Some Methodological Problems with the Nutritional Assessment of the 1997–98 El Niño Drought in PNG

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Abstract

Assessment of the impact of the 1997–98 drought on the rural population of PNG was primarily based on a sequence of three, rapid, national evaluations of food and water availability in local areas. Direct nutritional assessment played a minor, and late, role. An ambitious sample nutrition survey was conducted in early 1998, but the worst of the crisis was over by April when the survey report was completed.

This paper describes three methodological problems associated with the 1998 survey that may have limited its value to emergency administrators. Firstly, comparisons between the children's nutritional status of 1998 with those obtained from the 1982–83 PNG National Nutrition Survey (NNS) were not valid. This is because the age groups measured were different, with very young infants (0–6 months) not included in the 1998 survey. Since the nutritional status of PNG infants in this age group is relatively better than for older children, exclusion of this age group may have biased the 1998 results to appear worse than the 1982–83 ones. Secondly, comparisons of the results of the 1998 and 1982–83 surveys were invalid because of differences in the population sampling methods. Unless adjustment for geographical location is made, significant bias can occur. Finally, there were problems with making accurate anthropometric measurements of adult women, as indicated by those from some locations showing unusually high or low bodymass indices. Comparison of the results from one area with those of an earlier survey shows that measurement error is likely.

These findings emphasise both the need for appropriate sample selection if future anthropometric surveys are to take advantage of the 1982–83 NNS as baseline information, and the value of previous baseline data for evaluating results. It is suggested that the NNS still provides an invaluable baseline for children's nutritional status.

DURING 1997, as a result of the El Niño Southern Oscillation, large areas of PNG experienced a major drought. Frosts also occurred at higher altitudes. Food production was seriously threatened. Official assessment of the impacts of the drought and frosts largely centred on the rapid evaluation of both food availability and water viability in local agricultural systems (Barr 1999). Major relief programs were initiated following national assessments of food production and water supply in October and December 1997, which categorised drought effects at the level of census divisions. By comparison with emergency food situations elsewhere in the world, there was little emphasis on assessing or monitoring the nutritional effects of the food shortages using anthropometry and indices of nutritional status. There were a few local-level surveys, but at the national level there was only a single nutrition and food security assessment survey in Feb-

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ruary 1998, in sample areas of nine severely affected districts (as identified by the December 1997 food and water assessment).

This ambitious survey was undertaken by nine teams of provincial health staff under the leadership of a consultant nutritionist (Monsef et al. 1998) and funded by the Australian Agency for International Development (AusAID). Besides assessing nutritional status, the study aimed to assess the adequacy of the emergency drought rations and to identify problems, both immediate and long term, related to the use of drought and other emergency foods. By the time the nutrition survey report was completed in April, however, the worst of the crisis was over.

Two years after the 1997–98 drought, it is appropriate to evaluate some of the problems encountered by this survey. The purpose of this paper is to examine some of the methodological problems that limited the value of the survey results for emergency decision makers and aid administrators. While there are other wider strategic issues relating to the use, and especially timing, of nutrition investigations during periods of major food shortage in PNG that warrant discussion, these are not covered here. Thus, my intention is to highlight problems that, in future emergencies, can be avoided.

I will focus on two main features: firstly, to identify major problems concerned with comparing the 1998 children's results with those of the 1982–83 PNG National Nutrition Survey (NNS), which are the only national-level baseline data available; and secondly, to highlight problems with the measurement of adult women. These problems can be summarised in the form of three questions: who to measure; where to measure; and how to measure?

The 1998 Nutrition Survey

The 1998 nutrition survey was intended as a rapid nutrition assessment in some of the worst drought-affected areas of PNG. Using the rankings of the second national drought assessment (Allen and Bourke 1997b), the worst-affected district of each of the nine worst-affected provinces were selected (Monsef et al. 1998). Within each district, one census division was chosen randomly, and the populations of all census units within that census division were surveyed (Table 1).

