; (i.e. a negative Woolfs test does not rule out effect modification). In order to partly compensate for the limitations of Woolfs test, stratified analysis were presented and discussed for variables with a P-value below 0.10.

The question arises, why only unweighted results were presented?

Weighted analysis were also done and the results (listed in Appendix D) were almost identical to the unweighted results, (i.e. the interpretation of the weighted results would not have differed from the interpretation of the unweighted results, and the conclusions would have been identical).

In addition, differences between stratas (rural regions) was a reason not to present weighted results, especially when Woolf's test had a P-value below 0.10. Instead, the stratified results were shown, since they visualize the differences between the strata which resulted in a Woolf's test of $P<0.10$. Presenting only weighted results would disguise such differences. When initiatives towards immunization of at risk groups are to be directed, it is important to take regional differences (as shown by the stratified analysis) into account.

Because of the "roh=1 approach" and the corresponding large design effect, the two SAQ-variables "immunizations offered on a daily/weekly basis?" and "trained midwife in cluster" failed to show significant results in the univariate analysis when DEFF was taken into account. The "roh=1 approach" was selected since it was then straightforward to use the SAQ-variables in a logistic regression together with the variables from the individual questionnaire. Another aproach would be to do a

t-test on the differences in immunization coverage rates between clusters (i.e. communities) with daily or weekly immunization sessions/trained midwives and clusters without. The design effect of immunization (i.e. 1.26 for TT) would be considered. Also in this setting it would be necessary to rule out confounding by rural regions or to incorporate the weights in the analysis.

Unweighted t-tests as described above resulted in a significant association beween high immunization coverage for the children and immunization offered on a daily/weekly basis. This variable was just around the level of significance for women's TT, but having a trained midwife in the cluster showed a significant association with women's TT while it failed to show any significant association with child immunization status.

Since one SAQ-variable contributed to all rural logistic models, it seemed logical to stratify the rural samples by the SAQ-variable and carry out logistic regression analysis on the stratified rural subsamples (i.e the full vaccination rural sample was divided into two subsamples, dependent on whether immunizations were offered at least once a week, and logistic regression analysis were done separately for each subsample). However, the stratified logistic regression showed the same results as the unstratified.

It is important to emphasize the differences in the sample sizes used in my study. The rural samples were between three and four times as large as the urban samples. Because of the smaller sample size, associations which would have proven significant in the rural sample might have failed to prove significant in the urban sample, because of less power in the urban sample. Hence it is likely that some associations with immunization coverage with relevance for the the urban areas were not detected in my study.

9. CONCLUSION

Throughout the 1980s immunization rates have steadily risen. Now, when the immunization rates have stopped increasing, efforts have turned towards "reaching the unreached". While the great majority of children in Uganda and other countries receive BCG and TOPV1, many do not complete the EPI vaccination series; and neonatal tetanus is still a major concern, since most fertile women in the third world are not covered with two doses of tetanus toxoid.
This study has tried to asses risk factors and characterize:
- children who lack all immunizations
- children who do not complete the immunization series
- women who have not received TT.

Four outcome variables were used: complete lack of immunization, full vaccination, "drop-outs" and women's TT.

The characteristics of cluster surveys were discussed and the design effects were taken into account in the analysis. Separate analysis were done for the urban and rural areas. Since two rural regions were oversampled, weighted and Mantel-Hanzel stratified analysis were done in addition to the crude unweighted analysis. The results of these three types of analysis were almost identical indicating that neither was rural region an important confounder nor was the unweighted

results seriously biased by the over-sampling of some areas. Woolf's tests were performed in order to test for potential effect modification by rural region. Different types of possible biases and the problems of cross-sectional surveys were discussed.

Univariate analysis identified several risk factors, some of them applicable for all outcome variables, while other risk factors were outcome specific.

Logistic regression produced best fit models for each of the four rural and four urban outcome variables. A simplified overview, where the predictor characteristics were shown for the four outcomes, was presented in a rural and one urban table.These tables could be useful for health authorities at different levels when planning strategies for improved immunization coverage. Simple models in point format for identification of high risk groups were presented. These could be a useful tool for the local health workers in promoting Preventive Health at a health centre or dispensary far away from the academical world.

The conclusion is that high risk groups of children and women can be identified by combining risk factors and taking into account each factors odds ratio and contribution to the logistic model.

Different combinations of risk factors explain:

- why some children totally lack immunization;
- why some children are not fully immunized;
- why some children do not complete the vaccination series;
- why many mothers did not receive tetanus toxoid, while they were pregnant.

Ways to reach the unreached are discussed with regard to identification of high risk individuals and groups, as well as using every opportunity, (i.e. curative health contacts), to give missing vaccinations.

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APPENDIX A
SURVEY DESIGN

Source: UDHS-report.

Sample Design and Implementation

The sample used for the Uganda Demographic and Health Survey was a stratified, weighted probability sample of women aged 15-49 selected from 206 clusters. Due to security problems at the time of sample selection, 9 of the country's 34 districts, containing an estimated 20 percent of the population, were excluded from the sample frame. Primary sampling units in rural areas were sub-parishes, which, in the absence of a more reliable sampling frame, were selected with a probability proportional to the number of registered taxpayers in the sup-parish. This gives a first stage probability of:

$$P_{1i} = (a * T_i) / T$$

where

- a is the number of sub-parishes selected,
- T_i is the number of taxpayers in the sub-parish, and
- T is the total number for taxpayers in all sub-parishes.

Teams visited each selected sub-parish and listed all he households by name of the household head. Individual households were then selected for the interview from this list. The conditional household probability, P_{2i}, was calculated so that $P_{1i} * P_{2i} = f$, where f is the overall sampling fraction. The parameter f was estimated with the housing listing operation by stopping at every 10th household and recording the number of persons who slept last night in that household. In addition the South West region and the area in Central region known as Luwero Triangle were each over-sampled to provide a sample with sufficient size to produce independent estimates of certain variables for these two areas.

The urban sector was over-sampled by a factor of three compared with a proportionate urban/rural sample. Since it was not possible to use an appropriate sampling frame in the urban area, it was necessary to look for an alternative procedure. A convenient solution avoiding excessive cost was to use a two-phase sampling. A description of each phase follows.

- 1st Phase: A complete list of all administrative urban areas known as Resistance Council Ones (RC1s) was compiled and a sampling frame was created by systematically selecting 200 of these units with equal probability for a complete household updating.

