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An Observation on the Bias in Clinic-based Estimates of Malnutrition Rates

Margaret E. Grosh
Kristin Fox
and
Maria Jackson

The bias in clinic-based estimates of malnutrition rates is large and variable in this sample.

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Clinic-based data on malnutrition are the most readily available for following malnutrition levels and trends in most countries, but there is a bias inherent in clinic-based estimates of malnutrition rates.

Grosh, Fox, and Jackson compare annual clinic-based malnutrition data and those from four household surveys in Jamaica. The clinic data give lower estimates of malnutrition than the survey data in all four cases — significantly so in three.

The size of the bias was variable over time, so the clinic data were not a good indicator of either levels or trends in nutrition status.

An Observation on the Bias in Clinic-Based Estimates of Malnutrition Rates[1/]

1. Estimates of malnutrition rates based on weighing and measuring children who attend health clinics are frequently used by policy makers to follow the level of and trends in malnutrition, and to inform policy and program decisions which could affect malnutrition rates (see Mason and Mitchell (1983), Berg [1987] and ACC/SCN, [1989]). The data are used because they are the most available, recent, and inexpensive to collect. They may, however, be significantly biased. This paper compares clinic-based estimates of malnutrition rates with those obtained from household survey data. The first section of the paper outlines the advantages and possible types of bias in clinic-based data. The comparative literature from three other countries is described. In the third section, the two data series for Jamaica are juxtaposed and described. In the fourth section, some observations and speculations are made about causes of the bias and ways to correct for it.

Section I: Advantages and Disadvantages of Clinic Data

2. Availability at Low Cost. Children are weighed and measured as part of many health interventions. The primary reason for the weighing and measurement is to aid in the assessment and monitoring of the child's health. The data from individual children are aggregated and centralized through internal reporting systems, along with a great deal of other health and health service related information. The costs of generating clinic-based estimates of malnutrition rates are therefore difficult to separate from the costs incurred in patient diagnosis and general administrative overhead. While in many countries the internal reporting systems do not function well, the idea that reporting should take place is usually unquestioned. Thus clinic data are likely to be a continual source of information about the nutritional status of the population, with no (or few) costs directly attributable to the collection of the information. Furthermore, the information is frequently available on a monthly or quarterly basis so it is possible to track seasonal variations in malnutrition. Household surveys, in contrast, are expensive and infrequent.

3. Sources of Bias. The main problem with clinic data is that it comes not from a random sample of children, but from those who attend clinics. If those who attend clinics are not a random sample of all children, then the estimate of the malnutrition rate will be biased. Even among those children measured, some may not have their measurements reported into the central system, e.g. those measured in clinics with bad reporting systems, or in private clinics or hospitals which may not be part of the reporting network. If those children whose measurements are not reported are not random sample of all measured children, then further biases will be introduced.

1/ The authors would like to acknowledge valuable comments from Jere Behrman, Alan Berg, Doris Grosh, Judy McGuire, David Pelletier and Per Pinstrup-Anderson.

4. Direction of Bias. The direction of the bias caused by having a non-random sample of children is not clear. There are several factors which may affect biases in the u · of health clinics. Which of these predominates may vary from place to pl e and time to time. Children who go to clinics may be sick or sickly. Since most childhood illnesses can cause or accentuate malnutrition, and since malnourished children are more susceptible to illness, sick or sickly children are more likely to be malnourished than a random sample from the general population. On the other hand, children who go to clinics for preventive care may be less likely to be sick or malnourished than other children. It may also be that which children go to clinics is determined not by their health, but by the availability of services. In most countries, clinics are less accessible to the poor who are more often malnourished, so that clinic-based data would underestimate malnutrition rates. On the other hand, the wealthier children may receive most of their health care from private physicians not tied into the nutrition reporting system. In that case, the wealthy children, who are unlikely to be malnourished, would be under-represented in government clinic data, and malnutrition rates would be overestimated by data from public clinics.