The survey aimed to collect anthropometric measurements of the heights and weights of some 2123 children and over 1500 women. Such measurements, converted to indices of nutritional status (that is, weight-for-age and similar indices for children and bodymass index (BMI) for adults) would then allow comparison either with international reference standards or, and more significantly, with previous local PNG survey results, in order to evaluate the relative nutritional status of children and adults.

Table 1. Sample census divisions surveyed in the 1998 nutrition survey, with numbers of children and women measured.

Province	District	Census division	No. of children measured	No. of women measured	No. of women BMI calculated
Milne Bay	Rabaraba	Daga	382	307	284
Madang	Rai Coast	Warup	165	72	66
West New Britain	Kimbe	Bali–Witu	562	437	324
Simbu	Gumine	Nomane	155	184	57
Central	Goilala	Ivane–Auga	64	80	76
Enga	Kandep	Marient	137	202	185
Western Highlands	Tambul	Tambul	244	231	215
Gulf	Kaintiba	Mienta	272	291	228
Western	Nomad	Pare	142	74	72
Totals			2123	1878	1507

BMI = bodymass index
Source: Monsef et al. (1998, p. 11, 17, 31, Tables 1, 2, 11)

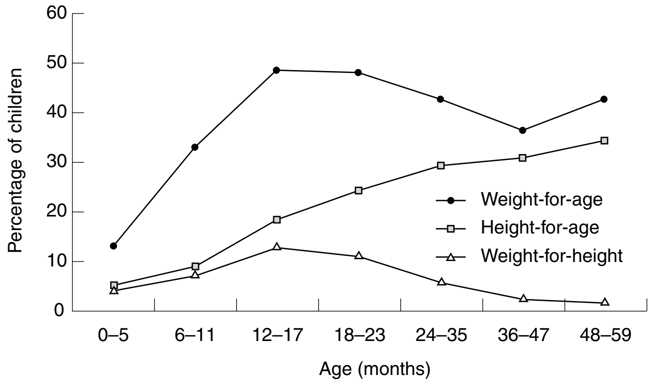

Figure 1. Percentage of PNG children less than 5 years of age below specific levels of median weight-for-age (< 80%), height-for-age (< 90%) and weight-for-height (< 80%) (NNS 1982–83).

The survey measured children aged between 6 and 59 months and their mothers (or other women attending). Every fifth woman was interviewed using a questionnaire to gather information about food security, consumption and food-relief distribution.

In order to evaluate nutritional status, the report presented its anthropometric results in two ways:

- as proportions of children below cut-off levels of median nutritional status indices, and
- as comparisons of the rates observed with both the earlier findings of the 1982–83 NNS and more recent data from maternal and child health clinics (for a variety of reasons, the health clinic data have limited use, and are not considered further here).

Comparison with the 1982–83 National Nutrition Survey

Comparison between the results of the 1998 survey and those of the 1982–83 NNS (Monsef et al. 1998) has two major problems: the age classes of the surveyed children; and, most significantly, the validity of grouping the 1998 samples by census division.

The problem of children's ages

The 1998 survey results on the nutritional status of children aged 6–59 months were directly compared with those reported by the 1982–83 NNS (Monsef et al. 1998). The NNS, however, measured children aged 0–59 months (Heywood et al. 1988) but the figures were not recalculated or adjusted for the 1998 comparison.[1]

Would adjusted figures (i.e. recalculation of the NNS data to include only children aged 6–59 months) make any difference to the comparisons? The answer is, in general, yes. This is because, in PNG, children's weights and lengths/heights are relatively greater for their age during the first few months following birth than they are subsequently (as shown in Fig. 1).

Thus, inclusion of children aged 0–6 months reduced the proportion of children below cut-off levels of median weight-for-age and height-for-age in the 1982–83 NNS figures. For instance, the example from Rabaraba District (Milne Bay Province) in Table 2 shows that the recalculated NNS figures for the age group 6–59 months for both weight-for-age, and height-for-age, are about 4–5% greater than the original figures based on all children aged 0–59 months. The difference for weight-for-height is minimal.