- 2nd Phase: After the first phase selection and updating was completed, a sub-sample of 50 RC1s were selected with probability proportional to size (size as reported in the housing listing). At the subsequent stage, 20 households were then systematically selected in each of the 50 RC1s for a total of 1,000 urban households.

Characteristics of the Sample

Table A.1 provides a summary of the outcome of the fieldwork for households and eligible women. Out of 5,587 addresses visited, 5,123 households were located. The remaining addresses (8.3 percent) were not valid households, either because the dwelling had been vacated or destroyed, or the household could not be located or did not exist. Of the located households, 5101 were successfully interviewed, producing a household response rate of 99.6 percent.

Table A.1 Summary of results of Household and Individual interviews UDHS 1988/89

Results of Interview and Response Rate	Number	Percent
Addresses Visited	5,587	100.0
Household located	5,123	91.7
Household absent last night	33	0.6
Unoccupied dwelling	245	4.4
Destroyed, no dwelling, other	186	3.3
Household Located	5,123	100.0
Interviewed	5,101	99.6
Not interviewed	22	0.4
HOUSEHOLD RESPONSE RATE		99.6
Eligible women	4,857	100.0
Not interviewed	127	2.6
Absent	57	1.2
Postponed	0	0.0
Refusal	12	0.2
Other	58	1.2
Interviewed	4,730	97.4
Eligible women per household		0.95
INDIVIDUAL RESPONSE RATE		98.4
OVERALL RESPONSE RATE		98.0

The household questionnaires identified 4,857 women eligible for the individual interview (that is, they were aged 15-49 and had spent the night before the interview in the selected household). This represents an average of slightly under one eligible women per household. Questionnaires were completed for 4,730 women, indicating an individual response rate of 98.4 percent. The overall response rate, that is, the product of response rates at the household and individual levels was 98.0 percent (Table A.1).

Contact was not made with 127 eligible women, either because the respondent was not at home during any of the visits by the interviewer, or because the respondent refused to be interviewed, or because of other reasons. In any case, the overall level of nonresponse is very low.

The response rates for the urban-rural areas, and regions were similar (Table A.2). In the urban areas, the overall individual response rate was 96.0 percent, compared with 97.7 percent for the rural areas. These lower rates of response in the urban areas are influenced by the low rates of response observed for Kampala.

Table A.2 Summary of results of Household and Individual interviews and Response Rates by Place of Residence, UDHS 1988/89

Place of Residence	HOUSEHOLD		INDIVIDUAL	
	Number	Rates	Number	Rates
Urban	931	98.4	1,004	96.0
Rural	4,192	99.8	3,853	97.7
West Nile	149	100.0	164	97.6
East	975	99.6	890	97.1
Central	1,849	99.0	1,433	97.4
West	382	99.0	349	98.6
South West	1,353	99.0	1,465	98.2
Kampala	448	96.7	556	95.0

APPENDIX B: Excerpts from UDHS Individual Questionnaire.

SECTION 1. RESPONDENT'S BACKGROUND

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP TO
101	RECORD THE NUMBER OF PEOPLE LISTED IN THE HOUSEHOLD SCHEDULE.	NUMBER OF PEOPLE..... ☐☐	
102	RECORD THE NUMBER OF CHILDREN AGED 5 AND UNDER LISTED IN THE HOUSEHOLD SCHEDULE WHO NORMALLY LIVE IN THE HOUSEHOLD.	NUMBER OF CHILDREN AGED 5 AND UNDER..... ☐☐	
105	How long have you been living continuously in (NAME OF VILLAGE, TOWN, CITY)?	ALWAYS.....95 VISITOR.....96 →107 YEARS..... ☐☐	
106	Just before you moved here, did you live in a village, in a town, or in a city?	VILLAGE.....1 TOWN.....2 CITY.....3	
107	In What month and year were you born? COMPARE AND CORRECT 107 AND/OR 108 IF INCONSISTENT.	MONTH..... ☐☐ DK MONTH.....98 YEAR..... ☐☐ DK YEAR.....98	
108	How old were you at your last birthday?	AGE IN COMPLETED YEARS ☐☐	
109	Have you ever attended school?	YES.....1 NO.....2 →113	
110	What was the highest level and grade of formal education you completed? CIRCLE CODE FOR BOTH LEVEL AND GRADE	LEVEL / GRADE PRIMARY 1 — 1 2 3 4 5 6 7 JUNIOR 2 — 1 2 3 SECONDARY 3 — 1 2 3 4 5 6 UNIV. 4 — 1 2 3 4 5 6	
112	CHECK 110: PRIMARY ☐ → 113 JUNIOR OR HIGHER ☐		→114
113	Would you please read this sentence? SHOW SENTENCE TO RESPONDENT AND CIRCLE CORRECT CODE.	READ EASILY.....1 WITH DIFFICULTY.....2 NOT AT ALL.....3	
114	Do you usually listen to a radio at least once a week?	YES.....1 NO.....2	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	TO
115	What is the major source of drinking water for members of your household?	PIPED INTO RESIDENCE.....01 PIPED INTO YARD OR PLOT.....02 PUBLIC TAP.....03 BOREHOLE.....04 WELL.....05 RIVER, LAKE, UNPROTECTED SPRING, SURFACE WATER.....06 PROTECTED SPRING.....07 TANKER TRUCK, OTHER VENDOR.....08 RAINWATER.....09 OTHER _____ (SPECIFY) 10	
115A	How far do you have to walk to your major source of drinking water in the dry season?	< 1/4 MILE.....1 1/4 - 1/2 MILE.....2 1/2 - 1 MILE.....3 1 - 3 MILE.....4	
116	What is the major source of water for household use other than drinking (e.g., handwashing, cooking) for members of your household?	PIPED INTO RESIDENCE.....01 PIPED INTO YARD OR PLOT.....02 PUBLIC TAP.....03 BOREHOLE.....04 WELL.....05 RIVER, LAKE, UNPROTECTED SPRING, SURFACE WATER.....06 PROTECTED SPRING.....07 TANKER TRUCK, OTHER VENDOR.....08 RAINWATER.....09 OTHER _____ (SPECIFY) 10	
117	What kind of toilet does your household have?	FLUSH TOILET.....1 LATRINE, PIT.....2 OTHER _____ (SPECIFY) 3 NO FACILITIES.....8	
119	Do you have, right now, soap in your house?	YES.....1 NO.....2	
120	Does your house have: Electricity? A radio? A hot plate/cooker? A charcoal iron? A television? A refrigerator? A charcoal stove?	YES NO ELECTRICITY.....1 2 RADIO.....1 2 HOT PLATE/COOKER.....1 2 CHARCOAL IRON.....1 2 TELEVISION.....1 2 REFRIGERATOR.....1 2 CHARCOAL STOVE.....1 2	
121	Does any member of your household own: A bicycle? A motorcycle? A motor vehicle (CAR, BUS, LORRY, TRACTOR) A canoe? A motor boat?	YES NO BICYCLE.....1 2 MOTORCYCLE.....1 2 MOTOR VEHICLE.....1 2 CANOE.....1 2 MOTOR BOAT.....1 2	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP TO
122	MAIN MATERIAL OF THE FLOOR. (RECORD OBSERVATION.)	PARQUET OR POLISHED WOOD.....1 CERAMIC TILES.....2 CEMENT.....3 COW DUNG.....4 EARTH/SAND.....5 OTHER _____ 6 (SPECIFY)	
130	What is your religion?	CATHOLIC.....1 PROTESTANT.....2 MUSLIM.....3 SEVENTH DAY ADVENTIST.....4 OTHER_____ 5 (SPECIFY)	
140	What is your tribe?	ACHOLI.....01 MUKIGA.....10 ALUR.....02 MUKONJO.....11 ATESO.....03 MUNYANKOLE...12 KARIMOJONG...04 MUNYORO.....13 LANGI.....05 MUSOGA.....14 LUGBARA.....06 MUTORO.....15 MADI.....07 MWAMBA.....16 MUGANDA.....08 SAMIA.....17 MUGISU.....09 SEBEI.....18 OTHER_____ 19 (SPECIFY)	
150	Are you a member of any of the following organizations? Mother's Union? YWCA? A cooperative? The Family Planning Association? The RC? Any other?	YES NO MOTHER'S UNION.....1 2 YWCA.....1 2 COOPERATIVE.....1 2 FPA.....1 2 RC.....1 2 OTHER_____ 1 2	

