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National Nutrition Survey Papua New Guinea, 2005

Department of Health of Papua New Guinea
UNICEF Papua New Guinea
University of Papua New Guinea
US, Centers of Disease Control and Prevention

FOREWORD

It is with great pleasure that I introduce this report of the PNG National Nutrition Survey 2005. This report confirms that nutrition problems in PNG remain severe. Poor nutrition is one of the most important underlying factors for the high rates of infant, child and maternal morbidity and mortality and low life expectancy in our country.

The country is now faced with the double burden of malnutrition. On the one hand, adoption of modern lifestyle leads to an increase in the prevalence of over-nutrition and obesity (life-style diseases). On the other hand, under nutrition is still prevalent, as evident in high rates of stunting and protein energy malnutrition (PEM), as well as anemia.

The food consumption patterns have changed over the last few decades, from starchy tubers (sweet potato, yams and taro) to cereals as the main source of energy. This is noTable not only in cities, but also in resource rich rural communities, where there is excess cash in the household and consequently traditional garden foods are replaced by store foods. It is expected that LNG project will accelerate the transition.

The Government is serious in addressing these issues, through the National Strategic Vision 2010-2050 and the National Health Plan 2011-2020. The Goal of the National Strategic Vision is to make PNG a smart, fair and happy country by 2050. Likewise the new National Health Plan 2011-2020 will aim to supplement this vision by improving the health of the population. The survey results provide the country with good baseline data to monitor and evaluate progress towards these goals, as well as for planning, programming, monitoring and evaluation of nutrition interventions at all levels of Government.

I deeply appreciate the support of UNICEF and the United States Centers for Disease Control and Prevention (CDC) for providing overall technical and financial assistance to carry out this important survey. My appreciation also goes to Dr Juergen Erhardt and team for analysis of the dry blood spot samples.

Special thanks are due to Division of Basic Medical Sciences, School of Medicine and Health Sciences at University of Papua New Guinea and the National Nutrition Survey Taskforce in overseeing execution of the Survey. And last but not least, the field workers and communities throughout PNG, for without their support this survey would not have been possible.

I call upon all Government Departments, Churches and Civil Society to take heed of the findings and address the nutrition problems the country is facing. I believe the mental and physical capacities of our population are significantly compromised by poor nutrition.

Hon. SASA ZIBE, MP
Minister for Health & HIV/AIDS

ACKNOWLEDGEMENTS

The Papua New Guinea National Micronutrient Survey 2005 was supported through a cooperative agreement between UNICEF and the Centers for Disease Control and Prevention (CDC). CDC provided technical assistance in planning and training for the survey, and in the analysis of the survey data, as well as technical advice for laboratory analysis and logistics.

A meeting to plan the survey was convened in July 2004 in Port Moresby, Papua New Guinea. Participants included officials from the National Department of Health (NDOH), University of Papua New Guinea (UPNG), CDC, Mahidol University, Thailand and UNICEF PNG. The final plan for the Papua New Guinea National Micronutrient Survey (PNGNMS) was developed through wide consultations with micronutrient stakeholders and experts both in PNG and at CDC.

Thanks to the former Secretary for Health, Dr. Nicholas Mann and the Senior Executive Management (SEM) for the permission to undertake the survey in Papua New Guinea. The National Nutrition Survey Taskforce comprised of people from the Department of Health, the University of PNG and UNICEF under the Chairmanship of Mr Enoch Posanai, Director Health Improvement Branch and currently Executive Manager Public Health, Department of Health. The Taskforce oversaw the execution of the PNG National Nutrition Survey from beginning to end. The local parties involved (Department of Health, University of Papua New Guinea (School of Medicine and Health Sciences) and UNICEF signed a Memorandum of Agreement. Thanks to all members of the Taskforce, who gave their time willingly to conduct the survey. Special thanks are extended to Ms Florence Addo, the PNG Nutrition Survey Manager, who took responsibility of the day-to-day running of the survey.

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MESSAGE FROM SECRETARY

As seen in the acknowledgement section of this report, the execution of the survey has been a tremendous effort by all involved, from Government Departments at all levels, University of Papua New Guinea, development partners, inside and outside the country and last but not least PNG communities.

Field surveyors travelled to all corners of this nation and visited villages so remote, villagers could not remember seeing a health worker.

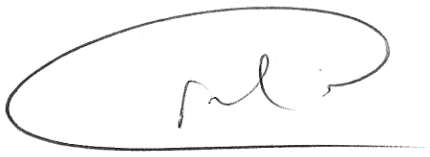
Globally, it is well documented that under-nutrition and vitamin and mineral deficiencies contribute to decreased learning capacity among infants and young children, reduced physical work capacity among adults, and increased morbidity and mortality among affected populations. PNG is no exception. This document provides the evidence that it is time to renew efforts by all to address nutrition issues in PNG. For, if we continue to neglect nutrition, PNG will never become the smart, fair and happy country, as envisaged in the National Strategic Vision 2010-2050.

Good nutrition of mothers and children is critical if we are to have a happy and healthy society. This is especially the case during the first 1,000 days of life from the start of a pregnancy and till the end of the second year. The quality of nutrition during those 1,000 days can help determine whether a mother and child survive pregnancy and whether a child is able to fight common childhood disease, experience enough brain development to go to school and hold a job as an adult, it is therefore important that we understand the determinants of good nutrition in PNG.

This is the first time, since the pioneering nutrition survey expedition by Hipsley and Kirk in 1947, that biochemical indicators are included. Results contained in the report provide a better understanding of nutrition status and micronutrient deficiencies in the regions and nationally.

I challenge each and every one of us to read this document carefully and use the information to draw up policies, guidelines and implement activity plans which would improve the health and nutrition status of all Papua New Guineans. The Department of Health will assist the Provinces in your endeavors to implement guidelines and protocols. The National Strategic Vision and Health Plan will be our guide. Sound monitoring and evaluation procedures must be developed to ensure that evidence is provided for accurate decision making.

I call on all provinces to ensure there is adequate human resource in place to guide and implement strategies that will enable us to be healthy, happy and wise.



DR CLEMENT MALAU
Secretary for Health

EXECUTIVE SUMMARY

This report summarizes findings from the second national nutrition survey in Papua New Guinea (PNG), with data collection during May-November 2005 by the Papuan New Guinea Department of Health (DoH) and UNICEF, with funding and technical support from the U.S. Centers for Disease Control and Prevention (CDC). The survey collected data on vitamin A, iodine, iron, and anemia status of the population, assessed overall nutritional status of target groups based on anthropometric indices, and provided other relevant information for the planning, implementation and monitoring of appropriate population based interventions to prevent vitamin and mineral deficiencies in Papua New Guinea. Population groups surveyed included: preschool children (6-59 months old), women of childbearing age (15-49 years old), and adult men (18 years and older).

Survey objectives and methods

The objectives of the survey were to:

- Determine the household coverage of adequately iodized salt
- Determine the urinary iodine levels among non-pregnant women of child bearing age 15-49 years
- Determine the prevalence of anemia, iron deficiency and iron deficiency anemia in children 6-59 months of age and non-pregnant women of child bearing age 15-49 years
- Determine the prevalence of vitamin A deficiency in preschool children 6-59 months of age and non-pregnant women of child bearing age 15-49 years
- Assess the nutritional status of preschool children (6-59 months) and non-pregnant women of reproductive age (15-49 years) and men (18 years ad older) based on anthropometric indicators
- Determine the prevalence of anemia in adult men 18 years and older
- Determine the contribution of malaria to anemia in preschool children and non-pregnant women of child bearing age and the contribution of hookworm to anemia in preschool children 24-59 months of age
- Assess the use and consumption levels of centrally-processed staple foods, in order to determine their suitability as vehicles for fortification

A two-stage, 100-cluster, probability proportional to population size (PPS) survey was performed with stratification by region (Southern, Highlands, Mamose and Islands) to generate national and regional estimates. In each of the 100 selected clusters, approximately 20 households were randomly selected using standard mapping, numbering, and segmentation methodologies.

SUMMARY OF RESULTS

The prevalence of various nutrition related parameters by population group is presented in Table 0-1.

Nutrition

Nutritional status based on anthropometric indices

Based on the WHO Child Growth Standards (Onis M et al 2008) just under half (43.9%) of the 937 Papua New Guinean preschool children 6-59 months of age surveyed, were found to be stunted in growth (height-for-age z score HAZ<-2), an indicator of chronic malnutrition; 4.5% were wasted, an indicator of acute malnutrition (weight-for-height z score WHZ <-2), and 18.1% were classified as underweight (weight-for-age z score WAZ<-2). There were some major regional differences. Mamose region had the highest prevalence of stunting (52.0%), wasting (8.2%) and underweight (31.9%). Based on WHO classifications (WHO, 1995), Papua New Guinea is a country with a "high" prevalence of stunting, a "medium" prevalence of underweight, and a "low" prevalence of wasting.

The prevalence of Chronic Energy Deficiency (CED) based on Body Mass Index (BMI <18.5 kg/m^2) among the 892 non-pregnant women 15-49 years of age surveyed was 5.3%. The prevalence was higher in the Southern region (11.2%) and in Mamose region (8.0%). Among non-pregnant women 17.4% were overweight (BMI 25.0 to 29.9 kg/m^2) and 5.1% (BMI ≥30 kg/m^2) were obese (WHO 1995).

The prevalence of Chronic Energy Deficiency (CED) based on Body Mass Index (BMI <18.5 kg/m^2) among the 787 men 18 years and older surveyed was 2.9%. The prevalence was highest in the Southern region (7.5%). Among the men surveyed 16.1% were overweight (BMI 25.0 to 29.9 kg/m^2) and 4.0% (BMI ≥30 kg/m^2) were obese (WHO 1995).

Infant and young child feeding

Most of the mothers of children 6-59 months of age interviewed (83.6%) reported that they initiated breastfeeding within the first 24 hours after birth. More than 85% of children were still breastfed up to one year of age across all four regions, with 80% of children still breastfed up to 18 months of age. More than 80% of children were introduced to foods or liquids other than breast milk before the WHO recommended age of 6 months of age.

Iodine

Iodine status

Among the non-pregnant women 15-49 years the median urinary iodine (UI) level was 170 µg/L and 28.9% of women had a UI <100 µg/L and 12.6% had a UI <50 µg/L. The WHO/UNICEF/ICCIDD (2001) minimum goals are to have no more than 50% of reproductive age women with UI under 100 µg/L and no more than 20% with a UI under 50 µg/L. Nationally, Papua New Guinea has been successful in meeting these targets. However, only 61.9% of the households had salt available on the day of the survey and in 8 of the 97 clusters surveyed none of the households had any salt. In households without salt on the day of the survey the median UI was 113.5 µg/L and 45.6% of women had a UI <100 µg/L and 23.9% had a UI <50

µg/L. In the households in clusters without any salt the median UI was 79.5 µg/L and 58.4% of women had a UI <100 µg/L and 35.1% had a UI <50 µg/L.

Household coverage and quality of iodized salt

Only 61.9% of the 1422 households surveyed had salt that could be collected and tested for iodine content. Of the salt samples that were collected 99.9% of all the salt had some iodine and 92.5% of the samples were adequately iodized >15ppm (WHO/UNICEF/ICCIDD, 2001). There were regional variations. In the Southern region 23.9% of the salt tested was inadequately iodized. All households in eight clusters did not have any salt available to be tested. Household members reported that difficulties finding salt was the main reason for not purchasing it.

Among the 839 households that reported purchasing salt commercially, an original labeled package of salt was available in approximately 53.6% of households. Of these 98.8% were labeled as "iodized". A wide variety of brands were available but the two most popular were Tru Cook salt and Jumbo.

Vitamin A

Vitamin A deficiency

Of the 875 children 6-59 months surveyed, 25.6% were vitamin A deficient (< 0.70µmol/l). Excluding children with inflammation (a marker of infection) 15.7% were vitamin A deficient. In Mamose 35.3% of children had the highest prevalence of vitamin A deficiency (20.1% excluding those with markers of inflammation). Even controlling for infection the prevalence of vitamin A deficiency is of high public health significance (WHO 1996).

Of the 751 non-pregnant women 15-45 years, the prevalence of vitamin A deficiency was very low with only 0.7% being deficient. Only 1.7% of women reported difficulties seeing at dusk when they were able to see well during the day.

Vitamin A supplementation

In this survey, 52.7% of children 6-59 months had ever received a vitamin A capsule and 15.5 % had received one in the last 6 months.

Anemia, iron deficiency and iron deficiency anemia

Anemia

Anemia prevalence as defined by WHO (WHO/UNICEF/UNU, 2001) among 910 preschool children 6-59 months old was 48.1%. This anemia prevalence is of high public health significance according to WHO criteria (WHO/UNICEF/UNU, 2001).

The prevalence of anemia among non-pregnant women was 35.7% (n=760), and 26.3% in men 18 years and older (n=778) indicating a moderate public health problem. In all target groups the prevalence was low in the Highlands and much higher in Mamose region.

Iron deficiency

Of the children surveyed 27.8% of children 6-59 months (n=872) were iron deficient (TfR> 8.0 µg/l), compared to 19.5% of non-pregnant women 15-49 years of age (n=751).

Iron deficiency anemia

Based on WHO cut-offs (WHO/UNICEF/UNU, 2001) the prevalence of iron deficiency anemia (IDA) among preschool children 6-59 months surveyed was 22.8%. Children 6-11 months were most likely to have IDA (36.6% prevalence). Among the non–pregnant women tested 15% were classified with IDA.

According to WHO criteria the high prevalence of anemia in children and moderate prevalence in women and men demonstrates a public health problem in Papua New Guinea. The low prevalence of iron deficiency and iron deficiency anemia indicates that iron deficiency is not the main cause of anemia and that infection and other factors are also important contributors (WHO/UNICEF/UNU 2001).

Fortification and awareness

Food fortification is a strategy that the government of Papua New Guinea is considering to improve the nutritional status of the population. This survey looked at the presence of five potential foods fortification vehicles, flour, sugar, oil, rice and salt. Nationally 12.7% of households had flour present in the household on the day of the survey; 36.0% oil; 27.0% sugar; 22.0% rice and 61.9% salt. Just under a third of all households had none of the staple products mentioned above (30.5%), 43.8% had 1-2 staple products and 25.7% had 3-5 products. In rural areas 34.6% of households had no products compared to just 10.4% of urban areas.

Table 0-1 Prevalence of various nutrition related indicators by population group, PNG National Nutrition Survey 2005

Target Group	Stunting[1] %	Underweight[2] %	Wasting[3] %	Median Urinary Iodine (µg/L) %	Urinary Iodine Deficiency[4] %	Anemia[5] %	Iron deficiency[6] %	Vitamin A deficiency[7] %
Preschool Children 6-59.9 mos.	43.9	18.1	4.5	--	--	48.1	27.8	25.6
Non-pregnant women 15-49.9 yrs	--	5.3	--	170.0	28.9	35.7	19.5	0.7
Men 18 yrs and older	--	2.9	--	--	--	26.3	--	--

[1] Stunting (Height-for-age) is defined by WHO as <-2.0 z-scores
[2] Underweight (Weight-for-age) Z-score) is defined by <-2.0 z-scores and BMI Kg/m^2 <18.5 in non-pregnant women and men
[3] Wasting (Weight-for-height) is defined by WHO <-2.0 z-scores
[4] Iodine deficiency defined as a public health problem when >50% of the population urinary iodine UI <100 µg/L.
[5] Anemia defined as Hb<11.0 g/dL in children, Hb<12.0 g/dL in women, and Hb<13.0 g/dL in men (Hb adjusted for altitude and cigarette smoking)
[6] Iron deficiency defined as transferrin receptor (TfR) > 8.0 µg/L
[7] Sub-clinical vitamin A deficiency is defined as serum retinol < 0.7 µmol/L, while severe vitamin A deficiency is defined as serum retinol < 0.35 µmol/L not excluding children with inflammation

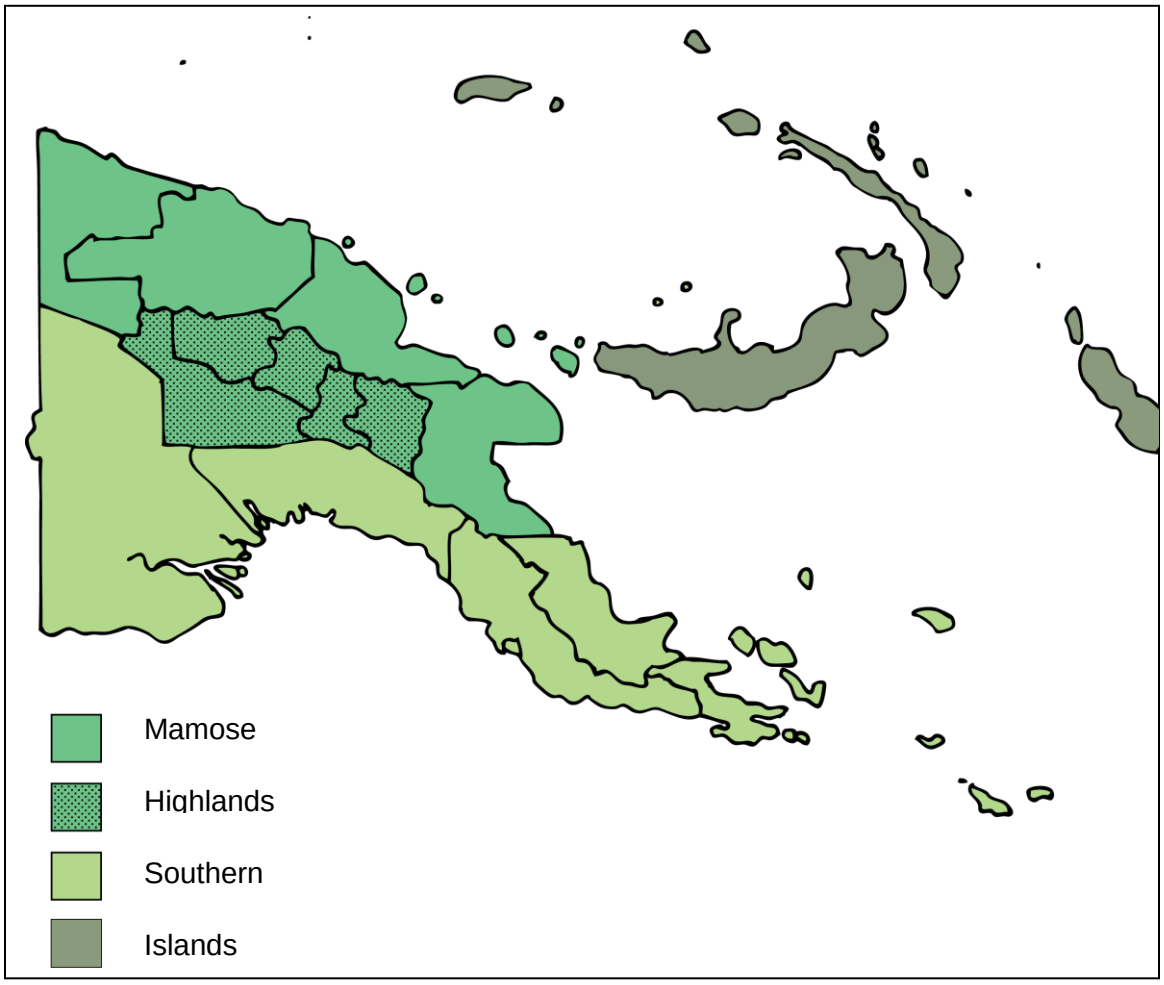
CONTENTS

ABBREVIATIONS

AGP	Alpha 1-acid glycoprotein
APP	Acute Phase Proteins
APR	Acute Phase Response
BAZ	Body Mass Index for Age Z scores
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CRP	C-Reactive Protein
DBS	Dried Blood Spot
DNPRD	Department of National Planning and Rural Development
EHP	Eastern Highlands Province
EPI	Expanded program of immunization
HAZ	Height-for-Age Z-score
Hb	Hemoglobin
HH	Household
HIV	Human immunodeficiency virus
HPLC	High Performance Liquid Chromatography
HCPS	Household and community practices survey
ICCIDD	International Council for Control of Iodine Deficiency Disorders
IDA	Iron Deficiency Anemia
IDD	Iodine Deficiency Disorders
IEC	Information, Education and Communication
IMMPaCt	International Micronutrient Malnutrition Prevention and Control Program
LBW	Low birth weight
MCH	Mother and Child Health
MDG	Millennium Development Goals
MICS	Multiple Indicator Cluster Survey
MOA	Memorandum of Agreement
MTSP	Medium term strategic plan
NCD	Non communicable diseases
NCHS	National Center for Health Statistics
NDOH	National Department of Health
NEC	National Executive Council
NHIS	National Health Information System
NNS 1982/83	National Nutrition Survey 1982/83
NSO	National Statistics Office
PEM	Protein Energy Malnutrition
PHA	Provincial Health Adviser
PMGH	Port Moresby General Hospital
PNG	Papua New Guinea
PNG NNS 2005	Papua New Guinea National Nutrition Survey 2005
PPM	Parts per million
PPS	Probability proportional to size
PSU	Primary sampling unit
RBP	Retinol binding protein
RDA	Recommended Daily Allowance
SD	Standard deviation
SEM	Senior Executive Management
SIA	Supplementary Immunization Activity
SMHS	School of Medicine and Health Sciences (part of UPNG)
TB	Tuberculosis

TfR	Transferrin receptor
UI	Urinary iodine
UNICEF	United Nations Children's Fund
UNU	United Nations University
UPNG	University of Papua New Guinea
USI	Universal Salt Iodization
VAD	Vitamin A Deficiency
WAZ	Weight-for-Age Z-score
WHO	World Health Organization
WHZ	Weight-for-Height Z-score
µ mol / L	Micromol per liter

MAP OF PAPUA NEW GUINEA SHOWING PROVINCIAL BORDERS AND SURVEY REGIONS



List of Provinces in each region of PNG

Southern region
Western
Gulf
Central
National Capital District
Milne Bay
Oro

Highlands region
Southern Highlands
Enga
Western Highlands
Simbu
Eastern Highlands

Mamose region
Morobe
Madang
East Sepik
Sandaun

Islands region
Manus
New Ireland
East New Britain
West New Britain
Autonomous Region of Bougainville

CHAPTER 1. BACKGROUND

1.1 Context

Papua New Guinea (PNG) is the largest of the Pacific Islands Nations. It comprises the eastern half of the Island of New Guinea in the Western Pacific, several large volcanic islands and some 600 small and scattered islands to the north and east in the Bismarck and Solomon Sea respectively. The total land area is over 462,840 square kilometers. PNG has a land border with the Indonesian province of Irian Jaya, and sea boundaries with Solomon Islands and Australia. The topography is among the most rugged in the world, with altitudes of over 4000 meters. PNG is extremely diverse geographically, with offshore volcanic islands, coral atolls, lowland forests and extensive swamps, dry savannah and alpine forests. Poor road networks, especially in the rural areas, make travelling difficult and very expensive, as many areas are not easily accessible. PNG relies heavily on coastal shipping and domestic air services, rather than road transport. It is estimated that about a third of the population lives below the poverty line (World Bank 1999) and more than 85 % lives in rural areas (National Statistical Office 2001).

Administratively, PNG is divided into 20 provinces and 89 districts. These are grouped for convenience into four regions, Southern, Highlands, Mamose and Islands.

1.2 Malnutrition in Papua New Guinea

Papua New Guinea displays an enormous diversity in its geography, ecology and human biology. The Papua New Guinea National Nutrition Survey 1982/83 (NNS 1982/83) found great variation in the extent of protein-energy malnutrition (PEM) among children under 5 years between different regions. Even within provinces there was considerable variation between districts (Heywood et al 1988).

1.2.1 Nutritional status

Nutrition plays a critical role in the survival, growth and development of children, who can not reach their full potential if they are malnourished in childhood. Malnutrition in all its forms affects socio–economic development in PNG. The development goals outlined in the government Medium Term Strategic Plan (MTSP), the Millennium Development Goals (MDGs), cannot be achieved if malnutrition remains a public health issue.

Malnutrition is considered one of the most important underlying causes of poor health outcomes in PNG. The National Nutrition Survey (NNS) of 1982/1983 was conducted on children 0-59 months of age. According to this survey 29.9% of mainly rural children 0-59 months of age were underweight and 43.2% stunted and 5.5% wasted (Heywood et al 1988). The National Household Food Consumption Study of 1996 reported that 8.1% of the children in PNG were wasted and 42.9% stunted based on the NCHS/CDC/WHO reference (Gibson and Rozelle 1998). Both the 1982/83 survey and the 1996 survey found that children in their second year of life were most at risk of being wasted and stunted.

The 1982/83 NNS also found that children in the Highlands region (> 600 m) were significantly shorter but also significantly heavier than lowland (0-600 m) children

(Heywood 1988). The Papua New Guinea Household Food Survey in 1996 also identified a much higher prevalence of stunting and a lower prevalence of wasting in the children living in the Highlands compared to children in coastal areas (Gibson and Rozelle 1998).

The prevalence of malnutrition appears to be lower in urban areas. A survey carried out in 1986/87 on 568 children under the age of 5 years reported a much lower prevalence of underweight, stunting and wasting in urban areas in comparison to rural areas (Jenkins and Zemel 1990).

Low birth weight (LBW) (<2500g) is thought to be a serious problem in PNG. A study by Muller et al found that within PNG, birth weights vary according to geographic location. Children from the central highlands and from affluent lowland areas had the highest birth weights, while they were lowest in the Sepik, Western, Madang and Milne Bay Provinces and remote highland fringe areas. Maternal education, socio-economic status and diet were important predictors, but only differences in maternal diet were correlated with the observed spatial patterns (Marks 1992 and Muller at et 2002).

The 1982/83 survey collected 6128 self reported birth weights. The mean birth weight was 2.93 Kg and 18.6% of babies had a birth weight less than 2.5kg (Muller et al 2001).The National Health Information System (NHIS) reported a prevalence of low birth weights of around 9-10 % nationally for the period 2002-2006, which is lower than the NNS 1982/83 prevalence (Muller at al 2001). The NHIS also found differences in LBW prevalence between provinces. Rates of LBW were highest in those provinces with high levels of child under-nutrition (Western, Milne Bay, Madang, East Sepik and Sandaun provinces), as well as National Capital District. In a retrospective study at Port Moresby General Hospital, researchers reported a mean birth weight of 3252 grams for babies born at term. Babies of Highland descent were significantly heavier than babies of Papuan ancestry (Klufio 1992).

There is very little data on the nutritional status of adults and no nationally representative data on under and over nutrition in adults in Papua New Guinea. One study by Taufa et al (1993) found in a survey of men and women in Lihir a substantial reduction of weight with age, (associated initially with a decline in fat reserves and eventually with a decline in lean body mass) and a minor reduction in height with age in rural female adults in Papua New Guinea. The trend for weight loss in men with age was less striking (Taufa 1995).

Another study conducted by Hodge et all in 1996 found that men and women older than 18 in rural communities in Papua New Guinea have a relatively low prevalence of obesity (Body mass index BMI >30), especially in the Highlands. Obesity is more prevalent in the urban coastal areas (27% and 38% for men and women respectively) compared to the rural Highlands (3% and 2% for men and women respectively).

A longitudinal study of the Wopkaimin people, landowners of the Ok Tedi mine in Western Province compared changes in health and nutrition status with the people of Mount Obree in the Central Province. At the start of this study in 1982, health and nutrition status was comparable in both groups. After 10 years, the mean weight had increased in all age groups of the Wopkaimin population, whereas mean body weight of the Mount Obree population remained the same. The royalties of the Ok Tedi mine had led to the economic development of the Wopkaimin people, whereas in the Mount Obree region, no economic development had taken place (Taufa 1995[1]).

1.2.2 Micronutrient status

Neither the 1982/83 survey nor the 1996 survey looked at micronutrient deficiencies in PNG. Limited data on local and selected populations have shown that micronutrient deficiencies might be common in at least some populations. The available data has suggested that there are considerable differences in the prevalence of micronutrient deficiencies and disease burdens between regions and even between districts. Most of the data that does exist concerns young children and there is little information on the status of adults.

Iodine deficiency

There are no national data on the prevalence of iodine deficiency in PNG. There have been several studies that have shown a high prevalence of goitre especially in the Highland areas, with the prevalence increasing with altitude (Hipsley et al 1947 and McCullagh 1963). There has been no systematic study of the spatial distribution of endemic goitre but there have been reports of goitre from most provinces in PNG (Heywood 1992).

Despite the availability of iodized salt some studies conducted in the late 1990s indicate that endemic goiter is still present in specific isolated areas of the country. For example, in Memyamya District the incidence of goitre in 1997 was 14 % among the schoolchildren surveyed (Amoa et al 1997).

Recent studies on urinary iodine (UI) concentrations in women and children in different parts of Papua New Guinea confirm the presence of iodine deficiency disorders in remote locations suchas Hella Region, Southern Highlands Province, see Table 1.1 (Temple et al 2005).

Table 1.1: Urinary iodine (UI) concentrations in women and children in regions of Papua New Guinea

	Median UI (µg/L)	% with UI level below 50 µg/L
Children age 6-12 years (Hella Region SHP) [1]	48	52.8
Male children age 6-12 years (Hella Region SHP) [1]	67	46.7
Female children age 6-12 years (Hella Region SHP) [1]	44	59.8
Pregnant women (Lae City) [2]	231	3.3
Non-pregnant women (NCD*) [3]	163	7.2
Lactating women (NCD) [3]	134	17.5
Pregnant women (NCD) [3]	180	6.6

[1] Temple et al., 2005
[2] Amoa and Rubiang, 2000
[3] Temple et al., 2006
*National Capital District

Vitamin A

There are very limited data on vitamin A status in PNG. There are very few reported cases of night blindness and other clinical manifestations of Vitamin A deficiency. A study, conducted in East Sepik province in 1990 reported that 91% of participating children-under-15 years had serum retinol levels below 0.70 µmol/L. In 1994, a hospital-based survey was conducted in several provinces in Papua New Guinea, and six children among 1027 (6 –72 months) were identified with clinical xerophthalmia (USAID VITAL 1993).

Between 1996 and 1998, a study of children 6-71 months old was carried out in several major centers and some remote locations. Of the 322 children 6-59 months surveyed, 27.6 % were vitamin A deficient (≤ 0.7 Mm/L) (Friesen et al 1998).

Anemia, iron deficiency and iron deficiency anemia

Data on anemia are also limited and most population based anemia data was collected in the 1970-80's. Most of the results were obtained as by products of large-scale population surveys for blood groups and other genetic and anthropological markers.

The review paper by Kariks and Woodfield (1972) reported that 21.5% of the total population had a hemoglobin value of < 10 g/dl and 63.3% had a hemoglobin below 12 g/dl. Regional patterns were noted and anemia was reported to be more prevalent in coastal areas. Anemia was also more prevalent in people living in isolated areas who subsist on a mainly vegetarian diet.

There are some anemia data on pregnant women but almost all of these studies are on women who attended antenatal clinics. Most of the studies were also conducted in Port Moresby clinics and hospital. Most of these studies reported very high levels of anemia in pregnant women. In 1986, in a study of 600 pregnant women at Port Moresby General Hospital, 81% percent of the participating women had a hemoglobin level below 11 g/dL, and 59% had a hemoglobin level below 10 g/dL (Sill et al 1986).

A survey carried out in 1998 identified a high prevalence of anemia in children under five years (Hb<11 g/dL) (Friesen et al 1998[1]). The highest prevalence of anemia was observed in the East Sepik Province, where 91% of children less than five years had a Hb<11g/dl. The prevalence of anemia was lowest among children from the Western Highlands Province, with 35% having a Hb<11g/dl. In addition, a lower percentage of children in the Western Highlands Province had positive malaria slide.

Malaria

All four Plasmodium species (Plasmodium falciparum, Plasmodium vivax, Plasmodium malariae and Plasmodium ovale) are present in PNG. The severity of malaria infections range from "anaphelism sans malaria", through unsTable low levels of endemicity where outbreaks are common, to holo-endemic transmission comparable to the most endemic areas of Sub-Saharan Africa (Muller at al 2003).

Before the 1950s, malaria transmission was unusual in most parts of the Highlands, particularly at high altitudes (above 1200 m.). Malaria outbreaks became common after opening of the Highlands Highway, with increased travel to and from the coast (Dapeng

2004). Malaria epidemics in the highlands, often in the late rainy and early dry season, are characterized by relatively small, isolated outbreaks that result in a large number of deaths in all age groups among the non-immune population. This pattern is different from malaria in coastal and islands regions, where there is a constant transmission throughout the year. As the population is more accustomed to malaria outbreaks, deaths are rare and most occur among young children.

Hemoglobinopathies

Other factors that might impact the hemoglobin status of Papua New Guineas included alpha thalasseamia and other hemoglobinopathies which can decrease the hemoglobin concentrations in the blood. Various studies have shown that α- thalassemia is very common in PNG and is particularly common in coastal areas where malaria is endemic. In a study by Flint et al (1986), DNA samples were analyzed from throughout the South Pacific. From the PNG samples, 4% of the Highlands samples had the trait, whereas the rate for the coastal samples was 39%. Coastal samples showed variation; of the north coastal samples 68 % had α thalassaemia; of south coastal samples, 22% and of the east coastal samples, 38%.

Preliminary geographical and linguistic analyses suggest that the prevalence of α-thalassaemia may be related to altitude rather than linguistic grouping and hence that resistance to malaria may be at least one reason why α-thalassaemia is so common in some populations (Oppenheimer 1984). Hypochromic anemia in tropical or subtropical populations should not necessarily be attributed to iron deficiency (Bowden 1985).

In a recent study by O'Donnell et al (2006), the effect of maternal α-thalassaemia on pregnancy was assessed in the north coastal region of Papua New Guinea (PNG), where malaria is hyperendemic and α-thalassaemia is extremely common. The median haemoglobin concentration during pregnancy and after delivery was about 1.0 g/dl lower in homozygous α-thalassaemia than in women with a normal α- globin genotype ($P < 0.001$). The frequency of the -α genotype in mothers was 0.61. Although the median haemoglobin concentration was significantly lower in mothers homozygous for alpha+ -thalassaemia than those with a normal alpha-globin genotype, this did not result in adverse pregnancy outcomes.

Helminthes

The review by Kariks and Woodfield (1972) estimated that intestinal parasites (worms) affect approximately 75% of the population. The intensity of the infestation is generally low and depending on the intensity of the infestation 2 to 100 ml of blood is lost per day. In addition to hookworms, bites and loss of blood from mosquitoes, sand flies and other blood sucking insects contribute to the prevalence of anemia.

1.2.3 Infant and young child feeding

Most studies on infant and child feeding report that breastfeeding is almost universal and usually continues well into the 2nd year of life (Frisen at al 1998 and Mgone 2002). One survey from two districts in EHP and Madang found that nearly all children under 4 months of age were breast fed and of those children 85% were exclusively breast fed (EBF), this decreased to approximately 80% at 6 months (Mgone 2002). Several other studies have also supported the findings that a large proportion of children under 6

months of age are breastfed in PNG. Several studies have shown that while breastfeeding is very common many women do not give colostrum to the child due to beliefs such as this milk is “dirty milk”. Breastfeeding is also much less prevalent in women in formal employment (Friesen 1995). Some studies also found that bottle feeding is more common in adopted children and adoption in the Highlands provinces is higher than other parts of PNG (Peters 2000).

The NNS 1982/83 contains information on food consumption (24-hour-recall). Diet and socioeconomic status were found to be the two most important variables in predicting patterns of child growth in Papua New Guinea. While socioeconomic status was the most important factor determining variation in growth within areas, differences in diet and the physical environment were the main determining factors between regions (Muller 1999).

The NNS 1982/83 concluded that the cause of the high prevalence of stunting appears to be the late introduction, infrequent feeding and low nutrient density of complementary foods. The bulkiness of the root crops, from which up to 80% of the total dietary energy is derived, may make it difficult to consume enough to satisfy requirements for energy, protein and other nutrients. Many other studies also support the findings of this survey and report that as many as 40% of children 6-9 months have not received any complementary foods.

Acute food shortages are rare and usually related to extraordinary climatic events such as El Nino phenomenon (Allen 1997). Therefore quality rather than quantity seems to be the major nutritional problem in rural PNG (Muller 1999). Mueller found that consumption of rice, tinned fish and meat, fresh fish and legumes, were significantly positively correlated with child growth in length and /or weight . These food items are much higher in protein, zinc and energy contents than the local staple foods (Ohtsuka 1984). Children in villages with high consumption of sago on the other hand were significantly lighter.

1.3 Nutrition Interventions to date

There are several nutrition interventions that have been established in PNG to help improve the nutrition status of the population. These strategies are as follows:

1.3.1 Iodized salt

In 1995, PNG amended the Pure Food Standards (PFS) making it mandatory for all salt imported into the country to be iodized with potassium iodate at 30 ppm. In February 2007, the National Executive Council (NEC) endorsed the Food Sanitation Regulation 2007, which is now enforced. The household coverage of iodized salt has never been determined nationally. Some small surveys show a wide variation in estimates of coverage in different locations.

1.3.2 Vitamin A supplements for children 6-59 months

In 2002, based on recommendations by the PNG Pediatric Society and UNICEF, the National Department of Health introduced distribution of high dosage vitamin A capsules to children at 6 and 12 months by adding it to the routine immunization schedule.

