

## Detection and treatment of childhood malnutrition in Papua New Guinea

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### SUMMARY

This paper reviews the importance of childhood malnutrition in Papua New Guinea and other developing countries. Emphasis is given to two important causes: chronic disease and limited food supply. Definitions and diagnostic criteria for malnutrition are discussed with particular focus on the mid-upper-arm circumference (MUAC). The design of a MUAC measuring tape with written treatment guidelines for use at the aid post level and a pilot project used to test the tape are described. The rationale for six treatment steps for malnutrition are described. The importance of community education, support through church groups and effective ongoing preventive health programs at the village level are stressed.

### Introduction

For developing countries the use of the word 'malnutrition' to explain the many thin and stunted children can be misleading, as it may imply that the underlying cause is primarily inadequate food intake. For many malnourished children, food intake problems are secondary to endemic chronic infectious diseases. The sick infected child will not eat normal amounts of food, may not absorb food properly and has higher metabolic demands. The most important infectious diseases are malaria, tuberculosis, diarrhoeal diseases, parasitic infection and respiratory infections. 49% of the 10 million deaths due to these diseases among under-five children each year in developing countries are associated with malnutrition (1) (Figure 1).

In Papua New Guinea (PNG), a study of children with acute lower respiratory infection (ALRI) in the highlands (2) revealed that those with malnutrition were 4 times more likely to be admitted to hospital with ALRI and once admitted were 4 times more likely to die. Wasted children are at an increased risk of death, but children who are both stunted and wasted may be at greatest risk (3). For many malnourished children, the final mode of death

is yet another episode of diarrhoea, malaria or pneumonia. Deaths in thin and/or short children with diarrhoea, malaria, pneumonia or tuberculosis are rarely recorded as being due to malnutrition, but are recorded under the disease diagnosed just before death. If the underlying malnutrition is detected and treated at an earlier stage these deaths should be less likely to occur.

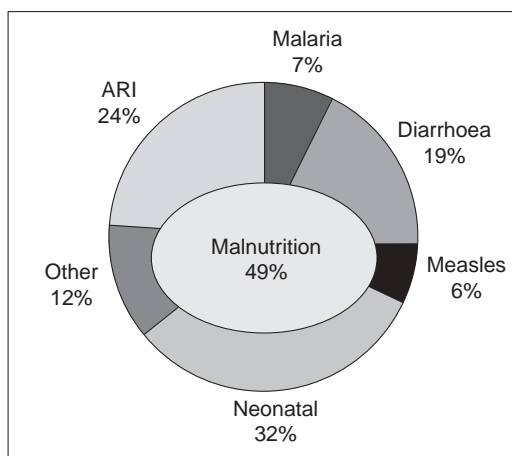


Figure 1. Distribution of 10.4 million deaths among children under 5 years old in all developing countries, 1995. From Malnutrition – The Global Picture. Nutrition for Health and Development. WHO Internet Site: <http://www.who.int/nut> (1). ARI = acute respiratory infection.

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For the individual child with malnutrition the question frequently remains as to whether infection stopped the child eating, whether food deficiency lowered immunity and increased susceptibility to infection, or whether both factors are active. The relative importance of endemic disease and food supply will vary from country to country, from time to time and across individual children. Paramount to a successful program to reduce the burden of childhood malnutrition is addressing infectious disease and food supply problems at the same time. This is important from a public health perspective and also for the individual child, to address the vicious spiral of increasing infection load and deteriorating nutritional status (4).

### **The diagnosis of malnutrition**

The generally accepted definition of malnutrition is based on the Waterlow classification, which was derived from growth measurements of school children in Boston, USA (5). Wasting was defined as less than 80% of the 50th centile for weight for length and stunting as less than 90% of the 50th centile for height for age (6). Because of the difficulty in accurately measuring children's height, low weight for age (W/A) became used by most developing countries to define childhood malnutrition. Some questions remain about the relevance and practical utility of growth lines as a nutrition reference for children in developing countries; both the Boston weights and the growth lines have been derived from at least some artificially fed and some overfed American children.

Acute malnutrition initially causes wasting and the wasted child is at immediate risk. Lack of nutrient influx into the body causes utilization of stored fat for metabolism. When the fat stores are depleted muscle is consumed. Loss of muscle mass is the best predictor of mortality for malnourished children (7). During periods of catabolism, growth in height does not occur or is minimal. The susceptibility to infection may relate to the reduced capability of the child to mount an immune response. It may also be associated with reduced cell turnover and increased permeability of the body's mucous membranes. This in turn may be due to lack of essential

micronutrients, particularly vitamin A and zinc. Stunting follows wasting and progresses during periods of acute or chronic malnutrition. To some extent the degree of stunting reflects the duration that the child has been wasted. However, in contrast to wasting, stunting recovers relatively slowly but the stunted child who is no longer wasted may be less at risk of subsequent infection or death, as there has been a replenishing of nutrients to the extent of replacement of lost muscle and subcutaneous fat. Perhaps there is some truth in the statement "look after the wasting and the stunting will look after itself". This may be interpreted in other words: "screen for and treat wasting and stunting will be prevented or minimized".

The difficulty with using weight for age for the detection of malnutrition is that wasting can only be diagnosed by the detection of a 'flat' growth line. This requires accurate and sequential weight measurements, plotted correctly on the child's growth chart. Other problems with weight for age occur for the child with kwashiorkor who is oedematous, and in whom the excess fluid contributes to a weight for age in the normal range. For the child who has a heavy *Ascaris* infection, worms are weighed along with the child. Because of these considerations, there has been concern how readily low weight for age can identify children at risk of increased morbidity and mortality. As an alternative, another assessment method has been devised which focuses on the detection of wasting by measurement of the mid-upper-arm circumference (MUAC). This may be the most practical method for assessing wasting and bears a direct relationship to muscle mass and risk of mortality (7).