5. Constancy of Bias. Even if estimates of the malnutrition rate are biased, if the amount and direction of bias is constant, a series of clinic data could still serve to monitor whether nutritional status was improving or deteriorating. It would seem that, in the short run, the factors which would determine the bias would be about constant. In the long run, or in periods of crisis, some of the same factors which would affect nutrition status may also affect the balance of who goes to clinics, and therefore, the bias with which the malnutrition rate is measured. In a period of economic crisis, for example, wages and employment may fall and prices rise, which would stress families' abilities to feed themselves. At the same time, the government may reduce spending on health and nutrition programs, leading to fewer staff or hours of operation at the clinics, and longer queues. That may change the number of people willing to use government clinics. Or even if people with sick children are willing to queue, parents may forgo preventive visits for their children. Those who previously could afford private care may shift to public care. These kinds of changes in patterns of health care use would affect the amount of bias in the malnutrition rate as measured from clinic data.

Section II: The Comparative Literature

6. The discussion thus far has made it clear that clinic malnutrition data may be biased. There is not a clear presumption as to the direction, strength, or even constancy of the bias. These issues are best resolved empirically. There is, however, a surprisingly slim literature on the subject.

7. The authors are aware of three studies which compare anthropometric data from household surveys and clinics in order to examine the differences in estimates of malnutrition rates. For El Salvador, Trowbridge, et al., (1980) compared household survey data for five regions to the clinic data from two contiguous time periods. The clinic data estimated malnutrition to be considerably higher than the household survey data, from 70-180% higher. The regional distribution of malnutrition as estimated from both sources

coincided, and the authors concluded that the clinic data were very useful for assessing nutritional status.

8. For Botswana, UNICEF/Cornell (1983) compared household survey data for the catchment areas of 22 clinics with the clinic data from two contiguous time periods. The average difference over these areas was that clinic data provided a lower estimate of malnutrition than survey data by about 11 percent. There were, however, much larger differences in some areas. In about one third of the areas, the differences were less than ten percent; in a further third, the differences were between ten and twenty-five percent; and in the remaining third the differences were greater than twenty-five percent. The study concluded that the differences in estimate were important. Because clinic attendance at the time was 89 percent of children under five (food was being distributed to clinic attenders as a drought relief measure), the authors suggested that the differences were due not to sample error, but due to non-sample errors such as poor weighing and recording techniques, inaccurate clinic scales and the like.

9. For Swaziland, Serdula, et al., (1987), compared national household survey data with clinic data in four regions. In total, the estimate of the malnutrition rate among first time clinic attenders and the survey-based estimate were very close, and within the confidence interval of the survey estimate. The distribution by age was also very close. The regional distribution differs between the two, and the rates for children who have attended clinics more than once in a given year were much lower than for those who were attending the first time within the year. The authors concluded that surveillance data will not provide a valid estimate of nutritional status of the general population or of the difference between regions.

10. In order to add a further comparison to the literature, the next section presents the time series of clinic and household survey data available for Jamaica, and the general issues relating to sample bias are re-examined in light of that country's experience.

Section III: The Jamaican Case

11. Health Care in Jamaica. The clinic data presented here are from the Ministry of Health clinics. Jamaica has a well developed public health care system which provides free preventive and primary services. Ninety percent of the population lives within ten miles of a health center. The lowest level center is staffed by a midwife and two community health care workers. They do some extension work for maternal and child health. Jamaica also has an active private health system focused largely on primary care. The infant mortality rate is 11 per 1000 live births,[2/] vaccination coverage is 82 percent of children from one to four years for tuberculosis, 62 percent for measles, and life expectancy is 73 years.

2/ Ashley, et al. calculate a peri-natal mortality rate of 38 per 1,000 live births, which is consistent with an infant mortality rate rather higher from the 11 used in the World Development Report, 1990.

12. In Jamaica, the frequency of declared illness does not vary greatly by economic status (see Table 1), but patterns of health care use do vary. When ill, poor children are less likely than rich children to receive medical care. Rich children, however, are taken to private doctors much more often than poor children. Overall, the use of public health care is greatest for the middle range of economic level, somewhat less for the poor and still less for the rich. Use of preventative care follows the same pattern. The tendency of rich children to go to private doctors and of the poor not to get medical care when ill provides countervailing biases in the public system. The poor do use public clinics somewhat more than the rich, so there may be some tendency for clinic data to overestimate malnutrition rates.

13. Malnourished children are much more likely to be ill than those not malnourished (see Table 1). Even though they are slightly less likely to seek care, the overall percent using care is much higher. Malnourished and normal children choose public care with equal frequency, but malnourished children are more likely to go to hospital outpatient facilities rather than primary clinics. Malnutrition rates based on the whole public system would therefore overstate malnutrition, those based only on the primary care network would not show much bias.