Reporting the number of capsules distributed will be included in the revised National Health Information System, as currently this is not required. According to the PNG National Immunization Coverage Survey 2005-2006 around 70% of children, 6-12 month old, received at least one dose of vitamin A. There are differences in coverage for the regions; the Highlands Regions has the highest estimates with nearly 75 % of children 6-12 months old receiving at least one dose of Vitamin A capsules and Mamose the lowest with around 60% (National Department of Health 2007).

1.3.3 Anemia prevention and malaria control in pregnancy

Iron and folic acid supplementation is available to all pregnant women who attend antenatal clinics in PNG. Since the early 1960s iron supplementation and chloroquin prophylaxis for malaria (in areas of endemicity) have been part of the standard treatment in antenatal clinics in PNG. Folic acid was added to iron supplementation in the late 1970s (Fefol is used, which comprises of 200-mg ferrous sulfate and 0.5 mg of folic acid)

1.3.4 Population malaria control

In 2004 a universal bed net distribution program began. Using funding from the Global Fund to combat HIV/Aids, Malaria and TB the Department of Health began the process of supplying long lasting treated bed nets to the total population.

1.3.5 Improved infant feeding practices

In 2007 the Department of Health embarked on training health workers in infant and young child feeding counseling. TOT (Trainer-of-trainers) workshops have been completed for all regions on the WHO/UNICEF Infant and Young Child Feeding Counseling Course.

There are several NGO's that also actively work at improving infant and young child feeding.

1. 4 Rationale for the Papua New Guinea National Nutrition Survey

The survey was initiated by the Department of Health (DoH) and UNICEF in a collaborative effort with the U.S. Centers for Disease Control and Prevention (CDC) and the University of Papua New Guinea, Medical school. This survey is the first since the pioneering nutrition survey expedition in 1947 to include biochemical papameters and is part of an ongoing effort to develop national capacity in nutrition assessment, programming and monitoring.

The PNG survey is an integrated survey that describes the overall nutritional and micronutrient status of the population. The survey was implemented in order to:1) Prioritize and plan nutritional interventions in PNG; 2) Advocate to secure and sustain the required political and financial commitment for nutrition programs; 3) Serve as a baseline for monitoring the impact of nutrition interventions. Furthermore, conducting this survey was considered an opportunity to develop capacity of DoH and other partners and to establish useful institutional linkages involving various institutions, including the

School of Medicine and Health Science at the University of PNG, the Centers for Disease Control and Prevention, and various laboratories.

1.5 Objectives

The objectives of the survey were to:

- Determine the household coverage of adequately iodized salt
- Determine the urinary iodine levels among non-pregnant women of child bearing age 15-49 years
- Determine the prevalence of anemia, iron deficiency and iron deficiency anemia in children 6-59 months of age and non-pregnant women of child bearing age 15-49 years and prevalence of anemia in adult men 18 years and older
- Determine the prevalence of vitamin A deficiency in children 6-59 months of age and non-pregnant women of child bearing age 15-49 years
- Assess the anthropometric status of preschool children (6-59 years) and non-pregnant women of reproductive age (15-49 years) and men (18 years and older)
- Determine the contribution of malaria to anemia in children and non-pregnant women of child bearing age and the contribution of hookworm to anemia in children 24-59 months of age
- Assess the use and consumption levels of centrally-processed staple foods, in order to determine their suitability as vehicles for fortification

CHAPTER 2. METHODOLOGY

A two-stage cluster sampling design was applied with stratification to generate national and regional estimates. There are four regions in Papua New Guinea (Southern, Highlands, Mamose and Islands). The design of this survey does not allow for provincial estimates or any other categories other than regional (e.g. urban and rural). The recommendation to stratify the survey by region was based on the following assumptions:

- The diversity of the landscape, and agriculture and cultural practices may result in wide differences in the nutrition outcomes among the regions
- Programs may need to be introduced or targeted regionally. Region-specific estimates could help identify those regions in greatest need of interventions
- Not all nutritional interventions in Papua New Guinea are implemented nationwide and there are concerns that there could be significant regional variations

2.1 Sample size

The sample size for the PNG national micronutrient survey was determined using standard statistical procedures. The anticipated prevalence, desired precision, and assumed design effect for each outcome in each target group were determined based on the results from previous surveys and studies related to the outcomes of interest. Sample sizes for each outcome in each target group were calculated using the standard formula:

$$N = 1.96^2 \times \frac{pq}{d^2} \times DEFF$$

Where: N = Minimum sample size needed

1.96 = the z value to obtain a 95% confidence interval

p = the assumed prevalence of the nutrition outcome of interest in a target group

q = 1-p

d = the desired precision expressed as a half-confidence interval

DEFF = the design effect to account for the loss of statistical precision from cluster sampling

For many nutrition outcomes, conservative assumptions were made to intentionally overestimate the necessary sample size. The sample size is maximized if the prevalence is 50%. Similarly, design effects were overestimated to ensure adequate sample sizes.

For example, the calculation of a sample size for anemia in children 6-59 months of age was based on an estimated anemia prevalence of 50%, a precision of +/-10 percentage points, and a design effect of 2. Using the standard formula above, 192 children would be needed per region. The nationwide sample would require 4 times as many children 6-59 months of age because there are 4 strata, thus resulting in a total of 768 children. A certain proportion of selected households will be unavailable or refuse participation (household non-response) and a certain proportion of children in consenting households will be absent or their mothers will refuse consent for a finger stick (individual non-

response). Taking into account an estimated individual non-response of 20%, a household non response of 10%, and the proportion of children 6-59 months of age per household in PNG (0.7 children per household), the required number of households that need to be selected to obtain finger stick blood on 768 children is 1, 524. Table 2.1 shows a summary of the assumptions used to generate the sample sizes for the major outcomes (See appendix 1 for a detailed description of the assumptions).

Table 2.1 Assumptions and estimated sample size for nutrition outcomes, Papua New Guinea National Nutrition Survey 2005.

Target group	Indicator	Estimated prevalence	Precision (Stratum-specific half CI)	*DEFF Assumed	Sample size needed (all 4 strata)	Individual non-response	No. per HH	Non response for HH	Total number of HH for 4 strata
House hold (HH)	Presence of iodized salt in the household	0.5	±12	4.5	1201	0%	1	10%	1,334
Children 6-59 months	Anemia	0.5	±10	2	768	20%	0.7	10%	1,524
	Iron deficiency	0.5	±10	2	768	20%	0.7	10%	1,524
	Malaria	0.5	±12	3	800	20%	0.7	10%	1,588
	Vitamin A deficiency	0.5	±10	2	768	20%	0.7	10%	1,524
	Wasting	0.1	± 5	1.5	830	10%	0.7	10%	1,463
	Stunting	0.5	±10	1.5	576	10%	0.7	10%	1,016
Children 24-59 months [a]	Hookworm	0.5	±15	3	512	30%	0.5	10%	1,626
Women 15-49 years	Iron deficiency	0.5	±10	2	768	20%	1.37	10%	779
	Anemia	0.5	±10	2	768	20%	1.37	10%	779
	Malaria	0.5	±12	3	800	20%	1.37	10%	811
	BMI <17	0.1	± 5	1.5	830	10%	1.37	10%	748
	BMI >25	0.5	±10	3	1152	10%	1.37	10%	1,039
	Urinary Iodine	0.5	±10	2	768	20%	1.37	10%	779
Men > 18 years	Anemia	0.1	± 5	1.5	830	25%	1.5	10%	820
	BMI < 17	0.1	± 5	1.5	830	10%	1.5	10%	683
	BMI > 25	0.1	± 5	1.5	830	10%	1.5	10%	683

* DEFF = Design effect (assumed for these calculations)

[a] Hookworm was only collected in children 24-59 months because children in this age group have greater exposure. It is also easier to collect stool samples from children this age

For most of the outcomes and target groups of interest, there are very few data on which to base the assumptions necessary to calculate sample size. As described above, a prevalence of 50% was selected for such indicators to provide the largest sample size for the given target population. For a given target group, sample sizes were calculated separately for each nutrition outcome measured in that group, and the maximum size was taken for that target group. It was decided that the number of households for the entire survey should be 1600 households, as this will provide at least the desired precision for most of the nutrition outcomes of interest. Table 2.2 shows the number of target individuals to be included in the sample of 1600 HHS.

Table 2.2 Expected number of participants by target group per strata and nationally

Target group	Indicators	Number of expected samples from participants per Strata	Total number of participants nationally (4 strata in total) 1600 households
Children 6-59 months	Laboratory	202	808
	Anthropometry	227	908
Women 15-49 years*	Laboratory	197	788
	Anthropometry	222	888
Adult men 18 years and above*	Laboratory	203	812
	Anthropometry	243	972

* On ½ of all households
These figures take into account the expected presence of participants at the household and the household and individual response rates

At every household visited, anemia, iron deficiency, vitamin A deficiency, acute phase proteins, malarial load, wasting, underweight and stunting were assessed for each eligible child in the household. In all households with a child aged 24-59 months, hookworm was also measured. In every second household, anemia, iron deficiency, BMI, urinary iodine and malarial load was measured in all non-pregnant women of child-bearing age. In every second household, anemia was measured in all men above 18 years of age. See appendix 2 for the design effects (DEFF) for the major indicators.

2.1.1 First stage sampling

The National Statistical Office provided a list of all census units in PNG in an Excel spreadsheet created during the 2000 census. For each of the four regions a list of the number of households in each census unit, and a column of cumulative sums was created. In the first sampling stage, 25 primary sampling units (PSUs) were selected from this list for each region. Sampling probability proportional to size was done by calculating a sampling fraction (the total number of households in each of the four regions divided by the number of required PSUs [25]), and adding this sampling fraction repeatedly to an initial random number. Each census unit in which the resulting number fell became the site for one PSU. No census unit was selected more than once. If the census unit selected had fewer than 25 households the next nearest census unit was selected and combined with the original census unit. Appendix 3 shows a list of the census units selected. Final data was collected from 97 clusters. Three clusters were inaccessible (8, 58, 87) at the time of the survey due to logistical constraints. Despite efforts to reach them on several occasions data collection activities in these three clusters was aborted.

The 100 randomly selected PSUs are located in all 20 provinces and in 75 of the 87 districts in PNG: 16 districts in Southern region, 24 in the Highlands regions, 23 in the Mamose region and 12 in the Islands region. Although all the provinces were included in the survey, it is important to note that the precision around the estimates of the prevalence of all outcomes is not sufficient to interpret the results of the survey by province.

2.1.2 Second stage of sampling

In each PSU the survey team worked with the local leaders and the community to create a household listing of all households in the selected PSU. The households on the list were then numbered, and 20 households were selected using a random number table. In each PSU it was confirmed that all households currently residing in the PSU were included on the list of households. Any households missing on the list, such as recent returnees, were added to a preexisting list. In large primary sampling units (greater than 250 households), where it was not possible to make a list of all households, a map of the area was drawn and split into segments. The segments were approximately the same size and geographic boundaries such as roads, rivers, buildings and important landmarks were used to identify the boundaries of one segment from another. The number of households in each segment was listed and a list of cumulative sums was created. A segment of the PSU was then chosen at random, probability proportional to size. The households within the selected segment were then mapped and 20 households were selected. In situations where the selected PSU had fewer than 20 households the team leader combined the selected PSU with the closest neighboring census unit and made a complete listing of all the households in both the PSU and census unit.

In each selected household, all eligible persons in the identified target groups were asked to participate in the survey. For the purposes of the PNG national micronutrient survey, a household was defined as a group of people who share a common cooking pot and shared household resources, such as food and bedding. Members of a household were not necessarily relatives by blood or marriage.

All children 6-59 months of age were selected in every household included in the survey. Every non-pregnant woman aged 15-49 years and all men aged 18 years or older were invited to participate in the survey in every other household. Table 2.3 show the number of survey participants from each target group that participated in the survey.

Table 2.3 Number of survey participants, by region and nationally, PNG National Nutrition Survey 2005.

	Households	**Children (6-59 months)**	**Pregnant women of childbearing age (15-45 yrs)***	**Non-pregnant women of childbearing age (15-45 yrs**	**Men (18>yrs)**
Region					
National	1403	937	64	783	804
Southern	342	226	16	258	213
Highlands	359	209	19	181	212
Mamose	354	255	15	176	197
Islands	348	247	14	168	182

* Pregnant women were not a target group in the survey. Some of the women who were interviewed during the survey were pregnant. Thos women completed the survey questionnaire but were not asked to provide any biological samples or be weighed and measured.

2.2 Ethical considerations

The ethical and technical considerations of the survey were extensively reviewed. The survey methodology was approved by the Medical Research Advisory Committee of Department of Health. The right of individuals to choose to participate or not to participate was ensured and respected. Informed consent (see Appendix 4) was obtained from each adult participant and primary care giver of children asked to participate in the survey, once the purpose and content of the survey had been explained. Consent was obtained verbally and the interviewer indicated on the top of the participant form if consent was obtained or not. Participants were also informed that they were free to refuse at any point during the survey. The hemoglobin test result of each subject was provided and the subject was referred to the health clinic if the results indicated moderate to severe anemia as defined by WHO (WHO 2001).

2.3 Survey Teams, training and implementation

2.3.1 Survey teams

Six survey teams were recruited. Both a male and female members were assigned to each team. Each team was made up of 4 individuals as follows:

- One team leader
- One interviewer and anthropometry assistant
- One anthropometrist
- One laboratory technician

Where possible, cars were provided for the teams and the driver assisted teams where needed. For many of the clusters, the routes were impassible by car and local people were hired to assist with carrying equipment to the cluster. In each district, focal persons were identified and assigned by the Department of Health to assist teams. Focal persons provided the teams with assistance in locating the correct primary sampling unit, helping the team access the PSU, collecting specimens and data collection forms completed in the PSU and transporting them to Port Moresby. They also provided an essential link in the communication between the survey supervisor located in Port Moresby and team members and helped troubleshoot any problems in the field. The survey task force led by the survey coordinator supported and guided the teams in technical, logistical and managerial aspects throughout the data collection period. The CDC technical team was based in Port Moresby for the planning, training, and initial implementation phase of the survey. They provided intensive supervision and quality control for the collection of data in the Port Moresby PSUs. Once the survey was underway they returned to Atlanta and provided close support via telephone and email.

Team member selection began with an interview process by DOH/UNICEF. Most of the survey team members were staff from the Department of Health or were university students. Many of them had some experience working with NGOs or experience working in health care settings. It was required that each survey team included at least one male to ensure the security of the female team members.

Thirty one potential team members, selected from the interview process began training for the survey. After one week of training, 24 survey team members were selected from

the 31 training participants based on the results of a written test, previous experience and performance during the training. In each team one person was selected as the team leader. Team leaders were chosen based on skills and leadership qualities. The team leaders participated in an additional day of training. The survey pilot test proceeded with only the selected team members.

2.3.2 Training

A two-week training program was conducted to prepare the survey teams. Three technical advisors from CDC, with assistance from members of the University of Papua New Guinea and the Department of Health coordinated the training. The training was conducted in English. The training included lectures, PowerPoint presentations, practical exercises and role plays. The training covered aims and objectives of the survey, survey methodology, team composition, team and individual responsibilities, field procedures, selection of households and eligible participants, interview techniques, questionnaire administration, anthropometry, and blood, urine, stool and salt sample collection, storage, and transport guidelines.

Data collection forms were created after consultation with national and international organizations providing nutrition and health services to the population of Papua New Guinea. The types of data collected conform to the types of data that have previously been collected in Papua New Guinea. The data collection forms were first developed in English. Written translations were made into Pidgin and checked by back translation. All data collection forms can be found in Appendix 5. The survey instruments were pre-tested in Geruhu, a suburb of Port Moresby and Kalo village in Central Province. About 25 households in both locations participated in the pre-test. Neither of these sites were included in the survey and revisions to the procedures and data collections instruments were made based on these pretests.

Laboratory technicians in the teams were trained by a CDC laboratory specialist on the following:

- Correct techniques for finger puncture and capillary blood collection into microtainers;
- The use of field instruments (Hemocue) to measure haemoglobin;
- Monitoring of quality control when using the Hemocue
- Processing and storage of dried blood spots (DBS) for the analysis of retinol binding protein (RBP), transferrin receptor(TfR), acute phase proteins AGP and CRP;
- Monitoring of humidity for proper storage of DBS in the field
- Preparation of malaria slides;
- Collection, storage, and transport of urine and stool samples
- Collection, storage, and transportation of salt samples

The training concluded with a two-day pilot survey conducted in Hanuabada village in Port Moresby. Hanuabada was not included in any PSUs selected for the actual survey. The pilot simulated the surveying of one cluster by each team and was conducted under close supervision of senior technical advisors from CDC, the Department of Health, the University of Papua New Guinea and UNICEF. The pilot testing was followed by a day of organized feedback that addressed and resolved various technical and logistical issues.

2.3.3 Survey implementation

Following PSU selection, the Department of Health in Port Moresby sent letters to Provincial Health Advisors (PHA) informing them about the survey, the PSUs that had been selected, and the dates for data collection. The PHAs in turn informed the District Administrators of the selected districts of the PSUs to be assessed and dates of the survey. They also helped the survey coordinator to identify suitable focal points in the districts to assist teams with the survey. All relevant opinion leaders at provincial and district level, such as community health workers, were identified by the Department of Health and UNICEF and were acquainted with the survey objectives and implementation plan. These leaders were requested to encourage the population to participate in and support the survey. A formal request was also issued by the Department of Health to regional, provincial and district level leaders request their cooperation and support during the survey.

Before traveling to a selected census unit (village), the survey team first visited the respective main provincial centre to be introduced to the provincial administrator, PHA and health officials in the selected districtsdistrict governor and district health administration. They also met the focal person designated to assist the team during the course of the survey in the area. The team leader further described the aim, purpose and methodology of the survey and answered any questions the local authorities had.The focal person accompanied the team to the census unit in some circumstances.

Once in the PSU (village), the team contacted the village leaders and delivered the letters from the provincial and/or district officials. The team leader reiterated the objectives and procedure of the survey including the information that would be collected and how they would collect it. Once permission had been granted by the village leaders for the survey to go ahead a list was made of all the households in the census unit. Households to be surveyed were identified by selecting 20 households at random from the list using a random number Table.

A household was defined as a group of people who sleep and eat together on a regular basis. Household members didn't need to be living in the same room. However, if they shared their meals "from the same pot", they were considered members of the household. Families who lived in the same room with or without partition, but took their meals from separately prepared pots, were regarded as different households.

The head of a household was defined as the person in the household who makes the major decisions for all the household members, such as financial expenditures, schooling, medical care and food. If the household head was not at the house during the time of the survey, the individual with the household responsibilities while she or he was away was considered the 'acting' household head. If the household head had recently died, the spouse, parent, brother, or elder son of the deceased was considered the household head, depending on arrangements in each family.

Upon arrival at the selected households, the team leader usually accompanied by community leaders or representatives, explained to the head of the household the purpose and procedures of the survey and how the household was selected.

Each team conducted their first cluster of data collection in the Port Moresby area. This allowed for close supervision and support by the CDC technical team, and enabled quick response to unforeseen problems before the teams traveled to remote areas. A full day

review session was organized following the completion of the Port Moresby clusters, prior to the teams traveling outside the capital city.

2.3.4 Interview procedure

With the permission of the head of the household, the interviewer, anthropometrist and lab technician entered the household. The interviewer made further introductions of the survey to prospective participants and began the interview process. First, the household head was asked questions about the members of the household and their ages, the kind of facilities available to the household and also questions about the consumption of various centrally processed foods. A local calendar of events created by the team was used to determine ages of children living in the household. Local calendars were constructed by the team as needed because of different local events that have occurred in different parts of the country.

Before proceeding with individual interviews, informed consent was obtained from each participant, or in the case of children, their primary caretakers. Each participant was administered the appropriate questionnaire corresponding to the target group. Information on children under the age of five years was obtained through an interview with the primary caretaker. Where possible the interviews were conducted in Pidgin. When that was not possible, and none of the team members had experience in the local language, a local translator was used. One of the reasons for keeping the data collection form very simple was to avoid difficulties translating questions or responses. Local leaders and focal points accompanying the teams assisted with translation if needed. In addition to interview questions, anthropometric measurements, blood and urine were collected from the appropriate target groups. Table 2.4 details the indicators assessed for each target group.

Table 2.4 Target groups and indicators assessed, National Nutrition Survey, Papua New Guinea 2005

Target group	Specimen Collected or Measurement Taken	Indicators Assessed
Children (6 – 59 months)	Blood	- Hemoglobin - Retinol binding protein (DBS method) - Transferrin receptor (DBS method) - C- reactive protein (DBS method) - AGP (DBS method)
	Height and Weight	- Anthropometric status
Children (24-59 months)	Stool	- Hookworm egg count
Women (15 – 49 years)	Blood	- Hemoglobin - Retinol binding protein (DBS method) - Transferrin receptor (DBS method) - C- reactive protein (DBS method) - AGP (DBS method)
	Urine	- Urinary iodine
	Height and weight	- Anthropometric status
Men (18 ≥ years)	Blood	- Hemoglobin
	Height and weight	- Anthropometric status
Household	Salt	- Iodine content

In each household selected, the household head was asked questions about the household and current members of the household. In addition, a sample of each type of salt from each selected household was collected, if available, to be tested for iodine content.

In households where women were selected to be interviewed, survey workers asked each woman of reproductive age questions regarding night blindness, whether she used tobacco, whether she slept under a mosquito net, her last pregnancy and information about that child, such as the child's birth weight. Women who had given birth during the past three years prior to the survey were asked to recall the birth weight of her last born child. Where possible women were asked to show any documentation where the birth weight was recorded. Women were asked if they were currently pregnant, if thery were they were only asked to complete the questionnaire. Non-pregnant woman had their height and weight measurements taken, a urine sample collected and blood collected to test for Hb and to prepare dried blood spots and a malaria slide.

In households where men were selected to be interviewed, survey workers asked questions to each man regarding his educational status, tobacco usage and mosquito net usage. In addition, each man had his height and weight measurements taken and a finger prick conducted to assess his hemoglobin level.

Information was gathered from an adult household member, preferably the mother, on each child less than 5 years of age regarding mosquito net usage, breastfeeding history, vitamin A supplementation and introduction of complementary foods. Where available, baby clinic books were used to identify the child's correct age and record the date the child received his/her last vitamin A supplement. If baby clinic books were not available, then the age of the child was determined using mothers recall and a local calendar. Survey workers then took a sample of blood and tested the child's hemoglobin, prepared dried blood spots and a malaria slide. Mothers were asked to collect a stool sample from her child if the child was aged between 24-59 months of age. If the specimen could not be collected at the time of the visit, then the survey workers left a collection cup and returned the next day to collect the specimen. Survey workers also measured the child's weight and height. Children less than 5 years of age, women of reproductive age and men were weighed to the nearest 100 grams with the Seca Uniscale. For children less than 24 months of age, length was measured to the nearest millimeter in the recumbent position using a Shorr height board. Children 24 months of age or older were measured in a standing position using the Shorr board. Women's and men's height was measured using the Shorr board with the extension piece added.

Pre-printed labels were used to identify completed survey questionnaires and the associated biological and salt samples collected for later testing. Details of the labeling procedure are provided in Appendix 6.

When no-one was present in a survey household, the team revisited the household up to three times before declaring a non-response. If an eligible child, woman or man was absent when the survey team visited the household, the household was re-visited up to two times, before declaring the participant absent.

On average it took 4-5 days to complete data collection in each cluster. Travel between clusters took at least 1-2 days.

2.3.5 Anthropometry

Heights and weights of children aged 6 – 59 months, non-pregnant women 15-49 years and men ≥18 years were measured using standard methods[2] described in Appendix 7. Individuals were excluded if they had a disability that prevented them from standing up straight or lying down flat, were wearing casts or heavy bandages or if they were missing one or more limbs. The indices for interpreting pediatric and adult anthropometric data are provided in Tables 2.7 -2.9.

a) Age

When the date of birth was known, the age of preschool children was calculated based on the difference between the birth date and the date of the measurement. Verification of birth date by baby clinic book or other written record, for example baptism certificate, was made when possible. When the birth date of the child was unknown, a local event calendar (which included key religious and national events during the previous six years) was used to estimate the child's age. Women's and men's ages (in years) were based on self-report and without the use of a local event calendar.

b) Length/height

For children less than 24 months old, recumbent length was measured to the nearest 0.1 cm using a Shorr board. The same device was used to measure standing height to the nearest 0.1 cm for children >24 months. Adult women and men were measured to the nearest 0.1 cm using a Shorr board with the adult extension piece attached.

c) Weight

Seca Uniscales were used to measure weights of preschool children, women and men to the nearest 0.1 kg. Children who were too young to stand on their own were weighed while being held by their mothers (or an adult) using the mother-child tare function on the scale.

2.3.6 Blood collection - capillary sampling, processing and testing

Capillary blood was collected via finger puncture from the middle or ring finger using semi-automated lancets with 2.25 mm needles. Blood was collected into a microtainer as described in Appendix 8. If unsuccessful on the first attempt, a finger puncture was attempted a second time. For each participant, between 250-500 µL of blood was collected. Once the microtainer was filled, the microtainer was inverted ten times. The blood was then used to assess hemoglobin status and prepare malaria thick smears and dried blood spot cards (see procedures below). Blood collection materials were disposed in biohazard bags and taken to the district/provincial Department of Health biohazard waste management for incineration.

a) Hemoglobin measurement

Hemoglobin (Hb) concentration was determined in the household using the HemoCue system (Angelholm 2005). Quality control of each HemoCue instrument was performed every morning of data collection, using a control cuvette to ensure that the Hemocue optics were functioning properly (Appendix 9a and b). Three different levels of liquid

controls (high, medium and low) were also tested daily to ensure the integrity of the microcuvettes. If the Hb value was outside the expected range the Hemocue quality control was performed to ensure that the techniques being used and the equipment were accurate. If the accuracy reading was outside the range, of the control cuvette and the Hemocue had been cleaned, then the instrument was replaced.

Anemia was defined as low Hb concentration using World Health Organization criteria (WHO 2001) (see Table 2.13). Participants were informed whether their hemoglobin level was normal or low. If their hemoglobin was low they were referred to the nearest health clinic, (see appendix 10 for the team referral sheet and appendix 11 for the referral slips).

b) Malaria slide

A malaria thick smear was created for all children and women who participated in the survey and provided a blood sample. Using the 25 µL pipette tip, a drop of blood (approximately 12 µL) from the Microtainer was placed onto the slide. The drop of blood was spread into a circle about 1cm in diameter. The slide was then placed in the box and left until the smear was semi dry and the box could be shut (appendix 8). The slides were then sent to Port Moresby where they were read at the University of Papua New Guinea. The malaria prevalence of the initial analysis was very low and it was decided that the slides should be re-read. All of the slides were re-read in Papua New Guinea and the data were analyzed. The difference in the prevalence of malaria from the two sets of analysis was extremely large (there was a 58.7 percentage point difference for the national prevalence of malaria). A report comparing the data from the two analyses looked at malaria severity and malaria in relation to altitude and anemia. Based on the extreme differences in the data, and the lack of a relationship between malaria and altitude and hemoglobin it was decided to exclude the malaria data from this report.

c) Dried blood spot (DBS) collection, processing and testing

In this survey, dry blood spots (DBS) were used as it is the best method under field conditions that does not require centrifugation, freezing or transport of blood samples in a cold chain.

After the hemoglobin was tested and the malaria thick smear prepared, dry blood spots (DBS) were prepared by transferring the remainder of the blood in the microtainers to pre-printed circles on filter papers using a 25 µL calibrated micropipette. As many spots as possible were filled on the DBS cards. If blood was left in the microtainer after all spots had been filled, 25 µL spots were pipetted in the spaces between the circles taking care not to allow the spots to overlap. The DBS card was then transferred to cardboard racks that were specially designed for drying DBS-filter papers. The box holding the DBS card was left open during the remainder of the stay in the household and a small hand fan was positioned approximately 20 cm away form the box to help the card dry. The box was closed before being transported to the next house.

Each evening, after the spots were completely dry, the DBS cards were packed in low gas permeable bags, with each filter paper separated by glassine (weighing) paper and along with desiccant packs and humidity indicator cards. Each gas permeable bag was then put in pleated bags (Tyvek bags), for storage/shipping. For the duration of storage, humidity indicator cards were monitored every day and desiccants packets were changed as necessary. The DBS cards were sent to Port Moresby where they were packed in dry ice and shipped to the laboratories at CDC. From CDC they were re-

packaged and sent to SEAMEO-TROPMED laboratory in Jakarta, Indonesia, for testing of transferring receptor (TfR), retinol binding protein (RBP), C-reactive protein (CRP) and Alpha 1-acid glycoprotein (AGP).

In addition to the dried blood spots, venous blood samples were collected from a small subsample of participating non-pregnant women and children 6-59 months of age to calculate a correction curve needed for the RBP analysis.

2.3.7 Urine collection, processing and testing

Urine samples were collected from non-pregnant women according to specific procedures (Appendix 8). The lab technician pipetted equal amounts of urine (1.5 mL) from the cup into two pre-labeled iodine-free cryovials using a disposable pipette. The urine specimens were then stored in a cryovial box until they could be sent to Port Moresby. Once the samples arrived in Port Moresby they were kept frozen at <-20 ^{o}C. Urine collection caps and pipettes were disposed of in biohazard bags and taken to district/provincial MOPH biohazard waste management for incineration. The specimens were analyzed at the University of Papua New Guinea.

2.3.8 Stool testing

All eligible children 24-59 months were asked to provide a stool sample to look for the presence of hookworm infection. If the child was unable to provide a sample during the household visit, a container was left with the child's primary caretaker so that a specimen could be collected. Field workers arranged to re-visit the household the following day to collect the specimen. Using a wooden specimen stick, a small amount of stool (the size of a grape) was transferred to the specimen tube, which contained fixative. The cap was tightened and Parafilm was wrapped around the cap. The tube was then shaken vigorously and placed in a Ziploc bag before being transported to Port Moresby. The stool specimens were analyzed at the University of Papua New Guinea. A 10 % sub sample of the stool specimens was also analyzed at CDC.

2.3.9 Salt sample collection, processing and storage

The characteristics of household salt were assessed according to the type of salt (e.g. course versus fine), commercial producer (e.g. brand of salt), country where the salt was produced, the country where it was packaged and whether or not the salt was labeled as iodized.

Within each household, the household head was asked if a sample of each type of salt in the household could be taken from the household and tested. Households that provided a salt sample for quantitative analysis were given a replacement bag of national brand iodized salt.

Approximately four tablespoons of salt was collected from each household in a plastic Ziploc bag, and was sealed and labeled for transport to Port Moresby for quantitative analysis using the single wave length WYD Iodine Checker (Salt research institute 2006). Salt preparation and analysis was conducted according to the instrument manufacturer's procedures and was monitored by the Laboratory trainer from CDC.

If there were two types of salt in the household a sample of the second type of salt was also collected.

2.4 Data collection, entry and analysis

2.4.1 Data entry

A computer database, using CSPRO 3.1, was developed by a local consultant hired by UNICEF in Port Moresby to facilitate the entry of the survey data. Minimum and maximum allowable values, specified numbers of digits for entry, and skip patterns were embedded into the data entry screens to minimize data entry errors. The data were entered twice by trained university students at the University of Papua New Guinea, and the data files were compared electronically to correct any data entry errors.

Laboratory tests were single entered into Excel spreadsheets by each testing laboratory. Data in these spreadsheets were cleaned and merged with the questionnaire data, by individual or household ID numbers, for analysis.

2.4.2 Data analysis

Data analyses were performed using SPSS Version 13.0 (SPSS, Inc., Chicago, USA) and Epi Info Version 3.3.2, October 5, 2004 (CDC, Atlanta, USA).

Cutoffs to define vitamin and mineral deficiencies and their level of public health significance were based on WHO, UNICEF, CDC and INACG recommendations (Table 2.5). Cut-offs for anthropometry indicators used the new WHO growth standard (De Onis et al 2008).

Table 2.5 Biochemical indicators and cutoffs used to identify nutrition status within target group, National Nutrition Survey, Papua New Guinea 2005

Nutrition status	Indicator	Target group		
		Children (6-59 months)	**Non-Pregnant women (15-49 years)**	**Men (18> years)**
Iodine deficiency	Urinary iodine (UI)	Not tested	International cutoff not agreed upon. For this survey a median UI <100 µg/L was used as an indictor of moderate deficiency in the population	Not tested
Vitamin A deficiency	Retinol binding protein (RBP)	≤ 0.35 umol/L severe deficiency ≤ 0.70 umol/L deficiency	≤ 0.35 umol/L severe deficiency ≤ 0.70 umol/L deficiency	Not tested
Anemia	Hemoglobin (Hb)	<11.0 g/dL	<12.0 g/dL	<13.0 g/dL
Iron deficiency	Transferrin receptor (TfR)	>8.0 µg/l	>8.0 µg/l	Not tested
Iron deficiency anemia	Elevated TfR and low Hb	Hb<11.0 g/dL and TfR>8.0 µg/l	Hb<12.0 g/dL and TfR>8.0 µg/l	Not tested

2.4.3 Statistical weighting

Statistical weighting was used in the analysis because the actual number of households surveyed between regions was variable; therefore weighting at the regional level was required to calculate national estimates.

2.4.4 Anthropometry analysis and interpretation

a) Infants

Stunting, underweight, and wasting, were assessed in children using the new WHO 2006 growth standards (De Onis et al 2008). The results from the new WHO standards are presented in the body of the report. Information on anthropometric indices is presented in Table 2.6.

Table 2.6 Anthropometric indices

Type of malnutrition	Anthropometric index	Degree of malnutrition	Definition using z-score
Acute	Weight-for-height	Moderate	≥ -3.0 but < -2.0
		Severe	< -3.0 or edema
		None	≥ -2.0
Chronic	Height-for-age	Moderate	≥ -3.0 but < -2.0
		Severe	< -3.0
		None	≥ -2.0
Underweight	Weight-for-age	Moderate	≥ -3.0 but < -2.0
		Severe	< -3.0
		None	≥ -2.0

The anthropometric indicators length/height-for-age, weight-for-age, weight-for-length/height were determined for children surveyed using the WHO Anthro package. Values outside the following ranges were excluded from analyses as recommended by WHO:

Weight-for-Height Z-score (WHZ) <-5.0 or >5.0
Weight-for-Age Z-score (WAZ) <-6.0 or >5.0
Height-for-age Z-score (HAZ) <-6.0 or >6.0

At the population level, the prevalence of low Z-scores for each anthropometric index is categorized according to prevalence and public health significance (Table 2.7).

Table 2.7 Relative prevalence of low anthropometric values (WHO 1995)

Anthropometric Index	Low	Medium	High	Very High
Moderate WHZ	<5.0%	5.0-9.9%	10.0-14.9%	≥15.0%
Moderate HAZ	<20.0%	20.0-29.9%	30.0-39.9%	≥40.0%
Moderate WAZ	<10.0%	10.0-19.9%	20.0-29.9%	≥30.0%

b) Adults

Body Mass Index (BMI) was calculated for non pregnant women and men as weight (kg) divided by height (m) squared (wt[kg]/ht $[m]^2$). Malnutrition was assessed using WHO-recommended categories for BMI (WHO 1995).

BMI is used to classify an individual as underweight, normal weight, overweight or obese (see Table 2.8).

Table 2.8 BMI categories, National Nutrition Survey

BMI	Category of malnutrition
< 16.0	Severe thinness
16.0 – 16.9	Moderate thinness
17.0 - 18.4	Mild thinness
18.5 - 24.9	Normal
25.0 - 29.9	Overweight
≥ 30	Obese

Women who were pregnant at the time of the survey did not have their height and weight measured or blood and urine specimens collected.

The public health significance of the population prevalence of low BMI (<18.5) is presented in Table 2.9. A high prevalence of low BMI may be an indication of food insecurity and/or widespread disease. Excessive thinness may also highlight the vulnerability of populations living in difficult circumstances such as seasonal variation, drought or epidemics (WHO 1995).

Table 2.9 Categories of prevalence of low BMI (<18.5) according to public health significance (WHO 2008)

Normal	Low Prevalence (warning sign, monitoring required)	Medium Prevalence (poor situation)	High Prevalence (serious situation)	Very High Prevalence (critical situation)
3-5%	5-9%	10-19%	20-39%	≥40%

2.4.5 Urinary iodine analysis (UI) and data interpretation

Urinary Iodine (UI) concentration is the recommended biochemical index of choice for evaluating the degree of iodine deficiency and for assessing the impact of deficiency control programs. When appropriate sampling procedures are used, the UI concentration in casual urine samples collected from either children (6 – 12 years) or non-pregnant women can provide an adequate assessment of the iodine nutrition status in the population. The UI concentration in an individual can vary within a day and from day to day. This variation tends to even out among populations. Thus, the population distribution of the UI concentration is important, rather than individual UI concentrations. The UI concentrations obtained from populations are usually not normally distributed; the

median (rather than the mean) is therefore used as a measure of central tendency. In addition, percentiles rather than standard deviations are used as measures of spread.

For this survey Iodine deficiency was based on low urinary iodine (UI) level in a casual urine sample using Method A with ammonium persulfate (WHO 2001). Specimens were analyzed at the University of Papua New Guinea. Iodine status was only assessed for women of child-bearing age (15-49 years) as the survey was a household survey and school age children would be harder to access at the household.

The interpretation of a population's iodine status based on median urinary iodine levels is presented in Table 2.10.