### **Prevalence of malnutrition in PNG**

Papua New Guinea has a significant number of children below 80% weight for age, who are classified as malnourished by the Wellcome criteria. Although weight for age data have been routinely collected at maternal and child health (MCH) clinics and are part of the Department of Health (DOH) information system, prevalence data derived from these sources may not be representative of the child population in PNG. Clinic coverage varies, re-

### PNG National Nutrition Survey 1982-1983 Proportion of Children below 80% Weight for Age

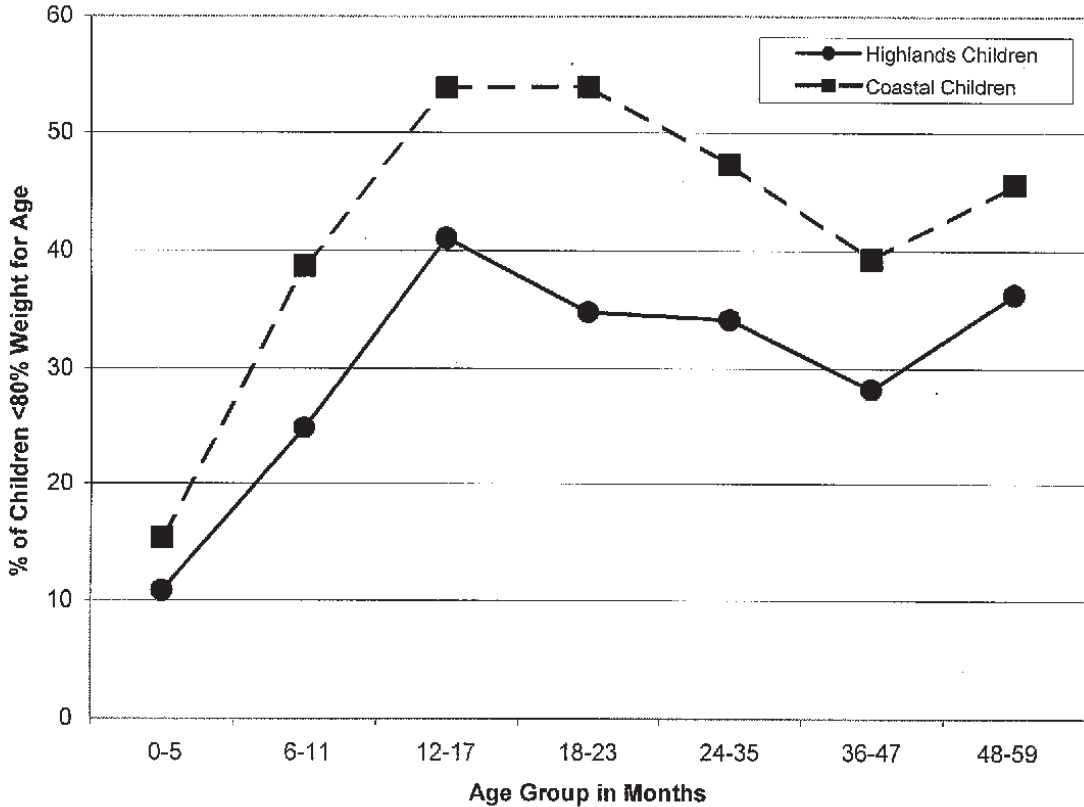


Figure 2. Papua New Guinea National Nutrition Survey 1982-1983. Prevalence of weight for age <80%. Coastal versus highlands children by age group.

attenders are included in the data and before 1988 there were problems with the absence of a suitable denominator (8). The most reliable data of childhood nutritional status was obtained during the 1982/1983 National Nutrition Survey (9). According to these data (9), the nationwide prevalence of W/A less than 80% was 38%. This varied from province to province, ranging from 21% in Western Highlands to 57% in Milne Bay Province. A lower percentage of children in the highlands provinces (30%) than in the coastal provinces (43%) had W/A less than 80% (Figure 2).

The proportion of wasted (thin) and stunted (short) children varies between provinces. Severe wasting, as defined by a weight for length (W/L) less than 80% of the Harvard standard, had a nationwide prevalence of 6%; and ranged between 2% in West New Britain

and 13% in Western Province. The percentage of children with severe wasting in the highlands (3.6%) was only half of that in coastal areas (6.8%).

Stunting, defined by a length for age (L/A) of less than 90% of the Harvard standard, had a nationwide percentage of 23%. The highest prevalence of stunting was in Milne Bay Province (37%) and the lowest was in Western Province (15%). This is the only nutritional indicator that was worse in highlands than coastal provinces (Figure 3). It seems likely that children have a genetic predisposition to be tall and thin on the coast and short and stocky in the highlands. The reason behind this may well be the need for extra cold protection in the highlands. In other words, in the colder highland climate, when food intake is reduced, growth in height may be more

readily sacrificed for addition of subcutaneous fat because of the survival need for insulation. In contrast, on the coast, for the same level of food intake, growth in height will continue at the expense of subcutaneous fat. However, subsequent analysis of the 1982/1983 National Nutrition Survey dietary data suggested that dietary differences (low intake of fat by highlands children) may be the most important factor. A similar finding was reported in 1981 in the highlands (10) and the implication then was that low weight for age is increasingly due to stunting rather than wasting as children get older. This study raised the concern that W/A monitoring may result in the over-diagnosis of 'malnutrition' in children who are stunted but not wasted and questioned the relationship of these anthropological measurements to childhood morbidity and mortality.

It is important to note the rates of defined malnutrition by age group, as this is critical when considering interventions to address this problem. Nationwide, the highest incidence of W/A < 80% is in the second year of life (Figure 2). The prevalence of wasting and severe wasting (W/L < 90% and W/L < 80%) peak at 12-17 months (Figures 4 and 5). Prevalence of stunting (L/A < 90%) increases with age up to 60 months (Figure 3). All types of malnutrition are less common below 12 months of age. This is almost certainly because of the protective effect of prolonged breastfeeding.