1. For instance, Tables 8, 9 and 10 in Monsef et al. (1998), which presented weight-for-height, weight-for-age and height-for-age comparisons, respectively, all used the 1982–83 NNS percentage figures below cut-off figures for children aged less than 5 years, which were taken from the published table in Heywood et al. (1988). However, there are a number of unresolved discrepancies between the NNS figures, as given in the 1998 report, and those appearing in Heywood et al. (1988). It is worth pointing out that institutional memory is poor in Port Moresby: there were undoubtedly real practical problems of poor access to the relevant reports and publications, let alone the 16-year-old computer files of the NNS data.

Table 2. Comparison of proportions of Rabaraba District children below cut-off levels of median nutritional status indices for two age classes: 0–59 months ($n = 225$) and 6–59 months ($n = 202$) (1982–83 National Nutrition Survey data).

Weight-for-height < 80%		Weight-for-age < 80%		Height-for-age < 90%	
0–59 months	6–59 months	0–59 months	6–59 months	0–59 months	6–59 months
14.2	14.4	59.1	64.4	36.9	40.1

Source: PNG Institute of Medical Research (no date; figures recalculated from Table 5 of this source)

This example illustrates that use of the 1982–83 NNS nutritional status rates calculated for children aged 0–59 months as a baseline for comparison with subsequent rates based on children 6–59 months, is likely to be invalid. In the case of the 1998 survey, the unadjusted comparisons of weight-for-age and height-for-age tended to make the 1998 results appear worse than the 1982–83 baseline results, even where there may have been no real difference between them.

In future, where comparisons need to be made using different age groups of children from those used in the original NNS survey, it is essential that the NNS rates should be recalculated, either using the age breakdowns appearing in the provincial NNS reports (e.g. PNG Institute of Medical Research, no date)[2] or, ideally, by accessing the data from the original NNS computer files held at the PNG Institute of Medical Research in Goroka.

The problem of different sampling units

The NNS 1982–83 sampled children by census units (villages) within particular environmental zones in provinces (Heywood et al. 1988; Keig et al. 1992; Smith et al. 1992; PNG Institute of Medical Research, no date). For Department of Health convenience, many of the results were presented at the level of administrative districts. Because the sampled census units within districts were stratified by environmental zones, they were not necessarily representative of the whole district population. For this reason, the provincial reports warned explicitly that valid comparisons between the NNS data and new surveys would require surveying 'children in the same, or comparable, villages' (PNG Institute of Medical Research, no date).

In the 1998 survey, however, children were surveyed only from a single census division chosen randomly within each district: in other words, from only one random part of each district. Unfortunately, because of major environmental variation, some districts contain census divisions that differ radically from the district 'average'. This means that the comparisons made between the 1998 survey and the NNS may not be valid unless the data are further subdivided by location.

For example, in Milne Bay Province, the 1998 report's analysis of the Rabaraba District child anthropometry illustrates the problem of an unrepresentative 1998 sample used for comparison with the NNS baseline. Rabaraba District is divided (see Fig. 2) into four

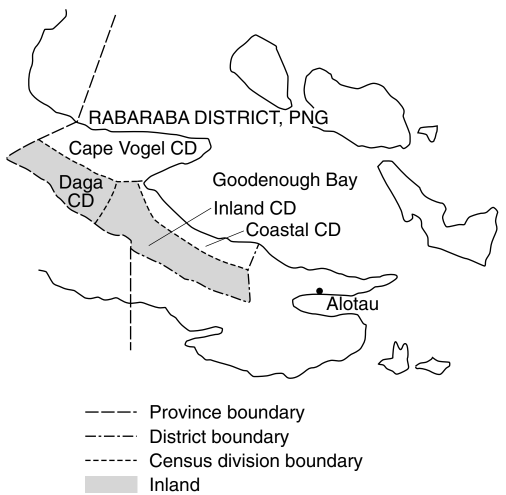

Figure 2. Census divisions of Rabaraba District, Milne Bay Province.