Table 2.10 Epidemiological criteria for assessing a population's iodine status based on median urinary iodine concentrations

Median urinary iodine (ug/l)	Iodine intake	Iodine Status
Non-pregnant women		
< 20	Insufficient	Severe iodine deficiency
20-49	Insufficient	Moderate iodine deficiency
50-99	Insufficient	Mild iodine deficiency
100-199	Adequate	Adequate iodine nutrition
200-299	Above requirements	May pose a slight risk of more than adequate iodine intake in these populations
≥300	Excessive	Risk of adverse health consequences (iodine-induced hyperthyroidism, autoimmune thyroid disease)

2.5.6 Salt

The World Health Organization guidelines state that for successful elimination of iodine deficiency at least 90% of households should have access to, and regularly use, adequately iodized salt (≥15 parts per million [ppm] iodine content) (WHO/ICCIDD/UNICEF 2007).

2.5.7 Anemia

Anemia, defined as low Hb, is often used as a proxy indicator of iron deficiency. The Hb cut-offs for anemia, based on age and sex, are presented in Table 2.5. Hb values <4 g/dL or >18 g/dL were considered extreme and excluded from the analysis.

To determine the prevalence of anemia, the individual observed Hb concentrations were adjusted based on altitude, and cigarette smoking, according to WHO/UNICEF/UNU 2001 and INACG 2004 recommendations (Table 2.11).

Table 2.11 Adjustments to observed Hb values based on altitude, and cigarette smoking (WHO/UNICEF/UNU 2001, Nestel 2004 and CDC 1998)

Condition	Hemoglobin Adjustment (g/dL)
Altitude (m)	
m < 1000	--
1000≤ m <1250	-0.2
1250≤ m <1750	-0.5
1750≤ m <2250	-0.8
2250≤ m <2750	-1.3
2750≤ m <3250	-1.9
3250≤ m <3750	-2.7
3750≤ m <4250	-3.5
4250≤ m <4750	-4.5
4750≤ m <5250	-5.5
M ≥ 5250	-6.7
Cigarettes smoked per day	
Fewer than 10 cigarettes/day	--
10 ≤ cigarettes/day < 20	-0.3
20 ≤ cigarettes/day	-0.5
Smoker, amount unknown	-0.3

The public health significance of anemia, based on prevalence of the indicator, is presented in Table 2.12.

Table 2.12 WHO classification of public health significance of anemia in populations based on the prevalence of anemia

Category of public health significance	Prevalence of anemia (%)
Severe	≥ 40
Moderate	20.0 – 39.9
Mild	5.0 – 19.9
Expected	≤ 4.9

2.5.8 Iron deficiency (ID)

Transferrin receptor levels >8.0 µg/l for children 6-59 months old and non pregnant women of child bearing age were used to indicate iron deficiency (WHO 2001).

2.5.9 Iron deficiency Anemia (IDA)

An individual was classified with IDA if s/he was simultaneously categorized with both iron deficiency (high TfR) and anemia (low haemoglobin) according to the criteria outlined above.

2.5.10 Vitamin A deficiency (VAD)

Vitamin A deficiency was defined as RBP less than 0.70µmol/l (Sommer 2002). The presence of infection and/or inflammation was assessed using C-reactive protein (CRP)

and Alpha acid-1 glycoprotein (AGP). An elevated CRP concentration (>5 mg/L) and an elevated AGP concentration (>1.2 mg/L) indicates the presence of an acute phase response due to infection and/or inflammation (Erdhardt 2006). The prevalence of vitamin A deficiency was calculated in two ways, 1) not excluding for inflammation (ie elevated acute phase proteins) and 2) excluding the vitaminA results of women and children with inflammation identified by a CRP >5mg/L and/or AGP >1.2 mg/l.

Sub-clinical vitamin A deficiency is defined as retinol binding protein < 0.7 µmol/L, while severe vitamin A deficiency is defined as retinol binding protein < 0.35 µmol/L. The public health burden of vitamin A deficiency can be determined based on the prevalence of low serum retinol in preschool children, as proposed by the WHO (Table 2.13). In addition, criteria proposed by the International Vitamin A Consultative Group (IVACG) state that a prevalence of serum retinol concentration < 0.7 µmol/L >15% among children 2-5 years of age constitutes a public health problem.

Table 2.13 Public health burden of vitamin A deficiency based on serum retinol ≤0.70µmol/L in children ≥ 1 year (WHO 1996)

Public health burden of vitamin A deficiency	Prevalence of low serum retinol (%)
Mild	≥2 to ≤10
Moderate	>10% to <20
Severe	≥20

2.5.11 C- reactive protein (CRP) analysis

The acute phase proteins (APP) are biomarkers for sub-clinical inflammation. The APP includes C-reactive protein (CRP) and Alpha-1-acid-glycoprotein (AGP). CRP is an indicator of acute inflammation, because plasma concentration of CRP starts to increases 6 hours after on-set of infection, it reaches maximum 24 to 48 hours later and start decreasing thereafter. AGP is an indicator of chronic inflammation, because plasma concentration of AGP is slow to rise and reaches maximum about 2 to 5 days after infection (Biesalski 2007).

The prevalence of infection acute phase proteins was assessed by the elevation of C-reactive protein (CRP). According to the manufacturer, a concentration of >5 mg/L indicated an acute phase response and subjects with positive CRP test results were excluded from analysis of vitamin A deficiency.

2.5.12 Alpha 1-acid glycoprotein (AGP) Analysis

The prevalence of chronic infection acute phase proteins was assessed by the elevation of Alpha 1-acid glycoprotein (AGP). According to the manufacturer, a concentration of >1.2mg/L indicates an acute phase response. The vitamin A data of all individuals with elevated AGP (>1.2mg/L) were excluded from the data used to indicate prevalence of vitamin A deficiency.

SUMMARY OF KEY FINDINGS

CHAPTER 3. DEMOGRAPHIC CHARACTERISTICS

The population groups included in the survey and the number of participants surveyed for the indicators are summarized in Table 3.1.

Table 3.1 Survey sample size by indicator and population group, National Nutrition Survey, Papua New Guinea 2005

Indicator	Preschool Children 6-59 months	Non-pregnant women 15-49 years	Adult men >18 years	Household
ANTHROPOMETRY*				
Weight and height/length	930	779	789	-
IODINE				
Urinary iodine	-	690	-	-
Salt (WYD Checker)	-	-	-	820
STOOL				
Hookworm**	363	-	-	-
VITAMIN A				
Retional binding protein (DBS)	875	756	-	-
INFLAMMATION				
CRP (DBS)	874	756	-	-
AGP (DBS)	874	756	-	-
ANEMIA AND IRON DEFICIENCY				
Hb	910	760	778	-
TfR (DBS)	872	753	-	-

* One or more anthropometric measures
** Children 24-59 months

3.1 Preschool children

The age and sex distribution of the 937 children 6-59 months of age who were surveyed are presented in Table 3.2. The mean age of the children was 31 months with a median age of 30 months. The children were proportionally distributed by age groups (see Table 3.2) except for the children aged 48-59 months. The number of children in this age group was lower than expected. The survey was household based so some of the children in this age group may have been attending school and not available to participate.

Although the proportion of boys (54.6%) was slightly higher than that of girls (45.4%), the sex ratio of boys to girls was 1.2, and a ratio between 0.8 and 1.2 indicates that the sampling of boys compared to girls in the survey is likely not biased (Prudhon 2001).

Table 3.2 Age and sex distribution of children 6 through 59 months of age by region, PNG National Nutrition Survey 2005 (N=934)

Age group (months)	Southern		Highlands		Mamose		Islands		National*	
	N	%	N	%	N	%	N	%	N	%
6-11	29	12.9	23	11.0	25	9.8	29	11.8	106	11.2
12-23	54	24.0	51	24.4	68	26.8	56	22.8	229	24.8
24-35	60	26.7	49	23.4	58	22.8	68	27.6	235	24.6
36-47	52	23.1	45	21.5	48	18.9	53	21.5	198	21.1
48-59	30	13.3	41	19.6	55	21.7	40	16.3	166	18.4
Sex										
Male	121	54.0	122	58.7	134	52.5	127	51.4	504	54.6
Female	103	46.0	86	41.3	121	47.5	120	48.6	430	45.4

*Weighted analysis to account for complex survey design

3.2 Women of childbearing age

A total of 850 women aged 15 through 49 years participated in the survey and their age distribution is shown in Table 3.3. The largest proportion of women (20.2%), were 25-29 years old, while 40-44 year old women represented the smallest proportion (8.0%). Overall, the women surveyed were more likely to be younger (54.7% were <30 years old).

The majority of women (72.6%) had some form of education, with 44.4% of women education between grades 4 and 8. The survey did not include questions about literacy.

Out of the 850 women included in the survey, 71.8% of women had ever been pregnant. At the time of the survey 8.1% of women were currently pregnant. These women were included in the survey but they were not measured and did not have any blood or urine specimens collected. Just over half of the women (57.9%) had delivered a child within the previous three years. Where possible, the interviewer confirmed this by looking at the woman's Meri book [1].

Almost a quarter of women smoked cigarettes. In Mamose region the proportion of women who smoke rose to just over a third of women. Most women were light smokers with the majority smoking less than 10 cigarettes per day on average. Table 3.3 summarizes the demographic characteristics of women surveyed.

[1] Meri book is a women's health card.

Table 3.3 Distribution of demographic characteristics of women 15 through 49 years by region, PNG National Nutrition Survey 2005

Characteristics	Southern		Highlands		Mamose		Islands		National	
	N	%	N	%	N	%	N	%	N	%
Age groups										
15-19	49	19.0	37	18.4	25	13.2	30	16.9	141	16.9
20-24	60	22.1	31	15.4	38	20.0	23	13.0	152	17.6
25-29	50	17.3	47	23.4	32	16.8	38	21.5	167	20.2
30-34	34	12.1	36	17.9	32	16.8	40	22.6	142	17.1
35-39	26	9.6	22	10.9	28	14.7	16	9.0	92	11.4
40-44	30	11.0	10	5.0	18	9.5	18	10.2	76	8.0
45-49	24	8.8	18	9.0	17	8.9	12	6.8	71	8.6
Highest grade of education										
No formal education	44	16.1	69	34.3	60	34.1	17	9.7	190	27.4
Grades 1-3	18	6.9	23	11.4	27	15.3	22	12.6	90	11.7
Grades 4-8	136	51.1	80	39.8	73	41.5	96	54.9	385	44.4
Grades 9-12	66	24.4	28	13.9	15	8.5	38	21.7	147	15.7
Higher education	5	1.5	1	0.5	1	0.6	2	1.1	9	0.8
Ever been pregnant										
Yes	196	70.9	137	68.2	147	77.0	135	74.2	615	71.8
No	80	29.1	64	31.8	44	23.0	47	25.8	235	28.2
Currently pregnant										
Yes	16	5.6	19	9.5	15	7.9	14	7.7	64	8.1
No	258	94.1	181	90.5	176	92.1	168	92.3	783	91.9
Delivery within past 3 years										
Yes	102	51.6	82	57.7	88	59.9	85	63.0	357	57.9
No	96	48.4	60	42.3	59	40.1	50	37.0	265	42.1
Smokes cigarettes										
Yes	41	13.6	43	21.4	66	34.6	32	17.7	182	22.9
No	234	86.4	158	78.6	125	65.4	149	82.3	666	77.1
Average no: cigarettes per day										
1-9	38	94.0	35	83.3	52	81.3	30	93.8	155	84.8
10-19	2	6.0	4	9.5	3	4.7	1	3.1	10	6.5
20+	0	0.0	3	7.1	9	14.1	1	3.1	13	8.6

Weighted analysis to account for complex survey design

3.3 Adult men

Table 3.4 shows the demographic characteristics of men surveyed. The greatest proportion of men included in the survey were between 18 and 29 years of age. Almost a quarter of the men surveyed had no formal education. Just over half of the men had received some education between grades 1-8. Approximately the same proportion of men as women had education between grades 4-8. Just over half of all men smoked tobacco. Most men smoked less then 10 sticks per day but almost a fifth of men smoked more than 10 sticks per day.

Table 3.4 Distribution of demographic characteristics of men 18 years and older by region, PNG National Nutrition Survey 2005

Characteristics	Southern		Highlands		Mamose		Islands		National	
	N	%	N	%	N	%	N	%	N	%
Age groups										
18-29 years	74	34.6	76	36.0	69	35.2	62	34.6	281	35.3
30-39	48	23.3	45	21.3	58	29.6	53	29.6	204	25.0
40-49	48	23.0	38	18.0	30	15.3	31	17.3	147	18.2
50-59	26	12.1	28	13.3	27	13.8	17	9.5	98	12.6
60-69	14	7.0	17	8.1	11	5.6	14	7.8	56	7.2
70+	0	0	7	3.3	1	0.5	2	1.1	10	1.6
Highest grade of education										
No formal education	16	8.2	66	31.6	33	17.8	14	7.9	129	20.0
Grades 1-3	15	7.2	28	13.4	29	15.7	14	7.9	86	11.9
Grades 4-8	104	48.3	78	37.3	90	48.6	94	52.8	366	44.6
Grades 9-12	67	35.2	31	14.8	30	16.2	51	28.7	179	21.2
Higher education	2	1.2	6	2.9	3	1.6	5	2.8	16	2.2
Smokes cigarettes										
Yes	117	54.6	105	50.5	129	65.9	112	61.5	463	56.9
No	91	45.4	103	49.5	66	34.1	70	38.5	330	43.2
Average no: cigarettes per day										
1-9	96	80.8	78	74.3	105	80.8	102	91.1	381	80.1
10-19	13	11.0	16	15.2	17	13.1	7	6.3	50	12.4
20+	10	8.2	11	10.5	8	6.2	3	2.7	32	7.5

Weighted analysis to account for complex survey design

3.4 Household characteristics

A summary of the household data is presented in Table 3.5. Less than a fifth of survey respondents lived in urban areas of Papua New Guinea. The highest proportion of people living in urban areas was in the Southern region as the National Capital District falls within this region. Urban and rural areas were defined using information from the National statistics bureau and the census, which had determined if a census unit was considered urban or rural.

Just half of all households (47.5%) had at least one preschool child (6-59 months of age). The average number of children per household did not differ much between regions. The Mamose region had the highest proportion of children 6-59 months per household compared to the other three regions.

Nearly all the households had at least one adult man residing there (95.0%). There were more men living in households in the Southern region compared to the other three regions and nationally. Overall, compared to households without men, there were a greater proportion of households that did not have a woman residing there (13.4%). The average number of women per household was lower in the Highlands and Island regions.

Table 3.5 Household demographic characteristics, PNG National Nutrition Survey 2005

	Southern		Highlands		Mamose		Islands		National	
Demographic characteristic	N	%	N	%	N	%	N	%	N	%
Location										
Urban	124	36.3	39	10.9	53	15.0	27	7.8	243	16.8
Rural	218	63.7	320	89.1	301	85.0	321	92.2	1160	83.2
Number of preschool children (6-59 months) per household										
0	171	50.1	177	49.3	153	43.2	159	45.7	660	47.2
1	106	31.1	135	37.6	133	37.6	126	36.2	500	36.0
2	55	16.1	39	10.9	62	17.5	58	16.7	214	14.7
3	6	1.8	6	1.7	6	1.7	5	1.4	23	1.7
≥4	3	0.9	2	0.6	0	0	0	0	5	0.4
Average No. per HH	0.73		0.67		0.78		0.74		0.72	
Number of women (15-49 years) per household										
0	43	12.6	57	15.9	41	11.6	42	12.1	183	13.4
1	182	53.4	205	57.1	203	57.3	215	61.8	805	57.1
2	68	19.9	62	17.3	71	20.1	61	17.5	262	18.6
3	34	10.0	22	6.1	32	9.0	23	6.6	111	7.8
4	8	2.3	10	2.8	5	1.4	3	0.9	26	2.0
5	5	1.5	1	0.3	2	0.6	3	0.9	11	0.7
6	0	0	2	0.6	0	0	1	0.3	3	0.2
≥7	1	0.3	0	0	0	0	0	0	1	0.1
Average No. per HH	1.42		1.26		1.33		1.26		1.31	
Number of men (18-60 years) per household										
0	18	5.3	19	5.3	15	4.2	18	5.2	70	5.0
1	174	51.0	215	59.9	228	64.4	224	64.4	841	60.0
2	87	25.5	87	24.2	73	20.6	68	19.5	315	22.8
3	37	10.9	29	8.1	26	7.3	27	7.8	119	8.4
4	17	5.0	6	1.7	9	2.5	5	1.4	37	2.6
5	8	2.3	0	0	2	0.6	4	1.1	14	0.8
6	0	0	2	0.6	1	0.3	1	0.3	4	0.3
≥7	0	0	1	0.3	0	0	18	0.3	2	0.1
Average No. per HH	1.66		1.45		1.42		1.42		1.48	

Weighted analysis to account for complex survey design

3.5 House structure

Using the national census definition for types of house structure the survey interviewers classified the structure occupied by each household participating in the survey. Table 3.6 summarizes the prevalence of different housing structures of survey respondents. Most respondents live in traditional style housing (Table 3.6).

Table 3.6 Distribution of households by type of housing structure and by region. PNG National Nutrition Survey 2005

Type of House	Southern		Highlands		Mamose		Islands		National	
	N	%	N	%	N	%	N	%	N	%
High cost house	10	2.9	12	3.3	6	1.7	21	6.1	49	3.2
Low cost house	7	2.1	13	3.6	13	3.7	20	5.8	53	3.7
Flat	9	2.6	0	0	1	0.3	0	0	10	0.6
Duplex	8	2.4	3	0.8	2	0.6	15	4.3	28	1.6
Domestic Quarters	1	0.3	0	0	2	0.6	0	0	3	0.2
Makeshift	22	6.5	5	1.4	2	0.6	27	7.8	56	3.0
Traditional	198	58.2	285	79.4	274	77.4	163	47.2	920	70.7
Self-help High cost	20	5.9	6	1.7	8	2.3	50	14.5	84	4.3
Self-help low cost	65	19.1	35	9.7	45	12.7	49	14.2	194	12.8
Other	0	0.0	0	0.0	1	0.3	0	0.0	1	0.1

Weighted analysis to account for complex survey design

3.6 Household water supplies

Survey respondents accessed water from many different sources. Surface water was the most commonly used form of water, but in the Southern region almost a third of households accessed water from a well. In the Highlands and Mamose region the most common source of household water was from rivers and streams and for the Islands the most common source was rainwater (Table 3.7).

Table 3.7 Distribution of main source of household drinking water by region, PNG National Nutrition Survey 2005

Source of drinking water	Southern		Highlands		Mamose		Islands		National	
	N	%	N	%	N	%	N	%	N	%
Piped	99	28.9	47	13.1	77	21.8	33	9.5	256	18.3
Well	99	28.9	-	-	44	12.4	18	5.2	161	10.3
Surface	53	15.5	280	78	168	47.5	110	31.6	611	49.7
Communal tank	20	5.8	26	7.2	30	8.5	4	1.1	80	6.4
Rainwater	44	12.9	5	1.4	33	9.3	180	51.7	262	13.5
Other Source	26	7.6	-	-	2	0.6	1	0.3	29	1.9

Weighted analysis to account for complex survey design

3.7 Household sanitary facilities

Table 3.8 summarizes the different types of sanitary facilities used in households included in the survey. Approximately half of all households nationally and regionally used latrines as their primary sanitary facility. The only exception was the Highlands region where an open pit was more commonly used. In the Southern region about one fifth of households did not use any facilities at all. The use of septic tanks was more common in the Islands and Southern region.

Table 3.8 Distribution of households by type of sanitary facilities and by region, PNG National Nutrition Survey 2005

	Southern		Highlands		Mamose		Islands		National	
Type of Sanitary facility	N	%	N	%	N	%	N	%	N	%
No facilities - bush or field	73	21.4	24	6.7	28	7.9	86	24.7	211	12.6
Flush to sewage system or septic tank	43	12.6	22	6.1	14	4.0	58	16.7	137	8.4
latrine (water, traditional or VIP)	217	63.5	69	19.2	247	69.8	174	50.0	707	47.1
Pit/bucket/overhang	9.0	2.6	244	68	65	18.4	29	8.3	347	31.6
Other	-	-	-	-	-	-	1	0.3	1	0.3

Weighted analysis to account for complex survey design

3.8 Frequency of listening to the radio

The purpose of asking a question on listening to the radio was to be able to ascertain if radio would be a good medium for communicating health messages. Table 3.9 presents the frequency with which households in PNG listen to the radio.

Just under half of all the households interviewed never listen to the radio. Only 16.9% of households listen to the radio on a daily or weekly basis. People in the Islands have more access to the radio than people in the other regions.

Table 3.9 Distribution of frequency of radio listening by region, PNG National Nutrition Survey 2005

	Southern		Highlands		Mamose		Islands		National	
Frequency of radio listening	N	%	N	%	N	%	N	%	N	%
Never	116	34.2	205	58.2	144	40.8	72	21.1	537	44.1
Every day	45	13.3	54	15.3	49	13.9	26	7.6	174	13.5
Every week	12	3.5	3	0.9	5	1.4	51	14.9	71	3.4
Occasionally	103	30.4	90	25.6	123	34.8	149	43.6	465	31.4
Other	63	18.6	352	58.2	32	9.1	44	12.9	139	7.5

Weighted analysis to account for complex survey design

CHAPTER 4. ANTHROPOMETRY

This chapter summarizes data on overall nutritional status of preschool children (6-59 months), non-pregnant women of childbearing age (15-49 years) and adult men age 18 years and older. Cut-offs for anthropometry indicators used the WHO child growth standards (De Onis 2008). The prevalence of stunting, wasting and underweight calculated using the NCHS/CDC/WHO reference is included in appendix 12.

4.1 Preschool Children

4.1.1 Length/Height-for-age (HAZ)

Of the 937 children surveyed 930 had at least one anthropometric measurement, 892 had valid length or height, age and sex data which allowed for the determination of length/height-for-age (HAZ) values. HAZ values outside of the plausible range (described in methods section) were excluded from these analyses. The mean z-score was -1.81 (SD=1.39). Potentially erroneous HAZ values were most likely due to inaccurate age determinations for the children because of inexact birth dates as well as inaccurate height measurements.

The HAZ data in preschool are summarized in Table 4.1. The estimated prevalence of stunting (HAZ <-2 SD) was 43.9%. This is considered “high” (WHO, 1995) and reflects a serious problem of chronic malnutrition among young children in PNG.

Children in the Mamose region were most likely to be stunted whereas children in the Southern region were less stunted. There was a strong association between stunting and urban and rural location, with children in rural areas being more likely to be stunted.

Males were also more likely to be both moderately and severely stunted than females. There was a strong association between age and stunting. Children aged 6-11 months had a lower prevalence of stunting than other age groups (24.1%). The prevalence of stunting rises sharply in children 12-23 months to 45.5% and remains high in children up to 59 months of age.

Table 4.1 Length/Height–for-age Z-score (HAZ) summary statistics among children 6-59 months, PNG National Nutrition Survey 2005. WHO standard 2005

			Prevalence of low HAZ (%)			
Demographic Characteristic	**N**	**Mean HAZ ± SD**	**<-2 SD**	**95% CI**	**<-3 SD**	**95% CI**
National	**892**	**-1.81 ± 1.39**	**43.9**	**38.8, 49.2**	**17.6**	**14.6, 21.0**
Region						
Southern	214	-1.44 ± 1.43	30.8	21.0, 42.8	10.7	5.7, 19.2
Highlands	203	-1.88 ± 1.39	46.3	38.0, 54.9	17.7	13.1, 23.5
Mamose	244	-2.03 ± 1.41	52.0	40.6, 63.3	23.4	16.9, 31.3
Islands	231	-1.77 ± 1.27	40.3	32.1, 49.0	15.2	10.1, 22.2
Residence						
Urban	175	-1.46 ± 1.19	27.8	19.1, 38.5	8.4	4.3, 15.7
Rural	717	-1.90 ± 1.42	47.9	42.3, 53.6	19.9	16.5, 23.8
Sex						
Male	484	-1.99 ± 1.41	47.4	41.6, 53.3	22.8	18.6, 27.6
Female	408	-1.61 ± 1.34	39.6	33.3, 46.3	11.3	8.6, 14.8
Age groups (months)						
6-11	100	-1.09 ± 1.49	24.1	15.9, 34.8	6.1	2.6, 13.6
12-23	223	-1.85 ± 1.47	45.5	37.7, 53.7	19.3	14.3, 25.4
24-35	215	-1.89 ± 1.34	47.4	40.2, 54.7	18.0	13.1, 24.3
36-47	192	-1.97 ± 1.24	46.8	39.8, 53.9	18.9	13.9, 25.0
48-59	162	-1.91 ± 1.33	45.7	37.2, 54.4	20.2	14.5, 27.4

Means and standard deviations (SD) are weighted and are calculated assuming simple random sampling; prevalence estimates and 95% CI are calculated using statistical weights to account for the complex sample design.

4.1.2 Weight-for-Height/Length

Of the 937 preschool children surveyed, 897 children had valid weight, height/length and sex data to allow for the determination of weight–for-height/length Z-scores (Table 4.2). The mean z-score was -0.12 (SD= 1.08), (Table 4.2). Wasting was not very prevalent among children less than five years of age in Papua New Guinea. Using the WHO 2005 standards 4.5% of children had a low Weight-for-Height. Of these children 0.9% of children were severely wasted (WHZ<-3).

Children in the Mamose region were more likely to be wasted than children in the other three regions. The prevalence of wasting in the Highlands was much lower than in the other regions and none of the children in the Highlands were severely wasted. The prevalence of wasting was not substantially different based on urban and rural location or sex of the children.

Table 4.2 Weight-for-Height Z-score (WHZ) summary statistics among children 6-59 months, PNG National Nutrition Survey 2005. WHO standard 2005.

Demographic Characteristic	N	Mean WHZ ± SD	Prevalence of low WHZ (%)			
			< -2 z-scores	95% CI	<3 z-scores	95% CI
National	**897**	**-0.12 ± 1.08**	**4.5**	**3.1, 6.5**	**0.9**	**0.4, 1.9**
Region						
Southern	212	-0.41 ± 0.94	3.3	1.4, 7.7	0.9	0.2, 3.7
Highlands	203	-0.51 ± 1.02	1.5	0.5, 4.2	0.0	0.0
Mamose	244	-0.55 ± 1.05	8.2	4.7, 13.8	2.0	0.8, 5.3
Islands	238	-0.23 ± 1.02	5.0	2.7, 9.1	0.4	0.1, 2.9
Residence						
Urban	174	-0.05 ± 1.11	2.4	0.5, 10.0	0.0	0.0
Rural	723	-0.13 ± 1.08	5.0	3.4, 7.4	1.1	0.5, 2.3
Sex						
Male	485	-0.10 ± 1.12	4.9	3.2, 7.4	1.0	0.4,2.4
Female	412	-0.15 ± 1.03	4.0	2.2, 7.0	0.8	0.3, 2.3
Age groups (months)						
6-11	103	-0.49 ± 1.08	8.3	4.4, 15.0	0.0	0.0
12-23	224	-0.42 ± 1.11	8.3	5.0, 13.0	1.5	0.5, 4.4
24-35	213	-0.007 ± 1.02	4.4	2.1, 8.9	0.8	0.2, 3.2
36-47	193	-0.07 ± 1.06	1.5	0.5, 4.6	1.2	0.3, 4.5
48-59	161	-0.16 ± 1.00	0.4	0.0, 2.6	0.0	0.0

Means and standard deviations (SD) are weighted and are calculated assuming simple random sampling; prevalence estimates and 95% CI are calculated using statistical weights to account for the complex sample design.

4.1.3 Weight-for-Age

Of the 937 preschool children surveyed, 924 children had valid weight, age and sex data to allow for the determination of weight–for-age Z-scores (Table 4.3). The mean z-score was -1.10 (SD= 1.15). Overall the prevalence of WAZ <-2 was 18.1%. Most of the children were only moderately underweight, with the prevalence of severe underweight being very low (5.2%).

Children in the Mamose region were more likely to be underweight than children in the other three regions. Almost one third of children in Mamose were underweight and these children were twice as likely to be severely underweight than children from the other regions.

Table 4.3 Weight-for-age summary statistics (WAZ) among children 6-59 months, PNG National Nutrition Survey 2005. WHO standard 2005

			Prevalence of low WAZ (%)			
Demographic Characteristics	**N**	**Mean WAZ ± SD**	**<-2 SD**	**95% CI**	**<-3 SD**	**95% CI**
National	**924**	**-1.10 ± 1.15**	**18.1**	**14.9, 21.9**	**5.2**	**3.7, 7.2**
Region						
Southern	217	-1.08 ± 1.07	17.1	10.3, 26.9	4.6	1.8, 11.2
Highlands	207	-0.69 ± 1.03	7.2	4.3, 11.9	1.9	0.6, 5.7
Mamose	254	-1.52 ± 1.12*	31.9	24.4, 40.4	9.1	5.7, 14.0
Islands	246	-1.15 ± 1.19	15.0	11.2, 19.9	4.9	2.6, 9.1
Residence						
Urban	178	-0.81 ± 0.96	12.3	4.8, 28.2	0.8	0.1, 4.8
Rural	746	-1.17 ± 1.17	19.5	16.2, 23.4	6.2	4.5, 8.5
Sex						
Male	500	-1.17 ± 1.11	21.0	17.1, 25.6	6.4	4.2, 9.6
Female	424	-1.02 ± 1.17	14.6	11.0, 19.2	3.7	2.2, 6.0
Age groups (months)						
6-11	104	-0.91 ± 1.43	20.2	13.2, 29.6	2.3	0.7, 7.2
12-23	227	-1.21 ± 1.20	23.2	18.2, 29.2	8.4	5.2, 13.4
24-35	232	-1.11 ± 1.12	17.4	12.5, 23.6	4.2	2.2, 7.7
36-47	196	-1.11 ± 1.04	14.3	9.7, 20.6	5.4	3.2, 9.1
48-59	165	-1.04 ± 1.01	15.3	10.1, 22.6	3.5	1.3, 8.9

Means and standard deviations (SD) are weighted and are calculated assuming simple random sampling; prevalence estimates and 95% CI are calculated using statistical weights to account for the complex sample design.

4.1.4 Body Mass Index for age

WHO recommends that body mass index for age is used to calculate the prevalence of overweight in children 6-59 months (De Onis 2008).

Of the 937 preschool children surveyed, 892 children had valid weight, height/length, age and sex data to allow for the determination of body mass index for age Z-scores. Overall the prevalence of overweight (BAZ >2 z scores) was 4.8%. In comparison, 2.3 % of children of children in the WHO reference population fall into this category. Children in the Highlands were more likely to be overweight than children from the other regions (Table 4.4).

The prevalence of overweight is very low in children less than one year of age. It peaks at around 3-4 years of age and declines slightly in the 4-5 year old age group.

Table 4.4 Body Mass-for-age Z-score (BAZ) summary statistics among children 6-59 months, PNG National NutritionSurvey 2005. WHO standard 2005.

		Prevalence of low BAZ (%)					
Demographic Characteristics	**N**	**< -2 z-scores**	**95% CI**	**-2 - +2 Z-scores**	**95% CI**	**> + 2 Z-scores**	**95% CI**
National	**892**	**3.9**	**2.7, 5.8**	**91.3**	**88.5, 3.5**	**4.8**	**3.0, 7.5**
Region							
Southern	212	2.8	1.2, 6.7	95.3	91.2, 97.5	1.9	0.6, 5.9
Highlands	202	1.0	0.3, 3.7	89.1	81.6, 93.8	9.9	5.4, 17.3
Mamose	241	7.5	4.4, 12.4	90.9	86.3, 94.0	1.7	0.7, 4.1
Islands	237	4.6	2.3, 9.0	91.6	87.5, 94.4	3.8	2.1, 6.9
Residence							
Urban	174	3.0	0.9, 9.5	91.5	78.0, 97.1	5.4	1.0, 24.4
Rural	718	4.1	2.7, 6.3	91.3	88.7, 3.3	4.6	3.2, 6.7
Sex							
Male	483	3.9	2.5, 5.9	90.3	86.9, 92.9	5.8	3.7, 9.0
Female	409	4.0	2.4, 6.7	92.5	88.8, 95.1	3.5	1.6, 7.2
Age groups (months)							
6-11	103	8.6	4.6, 15.6	89.9	82.4, 94.4	1.4	0.2, 9.6
12-23	224	6.8	4.0, 11.3	90.5	85.9, 93.7	2.7	1.2, 6.0
24-35	213	3.0	1.3, 6.7	92.0	86.3, 95.5	5.0	2.2, 10.8
36-47	191	2.1	0.8, 5.5	89.9	84.5, 93.5	8.0	4.8, 13.3
48-59	160	0.4	0.1, 2.6	94.0	85.4, 97.7	5.6	2.0, 14.5

Prevalence estimates and 95% CI are calculated using statistical weights to account for the complex sample design.

Figure 4.1 shows that, as expected, stunting was the most prevalent while wasting was the least common form of malnutrition.

Figure 4.1 Prevalence of general malnutrition among children 6-59 months old based on anthropometric indicators, PNG National Nutrition Survey 2005.

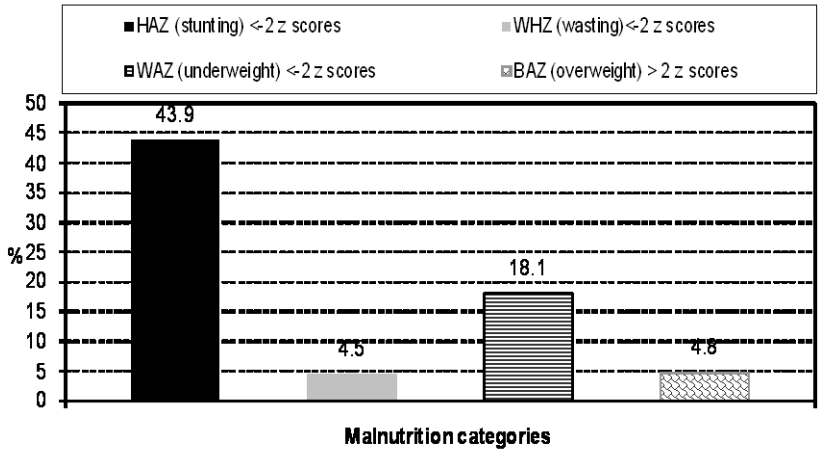


Figure 4.2 presents the distribution of HAZ, WAZ and WHZ z-scores against the WHO 2005 standard. The distribution of HAZ and WAZ z-scores is shifted to the left of the reference population, and the WHZ z-score is shifted only slightly to the left.

Figure 4.2 Observed Z-score distributions (HAZ, WAZ, WHZ) in children 6-59.9 months calculated from the WHO standard, PNG National Nutrition Survey 2005.

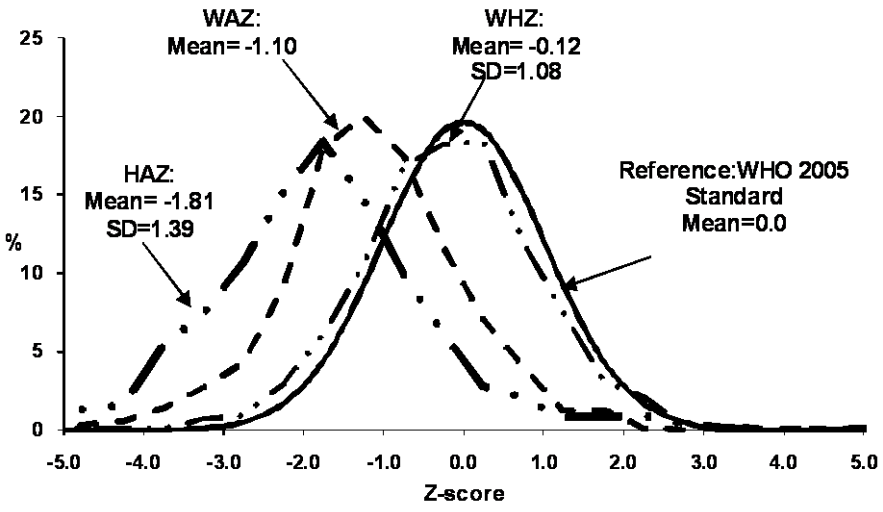
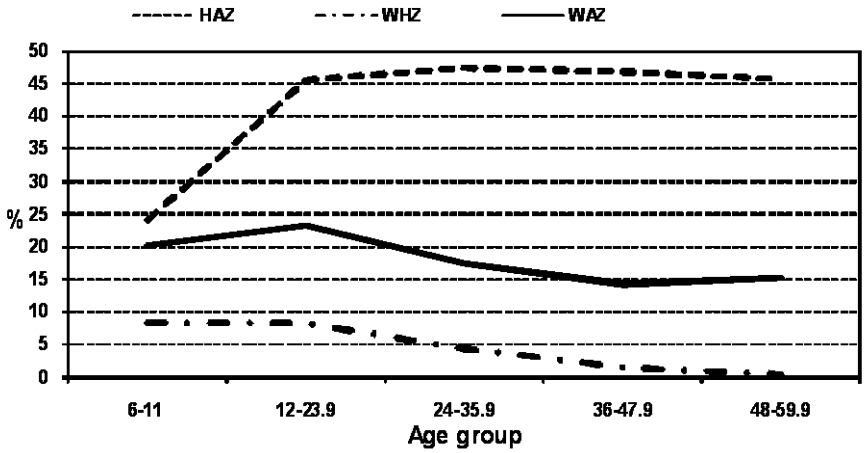


Figure 4.3 shows the prevalence of stunting (HAZ), wasting (WHZ) and underweight (WAZ) by age group. This graph demonstrates that stunting increases very rapidly from 6 months, whereas wasting and underweight peak in the 2nd year of life and, decreased thereafter with age.