In summary, malnutrition involving wasting (W/A < 80% and W/L < 80%) was more common in coastal children than highlands children. Wasting was most common between

### PNG National Nutrition Survey 1982-1983 Proportion of Children less than 90% Length for Age

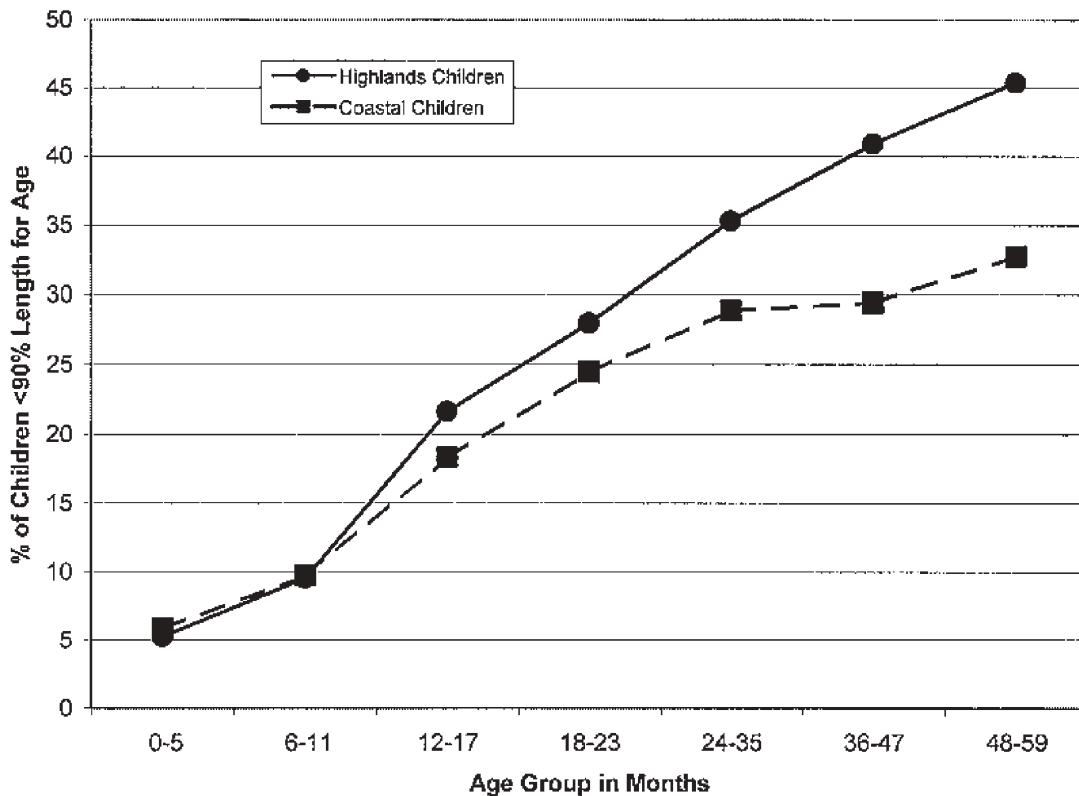


Figure 3. Papua New Guinea National Nutrition Survey 1982-1983. Prevalence of length for age <90%. Coastal versus highlands children by age group.

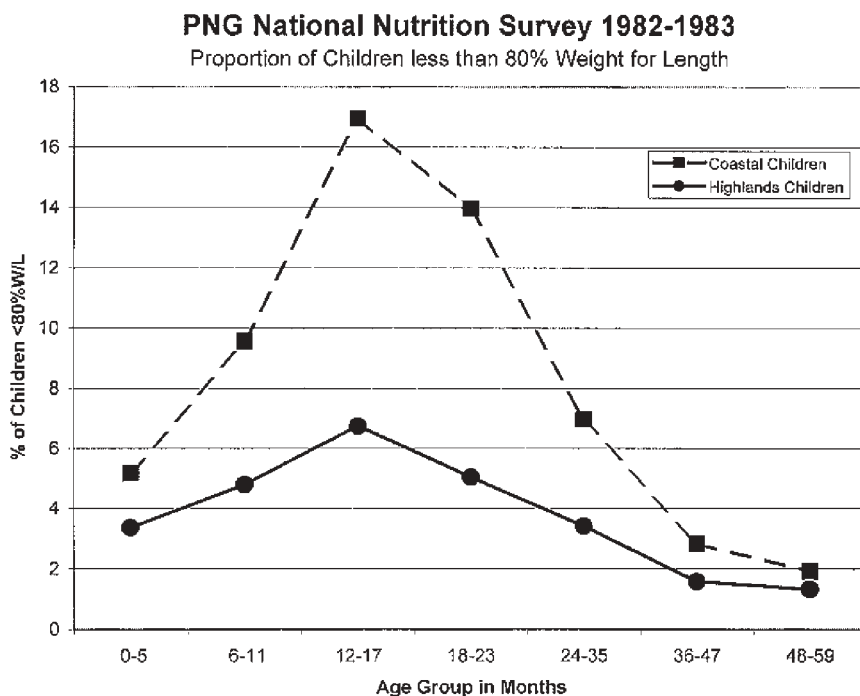


Figure 4. Papua New Guinea National Nutrition Survey 1982-1983. Prevalence of weight for length <80%. Coastal versus highlands children by age group.

