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Abbreviations

AFB	Acid Fast Bacilli
AIDS	Acquired Immune Deficiency Syndrome
ALRI	Acute lower respiratory infections
ANC	Ante natal care
BCG	Bacillus Calmette-Guérin
BMI	Body Mass Index
CFU	Colony forming units
CHIKV	Chikungunya virus
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Disease
CP	Central Province
CRF	Study-specific case record forms
CVD	Cardiovascular Disease
DENV	Dengue virus
DNA	Deoxyribonucleic acid
DOTS	Directly observed treatment, short-course
DSS	Demographic surveillance system
DSS	Demographic Surveillance Survey
DST	Drug Sensitivity Test
DTP	Diphtheria, tetanus and pertussis
EEDU	Environmental and Emerging Diseases Unit
EHP	Eastern Highland Province
EMPNG	ExxonMobil PNG Ltd.
EPEC/ETEC	Enteropathogenic E. coli /Enterotoxigenic E. coli
EPI	the Expanded Program on Immunization
GCP	Good Clinical Practice
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Positioning System
HAdV	Human Adenovirus
HepB	Hepatitis B
Hib	Haemophilus influenza type B
HIV	Human Immunodeficiency Virus
HNB	Hydroxynaphthol blue
HP	Hela Province
HPS	HIV, HPV and other STIs
HPV	Human Papilloma Virus
HR-HPV	High-risk sub-types of human papilloma virus
HRSV	Human Respiratory Syncytial Virus
HRV	Human rhinovirus
HSV-2	Herpes simplex type-2
IEC	Information, education and communication
iHDSS	Integrated Health and Demographic Surveillance System

Abbreviations

ILI	Influenza like illness
IMR	Institute of Medical Research
IRB	PNG Institute of Medical Research Institutional Review Board
LAMP	Loop-mediated isothermal amplification
LBW	Low birth weight
LLG	Local Level Government
LNG	Liquefied Natural Gas
MCH	Maternal and Child Health
MDG	Millennium Development Goals
MDR/TB	Multi-drug resistant tuberculosis
MGIT	Mycobacteria Growth Indicator Tube
MMR	Maternal mortality ratio
MP	Madang Province
MRAC	The PNG Medical Research Advisory Committee
MTB	Mycobacterium Tuberculosis
NCD	Non-Communicable Diseases
NDoH	The National Department of Health
NMR	Neonatal mortality rate
OPV	Oral Polio Vaccine
ORS	Oral rehydration salts
PCR	Polymerase chain reaction
PICT	Provider-initiated HIV counselling and testing
PIHP	Partnership in Health Project
PNG	Papua New Guinea
PNG Med J	Papua New Guinea Medical Journal
PNGIMR	Papua New Guinea Institute of Medical Research
PNGLNG	Papua New Guinea Liquefied Natural Gas
POM	Port Moresby
PPAQ	Papua New Guinea Physical Activity Questionnaire
PSI	Population Services International
QMLR	Queensland Mycobacterial Reference Laboratory
RIF	Rifampicin
RNA	Ribonucleic acid
RRV	Ross River virus
RSV	Respiratory syncytial virus
SG	SYBR® Green I
SOP	Standard Operating Procedures
SS	Sentinel Surveillance
STI	Sexually Transmitted Infections
TB	Tuberculosis
TBA	Traditional Birth Attendant
UNICEF	United Nations Children's Fund
UNSW	The University of New South Wales

Abbreviations

UPS	Urinary pregnancy test
UQ	The University of Queensland
VA	Verbal Autopsy
VBA	Village birth attendant
VCT	Voluntary counselling and testing
VDS	Vaginal discharge syndrome
WASH	Water, Sanitation and Hygiene
WHO	World Health Organisation
WPR	Western Pacific Region
ZN	Ziehl-Neelsen stains

Executive summary

As part of the Partnership in Health project (PiHP), the PNG Institute of Medical Research (PNGIMR) develops and submits semi-annual progress reports. This report covers and updates new data and finding since the last submission in September 2013. The work presented in this report includes new data and results covering the period of July 2013 – December 2013.

As an interim deliverable of the PiHP, the report does assume a basic understanding of the overall effort and does not fully reiterate well-known background information of either the PNG LNG Project or the PiHP. Whenever possible the focus is on new results developed since the September 2013 Report. The PiHP is a longitudinal effort. Therefore, the presentation of certain types of time sequence information is critical.

Health and demographic indicators and socio-cultural determinants do not change rapidly. Rather, they evolve over a period of several years. This is the power of the integrated Health and Demographic Surveillance System (iHDSS), i.e. revealing trends so that appropriate actions can be considered and taken by concerned stakeholders, authorities and individuals.

Since the September 2013 report, a large number of surveys have been completed, including a socio-economic survey, morbidity and mortality data monitoring, census updates (including in and out-migration), wealth analysis at household and community levels, febrile and diarrheal disease study (including establishment of a new POM Diagnostic Infectious Disease Research Laboratory), sexually transmitted infection study, water and sanitation survey, vaccination coverage, tuberculosis and non-communicable disease investigations.

The results of these efforts are presented in details in interlinked chapters of the report. Whenever possible, new findings and observations are emphasized in particular iHDSS locations such as Hiri, Hides, Karkar, and Asaro. Due to the large volume and longitudinal iHDSS data, the impact analysis will be preferentially presented in further in-depth analysis reports, with full QA/QC measures in comparison and control sites.

Chapter 1

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE POPULATION IN STUDY SITES

This Chapter report key findings and observations socio-demographic characteristics of the study population in four districts, namely Asaro, Hiri, Hides and Karkar. The data used were extracted from the iHDSS, including the Demographic Surveillance System (DSS) and the Census updates, which provide longitudinal and updated data from population-based surveys conducted at individual and household levels.

The data analysis focuses on key socio-demographic indicators such as the age and sex structure of the population, employment status, main occupation and marital status of the population aged 15 or above, and the highest educational level attainment among population aged 5 or above.

Material and methods

The Census update and the Demographic Household Survey are the main data source utilised in this Chapter.

Data sources

Census update

Trained community-based data collectors carried out the census survey. These data collectors are recruited by PNGIMR from the villages under the coverage of the project. These people have attained at least a grade ten level of education and are recommended by the community leaders in their respective villages. Hence, the data collectors have good knowledge about the community as well as relationship to the people in their villages.

Demographic update

Information on socio-demographic characteristics of the population deaths were collected by community-based data collectors, and then recorded by them in the survey forms at each update (two times a year). The last demographic survey update was conducted in September 2013.

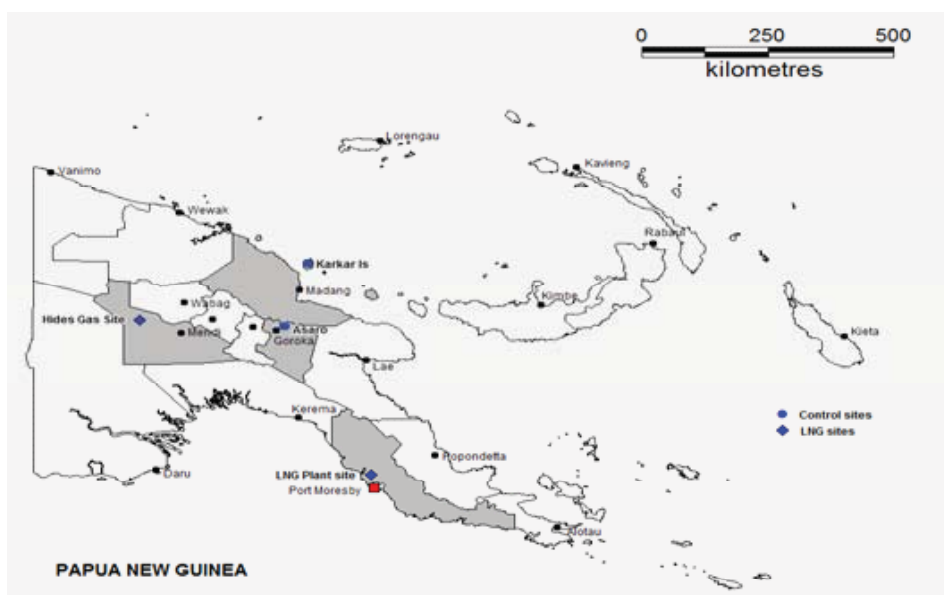


Figure 1 PiHP control and intervention sites, iHDSS, PNG, 2013

Data quality control and data management

All forms are checked upon arrival in the office and any potential mistakes are highlighted; questions from the supervisors are followed up in the field the next day. Ten percent of all households are randomly selected and are interviewed a second time to crosscheck the quality of the data collected.

The data forms were sent to data entry persons who enter the information into a PiHP database using MySQL template at PNGIMR Goroka and Madang. Data of sub-studies are linked together, using unique ID of each individual.

STATA statistical software version 11 is used for the data analysis.

Results

Age and sex population structure of study population

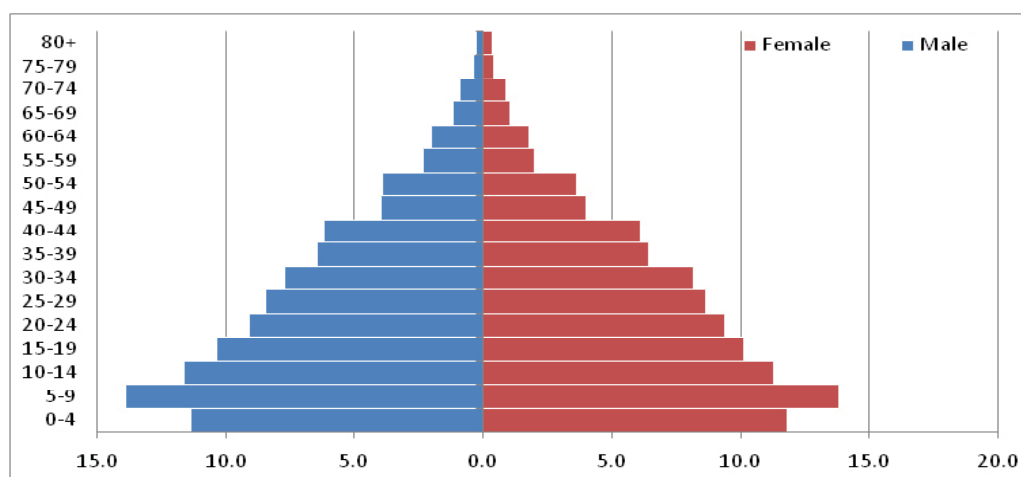


Figure 2 Population pyramid of Asaro, Hiri, Hides, Karkar, iHDSS, 2013

The age and sex population structure generated using the population data from the four iHDSS sites, located in four districts: Asaro, Hiri, Hides, and Karkar is shown in Figure 2¹. The population pyramid suggests that the population of these four districts is very young, with wide bars at the bottom. Overall sex composition of the population is balance. Further age and sex distribution structure of each district are presented in details in the following sections and more details in the Annexes.

However there are a couple of points that should be highlighted in this population pyramid. Firstly, the shorter bars at the bottom of the population pyramid illustrates that fewer children in both sexes were born in age group of 0-4.

Secondly, there was a relatively shortage of males and females in the age group of 45-49. This could be a result of a low fertility of the population (few children were born) in the period 1965-1970, reflecting significant social changes in the population over this period.

Employment status with LNG

Table 1. Whether or not working for LNG among population of working age 15-64, iHDSS, 2013

Employment with LNG	Hiri		Hides		Asaro		Karkar		Total	
	n	%	n	%	n	%	n	%	n	%
Yes	1,161	16.2	2,032	23.1	19	0.3	14	0.1	3,226	9.8
No	5,426	75.8	6,453	73.5	5,004	83.6	9,231	84.6	26,114	79.5
DK/NA	567	7.9	298	3.4	962	16.1	1,671	15.3	3,498	10.7
Total	7,154	100.0	8,783	100.0	5,985	100.0	10,916	100.0	32,838	100.0

Among 32,838 people of working age 15-64 captured in four sites of the iHDSS, around 10% reported being currently employed by LNG. It is obvious that the proportion of population of working age reported working for LNG were significantly high in Hides and Hiri, 23% and 16.2%, respectively. Asaro and Karkar have less than 0.3% of the working population reported working for LNG.

The following sections will present key findings in each project site.



Kairuku-Hiri District (Hiri) is one of the two intervention sites of the PiHP, located in The Central Province, with a population of 97,821. The Hiri iHDSS is located west of Port Moresby, the PNG National Capital. The iHDSS covers these four coastal villages, Porebada, Boera, Papa and Lealea. The combined village population is 12,228. Most inhabitants are either Motu or Koitabu speakers. Most inhabitants are either Motu or Koitabu speakers.

Hiri iHDSS can be reached by road in less than one hour from Port Moresby. Despite road access to and from Port Moresby, like many rural communities in PNG, basic services are lacking, and public infrastructure including roads, education, health and water supplies are in need in Hiri.

¹ Age and sex population pyramid was built for the population of all four study sites, with the total population of approximately 32,000. This type of analysis was not conducted for each study site because of small population size, often less than 10,000.

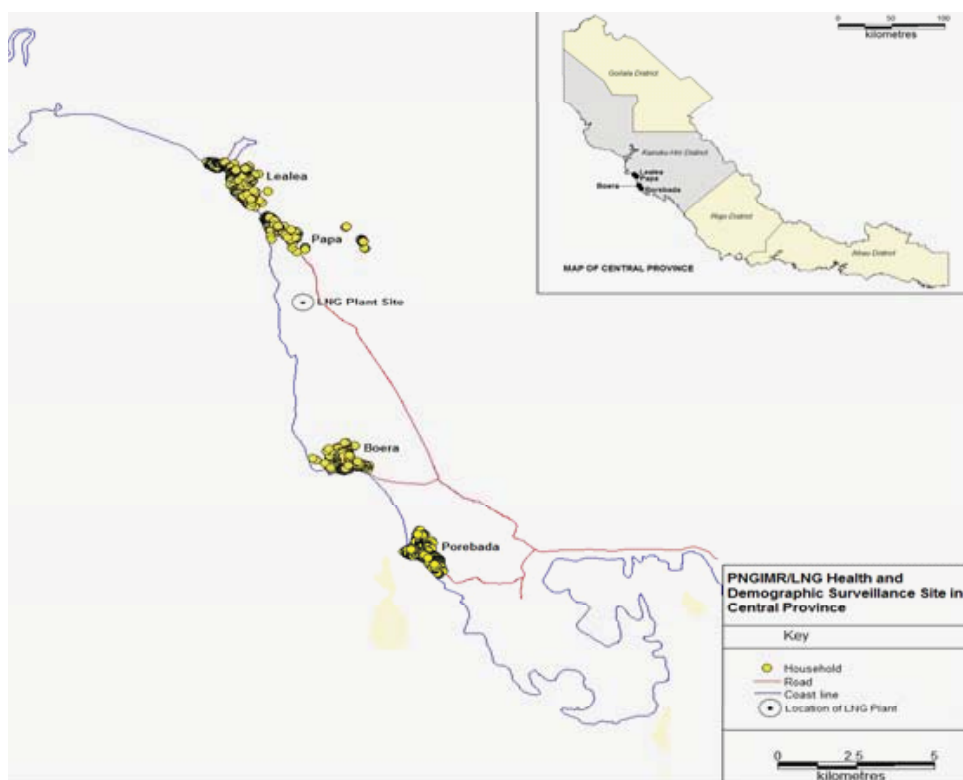


Figure 3 Map of Hiri and villages covered by iHDSS, 2013

The Population

A total population of 12,228 is recorded in the Hiri iHDSS by December 2103. This figure is slightly higher than the population reported in the 2013 IMR report, which recorded 12,148 people for the period reporting period January-June 2013.

Table 2 Population distribution by sex and age groups, Hiri, iHDSS, 2013

Age Group	Male		Female		Total		Sex Ratio M:F
	n	%	n	%	n	%	
0-4	957	7.8	878	7.2	1,835	15.0	109:100
5-9	833	6.8	748	6.1	1,581	12.9	111:100
10-14	722	5.9	635	5.2	1,357	11.1	114:100
15-19	622	5.1	570	4.7	1,192	9.7	109:100
20-24	636	5.2	611	5.0	1,247	10.2	104:100
25-29	540	4.4	488	4.0	1,028	8.4	110:100
30-34	478	3.9	396	3.2	874	7.1	120:100
35-39	474	3.9	394	3.2	868	7.1	120:100
40-44	318	2.6	243	2.0	561	4.6	131:100
45-49	250	2.0	270	2.2	520	4.3	93:100
50-54	221	1.8	211	1.7	432	3.5	105:100
55-59	160	1.3	135	1.1	295	2.4	119:100
60-64	106	0.9	75	0.6	181	1.5	141:100
65-69	67	0.5	50	0.4	117	1.0	134:100
70+	72	0.6	68	0.6	140	1.1	106:100
Total	6,456	52.8	5,772	47.2	12,228	100.0	112:100

Age Group	Male		Female		Total		Sex Ratio M:F
	n	%	n	%	n	%	
0-14	2,512	20.5	2,261	18.5	4,773	39.0	111:100
15-64	3,805	31.1	3,393	27.7	7,198	58.9	112:100
>=65	139	1.1	118	1.0	257	2.1	118:100
Total	6,456	52.8	5,772	47.2	12,228	100.0	112:100

Child dependency³ was 39% and elderly dependency⁴ was only 2.1%. Total dependency therefore, was only 41.1% of the population, indicating the socio-economic burden of the dependent population on the working population age 15-64 (58.9%). Total dependency ratio was 69.7%, meaning that there are approximately 70 dependants per every 100 working population. With such a low total dependency ratio⁵, the PNG economy has great potential for further development in coming next decades⁶.

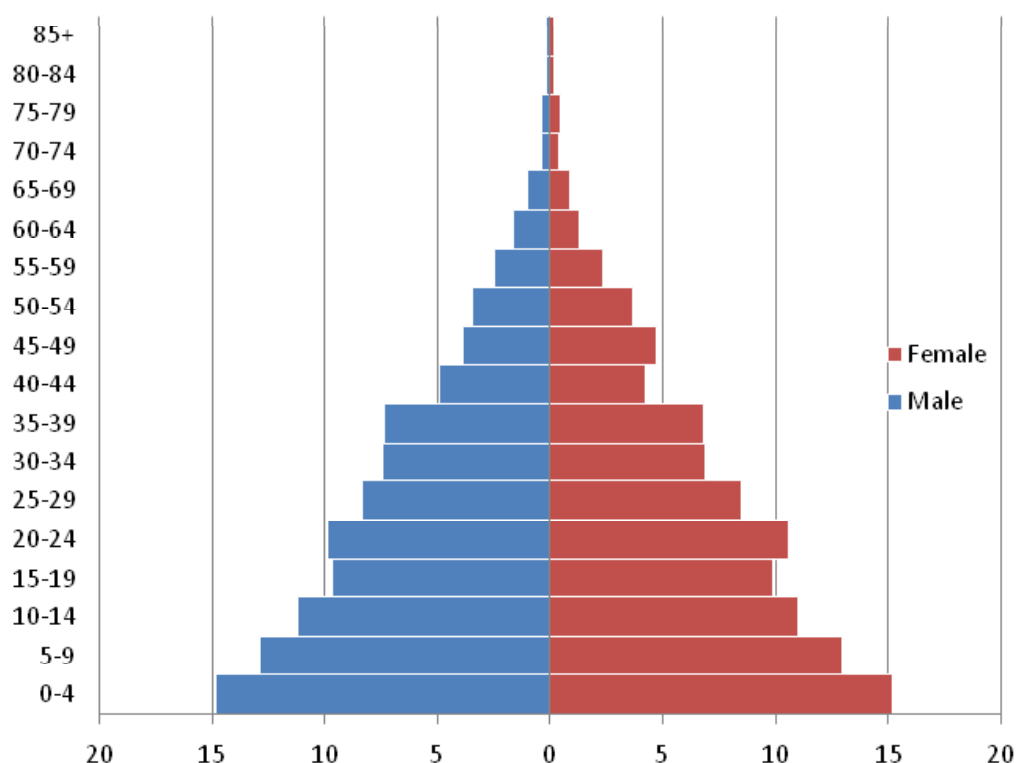


Figure 4 Population pyramid of Hiri, iHDSS, 2013

Hiri has a typical population pyramid of a young population. The base bar is consistent with the observation of 'baby boom' among children under 4 of age. The longer bars of the population in age group 20-24 could reflect a large in-migration flow of this young population into Hiri.

The sex ratio of the population of working age is relatively high, at 112 males/ 100 females could be a result from in-flow migration of young males for economic purpose. However, the sex ratio of elderly population was even higher at 118 males/ 100 females. This requires further analysis to provide insights into this observation.

Education

9,637 people aged 5 or above (5105 males and 4531 females) were included in the educational analysis. In general females attain lower educational levels i.e. no school or primary school, compared to males. In contrast, males are more likely to have higher educational levels, including secondary school, high school, vocational training and tertiary educational level, i.e., 10.1% for males versus 6.0% of females.

³Child dependency ratio is measured by the proportion of child population aged 0-14 per 100 population of working age.

⁴Elderly dependency is measured by the proportion of the population aged 65+ or more per 100 population of working age.

⁵Total dependency ratio is measured by the ratio between the total dependency and proportion of population of working age 15-64

⁶A population is conventionally considered as 'demographic dividends' if the total dependency of that population is equivalent or less than 50% of the population. In other words, there is only one dependant (or less) per every working person on average.

Table 3 Highest educational level attainment among the population aged 5 or above by sex, Hiri, iHDSS, 2013

Education Level	Male		Female		Total	
	n	%	n	%	n	%
No Education	62	1.2	74	1.6	136	1.4
Some Primary	1,624	31.8	1,748	38.6	3,372	35.0
Completed Primary	380	7.4	448	9.9	828	8.6
Some Secondary	1,097	21.5	931	20.5	2,028	21.0
Completed Secondary	602	11.8	449	9.9	1,051	10.9
National High School	112	2.2	72	1.6	184	1.9
Vocational	288	5.6	162	3.6	450	4.7
Tertiary	514	10.1	270	6.0	784	8.1
DK/ NA	427	8.4	377	8.3	804	8.3
Total	5,106	100.0	4,531	100.0	9,637	100.0

Employment

7,208 people of working age 15-64 (3810 males and 3398 females) were included in the employment and occupation analysis.

Table 4 Employment status and main occupation of population of working age 15-64 by sex, Hiri, iHDSS, 2013

Occupation Type	Male		Female		Total	
	n	%	n	%	n	%
Professional	329	8.6	149	4.4	478	6.6
Skilled	237	6.2	115	3.4	352	4.9
Unskilled	1,272	33.4	542	16.0	1,814	25.2
Military	29	0.8	3	0.1	32	0.4
Student	419	11.0	350	10.3	769	10.7
Unemployed	773	20.3	287	8.4	1,060	14.7
Subsistence	635	16.7	1,867	54.9	2,502	34.7
DK/NA	116	3.0	85	2.5	201	2.8
Total	3,810	100.0	3,398	100.0	7,208	100.0

People are mostly reported working under the category of 'unskilled', 33.4% for males and 16% for females. 34.7% of the respondents reported working in 'subsistence' category, including farming, gardening and fishing industries. 16.7% of the males compared to 54.9% of females reported working in this category³.

Marital status

7,437 people aged 15 or above (3933 males and 3504 females) were included in the analysis of marital status.

Table 5 Marital status of population aged 15+ by sex, Hiri, iHDSS, 2013

Marital Status	Male		Female		Total	
	n	%	n	%	n	%
Single	1,327	33.7	726	20.7	2,053	27.6
Married	2,159	54.9	2,256	64.4	4,415	59.4
Separated/ Divorced	78	2.0	138	3.9	216	2.9
Widowed	119	3.0	218	6.2	337	4.5
DK/ NA	250	6.4	166	4.7	416	5.6
Total	3,933	100.0	3,504	100.0	7,437	100.0

Males are more likely single than females, 33.7% compared to 20.7%. In contrast, females are more likely getting married than males, 64.4% and 54.9%, respectively. There were also more females being reported as divorced, separated, and widowed than males.

It is noted that among 2053 single people, single males were 1327 compared to 726 females. It suggests a relative shortage of single females in the community. By contrast, the numbers of females reported as married, divorced/separated were higher than their male counterparts.

HIDES/KOMO



Hides iHDSS is one of the two intervention sites of the PiHP, located in the recently founded Hela Province. Geographically the area is very remote and rugged. Cultural norms and practices are still an integral part of the locals' lives. People still live in clans and sub-clans, and maintain a traditional lifestyle. Most of the houses are traditionally built with very few semi-permanent buildings. The main tokples language spoken is Huli which is also the common name given to people from that region. Other languages include pidgin and a rare percentage of English speakers. Hides is also home to the Komo Airfield, which to date is fully functional. The main health facilities are Mananda Health Centre and Para Clinic which is run by the Evangelical Church of PNG (EC-PNG). There are elementary and primary schools present however no evidence of high schools.

The three main divisions that PiHP concentrates on are Haliago, Hibiria and Gigiria in Hides. There has been a substantial increase in the population count for each division, particularly for Division 3, where the population has experienced substantial socio-economic changes, possibly associated with the recent PNG LNG Development Programme in the district, with volume limited amount of in-migration of young people into the district for job and economic purposes. More detailed data and information on this observation are presented in Chapter 8.

³No data on employment in Hiri were reported in the 2013 Report, so comparison or trend analysis of employment appears challenging.

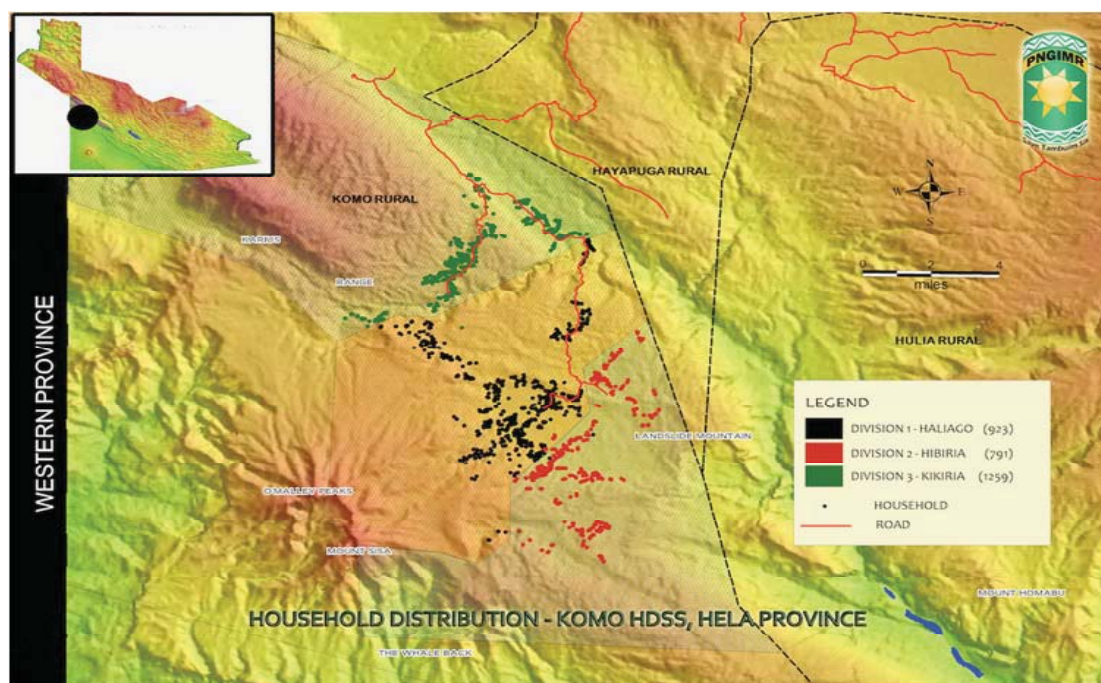


Figure 5 Map of Hides and household distribution, Hides, iHDSS, 2013

The Population

Table 6 Population distribution by sex and age groups, Hides, iHDSS, 2013

Sex Group	Male		Female		Total		Sex Ratio M:F
	n	%	n	%	n	%	
0-4	731	5.3	770	5.6	1,501	10.9	95:100
5-9	966	7.0	896	6.5	1,862	13.5	108:100
10-14	824	6.0	706	5.1	1,530	11.1	117:100
15-19	716	5.2	674	4.9	1,390	10.0	106:100
20-24	623	4.5	617	4.5	1,240	9.0	101:100
25-29	718	5.2	694	5.0	1,412	10.2	103:100
30-34	666	4.8	709	5.1	1,375	9.9	94:100
35-39	485	3.5	466	3.4	951	6.9	104:100
40-44	597	4.3	520	3.8	1,117	8.1	115:100
45-49	265	1.9	211	1.5	476	3.4	126:100
50-54	269	1.9	193	1.4	462	3.3	139:100
55-59	99	0.7	64	0.5	163	1.2	155:100
60-64	96	0.7	97	0.7	193	1.4	99:100
65-69	51	0.4	35	0.3	86	0.6	146:100
70+	40	0.3	33	0.2	73	0.5	121:100
Total	7,146	51.7	6,685	48.3	13,831	100.0	107:100

Age yrs	Male		Female		Total		Sex Ratio M:F
	n	%	n	%	n	%	
0-14	2,521	18.2	2,372	17.1	4,893	35.4	106:100
15-64	4,534	32.8	4,245	30.7	8,779	63.5	107:100
>=65	91	0.7	68	0.5	159	1.1	134:100
Total	7,146	51.7	6,685	48.3	13,831	100.0	107:100

The Hides iHDSS recorded 13,831 people in the district. Sex ratio of the entire population is of 107 males per 100 females. However, the sex ratios tend to increase in higher age groups i.e. it increased from the normal level of 104 males per 100 females in age group 35-39 to the extremely high level of 146 males per 100 females in the age group 65-69. This suggests female mortality rates are higher than male mortality rates in such age groups.

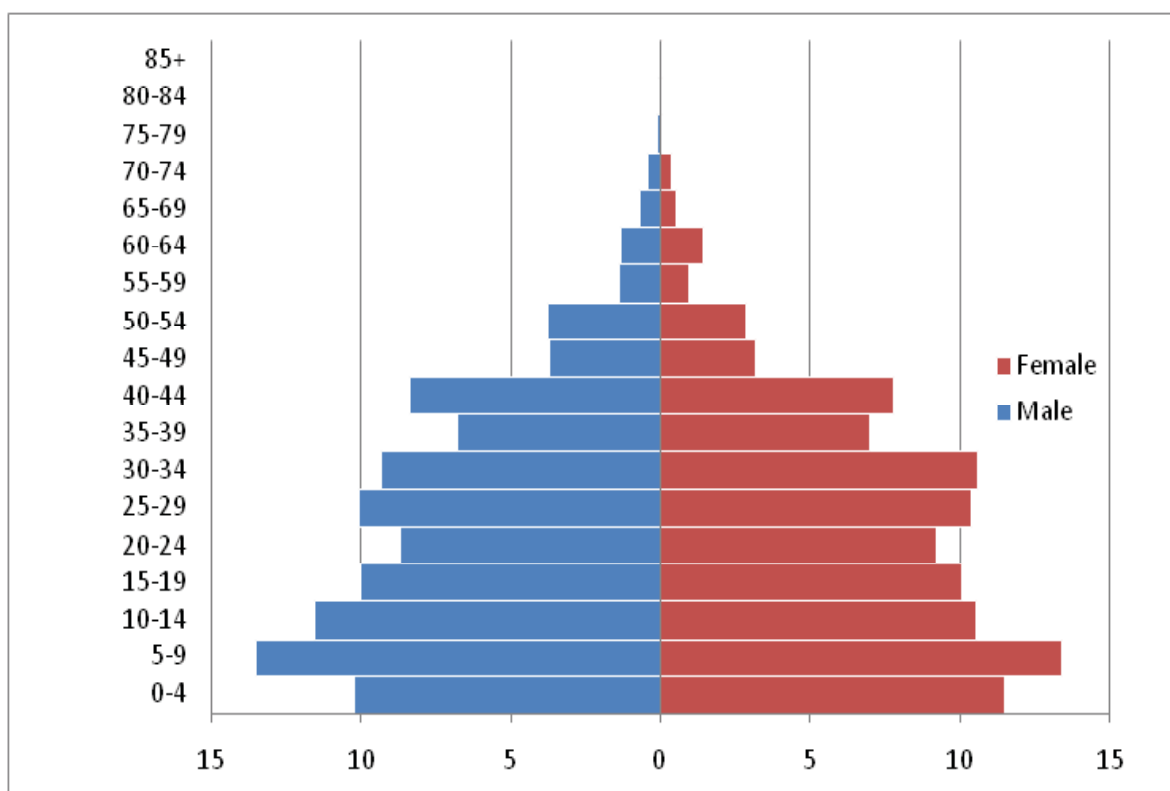


Figure 6 Population pyramid of Hides, iHDSS, 2013

The population pyramid of Hides is distorted due to some reasons, probably due to the in-migration flow as reflected in larger population in age groups 25-29 and 30-34. However, this hypothesis cannot explain the larger population of 40-44 in Hides. This observation could be due sampling error, and selection of study site/ population could be playing a role. The shorter bar of population aged 0-4 is a result from the declined fertility in Hides in the last few years.

Education

Table 7 Highest educational level attainment among the population aged 5 or above by sex, Hides, iHDSS, 2013

Education Level	Male		Female		Total	
	n	%	n	%	n	%
No Education	2,813	46.7	3,150	56.7	5,963	51.5
Some Primary	1,677	27.8	1,335	24.0	3,012	26.0
Completed Primary	184	3.1	136	2.4	320	2.8
Some Secondary	408	6.8	181	3.3	589	5.1
Completed Secondary	128	2.1	38	0.7	166	1.4
High School	7	0.1	6	0.1	13	0.1
Vocational	28	0.5	3	0.1	31	0.3
Tertiary	35	0.6	10	0.2	45	0.4
DK/ NA	749	12.4	694	12.5	1,443	12.5
Total	6,029	100.0	5,553	100.0	11,582	100.0

11582 people aged 5 or above were included in the educational analysis. About 50% of this population reported no schooling and approximately one quarter reported attaining some primary educational level. Furthermore, the proportions of population reported attaining secondary school, high school and vocational training levels were very low, at about 1%. Only 0.4% of the population, 0.6% of males and 0.2% of females, reported attaining tertiary educational level.

Employment

Employment status and main occupation of population of working age 15-64 by sex, Hides iHDSS, 2013

Occupation Type	Male		Female		Total	
	n	%	n	%	n	%
Professional	170	3.8	26	0.6	196	2.2
Skilled	389	8.6	34	0.8	423	4.8
Unskilled	1,343	29.6	211	5.0	1,554	17.7
Military	10	0.2	5	0.1	15	0.2
Student	475	10.5	369	8.7	844	9.6
Unemployed	155	3.4	61	1.4	216	2.5
Subsistence	1,862	41.1	3,433	81.0	5,295	60.4
DK/NA	128	2.8	97	2.3	225	2.6
Total	4,532	100.0	4,236	100.0	8,768	100.0

8768 people of working age 15-64 currently living in the defined Hides iHDSS catchment were included in the analysis of employment status and occupation. The majority of the population (60%) reported working in 'subsistence' category. Females are twice as likely as males to be involved in gardening, farming and fishing, around 80% and 40%, respectively. The unemployment rate was reported low in Hides, 3.4% for males and 1.4% for females.

Marital status

Table 8 Marital status of population aged 15+ by sex, Hides, iHDSS, 2013

Marital Status	Male		Female		Total	
	n	%	n	%	n	%
Never Married	1,794	38.8	1,044	24.2	2,838	31.8
Married	2,574	55.7	2,845	66.0	5,419	60.6
Separated/Divorced	65	1.4	149	3.5	214	2.4
Widowed	77	1.7	190	4.4	267	3.0
DK/ NA	115	2.5	84	1.9	199	2.2
Total	4,625	100.0	4,312	100.0	8,937	100.0

There were 8937 people aged 15 or above included in the marital status analysis for Hides. Similar to observations in Asaro, Hides data show a gap between males and females in marital status. While there were more single males than females, 38% compared to 24%, the proportion of married females was higher than that of their male counterparts, 66% and 56%, respectively. This could be due to polygamy phenomenon, but further study is needed to provide insights into this observation.



The people of Asaro mostly depend on farming agricultural products to sustain themselves, apart from growing coffee which is their main cash crop. The 3 main tokples language Asaro people communicate in are; Gahuku, Siane and Dano/Tokano apart from the common pidgin that is also regularly spoken. There are four health facilities, where locals access to receive basic health services. Furthermore, Asaro has more than 10 educational facilities where local children attend.

The Demographic Surveillance System (DSS) of the Asaro Valley was re-established by the Partnership in Health Project in 2011. The valley is one of the two iHDSS control sites and is approximately 40-45km Northeast of Goroka town. There are currently 26 field reporters who conducted the census survey and the annual DSS update survey.

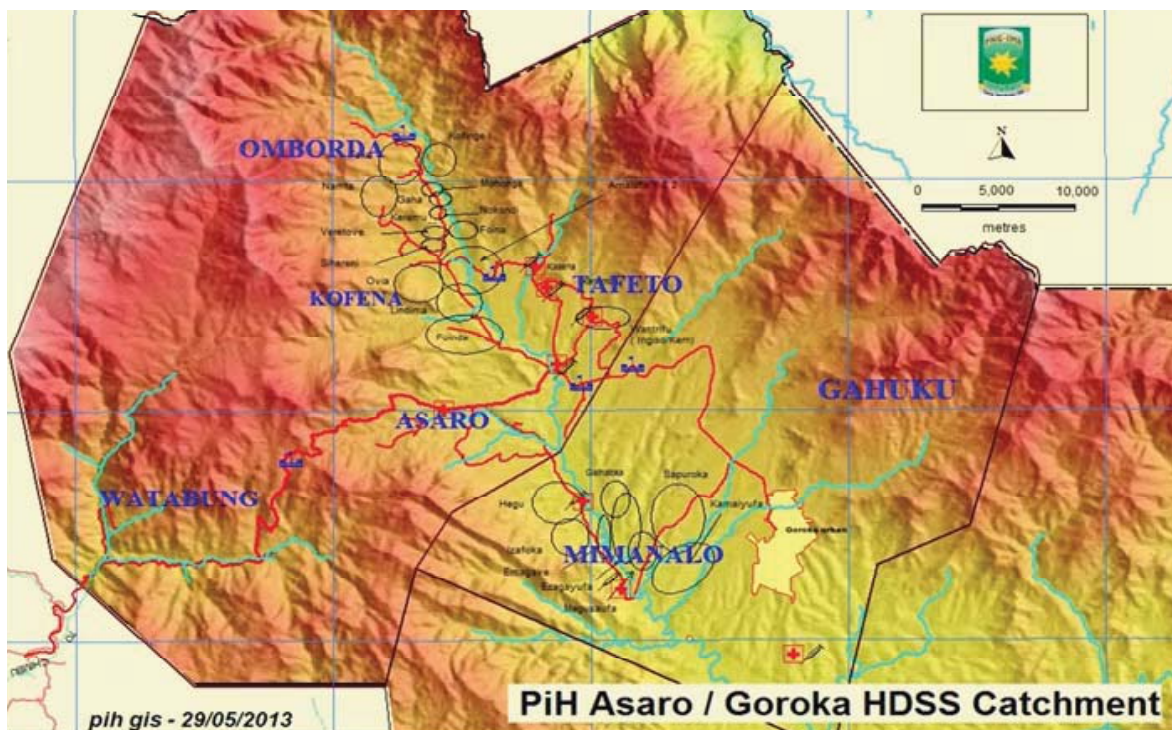


Figure 7 Map of Asaro and villages covered by iHDSS, 2014

The Population

Table 9 Population distribution by sex and age groups, Asaro, iHDSS, 2013

Age Groups	Male		Female		Total		Sex Ratio M:F
	n	%	n	%	n	%	
0-4	522	5.3	471	4.8	993	10.1	111:100
5-9	658	6.7	687	7.0	1,345	13.7	96:100
10-14	557	5.7	498	5.1	1,055	10.8	112:100
15-19	514	5.2	402	4.1	916	9.3	128:100
20-24	419	4.3	421	4.3	840	8.6	100:100
25-29	364	3.7	374	3.8	738	7.5	97:100
30-34	326	3.3	411	4.2	737	7.5	79:100
35-39	303	3.1	306	3.1	609	6.2	99:100
40-44	336	3.4	382	3.9	718	7.35	88:100
45-49	205	2.1	181	1.8	386	3.9	113:100
50-54	215	2.2	205	2.1	420	4.3	105:100
55-59	158	1.6	115	1.2	273	2.8	137:100
60-64	162	1.6	144	1.5	306	3.1	113:100
65-69	112	1.1	97		209	2.1	115:100
70+	153	1.6	147	1.5	300	3.1	104:100
Total	5004	50.8	4841	49.2	9,845	100	103:100

Age Groups	Male		Female		Total		Sex Ratios M:F
	n	%	n	%	n	%	
0-14 (children)	1737	17.6	1656	16.8	3,411	34.4	105:100
15-64 (working)	3002	30.5	2941	29.9	5,973	60.4	102:100
>=65 (elderly)	265	2.7	244	2.5	512	5.2	109:100
Total	5004	50.8	4841	49.2	9,845	100	103:100

The Asaro iHDSS covers 9,845 people in 2976 households, divided into 26 villages. Sex ratio of the whole population was of 103 males per 100 females. However, the sex ratios were relatively high among populations in age groups between 45 and 69, particularly age group 55-59 (137 males per 100 females), and extremely low in age group 30-34 (79 males per 100 females). This could be biases due to small sizes of such populations. Working population aged 15-64 accounts for 60.4% of the entire population. Total dependency was 39.6%, including 34.4% of child dependency and 5.2% of elderly dependency. The population is very young as reflected in the population aging index (15%).