14. Because both the public and private health care systems in Jamaica are well developed, the children using the public system are not radically unrepresentative of children in the general Jamaican population. Biases in clinic-based estimates of malnutrition rates may thus be much smaller in Jamaica than in other countries.

15. Clinic Data. The clinic data is reported through the Monthly Clinic Summary Report System (MCSR) instituted as part of the Ministry of Health's information system in 1980. The reporting system tallies the frequency of normal or low weights for age for children weighed. It reports mostly on those children who attend "child health clinics" scheduled for specific days at primary health centers. The clinics are organized to provide mainly preventive care (well-baby checks, vaccinations, and growth monitoring) but also provide curative care for sick children. If children attend "curative clinics" on a different day from the "child health clinic", it is less likely that they will be weighed or that, if weighed, that their weights will be included in the reporting system. Although a system of home visits by community health workers exists, the reporting of the weights from them is somewhat irregular. The weights of children seen at hospital outpatient clinics (about one third of public primary care for curative purposes[3/]) are not reported through the MCSR. Private health care providers are not linked to the system.

16. Upon its institution in 1980, the Monthly Clinic Summary Report system reported all observations for a child during the quarter. This appeared to lead to double-counting of children. In 1983, therefore, the system was refined so that only the first observation of a child during the quarter was reported in the tally. The system has been well implemented with regular, timely compliance by most of the public health clinics.

3/ From unpublished analysis of the Survey of Living Conditions, Round III, data.

Table 1
Health Care Use by Children 0-35 Months

		Curative Care			Preventive Care
	% Reported Ill, Last 4 Weeks	% Ill, and Used Health Care	% Ill and Used Public Health Care	% Ill, and Used Public Primary Care	% Used Public in Last 6 Months
Total	28	16	9	6	19
Quintile					
Poorest	26	16	9	6	16
2	29	11	8	6	22
3	29	18	13	9	21
4	28	18	9	4	19
Richest	26	14	4	2	12
Nutritional Status*					
Malnourished	38	20	13	7	21
Normal	27	15	9	6	17

* Malnourished children are those who have a weight for age of less than 80% of the standard used by the National Center for Health Statistics, i.e., are moderately or severely malnourished by WHO standards.

Source: Survey of Living Conditions, Round III.

17. Prior to the establishment of the MCSR, reporting was infrequent and much less systematic. In 1977, 1978 and 1979, for example, insufficient reports were received to estimate a reliable nationwide malnutrition rate. The 1978 health and nutrition survey results are therefore compared with the clinic data from 1976. In that year reliable clinic data were available from only seven of Jamaica's fourteen parishes. The comparison is thus only for the seven parishes.

18. The factors which affect the selection of children into the MCRS system provide biases in different directions. The predominance of preventive care in the observations should lead to an underestimate of malnutrition as these are the children with the best vaccination rates, most health education of their mothers, presumably good access to medical care, etc. The inclusion of some home health visits may counteract this bias to some extent. The exclusion of children who receive their care from private physicians excludes

Table 2
Rates of Malnutrition of Children 0-35 Months
Clinic and Survey Data
Jamaica, 1975-1989

	Clinic Data				Household Survey Data			
GOMEZ STANDARD								
Year	**Normal**	**Grade I**	**Grade II**	**Grade III**	**Normal**	**Grade I**	**Grade II**	**Grade III**
1976 *	73.2	22.2	3.9	0.7				
1977	-	-	-	-				
1978 *	-	-	-	-	60.2	32.4	6.5	0.8
1979	-	-	-	-				
1980	74.4	21.6	3.6	0.5				
1981	73.3	22.8	3.3	0.5				
1982	74.1	22.3	3.2	0.4				
1983	74.3	22.1	3.1	0.6				
1984	73.0	22.9	3.6	0.5				
1985	72.9	22.6	4.0	0.5				
Q1 **	75.0	21.1	3.4	0.5	63.3	29.3	6.2	1.2
1986	73.9	21.8	3.9	0.4				
1987	75.7	20.7	3.3	0.3				
1988***	-	-	-	-				
1989								
Q.3					70.0	25.6	3.1	1.3
Q.4					71.2	25.6	2.5	0.7

	WHO STANDARDS					
	Normal	**Moderate**	**Severe**	**Normal**	**Moderate**	**Severe**
1989						
Q.3	93.6	6.1	0.3	90.3	8.4	1.3
Q.4	93.3	6.4	0.3	92.7	6.5	0.8

* 7 parishes only, for children 0-59 months.
** Refers to the first quarter of the clinic data.
*** The reporting shifted from Gomez to WHO standards. Because the timing of the switch was not uniform, and some confusion ensued, the data for 1988 mix the two measures and are not reliable estimates of either.