SECTION 2. REPRODUCTION

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP TO
201	Now I would like to ask about all the births you have had during your life. Have you ever given birth?	YES.....1 NO.....2	→206
202	Do you have any sons or daughters you have given birth to who are now living with you?	YES.....1 NO.....2	→204
203	How many sons live with you? And how many daughters live with you? IF NONE ENTER '00'.	SONS AT HOME..... DAUGHTERS AT HOME.....	
204	Do you have any sons or daughters you have given birth to who are alive but do not live with you?	YES.....1 NO.....2	→206
205	How many sons are alive but do not live with you? And how many daughters are alive but do not live with you? IF NONE ENTER '00'.	SONS ELSEWHERE..... DAUGHTERS ELSEWHERE.....	
206	Have you ever given birth to a boy or a girl who was born alive but later died? IF NO, PROBE: Any (other) boy or girl who cried or showed any sign of life but only survived a few hours or days?	YES.....1 NO.....2	→208
207	How many boys have died? And how many girls have died? IF NONE ENTER '00'.	BOYS DEAD..... GIRLS DEAD.....	
208	SUM ANSWERS TO 203, 205, AND 207, AND ENTER TOTAL. IF NONE ENTER '00'.	TOTAL.....	
209	CHECK 208: Just to make sure that I have this right: you have had in TOTAL ____ live births during your life. Is that correct? YES ☐ NO ☐ → PROBE AND CORRECT 201-209 AS NECESSARY		
210	CHECK 208: ONE OR MORE BIRTHS ☐ NO BIRTHS ☐		→220

211 Now I would like to talk to you about all of your births, whether still alive or not, starting with the first one you had. (RECORD NAMES OF ALL THE BIRTHS IN 212. RECORD TWINS ON SEPARATE LINES AND MARK WITH A BRACKET.)

212 What name was given to your (first, next) baby?	213 Is (NAME) a boy or a girl?	214 In what month and year was (NAME) born? PROBE: What is his/her birthday? OR: In what season?	215 Is (NAME) still alive?	216 IF DEAD: How old was (NAME) when he/she died? RECORD DAYS IF LESS THAN ONE MONTH, MONTHS IF LESS THAN TWO YEARS, OR YEARS.	217 IF ALIVE: How old was (NAME) at his/her last birthday? RECORD AGE IN COMPLETED YEARS.	218 IF ALIVE: Is he/she living with you?
01 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO 2 → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
02 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO 2 → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
03 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO 2 → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
04 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO 2 → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
05 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
06 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
07 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2

212 What name was given to your next baby?	213 Is (NAME) a boy or a girl?	214 In what month and year was (NAME) born? PROBE: What is his/her birthday? OR: In what season?	215 Is (NAME) still alive?	216 IF DEAD: How old was (NAME) when he/she died? RECORD DAYS IF LESS THAN ONE MONTH, MONTHS IF LESS THAN TWO YEARS, OR YEARS.	217 IF ALIVE: How old was (NAME) at his/her last birthday? RECORD AGE IN COMPLETED YEARS.	218 IF ALIVE: Is he/she living with you?
08 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO 2 → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
09 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO 2 → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
10 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO 2 → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
11 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO 2 → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
12 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO 2 → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO NEXT BIRTH)	AGE IN YEARS..	YES 1 NO 2
13 (NAME)	BOY 1 GIRL 2	MONTH... YEAR....	YES 1 NO 2 → (GO TO 217)	DAYS.....1 MONTHS...2 YEARS....3 (GO TO 219)	AGE IN YEARS..	YES 1 NO 2

219 COMPARE 208 WITH NUMBER OF BIRTHS IN HISTORY ABOVE AND MARK:

NUMBERS ARE SAME ☐ ↓

NUMBERS ARE DIFFERENT ☐ → (PROBE AND RECONCILE)

INTERVIEWER: FOR EACH LIVE BIRTH: YEAR OF BIRTH IS RECORDED
FOR EACH LIVE CHILD: CURRENT AGE IS RECORDED
FOR EACH DEAD CHILD: AGE AT DEATH IS RECORDED ☐