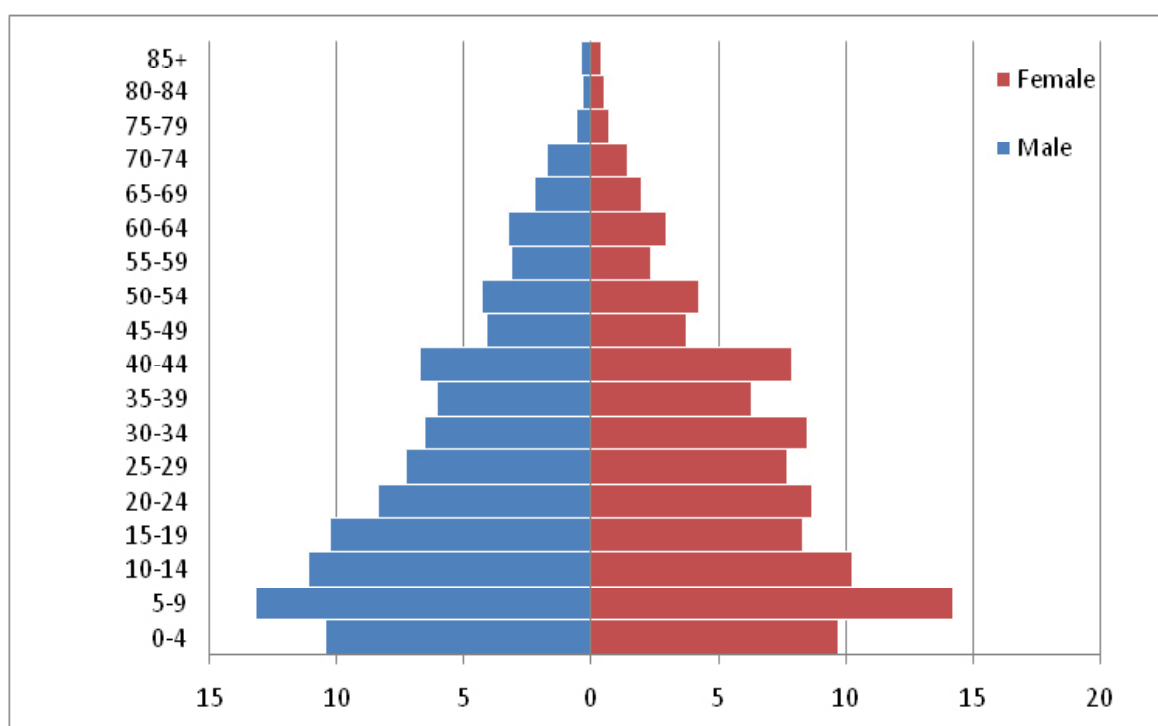


Figure 8 Population pyramid of Asaro, iHDSS, 2013

The population pyramid of Asaro show that the fertility has been declined in the last 4 years, as reflected in the shorter bottom bar, after a 'baby boom' in a decade ago as reflected in relative longer bars of the population age groups 5-9 and 10-14. But again the long and short bars of the female populations of different age groups obviously show the systematic errors in the population data of Asaro.

Education

Table 10 Highest educational level attainment of the population by sex, Asaro, iHDSS, 2013

Education Level	Male		Female		Total	
	n	%	n	%	n	%
No Education	858	20.42	1,319	32.06	2,177	26.18
Some Primary	2,270	54.02	2,047	49.76	4,317	51.91
Completed Primary	119	2.83	102	2.48	221	2.66
Some Secondary	518	12.33	283	6.88	801	9.63
Completed Secondary	88	2.09	39	0.95	127	1.53
High School	13	0.31	4	0.10	17	0.20
Vocational	60	1.43	20	0.49	80	0.96
Tertiary	9	0.21	6	0.15	15	0.18
DK/NA	267	6.35	294	7.15	561	6.75
Total	4,202	100	4,114	100	8,316	100

^aPAI is measured by the ratio between proportion of the elderly aged 65 and above and proportion of the children aged 0-14. Some countries calculate proportion of population aged 60+.

8316 people aged 5 or above (4202 males and 4114 females) were taken into the analysis of highest educational level attainment. Asaro data showed similar findings, which were observed in Hides. The education status seems extremely poor in Asaro, with more than three quarter of the population reported having no school or some primary education. It was even worse for females, 81% compared to 72% of males.

Employment

5980 people of working age 15-64 were included in the analysis. The majority of the population (75%) works in 'subsistence' category, including farming, gardening and fishing. Females are more likely than males to participate in this category, 83% compared to 66%, respectively. The proportion of population working in 'subsistence' in Asaro is much higher than that in Hides, 75% and 60%, respectively.

The unemployment rate was very low in Asaro, around 1% for both males and females. Also very few people are under the categories 'skilled' and 'professional', only 1% and 3%, respectively. Additionally the number of people working as 'unskilled' is also very low, 2.5%. The proportion of population working as professionals and skilled workers is high lower in Asaro, 4.3% compared to 7% in Hides.

Majority of males work under two main categories: subsistence (66.2%) and student (19.7%).

Table 11 Employment status and main occupation of population of working age of 15-64 by sex, Asaro, iHDSS, 2013

Occupation Type	Male		Female		Total	
	n	%	n	%	n	%
Professional	138	4.56	62	2.10	200	3.34
Skilled	44	1.45	14	0.47	58	0.97
Unskilled	121	4.00	29	0.98	150	2.51
Military	25	0.83	2	0.07	27	0.45
Student	595	19.66	326	11.04	921	15.40
Unemployed	41	1.35	29	0.98	70	1.17
Subsistence	2,005	66.24	2,453	83.07	4,458	74.55
DK/ NA	58	1.92	38	1.29	96	1.61
Total	3,027	100	2,953	100	5,980	100

Observations of occupation and employment status among females are similar that of males. However, females are more likely than males to work in 'subsistence' category (83%) and they also tend to participate earlier than males partners in this work. Indeed, young females are less likely than male counterparts to study, 62.4% compared to 75.3% of the age group 15-19 attending school.

Marital status

6450 people age 15 or above (3267 males and 3183 females) living in Asaro was included in the analysis of marital status. More than 20% of the population is single, and more than 60% are married.

Table 12 Marital status of population aged 15+ by sex, Asaro, iHDSS, 2013

Marital Status	Male		Female		Total	
	n	%	n	%	n	%
Single	984	30.12	477	14.99	1,461	22.65
Married	1,894	57.97	2,132	66.98	4,026	62.42
Separated/ Divorced	147	4.50	222	6.97	369	5.72
Widowed	92	2.82	255	8.01	347	5.38
DK/ NA	150	4.59	97	3.05	247	3.83
Total	3,267	100	3,183	100	6,450	100

However, it is noted that the proportion of single males are doubled to their female counterparts, 30% compared to 15%. That mean the phenomenon of 'squeeze' marriage could be happen in Asaro, where about 15% of males could have difficulty in finding their female partners in the same age cohorts. Again, polygamy could be a confounder, but further study is required to confirm.

Indeed, further analysis of marital status by age group show that while 80% of males in age group 20-24 and 40% of the age group 25-29 are single, these proportions are only 30% and 10% in the respective female age group cohorts. That means these young single men will have to either look for women outside of Asaro or women of younger age cohorts.



Karkar district is a volcanic island located 30km off of the PNG coast in the Bismarck Sea and is part of Madang Province, with the total population approximately 60,000. The island's soil is known for its fertility and large plantations produce the island's main exports of cocoa and coconut and provide a large amount of the local employment opportunities. Inhabitants of the island come from one of two language groups: Waskia in the North half of the island and Taskia in the South. Most inhabitants are either Lutheran or Catholic.

One main road runs around the coast of the island and provides access to the three available health facilities. Gaubin Hospital is the largest of the facilities and is a Lutheran run institution.

Karkar has been unaffected by the extensive and intensive mining activity that has occurred in Madang; hence, Karkar is considered as an appropriate location for control site in comparison with the coastal impact villages located in Hiri.

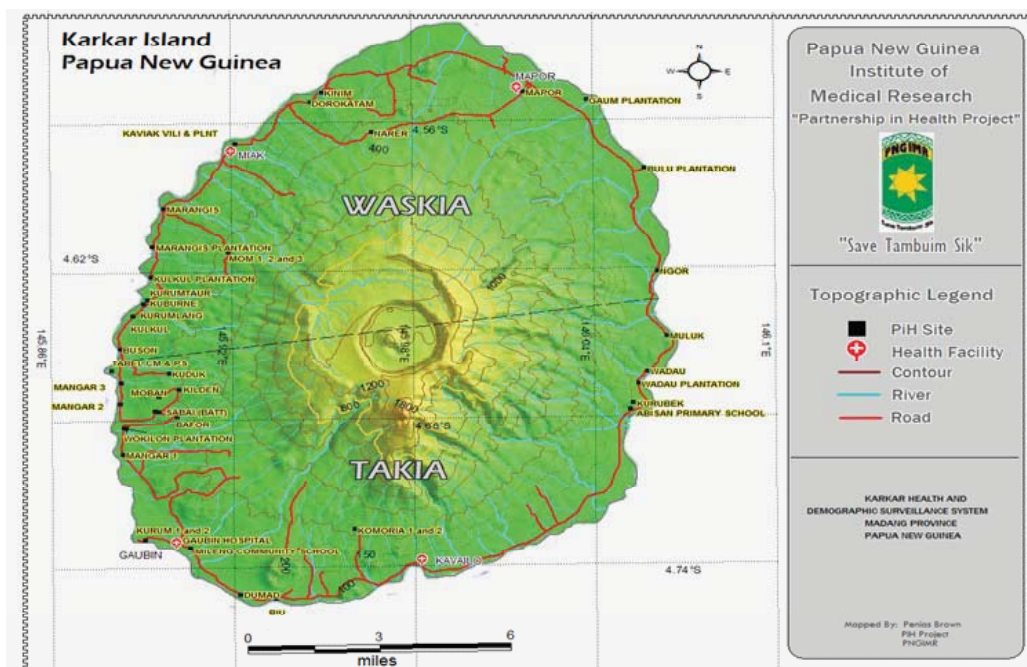


Figure 9 Map of Karkar, iHDSS, 2013

The Population

18,413 people recorded in the iHDSS in Karkar. The age structure of Karkar population is typical for a young population with the larger proportions of younger age groups and smaller proportions of higher age groups i.e. the proportion of population was highest at age group of 5-9 (15%) and declined gradually to 1% for the age group 65-69.

Table 13 Population distribution by sex and age groups, Karkar, iHDSS, 2013

Age yrs	Male		Female		Total		Sex Ratio M:F
	n	%	n	%	n	%	
0-4	1,004	5.5	958	5.2	1,962	10.7	105:100
5-9	1,468	8.0	1,270	6.9	2,738	14.9	116:100
10-14	1,190	6.5	1,099	6.0	2,289	12.4	108:100
15-19	1,076	5.8	991	5.4	2,067	11.2	109:100
20-24	891	4.8	793	4.3	1,684	9.1	112:100
25-29	767	4.2	701	3.8	1,468	8.0	109:100
30-34	706	3.8	605	3.3	1,311	7.1	117:100
35-39	562	3.1	514	2.8	1,076	5.8	109:100
40-44	507	2.8	452	2.5	959	5.2	112:100
45-49	396	2.2	384	2.1	780	4.2	103:100
50-54	398	2.2	338	1.8	736	4.0	118:100
55-59	238	1.3	205	1.1	443	2.4	116:100
60-64	213	1.2	152	0.8	365	2.0	140:100
65-69	99	0.5	91	0.5	190	1.0	109:100
70+	171	0.9	174	0.9	345	1.9	98:100
Total	9,686	52.6	8,727	47.4	18,413	100.0	111:100

Age yrs	Male		Female		Total		Sex Ratio M:F
	n	%	n	%	n	%	
0-14	3,662	19.9	3,327	18.1	6,989	38.0	110:100
15-64	5,754	31.2	5,135	27.9	10,889	59.1	112:100
>=65	270	1.5	265	1.4	535	2.9	102:100
Total	9,686	52.6	8,727	47.4	18,413	100.0	111:100

Sex ratio of the entire population is moderately high, 111 males per 100 females, and fluctuates around this level across age groups i.e. 110/100 for children age 0-14, 112/100 for population of working age 15-64. These sex ratios are comparable to that of Hiri. However, the sex ratio of the elderly population age 65+ was much lower in Karkar (102) than in Hiri (118). Further study on sex ratio of the population could provide more insights into this differential.

The population of working age accounted for 59% of the population with a total dependency ratio of only 69%, meaning that there are only 69 dependents for every 100 people of working age. This implies great potential of the labour force for socio-economic development in Karkar.

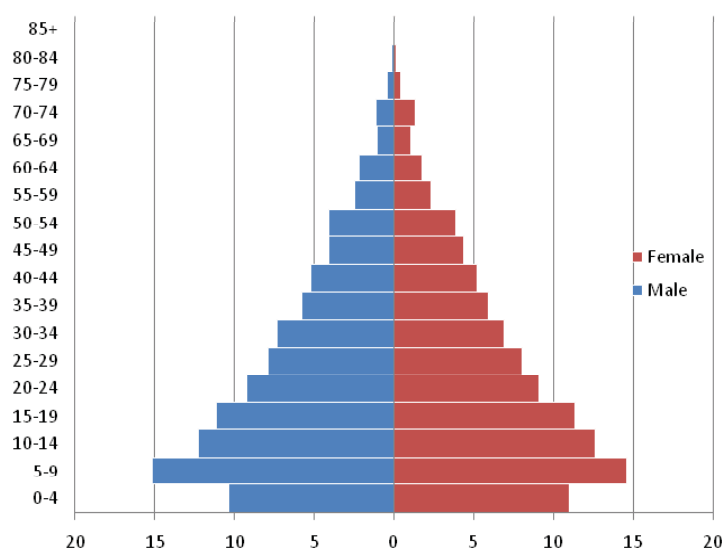


Figure 10 Population pyramid of Karkar, iHDSS, 2013

The population pyramid of Karkar is a typical for a young population and similar to that for the whole population of four sites. However, it is markedly shorter bar of the children in age group 0-4, reflecting a sharp decline in fertility in the Karkar in the last 4 year.

Education

Table 14 Highest educational level attainments among population aged 5 or more by sex, Karkar, iHDSS, 2013

Education Level	Male		Female		Total	
	n	%	n	%	n	%
No Education	454	5.6	489	6.8	943	6.1
Some Primary	4,983	61.4	4,734	65.5	9717	63.3
Completed Primary	802	9.9	707	9.8	1509	9.8
Some Secondary	774	9.5	500	6.9	1274	8.3
Completed Secondary	216	2.7	115	1.6	331	2.2
High School	39	0.5	18	0.2	57	0.4
Vocational	75	0.9	18	0.2	93	0.6
Tertiary	90	1.1	38	0.5	128	0.8
DK/NA	682	8.4	606	8.4	1288	8.4
Total	8,115	100.0	7,225	100.0	15,340	100.0

The majority of the population (63%) reported attaining some primary school. The proportion of population with no schooling was around 6% in Karkar, slightly higher than Hiri, 1.4%.

Employment

10542 people of working age 15-64 were included in the analysis of employment status and main occupation.

Table 15 Employment status and main occupation of population of working age 15-64 by sex, Karkar, iHDSS, 2013

Occupation type	Male		Female		Total	
	n	%	n	%	n	%
Professional	145	2.6	75	1.5	220	2.1
Skilled	143	2.6	30	0.6	173	1.6
Unskilled	124	2.2	54	1.1	178	1.7
Military	8	0.1	6	0.1	14	0.1
Student	1,413	25.6	1,075	21.4	2488	23.6
Unemployed	39	0.7	16	0.3	55	0.5
Subsistence	3,558	64.4	3,689	73.6	7247	68.7
DK/NA	97	1.8	70	1.4	167	1.6
Total	5,527	100.0	5,015	100.0	10,542	100.0

The majority of the population (68.7%) reported working in the areas of farming, fishing and gardening. Females are more likely than males involving in this occupation, 74% compared with 64%, respectively. Students account for the second large proportion of the population, nearly about one quarter of the population are currently students. Again, numbers of people working in 'professional' and 'skilled' categories are only around 2%, much lower than that in Hiri, 11.5%.

Marital status

Marital status of population aged 15+ by sex Karkar , iHDSS, 2013

Marital Status	Male		Female		Total	
	n	%	n	%	n	%
Single	2,517	41.8	1,534	28.4	4,051	35.5
Married	3,056	50.8	3,162	58.6	6,218	54.5
Separated/Divorced	107	1.8	247	4.6	354	3.1
Widowed	125	2.1	310	5.7	435	3.8
DK/ NA	213	3.5	141	2.6	354	3.1
Total	6,018	100.0	5,394	100.0	11,412	100.0

11412 people were included in the analysis of marital status. Around half of the population was in marriage and one third are single. It is noted that the proportion of single males is significant, accounted for 42% of the males. The number of single males is approximately one thousand more than single females in the site. It accounted for around 20% of the male population or around 10% of the population. This analysis confirms the above observation of high sex ratio of population of working age. The proportion of single population was higher in Karkar than in Hiri, 35.5% and 27.6%, respectively.

Conclusion

The population of the four study sites is young. However, the fertility has been observed declining considerably in the past 5 years, as reflected in smaller proportion of the population of age group 0-4 in the population (This population accounted for 15% in Hiri compared to 10.7% in Karkar, and 10.9% in Hides compared to 10.1% in Asaro). Further study of the impact of socio-economic development on fertility behaviour of the population will provide further insights into this observation.

The high male-to-female sex ratio phenomenon in the study population, particularly among people of working has been well captured in the iHDSS, and reported in the previous reports. This phenomenon has been observed, not only in Hiri and Hides districts, where economic activities are attracting more young males moving in, but also in Karkar and Asaro, where the majority of the population working in farming, gardening and fishing. About 10% of the single adult males (approximately 3000) are 'surplus'. More in-depth analyses are needed to provide insights into this phenomenon for effective solutions for sustainable socio-economic development of PNG.

The recent development of LNG activities in PNG has obvious impacts on the labour market, particularly in Hides and Hiri, where the 23% and 16% of the study population of working age were reportedly employed at the time of the study. Job opportunities are also attracting a limited number of young males migrating in. Hiri and Hides are also districts with large cohorts of population of working age. As the construction phase of the PNG LNG Project ends demobilization of much of the work force will occur.



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ANNEXES

Annex 1 Highest educational level attainment amongst males by age group, Hiri, iHDSS, 2013

Age group	No Education		Some Primary		Completed Primary		Some Secondary		Completed Secondary		High School		Vocational		Tertiary		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
5-9	10	2.2	249	54.2	1	0.2	0	0.0	0	0.0	1	0.2	0	0.0	2	0.4	196	42.7	459	100.0
10-14	10	1.4	602	83.6	13	1.8	23	3.2	1	0.1	0	0.0	0	0.0	1	0.1	70	9.7	720	100.0
15-19	13	2.1	189	30.4	87	14.0	232	37.3	57	9.2	13	2.1	5	0.8	6	1.0	20	3.2	622	100.0
20-24	7	1.1	124	19.6	64	10.1	191	30.1	120	18.9	33	5.2	29	4.6	59	9.3	7	1.1	634	100.0
25-29	4	0.7	68	12.6	49	9.1	158	29.3	110	20.4	20	3.7	46	8.5	75	13.9	9	1.7	539	100.0
30-34	2	0.4	82	17.2	42	8.8	130	27.3	83	17.4	15	3.1	42	8.8	61	12.8	20	4.2	477	100.0
35-39	0	0.0	114	24.3	44	9.4	111	23.6	77	16.4	8	1.7	46	9.8	50	10.6	20	4.3	470	100.0
40-44	2	0.6	54	17.0	25	7.9	74	23.3	61	19.2	10	3.2	30	9.5	50	15.8	11	3.5	317	100.0
45-49	4	1.6	50	20.2	20	8.1	61	24.7	29	11.7	3	1.2	18	7.3	47	19.0	15	6.1	247	100.0
50-54	2	0.9	31	14.2	13	5.9	39	17.8	37	16.9	2	0.9	20	9.1	65	29.7	10	4.6	219	100.0
55-59	2	1.3	22	13.8	7	4.4	42	26.3	16	10.0	3	1.9	23	14.4	35	21.9	10	6.3	160	100.0
60-64	3	2.9	10	9.5	7	6.7	19	18.1	7	6.7	3	2.9	11	10.5	34	32.4	11	10.5	105	100.0
65-69	1	1.5	5	7.6	3	4.5	13	19.7	4	6.1	1	1.5	10	15.2	20	30.3	9	13.6	66	100.0
70+	2	2.8	24	33.8	5	7.0	4	5.6	0	0.0	0	0.0	8	11.3	9	12.7	19	26.8	71	100.0
Total	62	1.2	1,624	31.8	380	7.4	1,097	21.5	602	11.8	112	2.2	288	5.6	514	10.1	427	8.4	5,106	100.0

Annex 2 Highest educational level attainment amongst females by age group, Hiri, iHDSS 201

Age yrs	No Education		Some Primary		Completed Primary		Some Secondary		Completed Secondary		National High School		Vocational		Tertiary		Don't know or NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
5-9	5	1.3	242	61.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	146	37.2	393	100.0
10-14	8	1.3	537	84.8	13	2.1	15	2.4	1	0.2	0	0.0	1	0.2	0	0.0	58	9.2	633	100.0
15-19	9	1.6	197	34.6	71	12.5	202	35.4	52	9.1	12	2.1	5	0.9	4	0.7	18	3.2	570	100.0
20-24	10	1.6	134	21.9	79	12.9	183	30.0	100	16.4	28	4.6	15	2.5	46	7.5	16	2.6	611	100.0
25-29	6	1.2	96	19.7	64	13.1	152	31.2	77	15.8	18	3.7	16	3.3	35	7.2	23	4.7	487	100.0
30-34	2	0.5	106	26.9	45	11.4	100	25.4	65	16.5	6	1.5	19	4.8	37	9.4	14	3.6	394	100.0
35-39	5	1.3	120	30.5	44	11.2	104	26.4	53	13.5	3	0.8	20	5.1	34	8.6	11	2.8	394	100.0
40-44	3	1.2	54	22.2	25	10.3	55	22.6	41	16.9	4	1.6	19	7.8	34	14.0	8	3.3	243	100.0
45-49	10	3.7	84	31.2	37	13.8	46	17.1	19	7.1	0	0.0	22	8.2	36	13.4	15	5.6	269	100.0
50-54	4	1.9	59	28.0	39	18.5	30	14.2	23	10.9	1	0.5	25	11.8	18	8.5	12	5.7	211	100.0
55-59	3	2.2	49	36.3	11	8.1	28	20.7	11	8.1	0	0.0	10	7.4	14	10.4	9	6.7	135	100.0
60-64	4	5.3	25	33.3	7	9.3	13	17.3	6	8.0	0	0.0	4	5.3	8	10.7	8	10.7	75	100.0
65-69	3	6.1	16	32.7	9	18.4	2	4.1	1	2.0	0	0.0	3	6.1	2	4.1	13	26.5	49	100.0
70+	2	3.0	29	43.3	4	6.0	1	1.5	0	0.0	0	0.0	3	4.5	2	3.0	26	38.8	67	100.0
Total	74	1.6	1,748	38.6	448	9.9	931	20.5	449	9.9	72	1.6	162	3.6	270	6.0	377	8.3	4,531	100.0

Annex 3 Employment status and main occupation amongst males aged 15+ by age group, Hiri, iHDSS, 2013

Age yrs	Professional		Skilled		Unskilled		Military		Student		Subsistence		Unemployed		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
15-19	2	0.3	5	0.8	84	13.6	1	0.2	314	50.7	69	11.1	6	1.0	41	6.6	619	100.0
20-24	18	2.8	22	3.5	236	37.2	0	0.0	54	8.5	99	15.6	16	2.5	20	3.2	634	100.0
25-29	40	7.4	34	6.3	224	41.6	7	1.3	20	3.7	78	14.5	6	1.1	6	1.1	539	100.0
30-34	39	8.2	44	9.2	225	47.3	6	1.3	8	1.7	68	14.3	4	0.8	4	0.8	476	100.0
35-39	50	10.6	41	8.7	196	41.5	7	1.5	9	1.9	77	16.3	4	0.8	10	2.1	472	100.0
40-44	44	13.8	17	5.3	127	39.9	3	0.9	8	2.5	55	17.3	2	0.6	7	2.2	318	100.0
45-49	41	16.5	20	8.1	84	33.9	2	0.8	3	1.2	53	21.4	1	0.4	11	4.4	248	100.0
50-54	44	20.0	33	15.0	46	20.9	3	1.4	2	0.9	46	20.9	1	0.5	7	3.2	220	100.0
55-59	35	21.9	14	8.8	32	20.0	0	0.0	0	0.0	45	28.1	1	0.6	2	1.3	160	100.0
60-64	15	14.3	6	5.7	15	14.3	0	0.0	1	1.0	38	36.2	0	0.0	5	4.8	105	100.0
65-69	1	5.3	1	5.3	3	15.8	0	0.0	0	0.0	7	36.8	0	0.0	3	15.8	19	100.0
Total	329	8.6	237	6.2	1272	33.4	29	0.8	419	11.0	635	16.7	41	1.1	116	3.0	3810	100.0

Annex 4 Employment status and main occupation amongst females aged 15+ by age group, Hiri, iHDSS, 2013

Age group	Professional		Skilled		Unskilled		Military		Current student		Subsistence		Unemployed		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
15-19	5	0.9	1	0.2	52	9.1	0	0.0	289	50.7	133	23.3	6	1.1	24	4.2	570	100.0
20-24	13	2.1	25	4.1	124	20.3	1	0.2	30	4.9	321	52.6	12	2.0	14	2.3	610	100.0
25-29	16	3.3	25	5.2	93	19.2	1	0.2	9	1.9	281	58.1	3	0.6	8	1.7	484	100.0
30-34	23	5.8	15	3.8	67	17.0	0	0.0	7	1.8	250	63.5	2	0.5	8	2.0	394	100.0
35-39	20	5.1	17	4.3	66	16.8	0	0.0	12	3.0	248	62.9	1	0.3	9	2.3	394	100.0
40-44	27	11.1	12	4.9	40	16.5	0	0.0	2	0.8	149	61.3	0	0.0	2	0.8	243	100.0
45-49	21	7.8	13	4.8	39	14.4	0	0.0	1	0.4	178	65.9	3	1.1	4	1.5	270	100.0
50-54	15	7.1	4	1.9	32	15.2	1	0.5	0	0.0	145	69.0	2	1.0	4	1.9	210	100.0
55-59	4	3.0	3	2.2	17	12.6	0	0.0	0	0.0	101	74.8	0	0.0	6	4.4	135	100.0
60-64	5	6.7	0	0.0	8	10.7	0	0.0	0	0.0	53	70.7	0	0.0	5	6.7	75	100.0
65-69	0	0.0	0	0.0	4	30.8	0	0.0	0	0.0	8	61.5	0	0.0	1	7.7	13	100.0
Total	149	4.4	115	3.4	542	16.0	3	0.1	350	10.3	1867	54.9	29	0.9	85	2.5	3398	100.0

Annex 5 Marital status amongst males aged 15+ by age group, Hiri, iHDSS, 2013

Age yrs	Single		Married		Separated/ Divorced		Widowed		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
15-19	440	71.3	20	3.2	0	0.0	0	0.0	157	25.4	617	100.0
20-24	392	61.7	191	30.1	4	0.6	1	0.2	47	7.4	635	100.0
25-29	180	33.5	332	61.7	9	1.7	6	1.1	11	2.0	538	100.0
30-34	119	24.9	329	68.8	17	3.6	3	0.6	10	2.1	478	100.0
35-39	81	17.1	365	77.2	13	2.7	8	1.7	6	1.3	473	100.0
40-44	53	16.7	246	77.4	16	5.0	2	0.6	1	0.3	318	100.0
45-49	37	14.8	194	77.6	4	1.6	11	4.4	4	1.6	250	100.0
50-54	16	7.2	182	82.4	6	2.7	15	6.8	2	0.9	221	100.0
55-59	7	4.4	127	79.4	4	2.5	21	13.1	1	0.6	160	100.0
60-64	2	1.9	83	79.0	3	2.9	14	13.3	3	2.9	105	100.0
65-69	0	0.0	53	80.3	2	3.0	9	13.6	2	3.0	66	100.0
70+	0	0.0	37	51.4	0	0.0	29	40.3	6	8.3	72	100.0
Total	1,327	33.7	2,159	54.9	78	2.0	119	3.0	250	6.4	3,933	100.0

Annex 6 Marital status amongst females aged 15+ by age group, Hiri, iHDSS, 2013

Age yrs	Never Married		Married		Separated/ Divorced		Widowed		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
15-19	378	66.4	64	11.2	4	0.7	1	0.2	122	21.4	569	100.0
20-24	203	33.3	355	58.3	23	3.8	3	0.5	25	4.1	609	100.0
25-29	62	12.7	394	80.9	21	4.3	6	1.2	4	0.8	487	100.0
30-34	33	8.4	338	85.6	17	4.3	5	1.3	2	0.5	395	100.0
35-39	26	6.6	329	83.5	25	6.3	11	2.8	3	0.8	394	100.0
40-44	10	4.1	208	86.0	15	6.2	9	3.7	0	0.0	242	100.0
45-49	11	4.1	225	83.3	12	4.4	21	7.8	1	0.4	270	100.0
50-54	2	0.9	155	73.5	11	5.2	39	18.5	4	1.9	211	100.0
55-59	1	0.7	91	67.4	8	5.9	33	24.4	2	1.5	135	100.0
60-64	0	0.0	51	68.0	1	1.3	23	30.7	0	0.0	75	100.0
65-69	0	0.0	25	50.0	0	0.0	23	46.0	2	4.0	50	100.0
70+	0	0.0	21	31.3	1	1.5	44	65.7	1	1.5	67	100.0
Total	726	20.7	2,256	64.4	138	3.9	218	6.2	166	4.7	3,504	100.0

Annex 7 Highest educational level attainment amongst males by age group, Asaro, iHDSS, 2013

Age group	No Education		Some Primary		Completed Primary		Some Secondary		Completed Secondary		High School		Vocational		Tertiary		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
5-9	2	0.5	211	55.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	165	43.7	378	100.0
10-14	26	4.7	492	88.3	6	1.1	2	0.4	0	0.0	0	0.0	0	0.0	0	0.0	31	5.6	557	100.0
15-19	31	6.0	382	74.3	13	2.5	77	15.0	4	0.8	0	0.0	1	0.2	0	0.0	6	1.2	514	100.0
20-24	45	10.7	174	41.5	22	5.3	140	33.4	22	5.3	5	1.2	7	1.7	1	0.2	3	0.7	419	100.0
25-29	41	11.3	173	47.5	23	6.3	83	22.8	18	4.9	4	1.1	18	4.9	1	0.3	3	0.8	364	100.0
30-34	48	14.7	170	52.1	17	5.2	67	20.6	13	4.0	2	0.6	4	1.2	0	0.0	5	1.5	326	100.0
35-39	63	20.8	172	56.8	10	3.3	37	12.2	9	3.0	2	0.7	9	3.0	0	0.0	1	0.3	303	100.0
40-44	82	24.4	170	50.6	11	3.3	50	14.9	7	2.1	0	0.0	10	3.0	1	0.3	5	1.5	336	100.0
45-49	67	32.7	103	50.2	4	2.0	20	9.8	6	2.9	0	0.0	2	1.0	2	1.0	1	0.5	205	100.0
50-54	104	48.4	72	33.5	3	1.4	21	9.8	2	0.9	0	0.0	6	2.8	3	1.4	4	1.9	215	100.0
55-59	82	51.9	50	31.6	8	5.1	11	7.0	5	3.2	0	0.0	1	0.6	1	0.6	0	0.0	158	100.0
60-64	96	59.3	53	32.7	2	1.2	3	1.9	1	0.6	0	0.0	1	0.6	0	0.0	6	3.7	162	100.0
65-69	74	66.1	25	22.3	0	0.0	5	4.5	1	0.9	0	0.0	1	0.9	0	0.0	6	5.4	112	100.0
70+	97	63.4	23	15.0	0	0.0	2	1.3	0	0.0	0	0.0	0	0.0	0	0.0	31	20.3	153	100.0
Total	858	20.4	2,270	54.0	119	2.8	518	12.3	88	2.1	13	0.3	60	1.4	9	0.2	267	6.4	4,202	100.0

Annex 8 Highest educational level attainment amongst females by age group, Asaro, iHDSS 2013

Age group	No Education		Some Primary		Completed Primary		Some Secondary		Completed Secondary		High School		Vocational		Tertiary		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
5-9	7	1.6	243	56.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	181	42.0	431	100.0
10-14	17	3.4	454	91.2	7	1.4	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	19	3.8	498	100.0
15-19	34	8.5	299	74.4	13	3.2	52	12.9	1	0.2	0	0.0	0	0.0	0	0.0	3	0.7	402	100.0
20-24	69	16.4	228	54.2	29	6.9	69	16.4	14	3.3	3	0.7	7	1.7	1	0.2	1	0.2	421	100.0
25-29	78	20.9	190	50.8	18	4.8	67	17.9	11	2.9	1	0.3	4	1.1	0	0.0	5	1.3	374	100.0
30-34	119	29.0	227	55.2	16	3.9	35	8.5	4	1.0	0	0.0	3	0.7	2	0.5	5	1.2	411	100.0
35-39	119	38.9	148	48.4	5	1.6	20	6.5	2	0.7	0	0.0	3	1.0	0	0.0	9	2.9	306	100.0
40-44	191	50.0	144	37.7	9	2.4	22	5.8	4	1.0	0	0.0	2	0.5	2	0.5	8	2.1	382	100.0
45-49	118	65.2	45	24.9	1	0.6	9	5.0	1	0.6	0	0.0	1	0.6	1	0.6	5	2.8	181	100.0
50-54	166	81.0	26	12.7	2	1.0	5	2.4	1	0.5	0	0.0	0	0.0	0	0.0	5	2.4	205	100.0
55-59	91	79.1	16	13.9	1	0.9	1	0.9	1	0.9	0	0.0	0	0.0	0	0.0	5	4.3	115	100.0
60-64	124	86.1	14	9.7	1	0.7	1	0.7	0	0.0	0	0.0	0	0.0	0	0.0	4	2.8	144	100.0
65-69	80	82.5	9	9.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	8	8.2	97	100.0
70+	106	72.1	4	2.7	0	0.0	1	0.7	0	0.0	0	0.0	0	0.0	0	0.0	36	24.5	147	100.0
Total	1,319	32.1	2,047	50	102	2.5	283	6.9	39	0.9	4	0.1	20	0.5	6	0.1	294	7.1	4,114	100.0

Annex 9 Employment status and occupation amongst males of working age 15- 64 by age group, Asaro, iHDSS, 2013

Age group	Professional		Skilled		Unskilled		Military		Student		Unemployed		Subsistence		DK/ NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
15-19	1	0.2	0	0.0	0	0.0	1	0.2	387	75.3	6	1.2	89	17.3	30	5.8	514	100
20-24	4	1.0	7	1.7	10	2.4	5	1.2	161	38.4	16	3.8	208	49.6	8	1.9	419	100
25-29	17	4.7	3	0.8	10	2.7	0	0.0	39	10.7	6	1.6	285	78.3	4	1.1	364	100
30-34	18	5.5	3	0.9	11	3.4	2	0.6	5	1.5	4	1.2	280	86.2	2	0.6	325	100
35-39	18	5.9	6	2.0	21	6.9	3	1.0	0	0.0	4	1.3	250	82.5	1	0.3	303	100
40-44	30	8.9	10	3.0	19	5.7	4	1.2	1	0.3	2	0.6	268	79.8	2	0.6	336	100
45-49	19	9.3	2	1.0	14	6.9	5	2.5	1	0.5	1	0.5	159	77.9	3	1.5	204	100
50-54	15	7.0	5	2.3	16	7.4	3	1.4	0	0.0	1	0.5	173	80.5	2	0.9	215	100
55-59	10	6.3	1	0.6	14	8.9	1	0.6	0	0.0	1	0.6	130	82.3	1	0.6	158	100
60-64	5	3.1	5	3.1	4	2.5	1	0.6	1	0.6	0	0.0	144	88.9	2	1.2	162	100
65-69	1	3.7	2	7.4	2	7.4	0	0.0	0	0.0	0	0.0	19	70.4	3	11.1	27	100
Total	138	4.6	44	1.5	121	4.0	25	0.8	595	19.7	41	1.4	2,005	66.2	58	1.9	3,027	100

Annex 10 Employment status and occupation amongst females of working age 15-64 by age group, Asaro, iHDSS, 2013

Age group	Professional		Skilled		Unskilled		Military		Student		Unemployed		Subsistence		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
15-19	0	0.0	0	0.0	0	0.0	0	0.0	251	62.4	6	1.5	129	32.1	16	4.0	402	100.0
20-24	7	1.7	3	0.7	2	0.5	0	0.0	64	15.2	12	2.9	330	78.4	3	0.7	421	100.0
25-29	7	1.9	5	1.3	5	1.3	0	0.0	10	2.7	3	0.8	343	91.7	1	0.3	374	100.0
30-34	13	3.2	0	0.0	7	1.7	0	0.0	1	0.2	2	0.5	382	92.9	6	1.5	411	100.0
35-39	10	3.3	3	1.0	6	2.0	0	0.0	0	0.0	1	0.3	285	93.1	1	0.3	306	100.0
40-44	17	4.5	2	0.5	4	1.0	0	0.0	0	0.0	0	0.0	358	93.7	1	0.3	382	100.0
45-49	5	2.8	1	0.6	2	1.1	0	0.0	0	0.0	3	1.7	168	92.8	2	1.1	181	100.0
50-54	1	0.5	0	0.0	1	0.5	1	0.5	0	0.0	2	1.0	199	97.1	1	0.5	205	100.0
55-59	2	1.7	0	0.0	2	1.7	0	0.0	0	0.0	0	0.0	109	94.8	2	1.7	115	100.0
60-64	0	0.0	0	0.0	0	0.0	1	0.7	0	0.0	0	0.0	140	97.2	3	2.1	144	100.0
65-69	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	10	83.3	2	16.7	12	100.0
Total	62	2.1	14	0.5	29	1.0	2	0.1	326	11.0	29	1.0	2,453	83.1	38	1.3	2,953	100.0