Figure 4.3 Prevalence of HAZ, WAZ and WHZ <-2 SD by age group, PNG National Nutrition Survey 2005.



4.2 Non-pregnant women of childbearing age (15-49 years old)

Heights and weights of adult women were measured to assess their overall nutritional status based on body mass index (BMI). Of the 783 non-pregnant women surveyed, 772 women had both valid weight and height data to allow for the determination of body mass index (BMI). There were 64 pregnant women who were not measured. A summary of anthropometric data on 772 non-pregnant women of child bearing age is presented in Table 4.5. There was a trend toward increasing weight of women by age. Women in Mamose were also more likely to weigh less than women in other regions.

Table 4.5 Mean height and weight of non-pregnant women 15-49 years of age, PNG National Nutrition Survey 2005

Demographic characteristic	N	Mean height[1] ± SD	N	Mean weight[2] ± SD
National	**772**	**155.1 ± 6.2**	**779**	**55.3 ± 10.7**
Regional				
Southern	250	156.6± 6.1	254	55.9 ± 11.7
Highlands	182	153.8± 5.3	182	56.4 ± 8.5
Mamose	174	153.6± 6.7	176	50.7 ± 9.2
Islands	166	156.1± 6.0	167	57.9 ± 11.5
Residence				
Urban	185	156.7 ±6.1	189	60.4 ± 12.9
Rural	587	154.6 ±6.11519	590	53.6 ± 9.4
Age Group (years)				
15-19.9	136	154.5 ± 5.8	136	53.2± 7.6
20-29.9	280	1545.2 ± 6.5	282	54.1 ± 8.7
30 – 39.9	208	155.1 ± 6.6	211	56.7 ± 12.5
40-49.9	141	155.0 ± 5.4	143	57.7± 13.4
Education				
None	173	153.0 ± 6.1	174	51.8 ± 9.5
1-3 years	426	155.5 ± 6.0	431	55.3 ± 10.6
4 years +	144	157.0 ± 5.8	145	59.7 ± 11.1

Means are weighted and standard deviations (SDs) calculated assuming simple random sampling
1 In centimeters
2 In kilograms

The mean BMI for women was 22.9 (SD 3.8). The prevalence of underweight women with a BMI of <18.5 was low (5.3%). The highest prevalence of underweight was in the Southern region (11.2%).

Women in the Highlands and Islands were more overweight than women in the other two regions. The prevalence of obese women with a BMI of >30.0 in PNG was below 10% in all four regions and nationally.

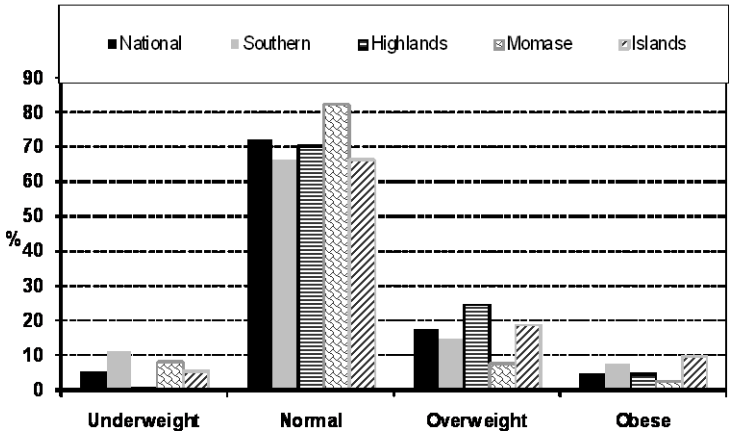
There was a strong association between educational attainment and BMI. A higher proportion of women with education up to grades 9-12 were obese compared with women with less education. Women in urban areas were also more likely to be overweight and obese than women living in rural areas. All BMI calculations by various indicators are displayed in Tables 4.6 and figure 4.4.

Table 4.6 Summary of body mass index (BMI) data for non-pregnant women 15-49 years of age, PNG National Nutrition Survey 2005

		Body Mass Index				
Demographic Characteristics	**N**	**<18.5 (CI 95%) Underweight**	**18.5-24.9 (CI 95%) Normal**	**25.0-29.9 (CI 95%) Overweight**	**>30.0 (CI 95%) Obese**	**Mean ± SD**
National	**772**	**5.3 3.5, 7.8**	**72.2 67.5, 76.4**	**17.4 14.1, 21.4**	**5.1 3.4, 7.7**	**22.9 + 3.8**
Regional						
Southern	250	11.2 7.6,16.2	66.4 58.5,73.5	14.9 9.9,21.9	7.5 4.2, 13.1	22.8 + 4.3
Highlands	182	0.5 0.1, 3.8	70.3 61.3, 78.0	24.7 18.4, 32.4	4.4 2.0, 9.2	23.8 + 3.0
Mamose	174	8.0 3.5, 17.3	82.2 72.9, 88.8	7.5 3.7, 14.5	2.3 0.7, 7.3	21.4 + 3.0
Islands	166	5.4 3.0, 9.5	66.3 56.6, 74.8	18.7 12.9, 26.2	9.6 3.7, 22.9	23.7 + 4.1
Residence						
Urban	185	4.8 2.2, 10.1	58.4 48.7, 67.5	23.2 14.9, 34.2	13.6 7.5, 23.4	24.6 + 4.7
Rural	587	5.4 3.4, 8.5	75.5 70.6, 79.9	16.0 12.5, 20.2	3.1 1.8, 5.3	22.4 + 3.3
Age Group (years)						
15-19.9	136	3.6 1.8, 7.3	73.0 64.3, 80.2	22.2 15.1, 31.4	1.2 0.2, 8.7	22.3 + 2.9
20-29.9	280	5.1 2.6, 9.5	78.2 70.9, 84.1	13.9 9.4, 20.0	2.8 1.3, 5.9	22.5 + 3.1
30- 39.9	208	6.6 3.8, 11.2	64.0 56.2, 71.1	21.4 15.2, 29.2	8.1 4.5, 14.1	23.4 + 4.4
40-49.9	141	5.5 2.9, 10.1	70.8 62.2, 78.2	14.2 9.1, 21.4	9.5 5.4, 16.3	23.7 + 4.7
Education						
None	173	7.7 4.5,12.7	76.7 70.2, 82.2	13.8 9.6, 19.5	1.8 0.6, 5.5	22.1 + 3.4
1-3	426	4.6 2.6, 8.0	73.3 68.1, 77.9	18.0 14.0, 22.9	4.1 2.4, 6.9	22.9 + 3.7
4+	144	3.3 1.5, 7.0	59.6 48.7, 69.6	23.5 14.7, 35.3	13.7 8.1, 22.1	24.1 + 4.3

Prevalence estimates and 95% CIs calculated using statistical weights and take into account the complex sample design; the means and SDs were weighted and calculated assuming simple random sampling.

Figure 4.4 BMI among non-pregnant women nationally and by region, PNG National Nutrition Survey 2005



4.3 Men 18 years of age and older

Heights and weights of adult men were measured to assess their overall nutritional status based on body mass index (BMI). Of the 804 men surveyed, 787 men had valid weight and height data to allow for the determination of body mass index (BMI). A summary of anthropometric data on 787 men 18 years and older are presented in Table 4.7

Table 4.7 Mean height and weight of men 18 years and older, PNG National Nutrition Survey 2005

Demographic characteristic	N	Mean height[1] ± SD	N	Mean weight[2] ± SD
National	**787**	**164.3 ± 7.1**	**789**	**62. 1 ± 10.3**
Regional				
Southern	206	165.7 ± 7.2	206	61.9 ± 11.2
Highlands	206	162.7 ± 5.9	207	63.3 ± 9.8
Mamose	195	162.1 ± 7.2	195	57.7 ± 9.0
Islands	180	167.1 ± 6.9	181	65.6 ± 9.4
Residence				
Urban	135	165.6 ±7.5	135	66.0 ± 13.7
Rural	652	164.1 ± 7.1	654	61.2 ± 9.2
Age Group (years)				
18-29.9	274	164.9 ± 7.3	274	61.1 ± 7.5
30 – 39.9	202	164.8 ± 6.6	202	63.7 ± 9.8
40-49.9	145	164.2 ± 7.1	146	63.1 ± 12.3
50-59.9	98	163.7 ± 7.3	98	62.9 ±13.6
60+	63	161.5 ± 7.0	64	57.9 ± 10.1
Education				
None	128	161.0 ± 6.2	128	57.4 ± 8.65
1-3 years	86	162.3 ± 7.0	85	58.8 ± 8.9
4 years +	556	165.4 ± 7.0	555	63.5 ± 10.1

Means are weighted and standard deviations (SDs) calculated assuming simple random sampling
1 In centimetres
2 In kilograms

The mean BMI for men was 23.1 (SD 3.1). The prevalence of underweight men with a BMI of <18.5 was very low in all regions. There is a low prevalence of obese men with a BMI of >30.0 in PNG. All BMI calculations by various indicators are displayed in Tables 4.8 and figure 4.5.

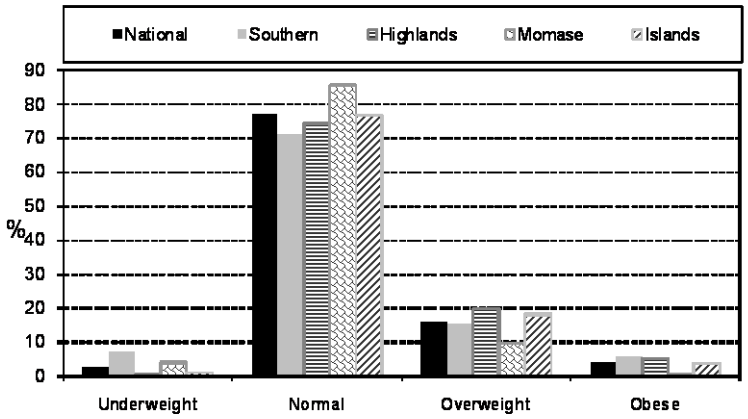
Men who lived in urban areas were much more likely to be obese than men living in rural areas.

Table 4.8 Summary of body mass index (BMI) data for men 18 > years, PNG National Nutrition Survey 2005

Demographic Characteristics	Body Mass Index					
	N	Underweight <18.5 (CI 95%)	Normal 18.5-24.9 (CI 95%)	Overweight 25.0-29.9 (CI 95%)	Obese >30.0 (CI 95%)	Mean ± SD
National	**787**	**2.9 1.9, 4.5**	**77.0 72.7, 80.8**	**16.1 13.0, 19.9**	**4.0 2.4, 6.4**	**23.1 ± 3.1**
Region						
Southern	206	7.5 4.3, 12.7	71.0 62.0, 78.6	15.7 9.7, 24.2	5.9 2.6, 12.9	22.4 ± 3.4
Highlands	206	0.5 0.1, 3.5	74.3 65.5. 81.4	19.9 14.2, 27.2	5.3 2.4, 11.3	23.9 ± 3.0
Mamose	195	4.1 1.9, 8.5	85.6 78.2, 90.8	9.7 5.4, 16.9	0.5 0.1, 3.6	21.8 ± 2.3
Islands	180	1.1 0.3, 4.5	76.7 69.5, 82.6	18.3 12.6, 25.9	3.9 2.1, 7.1	23.4 ± 3.1
Residence						
Urban	135	4.9 2.3, 10.4	63.0 54.4, 70.8	20.7 14.6, 28.4	11.4 6.3, 19.9	24.3 ± 4.2
Rural	652	2.5 1.5, 4.3	79.9 75.2, 83.9)	15.2 11.7, 19.4	2.4 1.2, 4.6	22.8 ± 2.7
Age Group (years)						
18-29	274	2.5 1.2, 5.3	81.6 75.1, 86.7	15.6 10.9, 22.0	0.3 0.0, 1.7	22.6 ± 2.2
30-39	202	1.0 0.3, 3.0	76.2 68.5, 82.4	16.7 11.2, 24.3	6.1 3.4, 10.8	23.5 ± 2.8
40-49	145	2.1 0.8, 5.8	76.8 68.7, 83.3	15.2 9.8, 22.6	5.9 3.1, 11.1	23.2 ± 3.8
50-59	98	7.0 3.4, 13.9	64.8 53.4, 74.7	19.6 12.2, 29.8	8.6 3.5,19.9	23.6± 4.2
60+	63	6.3 2.7, 14.4	77.7 66.8, 85.7	14.3 7.6, 25.2	1.7 0.2, 11.6	22.3 ± 3.2
Education						
None	128	3.2 1.3, 7.7	85.1 76.2, 91.0	10.7 5.7, 19.2	1.0 0.1, 7.0	22.1 ± 2.6
1-3 years	85	5.4 2.0, 14.2	81.0 70.5, 88.4	13.6 7.7, 22.7	0	23.2 ±3.2
4 years +	555	2.5 1.5, 4.2	73.8 68.7, 78.4	18.4 14.4, 23.2	5.3 3.2, 8.5	22.3 ± 2.4

Prevalence estimates and 95% CIs calculated using statistical weights and take into account the complex sample design; the means and SDs were weighted and calculated assuming simple random sampling.

Figure 4.5 BMI among men > 18 years nationally and by region, National Nutrition Survey, Papua New Guinea 2005



4.4 Birth weight

A total of 357 women had given birth in the previous 3 years. Of these women, 178 reported that they knew the birth weight of their last born child. Of those who reported the birth weight, 71.0% had the birth weight recorded in the child's clinic book, 27.8% recalled the birth weight and 1.1% of women had another form of documentation with the birth weight recorded.

The mean birth weight was 3140 grams, which is considered a healthy birth weight. Overall, 7.9% of babies were reported to be less than 2500 grams (Table 4.9). The Southern region had the greatest prevalence of low birth weight (22.2%) which is much higher than in any of the other regions.

The birth weight data should be interpreted with caution as there is no way of knowing how soon after birth the child was weighed and only half of the women who had given birth in the last 3 years recalled the baby's birth weight. The WHO recommends that babies are weighed within an hour of birth before postnatal weight loss occurs. In PNG it is possible that some babies were measured a few days after the birth. Moreover, the number of birth weights recorded is small and the birth weights that were recalled might not be accurate. Of the mothers that did recall the birth weight the prevalence of low birth weight was 3.8%. The prevalence of low birth weight recorded on the baby clinic book or other documentation was 8.1%.

Table 4.9 Distribution of birth weights* of infants born within the last three years prior to the survey, by maternal factors, PNG National Nutrition Survey 2005

Demographic Characteristic	N	% <2500	95% CI	Mean birth weight	95% CI
National	178	7.9	4.8, 12.6	3140	3031, 3249
Region					
Southern	68	22.2	12.5, 36.2	2834	2665, 3004
Highlands	38	0.0	0.0	3440	3241, 3639
Mamose	25	8.0	2.0, 26.9	2898	2665, 3129
Islands	47	6.4	2.0, 18.2	3119	2978, 3258
Residence					
Urban	69	7.7	3.2, 17.4	3166	2948, 3383
Rural	109	7.9	4.2, 14.6	3126	2986, 3266

*Birth weights were reported by mothers
Means and standard deviations (SD) are weighted and are calculated assuming simple random sampling; prevalence estimates and 95% CI are calculated using statistical weights to account for the complex sample design.

4.5 Discussion: Anthropometry

Based on WHO classifications (1995) relative to other countries at the time of the survey, PNG is a country with a "high" prevalence of stunting. The overall standard deviation (SD) for stunting distribution was 1.39 (Table 4.1). This is higher than the SD of 1.0 for HAZ distribution in the reference population, and is the result of some measurement errors combined with the lack of exact age determinations for the children. Because of this "artificially" wider HAZ distribution, the prevalence of HAZ <-2 may be somewhat falsely increased.

The prevalence of wasting among Papuan New Guinean preschool children was low except in Mamose where it is nearly four times the expected prevalence of 2.3% in a reference population, and thus places children in Mamose in the "medium" prevalence for wasting (WHO, 1995). The WHZ SD was 1.08. This suggests that there were few measurement errors.

According to WHO categorization, PNG has a "medium" prevalence of underweight among its preschool population (WHO, 1995). The SD of the WAZ distribution (1.15) is smaller than the SD of the HAZ distribution. This may be because the children were weighed with better precision and accuracy than they were measured for length or height. Children in Mamose were more likely to be underweight than children in the other regions.

Although there are differences in methodology, the findings from this survey are similar to those of the NNS1982/83 (Heywood 1988) and PNG HFS 1996 (Gibson and Rozelle 1996). Although the problem of underweight and wasting is not critical at a national level it is important to recognize that there are regions and age groups which are at particular risk. Children in Mamose are at a much greater risk of the consequences of poor growth for all three indicators (HAZ, WAZ and WHZ) than children in the other three regions.

Children aged 6-23 months had the highest prevalence of wasting. The prevalence of wasting drops drastically at 24 months and was almost non existent in children in the 48-59 month age group. This is similar to the findings of Gibson and Rozelle reported in the PNG Household Survey 1996[4]. They found that the highest rate of wasting occurs in the second year of life, which was also the time of greatest risk found by the NNS 1982/83(Heywood 1988).

Recent global estimates suggest that malnutrition, based on anthropometric indicators, is associated with over 50% of all deaths among children (WHO 2000). The high prevalence of stunting and medium prevalence of underweight among young children highlight the poor nutritional status of children in PNG.

The national prevalence of overweight and obesity among non-pregnant women and men are low, but should be monitored for a potential increasing trend as seen in a number of other developing nations and in many other Pacific Island Nations. WHO warns that even in the poorest countries, major chronic disease risk factors are increasing (Chopra et al 2002). Thus, already strained health systems are faced with an increased burden of non-communicable diseases at the same time as a persisting burden of under nutrition and infectious diseases.

CHAPTER 5. IODINE DEFICIENCY DISORDERS

This chapter provides estimates on the burden of iodine deficiency in non-pregnant women of child bearing age (15-49 years) and the coverage of iodized salt in Papua New Guinea.

5.1 Background to Papua New Guinea Universal Salt Iodization

In 1995, PNG amended the Pure Food Standards making it mandatory for all salt imported into the country to be iodized with potassium iodate and iodine content at 30 ppm. According to the PNG Food Sanitation Regulations 2007 the iodine content of tablesalt should not be less than 40 ppm. The PNG Food Sanitation Regulations 2007 have mantained these standards.

5.2 Iodine status

WHO defines the iodine deficiency disorders (IDD) as a public health problem when greater than 50% of a population have UI <100 µg/L or greater than 20% have UI <50 µg/L (WHO/UNICEF/ICCIDD, 2001). In PNG the median urinary iodine (UI) of 170 µg/L among non-pregnant women of childbearing age is well above the cut-off of 100 µg/L. Although there is some concern in the scientific community that the cut-off for all women should be higher, as women of reproductive age are likely to become pregnant. The median urinary iodine results for women in all four regions were all adequate (>100 µg/L), but the Island women have the highest iodine nutrition (290 µg/L)and the Highlands have the lowest (129.5 µg/L) (Figure 5.1 and Table 5.1).

Figure 5.1 Proportion of non-pregnant women with urinary iodine <100 µg/L by region and urban and rural localities, PNG National Nutrition Survey 2005.

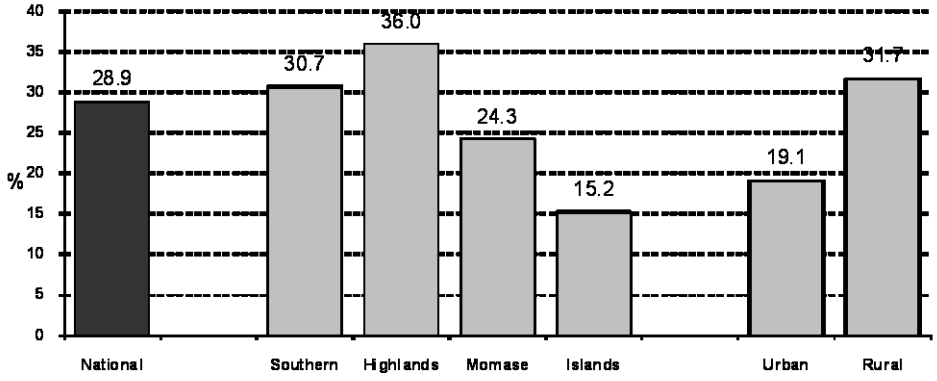


Table 5.1 Urinary iodine in non-pregnant women 15-49 years, PNG National Nutrition Survey 2005

		Prevalence (%) of urinary Iodine concentrations (µg/L)				
Demographic Characteristic	**N**	**<50 CI 5%**	**50-99.9 CI 95%**	**100 -149.99 CI 95%**	**≥150 CI 95%**	**Median**
National	**690**	**12.6**	**16.3**	**14.9**	**56.1**	**170.0**
		9.1, 17.3	**13.3, 19.9**	**12.5, 17.7**	**50.4, 61.7**	
Region						
Southern	243	12.5	18.3	15.0	54.2	159.0
		8.4, 18.4	13.3, 24.7	10.8, 20.3	45.0, 63.0	
Highlands	150	15.3	20.7	18.7	45.3	129.5
		8.2, 26.8	15.5, 27.0	14.2, 24.1	35.9, 55.2	
Mamose	152	13.2	11.2	13.8	61.8	223.0
		7.9, 21.1	6.0, 19.8	9.5, 19.7	48.4, 73.7	
Islands	145	4.1	11.0	6.2	78.6	290.0
		1.3, 12.1	96.5, 18.1	3.4, 10.9	67.6, 86.6	
Residence						
Urban	180	4.6	14.4	18.9	62.1	185.1
		2.3, 9.2	10.4, 19.7	15.1, 23.4	55.2, 68.5	
Rural	510	14.9	16.9	13.8	54.5	168.2
		10.7, 20.3	13.2, 21.3	11.0, 17.2	47.6, 61.2	
Age group (years)						
15-19.9 years	116	12.6	17.9	11.6	58.0	176.0
		6.7, 22.6	11.2, 27.5	6.3, 18.7	45.8, 69.8	
20-29.9 years	117	9.9	17.8	18.6	53.8	163.1
		5.9, 16.2	12.8, 24.3	13.9, 24.4	46.1, 61.2	
30-39.9 years	133	11.0	17.7	13.9	57.4	182.0
		6.4, 18.2	12.0, 25.2	9.5, 20.0	48.0, 66.3	
40-49.9 years	115	20.5	10.5	12.7	56.6	182.2
		13.2, 30.3	5.7, 17.9	7.1, 21.7	45.1, 67.3	
Grade of education						
None	146	19.9	22.6	15.2	42.3	116.5
		13.0, 29.3	16.8, 29.6	10.3, 21.9	31.3, 54.0	
1-3	384	12.4	16.1	14.9	56.6	172.0
		8.7, 17.3	12.5, 20.4	11.2, 19.6	49.9, 63.1	
4 +	135	4.0	8.3	16.2	71.4	209.0
		1.5, 10.2	4.6, 14.7	10.7, 23.7	63.3, 78.4	
Salt in HH						
Salt present	470	7.5	13.9	15.4	63.2	203.5
		4.7, 11.8	10.4, 18.2	12.4, 19.1	57.8, 68.3	
Salt not present	220	23.9	21.7	13.7	40.7	111.4
		16.7, 32.9	17.1, 27.1	9.6, 19.2	30.0, 52.4	

Salt in cluster*						
Salt present	640	10.4 7.4, 14.5	15.6 12.5, 19.4	15.1 12.6, 18.1	58.8 53.9, 63.6	182.5
Salt not present	50	35.1 23.3, 49.2	23.3 15.4, 33.8	13.5 5.8, 28.1	28.1 9.8, 58.2	79.5

*8 of the 97 clusters surveyed had no household salt on the day of the survey
Weighted analysis to account for complex survey design

In households that did not have salt the median urinary iodine level was much lower than in households which had salt. As most of the salt in PNG is adequately iodized, see section 5.2, this would suggest that households that did not have salt on the day of the survey do not routinely use salt.

During the survey there were eight clusters where none of the households had any salt at all. All of the households that had no salt were in rural areas of PNG. There were 60 women in these clusters and 50 of them provided urine samples for the purpose of this survey. When household heads from these clusters were questioned about the absence of salt most reported that they had no access to it. The median urinary iodine level in those clusters without any salt present was 79.5µg/L, which is below the cut-off of <100 µg/L. In clusters that had salt present the median UI was 182.5 µg/L.

When comparing households that have salt vs. households without salt, the prevalence of low urinary iodine <100 ug/L was 45.6% in households without salt compared to 21.4% in households that had salt. In clusters without salt, the prevalence of low urinary iodine was 58.4%.

5.3 Household salt coverage

At least one type of salt was present in 61.9% of all of the households surveyed. Most of the salt available in the households was fine Table salt or cooking salt (90.2%). In households that had salt 98.8% of it was purchased. In 53.6% of households the salt was still in its original packaging. Some families reported buying salt refills and adding it to their original container.

The most popular brands of salt are Tru Cook (28.0%) and Jumbo (24.8%), but there is a wide variety of salt available. Table 5.2 presents the brands of salt available in the households included in the survey.

Table 5.2 Availability and brand of salt (in original containers) in the household, PNG National Nutrition Survey 2005

	Percent of salt available by region and urban/rural locality (%)						
	Southern	**Highlands**	**Mamose**	**Islands**	**Urban**	**Rural**	**National**
Salt present in household	**50.4**	**64.5**	**63.8**	**68.1**	**79.2**	**58.5**	**61.9**
Brand of salt							
Crystal	42.4	2.6	19.2	5.7	30.9	10.7	14.7
Jumbo	15.3	43.5	12.3	17.1	14.4	27.5	24.8
King	22.4	3.5	12.3	5.7	17.4	7.7	9.7
Saxa	1.8	0.9	2.3	4.1	12.1	1.4	3.6
Sky	0.0	0.0	16.9	0.0	2.4	6.1	5.4
Tru cook	0.0	34.8	20.0	56.1	11.1	32.2	28.0
Other	8.2	14.8	16.9	11.4	11.6	14.4	13.9

Weighted analysis to account for complex survey design

For a list of the clusters where no salt was available please see appendix 14

5.4 Quality of iodized salt

Salt samples (n=839) from 820 households were qualitatively assessed for iodine content using the WYD checker in the laboratory at the University of Papua New Guinea. Overall, 92.5% of the samples contained ≥15 ppm of iodine and the median iodine content of the salt was 50 ppm. The distribution of the level of iodine in the salt samples is presented in Table 5.3.

Table 5.3 Prevalence of various levels of iodine in salt and median iodine levels (ppm) based on WYD analysis, PNG National Nutrition Survey 2005

Demographic Characteristics	**N**	**Percentage of HHs with various levels of iodine (ppm) in salt****				**Median salt Iodine (ppm)***
		0 ppm no iodine	**>0-14.9 ppm**	**≥15-29.9 ppm**	**≥30 ppm**	
National	**839**	**0.1**	**7.4**	**10.9**	**81.6**	**50.1**
Region						
Southern	163	0	23.9	25.8	50.3	30.8
Highlands	222	0	0.5	5.9	93.7	54.7
Mamose	217	0.5	10.1	12.4	77.0	46.1
Islands	237	0	2.1	4.6	93.2	55.6
Residence						
Urban	184	0.6	11.4	18.6	69.4	43.1
Rural	655	0	6.3	8.8	84.9	49.9

Weighted analysis to account for complex survey design

*The median iodine content of salt (in ppm) was based on salt with some measurable level of iodine (i.e., calculation excludes salt samples with no iodine).

** This Table shows all salt samples, including households where two types of salt was available.

The indicator used to assess the coverage of the salt iodization intervention, is the percentage of households using salt containing at least 15 ppm iodine [3]. The target coverage rate for the elimination of iodine deficiency is that 90% of households should be using food grade salt with an iodine content of at least 15ppm. Nationally, PNG met this target; however in the Southern region 23.9% of the salt was inadequately iodized.

Approximately 53.5% of the salt tested had its original salt packaging available and of these, 98.0% were labelled as iodized. Among those, 92.5% of the samples contained at least 15 ppm of iodine. In the Southern region however, only 76.1% of the salt advertised as iodized was iodized with ≥15ppm iodine.

5.5 Discussion: Iodine

The median urinary iodine 170.0 ug/L in Papua New Guinea is considered acceptable as it is well above the cut off of 100 ug/L. However, a major problem identified during the PNG survey is that there were many households that did not have any salt available in the household that could be tested on the day of the survey. There were also several clusters where none of the households in the entire cluster had salt available and when asked, some clusters reported that they often did not routinely have any access to salt.

Overall the salt that was available was adequately iodized (≥15ppm). Except for the Southern region, in the other three regions more than 90% of salt was adequately iodized. In the Southern region only 76.1% was adequately iodized. The results also indicate that there are hotspots around the country, particularly in rural areas where the population may have limited access to iodized salt. More needs to be done ensure access to those rural areas.

CHAPTER 6. ANEMIA, IRON DEFICIENCY AND IRON DEFICIENCY ANEMIA

This chapter summarizes various indicators related to anemia, iron deficiency, and iron deficiency anemia among children 6-59 months old, non pregnant women 15-49 years of age, and men aged 18 years and older.

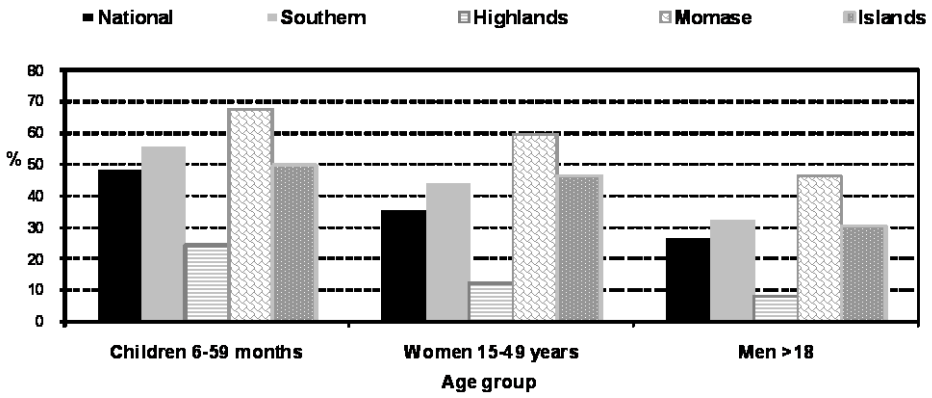
6.1 Anemia

The prevalence of anemia is based on hemoglobin data from capillary blood samples analyzed using the HemoCue instrument (HemoCue AB, Angelholm, Sweden). Anemia, defined as low Hb, is often used as a proxy indicator of iron deficiency. The Hb cut-offs for anemia, based on age and sex (WHO 2001, Nestel 2002), are presented in Table 2.14. To determine the prevalence of anemia, the individual observed Hb concentrations were adjusted based on altitude and cigarette smoking, according to (CDC1998) recommendations (Table 2.11).

6.1.1 Summary of anemia by target group

Figure 6.1 shows the prevalence of anemia by target group and by region. Children 6-59 months had the highest prevalence of anemia followed by non pregnant women (15-49 years) and then men.

Figure 6.1: Prevalence of anemia[1] by target group, National Nutrition Survey, Papua New Guinea 2005



[1] Hemoglobin (Hb) adjusted for altitude and cigarette smoking (men only). Anemia defined as Hb < 11.0 g/dL for children, Hb <12.0 for non-pregnant women and Hb <13.0 g/dL for men.

6.1.2 Anemia among children (6-59 months of age)

Of the 937 preschool children surveyed 910 (97.1%) had their hemoglobin values recorded, Table 6.1. The mean hemoglobin concentration for children 6-59 months was

10.88 g/dL (SD 1.65). Almost half of the children included in the survey were anemic. The hemoglobin distribution was shifted substantially to the left in comparison to the US reference population of non-anemic children (figure 6.2).The prevalence of anemia was strongly associated with region. The prevalence of anemia was highest in children in Mamose region (67.5%). Children in the Highlands had the lowest prevalence of anemia (24.3%). There were no substantial differences in the prevalence according to sex or urban/rural location.

The prevalence of anemia was very high in children 6-11 months of age (69.2%). As expected the prevalence drops slightly in children 12-23 months of age and continues to decline after two years of age. Just over one third of children 48-59 months of age were anemic.

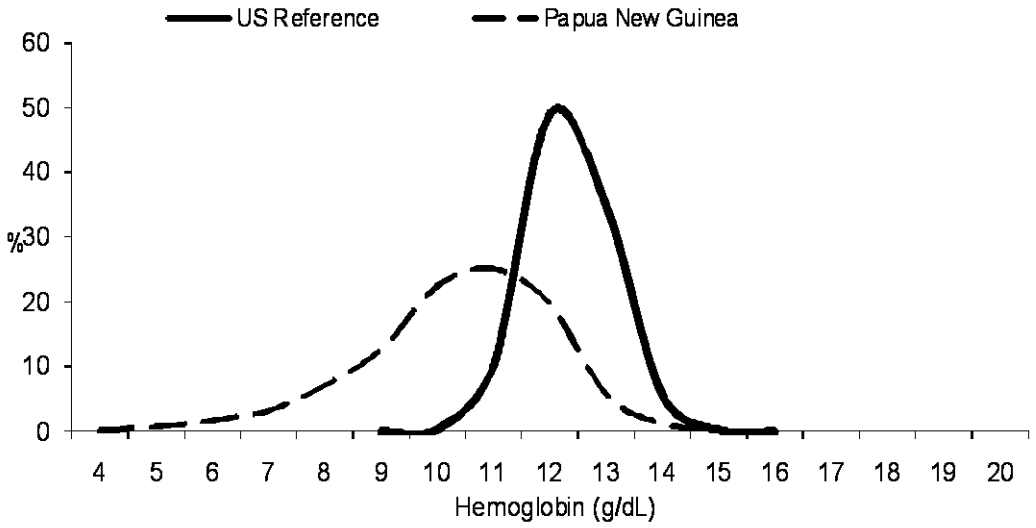
According to WHO a prevalence of >40.0% anemia in the population represents a severe problem in a population (WHO/UNICEF/UNU, 2001). [The problem of anemia in Mamose, Islands and the Southern region is classified as severe].

Table 6.1 Prevalence of anemia and mean hemoglobin levels among children (6-59 months), PNG National Nutrition Survey 2005

Demographic Characteristics	N	Prevalence of anemia[1] (%)	CI 95%	Mean[2] hemoglobin (g/dl ± SD)
National	**910**	**48.1**	**42.7, 53.5**	**10.8 ± 1.6**
Region				
Southern	207	55.6	45.3, 65.3	10.6 ± 1.5
Highlands	206	24.3	16.2, 34.7	11.78± 1.4
Mamose	252	67.5	54.5, 78.2	10.2 ± 1.8
Islands	245	49.8	42.2, 57.4	10.8 ± 1.4
Residence				
Urban	173	41.1	28.7, 54.8	11.1 ± 1.5
Rural	737	49.7	43.6, 55.9	10.9 ± 1.7
Age Group (months)				
6-11	101	69.2	58.3, 78.3	10.2 ± 1.4
12-23	219	58.2	50.0, 65.9	10.6 ± 1.6
24-35	230	42.8	35.6, 50.4	10.9 ± 1.6
36-47	196	44.3	36.3, 52.6	10.1 ± 1.7
48-59	164	33.7	25.6, 42.9	11.4 ± 1.7
Sex				
Male	492	47.8	41.4, 54.2	10.8± 1.8
Female	415	48.3	42.1, 54.6	10.9± 1.6

Weighted analysis to account for complex survey design
[1] Anemia cut-off for preschool children is Hb <11.0 g/dL. Hemoglobin (Hb) measured by Hemocue™ and adjusted for altitude
[2] Means are weighted and standard deviations (SDs) calculated assuming simple random sampling

Figure 6.2 Hemoglobin distributions of preschool children (6-59 months) in Papua New Guinea 2005, compared to iron sufficient children in US



6.1.3 Anemia among non-pregnant women of childbearing age

Of the 783 non-pregnant women participating in the survey 760 had their hemoglobin values recorded. The mean hemoglobin concentration was 12.6 g/dL (SD=1.9). Just over one third of non-pregnant women were anemic. Rural women were almost twice as likely to be anemic compared to urban women. Women in Mamose region had a much higher prevalence of anemia than women in the other regions and women in the Highlands region had a very low prevalence of anemia. Age and education were not significantly associated with anemia prevalence or mean hemoglobin levels among non-pregnant women. Using the WHO criteria for defining anemia as a public health problem, the public health significance of the prevalence of anemia among non-pregnant women of child bearing age is moderate.

Table 6.2 Prevalence of anemia and mean hemoglobin levels among non-pregnant women of childbearing age (15-49 years), PNG National Nutrition Survey 2005.