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP TO
226	When during her monthly cycle do you think a woman has the greatest chance of becoming pregnant? PROBE: What are the days during the month when a woman has to be careful to avoid becoming pregnant?	DURING HER PERIOD....1 RIGHT AFTER HER PERIOD HAS ENDED....2 IN THE MIDDLE OF THE CYCLE....3 JUST BEFORE HER PERIOD BEGINS...4 AT ANY TIME....5 OTHER ______ (SPECIFY) .6 DK....8	
307	Have you ever used anything or tried in any way to delay or avoid getting pregnant? MARK APPROPRIATE BOX WITH AN 'X'.	YES.... ☐ NO.... ☐	>316
319	Is it acceptable or not acceptable to you that family planning information is provided on radio or in newspapers?	ACCEPTABLE....1 NOT ACCEPTABLE....2 DK....8	
319A	Is it acceptable or not acceptable to you that family planning be taught in schools?	ACCEPTABLE....1 NOT ACCEPABLE....2 DK....8	

SECTION 4. HEALTH AND BREASTFEEDING

401 CHECK 214:
ONE OR MORE LIVE BIRTHS SINCE JAN. 1983 ☐ | NO LIVE BIRTHS SINCE JAN. 1983 ☐ > (SKIP TO 501)

402 ENTER THE NAME, LINE NUMBER, AND SURVIVAL STATUS OF EACH BIRTH SINCE JAN. 1983 IN THE TABLE. BEGIN WITH THE LAST BIRTH. ASK THE QUESTIONS ABOUT ALL OF THE BIRTHS.

LINE NUMBER FROM Q. 212	☐☐	☐☐	☐☐	☐☐
	LAST BIRTH NAME ______ ALIVE ☐ DEAD ☐	NEXT-TO-LAST BIRTH NAME ______ ALIVE ☐ DEAD ☐	SECOND-FROM-LAST NAME ______ ALIVE ☐ DEAD ☐	THIRD-FROM-LAST NAME ______ ALIVE ☐ DEAD ☐
403 When you were pregnant with (NAME) were you given any injection to prevent the baby from getting tetanus, that is, convulsions after birth?	YES....1 NO....2 DK....8	YES....1 NO....2 DK....8	YES....1 NO....2 DK....8	YES....1 NO....2 DK....8
404 When you were pregnant with (NAME), did you see anyone for a check on this pregnancy? IF YES: Whom did you see? PROBE FOR THE TYPE OF PERSON AND RECORD THE MOST QUALIFIED.	DOCTOR....1 TRAINED NURSE/ MIDWIFE....2 TRADITIONAL BIRTH ATTENDANT....3 OTHER ______ (SPECIFY) .4 NO ONE 5	DOCTOR....1 TRAINED NURSE/ MIDWIFE....2 TRADITIONAL BIRTH ATTENDANT....3 OTHER ______ (SPECIFY) .4 NO ONE 5	DOCTOR....1 TRAINED NURSE/ MIDWIFE....2 TRADITIONAL BIRTH ATTENDANT....3 OTHER ______ (SPECIFY) .4 NO ONE 5	DOCTOR....1 TRAINED NURSE/ MIDWIFE....2 TRADITIONAL BIRTH ATTENDANT....3 OTHER ______ (SPECIFY) .4 NO ONE 5
405 Who assisted with the delivery of (NAME)? PROBE FOR THE TYPE OF PERSON AND RECORD THE MOST QUALIFIED.	DOCTOR....1 TRAINED NURSE/ MIDWIFE....2 TRADITIONAL BIRTH ATTENDANT....3 RELATIVE....4 OTHER ______ (SPECIFY) .5 NO ONE....6	DOCTOR....1 TRAINED NURSE/ MIDWIFE....2 TRADITIONAL BIRTH ATTENDANT....3 RELATIVE....4 OTHER ______ (SPECIFY) .5 NO ONE....6	DOCTOR....1 TRAINED NURSE/ MIDWIFE....2 TRADITIONAL BIRTH ATTENDANT....3 RELATIVE....4 OTHER ______ (SPECIFY) .5 NO ONE....6	DOCTOR....1 TRAINED NURSE/ MIDWIFE....2 TRADITIONAL BIRTH ATTENDANT....3 RELATIVE....4 OTHER ______ (SPECIFY) .5 NO ONE....6

418	At the time you became pregnant with (NAME OF LAST BIRTH), did you want to have that child then, did you want to wait until later, or did you want no (more) children at all?	THEN.....1 LATER.....2 NO MORE.....3

419 ENTER THE NAME, LINE NUMBER, AND SURVIVAL STATUS OF EACH BIRTH SINCE JAN. 1983 BELOW. BEGIN WITH THE LAST BIRTH. THE HEADINGS IN THE TABLE SHOULD BE EXACTLY THE SAME AS THOSE AFTER Q. 402. ASK THE QUESTIONS ONLY FOR LIVING CHILDREN.

	LAST BIRTH	NEXT-TO-LAST BIRTH	SECOND-FROM-LAST	THIRD-FROM-LAST
LINE NUMBER FROM Q. 212	☐☐	☐☐	☐☐	☐☐
	NAME_____ ALIVE ☐ DEAD ☐	NAME_____ →ALIVE ☐ DEAD ☐	NAME_____ →ALIVE ☐ DEAD ☐	NAME_____ →ALIVE ☐ DEAD ☐
420 Do you have a health card for (NAME)? IF YES: May I see it, please?	YES, SEEN.....1 YES, NOT SEEN.....2 (SKIP TO 422) NO CARD.....3	YES, SEEN.....1 YES, NOT SEEN.....2 (SKIP TO 422) NO CARD.....3	YES, SEEN.....1 YES, NOT SEEN.....2 (SKIP TO 422) NO CARD.....3	(GO TO 428) YES, SEEN.....1 YES, NOT SEEN.....2 (SKIP TO 422) NO CARD.....3
421 RECORD DATES OF IMMUNIZATIONS FROM HEALTH CARD.	NOT GIVEN / DA / MO / YR	NOT GIVEN / DA / MO / YR	NOT GIVEN / DA / MO / YR	NOT GIVEN / DA / MO / YR
BCG	1	1	1	1
POLIO 1	1	1	1	1
DPT 1	1	1	1	1
MEASLES	1	1	1	1
POLIO 2	1	1	1	1
DPT 2	1	1	1	1
POLIO 3	1	1	1	1
DPT 3	1	1	1	1
	(SKIP TO 422A)	(SKIP TO 422A)	(SKIP TO 422A)	(SKIP TO 422A)
422 Has (NAME) ever had a vaccination to prevent him/her from getting diseases?	YES.....1 NO.....2 DK.....8	YES.....1 NO.....2 DK.....8	YES.....1 NO.....2 DK.....8	YES.....1 NO.....2 DK.....8
422A CHECK ON CHILD'S ARM FOR A BCG SCAR AND MARK IF PRESENT OR ABSENT	SCAR PRESENT.....1 SCAR ABSENT.....2 CHILD NOT SEEN.....9	SCAR PRESENT.....1 SCAR ABSENT.....2 CHILD NOT SEEN.....9 (SKIP TO 423)	SCAR PRESENT.....1 SCAR ABSENT.....2 CHILD NOT SEEN.....9 (SKIP TO 423)	SCAR PRESENT.....1 SCAR ABSENT.....2 CHILD NOT SEEN.....0 (SKIP TO 423)
424E When (NAME) had diarrhea, did you give more, fewer, or the same amount of fluids?	MORE.....1 FEWER.....2 SAME.....3 DK..... 8	MORE.....1 FEWER.....2 SAME.....3 DK..... 8	MORE.....1 FEWER.....2 SAME.....3 DK..... 8	MORE.....1 FEWER.....2 SAME.....3 DK..... 8