Annex 11 Marital status amongst males aged 15+ by age group, Asaro, iHDSS, 2013

Age group	Single		Married		Separated/ Divorced		Widowed		DK/ NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
15-19	374	72.8	15	2.9	1	0.2	0	0.0	124	24.1	514	100.0
20-24	336	80.2	67	16.0	6	1.4	0	0.0	10	2.4	419	100.0
25-29	145	39.8	209	57.4	6	1.6	1	0.3	3	0.8	364	100.0
30-34	59	18.1	253	77.6	12	3.7	1	0.3	1	0.3	326	100.0
35-39	24	7.9	257	84.8	20	6.6	1	0.3	1	0.3	303	100.0
40-44	14	4.2	299	89.0	22	6.5	1	0.3	0	0.0	336	100.0
45-49	7	3.4	185	90.2	8	3.9	4	2.0	1	0.5	205	100.0
50-54	12	5.6	178	82.8	12	5.6	11	5.1	2	0.9	215	100.0
55-59	5	3.2	122	77.2	20	12.7	10	6.3	1	0.6	158	100.0
60-64	2	1.2	130	80.2	17	10.5	12	7.4	1	0.6	162	100.0
65-69	3	2.7	83	74.1	11	9.8	14	12.5	1	0.9	112	100.0
70+	3	2.0	96	62.7	12	7.8	37	24.2	5	3.3	153	100.0
Total	984	30.1	1,894	58.0	147	4.5	92	2.8	150	4.6	3,267	100.0

Annex 12 Marital status amongst females aged 15+ by age group, Asaro, iHDSS, 2013

Age group	Single		Married		Separated/ Divorced		Widowed		Don't Know or NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
15-19	263	65.4	57	14.2	2	0.5	0	0.0	80	19.9	402	100.0
20-24	137	32.7	253	60.4	20	4.8	1	0.2	8	1.9	419	100.0
25-29	36	9.6	309	82.6	26	7.0	0	0.0	3	0.8	374	100.0
30-34	10	2.4	355	86.4	39	9.5	5	1.2	2	0.5	411	100.0
35-39	12	3.9	262	85.6	22	7.2	10	3.3	0	0.0	306	100.0
40-44	10	2.6	321	84.0	32	8.4	19	5.0	0	0.0	382	100.0
45-49	4	2.2	140	77.3	27	14.9	10	5.5	0	0.0	181	100.0
50-54	1	0.5	167	81.5	10	4.9	27	13.2	0	0.0	205	100.0
55-59	1	0.9	84	73.0	12	10.4	17	14.8	1	0.9	115	100.0
60-64	1	0.7	83	57.6	14	9.7	44	30.6	2	1.4	144	100.0
65-69	1	1.0	53	54.6	8	8.2	35	36.1	0	0.0	97	100.0
70+	1	0.7	48	32.7	10	6.8	87	59.2	1	0.7	147	100.0
Total	477	15.0	2,132	67.0	222	7.0	255	8.0	97	3.0	3,183	100.0

Annex 13 Highest educational level attainment amongst males by age group, Hides, iHDSS 2013

Age group	No Education		Some Primary		Completed Primary		Some Secondary		Completed Secondary		High School		Vocational		Tertiary		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
5-9	125	21.6	63	10.9	1	0.2	2	0.3	0	0.0	0	0.0	0	0.0	0	0.0	389	67.1	580	100.0
10-14	373	45.3	336	40.8	5	0.6	5	0.6	0	0.0	0	0.0	1	0.0	0	0.0	104	12.6	824	100.0
15-19	305	42.6	330	46.1	10	1.4	31	4.3	2	0.3	0	0.0	0	0.8	0	0.0	38	5.3	716	100.0
20-24	271	43.5	218	35.0	23	3.7	64	10.3	11	1.8	0	0.0	4	4.6	3	0.5	29	4.7	623	100.0
25-29	337	46.9	192	26.7	29	4.0	65	9.1	32	4.5	4	0.6	5	8.5	8	1.1	46	6.4	718	100.0
30-34	301	45.2	159	23.9	46	6.9	81	12.2	32	4.8	2	0.3	8	8.8	10	1.5	27	4.1	666	100.0
35-39	232	47.8	120	24.7	25	5.2	52	10.7	16	3.3	0	0.0	5	9.8	8	1.6	27	5.6	485	100.0
40-44	324	54.3	129	21.6	28	4.7	61	10.2	17	2.8	1	0.2	2	9.5	3	0.5	32	5.4	597	100.0
45-49	155	58.5	56	21.1	8	3.0	21	7.9	5	1.9	0	0.0	3	7.3	1	0.4	16	6.0	265	100.0
50-54	182	67.7	39	14.5	7	2.6	14	5.2	5	1.9	0	0.0	0	9.1	0	0.0	22	8.2	269	100.0
55-59	63	63.6	17	17.2	2	2.0	4	4.0	4	4.0	0	0.0	0	14.4	0	0.0	9	9.1	99	100.0
60-64	66	68.8	15	15.6	0	0.0	6	6.3	2	2.1	0	0.0	0	10.5	2	2.1	5	5.2	96	100.0
65-69	43	84.3	0	0.0	0	0.0	2	3.9	1	2.0	0	0.0	0	15.2	0	0.0	5	9.8	51	100.0
70+	36	90.0	3	7.5	0	0.0	0	0.0	1	2.5	0	0.0	0	11.3	0	0.0	0	0.0	40	100.0
Total	2813	46.7	1,624	26.9	380	6.3	408	6.8	128	2.1	7	0.1	28	5.6	35	0.6	749	12.4	6029	100.0

Annex 14 Highest educational level attainment amongst females by age group, Hides, iHDSS 2013

Age group	No Education		Some Primary		Completed Primary		Some Secondary		Completed Secondary		High School		Vocational		Tertiary		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
5-9	120	22.4	55	10.3	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	359	67.1	535	100.0
10-14	345	48.9	258	36.5	4	0.6	4	0.6	0	0.0	1	0.1	0	0.0	0	0.0	94	13.3	706	100.0
15-19	306	45.4	309	45.8	12	1.8	24	3.6	1	0.1	0	0.0	0	0.8	0	0.0	22	3.3	674	100.0
20-24	303	49.1	181	29.3	30	4.9	52	8.4	10	1.6	0	0.0	1	4.6	1	0.2	39	6.3	617	100.0
25-29	404	58.2	178	25.6	24	3.5	34	4.9	8	1.2	1	0.1	1	8.5	6	0.9	38	5.5	694	100.0
30-34	427	60.3	154	21.8	37	5.2	36	5.1	12	1.7	1	0.1	1	8.8	1	0.1	39	5.5	708	100.0
35-39	327	70.2	84	18.0	12	2.6	14	3.0	1	0.2	1	0.2	0	9.8	0	0.0	27	5.8	466	100.0
40-44	391	75.2	70	13.5	12	2.3	9	1.7	4	0.8	0	0.0	0	9.5	0	0.0	34	6.5	520	100.0
45-49	171	81.0	23	10.9	2	0.9	2	0.9	1	0.5	1	0.5	0	7.3	0	0.0	11	5.2	211	100.0
50-54	153	79.3	16	8.3	3	1.6	6	3.1	1	0.5	0	0.0	0	9.1	1	0.5	13	6.7	193	100.0
55-59	59	92.2	2	3.1	0	0.0	0	0.0	0	0.0	0	0.0	0	14.4	0	0.0	3	4.7	64	100.0
60-64	88	90.7	4	4.1	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	1	1.0	4	4.1	97	100.0
65-69	27	77.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	15.2	0	0.0	8	22.9	35	100.0
70+	29	87.9	1	3.0	0	0.0	0	0.0	0	0.0	0	0.0	0	11.3	0	0.0	3	9.1	33	100.0
Total	3150	56.7	1,335	24.0	136	2.4	181	3.3	38	0.7	6	0.1	3	0.1	10	0.2	694	12.5	5553	100.0

Annex 15 Employment status and occupation amongst males aged 15+ by age group, Hides, iHDSS, 2013

Age group	Professional		Skilled		Unskilled		Military		Student		Unemployed		Subsistence		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
15-19	3	0.4	5	0.7	47	6.6	1	0.1	265	37.1	19	2.7	322	45.0	53	7.4	715	100.0
20-24	3	0.5	29	4.7	131	21.1	2	0.3	130	20.9	27	4.3	284	45.7	16	2.6	622	100.0
25-29	24	3.4	73	10.2	232	32.4	2	0.3	53	7.4	34	4.7	281	39.2	17	2.4	716	100.0
30-34	22	3.3	88	13.2	247	37.1	2	0.3	22	3.3	27	4.1	250	37.6	7	1.1	665	100.0
35-39	40	8.3	72	14.9	181	37.4	0	0.0	3	0.6	8	1.7	167	34.5	13	2.7	484	100.0
40-44	35	5.9	58	9.7	251	42.0	1	0.2	2	0.3	19	3.2	223	37.4	8	1.3	597	100.0
45-49	20	7.5	35	13.2	103	38.9	1	0.4	0	0.0	8	3.0	92	34.7	6	2.3	265	100.0
50-54	12	4.5	18	6.7	93	34.7	0	0.0	0	0.0	8	3.0	133	49.6	4	1.5	268	100.0
55-59	4	4.0	8	8.1	36	36.4	1	1.0	0	0.0	3	3.0	45	45.5	2	2.0	99	100.0
60-64	7	7.3	3	3.1	22	22.9	0	0.0	0	0.0	2	2.1	61	63.5	1	1.0	96	100.0
65-69	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	80.0	1	20.0	5	100.0
Total	170	3.8	389	8.6	1343	29.6	10	0.2	475	10.5	155	3.4	1862	41.1	128	2.8	4532	100.0

Annex 16 Employment status and occupation amongst females aged 15+ by age group, Hides, iHDSS, 2013

Age group	Professional		Skilled		Unskilled		Military		Student		Unemployed		Subsistence		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
15-19	0	0.0	2	0.3	14	2.1	2	0.3	233	34.6	3	0.4	380	56.5	39	5.8	673	100.0
20-24	2	0.3	3	0.5	35	5.7	1	0.2	98	15.9	13	2.1	451	73.1	14	2.3	617	100.0
25-29	4	0.6	8	1.2	43	6.2	0	0.0	24	3.5	17	2.5	585	84.5	11	1.6	692	100.0
30-34	6	0.9	9	1.3	50	7.1	0	0.0	10	1.4	14	2.0	607	86.3	7	1.0	703	100.0
35-39	0	0.0	4	0.9	19	4.1	1	0.2	2	0.4	4	0.9	423	91.2	11	2.4	464	100.0
40-44	5	1.0	5	1.0	27	5.2	0	0.0	1	0.2	3	0.6	468	90.3	9	1.7	518	100.0
45-49	1	0.5	2	1.0	12	5.7	0	0.0	1	0.5	3	1.4	189	90.0	2	1.0	210	100.0
50-54	7	3.6	1	0.5	8	4.1	0	0.0	0	0.0	2	1.0	173	89.6	2	1.0	193	100.0
55-59	0	0.0	0	0.0	1	1.6	0	0.0	0	0.0	0	0.0	61	96.8	1	1.6	63	100.0
60-64	1	1.0	0	0.0	2	2.1	1	1.0	0	0.0	2	2.1	90	92.8	1	1.0	97	100.0
65-69	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	100.0	0	0.0	6	100.0
Total	26	0.6	34	0.8	211	5.0	5	0.1	369	8.7	61	1.4	3433	81.0	97	2.3	4236	100.0

Annex 17 Marital status amongst males aged 15+ by age group, Hides, iHDSS, 2013

Age yrs	Single		Married		Separated/ Divorced		Widowed		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
15-19	644	89.9	18	2.5	0	0.0	0	0.0	54	7.5	716	100.0
20-24	503	80.7	104	16.7	3	0.5	0	0.0	13	2.1	623	100.0
25-29	361	50.3	324	45.1	12	1.7	6	0.8	15	2.1	718	100.0
30-34	164	24.6	470	70.6	9	1.4	8	1.2	15	2.3	666	100.0
35-39	54	11.1	419	86.4	6	1.2	2	0.4	4	0.8	485	100.0
40-44	49	8.2	519	86.9	11	1.8	13	2.2	5	0.8	597	100.0
45-49	10	3.8	235	88.7	7	2.6	9	3.4	4	1.5	265	100.0
50-54	4	1.5	242	90.0	6	2.2	13	4.8	4	1.5	269	100.0
55-59	2	2.0	89	89.9	4	4.0	4	4.0	0	0.0	99	100.0
60-64	2	2.1	83	86.5	4	4.2	7	7.3	0	0.0	96	100.0
65-69	1	2.0	38	74.5	2	3.9	10	19.6	0	0.0	51	100.0
70+	0	0.0	33	82.5	1	2.5	5	12.5	1	2.5	40	100.0
Total	1794	38.8	2574	55.7	65	1.4	77	1.7	115	2.5	4625	100.0

Annex 18 Marital status amongst females aged 15+ by age group, Hides, iHDSS, 2013

Age yrs	Single		Married		Separated/ Divorced		Widowed		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
15-19	541	80.3	86	12.8	2	0.3	1	0.1	44	6.5	674	100.0
20-24	300	48.6	296	48.0	9	1.5	3	0.5	9	1.5	617	100.0
25-29	127	18.3	519	74.8	26	3.7	11	1.6	11	1.6	694	100.0
30-34	40	5.6	635	89.7	23	3.2	6	0.8	4	0.6	708	100.0
35-39	14	3.0	409	87.8	23	4.9	17	3.6	3	0.6	466	100.0
40-44	9	1.7	448	86.2	35	6.7	26	5.0	2	0.4	520	100.0
45-49	5	2.4	170	80.6	13	6.2	22	10.4	1	0.5	211	100.0
50-54	4	2.1	153	79.3	11	5.7	22	11.4	3	1.6	193	100.0
55-59	1	1.6	34	53.1	3	4.7	25	39.1	1	1.6	64	100.0
60-64	2	2.1	61	62.9	3	3.1	28	28.9	3	3.1	97	100.0
65-69	1	2.9	22	62.9	1	2.9	11	31.4	0	0.0	35	100.0
70+	0	0.0	12	36.4	0	0.0	18	54.5	3	9.1	33	100.0
Total	1044	24.2	2845	66.0	149	3.5	190	4.4	84	1.9	4312	100.0

Annex 19 Highest educational level attainment amongst males by age group, Karkar, iHDSS, 2013

Age group	No Education		Some Primary		Completed Primary		Some Secondary		Completed Secondary		High School		Vocational		Tertiary		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
5-9	109	12.0	302	33.2	3	0.3	4	0.4	0	0.0	2	0.2	0	0.0	0	0.0	490	53.8	910	100.0
10-14	76	6.4	1,012	85.2	7	0.6	3	0.3	1	0.1	0	0.0	0	0.0	0	0.0	89	7.5	1188	100.0
15-19	19	1.8	944	87.8	53	4.9	38	3.5	4	0.4	0	0.0	1	0.1	1	0.1	15	1.4	1075	100.0
20-24	18	2.0	438	49.2	209	23.5	154	17.3	35	3.9	7	0.8	17	1.9	5	0.6	8	0.9	891	100.0
25-29	28	3.7	303	39.6	193	25.2	149	19.5	42	5.5	11	1.4	23	3.0	11	1.4	6	0.8	766	100.0
30-34	38	5.4	348	49.3	140	19.8	112	15.9	32	4.5	4	0.6	9	1.3	11	1.6	12	1.7	706	100.0
35-39	18	3.2	361	64.2	58	10.3	77	13.7	18	3.2	5	0.9	6	1.1	12	2.1	7	1.2	562	100.0
40-44	16	3.2	332	65.6	40	7.9	70	13.8	21	4.2	1	0.2	5	1.0	9	1.8	12	2.4	506	100.0
45-49	21	5.3	255	64.4	24	6.1	58	14.6	14	3.5	2	0.5	3	0.8	12	3.0	7	1.8	396	100.0
50-54	31	7.8	252	63.5	34	8.6	47	11.8	14	3.5	2	0.5	3	0.8	10	2.5	4	1.0	397	100.0
55-59	17	7.2	148	62.4	18	7.6	20	8.4	21	8.9	3	1.3	2	0.8	6	2.5	2	0.8	237	100.0
60-64	22	10.4	130	61.3	9	4.2	22	10.4	10	4.7	2	0.9	2	0.9	7	3.3	8	3.8	212	100.0
65-69	11	11.1	64	64.6	6	6.1	10	10.1	1	1.0	0	0.0	1	1.0	1	1.0	5	5.1	99	100.0
70+	30	17.6	94	55.3	8	4.7	10	5.9	3	1.8	0	0.0	3	1.8	5	2.9	17	10.0	170	100.0
Total	454	5.6	4983	61.4	802	9.9	774	9.5	216	2.7	39	0.5	75	0.9	90	1.1	682	8.4	8,115	100.0

Annex 20 Highest educational level attainment amongst females by age group, Karkar, iHDSS, 2013

Age group	No Education		Some Primary		Completed Primary		Some Secondary		Completed Secondary		High School		Vocational		Tertiary		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
5-9	68	9.3	265	36.1	4	0.5	4	0.5	0	0.0	2	0.3	0	0.0	0	0.0	391	53.3	734	100.0
10-14	70	6.4	934	85.1	3	0.3	4	0.4	1	0.1	1	0.1	0	0.0	1	0.1	84	7.7	1098	100.0
15-19	28	2.8	838	84.6	65	6.6	38	3.8	3	0.3	0	0.0	1	0.1	0	0.0	18	1.8	991	100.0
20-24	36	4.5	388	49.0	190	24.0	128	16.2	21	2.7	8	1.0	9	1.1	4	0.5	8	1.0	792	100.0
25-29	26	3.7	328	46.9	199	28.4	102	14.6	26	3.7	1	0.1	1	0.1	11	1.6	6	0.9	700	100.0
30-34	13	2.2	377	62.5	98	16.3	70	11.6	27	4.5	1	0.2	0	0.0	9	1.5	8	1.3	603	100.0
35-39	20	3.9	354	68.9	58	11.3	52	10.1	9	1.8	2	0.4	2	0.4	5	1.0	12	2.3	514	100.0
40-44	23	5.1	330	73.2	44	9.8	37	8.2	5	1.1	1	0.2	1	0.2	2	0.4	8	1.8	451	100.0
45-49	28	7.3	286	74.5	18	4.7	25	6.5	11	2.9	0	0.0	3	0.8	5	1.3	8	2.1	384	100.0
50-54	39	11.5	243	71.9	16	4.7	25	7.4	4	1.2	1	0.3	1	0.3	0	0.0	9	2.7	338	100.0
55-59	35	17.1	142	69.3	3	1.5	9	4.4	3	1.5	0	0.0	0	0.0	1	0.5	12	5.9	205	100.0
60-64	30	19.7	99	65.1	3	2.0	4	2.6	5	3.3	0	0.0	0	0.0	0	0.0	11	7.2	152	100.0
65-69	26	28.6	58	63.7	3	3.3	1	1.1	0	0.0	0	0.0	0	0.0	0	0.0	3	3.3	91	100.0
70+	47	27.3	92	53.5	3	1.7	1	0.6	0	0.0	1	0.6	0	0.0	0	0.0	28	16.3	172	100.0
Total	489	6.8	4734	65.5	707	9.8	500	6.9	115	1.6	18	0.2	18	0.2	38	0.5	606	8.4	7,225	100.0

Annex 21 Employment status and occupation amongst males of working age group 15-65, Karkar, iHDSS, 2013

Age group	Professional		Skilled		Unskilled		Military		Student		Unemployed		Subsistence		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
15-19	1	0.1	1	0.1	3	0.3	0	0.0	895	83.6	1	0.1	134	12.5	36	3.4	1,071	100.0
20-24	8	0.9	11	1.3	13	1.5	0	0.0	400	46.0	11	1.3	418	48.1	8	0.9	869	100.0
25-29	14	1.9	17	2.3	18	2.4	0	0.0	86	11.7	12	1.6	582	79.0	8	1.1	737	100.0
30-34	13	2.0	18	2.7	15	2.3	1	0.2	21	3.2	5	0.8	579	87.1	13	2.0	665	100.0
35-39	16	3.0	16	3.0	18	3.4	0	0.0	2	0.4	5	0.9	473	88.6	4	0.7	534	100.0
40-44	23	4.8	22	4.6	16	3.4	1	0.2	4	0.8	3	0.6	401	84.4	5	1.1	475	100.0
45-49	22	6.0	20	5.5	15	4.1	2	0.5	0	0.0	1	0.3	299	81.7	7	1.9	366	100.0
50-54	26	7.2	14	3.9	15	4.2	0	0.0	0	0.0	1	0.3	300	83.6	3	0.8	359	100.0
55-59	16	7.0	14	6.1	3	1.3	1	0.4	3	1.3	0	0.0	188	82.1	4	1.7	229	100.0
60-64	6	3.1	10	5.2	6	3.1	2	1.0	2	1.0	0	0.0	157	81.8	9	4.7	192	100.0
65-69	0	0.0	0	0.0	2	6.7	1	3.3	0	0.0	0	0.0	27	90.0	0	0.0	30	100.0
Total	145	2.6	143	2.6	124	2.2	8	0.1	1413	25.6	39	0.7	3,558	64.4	97	1.8	5,527	100.0

Annex 22 Employment status and occupation amongst females of working age group 15-65, Karkar, iHDSS, 2013

Age group	Professional		Skilled		Unskilled		Military		Student		Unemployed		Subsistence		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
15-19	0	0.0	1	0.1	3	0.3	1	0.1	779	78.8	2	0.2	179	18.1	23	2.3	988	100.0
20-24	7	0.9	5	0.6	8	1.0	4	0.5	241	31.2	7	0.9	496	64.2	5	0.6	773	100.0
25-29	13	1.9	5	0.7	7	1.0	1	0.1	30	4.4	4	0.6	612	90.0	8	1.2	680	100.0
30-34	17	2.9	4	0.7	11	1.9	0	0.0	15	2.5	1	0.2	534	90.5	8	1.4	590	100.0
35-39	10	2.0	2	0.4	8	1.6	0	0.0	4	0.8	0	0.0	470	94.2	5	1.0	499	100.0
40-44	11	2.6	5	1.2	5	1.2	0	0.0	2	0.5	0	0.0	401	93.3	6	1.4	430	100.0
45-49	7	1.9	3	0.8	3	0.8	0	0.0	2	0.6	0	0.0	347	95.6	1	0.3	363	100.0
50-54	6	1.9	3	0.9	6	1.9	0	0.0	2	0.6	1	0.3	299	92.6	6	1.9	323	100.0
55-59	4	2.0	2	1.0	1	0.5	0	0.0	0	0.0	0	0.0	192	96.0	1	0.5	200	100.0
60-64	0	0.0	0	0.0	2	1.4	0	0.0	0	0.0	1	0.7	137	93.8	6	4.1	146	100.0
65-69	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	22	95.7	1	4.3	23	100.0
Total	75	1.5	30	0.6	54	1.1	6	0.1	1,075	21.4	16	0.3	70	1.4	70	1.4	5,015	100.0

Annex 23 Marital status amongst females aged 15+ by age group, Karkar, iHDSS, 2013

Age group	Single		Married		Separated/ Divorced		Widowed		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
15-19	929	86.5	20	1.9	1	0.1	2	0.2	122	11.4	1,074	100.0
20-24	728	81.8	124	13.9	2	0.2	1	0.1	35	3.9	890	100.0
25-29	438	57.2	302	39.4	11	1.4	4	0.5	11	1.4	766	100.0
30-34	201	28.5	474	67.2	12	1.7	3	0.4	15	2.1	705	100.0
35-39	88	15.7	450	80.2	17	3.0	4	0.7	2	0.4	561	100.0
40-44	47	9.3	441	87.0	8	1.6	6	1.2	5	1.0	507	100.0
45-49	30	7.6	338	85.4	17	4.3	5	1.3	6	1.5	396	100.0
50-54	23	5.8	348	87.4	7	1.8	18	4.5	2	0.5	398	100.0
55-59	11	4.6	199	83.6	9	3.8	16	6.7	3	1.3	238	100.0
60-64	11	5.2	164	77.0	11	5.2	20	9.4	7	3.3	213	100.0
65-69	8	8.1	77	77.8	3	3.0	10	10.1	1	1.0	99	100.0
70+	3	1.8	119	69.6	9	5.3	36	21.1	4	2.3	171	100.0
Total	2,517	41.8	3,056	50.8	107	1.8	125	2.1	213	3.5	6,018	100.0

Annex 24 Marital status amongst females aged 15+ by age group, Karkar, iHDSS, 2013

Age group	Single		Married		Separated/ Divorced		Widowed		DK/NA		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
15-19	856	86.4	44	4.1	5	0.5	1	0.1	85	8.6	991	99.7
20-24	433	54.7	300	33.7	33	4.2	3	0.4	22	2.8	791	95.8
25-29	118	16.9	519	67.8	49	7.0	8	1.1	6	0.9	700	93.6
30-34	64	10.6	487	69.1	41	6.8	6	1.0	5	0.8	603	88.3
35-39	23	3.8	443	79.0	29	4.8	13	2.2	6	1.0	514	90.7
40-44	11	2.4	394	77.7	25	5.5	18	4.0	4	0.9	452	90.5
45-49	9	2.3	333	84.1	23	6.0	18	4.7	1	0.3	384	97.4
50-54	11	3.3	263	66.1	22	6.5	36	10.7	5	1.5	337	88.0
55-59	4	2.0	157	66.0	6	2.9	38	18.5	0	0.0	205	89.4
60-64	2	1.3	100	46.9	8	5.3	40	26.3	2	1.3	152	81.2
65-69	0	0.0	60	60.6	2	2.2	29	31.9	0	0.0	91	94.7
70+	3	1.7	62	36.3	4	2.3	100	57.5	5	2.9	174	100.6
Total	1,534	28.4	3,162	58.6	247	4.6	310	5.7	141	2.6	5,394	100.0

Chapter 2

TUBERCULOSIS KNOWLEDGE, ATTITUDE AND PRACTICE AND TUBERCULOSIS SURVEY IN HIRI

Part 1 Tuberculosis Knowledge, Attitude and Practice

Abstract

This Chapter presents key findings from a Knowledge, Attitude and Practice (KAP) survey on tuberculosis (TB). The survey aims at providing evidence for developing interventions to improve the prevention, care, treatment and management of TB in the community.

Participants from Hiri iHDSS had more knowledge and understanding on cause of TB and TB transmission than those from Asaro and Karkar. However, misperceptions were common across the three study sites. For example, TB infection could be through skin contacts, sharing food, using same utensils with TB patients. Approximately 30-40% of respondents did not know how long TB treatment could last for. Importantly, the majority of the population study did not believe in BCG vaccination that could help to prevent TB. Moreover, stigma and discrimination against TB patients and their family are common in the communities.

Material and methods

Objective

Understanding household-level health knowledge, attitudes and practices is essential for effective TB control in PNG. There is a need to (i) evaluate what level of knowledge people have regarding TB, including their belief of the causes of TB illness, (ii) understand what treatment is available, including perceptions of its “curability” and (iii) assess if the key KAP attributes will promote health seeking behaviour and compliance to treatment and care.

This study aims to assess (i) the overall knowledge levels of TB among sampled community members, patients and caregivers, (ii) the perception of TB transmission, treatment and prevention among tuberculosis patients and caregivers and (iii), and the risk factors for TB infection in targeted communities.

Methods

A cross-sectional study was employed where study participants (community members, TB patients and their caregivers) aged 15 years old and over, were randomly selected from the census records of the iHDSS. Sample size calculation was performed with 95% confidence level, 5% confidence interval. The sample sizes from each iHDSS were: 369 for Asaro, 360 for Hiri and 371 for Karkar HDSSs. The study was conducted in Asaro, Hiri and Karkar iHDSS from May 2013 to December 2013.

Surveys with questionnaire interviews were carried out with all the selected name lists generated by the iHDSS census records. Trained nursing officers administered the questionnaire. Questions about TB symptoms, causes of TB, transmission mode, how to cure TB, the prevention method from getting sick with TB and sources of TB health education were asked. The principle investigator checked all forms for their completeness and also conducted a quality checking on the initial answers by re-interviewing 25% of all questionnaires.

Data analysis

All data were doubly entered in Microsoft Access database, STATA 12 (Stata Corp. College Station, TX) was used for data analysis.

Study approval

This study was approved by the Medical Research Advisory Committees (MRAC, No. 10/17). We informed the Central Province Health advisors and the iHDSS community leaders. Informed consent was obtained from participants prior to interviews.

Results

A total of 1034 individuals gave their consent to participate in the survey, i.e. Asaro iHDSS (359), Hiri iHDSS (295), and Karkar iHDSS (380). In the Hiri iHDSS, the participants were from Papa (41); Porebada (109); Lealea (87); and Boera (58). The demographic characteristics are shown in Table 16.

Knowledge and local beliefs about tuberculosis illness and treatment

Most of the participants from Hiri had higher percentages of knowledge of tuberculosis causation (bacteria-79%), transmission (airborne-84%) and risk factors (living with TB patient-85%) and how to reduce transmission (cover mouth while coughing-61%) than those from Asaro and Karkar iHDSS. This level of “higher knowledge” was associated with the higher level of educational attainment observed in Hiri versus the other locations. This finding is consistent with the same observations made in Chapter 1 of this report.

Nevertheless, less than half of the all participants had knowledge about risk factors for TB infection such as living in crowded house, and very few knew about HIV infection as an important cofactor for contracting TB. Less than 10% believed that BCG vaccination could prevent TB illness, as they observed TB illness could happen with all people regardless of BCG vaccination.

The majority from Asaro and Karkar iHDSS participants indicated that they were not aware of the duration of medication treatment that is required, i.e., 6-8 months. The reported response for “duration of treatment” ranged from 1 week to 10 months.

Table 16 Socio-demographic characteristics of study population by site, iHDSS, 2013

	Asaro		Hiri		Karkar		Total	
	N	%	N	%	N	%	N	%
Total	359	34.70	295	28.50	380	36.70	1034	100
Sex								
Male	193	53.76	120	40.68	324	85.26	637	61.61
Female	166	46.24	175	59.32	56	14.74	397	38.39
Occupation								
Subsistence	304	84.68	42	14.24	235	61.84	581	56.19
Student	36	10.03	15	5.08	3	0.79	54	5.22
Home duty	1	0.28	109	36.95	36	9.47	146	14.12
Private employee	6	1.67	79	26.10	67	17.63	152	14.70
Government	10	2.79	16	5.42	27	7.11	53	5.13
Others	2	0.56	11	3.73	9	2.37	22	2.13
Unemployed	0	0.00	23	7.80	3	0.79	26	2.51
Education								
None	146	40.67	5	1.69	28	7.37	179	17.31
Grade 1 - 8	180	50.14	162	54.92	274	72.11	616	59.57
Grade 9 - 12	30	8.36	106	35.93	56	14.74	192	18.57
Tertiary	3	0.84	22	7.46	22	5.79	47	4.55
Marital status								
Never married	67	18.66	40	13.56	31	8.16	138	13.35
Married	258	71.87	230	77.97	291	76.58	779	75.34
Others	34	9.47	25	8.47	58	15.26	117	11.32
Smoking								
No	175	48.75	183	62.03	90	23.68	448	43.32
Yes, at the moment	29	8.08	6	2.03	10	2.63	45	4.35
Yes, sometimes	22	6.13	30	10.17	19	5.00	71	6.87
Yes, all the time	133	37.05	76	25.76	261	68.68	470	45.45
Betel nut								
No	126	35.10	24	8.14	28	7.37	178	17.21
Yes, at the moment	47	13.09	9	3.05	4	1.05	60	5.80
Yes, sometimes	44	12.26	115	38.98	20	5.26	179	17.31
Mean Age	38.7 ± 14.8		39 ± 13.4		44.9 ± 13.6		41.07 ± 14.28	
House size	4.72 ± 1.66		9.64 ± 1.37		4.87 ± 2.21		6.17 ± 3.78	
TB ill at interview	8		14		28		50	
Have family TB history	147 (40.95%)		204 (69.15%)		273 (71.84%)		624 (60.35%)	

Table 17 TB knowledge among population by study sites, iHDSS, 2013

	Asaro		Hiri		Karkar		Total	
	N	%	N	%	N	%	N	%
Total number of participants	359	34.70%	295	28.50%	380	36.70%	1034	100
TB caused by Bacteria	97	27.02	233	78.98	89	23.42	419	40.52
Airborne transmission	119	33.15	247	83.73	269	70.79	635	61.41
Risk factor-Crowded house	75	20.89	126	42.71	132	34.74	333	32.21
Risk factor-HIV infection	24	6.69	43	14.58	19	5.00	86	8.32
Risk factor-Living with TB case	249	69.36	252	85.42	232	61.05	733	70.89
Know duration of Rx	130	36.21	171	57.97	124	32.63	425	41.10
Know Cost of Rx	65	18.11	133	45.08	174	45.79	372	35.98
BCG prevent TB	13	3.62	49	16.61	22	5.79	84	8.12
Cover mouth while coughing	55	15.32	179	60.68	98	25.79	332	32.11

One of the common misperceptions and misunderstandings related to the causes of TB illness were attributions related to addiction to alcohol and/or smoking (29% Asaro; 5% Hiri; 24% Karkar). A common misperception was the belief that TB could be transmitted through sharing food and utensils, i.e., 55% Asaro, 11% Hiri, 31% Karkar. Skin contact with secretions from TB patients was another transmission mode belief, especially when TB patients chewed betel nut, spat saliva on the floor that in turn afforded other people an opportunity to come in contact with the saliva. Though a majority of respondents knew that living with TB patients was the most likely way to get TB infection, 38% of Hiri participants also believed that TB illness was inevitable as it passed on in the family line.

The perception of sorcery or witchcraft as a cause of TB was observed across all sites, particularly in Karkar, i.e., 28% in Karkar, 5% in Asaro, and 3% in Hiri. In an indepth interview about sorcery, respondents felt that witchcraft can make a target person more susceptible and vulnerable to TB illness, or worsen the current TB illness, which can in turn result in death. Most TB patients believed TB treatment would cure them; however, there were reservations about the drug effectiveness, i.e., if recovery was slow, respondents believed it was due to the witchcraft or sorcery.

Table 18 Misperception and misunderstanding on the causes of TB and mode of TB transmission among study population by study site, iHDSS, 2013

	Asaro		Hiri		Karkar		Total	
	N	%	N	%	N	%	N	%
Total number	359	34.70%	295	28.50%	380	36.70%	1034	100
Cause of TB due to								
Smoking/alcohol	104	28.97	14	4.75	91	23.95	209	20.21
Betel nut split	56	15.60	21	7.12	26	6.84	103	9.96
Sorcery and others	18	5.01	8	2.71	105	27.63	131	12.67
DK	84	23.40	19	6.44	69	18.16	172	16.63
TB transmission by								
Sharing food/Lime pot	213	59.33	122	41.36	345	90.79	680	65.76
Inherit in family	23	6.41	112	37.97	32	8.42	167	16.15
Skin contact	40	11.14	52	17.63	44	11.58	136	13.15
DK	20	5.57	6	2.03	20	5.26	46	4.45

Severity and Susceptibility to Tuberculosis

Table 19 Knowledge about TB and attitude toward TB patients by site, iHDSS, 2013

	Asaro		Hiri		Karkar		Total	
	n	%	n	%	n	%	n	%
Total number	359	34.70	295	28.50	380	36.70	1034	100
Knowing TB can kill	354	98.61	278	94.24	374	98.42	1006	97.29
Knowing TB being easily transmitted	318	88.58	257	87.12	350	92.11	925	89.46
Knowing TB as a threat in community	245	68.25	176	59.66	124	32.63	545	52.71
Observing TB associated stigma, discrimination	165	45.96	122	41.36	84	22.11	371	35.88

As showed in Table 19, the majority of participants believed the TB was a severe illness and could kill patients and was easily spread. More than half of participants in Asaro (68.25%) and Hiri (59.66%) thought that TB was a threat to their communities. Over 35% of participants indicated various forms of stigma exist among families and households of tuberculosis patients.

Generally, community members gave some form of support, although care was more confined within the immediate family. Assistance was given not from within close contacts of TB patients, as there was fear of catching the disease. It was common that upon hearing of TB within a family member many respondents expressed both sympathy and fear. In many homes of TB patients, the family members separated eating utensils and food.

Sources of TB health education

Around one third of participants had learned about tuberculosis from health workers. The second most common source of information was through family members and friends. School curriculum is also another main source of TB health education. Only a small number of respondents mentioned TB awareness via NGO groups, radio and IEC materials.

Table 20 Sources of TB information, education and communication by site, iHDSS, 2013

Source of TB information	Asaro		Hiri		Karkar		Total	
	N	%	N	%	N	%	N	%
Total	359	34.70	295	28.50	380	36.70	1034	100.00
Health centres	139	38.72	94	31.86	107	28.16	340	32.88
Posters/pamphlets	49	13.65	31	10.51	41	10.79	121	11.70
School curriculum	35	9.75	93	31.53	38	10.00	166	16.05
TB awareness activities	6	1.67	22	7.46	85	22.37	113	10.93
TV/Radios	3	0.84	10	3.39	3	0.79	16	1.55
Friends / families	102	28.41	42	14.24	84	22.11	228	22.05
DK	25	6.96	3	1.02	22	5.79	50	4.84

Discussion and conclusion

Most of respondents from Asaro and Karkar iHDSS had limited knowledge of the causes of TB and significant misunderstandings about the mode of TB transmission. Similar to a study in Central Tanzania, knowledge and perception of TB illness among communities varied greatly and incorrect views such as TB transmission via sharing domestic utensils were frequent [1]. Such perceptions can be re-enforced by misguided health messages by health providers such as in the Philippines where nurses advised TB patients to use separate eating utensils. While aiming to achieve maximum prevention, such advice resulted in stigmatization of TB patients [2]. Numerous studies pointed out that insufficient understanding of the causes of TB and protection against the disease trigger fear of infection and this fear in-turn influences the attitudes and behaviours of the community when interacting with TB patients by “judging and shaming TB patients” [3,4,5]. The fear of stigmatization and discrimination from their families was a common reason for participants not seeking diagnosis [10].

In order for TB control to be effective and achievable, TB cases need to be detected earlier and cured with DOTS as an effective treatment approach [6]. In line with a study in Vietnam, a better understanding of TB from a biomedical knowledge is associated with high levels of education but not with their health seeking action [7]. Interventions to promote health seeking behaviour among groups/individual with chronic cough are urgently needed.

Existing health education had raised some level of awareness of TB in PNG. However, more specific TB control promotion is needed to link the awareness raised from health education and to better health seeking action. Closer distance from home to health centre, which allows for easier access to healthcare services, is the main factor for patients visiting health centres [8]. A study in China showed that women and elder were less likely to seek health care and/or they sought health with lesser qualified health care providers due to the financial burden [9]. TB treatment and diagnosis in PNG are free of charge and available only at the public health services; however, other costs from seeking health care such travel and lost wages/labour were pointed out by respondents and the their importance as an impediment to seeking care needs to be explored in the PNG context in order to improve the logistics of DOTS delivery.

In particular among PNG males, the delay to seek health care was due to the perception of cough as a minor condition [10]. The first goal for TB health promotion needs to be to get people to recognize that prolonged cough is a serious condition that requires urgent diagnosis and treatment. Once the patients received TB diagnosis and treatment, proper adherence to the treatment is equally important. Future health education messages should therefore aim to improve knowledge, encourage the appropriate health seeking and treatment adherence of TB patients and reduce stigmatization of TB patients in the community. As this study showed that the majority of respondents did not know the duration of treatment. A TB study in Madang found

that when TB patients started feeling better, they would discontinue the treatment. Furthermore, movements of TB patients whilst on treatment, without a proper transfer and follow-up system greatly affected TB treatment adherence and compliance [10].

Comprehensive health education will target and steer family members and community members to be involved in TB awareness. TB awareness should be integrated into the health care system [3, 4, 5]. The existing channel such as health officers and peer groups or school students in community can be mobilized and developed to be part of TB health care partnership.