2. The NNS dataset used in the provincial reports differs slightly from that used in the earlier NNS analysis and by Heywood et al. (1998) due to 'cleaning' and checking of the original data. Use of the provincial data may therefore lead to slightly different results from those of Heywood et al. (1988). For example, this is illustrated here by comparing the figures for Rabaraba children aged 0–59 months in Table 2 (taken from the PNG Institute of Medical Research, no date), with those for 1982–83 in Table 3 (from Heywood et al. 1988).

census divisions, two of which are largely coastal/ lowland (Cape Vogel and Goodenough Bay Coastal), and two which are inland and at higher altitudes (Daga and Goodenough Bay Inland). The 1998 survey selected the inland Daga Census Division for its sample, and then compared the results from that single division with those for the whole Rabaraba District from the 1982–83 NNS. In the NNS, however, there were more coastal than inland children surveyed (see Table 4 below).

Table 3 shows the comparison that allowed the 1998 report to conclude that nutritional status had severely worsened in Rabaraba. In this comparison, the proportion of low weight-for-age children increased significantly from 60.6% to 82%, and the proportion of low height-for-age children also increased from 41.8% to 47.6% (Monsef et al. 1998).

This comparison, however, is invalid. Children's growth patterns appear to be very different in the inland and coastal parts of Rabaraba. This is illustrated in Table 4 where the 1982–83 NNS data were divided (see Fig. 2) between an inland area (Daga and Goodenough Bay Inland Census Divisions), and a coastal area (Cape Vogel and Goodenough Bay Coastal Census Divisions), and then recalculated. Thus, in 1982–83, the inland children were found to be much shorter and lighter than their coastal counterparts.

Had the 1998 survey results from the Daga Census Division of Rabaraba (Table 3) been compared with the inland results for Rabaraba from 1982–83 (Table 4), rather than with the composite Rabaraba District results, very different conclusions could have been drawn. For instance, weight-for-age showed little or no difference (82.0% in 1998 compared to 79.8% in 1982–83), while height-for-age was worse in 1982–83 (72.6% compared to 47.6% in 1998). In short, instead of nutritional status being worse during the 1997–98 drought in the inland areas of Rabaraba District, it actually appeared to have been better than in 1982–83.

In order to reflect the environmental diversity of PNG, the sampling frame developed for the 1982–83 NNS was complex. Despite this complexity, it is possible to use the NNS as a source of baseline data for comparison with subsequent surveys. What is important, though, is that neither districts nor census divisions be taken as the basic units for such comparisons without a careful examination of the distribution of originally sampled census units. Wherever possible, comparison should be made on the basis of data from the original, or similar, census units.

Table 3. Proportion (%) of Rabaraba District children below cut-off levels of median nutritional status indices: comparison between 1982–83 and 1998.[a]

Weight-for-height < 80%		Weight-for-age < 80%		Height-for-age < 90%	
1982–83	1998	1982–83	1998	1982–83	1998
16.5	15.7	60.6	82.0	41.8	47.6

[a]In 1982 $n = 249$ (Heywood et al. 1988, p. 94); in 1998, $n = 374–378$ (Monsef et al. 1998, p. 21, 23).
Source: Monsef et al. (1998, p. 28)

Table 4. Comparison of proportions (%) of inland and coastal Rabaraba District children aged 6–59 months below cut-off levels of median nutritional status indices in 1982–83.

Area	Sample number	Weight-for-height < 80%	Weight-for-age < 80%	Height-for-age < 90%
Inland[a]	84	13.1	79.8	72.6
Coastal[b]	120	15.0	56.7	17.5

[a]'Inland' includes 70 children from Daga Census Division, and 14 from Goodenough Bay Inland Census Division. Restriction to the Daga children alone gives similar proportions: i.e. 14.3% for weight-for-height, 82.9% for weight-for-age and 72.9% for height-for-age.
[b]Cape Vogel Census Division and Goodenough Bay Coastal Division
Source: recalculated from 1982–83 National Nutrition Survey computer files

The Problem of Accurate Anthropometric Measurement

Achieving accurate anthropometric measurements under emergency field conditions is always problematic. The 1998 nutrition report (Monsef et al. 1998) noted possible weaknesses in some of the measurements of adult women, especially those from Nomad (Kiunga District, Western Province). In Nomad, the BMI (weight/height squared) of women appeared to be very low: about 11% of women had a BMI of less than 16. In contrast, results from the Bali–Witu islands (Kimbe District, West New Britain Province), showed that BMIs tended to be extremely high, with about 50% of women having a BMI over 25, which may have been in part due to unusually small stature. Follow-up surveys to confirm or refute these extreme findings were recommended.