429	ENTER THE NAME, LINE NUMBER, AND SURVIVAL STATUS OF EACH BIRTH SINCE JAN. 1983 BELOW. BEGIN WITH THE LAST BIRTH. THE HEADINGS IN THE TABLE SHOULD BE EXACTLY THE SAME AS THOSE AFTER Q. 419. ASK THE QUESTIONS ONLY FOR LIVING CHILDREN.			
LINE NUMBER FROM Q. 212	☐☐	☐☐	☐☐	☐☐
	LAST BIRTH NAME______ ALIVE ☐ DEAD ☐	NEXT-TO-LAST BIRTH NAME______ →ALIVE ☐ DEAD ☐	SECOND-FROM-LAST NAME______ →ALIVE ☐ DEAD ☐	THIRD-FROM-LAST NAME______ →ALIVE ☐ DEAD ☐ (GO TO 501)
430 Has (NAME) had fever in the last four weeks?	YES....1 NO....2 (SKIP TO 433) DK....8	YES....1 NO....2 (SKIP TO 433) DK....8	YES....1 NO....2 (SKIP TO 433) DK....8	YES....1 NO....2 (SKIP TO 433) DK....8
431 Did you take (NAME) to a private doctor or to a hospital or clinic, traditional doctor or any other place to treat the fever. IF YES: Where taken?	DOCTOR....1 HOSPITAL/CLINIC.....2 TRADITIONAL DOCTOR..3 OTHER______..4 (SPECIFY) CHILD NOT TAKEN.....5	DOCTOR....1 HOSPITAL/CLINIC.....2 TRADITIONAL DOCTOR..3 OTHER______..4 (SPECIFY) CHILD NOT TAKEN.....5	DOCTOR....1 HOSPITAL/CLINIC.....2 TRADITIONAL DOCTOR..3 OTHER______..4 (SPECIFY) CHILD NOT TAKEN.....5	DOCTOR....1 HOSPITAL/CLINIC.....2 TRADITIONAL DOCTOR..3 OTHER______..4 (SPECIFY) CHILD NOT TAKEN.....5
433 Has (NAME) suffered from severe cough or difficult or rapid breathing in the last four weeks?	YES....1 NO....2 (GO TO NEXT COL) DK....8	YES....1 NO....2 (GO TO NEXT COL) DK....8	YES....1 NO....2 (GO TO NEXT COL) DK....8	YES....1 NO....2 (SKIP TO 501) DK....8
434 Did you take (NAME) to a private doctor, a hospital or clinic, a traditional doctor, or any other place to treat the problem? IF YES: Where was he/she taken?	DOCTOR....1 HOSPITAL/CLINIC.....2 TRADITIONAL DOCTOR..3 OTHER______..4 (SPECIFY) CHILD NOT TAKEN.....5	DOCTOR....1 HOSPITAL/CLINIC.....2 TRADITIONAL DOCTOR..3 OTHER______..4 (SPECIFY) CHILD NOT TAKEN.....5	DOCTOR....1 HOSPITAL/CLINIC.....2 TRADITIONAL DOCTOR..3 OTHER______..4 (SPECIFY) CHILD NOT TAKEN.....5	DOCTOR....1 HOSPITAL/CLINIC.....2 TRADITIONAL DOCTOR..3 OTHER______..4 (SPECIFY) CHILD NOT TAKEN.....5

SECTION 5. MARRIAGE

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP TO
501	Have you ever been married or lived with a man?	YES.....1 NO.....2	→519
502	Are you now married or living with a man, or are you widowed, divorced or not now living together?	MARRIED.....1 LIVING TOGETHER.....2 WIDOWED.....3 DIVORCED.....4 NOT NOW LIVING TOGETHER.....5	→507
503	Does your husband/partner live with you or is he now staying elsewhere?	LIVING WITH HER.....1 STAYING ELSEWHERE.....2	
504	Does your husband/partner have any other wives besides yourself?	YES.....1 NO.....2	→507
505	How many other wives does he have?	NUMBER..... DK.....98	→507
506	Are you the first, second,...wife?	RANK.....	
507	Have you been married or lived with a man only once, or more than once?	ONCE.....1 MORE THAN ONCE.....2	
508	In what month and year did you start living with your (first) husband or partner?	MONTH..... DK.....98 YEAR..... DK YEAR.....98	→510
509	How old were you when you started living with him?	AGE.....	
518	In how many localities have you lived for six months or more since you were first married (started living together) including this place?	NUMBER OF LOCALITIES.....	→520