Nonetheless, health education alone will not be effective for TB prevention and control as long as the PNG rural health system continues to decline. Since 2007, the National Department of Health of PNG has received major funding from the Global Fund to implement DOTS. The training of AFB microscopy in peripheral health level is on-going. This study will serve as guidance in order to improve the DOTS intervention in rural areas. To integrate the active case finding in the TB national control program is needed as well as functional TB diagnosis capacity in rural health settings.

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Part 2 Tuberculosis Active Case Detection Survey in Hiri iHDSS

Abstract

In Papua New Guinea (PNG), Tuberculosis (TB) is a major health problem and ranks as the number one cause of hospital death in 2008 [1]. The TB notification rate from AFB (Acid-Fast Bacilli) smear positive in PNG was 111 per 100,000; therefore, PNG is categorized as a high burden country by World Health Organisation [2]. DOTS TB control strategy was adopted in 1997 in a few provinces but the process towards its full implementation has been slow and inconsistent due to insufficient funding and manpower. In addition, the rural health facilities have deteriorated over several decades including a significant number of closures adding the challenge to the DOTS delivery. Internationally, the DOTS TB control program sets a goal at 70% of case detection and 85% of cure rate, with the aim to decrease the incidence of TB among non HIV-infected people by 5-10% per year [3, 4].

In PNG, only passive case finding of TB patients (i.e. only those who present to health facilities are screened and diagnosed) is adopted. Consequently, the current estimates of TB prevalence in PNG are based exclusively on notification records of TB patients that visited health facilities and received treatments. To-date no active case finding (i.e. actively screen and diagnose targeted populations or high risk groups) studies have been systematically carried out in key high potential disease burden areas where the PNG LNG Project is active, e.g., Hiri villages in the Central province. Therefore, PNGIMR, with support from the PNG LNG Project conducted the first active case detection survey in Hiri in order to determine the actual burden of TB illness in the Hiri iHDSS service areas.

Materials and methods

Study sites

This study was conducted in Hiri iHDSS, Central Province.

Sampling

A cross-sectional survey was carried out in Hiri iHDSS in September 2013 to February 2014. Since the individual is the unit of analysis not the household, the survey targeted the total population of the Hiri iHDSS. A house-to-house survey (covering all ages) was launched in order to detect individuals with cough for more than three weeks or/and who identified themselves as suffering from TB. Three weeks of persistent cough is a standard WHO criterion for possible TB. Those individuals identified as TB patients and were undergoing TB treatment, were reviewed (utilizing their health book) for their TB treatment. IMR also crosschecked patient records in the TB registration at the local health facilities.

Two morning sputum samples were collected from prolonged cough participants on two consecutive days. The specimens were delivered to the PiHP Infectious Diseases Diagnostic POM Laboratory located at UPNG Medical School. Laboratory analysis included Acid Fast Bacilli (AFB) microscopy and reading. All slides were doubly read, the slides in which both results were not "agreed", were sent to the PNGIMR TB lab in Madang for a third reading and confirmation of the results.

All sputum samples were decontaminated according to Petroff's method [5] and GeneXpert assays utilizing the Xpert MTB/RIF kit (Cepheid, Sunnyvale California USA) were performed. The results were recorded in the TB registration book (TB05 form) a reporting system of the National TB control program.

The TB register records at health facilities were reviewed to validate the survey result and to confirm the TB cases that had been diagnosed prior the survey in 2013.

Data Analysis

All data were doubly entered in Microsoft Access database and STATA 12 (Stata Corp. College Station, TX) was used for data analysis.

Study approval

The Medical Research Advisory Committees granted the approval (MRAC, No. 10/17). We informed the Central provincial Health advisors and the community leaders in HDSS. Informed consent was obtained from participants prior to sputum collection and interviews. Results of AFB tests and GeneXpert were made available to all participants who submitted the specimens. Participants with positive results were referred to nearby health facilities for registering and commencing TB treatment.

Results

Summary results are shown in Table 21 below. Data analysis also included confirmed (GeneXpert system) Hiri resident worker data obtained from the PNG LNG Project. These workers were residents of the specific villages included within the Hiri iHDSS.

Table 21 Results from the tuberculosis ACD survey, Hiri iHDSS, 2013

Hiri iHDSS	Number (N=13,310)
Number of villages	4
Total population survey	13,310
Cough for more than 3 weeks	185
Sputum submitted	370
TB diagnosed from this ACD survey*	16
TB cases diagnosed by ISOS (PNG LNG workers)	18
TB rate from ACD in 2013	120/100,000
TB cases from Passive case finding in 2013	34
TB rate from passive case detection in 2013	255/100,000
Total TB cases	68
Prevalence TB rate in 2013	510/100,000
RIF + from GeneXpert	4

* ACD= active case detection

IMR completed the active case detection (ACD) survey in Hiri (covered 100% of 13,310 populations). The TB rate from the ACD survey is presented in the Table above. We detected a high rate of TB in Hiri from the ACD survey (120 or 16/13,310*100,000).

Based on a review of TB records, there were 34 TB cases diagnosed from passive case detection, in addition to 18 TB cases diagnosed at the PNG LNG plant site. Therefore, there were a total of 68 TB cases in Hiri with the prevalence rate of 510/100,000 pop. The passive case detection will detect 34 cases or 255/100,000 population or 50% of total TB cases. Without the ACD survey and the support from the PNG LNG for TB diagnosis from their local staff, the survey would not capture 34 active TB cases.

IMR also detected four cases (6% or 4/68*100), which had RIF positive from GeneXpert, indicated MDR status. IMR has sent these samples for further testing at the Queensland Mycobacterium Reference laboratory in Brisbane to find out the drug resistance profile. IMR registered the three cases at the TB clinic in order to begin second line drug treatment. The case report of the MDR is presented in the Appendix.

A total of 82 suspected TB cases were seen at Hiri clinics in 2013, i.e., 60 were seen at Papa clinic, 13 at Porebada and 9 at Boera clinic. The total number of the prolonged cough was 276 (185 from ACD survey). Eighty-two or twenty-nine percent of the prolonged cough cases sought diagnosis and health care.

Of the 34 active TB cases registered in Hiri clinics, 19 were adult and 15 were paediatrics.

Discussion

We conducted the first active case detection survey in order to investigate the burden of TB illness in Hiri iHDSS. The results of this effort demonstrate a clear need to improve detection rate through a combination of active case detection and passive case detection in order to achieve a TB case detection rate of 70% as outlined in the PNG National TB control plan. The current passive case finding system only detects only 50% of TB cases.

Only 29% of prolonged cough household members sought diagnosis and health care in the Hiri iHDSS catchment. This low utilization of public health centres strongly implies that a significant number of TB cases remained un-detected in these communities. A similarly low rate of health services utilization was seen in rural India where only 23% of prolonged cough patients visited public facilities [6].

While passive case detection could conceivably detect 50% of cases, this level of detection would fall well short of the PNG national TB control target of 70% case detection. While an active case finding with its required high workloads may not be cost effective in low TB prevalence areas [7] some form of active case detection will be required to improve case detection rate in PNG where the current health system is only detecting 50% of new TB cases. Given the extremely high household occupancy rate in Hiri (>9/household) the high level of undetected cases is more than sufficient to continue driving TB transmission,



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Chapter 3

SENTINEL SURVEILLANCE

Abstract

The Environmental and Emerging Diseases Unit (EEDU) at PNGIMR have been leading the sentinel surveillance of febrile, diarrhoeal and respiratory diseases at the four iHDSS sites as part of the Partnership in Health programme.

The diagnostic capacity of the unit continues to be expanded on with more than 60 real-time PCR assays available for use. Inclusion of other febrile, diarrhoeal and respiratory diseases, especially assays for diseases that are termed “neglected”, are currently in the works. This will bring the number of assays to more than 80 by mid 2014.

The chikungunya outbreak reported last year has now “slowed down” with a significant drop in infection numbers. Occasionally, chikungunya cases are reported but nowhere near the level during the outbreak. EEDU also assisted the Morobe Provincial Health Authority and PNG National Department of Health in confirming a Shigella outbreak that occurred in Bulolo, Morobe Province. The outbreak lasted for 3 months between September and November 2013. More than 1,200 people were afflicted with shigellosis, of which 5 (3 children and 2 adults) died from the disease.

Sample collection at all four iHDSS sites are now underway. Construction of various infrastructure needed to facilitate sample collection is now completed or nearing completion. This has allowed us to start sample collection in Hides, Hiri and Karkar Island.

Preliminary results are being collated; however, at the present time numbers are too low to draw definitive conclusions on the current disease burden occurring in the communities at the study sites.

Introduction

Diarrhoeal Illness

Diarrhoeal illness is a serious challenge to developing nations worldwide. Papua New Guinea (PNG) is not exempted from diarrhoeal illness, it being one of the major causes of mortality in PNG. Most diarrhoeal illness is easily preventable with simple hygiene measures and treated with inexpensive treatment regimes. However, with only 40% of the locals have access to safe water supply and adequate sanitation [1], and access to treatment in some regional and remote areas of PNG limited, the burden of diarrhoeal diseases is high.

Recent work by the EEDU, some of which has been conducted with the support of PiHP, has increased our understanding of diarrhoeal aetiology in PNG [2-10]. However much still needs to be done to fully understand diarrhoeal aetiology in PNG, especially in young children. Sustainable build up of capacity to provide accurate diagnosis and assist health workers in providing care and education to communities nation-wide is essential [2].

Febrile Illness

Febrile illness is one of the most common presenting symptoms among patients in hospitals and health centres in tropical developing countries. Due to the large range of causes of febrile illness, diagnosis can be

a challenge especially for poorly equipped health facilities. In locations where malaria is endemic such as PNG, febrile cases are usually tested for malarial parasites by either a rapid test of microscopy. Malaria is given priority due to its severity, especially in children. However, most of the time the causes of febrile illness have been found to be non-malarial. Thus, we continue to investigate non-malarial febrile illnesses that are brought to our attention and contribute to the knowledge base on febrile illnesses in PNG [11-15].

Respiratory Illness

Respiratory illnesses in the form of acute lower respiratory infections (ALRI) continue to be the leading cause of mortality and morbidity worldwide. This is well reflected in PNG, where ALRI is the most common cause of hospitalizations in the first year of life [16].

Viral respiratory illness in PNG has been well characterised by recent publications [17-18], and we have historical data to illustrate the importance of the bacterial pathogens *Streptococcus pneumonia* and *Haemophilus influenza*. However, a detailed understanding of the aetiology of respiratory illnesses in PNG is lacking: while it would be valuable to further investigate the co-carriage of bacterial and viral respiratory pathogens, it falls outside the scope of the current work due to budgetary constraints.

Research on respiratory illness will go on and continued to be reported on by the unit as demonstrated by our ongoing research [18-20].

Materials and methods

Continued testing of retrospective samples using new assays

Retrospective samples used in the past to set up assays for detection of various pathogens will continue to be used for the set up of new assays currently in the pipeline. Assays that will be tested for include soil transmitted helminths, enteric protozoa and various other neglected pathogens.

Development of new assays

New assays are continuously being developed. They include expanding our panel for detection of febrile illnesses and enteric parasites. These include soil transmitted helminths (hookworms, roundworms, tapeworm, strongyloides) and enteric protozoa.

Collection and testing of samples from iHDSS sites

Samples were collected from health clinics participating in the PiHP iHDSS. Patients presenting to the clinics with febrile illness over 38°C were tested for malaria using a commercial rapid test. Regardless of the result, a blood sample was taken for further analysis. If the febrile patient was also showing respiratory symptoms a nasal swab sample was taken for respiratory pathogen screening. Patients presenting to the health clinics with a diarrhoeal illness were asked to provide a faecal sample. If a patient presented with a combination of symptoms (e.g. febrile illness with diarrhoeal and respiratory symptoms) then multiple samples were requested. All of the required sampling materials were provided by PNGIMR including detailed information sheets for the health-care practitioners to complete.

Collection and transport of stool samples

Case definition of diarrhoea- the passing of three or more loose stools (which take the shape of the container), in a 24 hour period. Self collected stool specimens were obtained from patients presenting to participating in iHDSS clinics with acute diarrhoea meeting the case definition. Specimens were labelled appropriately and linked to the iHDSS Morbidity Case Forms for identification of clinical history. Samples were stored at 4°C and transported to the PNGIMR laboratories for further analysis.

Bacterial stool culture and microscopic examination for parasitic pathogens were conducted according to standard procedures. Nucleic acids were extracted from the stool samples using the Qiagen Stool kit and molecular analysis using real-time PCR was conducted for the enteric pathogens listed in Table 22.

Table 22 Real-time PCR assays adopted and evaluated in laboratory for the Sentinel Surveillance study, iHDSS, 2013

Disease	Pathogens	Sample type
Enteric illnesses		
Cholera	Vibrio cholera	Stool sample
Shigellosis	Shigella spp	Stool sample
Salmonellosis	Salmonella spp	Stool sample
Campylobacteriosis	Campylobacter spp	Stool sample
Travellers' diarrhoea	Pathogenic E. coli (EPEC/ETEC)	Stool sample
Rotavirus	Rotavirus	Stool sample
Other enteric viruses	Adenovirus, Norovirus (GI and GII), Astrovirus, Sapovirus	Stool sample
Febrile illnesses		
Dengue fever	Dengue viruses (DENV1-4)	Blood sample
Murray Valley encephalitis	Murray Valley encephalitis virus	Blood sample, CSF
Japanese encephalitis	Japanese encephalitis virus	Blood sample, CSF
Chikungunya fever	Chikungunya virus	Blood sample
Ross River fever	Ross River virus	Blood sample
Typhoid fever	Salmonella enterica Typhi	Blood sample
Leptospirosis	Leptospira spp	Blood sample
Scrub typhus	Orientia tsutsugamushi	Blood sample
Influenza	Influenzavirus A and Influenzavirus B	NP swab
Other viral respiratory pathogens	Respiratory syncytial virus, parainfluenza virus, metapneumovirus, coronavirus, adenovirus, rhinovirus	NP swab
Vaccine preventable diseases		
Measles	Measles virus	Blood sample
Mumps	Mumps virus	Blood sample
Rubella	Rubella virus	Blood sample
Chicken pox	Varicella zoster virus	Blood sample
Diphtheria	Corynebacterium diphtheriae	Throat swab
Whooping cough	Bordetella pertussis	NP swab

Collection and transport of blood samples

Case definition of a febrile illness - a current fever of $\geq 38^{\circ}\text{C}$, OR reports a fever over the past 2 days (but not more than 2 weeks).

Blood samples (8-10ml for adults; 1-5ml for children) and blood culture bottles were collected from patients presenting to participating in iHDSS clinics who met the case definition of a febrile illness. Specimens were labelled appropriately and linked to the iHDSS Morbidity Case Forms for identification of clinical history. Samples were stored at 4°C and transported to the PNGIMR laboratories for further analysis.

Blood culture samples were analysed using standard procedures in the Bactec system. Serum was removed from blood samples and nucleic acids were extracted using the Qiagen DNeasy Blood and Tissue kit. Molecular analysis using real-time PCR was conducted for the febrile pathogens listed in Table 22.

Collection and transport of respiratory samples

Case definition of an acute lower respiratory illness - a history of fever OR measured fever of $\geq 38^{\circ}\text{C}$, AND cough, AND shortness of breath or difficulty breathing

Nasopharyngeal swabs were collected from patients presenting at participating iHDSS clinics meeting the

case definition of an acute lower respiratory illness. Specimens were labelled appropriately and linked to the iHDSS Morbidity Case Forms for identification of clinical history. Samples were stored at 4°C and transported to PNGIMR laboratories for further analysis.

Nucleic acids were extracted from the nasopharyngeal samples using the QIAamp Viral RNA Minikit and tested by real-time PCR for the respiratory pathogens listed in Table 22.

Chikungunya outbreak 2013

Patient samples received from throughout the country with the highest concentrations of chikungunya viral nucleic acids were put into cell culture with the aim of isolating the virus.

Shigella outbreak 2013

We received 11 samples from the PHA of Morobe province and they were screened for *Shigella* spp. by real-time PCR. Isolation was also attempted by bacteriological culture and speciation done by serotyping.

Results

SS Diarrheal illness

Asaro

A total of 15 samples were collected from Asaro between July 2013 and December 2013. However, only 13 were deemed appropriate for testing. Two of the samples were insufficient for nucleic acid extraction and were thus not included. Out of the 13 samples received, 3 had *Shigella* spp. (23.1%) and 1 (7.7%) isolate of *Yersinia pestis*. Parasites were also observed in the samples analysed, where one patient was infected with the roundworm (*Ascaris lumbricoides*) and four had *Giardia* spp. One patient with *Shigella* spp. infection was also co-infected with *Giardia* spp. Molecular testing of Asaro samples by real-time PCR to begin in 2014.

Hides

Sample collection in Hides started in September 2013. A total of 21 stool samples were collected from the study site. Of the 21 samples, 3 (14.3%) had rotavirus detected, two (9.5%) had norovirus, two (9.5%) had *Shigella* spp. and 13 (61.9%) had *Campylobacter* spp. Co-infections observed include two rotavirus/*Campylobacter* spp., one norovirus/*Campylobacter* spp. and 1 *Shigella* spp./*Campylobacter* spp.

Hiri

Sample collection in Hiri started in September 2013. A total of 18 stool samples were collected from the study site. Of the 18 samples, one (5.5%) had rotavirus, three (16.5%) had norovirus genotype 2, 11 (61.1%) had *Shigella* spp. and three (16.5%) had *Campylobacter* spp. Co-infections observed were one norovirus/*Shigella* spp., one rotavirus/norovirus, one norovirus/*Shigella* spp. and one *Shigella* spp./*Campylobacter* spp.

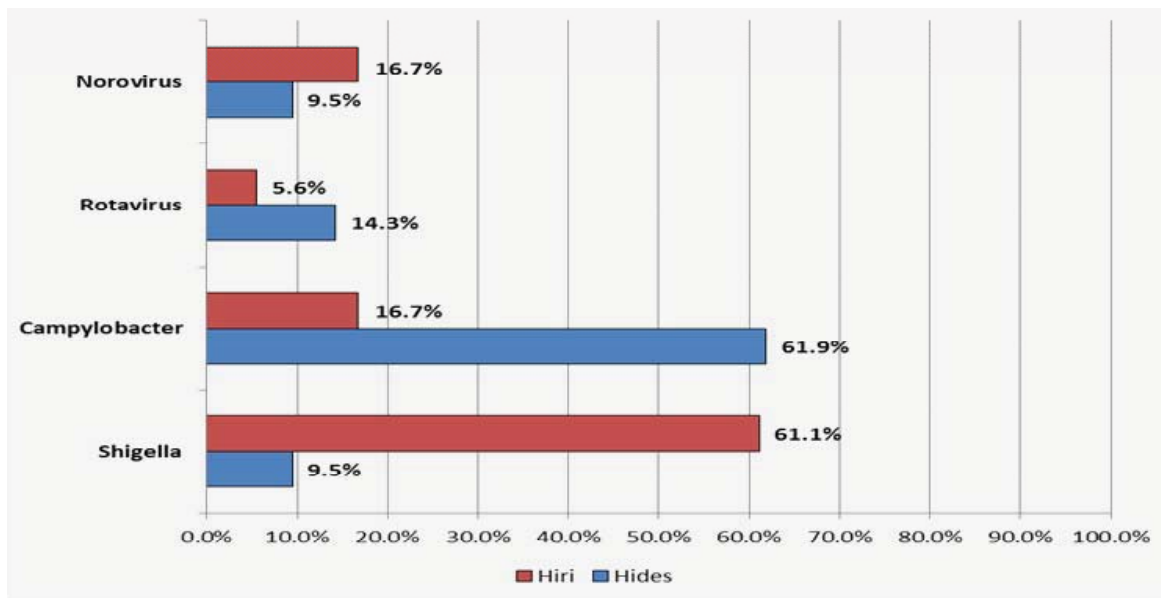


Figure 11 Diarrhoeal causes in Hiri and Hides in the period Sep-Dec 2013, iHDSS, 2013

Karkar

Sample collection on Karkar Island started in December 2013. One stool sample was collected from Karkar Island for diarrhoeal illness. Processing of Karkar Island samples will begin in 2014.

SS Febrile illness

Asaro

Twelve blood samples were collected from Asaro for febrile illness between July 2013 and December 2013. Bringing the total number of samples collected from Asaro for febrile illness to 55 samples since the start of the project. Sample testing by molecular assay have begun. Of the 12 collected between July and Dec 2013, three (25%) were positive for chikungunya virus.

Hides

Sample collection started in September 2013. One blood sample was collected from Hides and was negative for all pathogens tested.

Hiri

Sample collection started in September 2013. Twelve samples were collected in Hiri and were negative for all pathogens tested.

Karkar

Sample collection on Karkar Island started in December 2013. Five samples were collected from Karkar Island for febrile illness. Processing of Karkar Island samples will begin in 2014.

SS Respiratory illness

No respiratory samples were collected from the sites in July to December 2013.

Chikungunya outbreak 2013

To date we have isolated the virus from patient samples in cell culture. A total of eight isolates were obtained from eight provinces i.e. NCD, Madang, Chimbu, West New Britain, Eastern Highlands Province, Morobe, Manus (Manus Island) and Sandaun.

Shigella outbreak 2013

Of the 11 samples tested, 3 were positive for *Shigella* spp. by real-time PCR. Of the three samples that were positive, one was isolated in culture. Serotyping analysis performed by the Bacteriology section of PNGIMR

showed it to be *Shigella flexneri* Type II. These results have been reported to the PHA of Morobe, Angau Hospital in Lae and the NDoH.

Discussion

SS Diarrhoeal illness

We are still performing testing on samples that have been collected and as they come in. Real-time PCR assays are online and have been used to screen for enteric pathogens in samples coming in from Hides and Hiri. Real-time PCR testing of samples collected in Asaro will begin in 2014.

Initial results have demonstrated a very different picture from what was reported before and what is observed at the different sites. Previous work done by Howard et al [21] was however, not replicated by the results we are seeing, even though initial data in our previous report had showed similar prevalences from Hides. The current data showed a high rate of *Campylobacter* spp. (61.9%) infection in Hides and a high rate of *Shigella* spp. (61.1%) infection in Hiri.

The suspected isolation of *Yersinia pestis*, aetiologic agent for the plague, from a patient with dysentery comes as no surprise with the widespread prevalence of rats in PNG. However, this is believed to be the first isolation of *Yersinia pestis* from a human in PNG. Plans are underway to confirm the strain of *Yersinia pestis* isolated.

SS Febrile illness

Samples are starting to arrive and being received for testing and analysis at our labs in Port Moresby and Goroka. However the full panel of results are not yet available as we are trying to implement batch testing to reduce cost. As more results become available, they will be reported accordingly at the next 6-monthly report. Thus far we have not seen any positives for the first-line pathogen panel for febrile illness, except for chikungunya. Even so, chikungunya positives have only been observed in Asaro and not at the other three sites. We have also yet to see any dengue positives either at the study sites, which is highly unexpected.

As we continue to collect samples post-chikungunya outbreak and throughout the year during different seasons, the aetiologic agent detected would be expected to change. Second-line pathogen panel testing is also expected to start in 2014 which will give us a better insight into the current situation.

SS Respiratory illness

Due to the background carriage of the many respiratory pathogens, which may not cause illness in the general populace [22], and significant cut in funding, work on respiratory illness at the study sites has been streamlined. Respiratory illness investigations will be done alongside the influenza surveillance we perform for WHO, where we will investigate outbreaks of respiratory diseases throughout the country. Collection of swab samples from study sites will no longer be conducted, unless there is evidence of an outbreak of a respiratory disease in a study site.

Based on the information in the literature [17] and from our own work [18], continuing with the planned collection of swabs for respiratory illness would not garner us any added information on respiratory illness in PNG, as compared to febrile and diarrhoeal illness. What is needed is better education for the general public on reducing transmission risk and getting appropriate treatment (if available).

Outbreak Response

We were able to provide timely and full laboratory support during the three outbreaks reported here. This increased capacity is as a result of the effort put in by all parties involved including donor organisations, government and provincial agencies such as PHAs, NDoH, DAL and NAQIA in sharing information and putting forward the general health of the populace above everything else.

Towards the year end of 2013, the number of chikungunya cases reported throughout PNG had dropped significantly. This probably signals the end of the outbreak. No chikungunya virus was detected in samples collected from Hiri and Hides. This is probably due to the delays we faced and the samples were collected towards the end of the chikungunya outbreak, i.e. September 2013. Samples from Asaro collected from July to December showed viral presence in samples collected in July only. This reinforces our hypothesis that the outbreak is winding down or has ended. We still, however, expect to see chikungunya cases occasionally as the virus is now believed to be endemic PNG based on evidence from other outbreaks that have happened elsewhere [23]. All eight isolates obtained from 8 provinces during the outbreak will be further worked on to better understand the virus that was circulating.

The sample size received from the *Shigella* outbreak was admittedly very small compared to the scale of

the outbreak that was happening in Bulolo, Morobe Province. Of the 11 samples received, only three were positive, this low number of positives also demonstrates the fastidiousness of *Shigella* as an organism, making it hard to detect them in clinical samples. The shigellosis outbreak highlights the continued need for a sustainable hygiene training programme in place to prevent future enteric disease outbreak.

The chikungunya outbreak was perhaps an opportunity for national agencies, especially those involved in health, to review their modus operandi in the face of a major outbreak [12]. We were able to provide support and early confirmation to the responding agencies, namely NDoH [13]. However it does highlight the many loopholes in inter-agency communication, and the need for better response in the face of emergencies. Our expanded capacity to isolate the virus highlights the success of donors who had contributed to capacity building. The opportunity for training of staff during the outbreak was priceless, as it not only allowed them to put their work into greater perspective, but also the added significance of responding to an outbreak rapidly and providing diagnostic assistance to overburdened health centres, clinics and hospitals on the front lines. With this in mind, an inter-agency team is currently being worked on to respond to future outbreaks. Current interested partners to the initiative include the National Agriculture and Quarantine Inspection Agency (NAQIA) and Department of Agriculture and Livestock (DAL) and the NDoH.

Conclusion

PNGIMR's capacity in responding to outbreaks has been developed well in the last two years. The focus is now to maintain this capacity, while further expanding on our current facilities and response time.

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ANNEXES

List of publications arising from SS related research 2013

In Print

- Jonduo MH, Wong SS, Kapo N, Ominipi P, Abdad MY, Siba PM, McKenzie P, Webby R, Horwood PF. 2013. Surveillance of avian influenza viruses in Papua New Guinean poultry, June 2011 to April 2012. *Western Pacific Surveillance and Response*. 4(4): doi: 10.5365/wpsar.2013.4.4.004.
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- Greenhill A, Siba V, Horwood P. 2013. Reply to 'Apropos "Evaluation of serological diagnostic tests for typhoid fever in Papua New Guinea using a composite reference standard"'. *Clinical and Vaccine Immunology*. 20(2): 318.

In Press (accepted for publication)

- Kas MP, Horwood PF, Laman M, Manning L, Atua V, Siba PM, Greenhill AR. Isolation of *Vibrio cholerae* and other enteric microbiota from patients with suspected cholera in Madang Province, Papua New Guinea. *PNG Medical Journal*. In Press.
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Conference Proceedings

Horwood PF, Dagina R, Bande G, Reimer LJ, Koimbu G, Katusele M, Jimmy S, Ropa B, Siba PM, Pavlin BI. 2013. Virological and entomological investigations into the first outbreak of chikungunya in Papua New Guinea. Australian Society for Microbiology Symposium. Adelaide, Australia.

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Maure T, Soli KW, Kas M, Umezaki M, Morita A, Siba PM, Greenhill AG, Horwood PF. 2013. Aetiology of Paediatric Acute Watery Diarrhoea in Goroka, Papua New Guinea. Biological and Social Sciences Symposium. Lae, Papua New Guinea.

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Chapter 4

MATERNAL AND INFANT HEALTH

Abstract

Background: In PNG, 60-78% of women receives antenatal care and between 37%-53% of births are supervised. Unsupervised, non-health facility birth is a certain determinant for the poor health outcome of both the mother and her infant and in PNG maternal and neonatal mortality rates are high. The overall aim of the Maternal and Infant Health survey is to estimate: the prevalence and causes of maternal morbidity; the uptake of maternal and infant health services; and to investigate women's perceptions and experiences of pregnancy and childbirth in the four PiHP iHDSS locations.

Findings: Completed in two sites, Hiri and Karkar, 377 women were surveyed about their most recent pregnancy. More than two thirds of women attended antenatal care for the recommended minimum of four visits; most women presented in their second trimester.

Overall the standard of antenatal care received did not meet the minimum standard requirements, as outlined by the Department of Health National Guidelines for Antenatal Care. Opportunities to monitor for risk factors in pregnancy were missed, including the opportunity to provide valuable health education about the importance of supervised births.

62% of women gave birth at a health facility, but only 87.5% were attended by a health care worker. 44% of women who gave birth at home chose to do so; other women birthing at home did so because they were unable to reach a health facility due to labour progressing too quickly, or because of financial and transport difficulties.

Just over half of the women knew one or more danger sign in a neonate; 72% of these women knew two or more danger signs. Women in Hiri have better knowledge about at least one danger sign in neonates than those from Karkar, 74% and 34%, respectively.

The majority of neonates were breast fed within the first couple of hours following birth, a practice important for a safer outcome for the neonate, especially given the high proportion of low birth weight infants (14%).

Background

Maternal health refers specifically to the health of women surrounding pregnancy and child birth, that is, antenatal care, care during childbirth and postnatal care. Provision of antenatal care and births attended by skilled birth attendants impacts the survival of both the mother and her infant.

Every year an estimated 342,900 women die as a result of pregnancy and childbirth [1] - 99% of these deaths occur in developing countries, the majority in rural areas with the poorest and most remote areas bearing the burden. 88-98% of all maternal deaths could be avoided [2]; many maternal deaths occur due to poor service provision and lack of access to and use of available services. An estimated 50%-70% of all maternal deaths occur in the postpartum period⁹ - 45% within the first 24 hours following delivery [2].

A maternal death is frequently accompanied by either a stillbirth or early neonatal death. Every year an estimated 3million infants are stillborn -1million of these stillbirths occur during labour [3]. Four million neonate babies die - 3million within the 1st week of life; one million within the first 24hours after delivery [4]. Preterm delivery¹⁰ and low birth weight (LBW¹¹) are important risk factors for neonatal mortality. The majority of the 13million preterm deliveries that take place every year occur in low-middle income countries; 16% of infants in the developing world have LBW; these infants are 20 times more likely to die than heavier babies. 60-80% of all neonatal deaths occur in LBW infants.

Factors associated with maternal death are well documented and there is widespread agreement of the clinical interventions that could avert many maternal and perinatal deaths. If the maternal mortality ratio (MMR) in developing countries is to be reduced there is a need for increased attention to improved health care for women, including provision of high quality pregnancy and childbirth care and emergency obstetric care. Of particular importance is the need to ensure that all births are attended by skilled health professionals; timely management and treatment can make the difference between life and death. In many developing countries the health system is weak and cannot adequately respond to the health needs of mother and neonate due constraints including inadequate skilled attendants, lack of equipment, medications and supplies and a poor referral system.

Poor women in remote areas are the least likely to receive adequate health care during pregnancy and childbirth. Not least of the challenges related to maternal mortality is the fact that in many developing countries a significant proportion of births are carried out in homes, often in rural settings and largely assisted by a family member or a traditional birth attendant (TBAs).

Maternal and infant health in PNG

The social and geographical diversity, together with poor infrastructure can mean substantial barriers and constraints, especially in terms of provision of health care for many people in Papua New Guinea (PNG). Accurate estimations of morbidity and mortality in PNG are hampered by insufficient surveillance and reporting systems [5]; the overall health status of Papua New Guinean people is reported to be the lowest in the Pacific region.

Health indicators for maternal and neonatal health in PNG are poor. Between 60-78% of women receive any antenatal care (ANC) from a health professional [6,7] with just over half of all women receiving the recommended four antenatal visits [8]. Tetanus Toxoid coverage for pregnant women is 69% [6] - a reflection of a poor delivery service [5] leaving a large proportion of women and their unborn infants unprotected against tetanus.

PNG has the second highest MMR in the Asia-Pacific region and one of the highest in the world with an estimated 733 deaths per 100,000 live-births, a figure attributable to deterioration in rural health services coupled with poor uptake of available health services [5]. Between 37%- 53% of births are attended by a health professional [6,8]; 7% of women birthing at home are attended by a relative; 4% by a village birth attendant and 7% report birthing alone. Complications during childbirth, including prolonged labour, excessive bleeding and convulsions are high [6]. Unsupervised, non-health facility births are a certain determinant for the poor health outcome of both the mother and her infant [9].

While improvements have been seen in the Under-5 mortality rates in PNG, the neonatal mortality rate (NMR) remains relatively unchanged and high at 29 per 1,000 live births [6]. In rural facilities neonatal sepsis is one of the leading causes for admission accounting for 3.3% of all admissions; it is also one of the leading causes of mortality, accounting for 7.8% of all deaths in rural facilities in 2008 [8]. In PNG 10% of infants are of low birth weight, a significant risk factor for poor neonatal outcome, including mortality.

PNG is a signatory to the Millennium Development Goals (MDGs). While indicators towards MDG4

⁹The postpartum period: the period of time from approximately one hour after delivery of the baby up to 42 days after the birth of the infant.

¹⁰Pre-term delivery - delivery before 37 completed weeks of pregnancy

¹¹Birth weight less than 2.5 kg at delivery

(reduce child mortality) are slowly improving, MDG5 (Improve maternal health) is lagging behind and PNGs commitment to achieving progress towards MDG5 is clearly under threat [5]. There is an urgent need to focus and prioritise maternal and child health (MCH) in PNG if we are to begin to work towards achieving the MDGs. While the wider issue of health systems is addressed there is a need to address what can be done for women and their infants at the more local level. Considering the geographical and cultural diversity in PNG and access, uptake and availability of professional skilled health care during pregnancy, childbirth and the postpartum period, research that highlights specific constraints and problems women experience could add valuable information to this much needed area of health.

One of the overarching aims of the PNG LNG Partnership in Health Project (PiHP) is to monitor the impact of the PNG LNG project on the health of the population in both impact and control communities. The PiHP has provided an ideal platform for further research allowing the opportunity to gain specific information relating to maternal and infant health in each of the four study sites. The opportunity has allowed the research team to obtain information relating to barriers in accessing maternal and child health services and provide insight into current beliefs, practices and experiences surrounding pregnancy, childbirth and the postpartum period.

As a sub-study of this wider PiHP the overall aim of the Maternal and Infant Health survey is to estimate the prevalence and causes of maternal morbidity; the uptake of maternal and infant health services; and to investigate women's perceptions and experiences of pregnancy and childbirth at four sites in Papua New Guinea (PNG). The key objectives of this study are:

Primary Objectives

1. To estimate the prevalence of maternal morbidity (adverse health outcomes during pregnancy, labour, birth and the postnatal period);
2. To estimate the proportion of women who have supervised births.

Secondary Objectives

1. To identify women's experiences of antenatal care and their adherence to the advice and treatment provided;
2. To identify where women give birth and the decision-making processes relating to place of childbirth;
3. To explore women's experiences, perceptions and beliefs surrounding place of birth;
4. To identify the factors that hinder women's access to health care services during pregnancy, childbirth, and the postnatal period;
5. To identify women's experience and knowledge regarding care of the neonate infant.

Materials and Methods

Following the completion of the demographic and health survey in each of the four surveillance sites (Hides, Hiri, Asaro and Karkar Island) a sampling framework was developed. This cross sectional survey is to be conducted among 1000 women aged 15 – 44 years across all four demographic surveillance sites (200-250 women per site), following the baseline demographic surveillance, and subsequent follow-up survey phase. To date data collection for two of the four sites has been completed: Hiri district (Central Province) and Karkar (Madang Province). The survey was conducted among women who have given birth within the time frame that PiHP (2010 to 2013) and who are registered in the census with individual identity numbers within the PiHP demographic surveillance database. In order to reduce the risk of recall bias, we initially identified women based on their report of being pregnant at the most recent demographic update, that is those reporting being pregnant during late 2012 and early 2013. In order to reach our sample size it was necessary to extend the sample size to women who had given birth during 2012, 2011, 2010, but who still met the criteria for having individual identity numbers within the PiHP demographic surveillance database.

Women selected for inclusion were visited in the community by a trained member of the IMR research team who gained consent following completion of study-specific informed consent procedures. Participants were interviewed in *tok pisin* using a piloted, study-specific semi-structured questionnaire. Interviews took place in the women's own home, unless they requested for it to be undertaken elsewhere. Each interview took between 20-40 minutes to complete. Data collection took place between September and December 2013.

All surveys were completed using the iHDSS identity number. No subject names or other identifiers were recorded or stored in the same database as the completed survey forms. All surveys were entered into an MS Access database by members of the PiHP data entry team, all data was cleaned by the data manager prior to extraction in an excel spread sheet for review of the data. This report highlights the data collected for two sites: Hiri and Karkar. A brief description of this data is provided, by each site and combined.

This study was approved by the Medical Research Advisory Committee (MRAC) in Papua New Guinea

and from the Behavioural & Social Sciences Ethical Review Committee (BSSERC) at the University of Queensland (UQ) in Australia.

Findings

A total of 426 mothers were surveyed between September and December 2013: 198 in Hiri district and 228 in Karkar. Forty nine (49) surveys were excluded due to inaccurate identity number, or incomplete data. The data presented in this report relates to the remaining 377 women: 173 women from Hiri and 204 from Karkar.

Table 23 Socio-demographic data, Hiri and Karkar, iHDSS, 2013

	Hiri N= 173		Karkar N=204		Total N=377	
	n	%	n	%	n	%
Age group						
15-19	12	7.0	14	7.0	26	7.0
20-24	50	29.0	54	26.0	104	27.5
25-29	59	34.0	58	28.0	117	31.0
30-34	32	18.0	39	19.0	71	19.0
35-39	16	9.0	24	12.0	40	11.0
40+	4	2.0	12	6.0	16	4.0
N/K	0	0	3	1.0	3	0.5
Marital status						
Married	165	95.0	181	89.0	346	92.0
Single	7	4.0	3	1.0	10	2.5
Separated	1	1.0	16	8.0	17	4.5
Widow	0	0	2	1.0	2	0.5
N/K	0	0	2	1.0	2	0.5
Employment						
No paid job	6	3.0	1	0.5	7	2.0
Subsistence farmer	0	0	21	10.0	21	5.5
HH duties/housewife	145	84.0	180	88.5	325	86
Teacher	1	0.5	1	0.5	2	0.5
security guard	1	0.5	0	0	1	0.25
Other	20	12.0	0	0	20	5.0
N/K	0	0	1	0.5	1	0.25
Educational level						
No formal education	1	1.0	2	1.0	3	1.0
Primary school only	71	41.0	158	77.0	229	61.0
Secondary school	94	54.0	39	19.0	133	35.0
Technical college	0	0	5	2.0	5	1.0
Tertiary/ vocational level	4	2.0	0	0	4	1.0
University level	3	2.0	0	0	3	1.0

Socio-demographic history

The majority of women surveyed were aged between 20-29 years; 26 women (7%) were aged 15- 19 years (Table 23). Most women (92%) were married or living as married. 86% of women reported their occupation as housewife/ carrying out house hold duties. Twenty women from Hiri district reported being in paid employment, the majority of these employed either through the LNG project or the LNG/PiHP/PNGIMR programme. Women living in Hiri were more likely to have attended secondary school, compared to those living in Karkar (54% and 19% respectively). Twelve women (3%) reported having attended vocational, tertiary level education or university; the three women who reported having attended university were all from Hiri. More details on socio-demographic characteristics of the study population are presented in Chapter 1.

Obstetric history

Just over half of the women surveyed (55%) had given birth once or twice previously; 15% had given birth five times or more. Just under half (43%) of the 377 women gave birth to their last infant in 2013; 4% had given birth in 2010 (Table 24). The data presented in this report relates to each woman's most recent birth experience.