Demographic Characteristics	N	Prevalence of anemia[1] (%)	95 % CI	Mean hemoglobin[2] (g/dl ± SD)
National	**760**	**35.7**	**31.0, 40.7**	**12.6 ± 1.9**
Region				
Southern	244	44.2	34.0, 54.9	11.9 ± 2.0
Highlands	180	12.2	7.3, 19.8	13.6 ± 1.5
Mamose	174	59.8	49.1, 69.6	11.7 ± 1.7
Islands	162	46.3	36.0, 56.9	12.0 ± 1.6
Residence				
Urban	182	20.7	13.3, 30.9	12.9 ± 1.9
Rural	578	39.4	33.8, 45.2	12.4 ± 1.8
Age Group (years)				
15-19	134	34.5	26.7, 43.3	12.6 ± 1.8
20-29	278	34.5	28.9, 40.6	12.2 ± 1.9
30-39	207	37.4	29.5, 45.9	12.3 ± 1.8
40-49	141	36.6	27.4, 46.8	12.4 ± 2.1
Years of education				
None	167	43.1	34.2, 52.5	12.6 ± 1.9
1-3	425	36.1	30.9, 41.7	12.3 ± 1.9
4+	140	33.3	24.4, 43.7	12.3 ± 1.8

Weighted analysis to account for complex survey design
[1] Anemia cut-off for non-pregnant women is Hb <12.0 g/dL. Hemoglobin (Hb) measured by Hemocue™ and adjusted for altitude and smoking
[2] Means are weighted and standard deviations (SDs) calculated assuming simple random sampling

6.1.4 Anemia among men 18 years and older

Of the 804 men participating in the survey 778 had their hemoglobin values recorded. The mean hemoglobin concentration was 14.2 g/dL (SD 1.96) (Table 6.3). Overall 26.3% of men were anemic. Rural men had a significantly higher prevalence of anemia than urban men. Men in Mamose region had the highest prevalence of anemia, at 46.4%, while men in the Highlands region had the lowest prevalence at 8.3%. There was no difference in the prevalence of anemia by age or educational status. Using the WHO classification in PNG, the public health significance of the prevalence of anemia among men nationally is moderate, but the problem is severe in the Mamose region.

Table 6.3 Prevalence of anemia and mean hemoglobin levels among men (18> years), PNG National Nutrition Survey 2005

Demographic Characteristics	N	Percent anemic	95 % CI	Mean hemoglobin (g/dl ± SD)
National	**778**	**26.3**	**21.5, 31.9**	**14.2 ±1.9**
Region				
Southern	203	32.6	21.8, 45.6	13.8 ± 2.1
Highlands	205	8.3	4.1, 16.1	15.2 ± 1.6
Mamose	192	46.4	33.6, 59.6	13.3 ± 1.8
Islands	178	30.3	20.9, 41.8	13.8 ± 1.7
Residence				
Urban	134	10.8	6.0, 18.9	14.9 ± 1.6
Rural	644	29.6	24.0, 35.9	14.1 ± 1.9
Age Group (years)				
18-29	273	21.9	15.4, 30.1	14.4 ± 1.9
30-39	200	28.6	20.6, 38.2	14.2 ± 1.8
40-49	145	24.5	18.0, 32.5	14.2 ± 2.1
50-59	95	31.1	22.1, 41.8	13.9 ± 1.8
60+	64	35.1	22.8, 48.3	13.7 ± 1.2
Grade of education				
None	124	22.9	16.1, 31.6	14.4 ± 2.1
1-3	83	22.2	12.8, 35.7	14.3 ± 1.9
4+	552	27.9	22.5, 34.0	13.9 ± 1.9

Weighted analysis to account for complex survey design
[1] Anemia cut-off for men is Hb <13.0 g/dL. Hemoglobin (Hb) measured by Hemocue™ and adjusted for altitude and smoking
[2] Means are weighted and standard deviations (SDs) calculated assuming simple random sampling

6.2 Anemia and infection

Anemia has many contributing factors including malaria, helminth infection, diet and infection. Data on infection were combined with hemoglobin values to determine the percentage in each target group who were anemic. For this analysis, only the most vulnerable population groups (children 6-59 months and women) were assessed for infection as a contributing factor to anemia.

6.2.1 Anemia and infection in children 6-59 months

Of the 910 children who had hemoglobin values, 874 also had values for C-reactive protein (CRP) and α1-acid glycoprotein (AGP). The prevalence of anemia was higher in children with a marker of inflammation (either CRP or AGP) compared to those with no indication of inflammation (Table 6.4).

Table 6.4 Prevalence of anemia among those with markers of inflammation (CRP >5mg/L and AGP >1.2 mg/L) in children 6-59 months of age, PNG National Nutrition Survey 2005

Demographic Characteristics	N	Prevalence of Anemia[1] (%)	95% CI
Indicator of infection	**Elevated CRP >5mg/L)**		
National	283	66.3	59.2, 72.8
Southern	73	68.5	51.8, 81.5
Highlands	46	45.7	26.7, 65.9
Mamose	87	81.6	69.7, 89.6
Islands	77	61.0	52.9, 68.6
Indicator of Infection	**Elevated AGP (>1.2 mg/L)**		
National	282	61.3	54.0, 68.2
Southern	74	66.2	51.3, 78.5
Highlands	61	41.0	28.1, 55.2
Mamose	88	72.7	56.2, 84.7
Islands	59	71.2	56.2, 82.6
No indicator of infection			
National	494	39.2	33.6, 45.1
Southern	100	50.0	40.5, 59.5
Highlands	121	15.7	9.2, 25.4
Mamose	124	60.5	45.7, 73.6
Islands	149	41.6	32.1, 51.8

Weighted analysis to account for complex survey design

[1] Anemia cut-off for preschool children is Hb <11.0 g/dL. Hemoglobin (Hb) measured by Hemocue™ and adjusted for altitude

6.2.2 Anemia and helminth infection in children 6-59 months of age

Stool was collected from 363 children between the ages of 24-59 months during the survey. Various parasites were identified in the stool but as only hookworm and round worm are thought to contribute to anemia stools were only examined for these two parasites. These helminths were only found in 4.9% of the stool samples. There was no difference in the prevalence of anemia in children with or without hookworm or roundworm.

6.2.3 Anemia and infection in women 15-49 years

Of the 760 women who had hemoglobin values 756 also had values for CRP and 756 for AGP. There appeared to be an important difference in the prevalence of anemia in women with infection compared to those without an elevation of their acute phase proteins (APP). The prevalence of anemia is still severe in Momase region irrespective of infection (Table 6.5).

Table 6.5 Prevalence of anemia among those with markers of inflammation (CRP >5mg/L and AGP >1.2 mg/L) 15-49 years of age, PNG National Nutrition Survey 2005

Demographic Characteristics	N	Prevalence of Anemia (%)	95% CI
Indicator of Infection	**Elevated CRP >5mg/L)**		
National	76	46.9	34.4, 59.7
Southern	23	51.1	22.2, 79.3
Highlands	18	27.8	12.5, 50.8
Mamose	14	78.6	47.0, 93.8
Islands	21	47.6	25.9, 70.3
Indicator of Infection	**Elevated AGP (>1.2 mg/L)**		
National	63	57.8	42.9, 71.3
Southern	28	61.8	36.8, 81.8
Highlands	15	40.0	17.9, 67.0
Mamose	12	83.3	49.6, 96.2
Islands	8	62.5	29.4, 87.0
No indicator of infection			
National	638	34.2	29.5, 39.2
Southern	204	42.0	33.2, 51.4
Highlands	147	10.2	5.5, 18.3
Mamose	150	57.3	46.8, 67.3
Islands	137	46.0	35.9, 56.4

Weighted analysis to account for complex survey design
[1] Anemia cut-off for non-pregnant women is Hb <12.0 g/dL. Hemoglobin (Hb) measured by Hemocue™ and adjusted for altitude and smoking

6.3. Iron deficiency

6.3.1 Iron deficiency among children 6-59 months

Of the 937 children who participated in the survey, TfR was measured in 872 children. The prevalence of iron deficiency (>8.0 µg/l) was 27.8%. Iron deficiency was highest in the Southern region (44.6%) and lowest in the Highlands (10.8%). Children in the 6-11

month group had a higher prevalence of iron deficiency than children in the other age groups (Table 6.6 and Figure 6.3).

Table 6.6 Prevalence of iron deficiency among children (6-59 months), PNG National Nutrition Survey 2005

Demographic Characteristics	N	Prevalence (%) of Iron Deficiency[1]	95% CI	Mean TfR ± SD
National	**872**	**27.8**	**23.4, 32.7**	**7.3 ± 4.9**
Region				
Southern	195	44.6	33.8, 56.0	8.7 ± 5.2
Highlands	195	10.8	6.6, 17.0	5.3 ± 3.1
Mamose	238	34.0	25.0, 44.5	8.1 ± 6.3
Islands	244	29.9	20.6, 41.2	6.9 ± 3.5
Residence				
Urban	164	23.1	14.1, 35.5	6.5 ± 3.7
Rural	708	28.9	23.8, 34.6	7.2 ± 5.1
Age Group (months)				
6-11	95	39.7	28.8, 51.7	8.2 ± 4.7
12-23	209	37.0	29.5, 45.3	7.9 ± 4.6
24-35	219	24.2	18.1, 31.7	7.1 ± 4.5
36-47	189	25.5	19.1, 33.1	6.9 ± 4.5
48-59	157	15.8	10.5, 23.1	5.9 ± 5.3
Sex				
Male	465	29.4	24.4, 34.8	7.26 ± 4.9
Female	404	25.8	20.6, 31.8	6.90 ± 4.8

Weighted analysis to account for complex survey design
[1]Iron deficiency is TfR> 8.0 µg/l

6.3.2 Iron deficiency among non- pregnant women 15-49 years

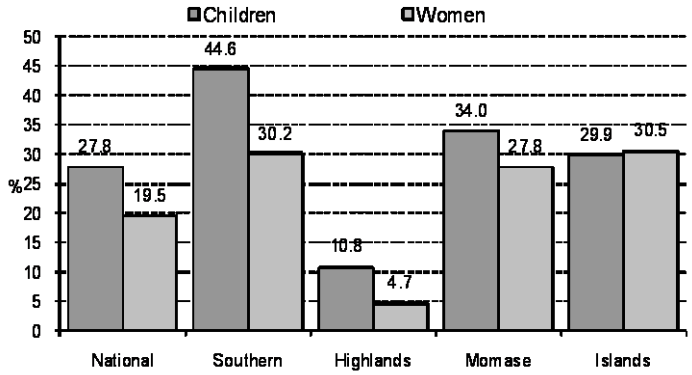
Of the 753 women with TfR results, the prevalence of iron deficiency (>8.0 µg/l) was 14.9%. Iron deficiency was highest in the Southern region (24.4%) and the Islands (23.0%) (Table 6.7).

Table 6.7 Prevalence of iron deficiency among women (15-49 years), as measured by DBS TfR, National Nutrition Survey, and PNG 2005

Demographic Characteristics	N	Prevalence (%) of Iron Deficiency [1] (DBS TfR)	95% CI	Mean TfR ± SD
National	**753**	**19.5**	**15.9, 23.5**	**6.06 ± 4.8**
Region				
Southern	247	30.0	21.7, 40.0	7.50 ± 5.5
Highlands	173	4.7	2.3, 8.9	4.43 ± 2.2
Mamose	169	27.8	20.1, 37.1	6.80 ± 4.0
Islands	164	30.5	20.8, 42.2	7.19 ± 6.0
Residence				
Urban	187	13.5	8.2, 21.6	5.36 ± 3.4
Rural	566	20.9	16.6, 26.0	6.24 ± 5.3
Age Group (years)				
15-19	133	29.7	21.8, 38.9	7.4 ± 5.6
20-29	274	17.7	13.2, 23.4	6.6 ± 5.2
30-39	203	16.5	11.3, 23.4	6.1 ± 3.8
40-49	136	16.5	10.3, 25.4	5.9 ± 4.0
Grade of education				
None	162	14.5	9.4, 21.9	6.5 ± 4.9
1-3	424	21.3	17.3, 25.9	6.8 ± 5.3
4+	139	19.7	12.8, 29.0	6.2 ± 3.9

Weighted analysis to account for complex survey design
[1]Iron deficiency is TfR> 8.0 µg/l

Figure 6.3 Prevalence of iron deficiency in children 6-59 months and non-pregnant women 15-49 years by region, PNG National Nutrition Survey 2005.



6.4 Iron deficiency anemia

Iron deficiency anemia was assessed by forming a combination indicator, elevated TfR (iron deficiency) and low hemoglobin (anemia).

6.4.1 Iron deficiency anemia in children 6-59 months of age

The prevalence of iron deficiency anemia in preschool children is 22.8% (Table 6.9). Nationally, iron deficiency accounts for almost 50% of the anemia among children 6-59 months. In children, a higher prevalence of iron deficiency anemia (IDA) was found in the Southern region. The prevalence of iron deficiency anemia was very high in children 6-11 months and dropped in each successive age group. There was little difference in the prevalence of IDA by sex or by residence.

Table 6.8 Prevalence of iron deficiency anemia among children (6-59 months), PNG National Nutrition Survey 2005

Demographic Characteristics	(TfR) and Hemoglobin (Hb) [1]		
	N	Prevalence of iron deficiency anemia (%)	95% CI
National	**868**	**22.8**	**18.8, 27.4**
Region			
Southern	194	35.6	26.4, 45.9
Highlands	195	7.7	4.6, 12.7
Mamose	236	31.4	22.1, 42.4
Islands	243	21.8	14.7, 31.1
Residence			
Urban	164	19.1	11.0, 31.2
Rural	704	23.7	19.1, 29.0
Age Group (months)			
6-11	95	36.6	26.4, 48.1
12-23	209	28.6	22.0, 36.3
24-59	219	18.9	13.7, 25.3
36-47	188	22.5	16.2, 30.3
48-59	157	12.8	7.8, 20.2
Sex			
Male	464	24.2	19.6, 29.5
Female	401	20.8	16.2, 26.4

Weighted analysis to account for complex survey design
[1] Iron deficiency anemia is TfR> 8.0 µg/l and Hb <11.0 g/dl.) Hb measured by Hemocue™ and adjusted for altitude

6.4.2 Iron deficiency anemia in non-pregnant women 15-49 years of age

The prevalence of iron deficiency anemia in non-pregnant women 15-49 years of age is 15.0% (Table 6.9). Nationally iron deficiency accounted for almost 50% of the anemia among non pregnant women 15-49 years of age.

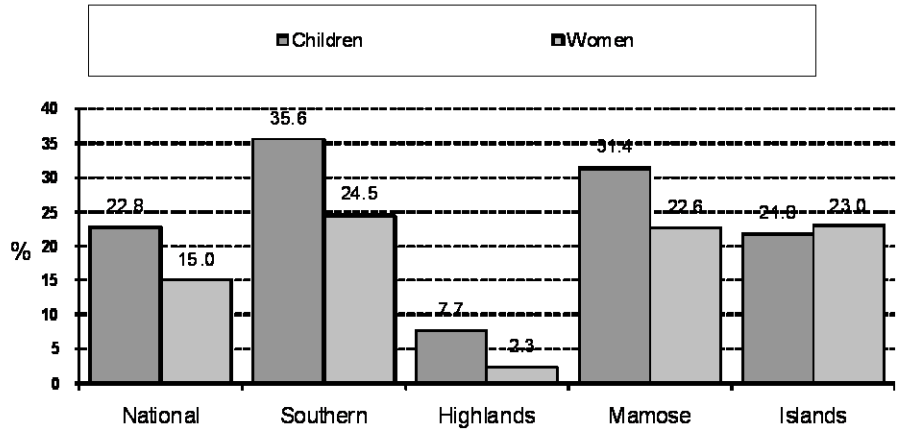
Table 6.9 Prevalence of iron deficiency anemia among non-pregnant women of childbearing age (15-49 years), PNG National Nutrition Survey 2005

Demographic Characteristics	DBS (TfR) and Hemoglobin (Hb)[1]		
	N	Percent with iron deficiency anemia	95% CI
National	**742**	**15.0**	**11.8, 18.8**
Region			
Southern	242	24.5	16.6, 34.5
Highlands	171	2.3	0.7, 7.2
Mamose	168	22.6	15.3, 32.2
Islands	161	23.0	15.4, 32.8
Residence			
Urban	182	12.0	7.0, 19.9
Rural	560	15.7	11.8, 20.5
Age Group (years)			
15-19	130	20.5	13.5, 29.8
20-29	273	13.5	9.6, 18.6
30-39	203	13.6	9.0, 20.2
40-49	136	14.6	8.7, 23.5
Grade of education			
None	156	11.6	7.0, 18.7
1-3	420	15.9	12.6, 20.0
4+	139	17.2	10.5, 26.8

Weighted analysis to account for complex survey design

[1]Iron deficiency anemia is TfR> 8.0 µg/l and Hb <12.0 g/dl.) Hb measured by Hemocue™ and adjusted for altitude and smoking.

Figure 6.4 Prevalence of iron deficiency anemia in children 6-59 months of age and non-pregnant women 15-49 years by region, PNG National Nutrition Survey 2005



6.5 Iron supplementation coverage

Among the 358 women who had given birth during the previous three years prior to the survey 79.1% of women reported receiving iron supplements at some point during their pregnancy (Table 6.10). Of the women who had received supplements there were no significant regional differences. Most women, (92.3%), obtained their iron tablets from health workers from a clinic or hospital.

Table 6.10 Use of iron supplements during last pregnancy, PNG National Nutrition Survey 2005

Demographic Characteristics	N	Prevalence of women reporting use of iron supplements during their last pregnancy (within three years of the survey date) (%)	95% CI
National	**358**	**79.1**	**72.5-84.6**
Region			
Southern	102	87.3	74.0-94.3
Highlands	82	78.0	64.7-87.4
Mamose	89	71.9	59.6-81.6
Islands	85	87.1	72.8-94.4

Weighted analysis to account for complex survey design

6.6 Discussion: Anemia, iron deficiency and iron deficiency anemia

In each of the target groups there is a high prevalence of anemia. The pattern is similar in all three target groups across the 4 regions, with people in Mamose and the Southern region having the highest prevalence. The high prevalence of anemia in men suggests that iron deficiency may not be the predominant cause of anemia in Papua New Guinea. Iron deficiency anemia in women is 19.5% and in children it is highest in the 6-11 months age group (27.8%).

Infections seem to be more related to anemia in children than in women. Children with elevated acute phase proteins are much more likely to be anemic than children without signs of inflammation.

Unfortunately due to technical difficulties we were not able to determine the malaria status of the survey participants so it is difficult to know to what extent malaria might have contributed to the anemia prevalence.

More work needs to be done to determine the aetiology of anemia in PNG. Iron fortification of food vehicles such as wheat flour, may help to reduce the prevalence of iron deficiency further but based on this data there are other causes of anemia that need to be addressed, such as infection and possibly malaria control.

To address the very high prevalence of anemia among young children, the feasibility of commercial and in-home fortification (e.g. using multiple micronutrient powders) of foods for infants and young children should be explored.

These data on iron supplementation have limited use as there is no indication of how many supplements women received, at which stage or pregnancy they received supplements and how frequently they took the supplements. Furthermore the survey did not collect hemoglobin on pregnant women so there is no information on their nutritional status during pregnancy. Although these data have limitations it indicates that systems are in place for supplement delivery at some point during pregnancy for just over 75% of pregnant women in Papua New Guinea. The policy on iron supplementation of pregnant women should also continue to be routine practice in antenatal care.

CHAPTER 7. VITAMIN A DEFICIENCY

This chapter summarizes indicators related to vitamin A deficiency among children 6-59 months old and non pregnant women 15-49 years of age. Vitamin A deficiency (<0.7µmol/l) was assessed by measuring retinol binding protein (RBP) on dried blood spots (DBS). Vitamin A status is affected by inflammation. The data are presented including and excluding children with inflammation as determined by elevated C-reactive protein (CRP) (>5mg/L) and/or elevated α 1-acid glycoprotein AGP (>1.2 mg/L).

7.1 Vitamin A deficiency among children 6-59 months

The prevalence of vitamin A deficiency in children 6-59 months of age including those with signs of inflammation is 25.6% and excluding inflammation (CRP and/or AGP) 15.7%. The prevalence of low RBP by demographic characteristics is presented in Table 7.1.

Children in the Mamose region are most at risk of vitamin A deficiency and children in urban areas are also more likely to be vitamin A deficient. Children in Mamose are more likely to be vitamin A deficient due to infection than children in other parts of the country. Figure 7.1 presents the regional prevalence of vitamin A deficiency including and excluding children with elevated acute phase proteins.

According to the WHO, criteria Vitamin A deficiency is considered to be a moderate public health problem if the prevalence is 10-20% and severe if the prevalence is $\geq$ 20%. Nationally the problem can be determined as moderate but in Mamose the problem is severe. In urban areas, the problem is also more severe than in rural areas.

Table 7.1 Prevalence of vitamin A deficiency for children 6-59 months, including and excluding inflammation[2]. PNG National Nutrition Survey 2005

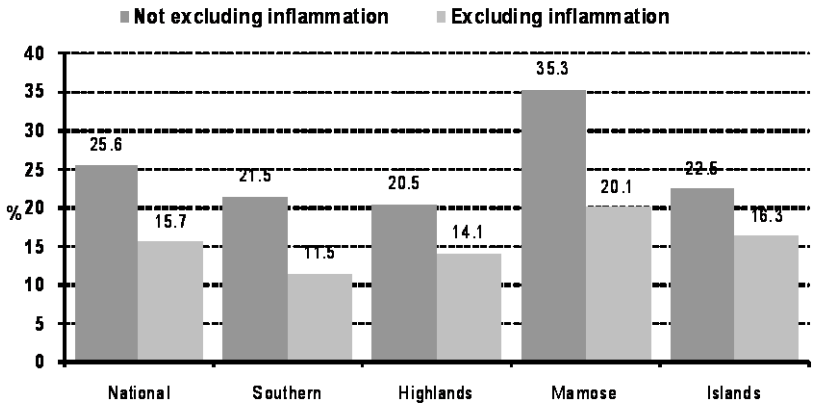
Demographic Characteristics	Prevalence of VAD [1]					
	All children			Excluding children with inflammation		
	N	Vitamin A deficiency (%)	95% CI	N	Vitamin A deficiency (%)	95% CI
National	**875**	**25.6**	**21.7, 30.1**	**591**	**15.7**	**12.6, 19.4**
Region						
Southern	195	21.5	15.1, 29.8	122	11.5	6.7, 19.0
Highlands	195	20.5	13.6, 29.8	149	14.1	10.5, 18.6
Mamose	241	35.3	27.4, 44.0	154	20.1	13.3, 29.4
Islands	244	22.5	15.2, 32.0	166	16.3	9.0, 27.6
Residence						
Urban	164	30.5	23.1, 39.2	119	21.4	13.9, 31.4
Rural	711	24.5	19.9, 29.7	472	14.3	11.2, 18.0
Sex						
Male	467	27.1	22.5, 32.2	307	17.1	13.3, 21.6
Female	405	24.1	19.4, 29.6	281	14.4	10.7, 19.2
Age Group (months)*						
6-11	95	37.8	27.4, 49.6	63	25.3	15.6, 38.4
12-23	209	27.0	21.4, 33.6	135	14.1	9.1, 21.2
24-59	221	24.8	18.2, 32.9	144	14.6	8.3, 24.3
36-47	189	22.6	16.8, 29.7	119	13.2	8.1, 20.9
48-59	158	21.8	15.9, 29.1	127	16.9	11.8, 23.5

Weighted analysis to account for complex survey design

[1]VAD retinol binding protein<0.7µmol/l

[2] Inflammation was defined as having elevated CRP(>5mg/L) and/ or AGP (>1.2 mg/L)

Figure 7.1 Prevalence of Vitamin A deficiency, including and excluding children with inflammation, PNG National Nutrition Survey 2005



7.2 Retinol binding protein (RBP) among non-pregnant women 15-49 years

The prevalence of vitamin A deficiency in non-pregnant women of child bearing age (15-49 years) in PNG was 0.7%.

7.3 Self-assessed clinical sign of vitamin A deficiency, poor eye sight

Questions concerning difficulty in vision during the last pregnancy were restricted to women of childbearing age who had reported at least one pregnancy during the three years prior to the survey.

Out of the 357 women who responded, 12.3% of women reported difficulties with their vision during their last pregnancy in the daytime and 9.0% at dusk. Out of all these 357 women, only 6 reported to have vision problems during dusk but not in the day (1.7%), which would suggest night blindness. Due to the vast numbers of local languages, the survey did not attempt to identify local terms for night blindness.

7.4 Vitamin A supplementation

A total of 52.7% of children 6-59 months of age had ever received a vitamin A capsule and 15.5% received a vitamin A capsule in the previous 6 months (Table 7.2). Of those that could recall where they had obtained the capsule 45.5% had obtained it from routine health center visits and 51.4% from supplementary immunization activities.

Table 7.2 Prevalence of children 6-59 months who had ever taken a vitamin A capsule and prevalence of those that had taken it in the last 6 months, PNG National Nutrition Survey 2005

Demographic Characteristics	N	Ever taken a vitamin A capsule (%)	95% CI	Taken vitamin A supplement in ≤ 6 months (%)	95% CI
National	**933**	**52.7**	**46.3-59.0**	**15.5**	**11.0, 21.4**
Region					
Southern	224	56.3	40.9- 70.5	8.4	4.5, 15.3
Highlands	208	39.9	30.0-50.7	12.0	7.4, 18.7
Mamose	255	61.6	48.3- 73.3	24.3	13.0, 40.8
Islands	246	56.9	44.2-68.7	15.0	7.3, 28.4
Residence					
Urban	180	52	41.9-61.8	15.5	9.3, 24.6
Rural	753	52.9	45.3-60.4	15.4	10.3, 22.7
Sex					
Male	503	55.2	48.5-61.7	16.5	12.1, 22.6
Female	430	49.7	42.0-57.5	14.1	9.1, 21.3
Age Group (months)*					
6-11	106	49.8	38.2-61.5	42.1	30.6, 54.5
12-23	220	51.8	42.2-61.2	21.6	14.3, 31.1
24-59	234	53.4	44.6-62.1	8.0	4.7, 13.4
36-47	195	51.9	42.7-61.1	8.6	4.5, 15.6
48-59	166	56	47-64.6	9.2	4.1, 19.1

Weighted analysis to account for complex survey design

7.5 Discussion: Vitamin A

Vitamin A status in PNG was assessed in children 6-59 months and in women 15-49 years using retinol binding protein (RBP) on dry blood spots. Ideally serum retinol would have been measured, as it is the gold standard for assessing vitamin A status, but logistical limitations meant that an alternative was needed. Retinol binding protein (RBP) is a suitable alternative to serum retinol (Gorstein 2008).

Serum retinol values are affected by inflammation but it is uncertain how RBP is affected by acute phase proteins such as CRP and AGP. Recent publications have proposed adjusting data to account for the effects of inflammation rather than discarding data (Thurnham 2008) but we were unable to do that in this analysis as the adjustments, so far, have only been proposed for serum ferritin and retinol. Therefore, the vitamin A data, as determined by RBP, is presented including and excluding for inflammation. As these data will be used to make policy and programmatic decisions, rather then for research purposes, it was appropriate to present the data in both ways.

The data shows that both including and excluding those with either marker of inflammation, vitamin A deficiency is a moderate to severe problem for children in Papua New Guinea and almost non existent in women of reproductive age. Among children in Mamose region the prevalence is higher than in the other 3 regions. Children in urban areas are also more likely to be vitamin A deficient than children in urban areas. This may be because they are less able to access fresh fruits and vegetables rich in vitamin A in urban areas.

Just over 50% of all children 6- 59 months had ever received a vitamin A capsule. Children in Mamose were most likely to have ever received a capsule and children in the Highlands least likely. Although it is not possible to determine from the data how many children had received the required number of capsules they were eligible for, 15.5% of children 6-11 months had received a capsule in the last 6 months. Despite the fact that children in Mamose had received more capsules than children in other parts of PNG there exposure to infections and malaria are likely to be more and overall their nutritional status appears to be worse. Interventions such as vitamin A supplementation need to be consistently delivered to all children so that children receive supplements routinely.

CHAPTER 8. INFANT AND YOUNG CHILD FEEDING

This chapter summarizes indicators related to infant and young child feeding among children 6-59 months of age and provides some information on the initiation of breastfeeding, the duration of feeding (although not exclusivity) and the age of onset of complementary feeding.

8.1 Breastfeeding

Table 8.1 presents the prevalence of mothers of children 6-59 months of age who initiated breastfeeding within the first 24 hours after birth. Most women in all areas of the country and in both urban and rural areas initiated breastfeeding within 24 hours.

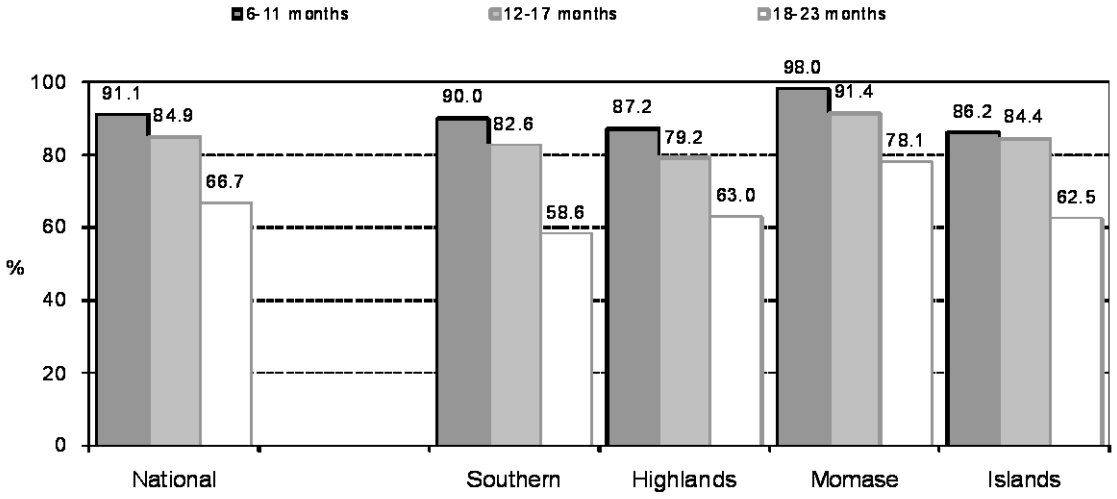
Table 8.1 Prevalence of breastfeeding within 24 hours of birth, PNG National Nutrition Survey 2005

Demographic Characteristics	Percent of children breastfed within 24 hours of birth		
	N	%	95% CI
National	**931**	**83.6**	**79.7, 86.8**
Region			
Southern	223	77.6	69.5, 92.6
Highlands	208	80.3	72.3, 86.4
Mamose	254	85.8	76.9, 91.7
Islands	246	94.7	91.1, 96.9
Residence			
Urban	179	80.0	68.2, 88.2
Rural	752	84.4	80.3, 87.8

Weighted analysis to account for complex survey design

In addition to early introduction of breastfeeding most children are also breastfed during the first 12 months of life. Figure 8.1 presents the number of children currently breastfeeding at the time of the survey by age and by region. Nationally 91.1% of children were breastfed between 6-11 months of age and 84.9% were breastfed between 12-17 months of age. The proportion of children breastfed between 18-23 months of age had dropped to 66.7%, although many women continued to breastfeed for a long time after their child reached 23 motnhs of age.

Figure 8.1 Prevalence of children currently breastfed by age and by region, PNG National Nutrition Survey 2005



8.2 Introduction of complementary foods

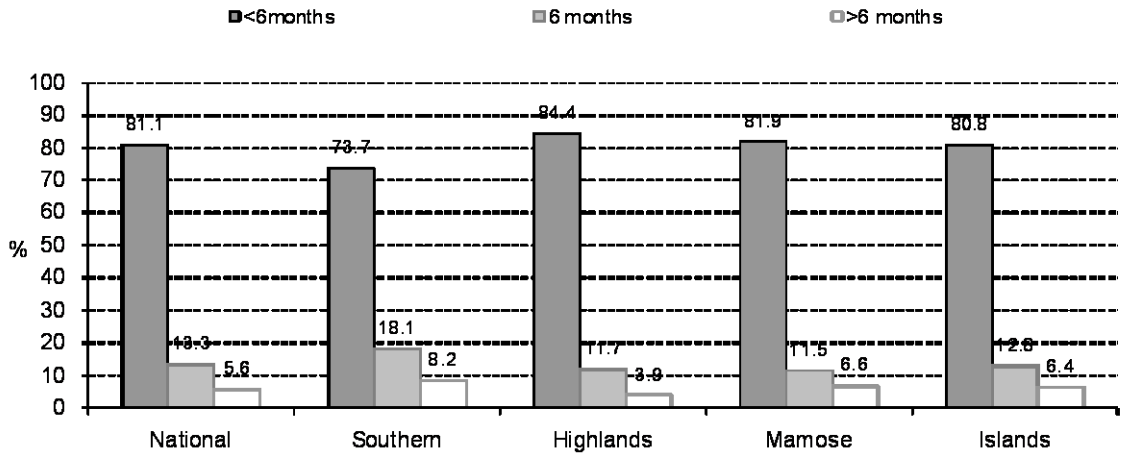
UNICEF and WHO recommend that complementary foods are introduced to the child at 6 months of age when breast milk alone is not sufficient to meet their growing needs. Nationally only 13.3% of children were given complementary foods at 6 months of age (Table 8.2). Complementary foods were considered to be any types of food other than breast milk or formula. More than 80% of children were introduced to complementary foods before the WHO recommended age of 6 months of age (Figure 8.2).

Table 8.2 Prevalence of timely introduction of complementary foods at 6 months of age, PNG National Nutrition Survey 2005

Demographic Characteristics	Prevalence of timely introduction to complementary foods		
	N	%	95% CI
National	**841**	**13.3**	**10.2, 16.5**
Region			
Southern	182	18.1	12.3, 25.9
Highlands	180	11.7	7.3, 18.1
Mamose	244	11.5	6.4, 19.7
Islands	235	12.8	8.6, 18.5
Residence			
Urban	157	10.6	6.1, 17.7
Rural	684	13.6	10.3, 17.9

Weighted analysis for prevalence to account for complex survey design

Figure 8.2 Age at first introduction to complementary foods, PNG National Nutrition Survey 2005



8.3 Discussion: Infant feeding

Breastfeeding provides newborns with protection against infection and chronic diseases, makes vital micronutrients available to newborns, and reduces the risk of death due to diarrhea, acute respiratory infections and other diseases (WHO 2001). These results demonstrated that the initiation and continuation of breastfeeding up until at least one year of age is very common in all parts of Papua New Guinea. Most children are breastfed during the first 24 hours after birth and there is not much regional variation. This survey does not provide information about exclusive breastfeeding or duration, but it does show that breastfeeding is initiated soon after birth for most infants.

In PNG complementary foods are introduced to the child at a very young age. This is concerning as the early introduction of complementary foods (before 6 months of age) provides few benefits and can be harmful. Early introduction may lead to the mother giving the child less breast milk and the weaning foods may not provide the infant with the same high quality nutrients that breast milk provides.

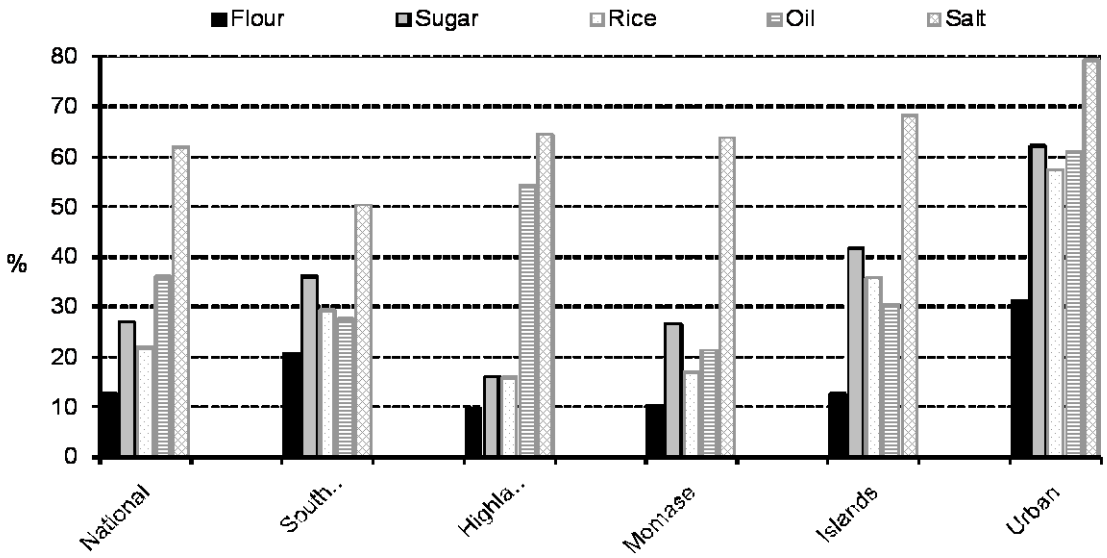
CHAPTER 9. FORTIFICATION VEHICLES

This chapter summarizes indicators related the availability of fortification vehicles (staple food products) in the household. One of the objectives of this survey was to identify potential food vehicles that could be fortified in Papua New Guinea.

The survey looked at five foods that could potentially be used as fortification vehicles. The foods of interest were flour, sugar, oil, rice and salt. The questions focused on the presence of these staples in the household at the time of the survey, the form of the product and the brand. The information collected from the survey will be used in conjunction with the data collected during the food fortification situational analysis that was conducted in July 2006 by Quentin Johnson from the Micronutrient Initiative to help the government of PNG to plan its fortification strategy (annex 14).

The presence of staple foods present in the household at the time of data collection is presented in Figure 9.1.