SECTION 6. FERTILITY PREFERENCES

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP TO
601	CHECK 502: CURRENTLY MARRIED OR LIVING TOGETHER ☐ ALL OTHERS ☐		→609
602	CHECK 220 AND MARK BOX. Now I have some questions about the future. NOT PREGNANT OR UNSURE ☐ Would you like to have a (another) child or would you prefer not to have any (more) children? PREGNANT ☐ After the child you are expecting, would you like to have another child or would you prefer not to have any (more) children?	HAVE ANOTHER.....1 NO MORE.....2 SAYS SHE CAN'T GET PREGNANT.....3 UNDECIDED OR DK.....8	→605
603	How long would you want to wait from now before the birth of a (another) child?	DURATION: MONTHS.....1 YEARS.....2 DK.....998	→605
604	CHECK 215: How old would your youngest child be? IF NO LIVING CHILDREN, CIRCLE '96'.	AGE OF YOUNGEST YEARS..... NO LIVING CHILDREN.....96 DK.....98	
605	For how long should a couple wait before starting sexual intercourse after the birth of a baby?	MONTHS.....1 YEARS.....2 OTHER_____.996 (SPECIFY)	
606	Should a mother wait until she has completely stopped breastfeeding before starting to have sexual relations again, or doesn't it matter?	WAIT.....1 DOESN'T MATTER.....2	
607	Do you think that your husband/partner approves or disapproves of couples using a method to avoid pregnancy?	APPROVES.....1 DISAPPROVES.....2 DK.....8	
608	How often have you talked to your husband/partner about this subject in the past year?	NEVER.....1 ONCE OR TWICE.....2 MORE OFTEN.....3	
609	In general, do you approve or disapprove of couples using a method to avoid pregnancy?	APPROVE.....1 DISAPPROVE.....2	
610	CHECK 202 AND 204: NO LIVING CHILDREN ☐ If you could choose exactly the number of children to have in your whole life, how many would that be? HAS LIVING CHILDREN ☐ If you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be? RECORD SINGLE NUMBER OR OTHER ANSWER.	NUMBER..... OTHER ANSWER _____ (SPECIFY)	

SECTION 7. HUSBAND'S BACKGROUND AND WOMAN'S WORK

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP TO
701	CHECK 501: EVER MARRIED OR LIVED WITH A MAN ☐ ALL OTHERS ☐		→714
	ASK QUESTIONS ABOUT CURRENT OR MOST RECENT HUSBAND/PARTNER.		
702	Now I have some questions about your (most recent) husband/partner. Did your husband/partner ever attend school?	YES.....1 NO.....2	→706
703	What was the highest level and grade of formal education your husband completed? CIRCLE CODE FOR BOTH LEVEL AND GRADE	LEVEL / GRADE PRIMARY 1 — 1 2 3 4 5 6 7 JUNIOR 2 — 1 2 3 SECONDARY 3 — 1 2 3 4 5 6 UNIV. 4 — 1 2 3 4 5 6 DK.....98	
705	CHECK 703: PRIMARY ☐ SECONDARY OR HIGHER ☐		→707
706	Can (could) he read a letter or newspaper easily, with difficulty, or not at all?	EASILY.....1 WITH DIFFICULTY.....2 NOT AT ALL.....3	
707	What kind of work does (did) your husband/partner mainly do?	FARMING .....01 FISHING .....02 MANUFACTURING .....03 BUILDING & CONSTRUCTION .....04 RETAILING .....05 SERVICES.....06 UNPAID FAMILY WORKER IN FARMING.....07 OTHER UNPAID FAMILY WORKERS....08 GOVT./PARASTATAL EMPLOYEE.....09 HOME MAKER.....10 STUDENT.....11 ECONOMICALLY NON-ACTIVE (AGED, SICK, DEFORMED ETC).....12	
717	MAIN MATERIAL OF THE ROOF (RECORD OBSERVATION)	THATCH.....1 PAPYRUS.....2 TINS.....3 IRON SHEETS.....4 ASBESTOS.....5 TILES.....6 CONCRETE.....7 OTHERS.....8	
718	MAIN MATERIAL OF THE WALLS (RECORD OBSERVATION OR ASK)	THATCH.....1 MUD AND POLES.....2 EARTH BRICKS.....3 CLAY BRICKS.....4 CEMENT BLOCKS.....5 CONCRETE.....6 STONES.....7 OTHER.....8	

APPENDIX C
ESTIMATES OF SAMPLING ERROR

Source: UDHS report, Appendix B.

The results from sample surveys are affected by two types of errors: (1) nonsampling error and (2) sampling error. Nonsampling error is due to mistakes made in carrying out field activities, such as failure to locate and interview the correct household, errors in the way questions are asked, misunderstanding of the questions on the part of either the interviewer or the respondent, data entry errors, etc. Although efforts were made during the design and implementation of the UDHS to minimize this type of error, nonsampling errors are impossible to avoid and difficult to evaluate analytically.

The sample of women selected in the UDHS is only one of many samples that could have been selected from the same population, using the same design and expected size. Each one would have yielded results that differed somewhat from the actual sample selected. The sampling error is a measure of the variability between all possible samples; although it is not known exactly, it can be estimated from the survey results. Sampling error is usually measured in terms of the "standard error" of a particular statistic (mean, percentage, etc.), which is the square root of the variance. The standard error can be used to calculate confidence intervals within which one can be reasonably assured that, apart from non-sampling errors, the true value of the variable for the whole population falls. For example, for any given statistic calculated from a sample survey, the value of that same statistic as measured in 95 percent of all possible samples with the same design (and expected size) will fall within a range of plus or minus two times the standard error of that statistic.

If the sample of women had been selected as a simple random sample, it would have been possible to use strightforward formulas for calculating sampling errors. However, the UDHS sample design depended on stratification, stages, and clusters; consequently, it was necessary to utilize more complex formulas. The computer package CLUSTERS was used to assist in computing the sampling errors with the proper statistical methodology.

The CLUSTERS programme treats any percentage or average as a ratio estimate, r=y/x. where both x and y are considered to be random variables. The variance of r is computed using the formula given below, with the standard error being the square root of the variance:

$$\text{var}(r) = \frac{1-f}{x^2} \sum_{h=1}^{H} \left[\frac{m_h}{m_h - 1} \left(\sum_{i=1}^{m_h} z_{hi}^2 - \frac{z_h^2}{m_h} \right) \right]$$

in which, $z_{hi} = y_{hi} - r\,x_{hi}$, and $z_h = y_h - r x_h$, where

h represents the stratum and varies from 1 to H,

m_h is the total number of EAs selected in the h-th stratum,

y_{hi} is the sum of the values of variable y in cluster i in the h-th stratum,

x_{hi} is the sum of the number of cases (women) in cluster i in the h-th stratum, and

f is the overall sampling fraction, which is so small that the CLUSTERS programme ignores it.

In addition to the standard errors, CLUSTERS computes the design effect (DEFT) for each estimate, which is defined as the ratio between the standard error using the given sample design and the standard error that would result if a simple random sample had been used. A DEFT value of 1.0 indicates that the sample design is as efficient as a simple random sample; a value greater than 1.0 indicates the increase in the sampling error due to the use of a more complex and less statistically efficient design.

Sampling errors are presented in Tables 2.1- 2.12 for 35 variables considered to be of major interest. Results are presented for the whole country, for urban and rural areas, for women in three broad age groups, and for the six regions as defined in this report. For each variable, the type of statistic (mean, proportion) and the base population are given in Table 1. For each variable, Table 2.1- 2.12 presents the value of the statistic, its standard error, the number of unweighted and weighted cases, the design effect, the relative standard error, and the 95 percent confidence limits.