Antenatal care

Overall, 94% of women reported attending for antenatal care during their most recent pregnancy. Most women attended for the first time during their second trimester, between three and six months of pregnancy (Table 24). More than two thirds of women attended antenatal clinic four or more times, with a higher proportion seen in the women from Hiri, compared to Karkar (Table 24). Most women attended antenatal clinic at the health centre or aid post (data now shown). Thirty six women from Hiri reported being enrolled into the "healthy pregnancy study" – a sub study within the PiHP/PNGIMR programme which was conducted in Hiri district between 2012 and 2013.

Table 24 Obstetric history, Hiri and Karkar, iHDSS, 2013

		Hiri N= 173		Karkar N=204		Total N=377	
		n	%	n	%	n	%
Parity	1	53	30.5%	63	31%	116	31%
	2	48	28%	43	21%	91	24%
	3	30	17%	38	19%	68	18%
	4	19	11%	24	12%	43	11%
	5	10	6%	18	9%	28	7%
	>5	13	7.5%	18	9%	31	8%
Last birth							
Year of birth	2013	74	43%	88	43%	162	43%
	2012	53	31%	53	26%	106	28%
	2011	44	25%	50	24.5%	94	25%
	2010	2	1%	13	6.5%	15	4%
Location of birth	HC/Hospital	115	66%	118	58%	233	62%
	Village	58	34%	86	42%	144	38%
Type of birth	Normal/vaginal	167	96.5%	202	99%	369	98%
	Caesarean section	5	3%	1	0.5%	6	1.5%
	Vacuum extraction	1	0.5%	1	0.5%	2	0.5%
Outcome of infant	Stillbirths	1	1%	1	0.5%	2	0.5%
	Alive now	172	99%	203	99.5%	375	99.5%

At the antenatal clinic, only 95% of women had an abdominal palpation; 94% had fetal heart auscultation and 88% had their blood pressure monitored (Table 25). Less than half of all women had any blood test, of those who did have a blood test, 33% did not know what the test was for. Women were more likely to be tested for HIV and syphilis than have to haemoglobin estimation. Coverage for tetanus toxoid, malaria prophylaxis and provision of iron supplements was around 80% for both sites combined. Women frequently stated that they did not take all the tablets provided, often because they did not feel they were necessary or because the tablets made them feel nauseated (data not shown). While just over half of all women received a mosquito net, less than half of the women in Karkar were provided with one. Three quarters of all women were asked about their general health during their antenatal consultation and received information relating to the importance of a supervised birth.

Table 25 Antenatal care, iHDSS, 2013

		Hiri N= 167		Karkar N=186		Total N=353	
		n	%	n	%	n	%
Gestation at 1st AN visit							
	< 3 months	5	3%	1	1%	6	2%
	3-6 months	132	79%	121	65%	253	72%
	6-9 months	29	17%	56	30%	85	24%
	Not known	1	1%	8	4%	9	2%
Number AN visits							
	1	6	4%	8	4%	14	4%
	2	10	6%	17	9%	27	8%
	3	22	13%	36	19%	58	16%
	4	29	17%	57	31%	86	24%
	>4	100	60%	59	32%	159	45%
	Not Known	-	-	9	5%	9	3%
Care received at ANC							
	BP	152	91%	160	86%	312	88%
	Urine test (protein/sugar)	36	21%	24	13%	60	17%
	Blood test	89	53%	63	34%	152	43%
	Hb/HIV/HIV, Hb	20	22%	22	35%	42	28%
	HIV, Syphilis	45	53%	4	6%	49	32%
	Don't know	24	27%	27	43%	51	33%
	Blank field	0	-	10	16%	10	6%
	Palpation	158	95%	179	96%	337	95%
	Auscultation fetal heart	158	95%	174	93.5%	332	94%
	Checked for oedema	106	63%	131	70%	237	67%
	Asked about general health	131	78%	137	74%	268	76%
	Tetanus toxoid	147	88%	143	77%	290	82%
	Malaria prophylaxis	128	77%	153	82%	281	80%
	Worm tablets	45	27%	75	40%	120	34%
	Fefol (iron tablets)	138	83%	152	82%	290	82%
	Received a mosquito net	107	64%	88	47%	195	55%
	Advised where to give birth	115	69%	161	86.5%	276	78%

Last birth experience

Most women (98%) reported a normal, vaginal birth; two had caesarean sections and two had assisted vaginal births (Table 26). Five women gave birth to twins; four from Karkar and one from Hiri (data not shown). Two women reported stillbirths – both gave birth in the home; both infants were born at term, that is, between eight and nine months gestation.

Sixty two percent (62%) of women reported giving birth in a health facility, either an aid post, health centre or hospital. All those who gave birth in a health facility had wanted to give birth there, although six women would have preferred the hospital rather than the health centre and one woman wanted a health centre birth but was taken to the hospital. Women sought a health facility birth because they felt it was the safest place to give birth or because they were advised to do so at the antenatal clinic. A few women mentioned being advised to go there by their husbands.

Table 26 Location of birth and support during birthing, iHDSS, 2013

	Hiri N=173		Karkar N=204		Total N=377	
	n	%	n	%	n	%
Health facility births						
All HF births	115	66%	118	58%	233	62%
Assistance during birth						
Assisted at time of birth	107*	93%	118	100%	225	96%
Assisted by health care worker	95	89%	109	92%	204	87.5%
Male HCW	20	21%	7	6%	27	13%
Female HCW	72	76%	102	94%	174	85%
Student nurse	3	3%	0	0%	3	2%
Female relative/friend/VBA	8	7%	8	7%	14	7%
Husband	1	1%	0	0%	1	0.5%
Blank field/Assistant unknown	3	3%	1	1%	4	1.5%
Births in the village/community						
All community/village births	58	34%	86	42%	144	38%
Chose to give birth there	26	45%	37	43%	63	44%
Assistance during birth						
Assisted at time of birth	51	89%	78	91%	129	89.5%
Female relative	31	61%	53	68%	84	65%
Husband only	2	4%	2	2.5%	4	3%
Sister/friend	6	12%	14	18%	20	15.5%
CHW/NO in community	1	2%	2	2.5%	3	2%
VBA/VBA & relatives	11	21%	7	9%	18	14%
Nobody (was alone)	1	2%	8	9%	9	6%
Blank field/assistant unknown	6	10%	0	0%	6	4%

*8 births took place at POM general unassisted by anybody.

Of the 233 women who gave birth in a health facility, 96% were assisted during their birth, of whom 87.5% were assisted by a health care worker; 15 (7.5%) women reported being assisted by a relative or friend in the health facility (Table 26). Eight women who gave birth at Port Moresby hospital gave birth alone, a health care worker tending them after the birth of the baby, to cut the umbilical cord. Of the 144 women who gave birth in the community, 44% wanted to give birth there. The main reason for giving birth at home was because it was convenient and their choice. However, for some women there was more than one reason to birth at home, including: things were progressing too quickly; not enough time to get to a facility; lack of money for hospital fees and transport; lack of transport. A few women stayed at home because they were afraid of the health care workers- either because of a fear of exposing their body or because they had not attended antenatal care and were afraid of being scolded. Other women mentioned no guardian to take care of them at the facility or no relative to take care of other children in the home, hence their reason for staying back.

Nearly 90% of women birthing at home were assisted during childbirth; the majority (80.5%) assisted by a female relative or friend. A village birth attendant was present at 14% of all births in the community (Table 26). A small proportion of women gave birth while on their way to the health facility – two gave birth in vehicles, one birthed on the beach while waiting for a vehicle and one gave birth just outside the family home. Of the women who birthed in the village but had not wanted to, the main reason was due to insufficient time to get to the facility in time, for many the baby came much quicker than expected. A few women mentioned difficulty with fees for both hospital and transport and the issue of transport, especially during the night. Two women were sent home in false labour, giving birth that same evening at home.

Neonatal outcome and care

Overall 14% of neonates were of low birth weight and nearly half (48%) were between 2.5-3 Kg (Table 27). While most neonates (52%) were breast fed immediately following birth, or within 1-2 hours after birth (21%), 9% were not breast fed until more than 6 hours after they were born.

Just over half (52.5%) of all women knew some danger signs in the neonate; 72% of these women knew two

or more danger signs. The most frequently mentioned danger sign was fever, followed by crying too much (Figure 12). Overall, women's knowledge of danger signs was poor and was frequently only own due to past experience of sick infants.

Table 27 Birth weight, feeding and neonatal danger signs, iHDSS, 2013

	Hiri N=165		Karkar N=112		Combined N= 277*	
	n	%	n	%	n	%
Birth weight**						
<2.5 kg	19	11.5%	20	18%	39	14%
2.5-3.0 kg	77	46.5%	56	50%	133	48%
3.05-3.5kg	52	31%	29	26%	81	29%
3.05-4 kg	14	8%	7	6%	21	8%
> 4kg	3	2%	3	3%	6	2%
N/K	8	-	92	-	100	-
	Hiri N=173		Karkar N=204		Combined N= 377*	
	n	%	n	%	n	%
Time between birth and first breast feeding						
Immediately	112	65%	86	42%	198	52%
1-2 hours	14	8%	64	31%	78	21%
2-6 hours	17	10%	25	12%	42	11%
6-12 hours	4	2%	5	2%	11	3%
>12 hours	15	9%	7	3%	22	6%
Never breast fed	3	2%	2	1%	5	2%
Don't know	9	5%	15	7%	24	6%
Recognising danger signs in neonate						
Knew any danger signs	128	74%	70	34%	198	52.5%
Knew 1 danger sign	30	23.5%	24	34%	54	26%
Knew 2 or more danger sign	98	76.5%	45	64%	143	72%
Danger signs mentioned	0	-	1	1%	1	1%

* 377 women gave birth to 382 infants (5 sets twins); there were 2 stillbirths.

** Birth weights calculated on available birth weights only

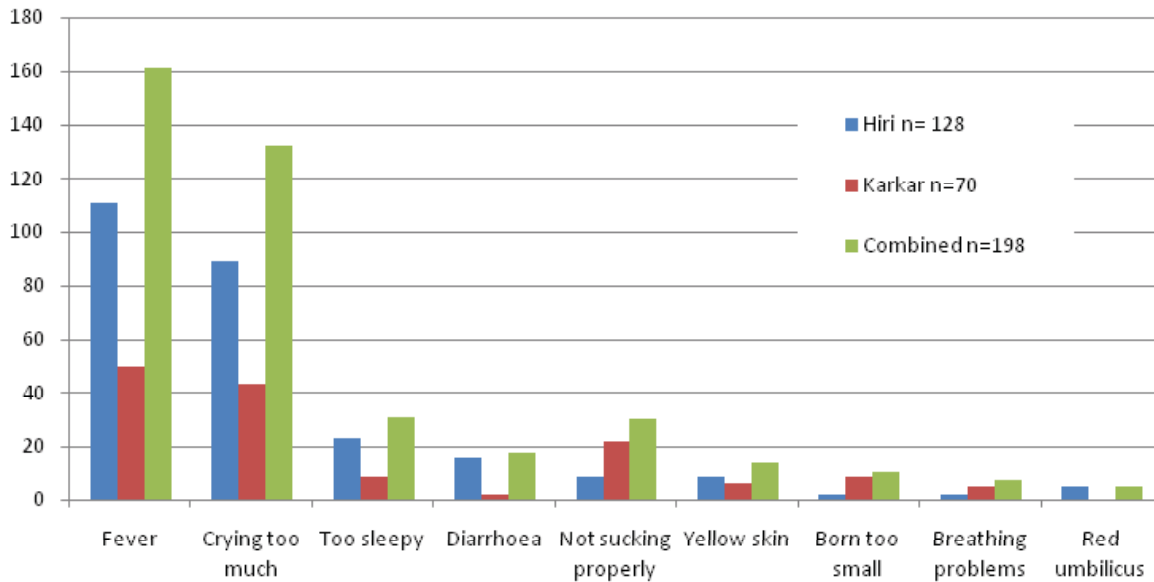


Figure 12 Women's knowledge of danger signs in neonates, iHDSS, 2013

Conclusion

Overall the data from these two sites highlights that the majority of women do attend for antenatal care with more than two thirds attending for the recommended minimum of four visits. Compared to those in Karkar, women in Hiri district were more likely to attend in the second trimester and attend more often. This may be due to their overall education level or due to access to the health facilities.

Overall the standard of antenatal care does not meet the minimum standard requirements, as outlined by the Department of health national guidelines for ante natal care; our findings suggest that women are not receiving the full range of ante natal care services in these two sites. The opportunity to monitor for risk factors in pregnancy, including anaemia, HIV, sexually transmitted infections and pre-eclampsia are being missed. In addition women and their unborn and infant are at increased of pregnancy complications, such as malaria due to poor issuing of mosquito nets and anti-malarials. The opportunity to provide valuable health education about the importance of supervised births is also not being exploited fully.

Nearly two thirds of women (62%) are choosing to attend a health facility to give birth. However, a small proportion of women are birthing alone at the facility; others are giving birth in the facility with support from an untrained family member.

Many women chose to birth at home simply because it was an easy choice to make. While for many other women wishing for a supervised birth they were hindered from reaching the facility because the labour progressed too quickly or because of financial and transport difficulties.

Just over half of all the women knew one or more danger sign in a neonate. Women in Hiri were more likely to know more danger signs when compared to women from Karkar. Three quarters of neonates were breast fed within the first couple of hours following birth, a practice important for a safer outcome for the neonate, especially given the proportion of low birth weight infants. Higher rates of low birth weight were noted in Karkar, compared to Hiri but there were more missing data relating to birth weight from the Karkar site which may account for this.



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Chapter 5

NON-COMMUNICABLE DISEASE AND ASSOCIATED RISK FACTORS

Abstract

This Chapter reports progress on a PiHP sub-study that aims, among other things, to establish the prevalence of selected non-communicable diseases (NCDs) and associated risk factors in the four HDSS. The 'Phase One' recruitment target is 300 adults (15-64 years old) and 100 children (6 months - <5 years) per HDSS, resulting in an overall sample of 1200 adults and 400 children. A total of 412 Adults and 57 children had been recruited as of December 31st, 2013. Key preliminary findings include the detection of: high blood pressure in 44.3% to 61.5% of adult participants across HDSS; high blood glucose in 12.2% to 39.4% of adult participants across HDSS; and elevated cholesterol and triglycerides in 26.4% to 47.1%, and 25% to 64.2% of adult participants, respectively. The current data indicate an immediate need for public health intervention including screening and IEC (information, education and communication) programs within Hiri iHDSS and NCD prevention and health promotion programs across all iHDSS sites. The data from Asaro and Karkar HDSS are most likely to be representative of NCD burden (and NCD risk) in rural communities across PNG, underlying their critical public health value as longitudinal surveillance sites.

Introduction

The rationale, aims and methodology of the PNG NCD study were fully described in a previous report on the PiHP [1]. To briefly summarize, non-communicable diseases (NCDs) are a leading cause of morbidity and mortality throughout the world [2,3] and are expected to increase in prevalence in Papua New Guinea (PNG) as a result of the current development boom. The PNG-specific evidence-base is insufficient to reliably identify the prevalence of NCDs across the country. Nor is there the capacity within the current health system to monitor the expected rise in NCD prevalence and associated risk factors. Accordingly, the aims of the PNG NCD Study are to:

1. Establish a baseline data set to determine among people living in two diverse study sites across PNG that are directly impacted by the PNG LNG project, and also in two non-impacted comparison sites:
  - a) the prevalence of selected NCDs (namely diabetes mellitus type 2, hypertension, acute coronary syndrome, stroke, chronic lung diseases and cancers) and associated lifestyle risk factors;
  - b) dietary habits and food security; and
2. Establish a surveillance system for longitudinal monitoring to detect any changes in the prevalence of NCDs and associated lifestyle risk factors, and also any changes in dietary habits and food security, among the four study sites.

It is anticipated that the study will provide a platform from which subsequent changes in NCD burden and their associated risk factors may be readily identified and appropriate public health interventions and policies developed and deployed in a timely manner.

The initial recruitment target (Phase one) is 300 Adults (15-65 yrs) and 100 Children (6mths – 5 yrs) per integrated Health and Demographic Surveillance System (iHDSS), resulting in a final sample size of 1200 Adults and 400 Children. A sample of this size will be sufficient to reliably calculate the prevalence of target NCDs and associated risk factors at the population level (combined iHDSS samples) and between project

impact (combined Hiri and Hides iHDSS samples) and comparison sites (combined Karkar and Asaro iHDSS samples). Pending additional funding, a second phase of recruitment will be conducted to achieve the preferred sample size of 1200 adults and 400 children per iHDSS (total sample: 4800 adults, 1600 children). A sample of this size will allow site-, age- and sex-specific analyses. Table 28 presents the number of participants recruited per iHDSS as of December 31st, 2013.

Table 28 Participant recruitment in the PNG NCD Study by HDSS, 2013

HDSS	Date Commenced	No. Participants Recruited		Total
		Adults	Children	
Hiri	April, 2013	151	27	178
Asaro	May, 2013	137	16	153
Hides/Komo*	July, 2013	25	2	27
Karkar Island	June, 2013	99	12	111
Total	-----	412	57	469

* Recruitment was postponed shortly after commencement due to an ongoing inability to store and process blood samples at the PNGIMR laboratory in Hides. It is anticipated that recruitment will recommence in February, 2014.

As shown in Table 28, phase one adult and child recruitment targets were 34.4% (412/1200) and 14.3% (57/400) achieved by December, 2013, respectively. Substantial impediments were experienced in participant recruitment across all sites, primarily relating to site access (especially in early morning and evenings), local disruptions (e.g. LLG elections) and participant access (e.g. unavailability of participants in paid employment). The study team have identified a range of strategies to overcome many of the commonly experienced impediments and it is anticipated that the phase one recruitment targets will be achieved within the 2014 calendar year (although potentially at different times across sites).

Findings

The PNG NCD Study involves the collection of a wide range of anthropometric, biological and self-reported lifestyle and health data as outlined in a previous report [1]. It is anticipated that multiple analyses, inclusive of inferential statistics examining the relationship between relevant individual, household and community level variables and NCD risk, will be conducted at the completion of phase one data collection. In the meantime, what follows is a preliminary descriptive analysis of selected variables from the Adult sample. The analyses were conducted on incomplete and uncleaned datasets available as of February, 2014. The findings may not be reflective of the general adult populations at each iHDSS and should be interpreted with some caution. Preliminary data on the child population will be presented in future reports.

Sample Characteristics

The age and sex characteristics of the preliminary adult sample are presented in Table 29. As shown, the sex ratio is relatively even, but participants in the 15-29 years of age category are currently underrepresented and participants in the 45-65 years of age category somewhat overrepresented (according to sample stratification).

Table 29 Age and sex characteristics of preliminary sample by iHDSS and overall, 2013

Characteristic		Hides	Hiri	Asaro	Karkar	Overall
		(n=0)	N=145 (%)	N=133 (%)	N=104 (%)	N=382 (%)
Age	15 - 29 yrs	-	40 (27.6)	35 (26.4)	18 (17.3)	93 (24.4)
	30 - 44 yrs	-	45 (31.1)	51 (38.4)	44 (42.3)	140 (36.7)
	45 - 65 yrs	-	60 (41.4)	47 (35.4)	42 (40.4)	149 (39.0)
Sex	Male	-	52 (35.9)	73 (54.9)	52 (50.0)	177 (46.4)
	Female	-	93 (64.1)	60 (45.1)	52 (50.0)	205 (53.6)

Food consumption and substance use

The self-reported frequency of specified food consumption by iHDSS site and overall is presented in Table 30. When answering, all participants were asked to consider food consumed during a typical week over the month prior to survey. Variation in diet is evident across the three iHDSS reported. In particular, vegetable consumption is low in Hiri iHDSS relative to Asaro and Karkar whereas protein consumption is low in Asaro compared to Hiri and Karkar. It is worth noting that the inter-quartile range for salt consumption in the Karkar iHDSS was seven, indicating participants reported either nil salt use or salt use every day.

Table 30 Self-reported frequency of specified food consumption by iHDSS and overall, 2013

During a typical week, on how many days do you eat/drink	Median No. of days consumed				
	Hides (n=0)	Hiri (n=145)	Asaro (n=133)	Karkar (n=104)	Overall (n=382)
Root vegetables/banana	-	2	7	7	7
Greens or other vegetables	-	1	6	7	5
Fruit	-	2	2	0	1
Fresh meat	-	5	1	7	2
Tinned meat	-	3	2	0	2
Fried food purchased from shop	-	0	1	0	0
Fried food cooked at home	-	2	3	0	2
Soft drinks	-	1	1	0	0
Salt added to food	-	7	7	0	7

The self-reported frequency of tobacco, *buai* and alcohol consumption by iHDSS and overall is presented in Table 31. Reference periods varied by substance type including current and daily use for tobacco, use over 30 days prior to survey for *buai* and use over prior 12 months and 30 days for alcohol. The tobacco, *buai* and alcohol questions were introduced approximately three months after the survey commenced; thus, the sample sizes are lower. As shown, self-reported tobacco use was highest in Karkar, *buai* use highest in Hiri and alcohol use lowest in Karkar.

Table 31 Self-reported frequency of tobacco, *buai* and alcohol consumption by iHDSS and overall, 2013

Substance	Measure	No. (%) of participants reporting use				
		Hides (n=0)	Hiri (n=36)	Asaro (n=52)	Karkar (n=57)	Overall (n=145)
Tobacco	Current	-	13 (36.2)	26 (50.0)	33 (57.9)	72 (49.7)
	Daily	-	11 (30.6)	23 (44.3)	32 (56.2)	66 (45.6)
Buai	Past 30 days	-	34 (94.5)	24 (46.2)	45 (79.0)	103 (71.1)
Alcohol	Past 12 months	-	18 (50.0)	18 (34.7)	6 (10.6)	42 (29.0)
	Past 30 days	-	18 (50.0)	16 (30.8)	1 (1.8)	35 (24.2)

History of non-communicable disease (NCD) and experience of NCD-related symptoms

Table 32 presents the self-reported history of selected NCDs by iHDSS and overall. All questions pertained to lifetime history of disease. Overall, few participants reported having received any form of NCD diagnosis from a health worker. Among those that had, diagnoses of high blood pressure/hypertension and chronic lung disease, COPD or asthma were most commonly reported.

Table 32 Self-reported history of selected non-communicable diseases (NCDs) by iHDSS and overall, 2013

Have you ever been told by a health worker that you have/had...	No. (%) of participants responding 'yes'				
	Hides (n=0)	Hiri (n=145)	Asaro (n=133)	Karkar (n=104)	Overall (n=382)
A stroke	-	2 (1.4)	0 (0)	0 (0)	2 (0.6)
Heart disease	-	2 (1.4)	0 (0)	0 (0)	2 (0.6)
High blood sugar or diabetes	-	5 (3.5)	0 (0)	0 (0)	5 (1.3)
Chronic lung disease, COPD or asthma	-	7 (4.9)	3 (2.3)	0 (0)	10 (2.7)
High blood pressure or hypertension	-	14 (9.7)	3 (2.3)	1 (1.0)	18 (4.8)
High cholesterol	-	0 (0)	0 (0)	0 (0)	0 (0)
Cancer	-	0 (0)	0 (0)	0 (0)	0 (0)

Table 33 presents self-reported experience of specified NCD-related symptoms. Sudden paralysis/weakness in the arms and/or legs on one side of the body for more than 14 hours is considered symptomatic of stroke. Pain or discomfort in the chest when walking, hurrying or walking uphill is indicative of heart disease. Ankle oedema or swelling is indicative of lung disease as is shortness of breath during rest, coughing or wheezing for greater than 10 minutes or coughing up sputum/phlegm most days during a three month period. As shown, participants from Hiri iHDSS reported the greatest number and range of symptoms whereas participants from Karkar reported the least. The most commonly reported symptoms across all sites were pain/discomfort in the chest when walking, hurrying or walking up hill.

Table 33 Self-reported experience of NCD-related symptoms by iHDSS and overall, 2013

Symptom	No. (%) of participants responding 'yes'				
	Hides (n=0)	Hiri (n=145)	Asaro (n=133)	Karkar (n=104)	Overall (n=382)
Sudden paralysis/weakness in arms/legs	-	21 (14.5)	0 (0)	0 (0)	21 (5.5)
Pain in chest when walking	-	35 (24.2)	15 (11.3)	2 (2.0)	52 (13.7)
Pain in chest when hurrying/walk uphill	-	37 (25.6)	19 (14.3)	2 (2.0)	58 (15.2)
Ankle oedema or swelling	-	0 (0)	0 (0)	0 (0)	0 (0)
Shortness of breath whilst resting	-	10 (6.9)	5 (3.8)	0 (0)	15 (4.0)
Coughing/wheezing for 10+ minutes	-	20 (13.8)	6 (4.6)	0 (0)	26 (6.8)
Cough sputum/phlegm most days/ 3months	-	9 (6.2)	0 (0)	0 (0)	9 (2.4)

Body Mass Index (BMI)

Table 34 presents a breakdown of participants' body mass index (BMI) by category. Underweight was defined as a BMI <18.5, normal weight defined as a BMI between >18.5 and <27, overweight as a BMI between 27 and <32 and obese as a BMI >32. The highest levels of overweight or obese were among adults from Hiri iHDSS, accounting for 38.9% of the surveyed population. Few participants from Asaro and Karkar were rated obese, although 14.5% of participants from Karkar met the criteria for underweight.

Table 34 Body-Mass Index (BMI) by iHDSS site and overall

Site	Sample No.	Body Mass Index			
		Underweight n (%)	Normal n (%)	Overweight n (%)	Obese n (%)
Hides	0	-	-	-	-
Hiri	144	9 (6.3)	79 (54.9)	35 (24.3)	21 (14.6)
Asaro	132	5 (3.8)	109 (82.0)	13 (9.9)	5 (3.8)
Karkar	104	15 (14.5)	79 (76.0)	9 (8.7)	1 (1.0)
Overall	380	29 (7.7)	267 (70.3)	57 (15.0)	27 (7.1)

Blood pressure

Table 35 presents participants' blood pressure readings based on the average of three consecutive reads taken at least one minute apart. Hypotensive was defined as a systolic/diastolic rate of <110/<70, normal as a rate of 110-120/70-80, pre-hypertensive as a rate >120-139/>80-89 and hypertensive as a rate 140+/90+. As shown, a large percentage of participants from all sites – ranging from to 44.3% (Karkar) to 61.5% (Asaro) were either pre-hypertensive or hypertensive. Fewer than 30% of participants across all sites had a blood pressure in the normal range.

Table 35 Blood pressure ratings by iHDSS and overall, 2013

Site	Sample No.	Blood Pressure			
		Hypotensive n (%)	Normal n (%)	Pre-hypertensive n (%)	Hypertensive n (%)
Hides	0	-	-	-	-
Hiri	145	34 (23.5)	41 (28.3)	41 (28.3)	29 (20.0)
Asaro	132	14 (10.6)	37 (28.1)	58 (44.0)	23 (17.5)
Karkar	104	27 (26.0)	31 (29.8)	38 (36.6)	8 (7.7)
Overall	381	75 (19.7)	109 (28.6)	137 (36.0)	60 (15.8)

Haemoglobin A1c

Haemoglobin A1c (HbA1c) is a measure of the percent of glucose in the blood stream. A HbA1c result of less than 5.7% is considered 'normal', 5.7% to 6.4% is considered pre-diabetic (i.e. 'at risk' of developing diabetes mellitus type 2) and 6.5% or more is considered diagnostic of diabetes. Table 36 presents the HbA1c results by iHDSS and overall. As shown, 22.8% (89/392) of adult participants randomly recruited from the Hiri, Asaro and Karkar iHDSS have blood glucose levels in the pre-diabetic (17.1%) or diabetic (5.7%) range. Prevalence is highest in the Hiri iHDSS where 39.6% (57/144) of adult participants tested in the pre-diabetic (25%) or diabetic (14.6%) range and lowest in Karkar iHDSS at 10.1% and 1.1%, respectively.

Table 36 HbA1c results by iHDSS and overall, 2013

Site	Sample No.	HbA1c Result*		
		Normal n (%)	Pre-Diabetes n (%)	Diabetes n (%)
Hides	0	-	-	-
Hiri	144	87 (60.5)	36 (25.0)	21 (14.6)
Asaro	149	128 (85.9)	21 (14.1)	0 (0)
Karkar	99	88 (88.9)	10 (10.1)	1 (1.1)
Overall	392	303 (77.3)	67 (17.1)	22 (5.7)

Lipid profile

Elevated cholesterol and triglycerides are known risk factors for cardiovascular disease. The number and percentage of participants with normal and elevated levels of these respective lipids are presented in Table 37. As shown, 35.7% of all participants had elevated cholesterol levels and 43.5% elevated triglyceride levels. Again, elevated levels of these lipids were highest in Hiri 47.1% and 64.2%, respectively.

Table 37 Lipid profile by iHDSS and overall, 2013

Site	Sample No.	Cholesterol		Triglycerides	
		Normal n (%)	Elevated n (%)	Normal n (%)	Elevated n (%)
Hides	0	-	-	-	-
Hiri	106	56 (52.9)	50 (47.1)	38 (35.9)	68 (64.2)
Asaro	91	67 (73.7)	24 (26.3)	57 (62.7)	34 (37.3)
Karkar	88	60 (68.2)	28 (31.8)	66 (75.0)	22 (25.0)
Overall	285	183 (64.3)	102 (35.7)	161 (56.5)	124 (43.5)

Discussion

The findings reported in this chapter are preliminary and should be interpreted with some degree of caution. The datasets remain incomplete and age, sex and other variables relevant to NCD disease and risk were not accounted for in the limited analyses presented. Furthermore, additional and equally important questionnaire, anthropometric and biological data are yet to be reported. Nevertheless, the reported findings do provide an initial insight into the NCD burden – or potential for NCDs – in the four study sites.

The data from Hiri iHDSS are particularly concerning and are suggestive of an existing high NCD burden in the general adult population or, in the very least, a population at serious risk of developing a high NCD burden. Objective, clinical measures of cardiovascular disease-, heart disease- and diabetes-risk factors were highest in participants from the Hiri iHDSS relative to other HDSS, ranging between 39.6% (elevated blood glucose) and 64.2% (elevated triglycerides) of surveyed participants. Given that a quarter of participants were aged between 15-29 years, then these findings are of even greater concern. Furthermore, poor dietary indicators, especially low consumption of fruit and vegetables and higher relative consumption of alcohol and buai, combined with relatively high experience of NCD-related symptoms and few reported health worker defined NCD diagnoses indicate low NCD-risk awareness and minimal clinical screening/intervention in the Hiri iHDSS adult population. Higher prevalence in this population is likely to be the result of a number of factors including genetic susceptibility and proximity to Port Moresby. Nevertheless, NCD risk is likely to be further heightened by the economic and lifestyle changes resulting from the PNG LNG project (given its predicted contribution to future Gross Domestic Product [4]) that – due to the presence of both the PNG LNG processing site and proximity to Port Moresby – the Hiri iHDSS population are likely to experience to a greater extent relative to other HDSS. Whilst it remains important to establish reliable prevalence data for the Hiri iHDSS adult population, these preliminary findings indicate an immediate need for NCD prevention, screening and intervention programs in this project impact site. It is also worth noting that buai consumption has previously been associated with increased incidence of type 2 diabetes mellitus and metabolic syndrome [5, 6], a relationship which may be of particular concern in Hiri given the high prevalence of buai consumption in this community.

Findings from the Asaro and Karkar HDSS' were less alarming relative to the Hiri iHDSS and are likely to be more reflective of NCD prevalence and risk in rural communities across PNG. Nevertheless, approximately between one quarter to one third of all adult participants in these two iHDSS had elevated cholesterol and/or triglycerides, 10-14% had high blood glucose levels and a majority of the recorded blood pressures were in the pre-hypertensive or hypertensive range. Similar to Hiri HDSS, few participants reported having received an NCD diagnosis further suggesting current screening and intervention programs may be inadequate (potentially non-existent). The reported prevalence of NCDs and associated risk factors were also substantially higher than those reported in earlier studies from the same or comparable communities [7-12]. For example, Scrimgeour et al (1989) found no cases of elevated cholesterol or triglycerides in a randomised cross sectional survey conducted in the Asaro valley in the late 1980s [7], and Boyce et al reported no cases of hypertension in a cross sectional survey conducted on Karkar island in the late 1970s [8]. The findings from Asaro and Karkar HDSS', when viewed in the light of these earlier studies, are suggestive of a generalised increase in NCD burden and risk across the country. The need for prevention, screening and intervention campaigns may be less urgent in these areas relative to Hiri; however, complacency will only exacerbate the future cost of the NCD burden to PNG. Thus, NCD prevention and health promotion campaigns should be prioritised in the short-term across all iHDSS – and ideally countrywide – with more intensive screening and intervention programs targeted towards Hiri iHDSS (and potentially other high risk urban and coastal communities in PNG). The Asaro and Karkar iHDSS also present as especially valuable

longitudinal surveillance sites in which the NCD burden and associated risk factors may be closely monitored over time. As suggested, NCD prevalence in these sites is likely to be reasonably representative of rural communities across PNG. The same is not true of the Hiri iHDSS (which already has an exceptionally high burden) and, for a range of reasons, may also be less true of the Hides iHDSS (although NCD data are not yet available for this site). Such long-term NCD surveillance in the Asaro and Karkar iHDSS would afford some assessment of the impact of NCD prevention campaigns and provide advance warning for the need to scale up screening and intervention programs.



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Chapter 6

MORTALITY AND MORBIDITY

Part I: Causes of death in the Partnership in Health Study Sites

Abstract

This Chapter is presented in two parts. The first part presents key findings from the cause of death analysis, using the Population Health Metrics Research Consortium (PHMRC) Verbal Autopsy (VA) instrument to follow up on deaths in the Health and Demographic Surveillance System Sites (iHDSS) under the Partnership in Health Project. The second Part summarises the findings from a morbidity study which collects all diagnoses from clinics in the iHDSS sites.

While the analysis of cases appearing at local clinics in the iHDSS reveals that infectious diseases continue to burden the services, findings from the mortality analysis point to an on-going epidemiological transition that is developing and progressing at different rates across the country. This transition is characterised by a move from a mortality structure dominated by infectious diseases to one where deaths are largely caused by non-communicable diseases (NCD). Of all the sites presented here Hides exhibits the least progression in terms of this transition and most of the mortality burden is caused by diseases that are infectious in nature. While many of these diseases, such as cardiovascular diseases and diabetes, are indicative of a change in lifestyles, other conditions most likely due to indoor air pollution like chronic obstructive pulmonary diseases and asthma, significantly contribute to this burden in some locations.

Mortality and morbidity differentials between sites are likely to be due to a number of social, historical and economic factors. Recent economic developments may bring with it an increased pace towards the epidemiological transition though this affect is likely to be felt differently in different areas of PNG. Current and future burdens should be considered with local culture and context in mind and policies and interventions should be designed accordingly.

Background

Mortality levels are comparatively high, diverse and changing rapidly in much of the Pacific region [1], yet we still know remarkably little about underlying cause of death (COD) patterns and how these are changing [2]. The majority of deaths in the region are not medically certified [3, 4]. yet COD data are critical to inform policy debates about priorities to reduce premature mortality and improve population health. In the absence of routine medical certification of deaths, Verbal Autopsies (VAs) are the only proven means of providing reliable data about COD patterns at the population level. A verbal autopsy (VA) is based on a structured questionnaire administered to the caregivers or family members of a recently deceased person to elicit signs and symptoms and their durations, together with other relevant information, in the period before death. Recent methodological advances in VA questionnaire design and in the development of automated diagnostic algorithms, which do not require physician input, permit much wider application of VA to monitor population health in low and middle income countries [5, 6]. Over recent decades there has been increasing international interest in the use of verbal autopsies to study population based mortality [7, 8]. In this study we

have employed the Population Health Metrics Research Consortium (PHMRC) VA instrument to follow up on deaths in the Partnership in Health Project Health and Demographic Surveillance Sites (HDSS). VAs are routinely used in Demographic and Health Surveillance Systems around the world such as the International Centre for Diarrheal Disease Research (ICDDR, B) Matlab site in Bangladesh [9] and the KEMRI/Centre for Disease Control (CDC) site in Kenya [10].

Like many countries Papua New Guinea (PNG) struggles to develop a routine registration system and collect vital statistics on its population. PNG has a rudimentary registration system and very little data exists to inform an epidemiological understanding of the burdens of disease in the country. For this reason, the data collected from a HDSS will be vital to building our understanding of mortality and epidemiological patterns in PNG. Furthermore, PNG is undergoing rapid economic development driven by a range of mineral and gas resource projects. The largest of these projects is the Exxon Mobil led PNG Liquefied Natural Gas (PNG LNG) project. The PNG LNG project is expected to more than double the PNG gross domestic product and provides a stable revenue stream for 25-30 years once fully operational. Economic development has globally been linked with epidemiological transitions characterized by reductions in infectious diseases and a simultaneous increase in non-communicable diseases (NCDs) as a result of associated lifestyle changes (see Chapter 5 on NCDs) [11-13] (see Chapter 5 for more details). The current economic trends, mortality decline, and clinical reports in PNG would suggest that the country has indeed entered this epidemiological transition. The extent and distribution of the transition within the country is poorly understood however.

The aims of the Partnership in Health Project (PiHP) are to compare changes over time in two impact sites where the PNG-LNG project is active (Hides in Hela Province and West Hiri in Central Province) and two comparison sites (Asaro in the Eastern Highlands and Karkar an island that is part of Madang Province). The collection of verbal autopsies and the physician review of the VA forms have been in process since 2010 in Hiri and 2011 in Asaro. Karkar and Hides data collection started more recently in late 2012. Here we present all deaths thus far reviewed by a physician and ascribed a probable cause of death as a preliminary analysis of the cause-specific mortality trends becoming evident.

Methods

Households in the HDSS are followed up every three months by local reporters. During these visits the reporters record any in or out migrations, pregnancies, births and deaths. Identified deaths are listed and given to the verbal autopsy team. Trained field staff coordinates with reporters to arrange a household visit at a time and location that suits the respondent. The interviews usually take place soon after the mourning period has come to an end. VA interviews can be emotional. After consent is obtained the respondent is ensured that they can stop the interview at any time and it is their choice to resume it at another time if they wish.

We have employed the Population Health Metrics Research Consortium (PHMRC) VA instrument in this study. Aside from asking questions about the signs and symptoms the deceased experienced prior to death, the standardised questionnaire also collects information on basic demographic and socio-economic covariates as well as some health care utilisation data. VA interviewers also ask to see and copy any information on health records that might be available. All VA forms are checked by independent members of the VA team for accuracy and consistency. Any forms with problems are sent back to the field for correction prior to data entry. VA forms, and where possible any health records included with the form, are then reviewed by a trained physician who ascribes a probable cause of death.

Causes of death were coded according to the International Classification of Disease-10 and data analyses were conducted using Stata12.0. The VA forms are then entered into an Access database. The VA data collected will also be analysed using computer-based analytical software developed at the Institute of Health Metrics and Evaluation (IHME) in Seattle and results will be compared with those of the physicians.

Analysis here has focused upon the differences in mortality patterns between sites. Numbers of deaths by cause of death are low full complete years of data collection for all sites started in 2012. As 2013 data is still incomplete analysis of time trends have not been conducted yet but will be available in the next report.

Results

To date 959 verbal autopsies have been conducted on deaths from the four HDSS sites. Of these a total of 800 (83.4%) have been through physician review and have had a probable cause of death ascribed to them (Table 38).