Figure 9.1 Prevalence of potential fortification vehicles in the household on the day of the survey, PNG National Nutrition Survey 2005



Of the households surveyed, 30.5% had none of the 5 staple products in the household on the day of the survey, 52.8% had 1-2 products and 35.6% had 3-5 products. Table 9.1 and Figure 9.2 present the number of staple foods a household had on the day of the survey. Regionally the Southern region had the greatest proportion of households with no staple products (39.3%). The Islands region had the greatest proportion of households with 3 -5 staple food items (33.9%). There is a strong association between the number of staple foods and urban and rural location. In rural households 34.6% had no staple food item versus only 10.4% of urban households. In urban areas 63.7% had 3-5 staple products compared to only 18.0% in rural areas.

Table 9.1 Prevalence of potential fortification vehicles in households, PNG National Nutrition Survey 2005

Demographic characteristics	Prevalence of staple food items in the household (%) (CI 95%)			
	N	0 products	1-2 products	3-5 products
National	1401	30.5 (24.9, 36.8)	43.8 (38.7, 49.1)	25.7 (20.5, 31.7)
Region				
Southern	341	39.3	27.6	33.1
Highlands	358	27.7	50.0	22.3
Mamose	354	31.6	48.3	20.1
Islands	348	23.3	42.8	33.9
Residence				
Urban	241	10.4	25.8	63.7
Rural	1160	34.6	47.4	18.0

Weighted analysis to account for complex survey design

9.1 Flour

Nationally 12.7% of households had some form of flour on the day of the survey. The Southern region had a higher prevalence of flour in the household than the other regions. Although the proportion of households with flour was low nationally almost a third of households in urban areas had flour (Table 9.1).

The most common type of flour found in households nationally was plain white flour (83.6%). However, in the Highlands and Mamose region approximately one quarter of households had whole meal flour. All flour that was in the households was purchased and in 40.2% of households the flour was still in the original packaging.

Table 9.1 Availability and type of flour available in the household, PNG National Nutrition Survey 2005

	Households with flour available by region and urban and rural locality (%)						
	National	Southern	Highlands	Mamose	Islands	Urban	Rural
Flour present in household	12.7	20.8	9.8	10.5	12.7	31.2	9.0
	Type of flour among households with flour (%)						
Whole meal	15.6	4.3	24.2	25.0	11.4	19.1	13.1
White	83.6	92.9	72.7	75	84.1	78.5	84.3
Not available for observation	2.7	2.9	3.0	0	4.5	2.4	2.6

Weighted analysis to account for complex survey design

The main brands of flour purchased are presented in Table 9.2. The most popular brand of flour is Flame. In 77.5% of the households the flour available was"Flame".

Table 9.2 Brand of flour available among households with flour by region and urban/rural locality, PNG National Nutrition Survey 2005

	(%)						
	National	**Southern**	**Highlands**	**Mamose**	**Islands**	**Urban**	**Rural**
Mothers choice	9.5	21.2	4.0	0	2.4	10.9	7.4
3 roses	13.0	4.5	20.0	16.7	19.0	14.4	12.7
Flame	77.5	74.2	76.0	83.3	78.6	74.7	79.9

Weighted analysis to account for complex survey design

9.2 Sugar

Nationally, 27% of households had some form of sugar on the day of the survey. Just under half of all households in the Islands had sugar. Availability of sugar in the household was strongly associated with urban/rural locality with two thirds of households in urban areas having sugar compared to only 19.9% of rural households. The main types of sugar that were present in the household at the time of data collection are presented in Table 9.3. In the households that had sugar 58.4% of households had kept the sugar in its original packaging.

The most common type of sugar found in households nationally was white sugar (81.8%). However, in the Southern region 30.3% of households and 26.4% of households in Mamose region had brown sugar. The most popular brand of sugar was Ramu.

Table 9.3 Availability and type of sugar available in the household by region and urban/rural locality, PNG National Nutrition Survey 2005

	Households with sugar on the day of the survey (%)						
	National	**Southern**	**Highlands**	**Mamose**	**Islands**	**Urban**	**Rural**
Sugar present in household	27.0	36.0	16.2	26.6	41.7	62.2	19.9
	Type of sugar in households with sugar (%)						
White sugar	81.8	65.5	94.4	72.5	96.5	76.8	83.4
Brown sugar	15.7	30.3	0	26.4	2.8	19.3	14.5
Not available for observation	2.5	4.2	5.6	1.1	0.7	3.8	2.2

Weighted analysis to account for complex survey design

9.3 Rice

Nationally, 22% of households had some rice in the household on the day of the survey. Just over a third of all households in the Islands had rice. As with the other staple foods, the availability of rice in the household was strongly associated with urban/rural locality with almost two thirds of households in urban areas having rice compared to only 14.9% of rural households. In households that had rice on the day of the survey, rice was purchased by 98.5% of the households and in 92.1% of households rice was still in its original packaging. The most common type of rice found in households nationally was white rice (97.3%).

The main brands of rice purchased are presented in Table 9.4. The most popular brand of rice is Roots (66%).

Table 9.4 Availability and brand of rice available in the household by region and urban/rural locality, PNG National Nutrition Survey 2005

	Households with rice on the day of the survey (%)						
	National	**Southern**	**Highlands**	**Mamose**	**Islands**	**Urban**	**Rural**
Rice present in household	22.0	29.4	15.9	16.9	35.9	57.4	14.9
	Brand of rice among households with rice(%)						
Ezy Cook	3.0	1.1	2.1	7.5	2.6	3.5	2.9
Flame	3.9	4.5	2.1	7.5	2.6	5.4	3.1
Roots	66.1	47.7	85.1	45.3	81.9	46.9	79.9
Trukai	24.7	44.3	10.6	32.1	12.1	41.0	12.2
Other	2.3	2.3	0	7.5	0.9	3.3	1.9

Weighted analysis to account for complex survey design

9.4 Oil

Nationally, 36.0% of households had some form of oil on the day of the survey. Just over half of all households in the Highlands had oil. Availability of oil in the household was strongly associated with urban/rural locality with two thirds of households in urban areas having oil compared to only one third of rural households. In households that had oil on the day of the survey, oil was purchased by 91.6% of the households. In 97.5% of households, the oil was still in its original packaging.

The most common type of oil found in households nationally was vegetable oil (47.6%). The second most popular type of oil was cooking oil (38.9%). The most popular brand of oil is Superior (22.4%), but there is a wide variety of brands of oil available which make up the composite category “other”. Table 9.5 presents the availability and brands of oil available in the households included in the survey.

Table 9.5 Availability and brand of oil available in the household by region and urban/rural locality, PNG National Nutrition Survey 2005

	Households with oil on the day of the survey (%)						
	National	**Southern**	**Highlands**	**Mamose**	**Islands**	**Urban**	**Rural**
Oil present in household	36.0	27.6	54.2	21.5	30.5	60.9	31.1
	Brand of oil in households with oil (%)						
Globe	9.8	4.7	3.7	27.8	11.8	9.7	9.8
Highland meadows	15.3	20.9	20.1	8.3	1.1	13.1	16.3
Mama	17.5	12.8	17.9	19.4	19.4	17.0	17.7
Superior	22.4	8.1	35.8	8.3	15.1	12.4	27.3
Other	35.0	53.5	22.4	36.1	52.7	47.7	28.8

9.5 Salt

At least one type of salt was present in 61.9% of all of the households surveyed. Most of the salt available in the households was fine Table salt or cooking salt (90.2%). Salt was purchased by 98.8% of the households that had salt on the day of the survey and in 53.6% of households, the salt was still in its original packaging. Some families reported buying salt refills and adding it to their original container.

The most popular brand of salt is Tru Cook (28.0%), but there is a wide variety of salt available. Table 9.6 presents the brands of salt available in the households included in the survey.

Table 9.6 Availability and brand of salt (in original containers) in the household by region and urban/rural locality, PNG National Nutrition Survey 2005

	Households with salt available on the day of the survey (%)						
	National	**Southern**	**Highlands**	**Mamose**	**Islands**	**Urban**	**Rural**
Salt present in household	61.9	50.4	64.5	63.8	68.1	79.2	58.5
	Brand of salt in household with salt (%)						
Crystal	14.7	42.4	2.6	19.2	5.7	30.9	10.7
Jumbo	24.8	15.3	43.5	12.3	17.1	14.4	27.5
King	9.7	22.4	3.5	12.3	5.7	17.4	7.7
Saxa	3.6	1.8	0.9	2.3	4.1	12.1	1.4
Sky	5.4	-	-	16.9	-	2.4	6.1
Tru cook	28.0	-	34.8	20.0	56.1	11.1	32.2
Other	13.9	8.2	14.8	16.9	11.4	11.6	14.4

Weighted analysis to account for complex survey design

9.6 Discussion: Fortification vehicles

The survey data indicate that potential fortification vehicles are much more available in urban areas versus rural and in some regions more than others in PNG. The Highlands and Mamose have fairly limited availability of fortification vehicles in the household compared to the Islands and the Southern region. One reason that the Southern region has more access to fortification vehicles is because this region encompasses the National Capital District (NCD).

Out of the five vehicles discussed in the survey, salt was the most common food item present in the household in all regions. In the questionnaire, the household head was asked if the household had that specific item on the day of the survey, which means that they might not have had it the day before. The results show that salt is the most common commodity, followed by oil and sugar.

When comparing the number of households by region and by rural and urban location, rural households tended to have far fewer potential fortification vehicles. In rural areas 34.6% of households had none of the 5 commodities versus 10.4% in urban areas.

Flour
Flour was the least common vehicle available in the households on the day of the survey. In households that did have flour, it tended to be white flour. There are few brands of flour available and the predominant brand is Flame.

Sugar
Sugar was much more common in urban rather than rural areas. Almost 50% of households in the Island's region had sugar on the day of the survey. White sugar was the most common and the predominant brand is Ramu.

Rice
Again rice was more common in households in urban areas. There are many brands of rice in PNG and the predominant brand used was Roots rice.

Oil
Oil was the second most common food commodity in households. Vegetable oil was the most common type of oil but again there were many brands with no brand more predominant.

Salt
Salt was the most common food commodity in the household. There were many brands of salt withTru Cook and Jumbo being the most popular.

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APPENDICES: PAPUA NEW GUINEA NATIONAL NUTRITION SURVEY 2005

APPENDIX 1: SAMPLE SIZE CALCULATIONS AND ASSUMPTIONS

Target group	Indicator	Estimated prevalence	Stratum-specific half CI	Sample size per stratum if SRS	DEFF	Sample size per stratum if cluster sampling	Sample size needed (all 4 strata)	Individual non-response	No. per HH	Non response for HH	Total number HH incl. non-response per strata	Total number of HH for 4 strata	Specimens if sample size = 1600 HH
HH	Salt HH	0.5	0.12	67	4.5	300	1200	0%	1	10%	333	1,334	1440
Children 6-59 months	Anemia	0.5	0.10	96	2	192	768	20%	0.7	10%	381	1,524	806
	Iron deficiency	0.5	0.10	96	2	192	768	20%	0.7	10%	381	1,524	806
	Malaria	0.5	0.12	67	3	200	800	20%	0.7	10%	397	1,588	806
	Vitamin A deficiency	0.5	0.10	96	2	192	768	20%	0.7	10%	381	1,524	806
	Wasting	0.1	0.05	138	1.5	207	830	10%	0.7	10%	366	1,463	907
	Stunting	0.5	0.10	96	1.5	144	576	10%	0.7	10%	254	1,016	907
Children 24-59 months	Hookworm	0.5	0.15	43	3	128	512	30%	0.5	10%	407	1,626	504
Women 15-49 years	Iron deficiency	0.5	0.10	96	2	192	768	20%	1.37	10%	195	779	789
	Anemia	0.5	0.10	96	2	192	768	20%	1.37	10%	195	779	789
	Malaria	0.5	0.12	67	3	200	800	20%	1.37	10%	203	811	789
	BMI <17	0.1	0.05	138	1.5	207	828	10%	1.37	10%	187	748	888
	BMI >25	0.5	0.10	96	3	288	1152	10%	1.37	10%	260	1,039	888
	Urinary Iodine	0.5	0.10	96	2	192	768	20%	1.37	10%	195	779	789
Men > 18 years	Anemia	0.1	0.05	138	1.5	207	828	25%	1.5	10%	205	820	810
	BMI < 17	0.1	0.05	138	1.5	207	828	10%	1.5	10%	171	683	972
	BMI > 25	0.1	0.05	138	1.5	207	828	10%	1.5	10%	171	683	972

APPENDIX 2: CONFIDENCE INTERVALS AND DESIGN EFFECTS FOR PRIMARY INDICATORS

Indicator*	Target Group	Sample Size	Prevalence (%) or mean and SD	95% Confidence Interval (%)	DEFF**
Stunting - Height-for-age Z-score (HAZ <-2 SD)	Children (6-59 mos)	892	43.9	38.8-49.2	2.5
Underweight - Weight-for-age Z-score (WAZ <-2 SD)	Children (6-59 mos)	924	18.1	14.9-21.9	1.9
Wasting - Weight-for-height Z-score (WHZ <-2 SD)	Children (6-59 mos)	897	4.5	3.1–6.5	1.5
Overweight – Body mass index for age(BAZ >2 SD)	Children (6-59 mos)	892	4.8	88.5- 93.5	1.8
BMI (mean)	Non-pregnant women (15-49 yrs)	772	22.9	22.4–23.32	2.6
BMI (mean)	Men 18 ≥ yrs	787	23.1	22.76-23.40	2.1
Urinary Iodine (**%**<100 µg/L)	Non-pregnant women (15-49 yrs)	690	28.9	23.9-34.7	2.3
Anemia (Hb< 11.0 g/dL)	Children (6-59 mos)	910	48.1	42.7-53.5	2.7
Anemia (Hb< 12.0 g/dL)	Non-pregnant women (15-49 yrs)	760	35.7	31.0-40.7	2.0
Anemia (Hb< 13.0 g/dL)	Men 18 ≥ yrs	778	26.3	21.5-31.9	2.7
TfR (> 8.0 µg/L)	Children (6-59 mos)	872	27.8	23.4-32.7	2.4
TfR (> 8.0 µg/L)	Non-pregnant women (15-49 yrs)	753	19.5	15.9-23.5	1.8
IDA (elevated TFR, low Hb)	Children (6-59 mos)	868	22.8	18.8-27.4	2.3
IDA (elevated TFR, low Hb)	Non-pregnant women (15-49 yrs)	742	15.0	11.7-18.8	1.8
RBP **(<**0.70µmol/l)	Children (6-59 mos)	875	25.6	21.7-30.1	2.1
Helminths	Preschool Children (24-59 mos)	363	4.9	3.5-6.8	1.4

Ever received a Vitamin A Capsule	Children (6-59 mos)	933	52.7	46.3-59.0	3.8
Breastfeed within 24 hours of birth	Children (6-59 mos)	931	83.6	79.7-86.8	2.1

*Cut-offs for micronutrient deficiencies as described in Chapter 2

** The design effect or DEFF is the ratio of the actual variance to the variance computed under the assumption of simple random sampling, thus calculating the loss of effectiveness by the use of cluster sampling, instead of simple random sampling; the larger the DEFF, the greater the variance

APPENDIX 3: LIST OF PRIMARY SAMPLING UNITS SELECTED FOR INCLUSION IN THE SURVEY

Clusters select for PNG national Nutrition survey					
Cluster no.	Province	District	Local Level Government	Ward	Census unit
Southern Region					
1	WP	M/Fly	Balimo U	BAL.UR	Bal.Urb 4
2	WP	N/Fly	Nomad	Mougulu	Mog.Miss.
3	WP	N/Fly	Nigerum	Miamrae	Senamrae
4	WP	S/FLY	MoreHead	Wemnevere	Iokwa
5	GP	Kerema	E/Kerema	Sarota	Sarota
6	GP	Kikori	Baimuru	Mariki	Upaia
7	CP	Abau	Amazon.B	Danava/G	Mailiu Is.
8*	CP	Goilala	Tapini	Cent.Ivan	Sene
9	CP	K/Hiri	Hiri	Akuku	Kuriva/On.
10	CP	K/Hiri	Mekeo/K	Rarai	Rarai
11	CP	Rigo	Rigo/C	Alukuni	Alukuni
12	NCD	NCD	POM	Waigani	Mor.1Gu.St
13	NCD	NCD	POM	Tok.Hla	Beech St
14	NCD	NCD	POM	Gord/Sar.	Gord.Rge
15	NCD	NCD	POM	Bor./Kor.	Rag.S'mmt
16	NCD	NCD	POM	Tow./Hbda	Autu.St.
17	NCD	NCD	POM	Bomana	Nine M/S
18	MBP	Alotau	Martna.	E/Cape	E/Cape
19	MBP	Alotau	Alotau.U	Alo./Town	Sewa
20	MBP	Esa'ala	Yale.LLG	Rambuso	E.Point/Ru.
21	MBP	K-Good.	Kiriwina	Lalela	Lalela
22	MBP	Sam/Mur.	W/Fergus.	Fatavi	Fatavi
23	ORO	Ijivitari	Oro Bay	Baberanda	Arugasusu
24	ORO	Ijivitari	Pop/U	Gewoto	Kikonda
25	ORO	Sohe	Higa.Rur.	Duve	Nomota
Highlands Region					
26	SHP	Imbonggu	Imbonggu	Parare1	Opokai
27	SHP	Kom/Mag	Hulia	Dauli 3	Dem Sch.
28	SHP	Kor/Kop.	N/Koroba	Hunjenoma1	Wake
29	SHP	Nipa/Kut.	Mendi Urb.	Mendi Twn.	Cath.Mis.
30	SHP	Nipa/Kut.	Nipa/Rural	Pulim3	Mala
31	Enga	Kandep	Kandep	Lakalap 2	Kitan
32	Enga	Laig/Poge.	Lagaip	Papayuku	Papayuku
33	Enga	Wabag	Wabag Ru.	Kiwi	Lanemanda
34	Enga	Wapnda	Tsak	Imangapos	Arumanda

35	WHP	Ang/SW	S/Wahgi	Tombil 1	Tombil 1
36	WHP	Dei	Dei Rural	Kambuki	Walga
37	WHP	Hagen	Mt.Hagen	Mt,HGN	Coun.S/me
38	WHP	Mul/Bay.	Mul	Minimp	Minimp
39	WHP	N/Wahgi	N/Wahgi	Milep 1	Kapolong
40	WHP	Tamb/Nebi	Nebilyer	Dumakona	Dumakona
41	Chimbu	Gumine	Mt.Digine	Karilmaril	Siminkoli
42	Chimbu	Kerowagi	Kerowagi	Pagau 3	Orua 2
43	Chimbu	Kundiawa	Waiye	Wandi	Guiye
44	EHP	Daulo	Asaro/Wat.	Kanosa	Foindiwei
45	EHP	Goroka	Goroka/U	Goroka/U	Homate St
46	EHP	Heganofi	Heganofi	Krevave	Tingunta
47	EHP	Kainantu	Kainantu	Binakenu	Ikana
48	EHP	Lufa	Lufa	Nupuru	Nupuru 1
49	EHP	Okapa	Okapa	Yagana	Aniaru
50	EHP	Ung.Bena	Ung.Ben	Orupa-Foe	Kurawa
Mamose Region					
51	Morobe	Bulolo	Mumeng	Zenag	Zenag
52	Morobe	Bulolo	Wau	Wandumi	Wandumi
53	Morobe	Huon Gulf	Morobe	Eware	Eware
54	Morobe	Kabum	Deyamos	Birimon	Imom
55	Morobe	Lae	Ahi	Lae City	K/Kum.Se
56	Morobe	Lae	Lae Urban	Lae City	Tent City
57	Morobe	Markam	Umi/Atzera	Atzunas	Tumoa
58*	Morobe	Menyama	Aseki	Mauwini	Korenga
59	Morobe	Nawae	Labuta	Musom/Tate	Tale
60	Morobe	Tewai/Sia.	Siasi	Lablab1	Bezek
61	Madang	Bogia	Yawar	Amber Arep	Arep
62	Madang	Madang	Mad./U	Mad./U	DAL Cres.
63	Madang	M/Ramu	Joe/staal	Ward 7	Arimbugor
64	Madang	R/Coast	R/Coast	Ward 4	Pisangana
65	Madang	Sumkar	Karkar	Ward 27	Kevasop
66	Madang	U/Bundi	Usino	Boko	Boko
67	ESP	Amb./Drek.	Gawanga	Bongos	Bongos
68	ESP	Angoram	Keram	Yanboe	Yanboe
69	ESP	Maprik	Bumb,/Mah.	Ilahita 3	Ilahita 7
70	ESP	Wewak	Turubu	Kinyare	Kinyare
71	ESP	W/Gawi	Burui/Kunai	Marap 2	Marap 2
72	ESP	Y/Saussia	E/Yangoru	Simb/Seng	Simb/Seng
73	Sandaun	A/Lumi	E/Aitape	Aitape/U	AirStrip/Set.
74	Sandaun	Nuku	Palmai	Wara	Wara/Sumil
75	Sandaun	V/Green R	Amanap	Iveig	Arump
Islands Region					
76	Manus	Manus	Lele/Bup.	Lapahan	Lapahan
77	Manus	Manus	Rapatona	Hahai	Hahai

78	NIP	Kavieng	Tikana	Panapai	Kaplaman
79	NIP	Kavieng	Kvg.U	Kvg.U	Rawal
80	NIP	Nama.	Cen.N.I	Konos	Pinikidu
81	NIP	Nama.	Nimamar	Londo.	Londo.1,2
82	ENBP	Gazelle	C/Gazelle	Tavilo/Set.	Tavilo Pltn.
83	ENBP	Gazelle	Lasul Bain.	Watmetki	Watmetki
84	ENBP	Gazelle	Vun./Toma	Taulil 1	Taulil 1
85	ENBP	Kokopo	D/York	Maren	Maren
86	ENBP	Kokopo	Raluana	Nguvalian	Nguvalian
87*	ENBP	Pomio	E/Pomio	Sampun	Sampun
88	ENBP	Rabaul	Balanta.	Karavia	Karavia
89	WNBP	Kand/Glou	Gasmata	Akolet	Kalagen
90	WNBP	Kand/Glou	Kand/Inland	Avet	Langarum
91	WNBP	Talasea	Bialla	Wilelo	Wilelo Pltn.
92	WNBP	Talasea	Bali/Witu	Lovanua	Matapupur
93	WNBP	Talasea	Kimbe/U	Kimbe/U	Sct.21/ABC
94	WNBP	Talasea	Mosa	Sarakolog	Togulo Ptn.
95	NSP	N/Boug.	Tinputz	Taonita	Periovi and Hoakop
96	NSP	N/Boug.	Buka	Peit	Kohino
97	NSP	N/Boug.	Nissan	Sigon	Nis.Hi. Sc
98	NSP	C/Boug.	Arawa	Eivo 2	Boira
99	NSP	S/Boug.	Buin	Konnou	Lukauko
100	NSP	S/Boug.	Bana	Lamane/E	Peile

*The clusters that couldn't be surveyed due to weather conditions and access problems are typed in grey

APPENDIX 4A: PAPUA NEW GUINEA NUTRITION SURVEY – CONSENT FOR PARTICIPATION (ENGLISH)

Household consent

- The Department of Health is doing a survey to find out if the people of Papua New Guinea are getting enough vitamin A and iron in the food they eat.
- By you permit the household to participate in the survey, you are helping us to improve the health of the people of Papua New Guinea.
- We are surveying the problem of anemia (low blood) and other nutrition problems among children ages 6-59 months, women (15-49 years) and men (18 years and above) in Papua New Guinea.
- We would like to ask you some questions about the children 6-59 months living in this household. We may also have some questions for the women and men living here.
- We would like to weigh and measure people in the household. We would also like to get a finger prick blood specimen to check for anemia. Testing the blood will also help us to determine if people in Papua New Guinea are receiving sufficient amounts of Vitamin A which is important to maintain good health. We would also like to collect a sample of stool from the children and we may need to collect a urine sample from the women in the household.
- The results of the survey will be returned to the Papua New Guinea health authorities. They will use these results to help create and improve nutrition and health programs in Papua New Guinea.
- Do you agree that your household can participate in this survey?

RECORD WHETHER OR NOT CONSENT IS PROVIDED ON THE HOUSEHOLD DATA COLLECTION FORM

Consent for primary caregivers of children 6-59 months are selected
(Read consent information to the primary caregiver of each child in the household)

- We would like to weight and measure your child
- We would like to take a finger prick blood specimen to check for anemia. Testing the blood will also help us to determine if children in Papua New Guinea are receiving sufficient amounts of Vitamin A which is important to maintaining good health. We would also like to collect a sample of your child's stool so that we can test the stool for worms.
- Do you agree that we can take measurements and a small blood sample and stool sample from your child?

RECORD WHETHER OR NOT CONSENT IS PROVIDED ON THE CHILD DATA COLLECTION FORM

Consent for women 15-49 years

- We would like to weight and measure you
- We would also like to get a finger prick blood specimen to check for anemia. Testing the blood will also help us to determine if women in Papua New Guinea are receiving sufficient amounts of Vitamin A which is important to maintaining good health. We would also like to collect a sample of your urine so that we can check you iodine status.
- Do you agree that we can take measurements and a small blood sample and urine sample from you?

RECORD WHETHER OR NOT CONSENT IS PROVIDED ON THE WOMEN'S DATA COLLECTION FORM

Consent for men 18 years and above

- We would like to weight and measure you
- We would like to get a finger prick blood specimen to check for anemia.
- Do you agree that we can take measurements and a small blood sample and urine sample from you?

RECORD WHETHER OR NOT CONSENT IS PROVIDED ON THE MEN'S DATA COLLECTION FORM

APPENDIX 4B: PAPUA NEW GUINEA NUTRITION SURVEY- CONSENT FOR PARTICIPATION (PIGIN)

Sevei o wok painimaut long Kaikai- Tok orait long go insait long sevei
Fom long kisim tok orait long ol lain long haus bilong go insait long sevei

- Helt Dipatmen i wok long karimaut wanpela sevei long painimaut sapos ol pipel bilong Papua Niugini i wok long kisim inap Vaitamin A na Ain long kaikai bilong ol. (Vaitamin na Ain em ol gutpela kaikai long helpim lukautim bodi long pait egensim ol binatang i save mekim man i sik.)

- Taim yu givim tok orait long ol hauslain bilong yu i kam insait long dispela sevei, yu helpim mipela long impruvim o kamapim gut helt bilong ol pipel long Papua Niugini.

- Mipela i mekim wok painimaut long hevi we animia (o sot long blut) na ol arapela i kamapim bikos pipel i no kisim ol kaikai we i ken helpim lukautim na kamapim gut helt bilong ol. Mipela i karimaut dispela sevei long ol pikinini krismas bilong ol i stap namel long 6 na 59 mun, ol meri (krismas bilong ol i stap namel long 15 na 49 yias) na ol man (i gat 18 krismas na I go antap) long Papua Niugini.

- Mipela i laik mekim sampela askim long yu long ol pikinini i stap long dispela haus husat i gat krismas namel long 6 na 59 mun.
  Bai mipela i gat sampela kwesten long ol bikpela man na meri i save stap hia.

- Mipela i laik skelim na kisim mesamen (o mak long tolpela o sotpela) bilong ol lain long haus. Mipela i laik kisim blut long finga bilong sekim long animia o sot long blut. Kisim tes long blut bai helpim mipela long save sapos ol pipel long Papua Niugini i wok long kisim inap Vaitamin A we i save helpim long kamapim gutpela helt bilong pipel. Mipela i laik kisim sempol o liklik hap pekpek bilong ol pikinini na wankain long pispis bilong ol meri long dispela haus.

- Bai mipela i givim bek risal long ripot bilong dispela sevei i kam bek long ol helt atoriti bilong Papua Niugini. Ol bai yusim ol dispela risal long helpim kamapim ol gutpela nutrisen (kaikai) na helt progrem bilong Papua Niugini.

- Yu wanbel long ol hauslain bilong yu i stap insait long dispela sevei?

REKOTIM LONG FOM BILONG KISIM RIPOT SAPOS OL HAUSLAIN I GIVIM TOK ORAIT BILONG OL LONG STAP LONG DISPELA SEVEI.

Ol bai glasim na skelim na kisim ol Konsent o Tok orait long ol praimeri keagiva o lain husat i lukautim ol pikinini namel long 6 na 59 mun.

(Ritim ol Konsent Infomesen o tok orait long go insait long sevei i go long ol lain I lukautim ol pikinini long haus**)**

- Mipela I laik skelim na mesarim sais bilong pikinini

- Mipela i laik sutim pinga na kisim blut sempol long sekap long animia. Kisim tes long blut bai helpim mipela long save sapos ol pikinini insait long PNG i wok long kisim inap Vaitamin A we i helpim long gat gutpela helt. Mipela i laik kisim sempol o liklik hap pekpek na wokim tes sapos i gat ol liklik snek long en.

- Yu wanbel long mipela i ken skelim na mesarim sais na kisim sempol bilong pekpek na blut long dispela pikinini bilong yu?

REKOTIM O SEKIM SAPOS I GAT TOK ORAIT PINIS LONG FOM BILONG KISIM OL RIPOT BILONG PIKININI

Tok orait long ol meri i gat krismas namel long 15 na 49 yias.

- Mipela I laik skelim na mesarim sais bilong yu
- Mipela i laik isi isi sutim pinga na kisim blut sempol long sekap long animia. Testim blut bai helpim mipela tu long save sapos ol meri long Papua Niugini i wok long kisim inap Vaitamin A long wanem em i helpim long gat gutpela helt. Mipela i laik kisim sempol bilong pispis long sekim mak bilong aidin long bodi.
- Yu wanbel long mipela i ken skelim na mesarim sais na kisim liklik sempol long blut na pispis long yu?

REKOTIM LONG DATA KOLEKSEN FOM O FOM YU KISIM RIPOT BILONG OL MERI LONG EN SAPOS OL I GIVIM TOK ORAIT BILONG OL.

Konsent o tok orait bilong ol man i gat 18 yias na moa

- Mipela I laik skelim na mesarim sais bilong yu
- Mipela i laik isi isi sutim pinga na kisim blut sempol long sekim long animia.
- Yu wanbel long mipela i ken skelim na mesarim sais na kisim liklik blut na pispis sempol long yu?

REKOTIM LONG DATA KOLEKSEN FOM BILONG OL MERI O FOM LONG KISIM RIPOT SAPOS OL I GIVIM TOK ORAIT LONG KISIM ASKIM LONG OL.

Pinis…..

APPENDIX 5: DATA COLLECTION FORMS

Cluster Number ☐☐☐ Household Number ☐☐

HOUSEHOLD QUESTIONNAIRE TEAM CODE ☐

"We would like to talk to you about your household, that is all the people who usually sleep and eat here."

"Mipela i laik toktok long yu long haus bilong yu. Dispela em olgeta pipel husat i save slip na kaikai hia."

Read the survey consent form and ask for verbal consent. If consent is not obtained then move on to the next household. If there are no adult household members present in the household schedule another visit when an adult household member will be present.

VERBAL CONSENT OBTAINED FROM ADULT HOUSEHOLD MEMBER Yes ☐ No ☐

1. Day/Month/Year of interview:	☐☐ Day ☐☐ Month ☐☐☐☐ Year	
2. Census Unit		
3. Ward		
4. LLG		
5. District		
6. Province		
7. Region		
8. HOW MANY PEOPLE NORMALLY LIVE IN THIS HOUSEHOLD? **HAMAS PIPEL I SAVE STAP LONG DISPELA HAUS?** *(People who usually eat and sleep in the household)*	☐☐	
9. ARE THERE ANY WOMEN BETWEEN THE AGES OF 15 AND 49 YEARS WHO USUALLY LIVE IN THIS HOUSEHOLD? **I GAT SAMPELA MERI WE KRISMAS BILONG OL I STAP NAMEL LONG 15 NA 49 YIAS I SAVE STAP LONG DISPELA HAUS?**	Yes ..... 1 No ..... 2 Refused ..... 7 Don't know 9	2⇨Q.12 9 ⇨Q.12

10. HOW MANY WOMEN BETWEEN 15 AND 49YEARS LIVE IN THIS HOUSEHOLD? **HAMAS MERI I GAT KRISMAS NAMEL LONG 15 NA 49 YIAS I SAVE STAP LONG DISPELA HAUS?**	☐	
11. COULD YOU PLEASE TELL ME THE NAME AND AGE OF EACH WOMAN AGED 15 TO 49 YEARS WHO LIVES IN THIS HOUSEHOLD EVEN IF THEY ARE NOT HERE RIGHT NOW? **PLIS INAP YU TOKIM MI NEM NA KRISMAS BILONG OL WAN WAN MERI I SAVE STAP LONG DISPELA HAUS NA I GAT KRISMAS NAMEL LONG 15 NA 49 YIAS, MASKI OL I NO STAP LONG HAUS NAU?**	Name Age (Years) 1._____ ☐☐ 2._____ ☐☐ 3._____ ☐☐ 4._____ ☐☐ 5._____ ☐☐	
12. ARE THERE ANY MEN AGED 18 YEARS AND OLDER WHO USUALLY LIVE IN THIS HOUSEHOLD? **I GAT SAMPELA MAN KRISMAS BILONG OL EM 18 NA MOA I SAVE STAP LONG DISPELA HAUS?**	Yes..... 1 No ..... 2 Refused ..... 7 Don't know 9	 2⇨Q.15 9⇨Q.15
13. HOW MANY MEN 18 AND OLDER LIVE IN THIS HOUSEHOLD? **HAMAS MAN WANTAIM KRISMAS NAMEL LONG 18 NA MOA I STAP LONG DISPELA HAUS?**	☐	
14. COULD YOU PLEASE TELL ME THE NAME AND AGE OF EACH MAN AGED 18 YEARS AND OLDER WHO LIVES IN THIS HOUSEHOLD EVEN IF THEY ARE NOT HERE RIGHT NOW? **PLIS INAP YU TOKIM MI NEM NA KRISMAS BILONG WAN WAN MAN I GAT 18 KRISMAS NA MOA, MASKI OL I INO STAP LONG HAUS NAU.**	Name Age (Years) 1. _____ ☐☐ 2._____ ☐☐ 3._____ ☐☐ 4._____ ☐☐ 5._____ ☐☐	
15. ARE THERE ANY CHILDREN AGED 6 MONTHS TO 5 YEARS WHO USUALLY LIVE IN THIS HOUSEHOLD? **I GAT SAMPELA PIKININI I GAT KRISMAS NAMEL LONG 6-PELA MUN NA 5-PELA KRISMAS I STAP LONG DISPELA HAUS?**	Yes..... 1 No ..... 2 Refused ..... 7 Don't know 9	 2⇨Q.18 9⇨Q.18
16. HOW MANY CHILDREN BETWEEN 6 MONTHS TO 5 YEARS LIVE IN THIS HOUSEHOLD? **HAMAS PIKININI I GAT KRISMAS NAMEL LONG 5-**	☐	

PELA MUN NA 5-PELA YIA I STAP LONG DISPELA HAUS?	
17. COULD YOU PLEASE TELL ME THE NAME AND AGE OF EACH CHILD AGED 6 MONTHS TO 5 YEARS WHO LIVES HERE EVEN IF THEY ARE NOT HERE NOW? **PLIS NINAP YU TOKIM MI LONG NEM NA KRISMAS BILONG WAN WAN PIKININI I GAT KRISMAS NAMEL LONG 5-PELA MUN NA 5-PELA KRISMAS I SAVE STAP LONG DISPELA HAUS. M ASKI OL I NO STAP LONG HAUS NAU, BAI YU GIVIM NEM NA KRISMAS BILONG OL.** *(Check the clinic book or other document for confirmation of names and ages)*	Name Age in: Years Months 1._____ ☐ ☐☐ 2._____ ☐ ☐☐ 3._____ ☐ ☐☐ 4._____ ☐ ☐☐ 5._____ ☐ ☐☐
18. What type of house is this? *(Observation: Use your own judgment. Do not ask the respondent the answer to this question)*	High cost house ..... 1 Low cost house ..... 2 Flat ..... 3 Duplex ..... 4 Domestic quarters ..... 5 Dormitory ..... 6 Makeshift ..... 10 Traditional ..... 11 Self-help high cost ..... 12 Self-help low cost ..... 13 Other (specify) ..... 8 Don't know 9
19. WHAT IS THE MAIN SOURCE OF DRINKING WATER FOR MEMBERS OF YOUR HOUSEHOLD? **YUPELA LONG HAUS I SAVE KISIM WARA BILONG DRING WE?** *(If necessary confirm this visually)*	Piped into yard or plot ..... 1 Piped into neighborhood (communal) ..... 2 Public well ..... 3 Well in yard ..... 4 Spring ..... 5 River/stream ..... 6 Pond/lake/dam ..... 10 Communal tank ..... 11 Rainwater ..... 12 Tanker-truck, vendor ..... 13 Refused ..... 7 Other (specify) ..... 8 Don't know 9
20. WHAT KIND OF TOILET FACILITY DOES YOUR HOUSEHOLD USE? **WANEM KAIN TOILET YUPELA I YUSIM?**	Flush to sewage system or septic tank ..... 1 Pour flush latrine (water seal type) ..... 2 Improved pit latrine (e.g., VIP) ..... 3 Traditional pit latrine ..... 4 Open pit ..... 5 Bucket ..... 6 No facilities or bush/field/beach ..... 10 Overhang latrine ..... 11 Refused 7

	Other (specify) ..... 8 Don't know 9
21. HOW OFTEN DO YOU LISTEN TO THE RADIO? **HAMAS TAIM YU SAVE HARIM REDIO?**	I never listen to the radio ..... 1 Every day ..... 2 Every week ..... 3 Occasionally ..... 4 Other (specify) 8

This next section should be completed by the female head of the household or another person in the household familiar with the salt, flour, oil, sugar and rice used in the household.