The confidence interval has the following interpretation. For the mean number of children ever born (CEB), the overall average from the sample is 3.493 and its standard error is 0.049. Therefore, to obtain the 95 percent confidence limits, one adds and subtracts twice the standard error to the sample estimate, i.e., 3.493 + or - (2 x 0.049), which means that there is a high probability (95 percent) that the *true* average number of children ever born falls within the interval of 3.395 to 3.592.

The relative standard error for most estimates for the country as a whole is small, except for estimates of very small proportions. The magnitude of the error increases as estimates for subpopulations such as particular age groups, and especially geographical areas, are considered. For the variable CEB, for example, the relative standard error (as a percentage of the estimated mean) for the whole country, rural areas, and Kampala is, respectively, 1.4 percent, 1.4 percent, and 7.1 percent. This means that the survey can provide estimates of CEB only with a margin of uncertainty (at the 95 percent confidence level) of +/- 2.8 percent, 2.8 percent, and 14.2 percent respectively for these three domains.

Table 1 List of selected variables with sampling errors, UDHS, 1988/89

Variable	Type	Description	Base Population
EDUC	Proportion	With educa	All women
SECED	Proportion	Secondary or more	All women
CUNION	Proportion	Currently in union	All women
MBEF18	Proportion	Union before 18	All women
BBEF18	Proportion	Birth before 18	All women
CEB	Mean	Children ever born	All women
CEB40	Mean	Children ever born	Women 40-49
CSUR	Mean	Children surviving	All women
PREG	Proportion	Pregnant	All women
KNW	Proportion	Knowing any method •	Women in union
KNWMOD	Proportion	Knowing any modern method	Women in union
KNWSRC	Proportion	Knowing method's source	Women in union
KNWOV	Proportion	Knows ovulatory cycle	Women in union
EVUS	Proportion	Ever use any method	Women in union
CURUSE	Proportion	Currently using any method	Women in uion
PILLUS	Proportion	Using pill	Women in union
TRUSE	Proportion	Using traditional methods	Women in union
APPRF	Proportion	Approving family planning	Women in union
WANTNM	Proportion	Wanting no more children	Women in union
WANT2	Proportion	Wanting to delay 2+ years	Women in union
BF	Mean	Breastfeeding interval	Births in last 3 years
AMEN	Mean	Amenorrhea interval	Births in last 3 years
ABST	Mean	Postpartum interval	Births in last 3 years
TETANU	Proportion	Received tetanus	Mothers, births last 5 years
ATTE	Proportion	Medical attention at birth	Mothers, births last 5 years
WCARD	Proportion	Had health card seen	Children 12-23 months*
BCG	Proportion	Received BCG	Children 12-23 months*
DPT	Proportion	Received DPT (3 dosis)	Children 12-23 months*
POL	Proportion	Received Polio (3 dosis)	Children 12-23 months*
MEASL	Proportion	Received Measles	Children 12-23 months*
FULLIM	Proportion	Fully immunized	Children 12-23 months*
DIAR	Proportion	Diarrhea last 2 weeks	Children < 5 years
HAGE	Proportion	Height for age	Children < 5 years
WAGE	Proportion	Weight for age	Children < 5 years
WHEIGH	Proportion	Weight for height	Children < 5 years

* With health card seen.

Table 2.1 Sampling errors for the entire sample, UDHS, 1988/89

Variable	Value	Standard error	Unweighted number	Weighted number	Design effect	Relative error	Confidence Limits R-2SE	Confidence Limits R+2SE
EDUC	.622	.012	4730.0	4730.0	1.679	.019	.598	.646
SECED	.103	.008	4730.0	4730.0	1.817	.078	.086	.119
CUNION	.672	.009	4730.0	4730.0	1.301	.013	.655	.690
MBEF18	.537	.011	4730.0	4730.0	1.571	.021	.514	.560
BBEF18	.408	.010	4730.0	4730.0	1.465	.026	.387	.429
CEB	3.493	.049	4730.0	4730.0	1.032	.014	3.395	3.592
CEB40	7.487	.167	619.0	649.6	1.177	.022	7.153	7.820
CSUR	2.827	.040	4730.0	4730.0	1.017	.014	2.746	2.907
PREG	.130	.005	4730.0	4730.0	1.124	.042	.119	.140
KNW	.840	.010	3055.0	3180.1	1.482	.012	.820	.859
KNWMOD	.779	.012	3055.0	3180.1	1.659	.016	.754	.804
KNWSRC	.722	.013	3055.0	3180.1	1.614	.018	.696	.748
KNWOV	.102	.006	3055.0	3180.1	1.026	.055	.091	.113
EVUS	.215	.012	3055.0	3180.1	1.663	.058	.190	.239
CURUSE	.049	.005	3055.0	3180.1	1.166	.093	.040	.058
PILLUS	.011	.002	3055.0	3180.1	.996	.173	.007	.014
TRUSE	.024	.003	3055.0	3180.1	1.046	.122	.018	.029
APPRFP	.653	.015	3055.0	3180.1	1.797	.024	.622	.684
WANTNM	.194	.009	3055.0	3180.1	1.201	.044	.177	.211
WANT2	.334	.009	3055.0	3180.1	1.082	.028	.316	.353
BF	18.613	.329	3165.0	3215.6	1.187	.018	17.954	19.272
AMEN	12.706	.301	3165.0	3215.6	1.088	.024	12.103	13.308
ABST	4.144	.271	3165.0	3215.6	1.344	.065	3.602	4.686
TETANU	.556	.014	4915.0	5003.9	1.625	.025	.528	.584
ATTE	.028	.003	4915.0	5003.9	1.228	.119	.022	.035
WCARD	.493	.021	481.0	466.7	1.263	.042	.452	.535
BCG	.980	.007	481.0	466.7	1.009	.007	.967	.993
DPT	.570	.027	481.0	466.7	1.179	.048	.515	.625
POL	.574	.028	481.0	466.7	1.189	.048	.518	.629
MEASL	.715	.030	481.0	466.7	1.415	.042	.655	.775
FULLIM	.477	.029	481.0	466.7	1.243	.061	.419	.536
DIAR	.243	.009	4268.0	4329.6	1.338	.037	.225	.261
HAGE	.448	.010	4268.0	4329.6	1.074	.021	.429	.467
WAGE	.234	.009	4268.0	4329.6	1.185	.038	.216	.251
WHEIGH	.019	.002	4268.0	4329.6	1.062	.129	.014	.024