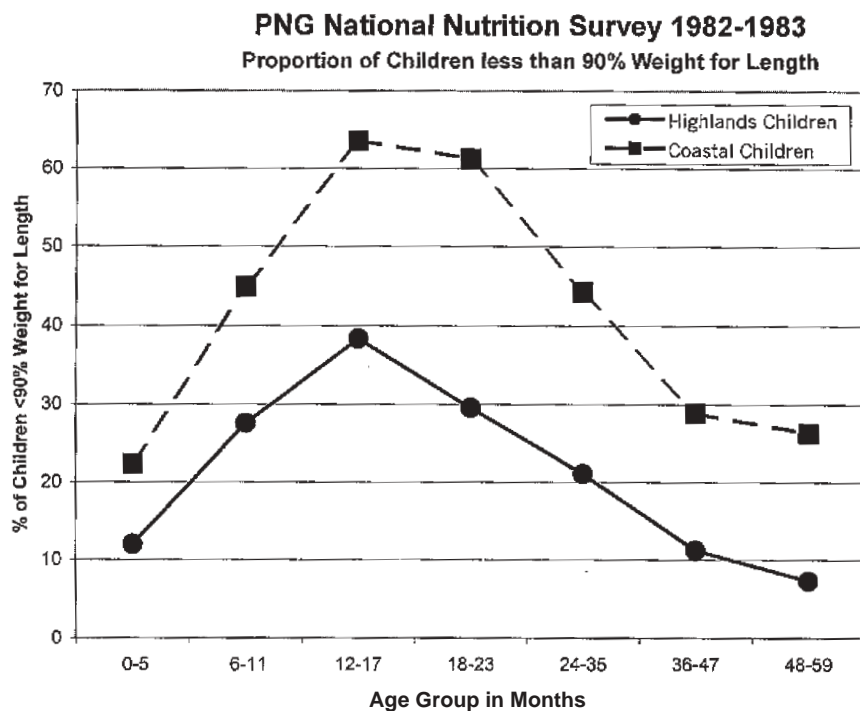


Figure 5. Papua New Guinea National Nutrition Survey 1982-1983. Prevalence of weight for length <90%. Coastal versus highlands children by age group.

the ages of 1 and 3 years, peaking in the second year of life. Stunting increased with age, especially in the highlands children. It would seem unlikely that there has been any significant reduction in the prevalence of malnutrition in PNG since the time of the 1982-1983 survey. Since the time of the survey health services have deteriorated (11), there has been a breakdown in law and order and the infant mortality rate has increased over the period between 1980 and 1990. The increase in the urban population has not been associated with a reduction in malnutrition (13).

### **Problems with the current method of malnutrition detection and treatment**

Childhood malnutrition must be taken seriously and programs must be put in place that will work effectively for early diagnosis, treatment and prevention. The weight for age/growth chart methodology has been used for at least 30 years in PNG; however, this does not appear to identify enough children early enough in their illness. This is particularly so for the 70% of children who live in remote villages with access to an aid post only. A flat or falling growth line (12) may be detected at mobile MCH clinics, but the regularity of these has been limited by funding and law and order problems. The rates of both moderate and severe malnutrition in 1982 suggest that, despite existing MCH clinics and reasonable levels of attendance at immunization clinics, many malnourished children are diagnosed late. For many who present with marasmus or kwashiorkor detection is too late and the mortality is high even in a well-equipped referral hospital (13). Why is the malnourished child not detected early? (14) Some possible reasons are:

- The child is not brought to the clinic because he or she is not considered sick.
- The child's health book with the W/A chart is lost.
- The child is not weighed because:
  - ◆ The health worker has no scales (particularly at aid post level)
  - ◆ The health worker has no time (urban clinic).

- The child is weighed at treatment clinic but the weight is not plotted because:
  - ◆ It is considered that 'it is the well baby clinic's job to plot the growth'.
- Weighing is inaccurate because:
  - ◆ The scales are faulty or poorly calibrated
  - ◆ The weighing technique is poor.
- Weight for age plotting is inaccurate because of:
  - ◆ An age calculation error
  - ◆ A chart reading error.
- The health worker is unable to decide if the growth chart is 'flat' because:
  - ◆ There are infrequent plots
  - ◆ There are previous plotting errors.
- The health worker notices that the child has a flat growth chart, but is unsure what to do about it.

Many of these problems could be minimized by appropriate inservice training for health workers and increased supervision. However, there is difficulty maintaining rust-free weighing scales at the aid post. Growth line monitoring has an inherent abstract nature that may be poorly understood. There may be unnecessary delay while waiting for a growth line to 'become flat'. These make the current method of growth monitoring less than ideal (15). Another deficiency of the Road to Health Chart is that mothers may not understand the significance of the chart (16,17) or it may not be adequately explained by health workers, and therefore fails as a health education tool also.

### **The MUAC tape as a method for detecting 'malnutrition'**

The MUAC tape (18) has the advantage that it is low cost, is simple and quick to use, can be carried anywhere and is waterproof. Worldwide, it has been used to assess the thinness of children from the age of 1 year to 12 years. It is, however, most useful in the age

group 1-5 years as the measurement standard is constant for this age group (80% of the Wolanski Standard is 14 cm for the age group 1-5 years). The tape has also been used for infants 6-11 months and shown to give valid results if a lower cut-off value is used (19). Because it is a direct measurement of the amount of subcutaneous fat and muscle MUAC may well be a more valid assessment of nutritional status than the more established gold standards of weight and length. This is especially so in kwashiorkor as oedema may cause a misleadingly normal weight for age and weight for length. The oedema of kwashiorkor is generally facial, truncal and in the lower limbs rather than in the midupper arm. As an education tool for mothers in PNG, the child having a 'thin arm' is more in line with the cultural understanding of malnutrition. The Melanesian Pidgin term for malnutrition is *bunnating* which literally means 'just bone, nothing else' or 'skin and bone'.

The type of tape used is important. In particular, the tape should be wide and be of the 'insertion' type to avoid measurement errors that occur when an ordinary tape

measure is used (20). Those who argue against the use of the MUAC tape claim that it does not always agree with the other gold standards of nutritional status (21). However, when a lower cut-off is used specificity improves, though, inevitably, sensitivity is reduced. If it is desired that only definite cases be identified (ie, children with both low W/A and W/L), then a lower cut-off value can be chosen, eg, 13.5 cm. MUAC is an indicator of muscle mass and correlates well with the risk of death (7).

The MUAC tape has been used to identify the children most likely to die in rural Bangladesh (22). In the past in PNG, the Nutrition Section of the national Department of Health (23) has promoted the tape for use and a tape was specially printed and available from the Department of Health. Use of the tape is described in the child health textbook for nurses and health extension officers (HEOs) (12) and the Paediatric Standard Treatment Book (24). In 1993, the PNG Child Survival Support Project (CSSP) tested the use of a MUAC tape. The design and outcome of this pilot project are discussed below.