"WE ARE INTERESTED IN THE TYPES OF FOOD THAT PEOPLE EAT IN PAPUA NEW GUINEA. I WILL BE ASKING TO SEE THE SALT, FLOUR, OIL, SUGAR AND RICE, AND THEIR PACKAGES, THAT YOU HAVE IN THE HOUSE TODAY. YOU MIGHT WANT TO COLLECT THESE ITEMS BEFORE WE BEGIN THIS PART OF THE INTERVIEW."
"MIPELA I GAT INTRES LONG OL KAIN KAIKAI WE OL PIPEL BILONG PNG I SAVE KAIKAIM. BAI MI ASKIM LONG LUKIM SOL, FLAUA, OIL, SUGA, RAIS, NA OL PEKET BILONG OL BIPO YUMI STATIM DISPELA HAP BILONG ASKIM."

SALT MODULE *If two or more types of salt are available in the household record information on the two main types of salt used in the household.*		
22. DO YOU HAVE ANY SALT CURRENTLY IN YOUR HOUSEHOLD NOW? **YU GAT SAMPELA SOL LONG HAUS BILONG YU NAU?**	Yes ..... 1 No ..... 2 Don't know 9	2 ⇨ Q. 40

23. *If Yes ASK* "MAY I SEE A SAMPLE OF EACH TYPE OF SALT YOU HAVE IN THE HOUSEHOLD" **"INAP MI LUKIM SEMPOL LONG OL KAIN SOL YU GAT LONG HAUS BILONG YU"** *(If there is more than one type of salt record the information for just one type of salt here. Record the information for another type of salt in the Type 2 salt module beginning with question 31.)* *(Observe the type of salt used and circle the appropriate answer)*	Fine Table salt ..... 1 Cooking salt ..... 2 Traditional salt ..... 3 Sea water used for cooking ..... 4 Refused ..... 7 Other (specify) ..... 8 Don't know 9	4 ⇨ Q.31
24. *If you DO NOT see the original salt bag or package ask* "COULD I PLEASE SEE THE ORIGINAL SALT BAG OR PACKAGE?" **"PLIS INAP MI LUKIM SOL BEK O PEKET SOL I BIN STAP LONG EN?"**	Yes, original salt bag or package observed ..... 1 No, original salt bag or package not observed .. 2	2 ⇨ Q. 29
25. Write the name of the brand of salt written on the package	Brand name _____	
26. Observe the country where the salt is produced	Papua New Guinea ..... 1 Australia ..... 2 India ..... 3 China…. ..... 4 Thailand…. ..... 5 Other (specify) ..... 8 Don't know 9	

27. Observe the country where the salt is packaged	Papua New Guinea ..... 1 Australia..... 2 India..... 3 China…..... 4 Thailand…. ..... 5 Other (specify) ..... 8 Don't know..... 9	
28. Observe – Is the salt iodized?	Yes..... 1 No or not stated on label ..... 2 Don't know..... 9	
29. MAY I ASK WHERE YOU GOT THE SALT FROM? **INAP MI ASKIM YU WE YU BIN KISIM DISPELA SOL?**	Purchased from a shop ..... 1 Purchased from a vendor ..... 2 Mined/collected from the rock ..... 3 Other (specify) ..... 8 Don't know..... 9	
30. MAY I TAKE A SAMPLE OF THIS SALT TO THE LABORATORY TO TEST FOR IODINE CONTENT? **INAP MI KISIM SEMPOL LONG DISPELA SOL I GO LONG LEBORETORI LONG TESTIM SAPOS EM MI GAT AIDIN LONG EN?** *(Collect the required amount of salt and replace the salt you have taken with 1 packet of iodized salt)*	Salt sample collected..... 1 Salt sample not collected ..... 2 Salt Type 1 Label	
TYPE 2 SALT ***If there is a second type of salt used in the household record the information here***		
31. DO YOU HAVE ANY OTHER TYPE OF SALT CURRENTLY IN YOUR HOUSEHOLD NOW? **YU GAT OL SAMPEAL NARAPELA SOL LONG HAUS BILONG YU NAU?**	Yes..... 1 No ..... 2 Don't know..... 9	2 ⇨ Q. 40
32. *If Yes ask* "MAY I SEE THIS SALT" **"INAP MI LUKIM DISPELA SOL?"** *(Observe the type of salt used and circle the appropriate answer)*	Fine Table salt ..... 1 Cooking salt ..... 2 Traditional salt ..... 3 Sea water used for cooking..... 4 Refused ..... 7 Other (specify) ..... 8 Don't know 9	
33. *If you DO NOT see the original salt bag or package ask* "COULD I PLEASE SEE THE ORIGINAL SALT BAG OR PACKAGE?" **"PLIS INAP MI LUKIM SOL BEK O PEKET SOL I BIN STAP LONG EN?"**	Yes, original salt bag or package observed ..... 1 No, original salt bag or package not observed.. 2	2 ⇨ Q. 38
34. Write the name of the brand of salt written on the package	Brand…….	

35. Observe the COUNTRY where the salt is produced	Papua New Guinea ..... 1 Australia..... 2 India..... 3 China…..... 4 Thailand…. ..... 5 Other (specify) ..... 8 Don't know..... 9
36. Observe the country where the salt is packaged	Papua New Guinea ..... 1 Australia..... 2 India..... 3 China…..... 4 Thailand…. ..... 5 Other (specify) ..... 8 Don't know..... 9
37. Observe – Is the salt iodized?	Yes..... 1 No or not stated on label ..... 2 Don't know..... 9
38. MAY I ASK WHERE YOU GOT THE SALT FROM? **INAP MI ASKIM YU WE YU BIN KISIM DISPELA SOL?**	Purchased from a shop ..... 1 Purchased from a vendor ..... 2 Mined/collected from the rock ..... 3 Other (specify) ..... 8 Don't know..... 9
39. MAY I TAKE A SAMPLE OF THIS SALT TO THE LABORATORY TO TEST FOR IODINE CONTENT? **INAP MI KISIM SEMPOL LONG DISPELA SOL I GO LONG LEBORETORI LONG TESTIM SAPOS EM MI GAT AIDIN LONG EN?** *(Collect the required amount of salt and replace the salt you have taken with 1 packet of iodized salt)*	Salt sample collected..... 1 Salt sample not collected ..... 2 Salt Type 2 Label

FLOUR MODULE

If two or more types of flour are available in the household record information on the flour most frequently consumed in the household.

40. DID YOU HAVE FLOUR IN THE HOUSEHOLD TODAY? **YU GAT WIT FLAUA LONG HAUS TEDE?**	Yes …… . 1 No …… 2 Don't know..... 9	2 ⇨ Q. 49
41. WHERE DID YOU GET THIS FLOUR? **YU BIN KISIM FLAUA WE?**	Shop ..... 1 Other (specify) ..... 8 Don't know..... 9	8 ⇨ Q. 49
42. PLEASE SHOW US SAMPLES OF THE FLOUR YOU BOUGHT IN THE SHOP? **PLIS SOIM MIPELA SEMPOL BILONG OLGETA WIT**	Whole meal flour..... 1 White flour (Plain) 2	

FLAUA YU BAIM LONG STOA *(Observe and circle the type of flour used)*	White (Self Raising) ..... 3 Don't know 9	
43. *If you DO NOT see the original bag or package the flour came in* *ASK* "COULD I PLEASE SEE THE ORIGINAL BAG OR PACKAGE THE FLOUR CAME IN?" **"PLIS INAP MI LUKIM PEKET FLAUA I BIN STAP INSAIT LONG EM NA YU BAIM?"**	Yes, bag observed ..... 1 No, bag not observed 2	2 ⇨ Q. 48
44. *Observe the brand written on the flour package and circle appropriate answer*	No label ..... 1 Mothers Choice ..... 2 3 Roses ..... 3 Flame ..... 4 Other (specify) _____ .. 8 Don't know 9	
45. *Observe the country where the flour is produced*	Papua New Guinea ..... 1 Australia ..... 2 India ..... 3 Other (specify) _____ .. 8 Don't know 9	
46. *Observe the country where the flour is packaged*	Papua New Guinea ..... 1 Australia ..... 2 India ..... 3 Other (specify) _____ .. 8 Don't know 9	
47. *Observe- Is the flour fortified with vitamins or minerals?*	Not fortified or not stated on label ..... 1 Fortified with iron ..... 2 Fortified with folic acid ..... 3 Fortified with iron and folic acid ..... 4 Fortified with other vitamins/minerals (specify) . 5 Enriched with vitamins and minerals ..... 6 Don't know 9	
48. DO YOU OR OTHERS FROM THIS HOUSEHOLD BUY BREAD THAT IS ALREADY MADE (NOT FROM YOUR OWN DOUGH)? **YU O OL NARAPELA LONG DISPELA HAUS I SAVE BAIM BRET WE OL I BEKIM PINIS (I NO DISPELA YU YET I MEKIM)**	Yes ..... 1 No ..... 2 Don't know 9	
OIL MODULE *If two or more types of oil are available in the household record information on the cooking oil most frequently consumed in the household.*		
49. DO YOU HAVE ANY OIL IN THE HOUSEHOLD NOW? **YU GAT OIL LONG HAUS NAU?**	Yes ..... 1 No ..... 2 Don't know 9	2 ⇨ Q. 57
50. WHERE DID YOU GET THIS OIL? **YU BIN KISIM WE?**	Shop ..... 1 Other (please specify) ..... 8 Don't know 9	8 ⇨ Q.57

51. PLEASE SHOW US SAMPLE OF THE OIL YOU BOUGHT FROM THE SHOP? **PLIS, SOIM MIPELA SEMPOL LONG OLGETA OIL YU BAIM LONG STOA.** *(Observe and circle the type of oil used)*	Observation not possible…….…… 1 VegeTable oil…..……. ..... 2 Sunflower oil…… ..... 3 Cooking oil ..... 4 Coconut oil..... 5 Palm oil ..... 6 Peanut oil..... 10 Canola oil..... 11 Olive oil ..... 12 Soy bean…..…….. ..13 Other (specify) _____.. 8 Don't know.....9	
52. If you DO NOT see the original container the oil came in or package ask "COULD I PLEASE SEE THE ORIGINAL CONTAINER OR PACKAGE THE OIL CAME IN?" **"PLIS INAP MI LUKIM ORIJINEL KONTENA O PEKET OIL I KAM LONG EN?"**	Yes, original container observed ..... 1 No, original container not observed..... 2	2 ⇨ Q. 57
53. Write the name of the brand of oil written on the package	No label or no brand ..... 9 Brand _____	9 ⇨ Q. 57
54. Observe the country where the oil is produced	Papua New Guinea ..... 1 Australia..... 2 Other (specify) _____.. 8 Don't know..... 9	
55. *Observe the* country *where the oil is packaged*	Papua New Guinea ..... 1 Australia..... 2 Other (specify) _____.. 8 Don't know…… 9	
56. Observe – Is the oil fortified with with vitamin A?	Yes..... 1 No or not stated on label ..... 2 Don't know..... 9	
SUGAR MODULE *If two or more types of sugar are available in the household record information on the sugar most frequently consumed in the household.*		
57. DO YOU HAVE SUGAR IN THE HOUSEHOLD NOW? **YU GAT SUGA LONG HAUS NAU?**	Yes …… ..... 1 No …… 2 Don't know..... 9	2 ⇨ Q. 65
58. WHERE DID YOU GET THIS SUGAR? **YU BIN KISIM DISPELA SUGA WE?**	Shop ..... 1 Other (please specify) ..... 8 Don't know..... 9	8 ⇨ Q. 65
59. PLEASE SHOW US SAMPLE OF THE SUGAR YOU BOUGHT IN THE SHOP? **PLIS, SOIM SEMPOL LONG OLGETA SUGA YU BIN BAIM LONG STOA.** (*Observe and circle type of sugar used)*	Observation not possible…….…… ….1 White sugar…..…… ..... 2 Brown sugar…… ..... 3 Dont know..... 9	
60. If you DO NOT see the original bag or package the sugar came in *ASK* "COULD I PLEASE SEE THE ORIGINAL BAG	Yes, bag observed..... 1 No, bag not observed 2	2 ⇨ Q.

OR PACKAGE THE SUGAR CAME IN?" **"PLIS INAP INAP MI LUKIM ORIJINEL BEK O PEKET SUGA I KAM LONG EN?"**		65
61. Observe the brand written on the sugar package and circle appropriate answer	No label..... 1 4 Roses..... 2 Ramu. ..... 3 CSR. ..... 4 Other (specify) _____.. 8 Don't know..... 9	
62. Observe the country where the sugar is produced	Papua New Guinea ....1 Australia…….. .2 Other (specify) _____.. 8 Don't know……. .9	
63. Observe the country where the sugar is packaged	Papua New Guinea ....1 Australia…….. .2 Other (specify) _____..... ....8 Don't know……. .9	
64. Observe- Is the sugar fortified with vitamins or minerals?	Not fortified or not stated on label ..... 1 Fortified with vitamin A ..... 2 Fortified with other vitamins/minerals (specify) . 5 Don't know..... 9	
RICE MODULE *IF TWO OR MORE TYPES OF RICE ARE AVAILABLE IN THE HOUSEHOLD RECORD INFORMATION ON THE RICE MOST FREQUENTLY CONSUMED IN THE HOUSEHOLD.*		
65. DO YOU HAVE RICE IN THE HOUSEHOLD NOW? **YU GAT RAIS NAU LONG HAUS BILONG YU?**	Yes ……..... 1 No ……..... 2 Don't know..... ...9	2 ⇨ END
66. WHERE DID YOU GET THIS RICE? **YU BIN KISIM DISPELA RAIS WE?**	Shop ..... 1 Self grown..... 3 Other (specify) ..... 8 Don't know..... 9	3 ⇨ END 8 ⇨ END
67. PLEASE SHOW US A SAMPLE OF THE RICE YOU BOUGHT IN THE SHOP? **PLIS, SOIM MIPELA OL SEMPOL LONG OL RAIS YU BAIM LONG STOA.** (*Observe and circle type of rice used)*)	Observation not possible……..……1 White rice…..……. ..... 2 Brown rice…….…..... 3 Don't know..... ..9	
68. If you DO NOT see the original bag or package the rice came in ASK "COULD I PLEASE SEE THE ORIGINAL S BAG OR PACKAGE THE RICE CAME IN?" **"INAP MI LUKIM ORIJINEL BEK O PEKET RAIS I KAM LONG EN"?**	Yes, bag observed..... 1 No, bag not observed 2	2 ⇨ END
69. Write the brand written on the rice package	No label or no brand ..... 9 Brand _____	9 ⇨ END
70. Observe the country where the rice is produced	Papua New Guinea ....1 Australia…….. ... .2 India..... 3 China ..... 4 Thailand.....…….5	

	Other (specify) _____.....… ....8 Don't know…… 9
71. Observe the country where the rice is packaged	Papua New Guinea ....1 Australia…….. ... .2 India ..... 3 China ..... 4 Thailand .....…….5 Other (specify) _____.....… ....8 Don't know…… 9
72. Observe- Is the rice fortified with vitamins or minerals?	Not fortified or not stated on the label ..... 1 Fortified with iron ..... 2 Fortified with riboflavin ..... 3 Fortified with niacin ..... 4 Fortified with iron, riboflavin and niacin ..... 5 Fortified with various vitamins and minerals..... 6 Enriched with vitamins and minerals ..... 10 Don't know 9

CHILD ONLY HH – Proceed to child (primary care taker data collection form) if there are eligible children (6 months to 5 years of age). If there are no eligible children in the household thank the respondent for his or her time and move on to the next house.

CHILD, MEN AND WOMEN HH – Proceed to the women, children and men data collection forms where applicable. If there are no eligible women, children or men in the household then thank the respondent and move on to the next house.

Data Entry Information Panel

(To be completed by the data entry clerks)

First Data entry clerk ID number		Second Data entry clerk ID number	

Cluster ☐☐☐ HH ☐☐ Child's Line Number ☐ Mother's Line Number ☐

CHILDREN (6 MONTHS TO 5 YEARS)

Label

TEAM CODE ☐

VERBAL CONSENT OBTAINED FROM PRIMARY CARETAKER Yes ☐ No ☐

If the eligible primary caretaker is not present schedule another visit to the household

1. Child's name:	
2. Child's age (see Q.17 of HH listing)	☐ Years ☐☐ Months
3. WHAT IS HIS/HER BIRTHDAY? **WANEM BONDE BILONG EM?**	☐☐ Day ☐☐ Month ☐☐☐☐ Year
4. Write the source of birthdate *(Even if the mother knows the exact birth date, check date and circle the source of information.)*	Clinic book .....1 Baptismal card .....2 Birth certificate .....3 Recall .....4 Refused .....7 Other (specify below) 8
5. IS (*name*) A BOY OR GIRL? **EM (NEM BILONG EM) PIKININI MAN O MERI?**	Boy .....1 Girl .....2 Refused .....7 Don't know 9
6. WHAT IS YOUR RELATIONSHIP TO (*name*)? **YU WANEM BILONG PIKININI (NEM)?** *(MAKE sure that the person you are interviewing is the primary caretakers before continuing on with the questionnaire. If they are not then schedule another visit when the primary caretaker is at home)*	Biological Mother .....1 Female caretaker .....2 Adoptive mother .....3 Refused.....7 Other (specify) .....8 Don't know 9
7. HAS (*name*) EVER RECEIVED A VITAMIN A CAPSULE (SUPPLEMENT)? **EM (NEM BILONG EM) I BIN KISIM VAITAMIN**	Yes .....1 No .....2 → 2⇨Q11 Refused .....7 Don't know .....9 → 9⇨Q11

KEPSUL A SAPLIMEN? *(show an example of the vitamin A capsule)*	
8. WHEN WAS THE LAST TIME (NAME) RECEIVED VITAMIN A CAPSULE? **WANEM TAIM EM BIN KISIM LASPELA VAITAMIN A KEPSUL?** (*Check the clinic book if it is available)*	☐☐ ☐☐ ☐☐☐☐ Day Month Year
9. *Write the source of the date of the last vitamin A capsule dose*	Clinic book .....1 Recall .....2 Refused.....7 Other (specify) .....8 Don't know 9
10. WHERE DID (*name*) GET THIS LAST VITAMIN A CAPSULE? **(NEM) I BIN KISIM LASPELA VAITAMIN A KEPSUL LONG WE?**	Routine health centre visit .....1 Sick child visit to health centre.....2 Supplementary Immunization Activity (SIA) .....3 Refused .....7 Other (specify) .....8 Don't know 9
11. WAS (*name*) BREASTFEED ON THE SAME DAY THAT HE/SHE WAS BORN? **MAMA I BIN GIVIM SUSU LONG (NEM) LONG DE EM BIN KARIM EM?**	Yes .....1 No .....2 Refused .....7 Don't know 9
12. HOW OLD WAS (*name)* WHEN YOU STARTED TO GIVE OTHER FOODS? **EM (NEM) BIN GAT HAMAS KRISMAS TAIM YU STAT LONG GIVIM LONG GIVIM OL ARAPELA KAIK I LONG EN?**	☐ ☐☐ Years Months
13. DID (name) RECEIVE BREAST MILK YESTERDAY? **(NEM) I BIN DRINGIM SUSU BILONG MAMA ASTE?**	Yes .....1 No .....2 Refused .....7 Don't know 9
14. DID (name) SLEEP UNDER A MOSQUITO NET LAST NIGHT? **(NEM) I BIN SLIP ANINIT LONG TAUNAM LONG LAS NAIT?**	Yes .....1 No .....2 Refused .....7 Don't know 9

*Weigh and measure each child after all questionnaires have been completed. **DO NOT** measure any children with casts, heavy bandages or disabilities that prevent them being measured.*
ANTHROPOMETRY MODULE

15. Child's weight	☐☐ . ☐ kg
16. Child's height *(Check age again:* *Less than 24 months: measure lying down* *24 months or more: measure standing up)*	☐☐☐ . ☐ cm
17. Circle result for height measurement	Measured ..... 1 Refused ..... 7 Other (specify) ..... 8 Unable 9
CHECK *Are there any other children in the household who are eligible for measurement? Pass the data collection form on to the laboratory technician*	

SPECIMEN COLLECTION MODULE	
18. Ask "WE WOULD LIKE TO TAKE A LITTLE BLOOD FROM YOUR CHILD'S FINGER, FOR TESTING. IS THIS OK? **"MIPELA I LAIK KISIM LIKLIK HAP BLUT LONG PINGA BILONG PIKININI BILONG YU LONG TESTIM. YU TOK ORAIT LONG DISPELA?"**	Yes ..... 1 No ..... 2 Refused ..... 7 Other (specify) 8
19. Write down the hemoglobin level *(If the Hb is 7 or less then write the result in the space provided and also on a referral sheet and on a referral slip for the health center)*	☐☐ . ☐ g/dl
20. Was a finger stick blood sample collected from this child?	Yes ..... 1 No ..... 2 Refused ..... 7 Other (specify) 8
21. Approximately how many microlitres of blood were collected from this child	☐☐ microl
22. Was a stool sample collected from this child? *(Only collect stool from children 24-59 months of age)*	Yes ..... 1 No ..... 2 Refused ..... 7 Other (specify) 8

THANK *the participant for their cooperation*
CHECK *that all the data collection form has been completed correctly*
CHECK *that the identification numbers are at the top of each page.*

FOR NCD CLUSTERS ONLY	
23. Was a venous blood sample collected from this child?	Yes .....1 No .....2 Refused .....7 Other (specify) 8
24. Approximately how many millilitres of venous blood were collected from this child	ml

THANK *the participant for their cooperation*
CHECK *that all the data collection form has been completed correctly*
CHECK *that the cluster and household identification numbers are at the top of each page.*

Data Entry Information Panel

(To be complete by the data entry clerks)

First data entry clerk ID number		Second data entry clerk ID number	

Cluster Number ☐☐☐ Household Number ☐☐ Woman's Line Number ☐

WOMEN (15-49 YEARS)

Label

TEAM CODE ☐

VERBAL CONSENT OBTAINED FROM ELIGIBLE WOMAN Yes ☐ No ☐

1. Woman's name:		
2. Woman's age	☐☐ years	
3. WHAT IS YOUR HIGHEST GRADE OF EDUCATION COMPLETED? **YU PINISIM WANEM GRET LONG SKUL?** *(0= No school completed 1-3=Elementary School 4-8= Primary School 9-12=Secondary school)*	Highest grade completed ☐☐ Refused .....7 Other (specify) .....8 Don't know 9	
4. DID YOU SLEEP UNDER A MOSQUITO NET LAST NIGHT? **YU BIN SLIP ANINIT LONG MOSKITO NET O TAUNAM LONG LAS NAIT?**	Yes .....1 No .....2 Refused .....7 Don't know 9	
5. HOW MANY MOSQUITO NETS DOES YOUR HOUSEHOLD HAVE? **HAUS BILONG YU I GAT HAMAS TAUNAM?**	Number of nets ☐☐	
6. DO YOU SMOKE? **YU SAVE SMOK TU?**	Yes .....1 No .....2 Refused .....7 Don't know 9	2⇨Q.8 9⇨Q.8
7. HOW MANY STICKS DO YOU SMOKE PER DAY? **HAMASPELA STIK SIMUK YU SAVE SMOKIM INSAIT LONG WANPELA DE?**	Number per day ☐☐	
8. HAVE YOU EVER BEEN PREGNANT? **YU BIN GAT BEL TU?** *(Should be asked by female or with female present.)*	Yes .....1 No .....2 Refused.....7 Don't know 9	2⇨Q.17 9⇨Q.17

9. HAVE YOU GIVEN BIRTH TO A CHILD IN THE LAST 3 YEARS? **INSAIT LONG LASPELA TRIPELA YIA, YU BIN KARIM WANPELA PIKININI TU?** (*This includes both live births and still births BUT NOT miscarriages*) *(Ask for meri book if available)*	Yes ..... 1 No ..... 2 Refused ..... 7 Don't know 9	 2⇨Q.17 9⇨Q.17
10. WHEN YOU WERE PREGNANT WITH YOUR LAST CHILD, DID YOU RECEIVE IRON TABLETS? **TAIM YU BIN BEL LONG LASPELA PIKININI BILONG YU, YU SAVE KISIM AIN TABLET?** *(Show an example of the iron Tablet)*	Yes ..... 1 No ..... 2 Refused ..... 7 Don't know 9	 2⇨Q.12 9⇨Q.12
11. WHO DID YOU RECEIVE THE IRON TABLETS FROM? **YU BIN KISIM OL AIN TABLET LONG HUSAT?**	Health centre .....1 Health workers on patrol .....2 VBA .....3 VHV.....4 Refused.....7 Other (specify) .....8 Don't know 9	
12. WAS YOUR LAST BORN CHILD WEIGHED AT BIRTH? **OL BIN SKELIM LASPELA PIKININI BILONG YU TAIM YU KARIM?**	Yes .....1 No .....2 Refused.....7 Don't know 9	 2⇨Q.15 9⇨Q.15
13. WHAT WAS THIS CHILD'S WEIGHT ***WANEM MAK LONG WEIT O HEVI BILONG EM?*** *(Record weight from baby book/health card, if available.)*	☐☐☐☐ grams	
14. Write down where information on the birth weight was obtained from.	From recall .....1 From clinic book .....2 Other (specify) 8	
15. WHEN YOU WERE PREGNANT WITH YOUR LAST CHILD, DID YOU HAVE DIFFICULTY SEEING DURING THE DAY? **TAIM YU BIN BEL WANTAIM LASPELA PIKININI BILONG YU, YU BIN GAT HEVI LONG LUKLUK LONG SAN?**	Yes .....1 No .....2 Refused .....7 Don't know 9	
16. WHEN YOU WERE PREGNANT WITH YOUR LAST CHILD DID YOU HAVE ANY DIFFICULTY SEEING AT DUSK? **TAIM YU BIN BEL WANTAIM LASPELA PIKININI BILONG YU, YU BIN GAT HEVI LONG LUKLUK TAIM EM I LAIK TUDAK?**	Yes .....1 No .....2 Refused .....7 Don't know 9	
17. ARE YOU CURRENTLY PREGNANT? **YU GAGT BEL NAU?** *(If YES end the interview. DO NOT take anthropometric measurements or urine or blood samples)*	Yes .....1 No .....2 Refused .....7 Don't know 9	1⇨END

Weigh and measure each woman after all questionnaires have been completed. **DO NOT** measure any woman with casts, heavy bandages or disabilities that prevent them being measured. **DO NOT** measure women who are pregnant.

ANTHROPOMETRY MODULE	
18. Woman's weight	kg
19. Woman's height	cm
20. *Circle result for height measurement*	Measured .....1 Refused .....7 Other (specify) .....8 Unable 9
CHECK Are there any other women in the household who are eligible for measurement? If not, pass the data collection form on to the laboratory technician.	

SPECIMEN COLLECTION MODULE **Do NOT take urine or blood samples from pregnant women**	
21. Was urine sample collected from this woman?	Yes .....1 No .....2 Refused .....7 Other (specify).....8
22. *Ask* "WE WOULD LIKE TO TAKE SOME OF YOUR BLOOD FROM YOUR FINGER, FOR TESTING. IS THIS OK? **"MIPELA I LAIK KISIM SAMPELA BLUT LONG PINGA BILONG YU LONG KARIMAUT TES. EM I ORAIT WANTAIM YU?**	Yes .....1 No .....2 Refused .....7 Other (specify) 8
23. Write down the hemoglobin level *(If the Hb is 7 or less then write the result in the space provided and also on a referral sheet and on a referral slip for the health center)*	☐☐ • ☐ g/dl
24. *Was finger stick blood sample collected from this woman?*	Yes .....1 Not available .....2 Refused .....7 Other (specify).....8
25. Approximately how many microlitres of finger stick blood were collected from this woman.	☐☐☐ microl

FOR NCD CLUSTERS ONLY	
26. Was a venous blood sample collected from this woman?	Yes .....1 Not available .....2 Refused .....7 Other (specify) 8
27. Approximately how many milliliters of venous blood were collected from this woman	ml

THANK *the participant for their cooperation*
CHECK *that all the data collection form has been completed correctly*
CHECK *that the identification numbers are at the top of each page.*

Data Entry Information Panel

(To be completed by the data entry clerks)

First data entry clerk ID number		Second data entry clerk ID number	

Cluster Number ☐☐☐ Household Number ☐☐ Man's Line Number ☐

MEN (18 YEARS AND ABOVE)

TEAM CODE ☐

VERBAL CONSENT OBTAINED FROM ELIGIBLE MAN Yes ☐ No ☐

1. *Man's name:*		
2. *Man's age.*	☐☐ years	
3. WHAT IS YOUR HIGHEST GRADE OF EDUCATION COMPLETED? **WANEM GRET LONG SKUL YU PINISIM?** *(0= No school completed 1-3=Elementary School 4-8= Primary School 9-12=Secondary school)*	Highest grade completed ☐☐ Refused ..... 7 Other (specify) ..... 8 Don't know 9	
4. DID YOU SLEEP UNDER A MOSQUITO NET LAST NIGHT? **YU BIN SLIP ANINIT LONG TAUNAM LAS NAIT?**	Yes ..... 1 No ..... 2 Refused ..... 7 Don't know 9	
5. DO YOU SMOKE? **YU SAVE SMOK TU?**	Yes ..... 1 No ..... 2 Refused ..... 7 Don't know 9	2⇨ Q. 7
6. HOW MANY STICKS DO YOU SMOKE PER DAY? **YU SAVE SMOKIM HAMAS STIK SIMUK LONG WANPELA DE?**	Number per day ☐☐	
Weigh and measure each man after all questionnaires have been completed. **DO NOT** measure any men with casts, heavy bandages or disabilities that prevent them being measured.		

ANTHROPOMETRY MODULE	
7. Man's weight	☐☐☐ • ☐ kg
8. Man's height	☐☐☐ • ☐ cm
9. Circle result for height measurement	Measured ..... 1 Refused ..... 7 Other (specify) ..... 8 Unable 9
CHECK *Are there any other men in the household who are eligible for measurement? Pass the data collection form on to the laboratory technician*	
SPECIMEN COLLECTION MODULE	
10. *Ask* "WE WOULD LIKE TO TAKE SOME OF YOUR BLOOD FROM YOUR FINGER, FOR TESTING. IS THIS OK?" **ASIM "MIPELA I LAIK KISIM SAMPELA BLUT LONG PINGA BILONG YU LONG TESTIM. DISPELA EM I ORAIT WANTAIM YU?**	Yes ..... 1 No ..... 2 Refused ..... 7 Other (specify) 8
11. *Write down the hemoglobin level (If the Hb is 7 or less then write the result in the space provided and also on a referral sheet and on a referral slip for t he health center)*	☐☐ • ☐ g/dl
12. Was finger stick blood sample collected from this man?	Yes ..... 1 Not available ..... 2 Refused ..... 7 Other (specify) 8

THANK *the participant for their cooperation*
CHECK *that all the data collection form has been completed correctly*
CHECK *that the identification numbers are at the top of each page.*

Data Entry Information Panel

(To be completed by the data entry clerks)

First data entry clerk ID number		Second data entry clerk ID number	

Cluster Number | | | | Household Number | | |

HOUSEHOLD CHECK LIST

TEAM CODE | | **Date of first interview:** | | | | | | | | |

Day Month Year

	Number of eligible persons	Number of persons who refused	Number of persons not available	Number of interviews incomplete	Number of interviews completed
Number of Children 6-59 months in the HH					
Number of women 15-49 years in the HH					
Number of men 18 years and above in the HH					
Result of HH interview: (circle one)	Completed ..... 1 Incomplete ..... 2 Refused ..... 3 Not at home ..... 4 HH not found/destroyed ..... 5 No eligible women, children or men ..... 6 Other (specify) 8				
Language of interview (circle one)	English ..... 1 Pidgin ..... 2 Local language without translator ..... 3 Local language using translator ..... 4 No interview ..... 5 Other (specify) 8				

TEAM LEADER'S CHECK

Sign only if you have checked the **ALL** forms to be completed correctly. Also make sure that all necessary information is recorded on the cluster collection form.

TEAM LEADER _____ Date: | | | | | **2005**

DAY **MONTH** **YEAR**

APPENDIX 6: LABELLING BIOLOGICAL SPECIMENS AND DATA COLLECTION FORMS

Proper and accurate labeling of all specimens collected in the field is one of the most important aspects of this survey. The label ID number will be used to match the questionnaire data on each survey subject with the results of laboratory testing of the specimens from that survey subject. Therefore, the ID number for each survey participant must be unique, that is, different from the ID number for all other participants. If the questionnaire ID number does not match the laboratory result ID number, then the laboratory result is unusable, and we have wasted the time, money, and participant discomfort involved in collecting that laboratory specimen.

Each biologic specimen from the same survey subject will have the same ID number. Therefore, since survey subjects will have multiple specimens obtained from them, there will be many labels with the same ID number. The laboratory technician must be careful to use labels with the same ID number on the same survey subject.

Each label has the following information:

- An ID number – This is the number which must be different for each survey subject
- A barcode - This barcode must be readable in the laboratory where testing will be done. Therefore, do not place anything over this barcode or rub it off.
- A specimen type – This indicates what type of biologic specimen is contained in the container marked with the label. Labels may say "Patient Quest.", "Capillary DBS," "Urine," "Stool", etc.

Labels used in this survey will use the following sequences of numbers:

Women and Children in Research Study	Numbers 001-299
Women and Children in Nutrition Survey	Numbers 300-2999
Salt in Validation Study and Nutrition Survey	Numbers 7000-9999

For each ID number, labels will be used for the following biologic specimens:

Use of the label	Number of labels	Type of specimen
Field use:		
Data collection form	1	Data collection form
Microtainer	1	Blood
Malaria slide	1	Blood
DBS card	4	Blood
Urine cup*	1	Urine
Urine cryovials*	2	Urine
Stool cup$^{\perp}$	1	Stool
Stool tube$^{\perp}$	1	Stool
TOTAL COPIES OF ID NUMBER	12	

* For women only

$^{\perp}$ For children only

Because survey subjects in the six Port Moresby clusters will participate in the validation study, additional labels will be needed for subjects in these clusters. In addition to the labels above, the following labels are also needed:

Use of the label	Number of labels	Type of specimen
Field use:		
Red top vacutainer tube	1	Blood
Purple top vacutainer tube	1	Blood
Serum cryovials	5	Blood
Venous DBS card	4	Blood
TOTAL COPIES OF ID NUMBER	9	

Different survey subjects will have different biologic specimens collected from them. For example, children will not have urine collected from them; therefore, the labels for urine will not be used for children. Women of child-bearing age and children less than 24 months of age will not have stool collected; therefore, the labels for stool specimens will not be used for these survey subjects. The laboratory technician must be careful to use the appropriate labels for the data collection forms and for each biologic specimen according to the age and sex of the survey subject.

Men participating in the survey will not require labels because no laboratory specimen will be collected from them for testing outside the household. The only laboratory testing they will undergo is testing by HemoCue for hemoglobin concentration; this testing will be done in the household and the results recorded directly on the data collection form.

Laboratory technicians should follow these labeling procedures at each household:

- Once the interviewer has completed interviews for all eligible survey subjects in a household, the data collection forms for these subjects will be passed on to the anthropometrist. Once the anthropometry is complete, the anthropometrist will pass the forms to the laboratory technician. The laboratory technician will ask the participants name or ask the mother to identify the child before proceeding with the collection of biologic specimens to be sure that the data collection form matches the survey subject.

- Labels for blood collection should be attached to the appropriate item (Microtainer, malaria slide, DBS card, urine cup and cryovials, stool cup and tube, red top tube, and purple top tube) before the fingerstick or phlebotomy is begun.

- Labels need to be attached to the specimen tubes so that they can be read left to right with the cap end on the left.

- Always leave a transparent part of the tube free of a label. This means that the label should be placed over an existing label on the container; if there are graduated numbers on the container, the label should not cover these.

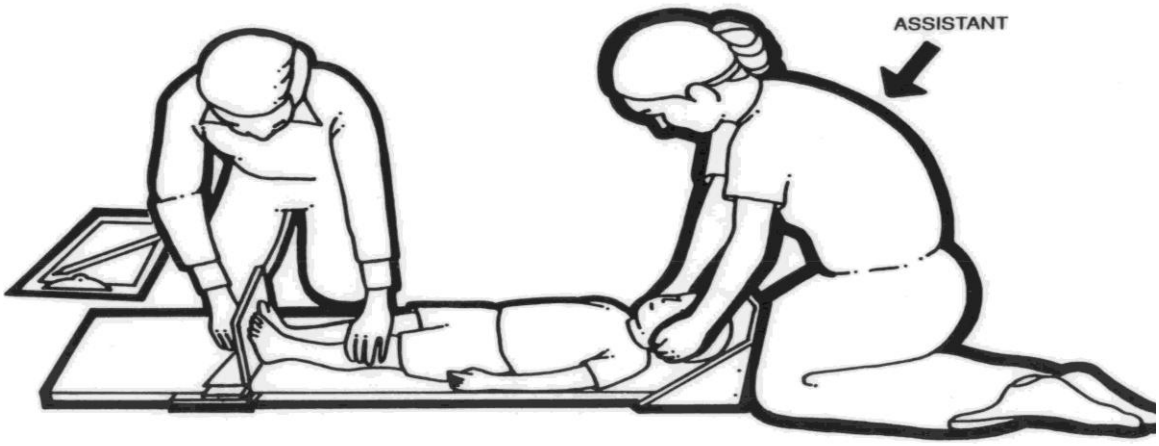
- When pipetting from one source to another, for example, from the microtainer to the DBS card, be absolutely sure that the labels on both containers have the same ID numbers. For example, if the ID number on the microtainer is 327 make sure that the labels on the DBS card also has an ID number of 327.