Table 2.2 Sampling errors for the urban population, UDHS, 1988/89

Variable	Value	Standard error	Unweighted number	Weighted number	Design effect	Relative error	Confidence Limits R-2SE	R+2SE
EDUC	.866	.015	964.0	542.2	1.393	.018	.836	.897
SECED	.389	.030	964.0	542.2	1.935	.078	.328	.450
CUNION	.535	.022	964.0	542.2	1.381	.041	.491	.580
MBEF18	.376	.025	964.0	542.2	1.584	.066	.326	.425
BBEF18	.331	.025	964.0	542.2	1.620	.074	.282	.380
CEB	2.611	.130	964.0	542.2	1.439	.050	2.350	2.872
CEB40	6.845	.379	84.0	47.2	.921	.055	6.087	7.603
CSUR	2.225	.107	964.0	542.2	1.133	.048	2.010	2.440
PREG	.124	.010	964.0	542.2	.939	.080	.105	.144
KNW	.957	.009	516.0	290.2	.970	.009	.940	.975
KNWMOD	.942	.011	516.0	290.2	1.030	.011	.921	.963
KNWSRC	.903	.013	516.0	290.2	1.001	.014	.877	.929
KNWOV	.198	.026	516.0	290.2	1.475	.131	.146	.249
EVUS	.525	.029	516.0	290.2	1.302	.055	.468	.582
CURUSE	.180	.021	516.0	290.2	1.248	.117	.138	.222
PILLUS	.070	.013	516.0	290.2	1.151	.185	.044	.096
TRUSE	.058	.010	516.0	290.2	1.014	.180	.037	.079
APPRFP	.793	.019	516.0	290.2	1.074	.024	.754	.831
WANTNM	.209	.023	516.0	290.2	1.271	.109	.164	.255
WANT2	.364	.021	516.0	290.2	.991	.058	.322	.406
BF	15.337	.713	561.0	315.5	1.090	.047	13.910	16.764
AMEN	9.369	.630	561.0	315.5	1.020	.067	8.109	10.629
ABST	5.904	.638	561.0	315.5	1.111	.108	4.628	7.179
TETANU	.749	.013	866.0	487.1	.752	.018	.723	.776
ATTE	.122	.017	866.0	487.1	1.207	.135	.089	.156
WCARD	.565	.047	87.0	48.9	1.174	.084	.470	.660
BCG	.977	.017	87.0	48.9	1.029	.017	.944	1.010
DPT	.851	.039	87.0	48.9	.952	.046	.773	.928
POL	.851	.039	87.0	48.9	.952	.046	.773	.928
MEASL	.839	.048	87.0	48.9	1.210	.057	.743	.935
FULLIM	.759	.047	87.0	48.9	.991	.062	.664	.853
DIAR	.201	.017	756.0	425.2	1.120	.086	.167	.236
HAGE	.257	.021	756.0	425.2	1.061	.081	.215	.299
WAGE	.128	.016	756.0	425.2	1.116	.125	.096	.160
WHEIGH	.010	.004	756.0	425.2	1.004	.406	.002	.018

Table 2.3 Sampling errors for the rural population, UDHS, 1988/89

Variable	Value	Standard error	Unweighted number	Weighted number	Design effect	Relative error	Confidence Limits R-2SE	R+2SE
EDUC	.590	.013	3766.0	4187.8	1.662	.023	.564	.617
SECED	.065	.007	3766.0	4187.8	1.852	.114	.050	.080
CUNION	.690	.009	3766.0	4187.8	1.256	.014	.671	.709
MBEF18	.558	.012	3766.0	4187.8	1.484	.022	.534	.582
BBEF18	.418	.011	3766.0	4187.8	1.392	.027	.396	.440
CEB	3.607	.052	3766.0	4187.8	.952	.014	3.504	3.710
CEB40	7.537	.178	535.0	602.3	1.172	.024	7.182	7.892
CSUR	2.905	.042	3766.0	4187.8	.947	.015	2.820	2.989
PREG	.130	.006	3766.0	4187.8	1.105	.047	.118	.142
KNW	.828	.011	2539.0	2889.9	1.436	.013	.806	.849
KNWMOD	.763	.014	2539.0	2889.9	1.615	.018	.735	.790
KNWSRC	.704	.014	2539.0	2889.9	1.579	.020	.675	.732
KNWOV	.092	.006	2539.0	2889.9	.974	.061	.081	.104
EVUS	.183	.013	2539.0	2889.9	1.733	.073	.157	.210
CURUSE	.036	.004	2539.0	2889.9	1.192	.123	.027	.044
PILLUS	.005	.002	2539.0	2889.9	1.113	.320	.002	.008
TRUSE	.020	.003	2539.0	2889.9	1.066	.148	.014	.026
APPRFP	.639	.017	2539.0	2889.9	1.766	.026	.605	.672
WANTNM	.193	.009	2539.0	2889.9	1.168	.047	.174	.211
WANT2	.331	.010	2539.0	2889.9	1.068	.030	.311	.351
BF	18.969	.361	2604.0	2900.1	1.172	.019	18.247	19.691
AMEN	13.069	.327	2604.0	2900.1	1.059	.025	12.415	13.723
ABST	3.953	.292	2604.0	2900.1	1.336	.074	3.369	4.537
TETANU	.535	.015	4049.0	4516.8	1.594	.028	.505	.565
ATTE	.018	.003	4049.0	4516.8	1.402	.179	.012	.025
WCARD	.486	.022	394.0	417.8	1.226	.046	.441	.531
BCG	.980	.007	394.0	417.8	.984	.007	.966	.994
DPT	.537	.030	394.0	417.8	1.134	.055	.478	.596
POL	.541	.030	394.0	417.8	1.144	.055	.481	.601
MEASL	.700	.033	394.0	417.8	1.371	.047	.634	.766
FULLIM	.445	.031	394.0	417.8	1.198	.070	.382	.507
DIAR	.248	.010	3512.0	3904.4	1.303	.039	.228	.267
HAGE	.467	.010	3512.0	3904.4	1.008	.021	.447	.487
WAGE	.244	.009	3512.0	3904.4	1.129	.039	.225	.263
WHEIGH	.020	.003	3512.0	3904.4	1.017	.134	.015	.025