Table 38 Physician reviewed verbal autopsies by site, iHDSS, 2013

	Asaro		Hides		Hiri		Karkar		Total
	n	%	n	%	n	%	n	%	n
VA completed	312	32.5%	109	11.4%	257	26.8%	281	29.3%	959
COD completed	303	37.9%	109	13.6%	235	29.4%	153	19.1%	800

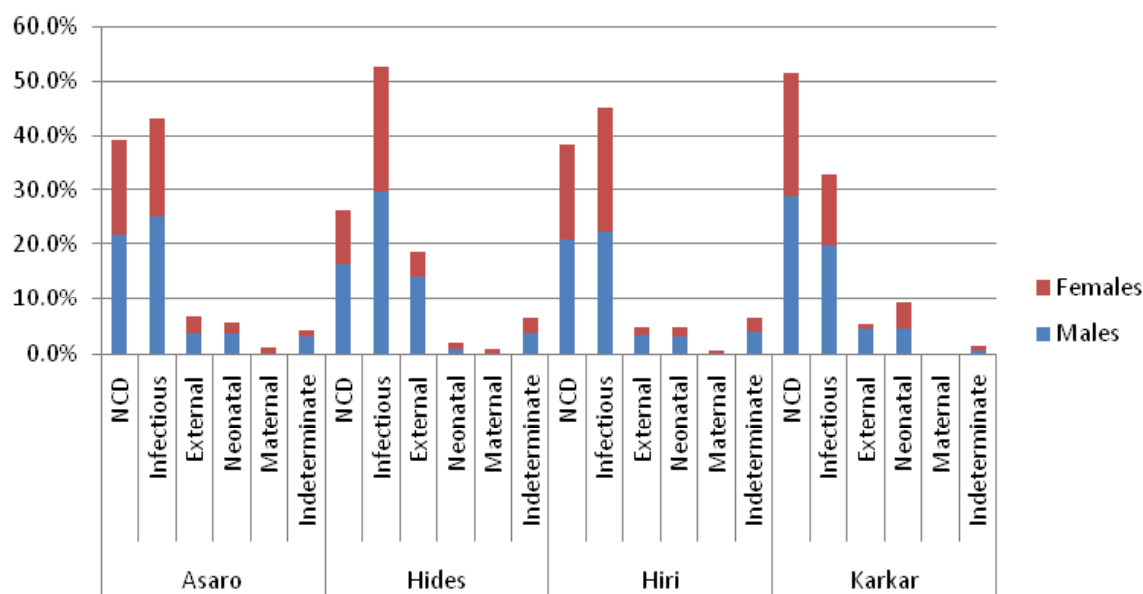
VA Verbal Autopsy; COD Cause of death

The deaths collected by the PiHP staff and presented in this chapter occurred over a period of five years. Table 39 shows the distribution of deaths analysed by verbal autopsy for which a year of death is available (19 cases are missing a year of death from Hiri). A number of VAs from Hiri and Asaro are in the process of quality checks and data entry and therefore numbers are low in these sites.

Table 39 Number of deaths with collected by year of death and site, iHDSS, 2013

	Asaro	Hides	Hiri	Karkar	Total
2009	0	0	16	0	16
2010	40	3	54	46	143
2011	131	6	72	54	263
2012	109	52	60	99	320
2013	32	48	36	82	198
Total	312	109	238	281	940

In order to capture all deaths, during the first census in each site reporters asked if any deaths had occurred in the household since the first of January 2010. In most locations the collection of deaths began before the demographic surveillance officially commenced. Indeed, the verbal autopsy project started in Hiri a number of months before the demographic surveillance and hence verbal autopsies were conducted on deaths from 2009.

**Figure 13 Probable cause of death by site and sex¹², 2010-2013, iHDSS, 2013**

NCD Non-communicable diseases

¹²Neonatal deaths include stillbirths

Figure 13 presents the proportion of deaths caused by site, sex and the different major groups of diseases; non-communicable diseases (NCD), infectious diseases, external causes and neonatal deaths. Those deaths for which no cause of death could be assigned are known here as indeterminate. The majority of deaths analysed here are males (56%). Amongst adults, there were more male deaths in all disease groups except for infectious diseases in Hiri where females and males make up almost equal proportions. Equal numbers of males and females were represented amongst neonatal deaths in Hides and Karkar but in both Hiri and Asaro males made up more than 60% of neonatal deaths.

The mortality pattern evident in Hides is dominated by infectious diseases which make up more than 50% of deaths in that population. The majority of deaths in Asaro and Hiri are also infectious in nature but non-communicable diseases like cardiovascular diseases and cancers are a very close second. In the previous report, very few deaths from Karkar had been collected and assigned causes of death, thus limiting our analysis. Our data now indicates that NCDs in Karkar cause more deaths than do infectious diseases. Neonatal deaths are particularly high in Karkar constituting almost 10% of all deaths. External causes of death are especially high in Hides reaching almost 20% of all deaths.

Pneumonia and diarrhoea are the leading causes of death in Hides (Figure 14). Chronic obstructive pulmonary disease (COPD) makes a major contribution to the total number of deaths particularly in Asaro where it was responsible for a third of all deaths due to non-communicable diseases and 18.9% of all deaths (Figure 15). A total of 9.9% of deaths in Asaro were due to all forms of cancer. In Hiri, the majority of non-communicable disease deaths were due to all cancers (13.9% of all deaths), diabetes (7.4%) and cardiovascular disease (7.4%)

Infectious diseases make up a total of 42.6% of all deaths and constitute the majority of deaths collected from Hides thus far. Pulmonary tuberculosis is the leading infectious cause of death in Hiri (13.8% of all deaths in Hiri) followed by Malaria and then HIV/AIDS (8.4% and 7.1% of all deaths in Hiri respectively) (Figure 16). Hiri however is unique in this ranking, as pneumonia is the leading cause of death in all other sites followed either by tuberculosis (Asaro) or diarrhoea (Hides and Karkar).

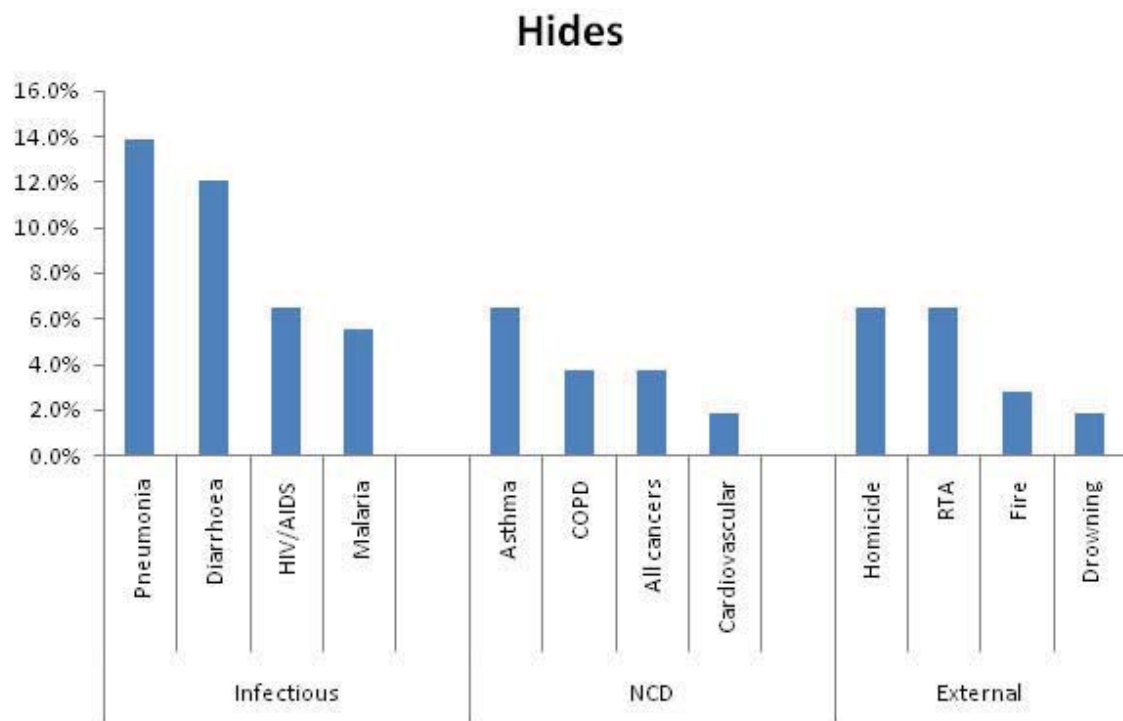


Figure 14 Leading causes of death in Hides, 2011-2013, iHDSS, 2013

COPD Chronic obstructive pulmonary disease

HIV/AIDS Human Immunodeficiency Virus/ Acquired Immunodeficiency Disorder Syndrome

NCD Non-communicable diseases

RTA Road traffic accidents

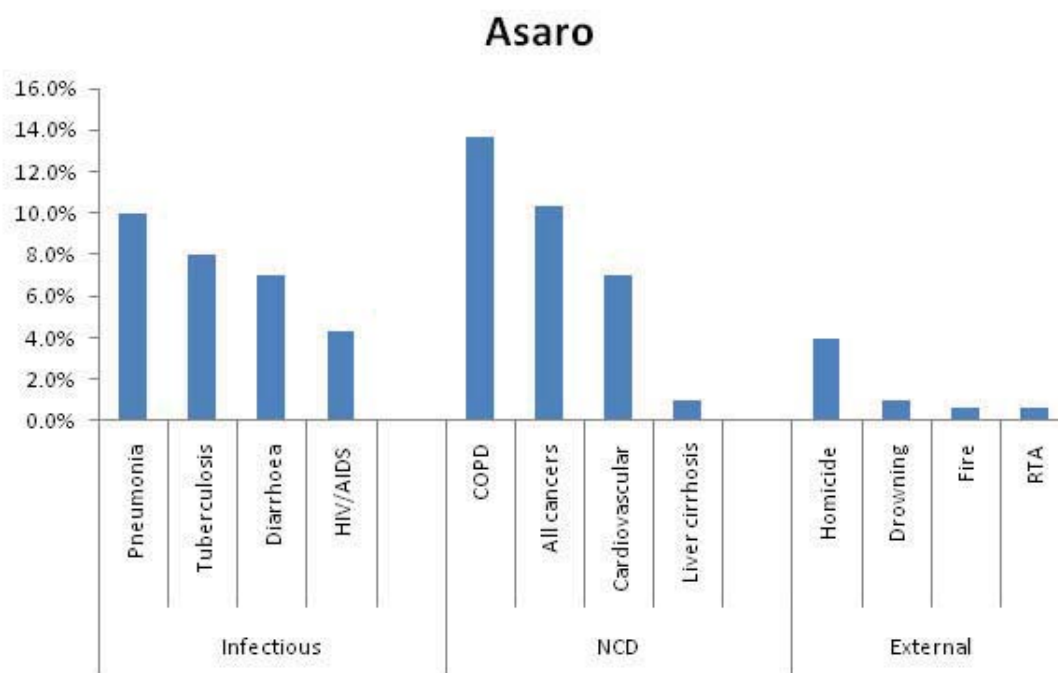


Figure 15 Leading causes of death in Asaro iHDSS (2010-2014)

COPD Chronic obstructive pulmonary disease

HIV/AIDS Human Immunodeficiency Virus/ Acquired Immunodeficiency Disorder Syndrome

NCD Non-communicable diseases

RTA Road traffic accidents

External causes of death play a significant role in mortality trends in both Asaro and Hides. Almost 60% of all external deaths in Asaro are attributed to homicide while homicide and road traffic accidents make up 70% of all external deaths in Hides.

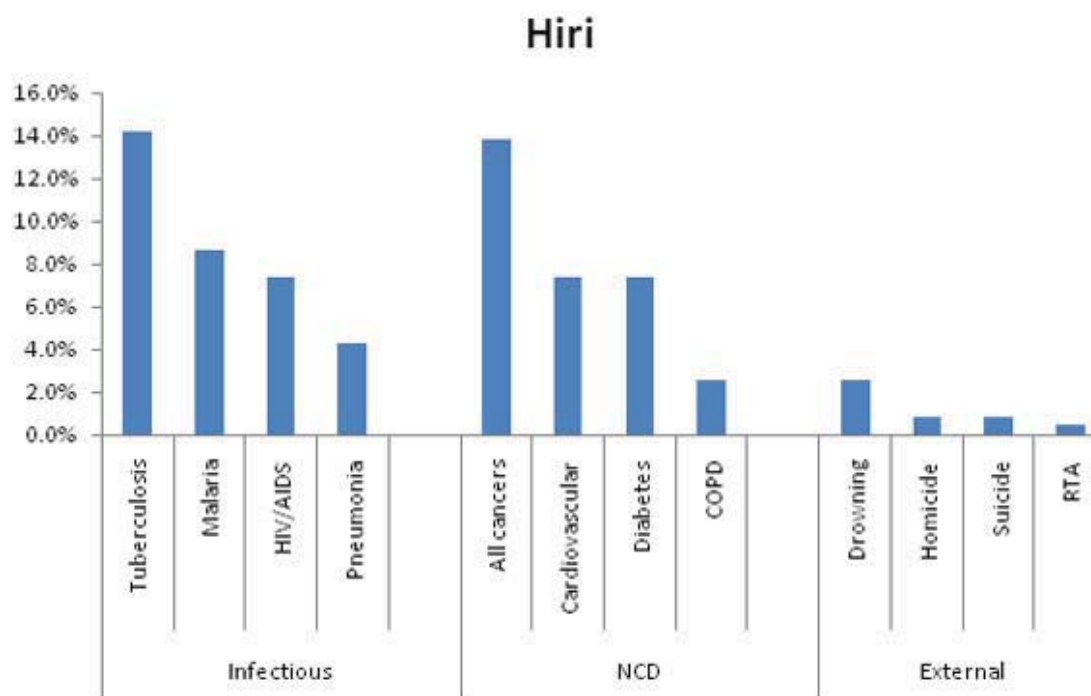


Figure 16 Leading causes of death in Hiri, 2010-2013, iHDSS, 2013

COPD Chronic obstructive pulmonary disease

HIV/AIDS Human Immunodeficiency Virus/ Acquired Immunodeficiency Disorder Syndrome

NCD Non-communicable diseases

RTA Road traffic accidents

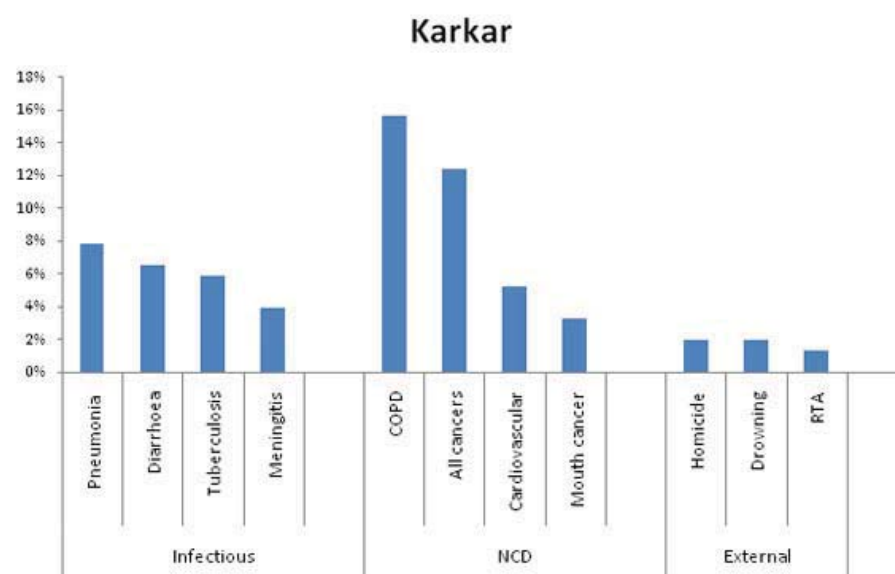


Figure 17 Leading causes of death in Karkar, 2010-2013, iHDSS, 2013

COPD Chronic obstructive pulmonary disease

HIV/AIDS Human Immunodeficiency Virus/ Acquired Immunodeficiency Disorder Syndrome

NCD Non-communicable diseases

RTA Road traffic accidents

High rates of HIV/AIDS deaths in Hiri seem to contradict findings from antenatal clinics. Table 40 shows the distribution of HIV/AIDS deaths by age, sex and year of death. Most of these deaths were identified in 2011 and the majority occur in those between the ages 25 and 34.

Table 40 HIV/AIDS deaths in Hiri iHDSS by age, sex and year of death

	2010		2011		2012		2013		Total
	Female	Male	Female	Male	Female	Male	Female	Male	
1-4	0	1	0	0	0	1	0	0	2
5-14	0	0	0	0	1	0	0	0	1
15-24	0	0	1	1	0	0	0	0	2
25-34	1	1	1	1	2	1	0	1	8
35-44	0	0	2	0	0	0	0	1	3
55-64	0	1	0	0	0	0	0	0	1
Total	1	3	4	2	3	2	0	2	17

The deaths that have been physician reviewed and presented here are distributed across age groups differently in each of the sites (Table 41). The majority of deaths presented from Asaro, for example occurred in individuals 55 years and older. This is in contrast to Hiri where the distribution of the deaths is spread over all age groups. Over 30% of deaths were among children under the age of 15 and almost 30% of deaths took place amongst young adults between the ages of 15 and 34. Deaths in Hides and Karkar indicate a greater proportion of deaths in neonates and infants less than one year of age.

Table 41 Deaths with an assigned cause of death by age and site (iHDSS 2010-2013)

Age group	Asaro		Hides		Hiri		Karkar		Total
	n	%	n	%	n	%	n	%	
< 1	25	8.3	16	14.7	17	7.2	25	16.3	83
1-4	13	4.3	13	11.9	14	6.0	9	5.9	49
5-14	11	3.6	12	11.0	7	3.0	3	2.0	33
15-24	9	3.0	4	3.7	22	9.4	7	4.6	42
25-34	40	13.2	12	11.0	34	14.5	8	5.2	94
35-44	27	8.9	19	17.4	27	11.5	13	8.5	86
45-54	24	7.9	11	10.1	32	13.6	11	7.2	78
55-64	53	17.5	12	11.0	30	12.8	20	13.1	115
65+	101	33.3	10	9.2	52	22.1	57	37.3	220
Total	303	100.0	109	100.0	235	100.0	153	100.0	800

Deaths due to non-communicable diseases tend to make up a greater proportion of all deaths with age, eventually making up the majority of deaths after the age of 45 (Figure 18). Many of these NCD deaths, however, are still premature in nature occurring in those under the age of 65. Indeed, almost half of NCD deaths occurred at relatively young ages between 35 and 64 years old (45%) and this is particularly true in the cases of cardiovascular disease and cancer (Table 42).

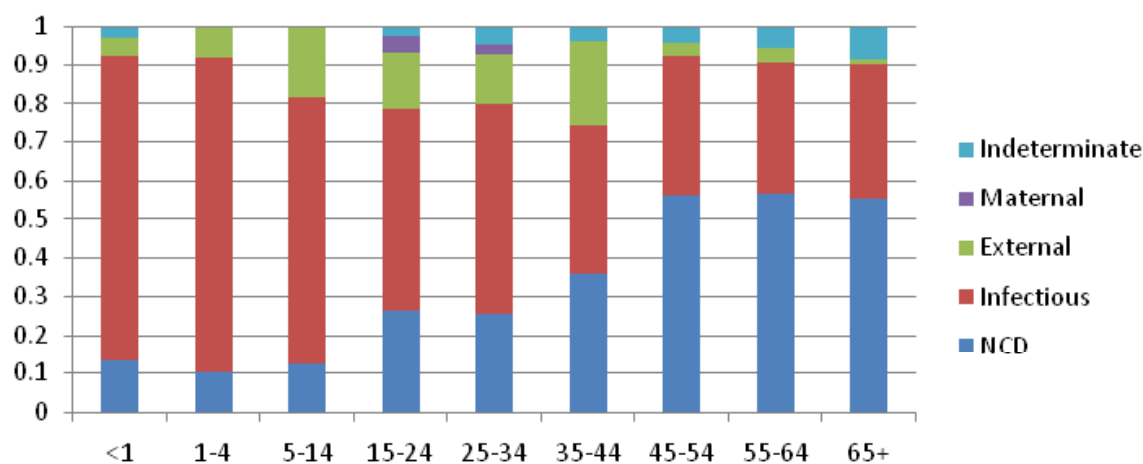


Figure 18 Cause of death (grouped diseases) by age group¹³ (iHDSS 2010-2013)

¹³Neonatal deaths not included in death under 1

Table 42 Major specific non-communicable causes of death by age group, 2010-2013, iHDSS, 2013

	COPD		Asthma		Cardiovascular		Diabetes		Cervical Cancer		Liver Cancer		Mouth Cancer		Other Cancers		Other NCD		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
<1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	7.9%	5	
1-4	0	0.0%	1	6.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	2.9%	3	4.8%	5	
5-14	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	6.3%	4	
15-24	1	1.3%	0	0.0%	5	10.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	7.9%	11	
25-34	0	0.0%	1	6.3%	5	10.4%	0	0.0%	4	14.8%	2	15.4%	3	27.3%	4	11.8%	5	7.9%	24	
35-44	2	2.7%	1	6.3%	7	14.6%	0	0.0%	7	25.9%	5	38.5%	1	9.1%	2	5.9%	5	7.9%	30	
45-54	6	8.0%	3	18.8%	7	14.6%	7	35.0%	6	18.5%	2	15.4%	1	9.1%	4	14.7%	8	12.7%	44	
55-64	16	21.3%	4	25.0%	8	16.7%	7	35.0%	9	33.3%	2	15.4%	4	36.4%	7	20.6%	8	12.7%	65	
65+	50	66.7%	6	37.5%	16	33.3%	6	30.0%	2	7.4%	2	15.4%	3	18.2%	15	47.1%	22	34.9%	122	
Total	75	100.0%	16	100.0%	48	100.0%	20	100.0%	28	100.0%	13	100.0%	12	100.0%	32	100.0%	63	100.0%	310	

COPD Chronic Obstructive Pulmonary Disease

NCD Non-communicable diseases

Table 43 Major specific infectious causes of death by age, group, 2010-2013, iHDSS, 2013

	TB		Extra-pulmonary TB		Pneumonia		Diarrhoea		HIV/AIDS		Malaria		Meningitis		Other Infections		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
<1	1	1.4%	0	0.0%	10	14.9%	7	15.2%	0	0.0%	2	6.5%	0	0.0%	10	15.9%	30	
1-4	4	5.6%	0	0.0%	10	14.9%	11	23.9%	3	8.1%	3	9.7%	2	13.3%	7	11.1%	40	
5-14	1	1.4%	2	16.7%	4	6.0%	4	8.7%	1	2.7%	2	6.5%	3	20.0%	6	9.5%	23	
15-24	12	16.9%	0	0.0%	1	1.5%	0	0.0%	2	5.4%	4	12.9%	2	13.3%	1	1.6%	22	
25-34	13	18.3%	1	8.3%	2	3.0%	2	4.3%	18	48.6%	4	12.9%	2	13.3%	9	14.3%	51	
35-44	11	15.5%	2	16.7%	2	3.0%	2	4.3%	10	27.0%	0	0.0%	0	0.0%	5	9.5%	32	
45-54	8	11.3%	1	8.3%	4	6.0%	3	6.5%	0	0.0%	5	16.1%	2	13.3%	5	7.9%	28	
55-64	12	16.9%	3	25.0%	10	14.9%	3	6.5%	2	5.4%	1	3.2%	2	13.3%	6	9.5%	39	
65+	9	12.7%	3	25.0%	24	35.8%	14	30.4%	1	2.7%	10	32.3%	2	13.3%	13	20.6%	76	
Total	71	100.0%	12	100.0%	67	100.0%	46	100.0%	37	100.0%	31	100.0%	15	100.0%	63	100.0%	341	

TB Tuberculosis

HIV/AIDS Human Immunodeficiency Virus/ Acquired

Immunodeficiency Disorder Syndrome

Table 44 External causes of death by age group, 2010-2013, iHDSS, 2013

	Choking		Drowning		Fall		Fire		Homicide		RTA		Suicide		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
<1	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.0%	0	8.3%	0	0.0%
1-4	0	0.0%	4	26.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
5-14	0	0.0%	2	13.3%	0	0.0%	3	75.0%	0	0.0%	1	0.0%	0	8.3%	0	0.0%
15-24	0	0.0%	1	6.7%	0	0.0%	0	0.0%	3	12.5%	1	8.3%	1	33.3%	6	33.3%
25-34	0	0.0%	2	13.3%	0	0.0%	0	0.0%	5	20.8%	4	33.3%	1	33.3%	12	33.3%
35-44	0	0.0%	3	20.0%	0	0.0%	1	25.0%	9	37.5%	5	41.7%	1	33.3%	19	33.3%
45-54	0	0.0%	1	6.7%	0	0.0%	0	0.0%	2	8.3%	0	0.0%	0	0.0%	3	0.0%
55-64	0	0.0%	1	6.7%	0	0.0%	0	0.0%	4	16.7%	0	0.0%	0	0.0%	5	0.0%
65+	0	0.0%	1	6.7%	1	100.0%	0	0.0%	1	4.2%	0	0.0%	0	0.0%	3	0.0%
Total	1	100.0%	15	100.0%	1	100.0%	4	100.0%	24	100.0%	12	100.0%	3	100.0%	60	100.0%

RTA Road traffic accidents

Discussion

Mortality statistics are a widely-used resource for setting spending priorities, but out of 192 countries worldwide, only 23 have high-quality death registration data, and 75 have no cause-specific mortality fraction information at all [14]. Recent large-scale health and development efforts such as the establishment of the Millennium Development Goals [15] and the Grand Challenges for Global Health [16] have helped to strengthen support for the need for evidence-based global health priorities. Accurate health metrics and improved statistics can provide crucial decision-making inputs that enable more efficient allocation of scarce financial resources towards the most pressing health needs [17]. Papua New Guinea (PNG) suffers greatly from a paucity of data on population health. Lack of information on mortality and morbidity trends precludes a full understanding of the forces driving population changes and means that decisions around health services and interventions are not well informed.

The data presented here are preliminary and there are a number of limitations to this analysis. Firstly, deaths in this analysis have been presented as proportions of total deaths and not as yearly rates. The calculation of rates will soon be possible when a full year of data collection has been complete and physician review on these deaths has been conducted. Data collection in Hides and Karkar started later than the other two sites and full data for any given year has not yet been achieved. Therefore, interpretation of results should be done with some caution. Secondly, no standard approach to physician review has been agreed [18, 19]. In order to ensure the highest accuracy in ascribing a probable cause of death to a VA physician review some researchers recommend that reviews be conducted independently by two physicians [20]. Where disagreements arise a third physician might be consulted and a consensus must be achieved [21]. At present there are only two trained physicians dedicated to the task of reviewing VA forms for the Partnership in Health project and forms have to be transported to be reviewed by those available making double review challenging. Verbal autopsies thus far collected will be also analysed by computer-based analytical software and results will be compared with the physician review results. Lastly, this analysis only examines one probable underlying cause of each identified death. A number of conditions, like HIV/AIDS and TB and diabetes and TB, are often associated with one another and many deaths are likely to be due to multiple causes of death. Future analysis should consider potential methods for in-depth investigations into this subject [14].

Despite these limitations, clear trends are becoming apparent from this unfolding study. Communities, like those in Hides and Asaro, which have had less exposure to urbanisation than the other sites may present patterns of disease that have not yet entered or are at the early stages of an epidemiological transition. Surprisingly a very high proportion of deaths in Karkar are attributed to non-communicable diseases. Over 40% of these, however, are due to COPD, which, like pneumonia, is probably due to wood smoke inhalation. In Hides, asthma overtakes COPD as the leading NCD. Though their etiology may be very different, asthma and COPD can have very similar symptoms and may be confused with one another. These results require further analysis.

Some findings in Hiri are not consistent with those found in the morbidity results collected from local clinics (See Part II of this chapter). Malaria and HIV/AIDS mortality in particular are higher than would be expected from observations made through the clinical studies. This could be due to a number of different reasons. The verbal autopsy methods and physician review employed here may be biased towards identification of these conditions, the individuals identified here may be older cases that have not presented at local clinics recently or have bypassed local clinics for larger health services in Port Moresby, or these may be people who have migrated into the iHDSS site as they approached death. A more in depth analysis of these cases will be pursued in the next report.

Table 45 presents some cause-specific deaths rates in PNG. The PiHP data series cannot be directly compared to these figures which represent deaths in health facilities aggregates at provincial level but these figures are indicative of the range of different mortality patterns observed across the areas where our surveillance is currently active. The National Capital District is where Port Moresby is located and is the most urbanised area of PNG. The Hiri West impact site in the PiHP project is very near to the National Capital District and the figures below are consistent with our findings in the area. Most notable are the very high rates of TB deaths, a large number of HIV/AIDS deaths and relatively high levels of NCD deaths compared to other regions presented here. Like our results, diarrhoea and acute respiratory diseases dominate as causes of death in health facilities in the Southern highlands (now Hela province).

While our Asaro rates of acute respiratory disease are reflected in the hospital records presented in Table 45, the high rates of COPD identified through VAs is not. One reason for this may be due to low attendance at health facility when COPD was the cause of a terminal illness [22]. Another reason may be that health facilities in PNG do not report the underlying cause of death on death certificates but instead use the reason for admission as the cause of death. For example, cor pulmonale, the most common a consequence of COPD, is often reported as a cause of death with other heart diseases.

We have identified deaths attributable to HIV/AIDS predominantly in Asaro and Hiri West. This is consistent with the hospital records collected by the National Health Plan where HIV/AIDS is one of the ten leading causes of death in Eastern Highlands and the National Capital District where Asaro and Hiri West are located (or are proximal to) respectively.

Table 45 Top ten causes of death from health facilities in four provinces and the National Capital District, iHDSS, 2013

	National Capital District	Central Province	Southern Highlands Province	Eastern Highlands Province	Madang Province
Pneumonia/ARI		16.14	21.88	8.29	6.71
Accidents and injury		11.32			5.34
Sepsis	10.92	10.48	7.88	9.18	10.53
Malaria and other vector-borne	4.15	9.43	7.44	6.24	13.11
Chronic respiratory		8.6	4.6		9.15
TB	15.07	8.6	5.69	6.6	7.77
Perinatal conditions		6.71	13.35	18.54	12.5
Cardiovascular	9.11	5.66	2.84	5.53	5.03
Anaemia		3.77	6.13		
Obstetric and Maternal		3.77			
Cancer	9.51			4.37	5.34
HIV and other STIs	6.76			6.95	
Other NCDs	6.36		4.81		
Neurological	5.76				
Diarrhoea and enteric			10.72	8.65	
Other genito-urinary	4.76				
Other gastro-intestinal	4.76			4.99	5.03
% of all deaths	77.16	84.48	85.34	79.34	80.51

ARI: Acute respiratory infections

TB: Tuberculosis

HIV: Human immunodeficiency virus

STIs: Sexually transmitted infections

NCDs: Non-communicable diseases

Source: Papua New Guinea National Health Plan 2008

A recent review of under-five mortality rates (U5MRs) in PNG based on the 2000 National Census [23,24] provides some insight into the diversity observed in mortality across PNG. This study disaggregated these data to district level (86 districts) and demonstrated large differentials among and within Provinces. Over the period from 1985 to 1999, U5MR was estimated to range from 26.2 deaths/1000 live births (LB) in Chimbu: Kundiawa-Gembogl to 236.0 deaths/1000 LB in Morobe: Menyama 86 districts. There is wide variation therefore in U5MR across PNG suggesting that the epidemiological transition may be at different stages of progress across the country and highlights the importance of selecting study populations with care.

PNG is entering a phase of rapid economic development and one that is likely to be characterised by major shifts in traditional social structures and therefore lifestyles. Small population studies like the Partnership in Health have the potential to provide crucial data which can supplement and enhance our understanding of this transition.

Part II: Morbidity

Clinics at each site collect data on presentations and diagnoses. The preliminary findings are presented here.

Hiri

Morbidity data have been collected from Porebada, Boera and Papa Clinics; however, the Boera and Porebada Clinic data are not complete. These clinics were not fully functional in 2013 due to renovation and new construction at the Boera clinic and insufficient staffing at Porebada clinic. From the fourth quarter of 2013 onward, the Central Province health office has provided additional staff at Porebada clinic and the Boera clinic construction is complete; therefore, IMR anticipates that Porebada and Boera Clinic data will be more fully available and robust in 2014.

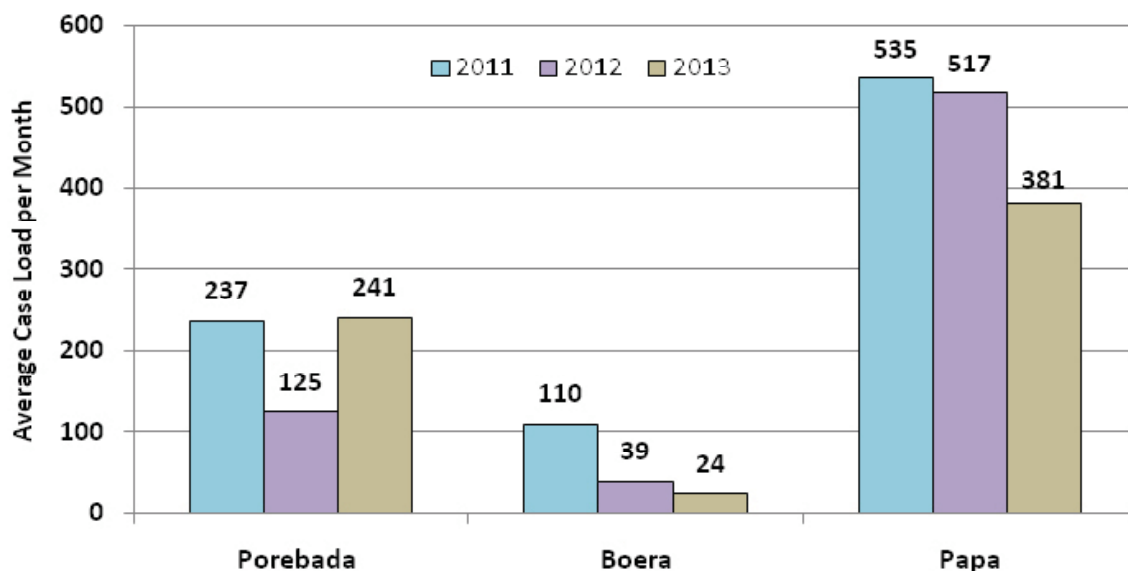


Figure 19 Hiri Clinics Monthly Census, 2011-2013, iHDSS

As shown in Figure 19, Papa monthly patient census has decreased from 500 to 400 patients per month. This decrease of case lead in Papa coincided with (i) peak construction at LNG worksite and rapid demobilization and (ii) modest improvement in Porebada caseload. Overall the total caseload across all relevant reporting Hiri clinics remained flat over the 2012/13-time period. The Papa Clinic was able to readily absorb and meet patient demand due to increased staffing and supplementation by PNGIMR. Papa Clinic expansion and supplemental staffing needs had been anticipated and planned for by the PNG LNG project and PNGIMR was able to successfully work with the Papa Clinic management (Salvation Army) to meet this well anticipated need.

The Hiri morbidity burden (Figures 24-26) is still dominated by respiratory diseases including upper and lower respiratory infections, pneumonia and COPD. There were slight increases in the number of diarrhoea and injury/road accidents. Skin disease continues to be important; however, the percent of total visits is stable. Malaria shows a persistent and significant decline and is likely related to the introduction of rapid

diagnostic test (RDT) kits. Malaria in Hiri is generally seasonal and also impacted by variability in seasonal rains and increasing urbanization (Figure 19). The PNG LNG and NGOs have done bed net distribution in Hiri and this also impacts caseloads. In general, bed net utilization rates are better in Hiri than in many other PNG coastal areas. Overall, the marked decline in malaria caseload confirms the multi-factorial influences on malaria transmission dynamics and the observation that “clinical malaria” is an unreliable diagnosis and more likely fever due to other respiratory etiologies, i.e., the clinical malaria patient load decline is offset by a rise in overall respiratory diseases.

Non-communicable diseases (NCDs) are occasionally documented but are far less prominent and at variance with the mortality pattern observed in Hiri. PNGIMR believes this is a critical and significant observation with serious future public health implications. The PNGIMR NCD study (Chapter 5) demonstrates the alarmingly high rate of abnormal lipid, glucose and blood pressure findings in Hiri villages. These data are based on systematic community surveys and indicate that there is an enormous burden of ‘silent disease’ that is not presenting to local clinics. In addition, there are clear demographic factors that are in play, i.e., most clinic visits are by women who tend to have somewhat lower levels of abnormal lipids, glucoses and elevated blood pressure. In addition, male villagers employed by the PNG LNG could conceivably have been evaluated at workplace clinics and would not be seen or evaluated at local clinics. Overall, IMR believes that NCDs are likely significantly under diagnosed and represent a major looming public health problem

Diarrhoeal and non-malarial febrile illness are under investigation through sophisticated diagnostic studies using the new POM Lab. Descriptions of the febrile and diarrhoeal disease studies are in Chapter 3 of this report.