Definitions - Gomez Scale: Normal children are those with weights over 90% of the reference standard. Grade I malnutrition is a weight for age from 75-89% of the reference standa Grade II is 60-74% of the standard; Grade III is less than 60 % of the standard, WHO SCALE: Normal children are those with weights for age over 80% of the reference standard. Moderate malnutrition is a weight for age from 60-80% of standard; severe malnutrition is a weight for age below 60% of standard. Both scales use the National Center for Health Statistics age and sex-specific growth standards.

Sources: Clinic Data -- Ministry of Health, Monthly Clinic Records System; 1978 Survey -- MOH (1978); 1985 Survey -- MOH (1985); 1989-Q3 Survey -- STATIN and PIOJ (1989); 1989-Q4 -- unpublished data from Survey of Living Conditions.

the wealthiest, and therefore those less likely to be malnourished. Thus even considering the particular features of Jamaica's clinic reporting system, the direction of bias is uncertain.

19. Household Survey Data. The household survey data presented here are from high quality national household surveys. The sample selection, training of anthropometrists,[4/] and data management are of good quality. The

4/ Staff of the Nutrition Division of the Ministry of Health trained the anthropometrists for the surveys.

measurements are therefore as good as are likely to be obtained. It will therefore be assumed in these comparisons that the household surveys represent the "true" malnutrition rate.

20. For 1985 and 1989 the survey and clinic data are both for children under 36 months of age. The number of observations used from the surveys were as follows: in 1978, 2007; in 1985, 3332; in July 1989, 509; and in November 1989-January 1990, 964. The confidence interval calculated for the WHO standard combined moderate and severe low weight-for-age malnutrition rates were all about plus or minus 1.5 percentage points around the estimate.

21. The 1978 survey tabulations provide information by parish and by age, but not by both simultaneously. Of necessity, survey observations are used for all children under 60 months in the seven parishes to which the clinic data correspond. For the fourteen parishes together, the difference between the combined Gomez grades I-III for children 0-59 months and for children 0-35 months was only 3 percent or 1 percentage point, so comparisons should be reasonably valid.

22. Although the household surveys and clinics report weights for children of the same age range, the distribution of children in that range may be different. Clinic attendance is usually most frequent among the youngest children. Vaccination norms, for example, would prompt three visits in the first six months of life, one visit between six and twelve months and one visit between twelve and eighteen months. Malnutrition rates are lowest in the first six months when breastfeeding is a main source of nourishment, and then peaks for 12-23 month olds after weaning. The distribution of children by ages of the clinic attenders will therefore influence the estimate of malnutrition rates. Properly, clinic data should be adjusted to prevent any biases of this sort from confusing comparisons with the household data. Unfortunately, the Jamaican clinic data are not tallied by age group so the comparison will be made with unadjusted clinic data.

23. The Comparison. In all four cases, the clinic data underestimated the malnutrition rate (see Tables 2 and 3). In three cases the clinic-based estimate fell outside the confidence interval for the survey-based estimate. In 1978 and 1985, using the Gomez classification, the combined rate of grades II and III was underestimated by clinic data by 37 and 47 percent, respectively. In 1989, WHO standards were used. For the combined moderate and severe categories, the clinic data underestimate malnutrition by 34 percent in the third quarter, but only 8 percent in the fourth quarter.

24. The degree of discrepancy between the clinic and survey estimates is very sensitive to the measure used in the comparison. In the first quarter of 1985 (1985-QI), for example, the clinic-based rate underestimates malnutrition as defined by the combined Gomez grades II and III by 47 percent. However, malnutrition as defined by Gomez grade I is underestimated by 28 percent. Malnutrition as defined by Gomez grade II is underestimated by 45 percent. The extent of adequate nutrition is overestimated by 19 percent. In general, the degree of underestimation of clinic-based malnutrition rates is higher for more serious forms of malnutrition.