Assessing the reliability of measurements requires careful protocols both in the field and during data checking.[3] Without sound baseline information, the accuracy of unexpected values may remain doubtful. The NNS 1982–83 did not measure adults and, therefore, does not provide such a national set of reference values. However, for some areas there are comparative data from regional or local surveys which can be used to evaluate measurement reliability. The following comparison makes use of data from a 1988 survey in Simbu Province.

In Gumine District (Simbu Province), the 1998 survey sampled the Nomane Census Division, where, as in the Bali–Witu islands, women were reported to have unusually high BMIs. According to the 1998 survey, only 2% of Nomane women had a BMI of less than 20, while more than half had a BMI of over 25 (Table 5). From this, it was concluded that the 'BMI of women in Gumine was healthy …approximately 55% were overweight/obese… Certainly women between the ages of 15–40 did not appear to have lost weight recently' (Monsef et al. 1998).

This evaluation sits awkwardly with the fact that Nomane had been classified as amongst the worst-affected drought areas in both the October and December 1997 assessments (Allen and Bourke 1997ab). Thus, when the women were measured in February 1998, Nomane had been experiencing a prolonged period (4–6 months) of unprecedented food shortage. Most (90%) of the Nomane women interviewed in February 1998 reported that their staple garden crops were exhausted; most households claimed that only a single distribution of relief food had been supplied in January (Monsef et al. 1998).

In this context, then, it is useful to compare the 1998 BMI figures with those collected 10 years earlier from some 286 Nomane women, as part of a large-scale nutrition survey of most of Gumine District (Table 5, Fig. 3). In 1988, the distribution was very different, with only 10% of Nomane women having a BMI over 25 (compared to 53% in 1998), and 13% below 20 (compared to 2%).

3. Alois Ragin (PNG Department of Health, pers. comm.) has pointed out to me that there were problems with some of the equipment, in particular the microtoises for measuring heights.

Table 5. Comparison of the distribution of bodymass index (BMI) in adult women in 1988 and 1998 in Nomane Census Division, Gumine District (Simbu Province).

BMI class	1988 survey[a]		1998 survey[b]	
	No. of women	%	No. of women	%
< 20	38	13.3	1	1.8
20–24.9	219	76.6	26	45.6
≥ 25	29	10.1	30	52.6
Totals	286		57	

[a]1988 survey: Groos and Hide (1989), BMI for this comparison calculated from original computer files.
[b]1998 survey: Monsef et al. (1998, pp. 17–18); BMI figures taken from bar diagram percentages in Figure 1 of source. Note that although a total of 184 Nomane women were measured in 1998, BMI was calculated for only 57 (Monsef et al. 1998, p. 17, 31). Since BMI was not calculated for pregnant women or for women lacking information on their pregnancy status, Nomane presumably had a high proportion of such women (Monsef et al. 1998, p. 16).

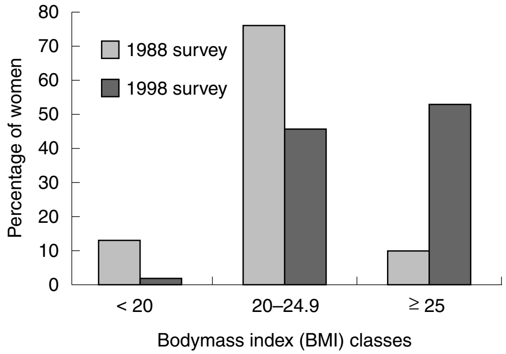

Figure 3. Distribution of adult women by BMI classes in Nomane Census Division, 1988 and 1998.