APPENDIX 7: ANTHROPOMETRY PROCEDURES

MEASURING CHILDREN

MEASURING THE CHILD'S LENGTH (IF UNDER 24 MONTHS OF AGE OR 85 CM):

1. Place the measuring board on a hard, flat surface, usually the floor. If you place the measuring board on a Table or other elevated surface, be sure you watch the child carefully so that he does not fall off.
2. Ask the child's caregiver to remove child's shoes and head / hair articles.
3. The assistant should kneel at the head end of the board in order to stabilize the head.
4. The measurer should kneel with both knees on the child's right side so that he can hold the head piece with his right hand.
5. With the assistance of the mother, the child should be placed on his back on the board so that the head is against the fixed foot board and the feet are at the open end of the board. The child's body should be straight and centered on the board.
6. The mother should be on the child's left side to comfort and reassure the child.
7. The measurer places the child's feet flat together against the foot board, while making sure the child's legs are straight and the heels and calves are against the board.
8. The assistant ensures that the top of the child's head is in contact with the foot piece and that the child's face is looking straight upward (perpendicular to the ground).
9. The measurer gently pushes the head piece against the feet and calls out the measurement to the nearest .1 cm.
10. The child should be released immediately after the measurement is called out. The measurer and the assistant can help the child rise or hand the child to the mother.

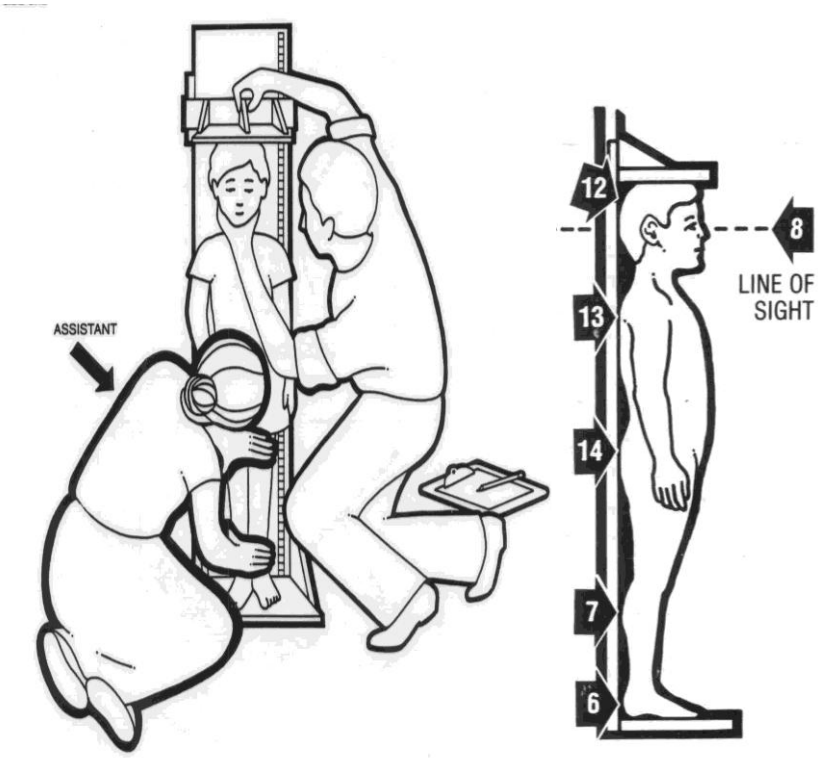


MEASURING THE CHILD'S HEIGHT:

1. Place the measuring board on a hard flat surface against a wall, Table, tree, staircase, or other immovable vertical surface.
2. Ask the child's caregiver to remove child's shoes and head / hair articles and then bring the child to the measuring board.
3. The assistant kneels on the child's right side.
4. The measurer kneels on one knee on child's left side.

5. Place the child's feet flat together against the center of the base board. Make sure the child's legs are straight and the heels and calves are against the board. The child's body should be in the center of the board. The assistant can place his right hand on the child's shins and the left hand on the child's knees.

6. Make sure that the child's face is looking straightforward (parallel to the ground). Make sure that the child's shoulders are level, hands are at the side, and head, shoulders, buttocks and heels are against the board.
7. The measurer can now place the headpiece against the board and lower it to the top of the child's head (flatten hair to head) using her right hand.
8. The measurer calls out the measurement to the nearest 0.1 cm to whomever is the recorder.
11. The child should be released immediately after the measurement is called out. The measurer and the assistant can help the child step off the height board.



MEASURING THE CHILD'S WEIGHT (DIGITAL SCALES)

1. Place the digital scale on the ground in as flat and horizontal a spot as possible Check to see if the scale is placed flat by trying to jiggle it, it should be firmly placed with all four feet in contact with the ground.
2. Switch the scale on by passing one's hand an inch over the surface of the solar detector.
3. Wait for the appearance of the zero.
4. Test the weight of the standard – if it is correct, then the scale is placed flat and is reading correctly. If not, move it and go through steps 1, 2 and 3.

5. After standardising the scale to the weight, weight the child by one of the two following methods:
   a. If the child is older and can stand quietly on the scale, place the child standing on the scale. Ensure that the child is balanced and is not being pressed down or held up by another adult. The child should not be touching anything during the weighing, or:
   b. If the child cannot stand or will not hold still while on the scale, place the mother on the scale. Wait until a weight reading appears, then while instructing the mother not to move, pass your hand over the solar detector. The scale should read "0." The mother must remain quietly on the scale throughout the procedure. Hand the child to the mother. Be sure neither the child nor the mother are touching anything. Wait until another reading appears on the scale; this will be the child's weight.
6. Record the weight as shown on the scale on the child's data collection form.

MEASURING ADULTS

MEASURING AN ADULT'S WEIGHT (DIGITAL SCALES)

1. Place the digital scale on the ground in as flat and horizontal a spot as possible Check to see if the scale is placed flat by trying to jiggle it, it should be firmly placed.
2. Switch the scale on by passing one's hand an inch over the surface of the solar detector.
3. Wait for the appearance of the zero.
4. Test the weight of the standard – if it is correct, then the scale is placed flat and is reading correctly. If not, move it and go through steps 1, 2 and 3.
5. After standardising the scale to the weight, ask the adult to stand on the scale. Ensure that they are standing quietly and not touching anything. Wait for the weight reading to appear. Record the weight on the data collection form.

MEASURING AN ADULT'S HEIGHT:

1. Place the measuring board on the ground against a wall, Table, tree, staircase, or other immovable vertical surface. Make sure it is sTable.
2. Ask the person to remove their shoes and head / hair articles.
3. Ask the person to place their feet together and against the center of the base board with their back to the board.
4. Make sure the person's legs are straight and the heels and calves are against the board.
5. Make sure that the person's face is looking straightforward (parallel to the ground). Make sure that the shoulders are level, hands are at the side, and head, shoulders, buttocks and heels are against the board.
6. Lower the headpiece to the top of the head (flatten hair to head),
7. Record the measurement to the nearest .1 cm.

APPENDIX 8: SPECIMEN COLLECTION PROCEDURES FOR THE SURVEY

MEN

All men in every second selected household will be asked to undergo testing for hemoglobin concentration. See annex 4.3 for the specific procedures for using the Hemocue photometer to measure hemoglobin.

1. The materials needed prior to testing each subject should be assembled. The materials include: a lancet, a Hemocue cuvette (remember to reseal the cuvette container immediately after taking out a cuvette for use), the Hemocue machine, an alcohol wipe, a gauze pad, and a bandage.

2. The patient's hand should be warm so that blood circulates freely before performing the finger stick. Rubbing or wrapping it in a warm towel will help warm the hand.

3. The patient's fingers should be relaxed but not fully bent; this allows for maximum blood flow. Use only the middle finger or ring finger for sampling, and remove rings from the finger before testing.

4. Put on your powder free gloves. Turn participant's hand upward. Massage participant's hand and lower part of the finger to increase blood flow.

5. Clean the puncture site with an alcohol wipe and dry it completely using a gauze pad.

6. Using a rolling movement of your thumb, lightly press the finger from the top knuckle towards the tip. This stimulates the flow of blood towards the puncture site.

7. When the thumb has reached the fingertip, maintain gentle pressure and puncture the side of the fingertip with a lancet, utilizing a quick press and release motion. Using the side of the finger causes less pain and produces the best flow of blood. Dispose of the lancet immediately into a sharps container.

8. Using a dry gauze pad, wipe away the first drop of blood to stimulate spontaneous blood flow. If necessary, gently press the finger until another drop of blood appears. Avoid "milking" the finger.

9. Collect at least three drops of blood in the microtainer. When this is completed, gently invert it 10 times to prevent clots from forming. Put the microtainer aside for a moment.

10. If less than 3 drops of blood are collected cap the microtainer and gently invert it 10 times to prevent clots from forming. Make a second finger stick and using a fresh microtainer attempt to collect the 3 drops of blood. [It is extremely unlikely that for such a small amount of blood that a second finger stick is necessary]

11. Place the gauze pad on the puncture site and ask the survey subject to apply pressure with another finger on the same had or the other hand.

12. Fill the Hemocue cuvette by holding the Microtainer in a horizontal position and carefully tilt the blood forward to the edge of the tube. Place the pointed tip of the Hemocue cuvette into the blood drop with the cuvette's groove facing upward. The cuvette will fill automatically by capillary action.

13. Never try to "top off" the cuvette after the initial filling. If the cuvette is not filled with the attempt, discard it in the sharps container and use a second cuvette.

14. Wipe off any excess blood from the sides of the cuvette with a Kim wipe, being careful not to touch the outer curved edge. Ensure that no blood is "sucked out" of the cuvette when wiping it.

15. Place the cuvette in the holder of the Hemocue and gently push the holder into the machine. The results will be displayed in approximately 15-45 seconds and will remain displayed for 4 minutes or until the slide arm is pulled out for removal of the cuvette.

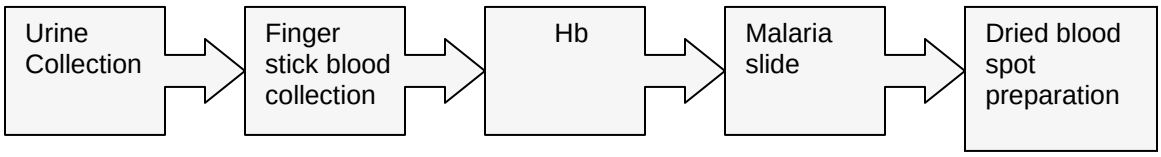
16. Record your results, dispose of the cuvette in the sharps container, and dispose of all other materials in the biohazard bag.

17. Have the man hold a gauze pad on the finger until bleeding stops. Put a band-aid on the spot where the prick was made, and ask the person to take it off the following day.

18. Tell the man whether his haemoglobin level is normal or low. If the Hemoglobin is <7 fill in a referral slip and write the man's name and haemoglobin on the Anemia referral sheet (see annex 4.4).

WOMEN

All women in every second household will be asked to consent to collection of finger stick blood and urine. The blood will be collected in a microtainer and used to fill the Hemocue cuvette, to make a thick malaria smear, and pipetted onto a DBS card. Below you will find the procedures for the collection of urine, the finger stick, Hemocue, malaria smear and DBS preparation.



Urine Collection

1. Give the woman a sterile, pre-labelled urine cup and the following instructions:
    - Wash hands with soap and water.
    - Do not open the collection cup until just before urinating.
    - Turn the cap upward while urinating, and then immediately place it back onto the cup after urination. Tighten the cap well.
    - Do not touch the inside of the cup nor allow it to come into contact with any parts of the body, clothing, or external surfaces. Minimize exposure to air.

2. Open the patient pack and place all specimen collection materials on top of disposable pad. Remove the two cryovials. Attach the patient's labels to the cryovials.

3. After the cup is returned, pipette equal volumes (at least 1.5 mL) into two labelled cryovials. Make sure they are not filled above the line indicating 1.8 ml. Overfilling will cause breakage when the specimen is frozen and the specimen will be lost. It is much better to have a smaller specimen available than to collect a larger specimen which then breaks the cryovial and is lost. Screw the caps tightly on the vials. Discard the pipette into the biohazard bag.

4. Place the cryovials into the tube box (in numerical order) and place a rubber band around the box before it goes back into the backpack.

5. Ask the woman to dispose of the remaining urine and place the cup into the biohazard bag.

Finger Stick procedure

1. Organise the contents of the patient pack and place all specimen collection materials on top of disposable pad. Open the alcohol swabs, gauze, and bandage. Have all items ready for blood collection. Attach the patient's labels to the malaria slide and DBS card.

2. The patient's hand should be warm so that blood circulates freely before performing the finger stick. Rubbing or wrapping it in a warm towel will help warm the hand.

3. The patient's fingers should be relaxed but not fully bent; this allows for maximum blood flow. Use only the middle finger or ring finger for sampling, and remove rings from the finger before testing.

4. Put on your powder free gloves. Turn participant's hand upward. Massage participant's hand and lower part of the finger to increase blood flow.

5. Clean the puncture site with an alcohol wipe and dry it completely using a gauze pad.

6. Using a rolling movement of your thumb, lightly press the finger from the top knuckle towards the tip. This stimulates the flow of blood towards the puncture site.

7. When the thumb has reached the fingertip, maintain gentle pressure and puncture the side of the fingertip with a lancet, utilizing a quick press and release motion. Using the side of the finger causes less pain and produces the best flow of blood. Dispose the lancet immediately into a sharps container.

8. Using a dry gauze pad, wipe away the first drop of blood to stimulate spontaneous blood flow. If necessary, gently press the finger until another drop of blood appears. Avoid "milking" the finger.

9. Keep the finger in a downward position and gently massage it to maintain blood flow. Hold the Microtainer® at an angle of 30 degrees below the collection site and use the scoop on the Microtainer® to guide the drop into the vial. Do not scrape the skin. Fill the Microtainer® to 350 - 500 µL level.

10. If less than 350 □ L of blood are collected cap the microtainer and gently invert it 10 times to prevent clots from forming. Make a second finger stick and using a fresh microtainer attempt to collect the 350 □ L of blood.

11. When sufficient blood is collected, cap the Microtainer® and gently invert it 10 times to prevent clots from forming. Place it aside for now.

12. Have the woman hold a gauze pad on the finger until bleeding stops. Put a band-aid on the spot where the prick was made, and ask the person to take it off the following day.

13. Place the label on the microtainer. If the label contains a barcode, the barcode needs to be vertical like a ladder when placed on the vial. If the barcode is not vertical, the laboratory will not be able to read the label. Place the label from left to right starting from the cap end and leave the graduated numbers on the tube visible. If you need to use a second microtainer than use the spare label for that patient.

14. Properly discard all used materials.

Hemoglobin testing procedure from a microtainer

1. Assemble all the materials needed prior to testing each subject; these materials will include: microtainer containing the blood from the survey subject, a Hemocue cuvette, Kim wipes, and the Hemocue machine turned on and ready to operate. Reseal the Hemocue cuvette container immediately after taking out a cuvette for use.

2. Remove the cap from the well-mixed microtainer

3. Fill the Hemocue cuvette by holding the Microtainer in a horizontal position and carefully tilt the blood forward to the edge of the tube. Place the pointed tip of the Hemocue cuvette into the blood drop with the cuvette's groove facing upward. The cuvette will fill automatically by capillary action.

4. Never try to "top off" the cuvette after the initial filling. If the cuvette is not filled with the attempt, discard it in the sharps container and use a second cuvette.

5. Wipe off any excess blood from the sides of the cuvette with a Kim wipe, being careful not to touch the outer curved edge. Ensure that no blood is "sucked out" of the cuvette when wiping it.

6. Place the cuvette in the holder of the Hemocue and gently push the holder into the machine. The results will be displayed in approximately 15-45 seconds and will remain displayed for 4 minutes or until the slide arm is pulled out for removal of the cuvette.

7. Record your results, dispose of the cuvette in the sharps container, and dispose of all other materials (except the Microtainer, you will need the remaining blood for the dry blood spots and malaria slide) in the biohazard bag.

Making a malaria thick smear from a microtainer

1. Place the correct label on the rough frosted end of the microscope slide, with the barcode fully visible on one side of the slide.

2. Using the 25 mL pipette, place a drop of blood from the Microtainer onto the slide (only use a little over half of the blood in the pipette tip – do not pipette out the full 25 mL. *Make sure that blood drop is placed on same side of the slide that the label's barcode is on.*

3. Spread the drop of blood with the end of the pipette tip to make an area about 1 cm in diameter.

4. Correct thickness is attained when newsprint is barely legible through the smear.

5. Stand the slide box on end and place slide into the slide box. Make sure slide is horizontal and level, as it would be if placed on the Table.

6. Do not lay slide box down (such that the slide is vertical) until the smear is mostly dry. This may take approximately 25 minutes.

7. When all the slides from that household are dry, put lid on slide box and secure it with a rubber band.

Preparing DBS cards from a Microtainer for PNG

1. After the malaria slide is prepared, place the cap back on the Microtainer and invert 10 times. Pipette 25 :L of whole blood from the Microtainer onto each circle on the dried blood spot (DBS) card. If blood is left in the Microtainer after all spots have been filled, use the spaces between the circles to pipette the rest of the blood. Be sure not to let any of the spots overlap each other or the straight lines on the card.

2. Open the DBS box and set it on end, so that the DBS cards are lying horizontally when inserted. Place the card into the DBS box such that it does not touch any of the other cards. Set the fan up about 20 cm from the open box and allow the breeze to blow across the cards. Allow the blood spots to dry for approximately 10 minutes before closing and transporting the DBS box.

3. Avoid touching the blood spot. Drying time may be longer if the humidity is high. Avoid exposing spots to high temperatures. If working in sunlight, construct a "tent" with aluminium foil to place around the DBS box and drying cards so that they are in the shade. If this is not done, direct sunlight can degrade the vitamin A in the blood spots.

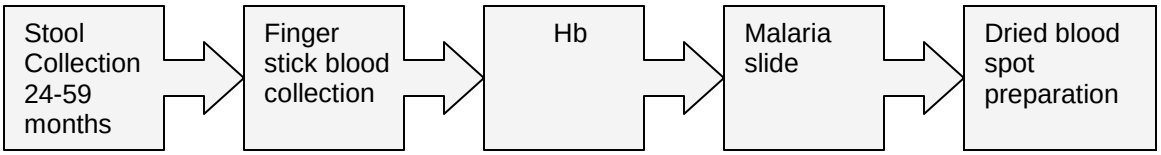
4. Each evening the DBS cards need to be stored correctly. Please follow these steps very carefully:

    - Each evening, stack the DBS cards with a piece of weighing paper in between the cards. This will keep the samples from contaminating one another. The blood spots should be completely dry before packing.

- Place the stack of DBS cards into a low gas-permeable plastic bag. Add 5 desiccant packs and a humidity indicator card (cut open the vacuum-sealed bags to retrieve these cards; do not place the sealed bag into the low gas-permeable bag). Check the humidity indicator (or Humonitor) card each evening to make sure none of its spots are pink. If even one is pink, replace the desiccant packs and the humidity indicator card with fresh ones.

CHILDREN 6-59 MONTHS OF AGE

The procedures for children are the same as for the women (see above). The only differences are that urine will NOT be collected for children and children 24-59 months will have a stool sample collected where possible.



1. After completing all of the blood collection at that household, give the mother or the child's caretaker a stool cup for each child involved in the survey and have her collect a stool sample from each child into that child's labelled cup.

2. Using the wooden stick, transfer enough stool to the tube containing fixative to bring it to the mark. This amount of stool is usually the size of a small bean.

3. Place the cap onto the tube and tighten. Wrap parafilm tightly around the cap

4. Shake the tube vigorously until the stool pellet is broken up. Then place the tube into a ziploc bag with the other tubes.

Notifying participants of their results

Participants will be given the result of their haemoglobin test before the survey team leaves the household. If the Hb result is 7 g/dl or lower, that survey subject will be referred to the nearest health facility. The name of the person referred will be entered onto the Anemia referral sheet (see annex 4.4). Due to logistical constraints resulting from the need to send all samples to laboratories in the United States, Indonesia, and Port Moresby and the difficulties in communication and transport within PNG, it would be extremely difficult to provide other tests results to survey participants.

APPENDIX 9A: HEMOCUE QUALITY CONTROL RECORD SHEET

Team number:	**LOW CONTROL**	**Lot number:**	**Value on package: ___ ___ . ___ ± ___**
Hemocue serial number:	**MEDIUM CONTROL**	**Lot number:**	**Value on package: ___ ___ . ___ ± ___**
Control cuvette number:	**HIGH CONTROL**	**Lot number:**	**Value on package: ___ ___ . ___ ± ___**

Quality control readings

Morning						Evening				
Date	Control cuvette	Low liquid control	Medium liquid control	High liquid control	Initials	Control cuvette	Low liquid control	Medium liquid control	High liquid control	Initials
/ / 05										
/ / 05										
/ / 05										
/ / 05										
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APPENDIX 9B: HEMOCUE TESTING PROCEDURES

Anemia, as determined by low hemoglobin (Hb), is often used as a proxy indicator for iron deficiency. One instrument used in testing for anemia is a photometer called Hemocue which tests the Hb concentration using a single drop of blood. This is a robust instrument that can give accurate readings in a field setting. However, errors in Hb assessment occur if appropriate procedures and techniques are not followed. Use of inappropriate procedures or techniques may lead to wide variations in Hb values. This then leads to incorrect estimates of anemia prevalence in the population.

The following steps are recommended to help ensure reliable testing of Hb using the Hemocue photometer.

Using the Hemocue for hemoglobin testing

Instrument calibration:

1. At the beginning and end of each day of data collection, check the instrument's accuracy using the control cuvette. The control cuvette is specific for that instrument, so you must check that the serial numbers on the Hemocue machine itself and the control cuvette match exactly.

2. Test the control cuvette as you would a cuvette containing blood from a survey subject. Write down the result on the Hemocue quality control record sheet (see annex 4.1).

3. If the reading does not fall within the range marked on the control cuvette box, clean the cuvette holder and the control cuvette with a dry Kim wipe.

4. If the reading continues to be outside the correct range or reads ERROR, do not use the instrument. It needs to be serviced or replaced.

5. If the control cuvette reads within the specified range listed on the box, write this result on the Hemocue quality control record sheet, making a note that the holder was cleaned, and perform quality control (QC) on the instrument.

Quality control:

1. Perform QC in the morning and evening of each day of data collection by measuring and recording the results for each of the low, normal, and high control vials.

2. Report results on the Hemocue hemoglobin quality control form.

Testing procedure from a Microtainer:

1. Assemble all the materials needed prior to testing each subject. Reseal the cuvette container immediately after taking out a cuvette for use.

2. Remove the cap from the well-mixed Microtainer tube.

3. Fill the HemoCue cuvette by holding the Microtainer tube in a horizontal position and carefully tilt the blood forward to the edge of the tube. Place the pointed tip (with the cuvette's groove facing upward) of the HemoCue cuvette into the blood drop. The cuvette will fill automatically by capillary action.

4. Never try to "top off" the cuvette after the initial filling. If the cuvette is not filled with the attempt, discard it in the sharps container and use a second cuvette.

5. Wipe off any excess blood from the cuvette with a Kim wipe, being careful not to touch the outer curved edge. This may be done by wiping the edges as you would a butter knife. Ensure that no blood is "sucked out" of the cuvette when wiping it.

6. Place the cuvette in its holder and gently push the holder into the photometer. The results will be displayed in approximately 15-45 seconds and will remain displayed for 4 minutes or until the slide arm is pulled out for removal of the cuvette.

7. Record your results directly from the HemoCue digital reading before removing the cuvette. Dispose of the cuvette in the sharps container, and dispose of all other materials in the biohazard bag.

Evening quality control:

1. Measure and record the results for each of the low and normal range control vials.

2. Report results on the HemoCue Hemoglobin Quality Control Form.

Common Problems to Avoid:

The following are some important points related to the use of the Hemocue machine and finger stick sampling procedures:

1) Keep the instrument clean, especially the cuvette holder.

A swab dabbed with alcohol can be used to clean away any dirt or dried blood. This should be done at least once a day or when there is a visible build-up of dirt or blood. Be sure the cuvette holder is dry before re-inserting it in the machine.

2) Ensure instrument accuracy

Check the accuracy of the instrument twice each day or when performance is questioned using the control cuvette which comes with each Hemocue instrument. Keep a log of all calibration and QC readings. If the readings are outside the range of the control cuvette or liquid controls and the Hemocue is clean, the instrument needs to be replaced.

3) Keep cuvettes clean, dry and away from heat

Cuvettes are good for 3 months after opening the bottle in which they are stored. Keep the container lid completely closed unless you getting out another cuvette to avoid unnecessary exposure of the cuvettes to air, especially in humid conditions. Heat and moisture will destroy the chemicals in the cuvette which can lead to inaccurate Hb measurements.

4) Make sure the finger stick is adequate

Wide variations can occur in Hb measurements if the finger stick is inadequate. Inadequate finger sticks may occur because the lancet did not penetrate deep enough to allow adequate flow of blood and a representative concentration of red blood cells. In most cases if the finger stick is

done poorly, Hb values will be underestimated and the prevalence of Anemia will be overestimated.

5) Avoid poor technique, such as:
   - Milking the finger to stimulate proper blood flow which will underestimate Hgb readings. This is often done when an inadequate finger stick has been done leading to poor blood flow.
   - Mixing alcohol with the blood - The patient's finger should be totally dry before the finger stick is done. Use alcohol to clean the finger before the stick and then wipe away each drop of blood with a dry wipe to avoid any mixing of blood with alcohol. Wiping away the first drop of blood also will minimize the mixing of sweat with blood in hot, humid climates. This error usually underestimates the Hb reading. Also, avoid removing a cuvette from the bottle when your fingers are wet with alcohol. Besides diluting the blood in the cuvette, alcohol can destroy the chemicals in the cuvette.
   - Obstructing blood flow to the puncture site**.** Do not hold the subject's hand so tightly as to obstruct blood flow to the fingers.

6) Adequately fill the cuvette

The cuvette needs to be filled with a drop of blood during one touch of the cuvette to the blood drop. If the flow of blood is interrupted for any reason and the cuvette is not filled, discard it and fill another cuvette. Do not "top off" the cuvette that is not completely filled by touching it a second time to the blood drop. This results in erroneous Hb readings...usually too high.

Any sign of air-bubbles within the circle means that the cuvette has not been filled adequately and should be discarded and a new cuvette used. The presence of bubbles will usually underestimate the Hb reading.

7) Do not "slam" the cuvette holder into position for reading.

Pushing the cuvette holder into the Hemocue machine suddenly or too rapidly will spray the blood in the cuvette into the Hemocue machine. This will not only invalidate the reading for that cuvette, but it will also dirty the inside of the Hemocue machine making future readings inaccurate.

APPENDIX 10: ANEMIA REFERRAL SHEET

Cluster number	HH Number	Name	Haemoglobin value	Referral Date	Team Leader Authorization (sign)
			□□ • □		
			□□ • □		
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			□□ • □		
			□□ • □		
			□□ • □		

APPENDIX 11: REFERRAL SLIP FOR ANEMIA

PNG NATIONAL NUTRITION SURVEY 2005 – REFERRAL FORM

Date patient seen in survey: _____/_____/ 2005

Name of patient: _____ Age: _____

Reason for referral: _____

_____

Name of referring person: _____

APPENDIX12: LENGTH/HEIGHT-FOR-AGE, WEIGHT-FOR-LENGTH/HEIGHT AND WEIGHT-FOR-AGE USING THE NATIONAL CENTER FOR HEALTH STATISTICS (NCHS/WHO/CDC 1978) GROWTH REFERENCE

Table 12.1 Length/Height-for-age Z-score (HAZ) summary statistics among children, PNG National Nutrition Survey 2005. NCHS/CDC/WHO reference population

	N	Mean HAZ ±	Prevalence of low HAZ (%)

Demographic Characteristic		SD	<-2 SD	95% CI	<-3 SD	95% CI
National	**895**	**-1.58 ± 1.30**	**36.3**	**31.5, 41.4**	**13.5**	**19.6, 26.4**
Region						
Southern	215	-1.24 ± 1.34	23.7	13.9, 37.4	15.3	9.3, 24.3
Highlands	203	-1.66 ± 1.35	41.4	32.9, 50.4	29.1	21.9, 37.4
Mamose	244	-1.83 ± 1.33*	45.9	35.4, 56.7	25.0	19.6, 31.3
Islands	233	-1.55 ± 1.35	33.5	25.8, 42.1	21.9	16.2, 28.9
Residence						
Urban	174	-1.21 ± 1.07	20.1	11.9, 31.8	15.5	9.4, 24.6
Rural	721	-1.67 ± 1.39*	40.2	34.9, 45.8	24.5	21.0, 28.5
Sex						
Male	485	-1.71± 1.36	39.6	33.8, 45.7	22.9	18.8, 27.6
Female	407	-1.42 ± 1.32	32.7	27.2, 38.6	22.9	18.8, 27.4
Age groups (months)						
6-11	101	-0.1.± 1.43	17.8	11.5, 26.6	13.9	8.4, 21.9
12-23	224	-1.75 ± 1.37	39.3	31.9, 47.1	22.3	16.4, 29.6
24-35	216	-1.47± 1.31	34.7	27.9, 42.2	25.0	19.4, 31.6
36-47	194	-1.71 ± 1.24	39.2	31.9, 47.0	23.2	17.7, 29.8
48-59	160	-1.75 ± 1.34	42.5	34.2, 51.3	25.6	19.2, 33.3

Means and standard deviations (SD) are weighted and are calculated assuming simple random sampling; prevalence estimates and 95% CI are calculated using statistical weights to account for the complex sample design.

Table 12.2 Weight-for-age Z-score (WAZ) summary statistics among children, PNG National Nutrition Survey 2005. NCHS/CDC/WHO reference population

			Prevalence of low WAZ (%)			
Demographic Characteristic	**N**	**Mean WAZ ± SD**	**<-2 SD**	**95% CI**	**<-3 SD**	**95% CI**
National	**927**	**-1.34 ± 1.13**	**26.4**	**22.8, 30.4**	**5.4**	**3.9, 7.4**
Region						
Southern	219	-1.31 ± 1.09	24.2	15.9, 35.0	5.0	2.2, 10.8
Highlands	208	-0.90 ± 1.04	11.5	7.5, 17.4	1.9	0.6, 5.7
Mamose	254	-1.72 ± 1.07*	40.2	31.8, ,49.1	9.8	6.3, 15.1
Islands	246	-1.35 ± 1.20	26.8	22.4, 31.8	4.1	2.0, 8.0
Residence						
Urban	179	-1.09 ± 0.97	18.4	9.2, 33.6	2.8	1.2, 6.4
Rural	748	-1.40 ± 1.16	28.3	24.7, 32.3	6.0	4.3, 8.4
Sex						
Male	500	-1.41 ± 1.06	27.8	23.5, 32.6	6.2	4.2, 9.1
Female	424	-1.26 ± 1.22	24.8	20.3, 29.9	4.2	2.7, 6.6
Age groups (months)						
6-11	104	-1.07 ± 1.46	24.0	16.9, 33.1	2.9	0.9, 8.7
12-23	227	-1.59 ± 1.13	34.4	28.4, 40.8	9.3	5.8, 14.3
24-35	233	-1.39 ± 1.12	28.3	22.4, 35.2	5.6	3.2, 9.5
36-47	198	-1.29 ± 0.99	20.2	15.5, 25.9	3.5	1.8, .9
48-59	165	-1.17 ± 1.02	21.8	15.9, 29.2	3.6	1.4, 8.9

Means and standard deviations (SD) are weighted and are calculated assuming simple random sampling; prevalence estimates and 95% CI are calculated using statistical weights to account for the complex sample design.

Table 12.3 Weight-for-Height Z-score (WHZ) summary statistics among children, PNG National Nutrition Survey 2005. NCHS/CDC/WHO reference population

Demographic Characteristic	N	Mean WHZ ± SD	Prevalence of low WHZ (%)			
			<-2 SD	95% CI	<-3 SD	95% CI
National	**898**	**-0.46 ± 0.91**	**4.2**	**2.9, 6.2**	**0.1**	**0.0, 0.8**
Region						
Southern	214	-0.66 ± 0.91	2.8	1.3, 5.8	0.0	0.0
Highlands	203	-0.16 ± 0.88	2.0	0.6, 6.0	0.0	0.0
Mamose	243	-0.76 ± 0.86	7.4	4.0, 13.4	0.4	0.1, 2.9
Islands	238	-0.48 ± 0.89	4.2	2.2, 7.8	0.0	0.0
Residence						
Urban	174	-0.44 ± 0.96	3.4	1.0, 11.5	0.0	0.0
Rural	724	-0.46 ± 0.95	4.4	2.9, 6.6	0.1	0.0, 1.0
Sex						
Male	485	-0.47 ± 0.96	4.3	2.6, 7.1	0.2	0.2, 0.2
Female	410	-0.44 ± 0.95	3.9	2.3, 6.6	0.0	0.0
Age groups (months)						
6-11	103	-0.54 ± 0.94	2.9	0.9, 8.6	0.0	0.0
12-23	224	-0.77 ± 1.03	10.3	6.6, 15.5	0.4	0.1, 3.1
24-35	215	-0.45 ± 0.91	3.7	1.9, 7.2	0.0	0.0
36-47	194	-0.27 ± 0.85	1.0	0.3, 4.1	0.0	0.0
48-59	160	-0.18 ± 0.85	0.6	0.1, 4.4	0.0	0.0

Means and standard deviations (SD) are weighted and are calculated assuming simple random sampling; prevalence estimates and 95% CI are calculated using statistical weights to account for the complex sample design.

APPENDIX 13: VISIT TO PAPUA NEW GUINEA BY MR. QUENTIN JOHNSON, TECHNICAL ADVISOR, MICRONUTRIENT INITIATIVE, CANADA.

25 June – 6th July 2006

EXECUTIVE SUMMARY

Selection of Food Vehicles for Fortification
Rice, wheat flour, and vegeTable oil can be considered as vehicles for staple food fortification in PNG based on the coverage data (67% of population covered), the central processing of these staple foods in PNG, and the per capita consumption (grams per day) of each of the target foods is sufficient. Rice and salt are already being fortified

Sugar
In the case of sugar the coverage data (supplied by Ramu Sugar management) is less than 50% for Table sugar directly consumed by the population. Sugar fortification should be considered to be a secondary food vehicle for fortification compared to rice, wheat and vegeTable oil.

Private Sector
The private sector industries in PNG all have a strong sense of social responsibility and they are in favor of staple food fortification for PNG provided that it is made mandatory for both nationally produced and imported staple foods.

Public Sector

- The Food Sanitation Council is well placed to direct the review of the food regulations and standards. The main weaknesses within the public sector are the ability to routinely inspect and monitor both national food production and imports; the ability to analyze foods for vitamins and minerals within the country; and sufficient funding.
- The Sanitation Food Regulations should be amended, to include Electrolytic Iron and Sodium Iron EDTA as a permitted form of Iron, and Reduced Iron should be removed as a permitted form of Iron
- Staple food fortification needs to be included in any revised Nutrition Policy and Strategy of the Department of Health.
- Provided that the government commitment and political will is evident through the policy and strategic commitment the Government of Papua New Guinea could prepare and submit proposal to GAIN for the implementation of vegeTable oil and wheat flour fortification. UNICEF Papua New Guinea has expressed willingness to support the Department of Health in the development of a proposal for submission to funding agencies

Proposed Fortification levels of staple foods

Collaboration with other Pacific Countries is necessary to allow for uniform fortification standards in the region.

Staple Food	Current Fortification	Proposed Fortification	Additional cost Fortification Cost $/MT of staple food (micronutrients only)
Salt	70 ppm Iodine production 30 ppm Iodine marketplace		
Rice	6 ppm Thiamine 60 ppm Niacin 30 ppm Iron	6 ppm Thiamine 60 ppm Niacin 30 ppm Iron 15 ppm Zinc 1.5 ppm Folic Acid	$0.50 per MT (for including Zinc and Folic Acid to existing) of rice
Wheat Flour	None	6 ppm Thiamine 2 ppm Riboflavin 55 ppm Niacin 1.5 ppm Folic Acid 60 ppm Iron 30 ppm Zinc	$1.50 per MT of wheat flour
VegeTable oil	None	80 IU Vitamin A per gram	$4.80 per MT of oil
Sugar1	None	50 IU per gram	$19.20 per MT of sugar

Sources: The Micronutrient Initiative Consultants Training course Dubai September 2003
The MI/CDC Iron workshop Cuernavaca Mexico December 2004
1 Sugar is considered to be a secondary food vehicle for PNG. Data provided for information purposes

APPENDIX 14: LIST OF CLUSTERS WHERE NO SALT WAS AVAILABLE IN ANY OF THE HOUSEHOLDS IN THE ENTIRE CLUSTER

Cluster number	Cluster name
6	Upaia (Kikori – Gulf Province)
7	Mailiu Island (Abau, Central Province)
22	Fatavi (Milne Bay Province)
26	Opokai (Imbongga, Southern Highlands Province)
30	Mala (Nipa, Southern Highlands Province)
54	Imon (Kabum, Morobe)
63	Arimbugor (Ramu, Madang)
89	Kalagen (Akolet, West New Britain Province)