Table 3
Comparison of Clinic and Survey Estimates
Combined Moderate and Severe Malnutrition

Year	Clinic Estimates	Survey Estimate & Confidence Interval	Clinic Data Underestimates Survey Estimate by
Combined Gomez II and III			
1976/78	4.6%	7.3% ± 0.9	37%
1985-Q1	3.9%	7.4% ± 0.9	47%
Combined WHO Moderate and Severe			
1989-Q3	6.4%	9.7% ± 2.6	34%
1989-Q4	6.7%	7.3% ± 1.0	8%

Sample Calculation: In the first quarter of 1985, the clinic data showed Gomez Grade II and III malnutrition to be 3.9%, while the household survey showed it to be 7.4% using the same measure. The clinic data underestimates the survey data by 47%(1 - 3.9/7.4 = 0.47).

Note: The WHO Moderate and Severe categories include all children with weights under 80% of the reference standard, while Gomez II and III categories include children with weights under 75% of the standard. It is not accurate to draw a conclusion about the trend in the malnutrition table itself when the measures used are not the same. The reader interested in the trend in malnutrition rate should refer to the Gomez Standard portion of Table 2.

Source: Table 2.

25. Not only is the degree of underestimation of malnutrition rates from clinic data large, it is not constant. It has ranged from 37 percent, to a high of 47 percent, down to a low of only 8 percent. If the estimate of malnutrition from clinic data were constantly of a certain magnitude, then following the rate over time would give a useful picture of changes in nutritional status. With the change in bias shown here, it would seem that clinic-based estimates will track changes in malnutrition rates only very imprecisely.

Section IV: Discussion

26. If the malnutrition rate as estimated by clinic data was biased by a known amount, adjustments could be made to produce a more accurate estimate. This section discusses how the bias in the estimate from clinic data relates to some of the factors which might cause the bias.

27. Changes in patterns of health care use could be expected to change the amount of bias in a clinic-based estimate of malnutrition rates. In Jamaica, accurate records of aggregate health care use and service availability were kept from 1980 on. As Table 5 shows, the proportion of children making their first preventive health visit before the age of six months has grown steadily from 1980 to 1988. Likewise, vaccination rates have increased. By these two

Table 4
Bias in Estimate by Degree of Malnutrition

Clinic Estimate Difference with "True" Survey Estimate

Gomez Standard

	Normal	I	II	III
1976/8	+22%	-31%	-40%	-13%
1985-Q1	+19	-28	-45	-58

WHO Standard

	Normal	Moderate	Severe
1989-III	+3	-28	-75
1989-IV	+1	-	-62

Sample Calculation: The 1985 first quarter clinic data showed that 75% of the children had normal weights by the Gomez Standard. The household survey in that quarter showed 63.3% of children with normal weights. Thus the clinic data overestimates the rate of normal nutritional status by 19% (1 - 74.0/63.3 = 0.19).

Source: Table 2.

measures, health coverage grew during the period. As the use of public preventive services becomes more general in the population, the amount of bias in malnutrition rates caused by estimating them using the sample of children using public preventive services can be expected to fall.

28. Many countries will not have such good statistics on use of health care but will have information on its availability as proxied by the number of clinics or medical personnel. In Jamaica, the number of clinics open was about constant. The number of nurses in the public health care system has declined gradually from 1984 to 1989. The number of community health aides, who are responsible for home visits for growth monitoring, was reduced by 50 percent between 1984 and 1985. These differences in health care resources could be expected to affect the use of care and thus the bias in the malnutrition rate. In Jamaica, in spite of a decline in the number of personnel who are usually in charge of child health clinic sessions, the number attending them seems to be growing steadily, as discussed above.

29. Another factor which could be expected to affect the bias in the estimate of malnutrition is the malnutrition rate itself. In the Jamaican case the malnutrition rate, as measured by the survey data, falls throughout the series but the underestimation of the rate from clinic data rises and then falls.