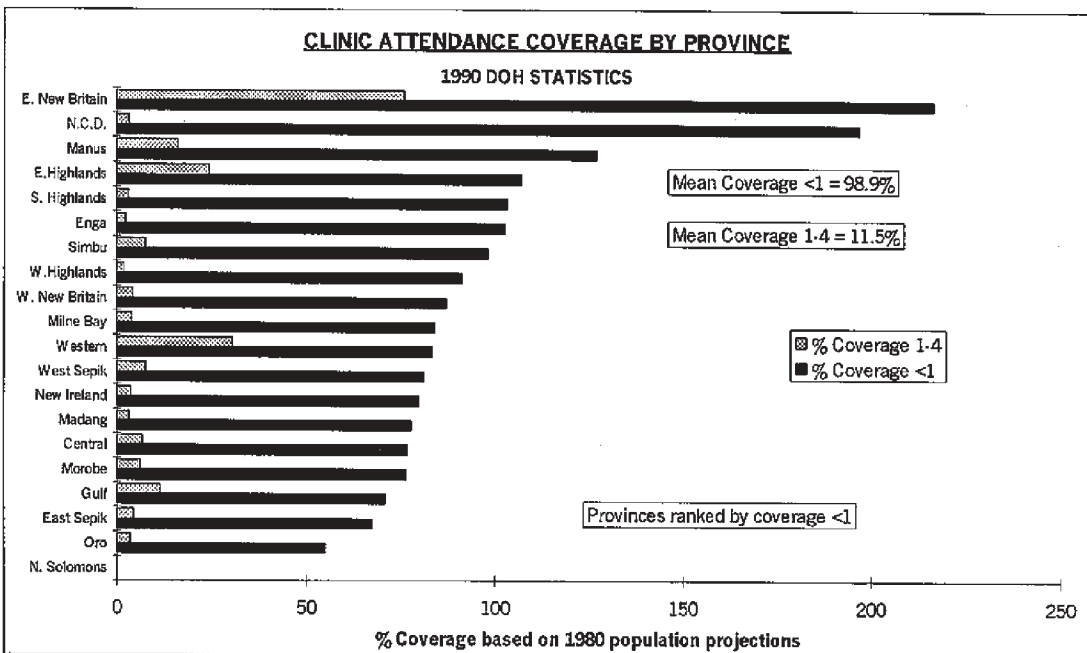


Figure 6. MCH coverage for children less than 1 year and children 1-<5 years by province – ranked by coverage under 1 year.

### The CSSP malnutrition detection and treatment pilot project

The Child Survival Support Project began in 1990 and was funded by USAID and the Government of PNG. Its objectives were to significantly lower child and maternal mortality over 5 years. The project came about because of increasing concern over the deteriorating rural health services in PNG, partly due to funding shortfalls after the closure of the Bougainville Copper Mine. Target Five of the project was to 'increase by 50% the percentage of children aged 0 to 5 years under surveillance for diagnosis and treatment of malnutrition'. As 70% of PNG children are located in rural villages, malnutrition peaks in the second and third year of life and the immunization schedule concludes in the first year of life, the MCH clinic coverage for the greatest proportion of malnourished children was very low (Figure 6). Therefore, an intervention based at the aid post level was thought most likely to meet the project target.

In order to make a more positive link between diagnosis and treatment of the thin child, a MUAC insertion tape was designed with a checklist for 6 basic treatment steps printed on the back (Figure 7). The criteria for mild to moderate malnutrition was set at 13.5 cm to ensure that children detected below this

level would be significantly thin, ie, most of them would also be below 80% weight for length. The cut-off for severe malnutrition was 12.5 cm. The tape was colour coded green if the MUAC was greater than 13.5 cm, yellow if the MUAC was 13.5 cm to 12.5 cm and red if the MUAC was < 12.5 cm. This reminded health workers of the cut-off values and also enabled workers with poor visual acuity to effectively use the tape. This tape was for the assessment of children aged 1 to 5 years only. Mothers of children under 1 year of age seen at the aid post were given preventive health education on nutrition using a flipchart illustrating the 6 nutrition messages.

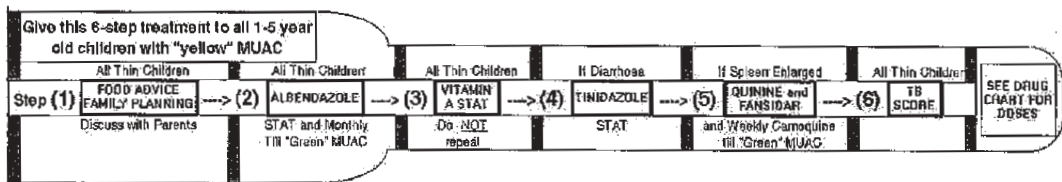
The six treatment steps for malnourished children were based on the existing treatment for malnourished children specified in the Standard Treatment Book (24). These steps and the rationale for them are described below.

#### Step 1. Health education

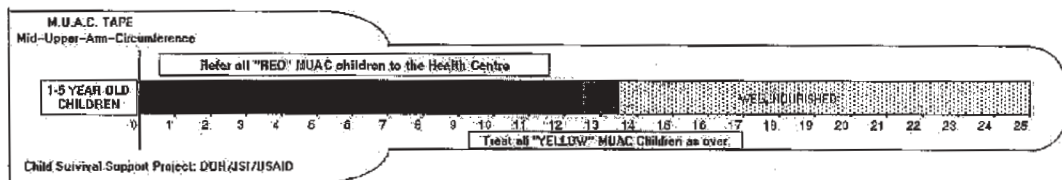
A special flipchart was designed to help the aid post worker give 3 messages to the parents of thin children.

“Your child is too thin”

This message shows the mother how the MUAC tape works and gives reasons for the



#### Back of Tape



#### Front of Tape

Figure 7. Child Survival Support Project. CSSP MUAC insertion tape – diagnosis and treatment reinforcement tool made with waterproof and stretch-resistant paper.

child being thin, eg, worms, malaria and not eating.