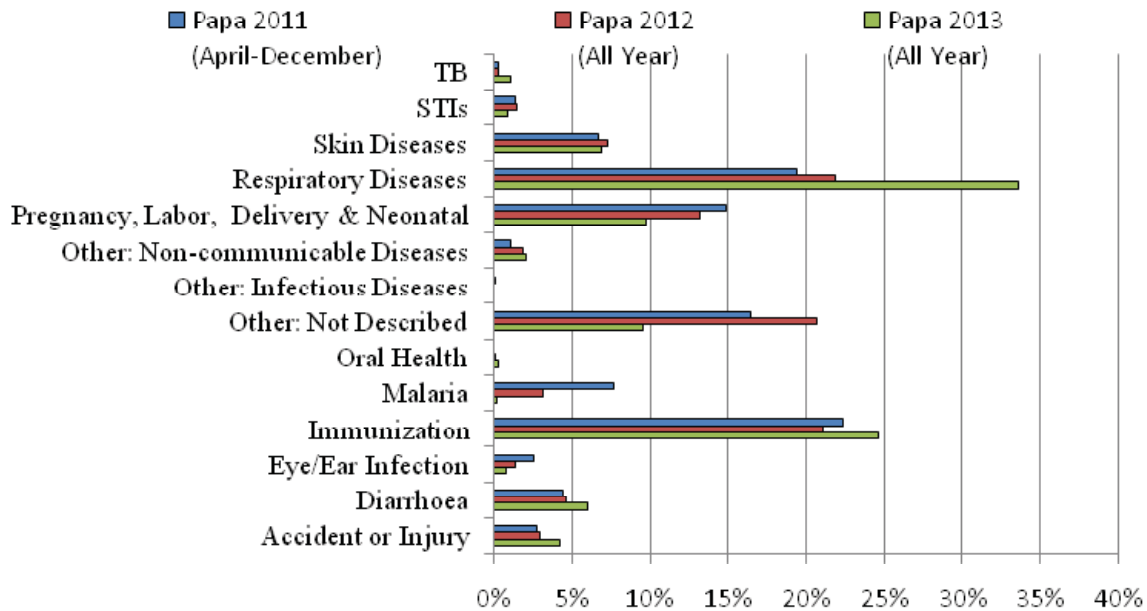


Figure 20 Clinical Diagnoses Papa Clinic 2011- 2013

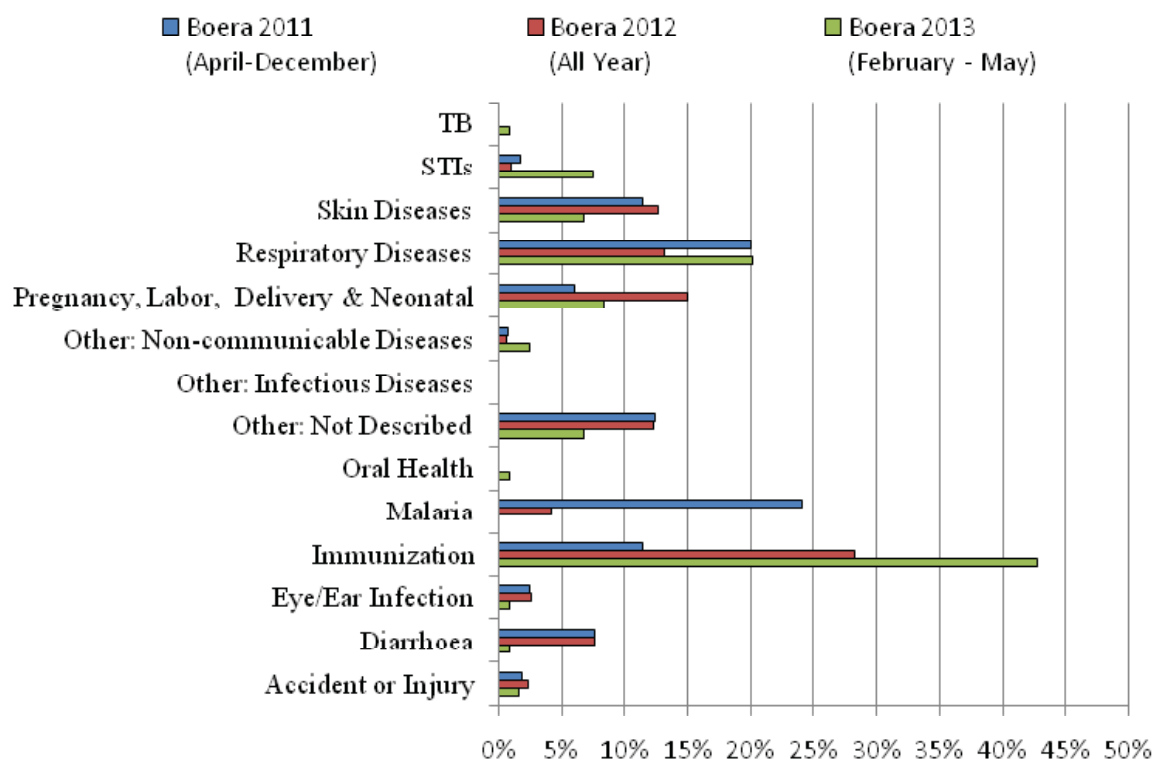


Figure 21 Clinical Diagnoses, Boera Clinic, 2011- May 2013, iHDSS, 2013

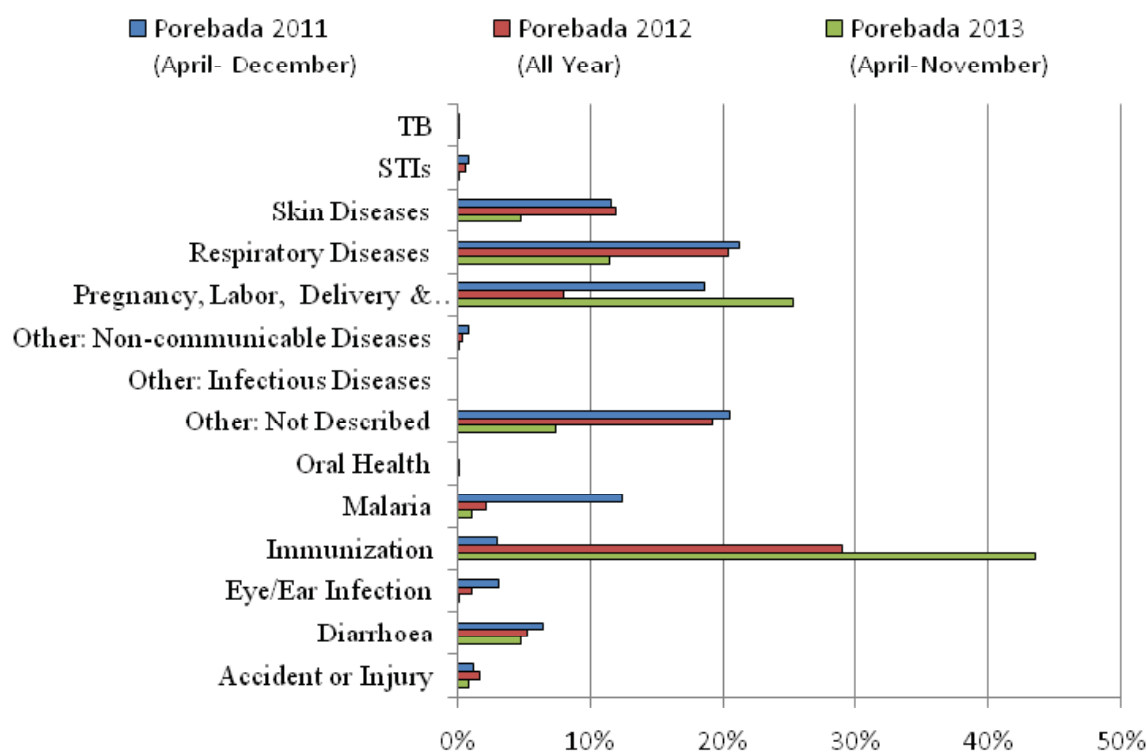
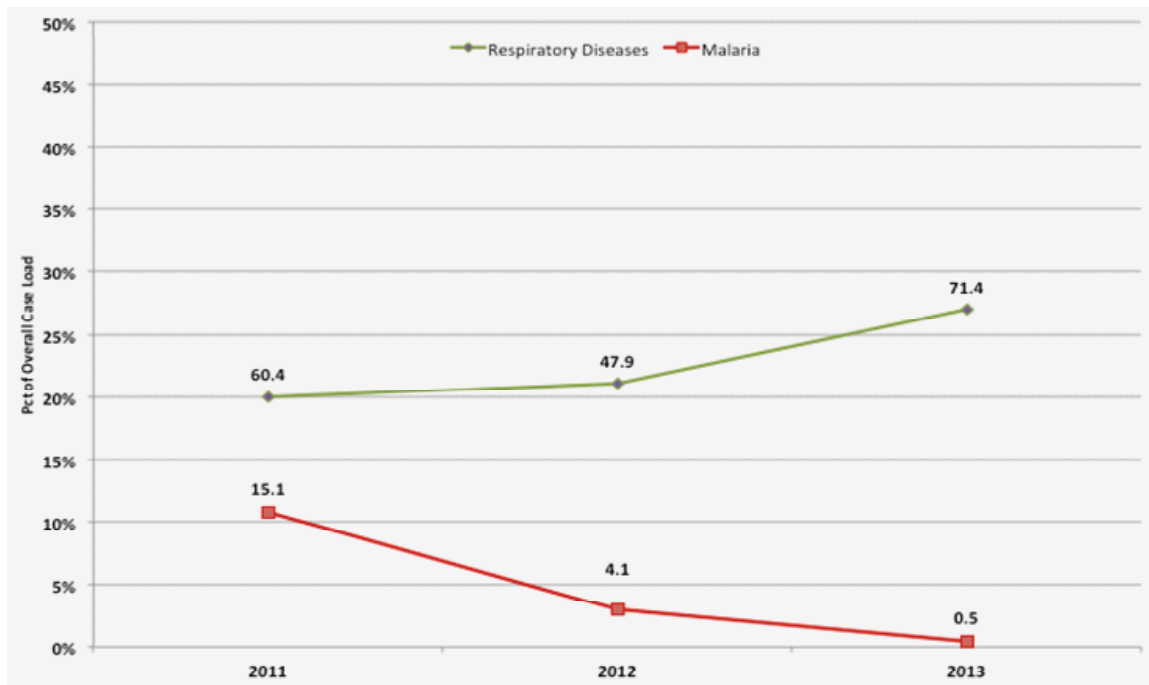


Figure 22 Clinical Diagnoses, Porebada Clinic, 2011-2013, iHDSS, 2013



*Data labels shows Avg. Number of cases seen per month across all Hiri clinics

Figure 23 Respiratory and Malaria Percents 2013

Hides

By using the monthly case reporting tally sheets from Mananda and Para Clinics, PNGIMR monitors morbidity in the Hides iHDSS catchment area. Both clinics are managed by ECPNG. The most current reported clinical data are shown in Figures 20-22. The overall patient caseloads in 2012 and 2013 were similar and illustrate that demand on clinical services stabilized over the period of peak PNG LNG construction in Hides. As illustrated, the morbidity patterns closely match each other with a high overall level of (i) respiratory disease (pneumonia, asthma, COPD and chronic cough), (ii) diarrhoea and (iii) skin disease. This current disease pattern is consistent with both the 2010/011 data and the historic pattern previously observed in Hides.

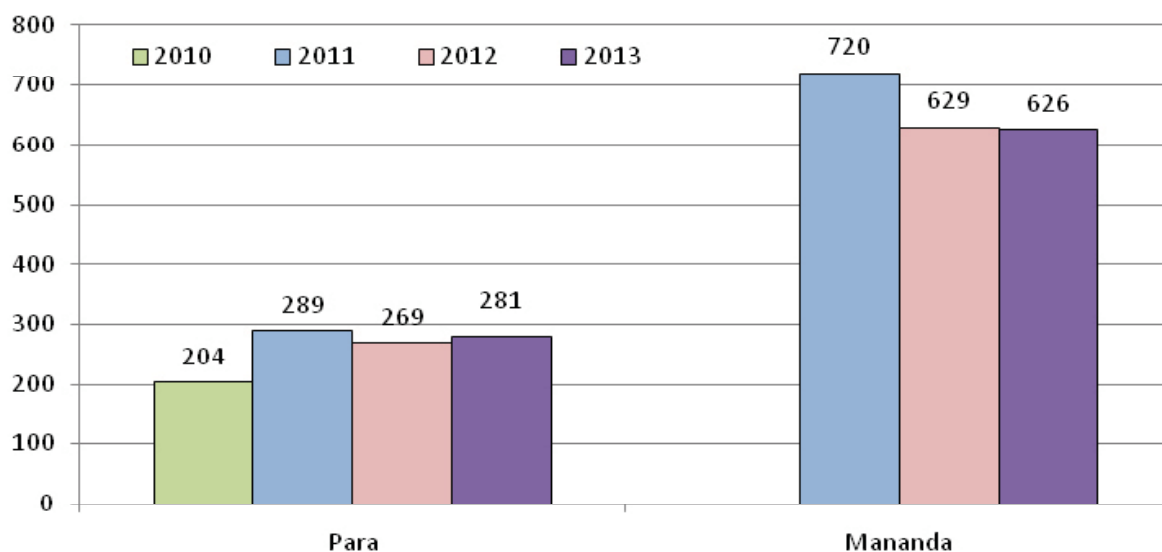


Figure 24 Average number of cases per month, Mananda and Para clinics, Hides, iHDSS, 2013

Note: Para Clinic was only open for 8 months in 2012 and 10 months in 2013; Mananda Clinic was only open for 11 months in 2013; It excludes Family Planning Visits

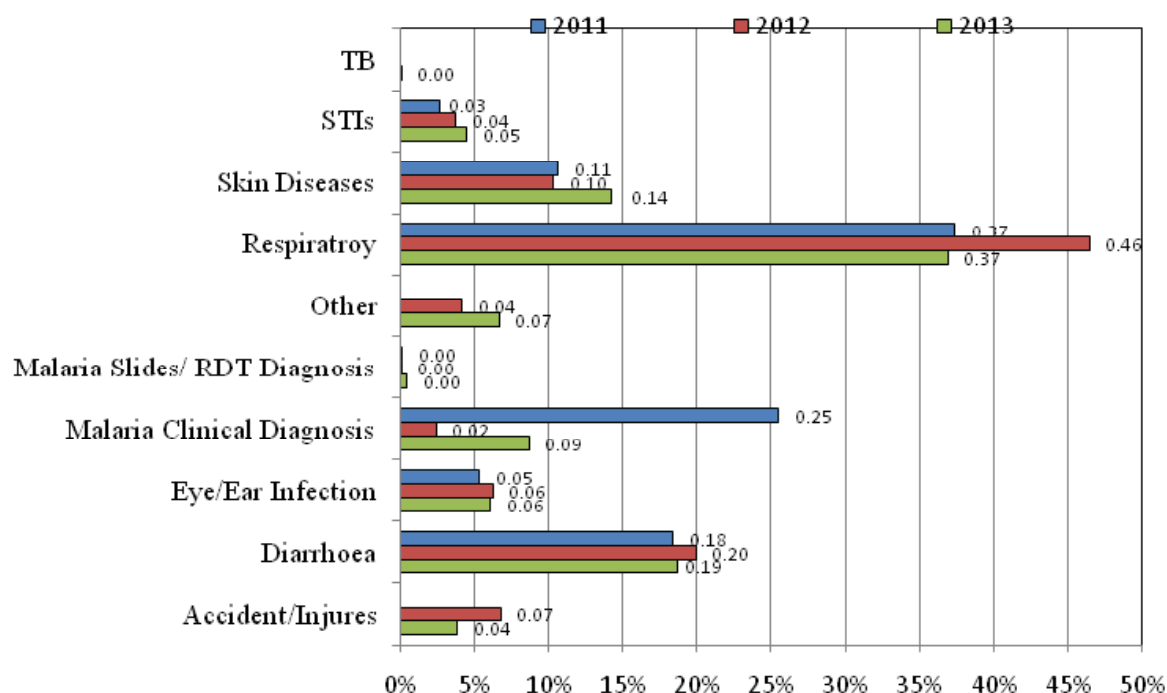


Figure 25 Mananda Clinic Morbidity, Hides, 2011-2013, iHDSS, 2013

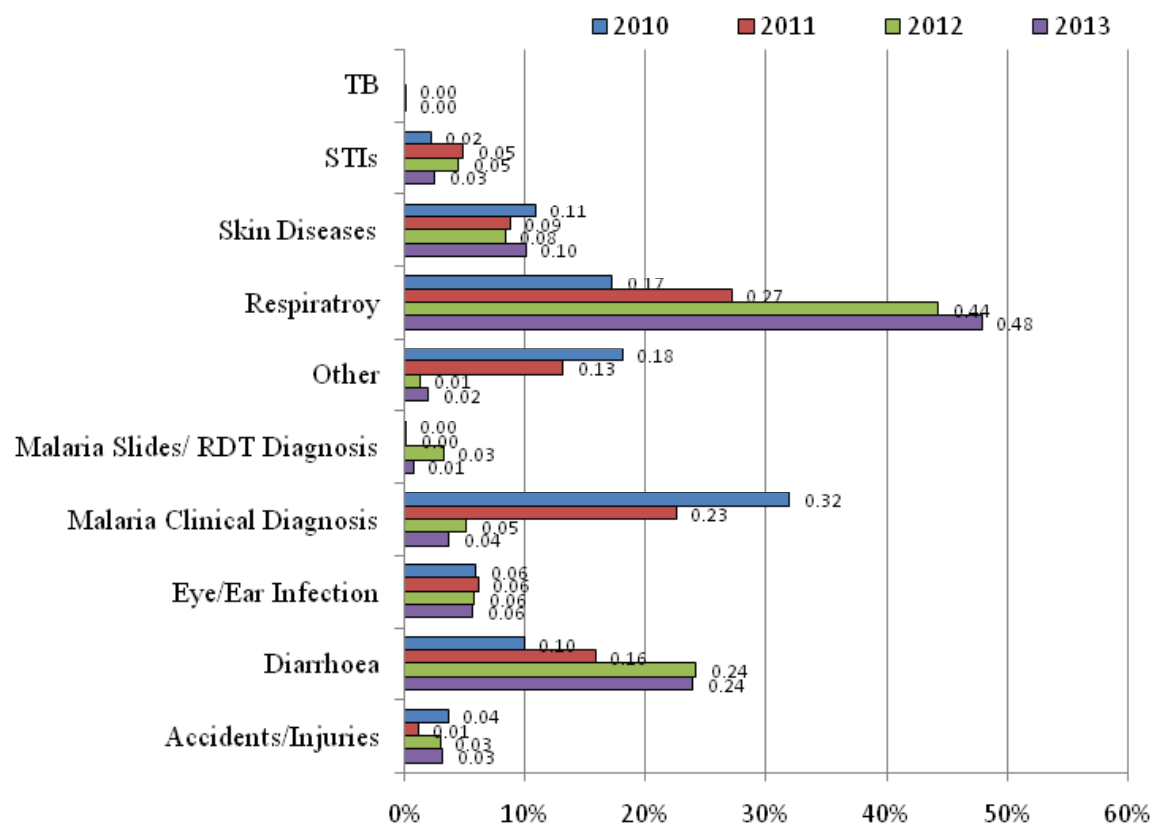


Figure 26 Para Clinic Morbidity, Hides, 2010-2013, iHDSS, 2013

The significant burden of respiratory and diarrheal diseases has increased over time in Hides. Diarrheal and febrile illness are under investigation through studies using new POM Lab. Descriptions of the febrile and diarrheal disease studies are in Chapter 4 of this report. Water and sanitation/hygiene are potentially significant contributors to the underlying diarrheal burden of disease, IMR has conducted a WASH (Water Sanitation Hygiene) survey in the first quarter of 2014 and the results will be presented in September 2014 report.

Asaro

Asaro morbidity data are described in this section (Figures 27-28). Asaro iHDSS is the comparison site for Hides.

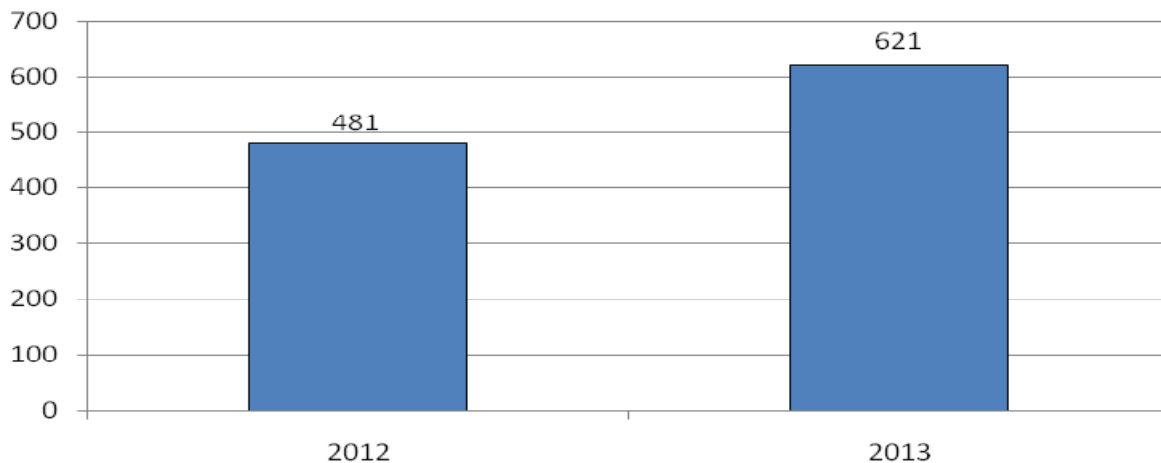


Figure 27 Average number of cases per month, Asaro health centre 2012-2013, iHDSS, 2013

*Excludes Family Planning and Immunization Services

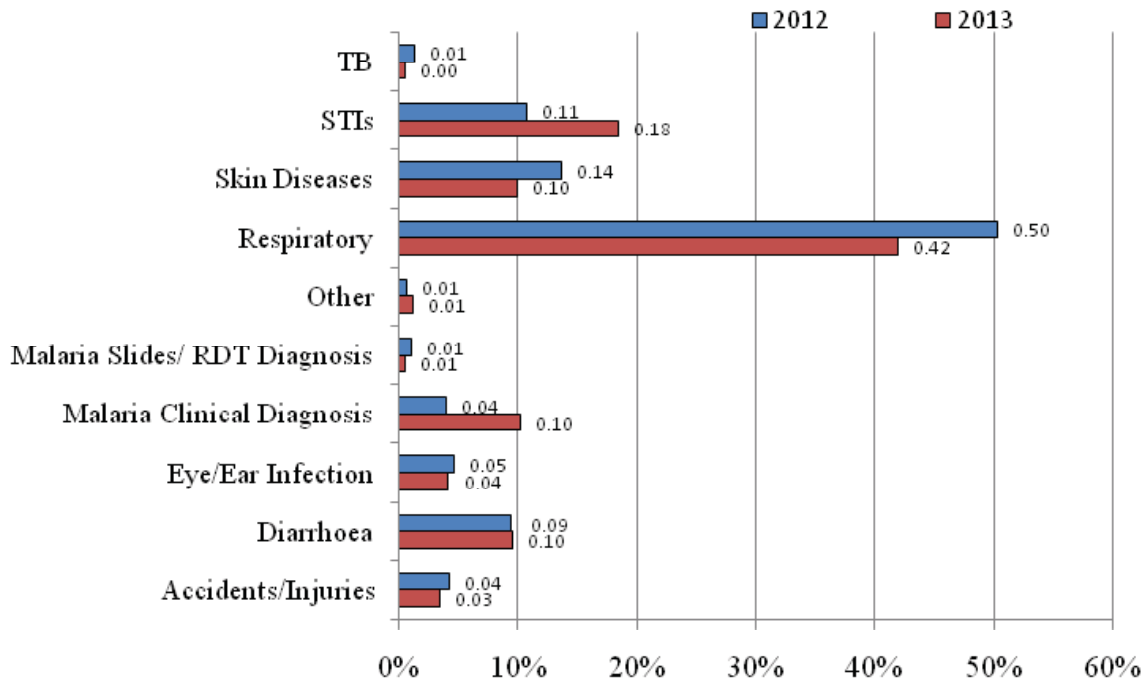


Figure 28 The causes of illness (%), Asaro, 2012- 2013, iHDSS, 2013

Similar to the other iHDSS locations, particularly Hides respiratory illness is the number one cause of illness reported by the health facility in Asaro iHDSS, followed by STIs and skin disease. Respiratory diseases declined from 50% in 2012 to 42% in 2013, while STIs increased from 11% to 18%. Diarrhoea remained unchanged, as did accident/injuries. Malaria clinical diagnoses increased while the Malaria RDT declined; however, there was an RDT supply chain problem in Asaro so these data should be viewed cautiously.

The non-impact Asaro iHDSS shows a rising demand for clinical services and a potential rise in STIs. Comparison to the Hides data demonstrates that respiratory illness still dominates the burden of disease in these highland locations. The high level of respiratory diseases is likely multifactorial including low immunization rates, indoor pollution exposures (cooking) and relatively high household occupancy levels.

Karkar

Over one third of the reported morbidity in Karkar is due to respiratory diseases. The rate of these diseases in 2013 was similar to 2012. Clinical malaria rate and malaria with RDT confirmed rate in 2013 were slightly lower than the rates in 2012. The reported skin disease, primarily due to yaws, was significantly increased in 2013 (Figure 29). The pneumonia (PNA) rate was increased from 2012 to 2013 (Figure 30).

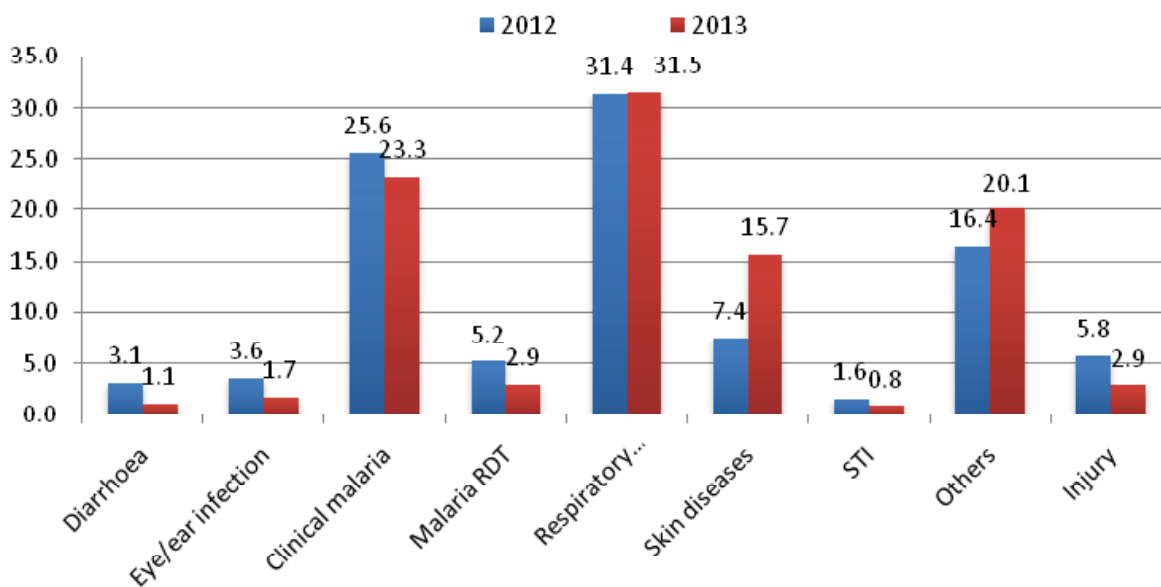


Figure 29 Morbidity as percentages of overall case load, Goubin hospital, Karkar iHDSS, 2013

2012= January to December 2012

2013 = January to June 2013

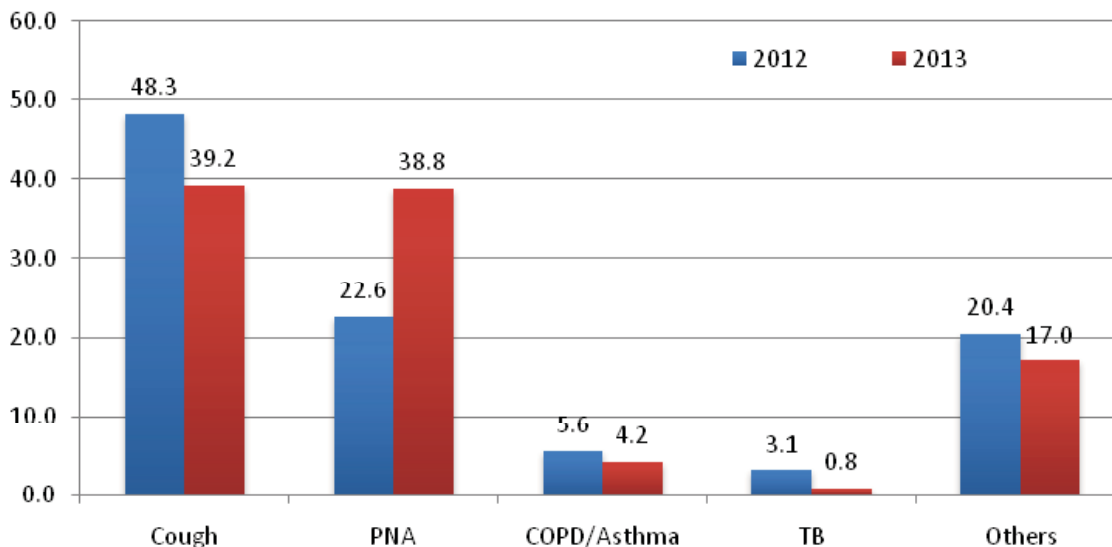


Figure 30 Respiratory diseases as percentages of overall respiratory illness case load, Goubin hospital, Karkar, iHDSS, 2013

Karkar Island morbidity data are just coming “on stream” and are expected to be more robust in future PNGIMR reports. The limited data again indicate that respiratory diseases dominate the reported clinical findings.



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ANNEXES

Papers

Gouda, H.N., Maraga, S., Rarau, P., Phuanukoonnon, S., Stewart, A.L., Serina, P., Ohno, S., Lorenzo, R., Murray, C., Lopez, A., Riley, I.R., Siba, P., Mortality and cause of death in Papua New Guinea. In Preparation

Reports

Gouda, H.N., Puanukoonnon, S., Siba, P. Report of Partnership in Health Project (PIH): 2011-2012. Goroka: PNGIMR, March, 2013

Conference Paper

1. Mortality and Cause of Death in four sites across Papua New Guinea. Gouda, H, Maraga, S, Rarau, P, Poka, H, Phuanukoonnon, S, Siba, P, Lehmann, D, Riley, I. Paper presented to the 49th Annual Medical Symposium, Lae, Papua New Guinea, 2-6 September, 2013.
2. Gouda, H.N., Maraga, S., Rarau, P., Phuanukoonnon, S., Siba, P., Stewart, A.L., Serina, P., Ohno, S., Lorenzo, R., Murray, C., Lopez, A., Riley, I. Mortality in transition: Causes of death in three sites in Papua New Guinea during 2011 and 2012. To be presented as a poster at the Second Global Congress on Verbal Autopsy in Rhodes 14-16 October 2013

Related Outcomes

1. An Internal Competitive Research Award was granted to Seri Maraga and Hebe Gouda (co-PIs) to conduct a qualitative study on the ethics surrounding verbal autopsy research methods in Papua New Guinea. This study is near completion and was presented at an international VA congress in October 2013:
2. Gouda, H.N., Maraga, S., Kelly, A., Wilson, L., Riley, I. Ethical and social issues affecting the implementation of verbal autopsy interviews in Papua New Guinea. To be presented at the Second Global Congress on Verbal Autopsy in Rhodes 14-16 October 2013
3. This work is also under preparation for publication and will be submitted to Social Science and Medicine within the next month.
4. The development of the PiHP iHDSS sites has reinvigorated an interest in past verbal autopsy studies conducted through the PNG Institute of Medical Research. A verbal autopsy instrument developed by IR Riley in the early 1970's at the foundation of the Tari surveillance unit has been employed at different sites in PNG up until 2001. A review of this data has been compiled and published:
5. Gouda, H.N., Lehmann, D., Riley, I.R. (2013) Measurement of Cause of Death in Papua New Guinea Populations using a locally developed verbal autopsy instrument: 1970-2001. Working Paper - Health Information Systems Knowledge Hub
6. Gouda, H.N., Lehmann, D., Riley, I.R. (2013) Measurement of Cause of Death in Papua New Guinea Populations using a locally developed verbal autopsy instrument: 1970-2001. To be submitted to International Journal of Epidemiology

Chapter 7

WEALTH ANALYSIS

Abstract

During the large-scale construction phase of the PNG LNG, residents of the Hides and Hiri impact sites have had substantial employment and business opportunities. How this economic opportunity is managed at a household level is extremely important and directly relevant to the goals of the PiHP. There is a strong and well-known relationship between socio-economic status and household level health status. The project construction activity has occurred over a multi-year year period (2009- present); however, peak construction has been passed (mid-2013) and a period of demobilization is ongoing. There will continue to be employment and economic activity during the 30+ years of operations but at much reduced scale – unlike the construction scale; therefore, it is extremely important to document, analyse and monitor both household/community level socio-economic status and its relationship to key health performance indicators. This chapter presents household and community wealth analysis comparisons across impact and control iHDSS locations based on an extensive socio-economic survey (SES).

Introduction

Previous PNGIMR analysis (October 2013 PNGIMR progress Report) has shown that the socioeconomic status of the Hiri villages has changed over the past 6 years, i.e., baseline pre- LNG project to October 2013. However, demonstrating change from baseline is not the same as establishing causation. In order to demonstrate that the LNG project is a critical direct and indirect factor in the observed changes, the Hiri villages are compared to another set of coastal fishing villages that have had no direct or indirect impacts from the PNG LNG Project.

Karkar Island was selected as the control site for the Hiri villages. Karkar is a volcanic island located 30km off of the PNG coast in the Bismarck Sea and is part of Madang Province. The total population of Karkar is about 60,000. From a PNGIMR perspective, a sample of about 20,000 was felt to be fully representative of the overall island population. Karkar has been unaffected by the extensive and intensive mining activity that has occurred in Madang; hence, Karkar was felt to be an appropriate “coastal control/comparison community” that could be compared to Hiri District communities. Extensive demographic data for the Karkar Island iHDSS was reported in the October 2013 PNGIMR Report.

Methods and Materials

The methodology used to compare the socioeconomic status (SES) of the Hiri (LNG) Villages and Karkar Island villages was extensively described in the October 2013 PNGIMR Report. The analysis is based on detailed socio-economic surveys performed in 2013. Traditional methods of wealth analysis rely on an examination of expenditure data. However, consumption expenditure analysis suffers from several problems that make it impractical as an analytic tool in the context of PNG, i.e., obtaining these data would be expensive, time consuming and logistically formidable. In order to avoid the complexities of expenditure data collection in developing country settings, researchers have looked for simpler surrogate metrics for describing household wealth. Asset analysis is an excellent surrogate metric and is a relatively simple and reliable proxy for household wealth. Rather than rely on a households spending over a given month, as is done in expenditure analysis, asset analysis looks at the accumulation of durable goods that exist at the household level. In a developing country setting, household wealth is an extremely strong predictor of a

variety of health outcomes; hence, the ability to “tie” together SES/wealth analysis and health is an extremely important function of the iHDSS.

Findings

Figure 31 shows the baseline wealth histogram for the villages analysed by the 2013 Karkar Island socio-economic surveys. Multiple Correspondence Analysis (MCA) techniques are used in the analysis. Households that are relatively wealthy will have a larger number of assets in both count and value. Certain assets will group together and will have a large impact on whether or not an individual household is considered poor or wealthy, while other assets will have minimal effect. Typically, assets (e.g., pots/pans, blankets) that nearly everyone has will have no impact on wealth, while assets that few people have (e.g., computers, TVs) may indicate a wealthy household. Conversely a household lacking an asset that most others have will likely “place” a household at a lower wealth level in an overall forced ranking of all households in a defined geographical area.

For this analysis, a total component score of -3 represents a high level of household poverty, while a score of positive 3 represents a high level of household wealth; a score of zero represents an average level of household wealth.

- A total component score of -3 represents a high level of household poverty
- A score of +3 represents a high level of household wealth
- A score of 0 represents an average level of household wealth

Over 90% of the households have a wealth score between -0.5 and 1.0. This means that while there is not a significant level of extremely impoverished households, the vast majority of the villagers live in relatively similar conditions, i.e., there are not major “wealth inequalities.”

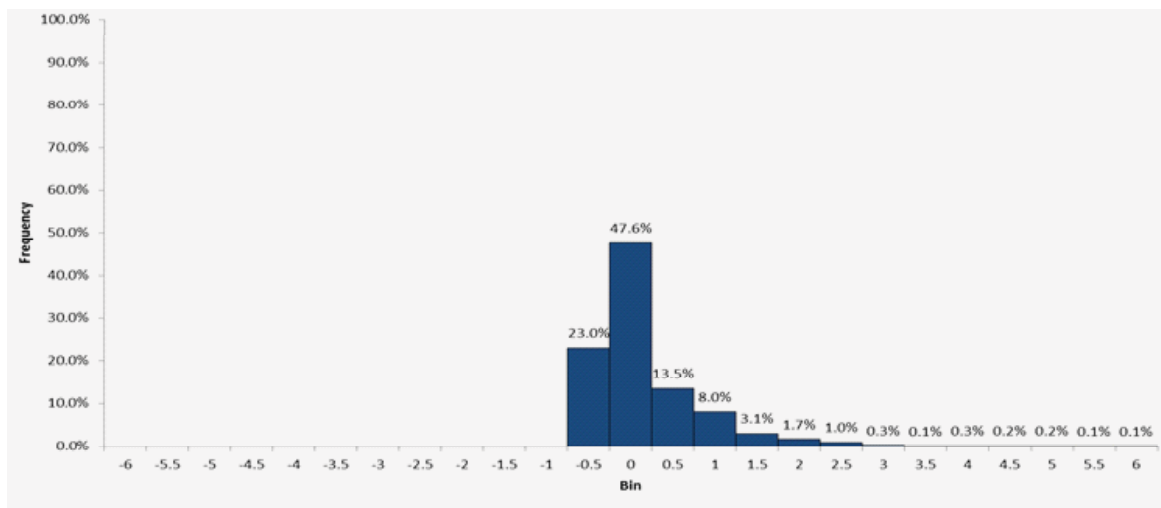


Figure 31 Histogram of First Principle Component, Karkar, iHDSS, 2013

Figure 32 shows the assets that contribute most to wealth or poverty for Karkar Island villages. These assets and their contributions to wealth or poverty will also be the same across all comparisons between Karkar Island and Hiri villages. Households that (i) lack goods that the majority of residents otherwise have (such as chairs, tables, and mobile phones) or (ii) do not live in permanent housing tend to have scores that indicate poverty. Households with permanent housing and its associated building materials, as well low cost durable goods tend to score above 0. In order to have a score above 1 and to be a part of the right side tail in Figure 31, a household must have electricity. Additional goods that require the use of electricity greatly increase the wealth score for a given household.

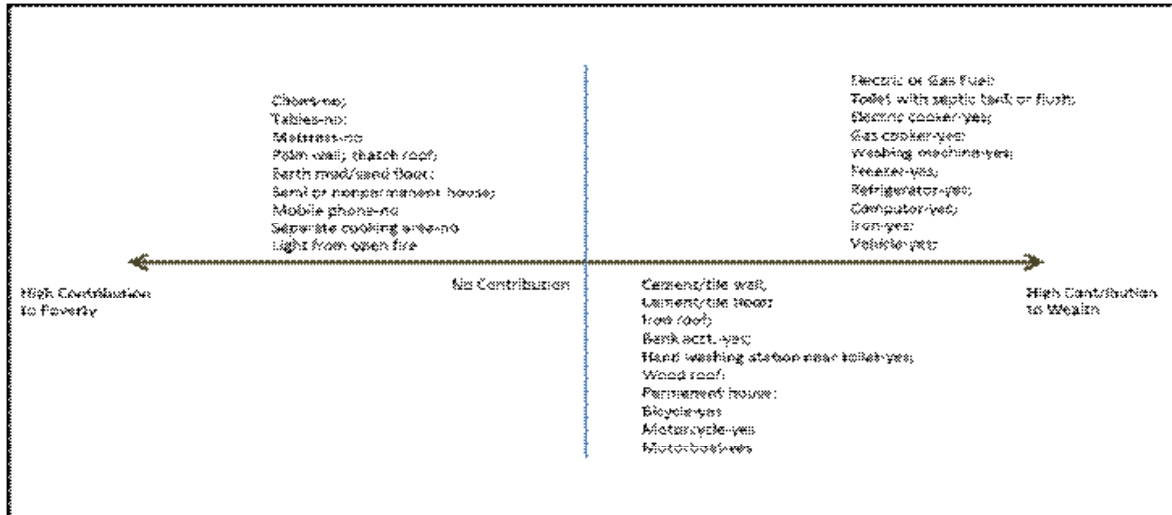


Figure 32 Asset Effect of Wealth-Karkar and Hiri Villages, iHDSS, 2013

Figure 33 shows the comparison of households with electricity for Karkar Island and Hiri villages. While a large percentage of households in the Hiri Villages have electricity, its presence is rare among Karkar households. As such, it should be expected that the Hiri villages will have higher wealth scores than their counterparts in Karkar.

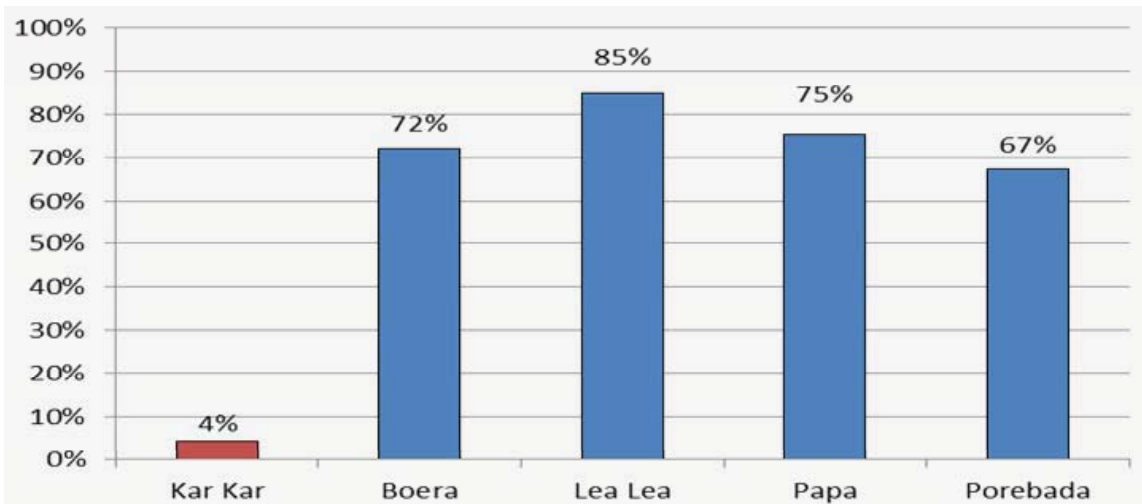


Figure 33 Percent of Households with Electricity, Hiri Villages v. Karkar, iHDSS, 2013

Figure 34 shows the SES comparison between the Karkar control size and the combined Hiri villages. The Hiri villages are substantially better off. As previously mentioned, the presence of electricity has the greatest effect on a household's wealth score. More Hiri residents have electricity than Karkar households; hence, the presence of electricity (and likely the presence of additional income afforded by the PNG LNG Project) allows for the purchase of assets that utilize electricity, such as sewing machines, refrigerators, and computers.