While a major improvement in the nutritional status of Nomane women is possible over the 10 years between 1988 and 1998, an increase of this magnitude, even under conditions of adequate food supply, seems unlikely. This is especially the case in the light of the very modest rate of change in Nomane women's nutritional status found between 1980 and 1988 (Groos and Hide 1989). Such an increase (particularly to the point of obesity or overweight), seems even less likely if the food availablity assessments of the previous few months are correct. Earlier surveys of short-term adult weight change in Simbu Province, both in Gumine District and elsewhere, have shown regular mean variations of 1–2 kilograms, usually linked to fluctuating food supplies (Bailey and Whiteman 1963; Harvey and Heywood 1983; Wohlt and Goie 1986). Thus weight loss, and hence reduced BMI, is to be expected in such situations. A preponderance of overweight women is not an expected finding in these circumstances.

In this case, then, the availability of comparative data on adult anthropometry raises major questions about the reliability of these Gumine District measurements.

To achieve reliable anthropometry for the purpose of nutritional status assessment requires not only adequate training in measurement under field conditions, but also the means of checking accuracy at various stages of recording and analysis. Regional baseline data can provide a valuable reference point for establishing expected values, as well as for detailed comparisons of changed nutritional status.

Conclusions

The focus of this paper has been on problems associated with the assessment of current nutritional status at the time of a major food crisis by means of comparison with pre-existing baseline information: the 1982–83 NNS in the case of children, and other surveys in the case of adults. The description of three specific problems highlights the ways in which such problems, if not avoided, may severely compromise the value of the results and recommendations of nutritional surveys at times when they are most needed.

Nutritional surveillance or monitoring using anthropometry during food emergencies can undoubtedly play a significant role in the task of determining those most in need, and the effectiveness of relief policies. The 1982–83 NNS, although now nearly 20 years old, still provides the only national level anthropometric baseline information on children (discussed further below). The 1982–83 results are still of considerable value for comparing with new survey data in order to evaluate current nutritional status. Such comparisons must, however, be based on similar age groups of children, and on samples of the same or similar census units. Above all, the basic skills involved in procedures for measuring, checking and recording anthropometry require the most careful cultivation. While good quantification is invaluable, unreliable numbers are often worse than no numbers.

Discussion

Given the significance of the use of comparative data for assessing nutritional status in times of emergency, it is worth asking whether the results of the 1982–83 NNS can still be regarded as providing useful baseline information on the nutritional status of children in PNG. No further national-level nutrition survey has been conducted since 1983. Both the 1998 survey (Monsef et al. 1998) implicitly, and the 1998 Human Development Report (ONP 1999) explicitly, have recommended the need for a new national nutrition survey. At present, this seems unlikely to be considered a major national priority. There is little evidence on which to evaluate the extent of changes in child growth, and hence nutritional status, over the last two decades.

An evaluation in 1992 (Hide et al. 1992), which examined all extant local and regional surveys since 1982, tentatively concluded that: (i) there appeared to have been some improvement in child growth in some areas with initially poor status (such as the Western

Schraders in Madang Province and Karimui in Simbu Province), but not in all such areas (such as the Eastern Schraders); and (ii) that no change occurred in one area that initially had a relatively good status (Gumine, in Simbu Province). Surveys since the early 1990s[4] have not been reviewed. In the absence of a major review, the position taken here is that the 1982–83 NNS still provides a valuable baseline, although its use for comparative purposes should take into account specific local circumstances (such as the effects of major resource developments, etc.) that are likely to have altered nutritional status.

Acknowledgments

My thanks to AusAID for allowing me to see and cite the 1998 survey report (Monsef et al. 1998), to the PNG Institute of Medical Research for providing the opportunity in 1987–89 to examine in detail the National Nutrition Survey of 1982–83, to Anita Groos and others for sharing the Gumine anthropometry in 1988, to Pam Swadling for assistance with Figure 2, to Ivo Mueller for presenting the paper in Lae in my absence, to Alois Ragin for most useful comments, and to the editors for removing ambiguities. The remaining faults are my responsibility.

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