“Give more food more often”

This message shows different foods and the frequency of feeding for young children.

“Family planning helps prevent thin children”

This message uses the example of corn planted too close together and illustrates methods of family planning.

This flipchart was one of a series of interactive flipcharts all designed by the CSSP to address maternal and child health issues (11). The health worker is guided about what to say by large print writing on the back of each illustration (Figure 8). Each flipchart was produced in Pidgin and English and designed with a matching colour poster to put on the wall and a pamphlet to further reinforce messages given.

## Step 2. De-worming with albendazole

This treatment is given to all thin children at the initial diagnosis and monthly thereafter until the child's MUAC reading is above 13.5 cm (green) or 3 months have elapsed, when the child is referred to the health centre. The aim was to maximize the child's absorption of the food he or she is able to eat by removing all worm infection and to improve the child's appetite.

This anti-helminth drug is the current approved standard ‘worm’ treatment in PNG. It is a benzimidazole antihelminthic,



Figure 8. Aid post worker using Child Survival Support Project interactive health promotion flipchart.

structurally related to mebendazole, and is similarly active against most nematode and some cestode worms. In a study of 1455 patients the respective efficacies of a single dose of albendazole against the following helminth infections were: enterobiasis 100%, ascariasis 89%, ancylostomiasis (*Necator americanus*) 88% and trichuriasis 70% (25). This and another study (26) showed that there were not any significant adverse effects of albendazole.

*Strongyloides fuelleborni*-like organism has been shown to cause a significant life-threatening intestinal disease (swollen belly syndrome) in young children in some areas of PNG (27). In strongyloidiasis, 400 mg albendazole given daily for 3 consecutive days is effective against some species.

In PNG because most treatments are symptom based, the two common reasons for health workers giving worm treatment to children are known passage of a worm and abdominal pain. The standard use of albendazole is a single dose, which may often be vomited by a sick child.

Many rural and urban children in PNG have a very significant worm load (28,29). The relationship between nutritional status and worm load has been studied in urban (30), highland (31) and well-nourished school children (32). Moderate to high hookworm egg count was associated with malnutrition in the highlands (31). It seems likely that if many worms are removed with a monthly dose of albendazole, thin children will have more nutrients available for their own growth.

## Step 3. High-dose vitamin A (200,000 units)

This treatment is given once to all thin children and is to protect them from vitamin A deficiency, which is likely to be present if they are thin and not eating. Vitamin A deficiency increases the risk of dying from measles and other infectious diseases and causes blindness.

Vitamin A can cause severe toxicity symptoms if high doses are repeated too often or if lower doses are taken regularly for a long period of time. In PNG, the past Paediatric Standard Treatment only recommended high-

dose vitamin A for children with severe malnutrition and dry eyes. The regimen recommended is that approved by the World Health Organization (WHO): 200,000 units daily for 2 days then a third dose after 1 week. The other 'standard treatment' indication for vitamin A in high dose is for measles (regardless of nutritional status), when a single dose of 200,000 units is given to children older than 1 year (100,000 units for children under 1 year).

Thin children who have not been eating adequately are likely to have depleted stores of vitamin A. This results in night blindness, then xerophthalmia and an inability of mucosal surfaces to regenerate or repair. Bacterial invasion is more likely. Vitamin A deficiency also causes T-cell dysfunction and defective mucus production, which allows bacteria to adhere more readily to the respiratory mucosa (33). The respiratory tract, the gastrointestinal tract, the urinary tract and skin all may be sites of infection. Controlled studies of mass administration of prophylactic vitamin A supplementation to children in areas of known deficiency have shown reduced mortality from respiratory and gastrointestinal infections (34,35). High-dose vitamin A has also been shown to prevent death in measles (36). In PNG the average diet contains green and yellow vegetables, which contain vitamin A. Therefore, the need for well-nourished children to receive supplemental vitamin A is uncertain. However, children more than 1 year of age with a 'yellow' (< 13.5 cm) MUAC are likely to have a low intake of vitamin A and low body stores. The single dose of 200,000 units given in the pilot project is a relatively low one and does have a margin of safety in the event of accidentally repeated doses.

#### **Step 4. Tinidazole for thin children with diarrhoea**

This drug has now replaced metronidazole (Flagyl) as the standard treatment in PNG for suspected amoebiasis (*Entamoeba histolytica*) or giardiasis (*Giardia lamblia*): both are causes of chronic diarrhoea in malnourished children and are difficult to diagnose at health centre or aid post levels (37). Tinidazole is effective as a single dose whereas metronidazole must be given 3 times a day for

5 days. Mild adverse reactions to tinidazole occur in about 15% of cases, of which the most common is mild gastrointestinal upset (8%) (38). Tinidazole may produce transient leucopenia and neutropenia but this is much less likely after a single dose.

More than 50% of malnourished children have chronic diarrhoea (13,39). Amoebiasis may cause alternating symptoms of diarrhoea and constipation with anorexia and abdominal pain. Blood, if present in the stool, may not be noticeable. In endemic areas, invasive amoebiasis of infants and children is common. Symptomatic disease is more common in 1-4 year olds than in adults. Malnutrition and amoebiasis is associated with ulceration of the large intestine (40).

Giardiasis, which is common in developing countries, is often an insidious infection causing chronic diarrhoea and malabsorption. The organism is difficult to isolate from stool and a duodenal aspirate is required for definitive diagnosis. A rate of 47% for giardiasis was reported from hospital patients in Colombia. Surveys in primary school children in Burma have shown a prevalence of 21% for *Giardia* and 6% for *E. histolytica*. A similar survey in Mexico City revealed a prevalence of 14% for both *Giardia* and *E. histolytica* (40). In PNG, the only national survey data available are those reported in 1968 (41) where *E. histolytica* cysts were found in the stool of 16% of highlanders, 13% of mainlanders and 11% of islanders. In view of the continued poor levels of hygiene in both rural and urban areas in PNG, the likelihood of a thin child with chronic diarrhoea having one or both of these infections is high.