30. The variable that looks most likely to explain the change in the amount of bias in clinic-based estimates of the malnutrition rate is the percent of children in the target population who are weighed and whose weights are

reported. This dipped in 1985 as the bias peaked. Changes in the percent of children weighed do not, however, explain the absence of bias in the fourth quarter of 1989. As could be expected, as the number of children with weights reported increases, biases in the estimation of malnutrition rates fall. It is important to note that the number of children with reported weights will be affected both by health care use -- i.e. the number of children who reach the public health care system, and by the rigor with which their weights are recorded and reported -- i.e. the resources available for health administration.

31. Theoretically, with adequate data it should be possible to construct a correction factor based on the percentage of children weighed, changes in the use of health care, availability of resources to the health care system, and the prevalence of malnutrition. The construction of accurate correction factors would, however, require many more points of comparison than a time series provides. Cross-sectional data from different regions could more easily generate the needed sample size for a reasonable econometric model. The sample size for the survey would, however, have to be quite large to ensure that the sample be representative for relatively small geographically areas. Very special studies would be needed to attempt such an exercise.

32. Finally it is interesting to compare the bias in clinic-based estimates of the malnutrition rates with that observed in Botswana, Swaziland and El Salvador. In Jamaica and Botswana the aggregate clinic-based estimates were lower than the survey-based estimates. In Swaziland they were about the same, and in El Salvador the aggregate clinic-based estimate was much higher than the survey-based estimate. In Jamaica the bias changed over time. In Botswana and Swaziland it varied by region, less so in El Salvador. In Swaziland the bias was constant with age. These comparisons strengthen the conclusion that the biases inherent in clinic data are variable and difficult to adjust for.

33. Conclusion. In Jamaica, the clinic-based data underestimated malnutrition rates in all four cases of comparison, seriously so in three. The degree of underestimate was variable, and the most abrupt change occurred within a single year. The degree of underestimate does not follow smoothly with either changes in children's use of public health care or with the resources devoted to public health care. There did appear to be an inverse relation between the percent of children weighed and the degree to which clinic data underestimated malnutrition.

34. Although convenient, clinic-based estimates of malnutrition rates are biased and unreliable. They predict neither the level nor the trend of malnutrition accurately, even with such well-developed public health services as those Jamaica has. Reliable estimates of malnutrition rates require household surveys, an unfortunate conclusion, given their relative expense and infrequency. If clinic-based estimates of malnutrition are to continue to be the mainstay of policy work, policy-makers should be aware of the problems in the estimates and make allowances in their interpretation for measurable changes in factors which may affect the extent of bias. Nutrition analysts should explore in many more countries the direction, size and constancy of bias in clinic-based estimates of malnutrition and its causes.

Table 5: Changes in Availability and Use of Services

Use of Services By Children

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
No of Visits										
First Visit - 6 Mo. (%)	58	68	65	70	79	75	69	79	81	
First Visit - 6-24 Mo. (%)	24	24	23	21	19	19	17	13	12	
Infants w/BCG (%)	17*	24*	20*	45*	74	72	93	89	87	
Measles (%)	33	43	22	47	60	69	117	102	94	
OPT (%)	4	15	30	54	58	64	77	83	77	
Polio (%)	19	45	45	51	57	62	76	82	77	
No. of Home Visits										
% of Children Weighed				32.2	31.3	30.5	36.2	38.8	37.9	39.1

* Doesn't count some infants vaccinated at delivery at the University or Maternity Hospitals.

Ministry of Health Staffing Levels

	1980	1981	1982	1983	1984	1985	1986	1987	1988
No. of Positions									
Doctors	273	370	393	414	388	317	365	397	367
Public Health Nurses	181	133	179	178	194	169	174	176	153
Other Registered Nurses*	2,124	1,869	1,918	1,937	1,998	1,815	1,640	1,548	1,411
Enrolled Assistant Nurses	1,178	708	998	986	981	830	746	846	708
Community Health Aides	1,190	1,174	1,183	1,173	1,168	555	386	509	539
Nutritionists	16	10	11	12	11	10	10	23	24*

* Including Assistants

Number of Clinics

	1980	1981	1982	1983	1984	1985	1986	1987
Clinic Type		361	364	372	375	369	360	363
I		195	198	203	206	201	191	191
II		86	86	88	88	88	89	89
III		76	76	78	78	77	77	78
IV		2	2	2	2	2	2	3
V		2	2	1	1	1	1	2

Source: Ministry of Health Information System.

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