#### **Step 5. Treat for resistant malaria if enlarged spleen or recurrent fever**

Children who have poor malarial immunity and are infected with chloroquine-resistant falciparum malaria have recurrent fevers and anorexia. This may contribute to malnutrition. RII and RIII resistant infections make up at least 10% of the malaria cases in most coastal areas of PNG (42). Because most children with fever are given standard antimalarial drugs it is mainly those who have resistant malaria who remain chronically ill and

anorexic and become malnourished. A thin child with a palpable spleen or recurrent fevers should therefore be treated for resistant malaria and the parents should be advised to obtain a permethrin-treated mosquito net, if possible (24).

#### **Step 6. Decide whether the child may have tuberculosis**

Tuberculosis (TB) is difficult to diagnose in children, especially if they have become malnourished (43). The Paediatric Tuberculosis Score is a simple clinical score system developed in PNG for empirical use in TB diagnosis and treatment (24,44). Tuberculosis is very common in PNG. Incidence and prevalence are much higher on the coast than in the highlands (8). There is a nationwide rising incidence.

In the past at the health centre level many children with active tuberculosis died with the diagnosis of 'malnutrition' because of the difficulty of diagnosis coupled with the rules of the tuberculosis control section which precluded treatment without definite proof.

The TB score has good agreement with decisions by paediatricians to commence treatment for tuberculosis. The TB score has been incorporated in the latest edition of the Paediatric Standard Treatment Book and also the TB and Leprosy Handbook (45).

In many health facilities PPD (purified protein derivative) for Mantoux testing is not available, so the full score is not possible. During the CSSP an abbreviated system was used, allowing the early referral of the thin child to the health centre or hospital if one or more of 3 suspicious features were present: family history of TB; chronicity of symptoms; or presence of large, painless, rubbery neck glands.

#### **Monthly review at the aid post**

Monthly monitoring of the thin child at the aid post was planned as follows: the child detected with a yellow MUAC (and no symptoms or signs requiring referral to the health centre) is treated at the aid post with the six treatment steps, then asked to come back

for review after 1 month. A Thin Child Treatment and Follow Up Card was used as part of the pilot project (Figure 9). If the MUAC is still 'yellow' and the child has no symptoms or signs requiring referral, a repeat dose of albendazole is given, Camoquin is resupplied for 1 month (if indicated) and further nutrition advice given. Again the child is asked to come back for review after another month. If after 3 months the MUAC is still 'yellow' then the child is referred to the health centre (if possible). A 'red' MUAC at any time means immediate referral to the health centre. It was emphasized that all pre-existing indications for referral of sick children should be followed regardless of the MUAC reading. The protocol for the diagnosis and treatment of thin children at the aid post and integration with MCH clinic and health centre management is summarized in a flowchart (Figure 10).

#### **Project design and qualitative output**

The final pilot project involved four groups of aid posts and their supervising health centres. The aim was to compare the existing method of malnutrition diagnosis and treatment against the MUAC tape reinforcement tool method in terms of the numbers of children diagnosed and whether child nutritional status improved. The area for the study was the Sepik River basin and the study design included an initial nutrition survey and a follow-up survey 12 months later. All aid post workers in the pilot study area took part in an inservice course. At follow-up, the knowledge, skills and attitude of the individual aid post workers regarding the diagnosis and treatment of malnutrition were evaluated.

The pilot project occurred between 1992 and 1993 and detailed analysis of the quantitative results will be reported elsewhere. The qualitative output of the project was immediately used to develop community education and health worker training materials for the further implementation phase of the CSSP. This method of malnutrition management at the aid post level was considered a success and was incorporated into the Child Survival 10-Step Checklist (46).

Of particular note was the positive effect on


THIN CHILD TREATMENT AND FOLLOW UP CARD				
Complete <u>only</u> if Child's MUAC is YELLOW or RED				
If MUAC is YELLOW do all 6 steps and review				
If MUAC is RED do steps 1 to 4 and refer to H. C.				
I am a CHW / APO / ORDERLY / Nurse Aide working at <u>B.N.A.M.</u> Aid Post				Code No: 
Child's Name				
Date	<u>29/9/92</u>	D.O.B.	<u>3/10/87</u>	left MUAC
Sex	<u>(M) F</u>	Age	<u>4</u> yrs	<u>12.8</u> cm
STEP (1)	Discuss with the mother.			Write Here When Done
	-Your child is too thin----->			tick [✓]
	-Give more food more often----->			tick [✓]
	-Family Planning----->			tick [✓]
STEP (2)	Albendazole stat (all thin children)----->			<u>2</u> tab
STEP (3)	Vitamin A stat (all thin children)----->			200,000iu [✓]
STEP (4)	If diarrhoea for a long time: Tinidazole stat----->			<u>0</u> tab
STEP (5)	If Spleen or Fevers: Primaquine stat-->			<del>1</del> tab N/C
	+ Course of Quinine----->			<u>1</u> tab
	and Fansidar----->			<u>1</u> tab
	+ Weekly camoquine for 1 month----->			<u>1</u> tab
STEP (6)	If - Someone in the Family has TB-->			Yes / (No)
	- Large Rubbery neck glands----->			Yes / (No)
	- Sick for more than 1 month----->			Yes / (No)
Refer immediately to the Health Centre if YES to any				
REVIEW MONTHLY	2nd	3rd	4th	Referred
	<u>11</u>	<u>11</u>	<u>11</u>	<u>11</u>
Left arm MUAC	<u>12.9</u> cm	<u>13.7</u> cm	<u>-</u> cm	Date Child Seen at H. C.
Left arm MUAC	<u>G/Y/R</u>	<u>G/Y/R</u>	<u>G/Y/R</u>	
ALBENDAZOLE	<u>2</u> tab	tab	tab	<u>1</u> / <u>1</u>
CAMOQUINE	<u>1</u> tab	tab	tab	
REFER CHILD TO HEALTH CENTRE IF MUAC IS RED OR IF STILL YELLOW ON FOURTH VISIT				
				

Figure 9. Thin Child Follow-up Card as used by aid post worker shows 'smiling face' rubber stamp.

**How to Diagnose and Treat Malnutrition in Children at the Clinic and Aidpost**

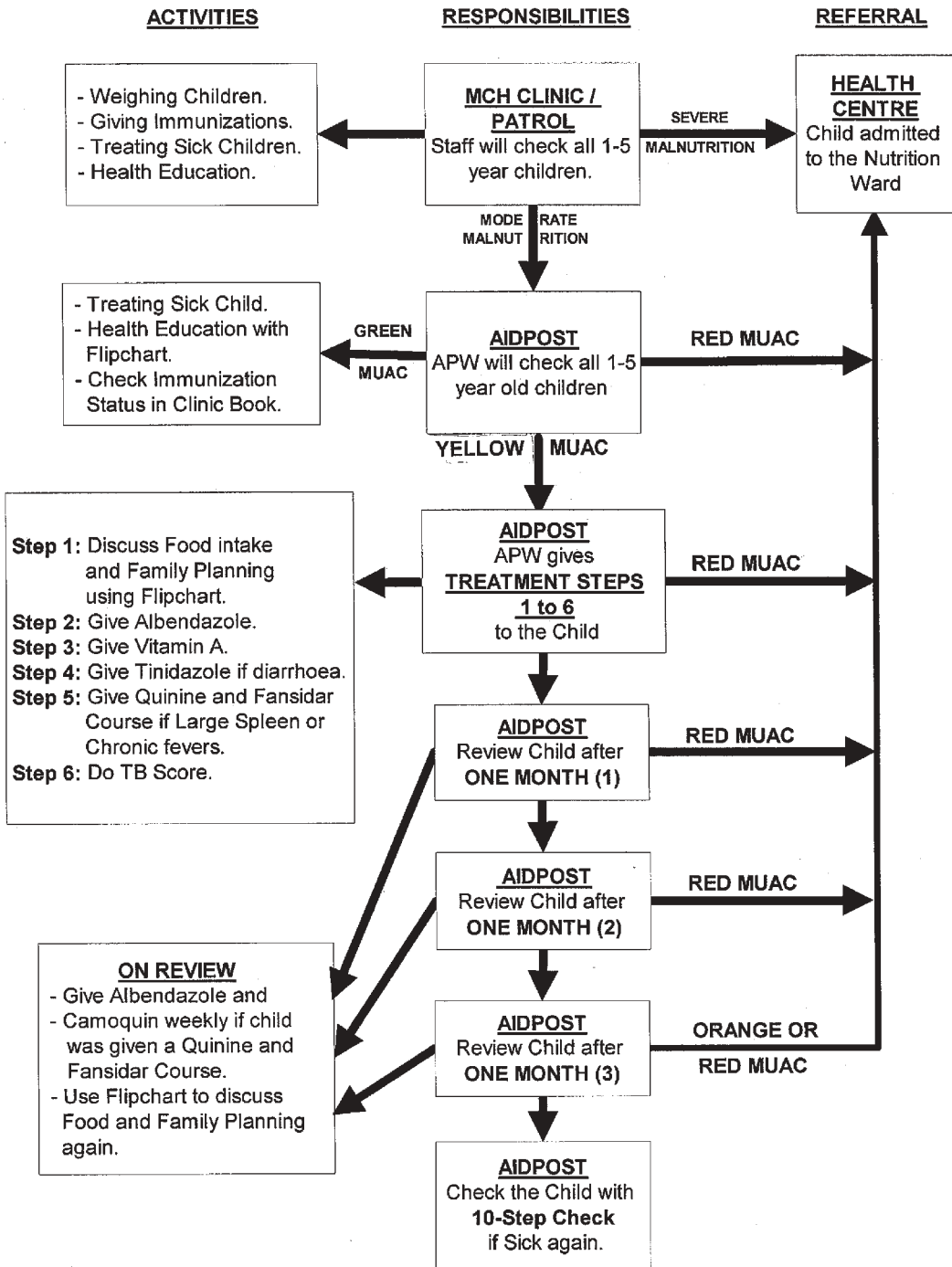


Figure 10. Protocol flowchart for the management of the thin child at the aid post showing integration with MCH clinic and health centre.

the functioning of the aid posts and health centres once the health workers had attended an inservice course and commenced monitoring for malnutrition in the described way. Some health centres developed nutrition gardens and obtained high-calorie foods to give to children with severe malnutrition admitted to the ward. One health centre started a chicken project, nutrition garden and a health centre shop to fund nutrition activities. The project highlighted the benefit of community involvement. This occurred more successfully during the nationwide introduction of the CSSP, when community and church groups were involved in workshops and trained to use the interactive health education flipcharts.

As a direct result of the pilot project, the technique for using the MUAC tape was further refined to reduce inter-observer differences. We found that reading the tape with 'sliding fingers' produced the most accurate readings, thus avoiding the tape being too tight or too loose. We produced a video to show how best to use the MUAC tape and how to avoid errors in reading (47). A malnutrition detection and treatment manual was distributed to aid post workers. These materials were used for nationwide health worker inservice training workshops, which were tested in Gulf and New Ireland Provinces in 1994 and introduced to all remaining provinces through 1995 and 1996. There is now a great need to continue to support and supervise health workers who have been trained. Apathy and inactivity inevitably recur if support is withdrawn.

### Conclusions

Effective solutions for reducing child malnutrition in rural areas require ongoing support to peripheral health workers. This includes reliable provision of medical supplies, materials, supervision and salary. The psychodynamics of health work is all-important and the support given by church and other groups at the community level allows the rural health worker to function and interact effectively with the community. Maintaining law and order is critical to the effective functioning of rural communities. Food security, water supply, toilet hygiene and availability of family planning are all relevant to childhood malnutrition. These require

programs through Environmental Health, Family Planning and the Department of Primary Industry. For people in villages, improvements in understanding of the causes of malnutrition, teaching of skills to identify malnourished children and an increased understanding of appropriate interventions will all be essential to reducing the huge mortality associated with malnutrition.

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