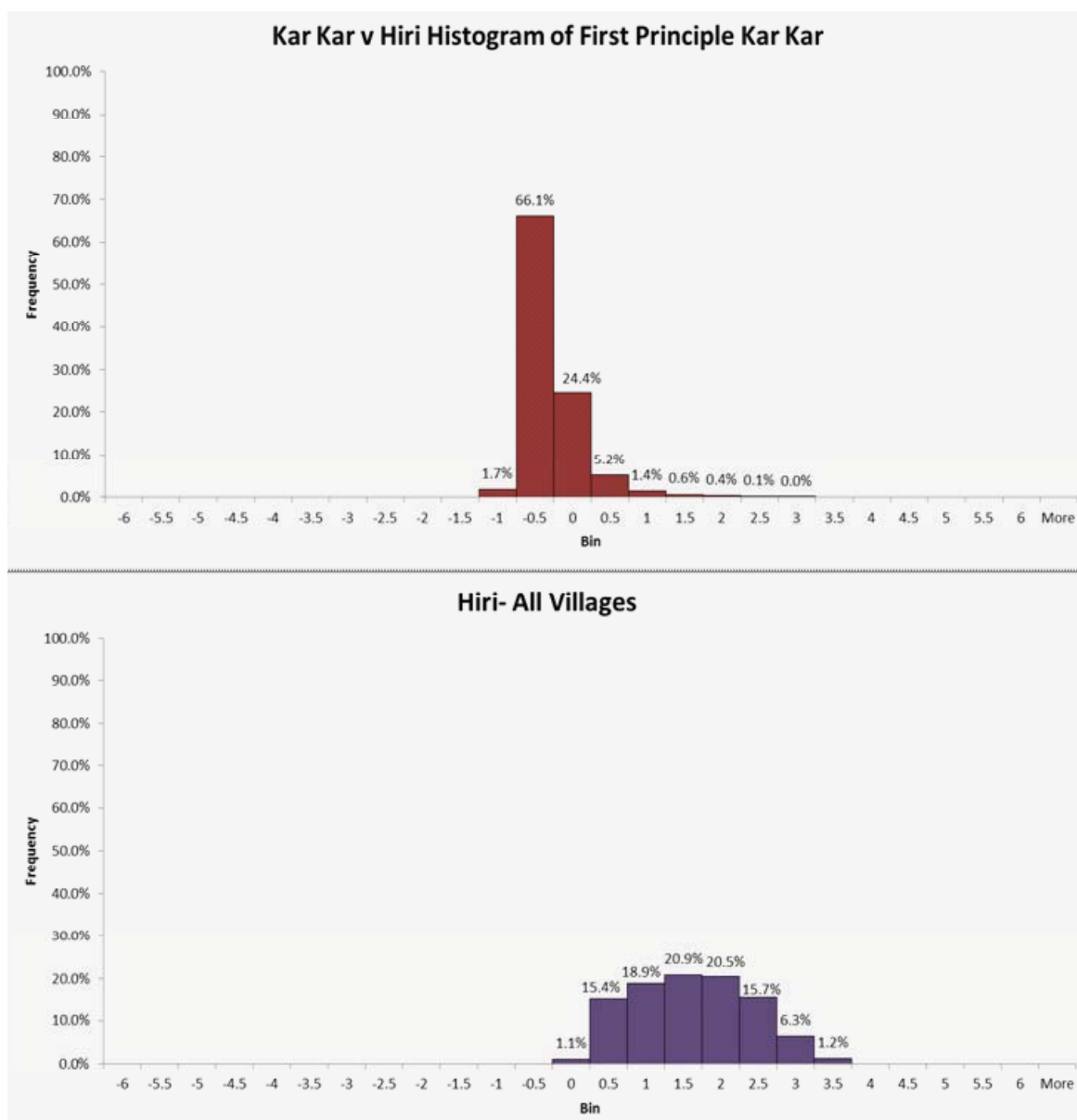


Figure 34 Histogram of First Principle Component, Karkar vs. Hiri, iHDSS, 2013

At the village level, Figure 35 shows the comparison of wealth scores between Lealea and Karkar. Lealea has a much longer tail of wealthy households than the other Hiri villages in large part due to having a higher percentage of residents with electricity. Thus, when compared to Karkar, Lealea scores are substantially higher, while the majority of Karkar residents are compressed into the two lowest sections. As seen in previous sections, the residents of Lealea own numerous electrically dependent appliances, the combination of which will affect each household's wealth score.

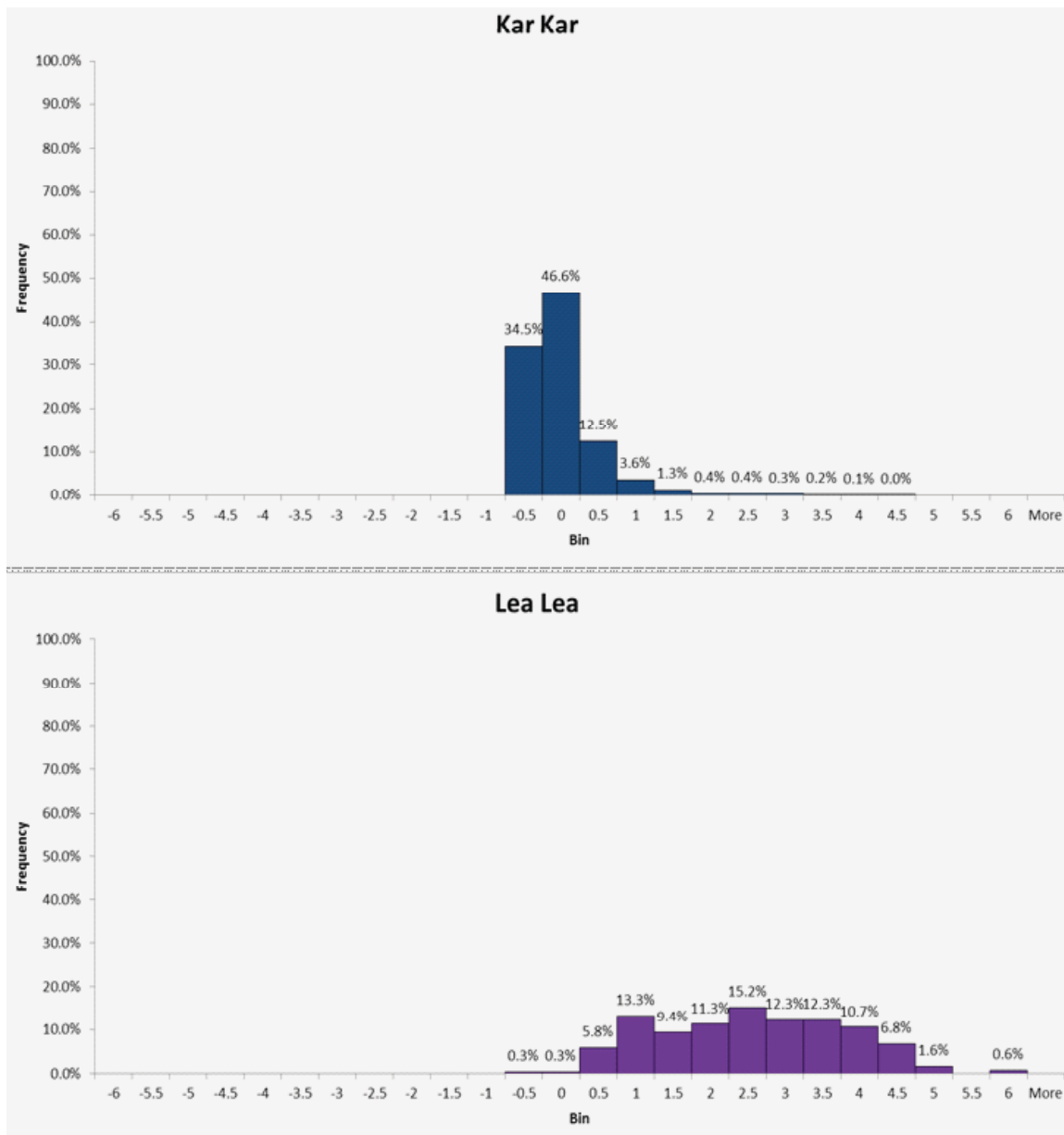


Figure 35 Histogram of First Principle Component, Karkar vs. Lealea, iHDSS, 2013

The comparison between Karkar and Papa is seen in Figure 36. There are relatively few differences when compared to Lealea, in part because of the two villages close geographical proximity. As has been seen in earlier sections, Papa is slightly poorer than Lealea; hence, the residents of Karkar are marginally better in comparison, with fewer residents in the -0.5 to 0 wealth score bin and more in the bins between values 0 and 1.5.

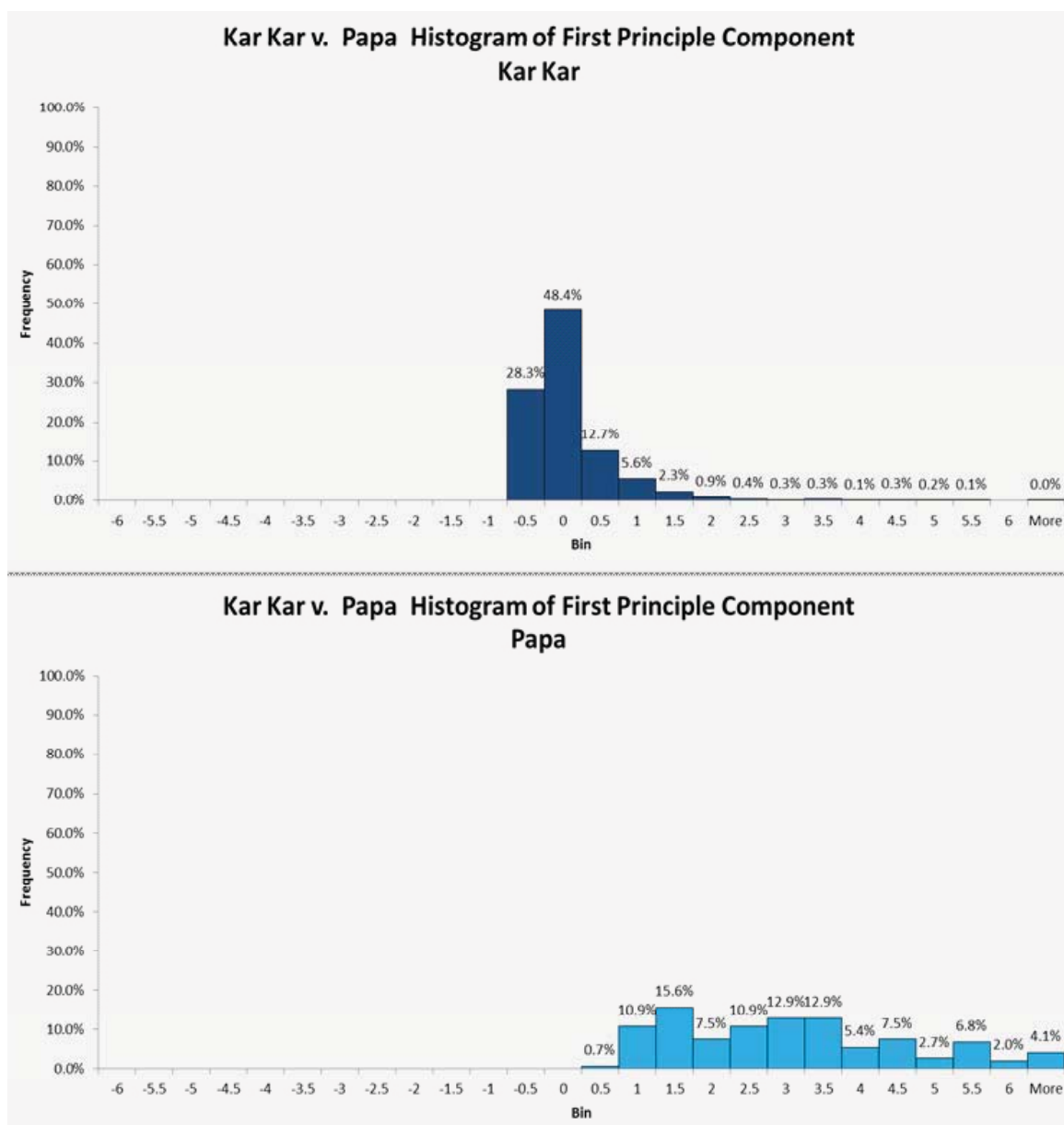


Figure 36 Histogram of First Principle Component-Karkar v. Papa 2013

Figure 37 shows the comparison of wealth scores between Karkar and Boera. Boera has a lower percentage of households with electricity than either Lealea or Papa; therefore, the residents of Karkar appear slightly better off when compared against Boera than when compared to either Lealea or Papa. Nevertheless, Boera households are substantially better off the Karkar households due to the large disparity between the two villages in the percentage of households with electricity.

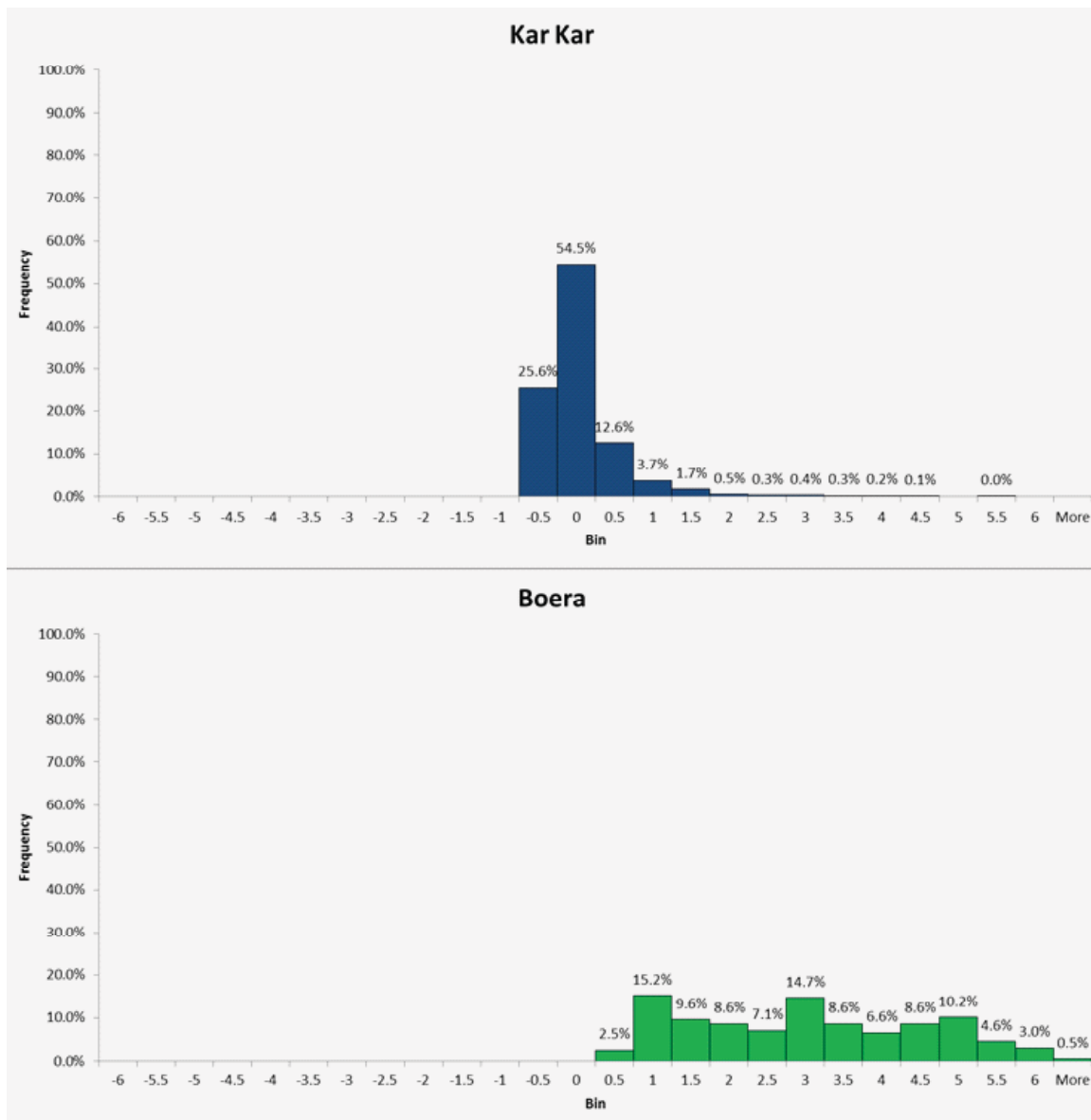


Figure 37 Histogram of First Principle Component, Karkar vs. Boera, iHDSS, 2013

The final comparison of Karkar against the individual Hiri villages is presented in Figure 38, which shows Karkar compared against Porebada. Porebada is the largest village in terms of population and has the most impact on the overall comparison between Karkar vs. overall Hiri. Karkar is substantially poorer than Porebada. Porebada has more residents with electricity in absolute terms. The effect of this is to shift more households in Karkar to the poorer bins when compared against a typical Hiri village.

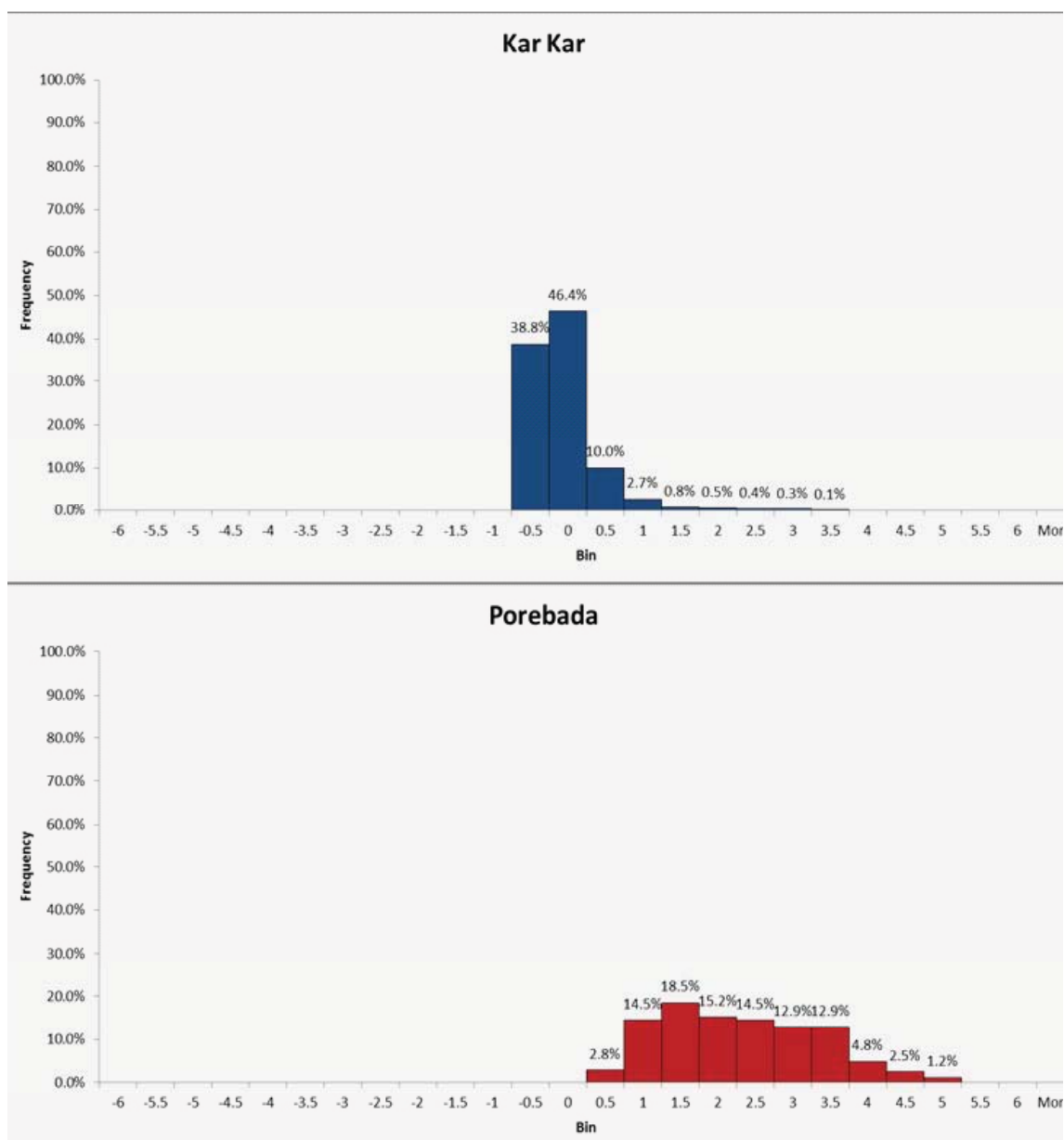


Figure 38 Histogram of First Principle Component-Karkar v. Porebada 2013

Discussion

Hiri versus Karkar Island Villages

Figures 29-30 have clearly shown that the LNG villages are substantially better off than the Karkar control villages. The main driver between the wealth scores is the presence of electricity that can be readily leveraged for consumer durable spending. Hiri residents are able to purchase the electrically powered goods that contribute to high wealth scores. Therefore, the increased income flowing into Hiri via PNG LNG Project can be readily used by households for consumer durable purchases. In the October 2013 PNGIMR Report, the marked positive changes, relative to pre-PNG LNG baseline, in Hiri consumer durable ownership was presented. In contrast to Karkar, Hiri villages demonstrate an overall wealth pattern consistent with an urban population that has converted to a wage economy. The PNG LNG Project has clearly accelerated this transformation from a mixed subsistence wage economy to a full-fledged urban lifestyle. As will be seen in subsequent chapters of this report, Hiri morbidity and mortality disease data generally confirm that the epidemiological transition, i.e., the movement from infectious diseases to non-communicable diseases is well underway. Hence, socio-economic and health data are generally aligned and epidemiologically coherent.

Asaro Valley Control Site Comparisons to Hides Villages

In parallel fashion to Karkar-Hiri, the Hides divisions are compared against a control site in order to understand the economic and health effects that the PNG LNG Project has had at a household and community level. The Asaro Valley is located in the Eastern Highlands and is unaffected by the PNG LNG Project. Hence, Asaro Valley allows for a “highlands to highlands” comparison. The 2013 population in Asaro iHDSS is 14197 from 2976 households. The iHDSS covers 26 villages in Asaro valley.

The baseline wealth scores for Asaro are given in Figure 39. The majority of residents have a score between -0.5 and 0.5. There is a substantial tail that shows that there are a small percentage of residents who are substantially better off than the majority of villagers.

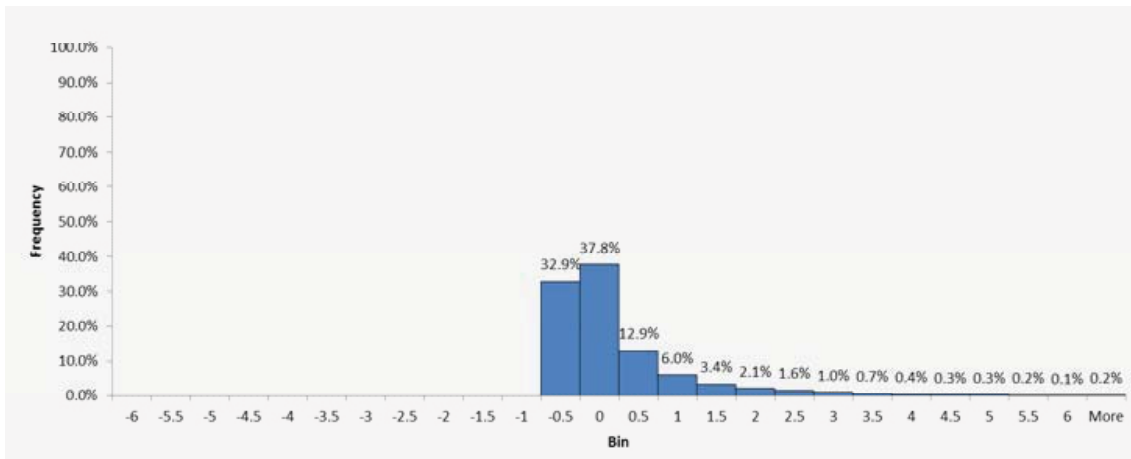


Figure 39 Histogram of First Principle Component-Asaro 2013

The assets (or lack of assets) that contribute most to either wealth or poverty are presented in Figure 40. Similar to the Karkar vs. Hiri villages' comparison, electricity and electrically powered goods contribute the most towards wealth. The ownership of basic assets such as tables and chairs increase the likelihood that a household will be on the positive side of a wealth score of zero, whereas the absence of such assets, as well as non-permanent housing building materials (i.e., “bush materials”) increases the likelihood that a household will have a wealth score of less than zero. The assets that contribute towards wealth or poverty are the same for Asaro as they are for each division of Hides.

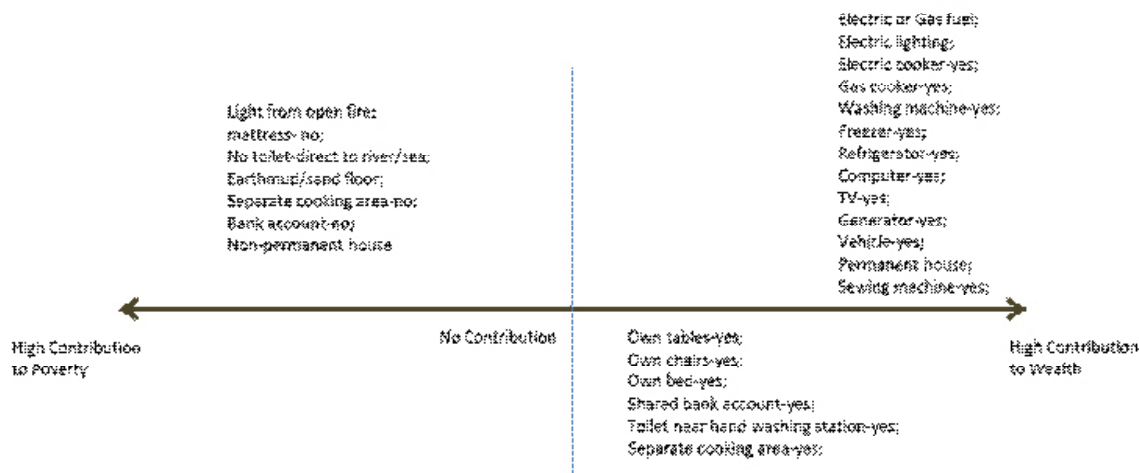


Figure 40 Asset Effect of Wealth-Asaro and Hides Villages, iHDSS, 2013

Figure 41 shows the overall comparison of wealth scores between Asaro and Hides. Both Asaro and Hides have substantial tails on the right hand side, indicating a small minority of relatively wealthy residents. These are the residents with electricity and account for 1-3% of the population depending on the division of Hides. The big difference between the two areas occurs within the -0.5 and 0.5 wealth scores. In Asaro, there are more households with a score between -0.5 and 0, whereas in Hides there are more residents with a score between 0 and 1.

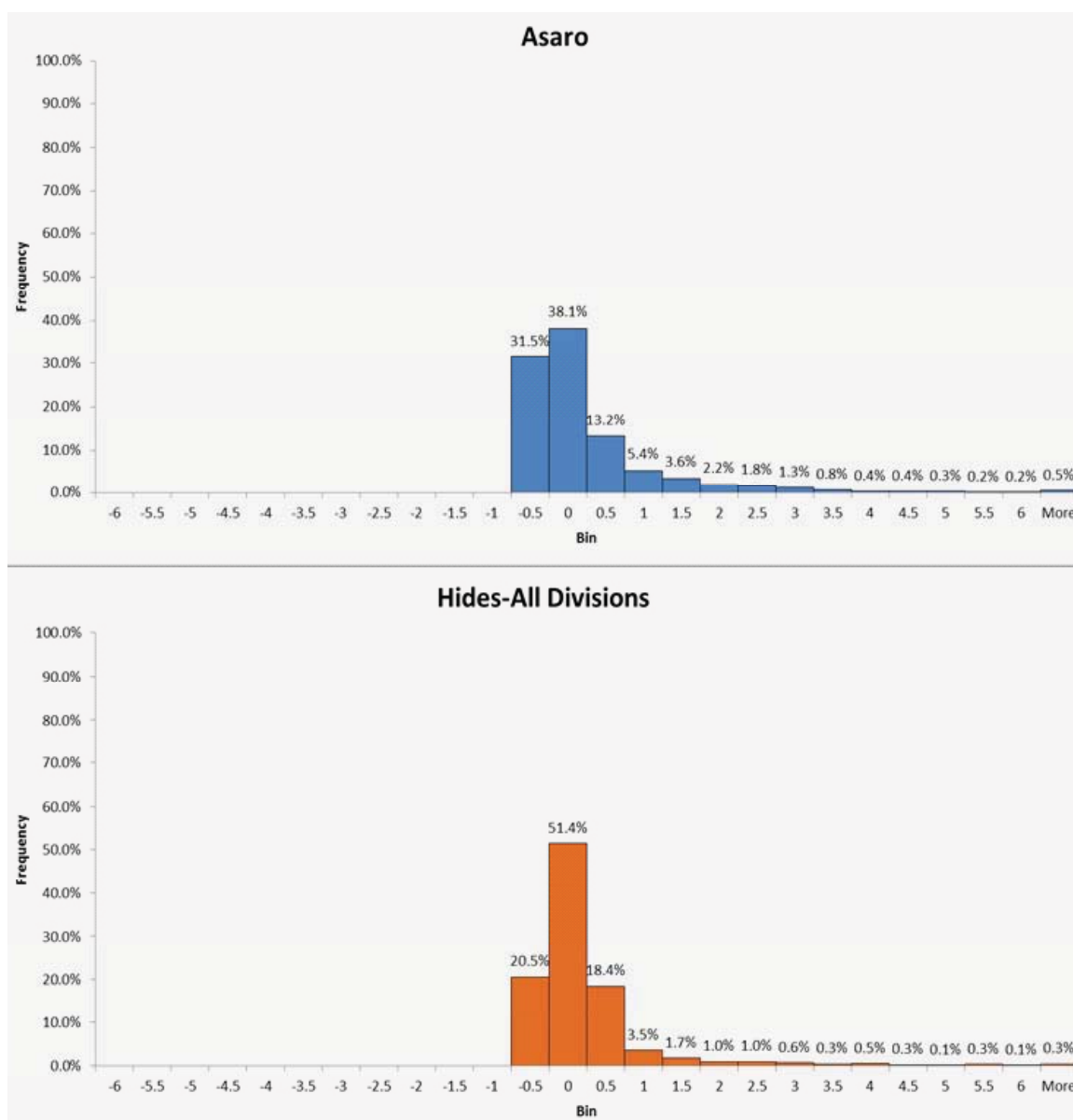


Figure 41 Histogram of First Principle Component, Asaro vs. Hides, iHDSS, 2013

Figure 42 shows the wealth score comparison between Asaro and Hides Division 1. There are more people in the right side tail in the Asaro histogram; however, there are fewer people in the -0.5 bin and more people in the 0 and 0.5 bins in the Hides Division 1 histogram. This would indicate that, on average, the residents of Hides Division 1 are slightly better off than the residents of Asaro.

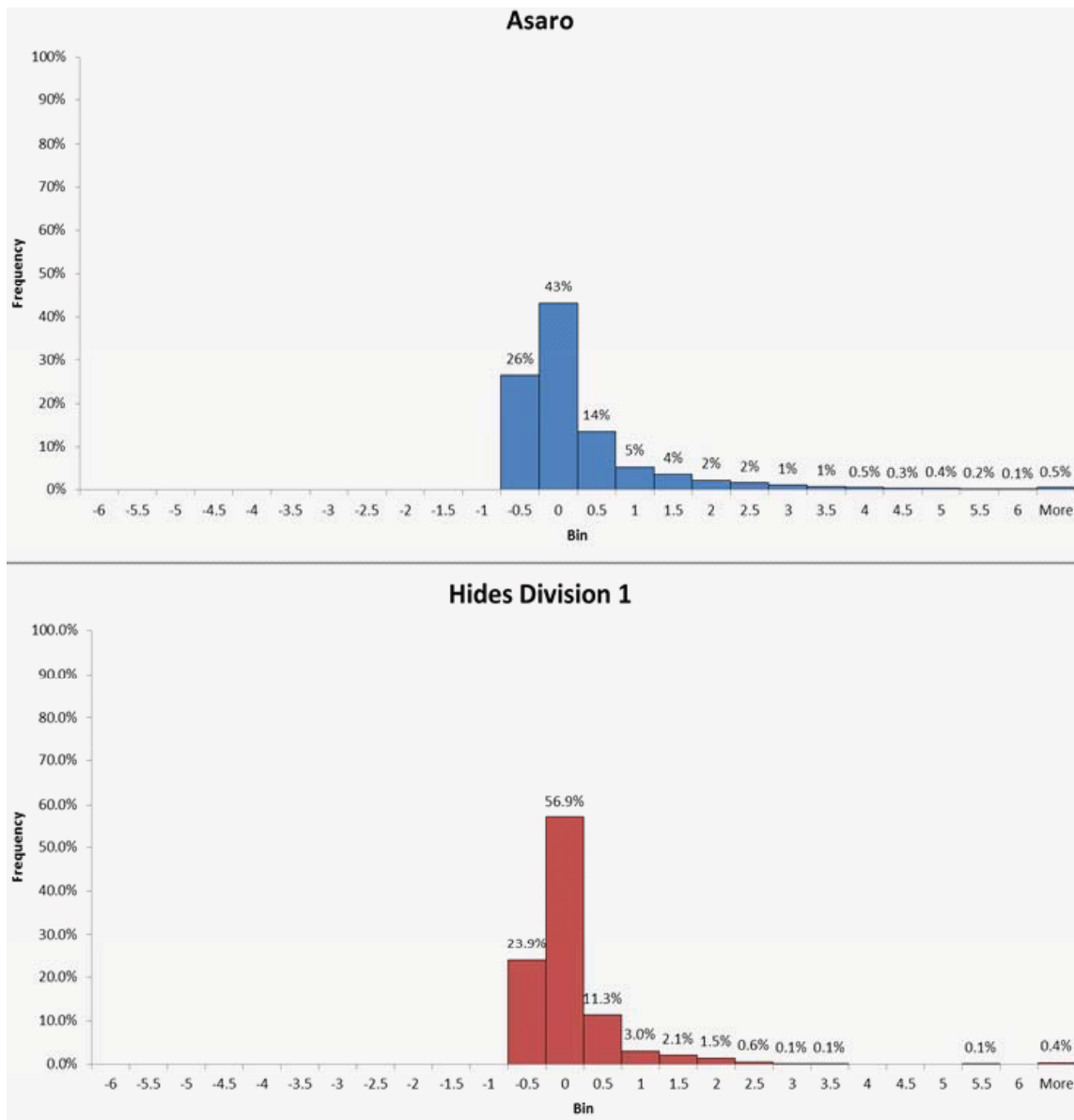


Figure 42 Histogram of First Principle Component, Asaro vs. Hides, Division 1, iHDSS, 2013

Wealth comparisons for Asaro and Hides Division 2 are presented in Figure 43. The trend is similar to that of Asaro vs. Hides Division 1: though there are fewer very wealthy residents, there are also fewer very poor residents, as bin -0.5 is 10 percentage points smaller in Hides D2 than in Asaro. This would indicate that the residents in Hides Division 2 own more low-cost assets (such as tables, chairs, mobile phones), or have slightly better housing components (such as a separate cooking area) than their counterparts in Asaro.

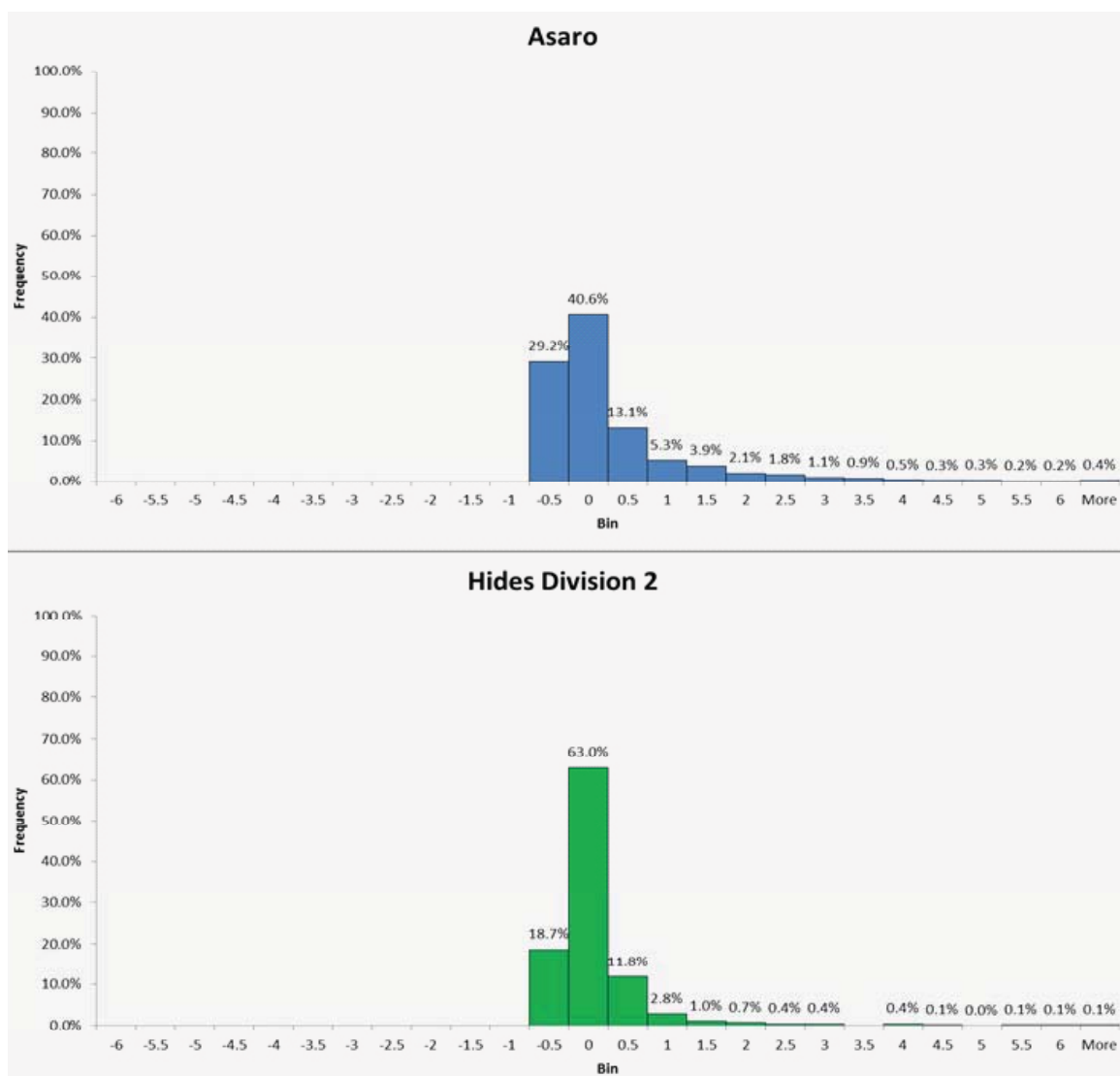


Figure 43 Histogram of First Principle Component, Asaro vs. Hides, Division 2, iHDSS, 2013

The comparison between Asaro and Hides Division 3 is given in Figure 44. Hides Division 3 has substantially fewer people (over 37 percentage points) in the -0.5 bin than Asaro, and has significantly more people in the 0.5 wealth score bin (nearly 16 percentage points). The right sided tails of the two areas, i.e., those residents with electricity, remain similar for the two areas.

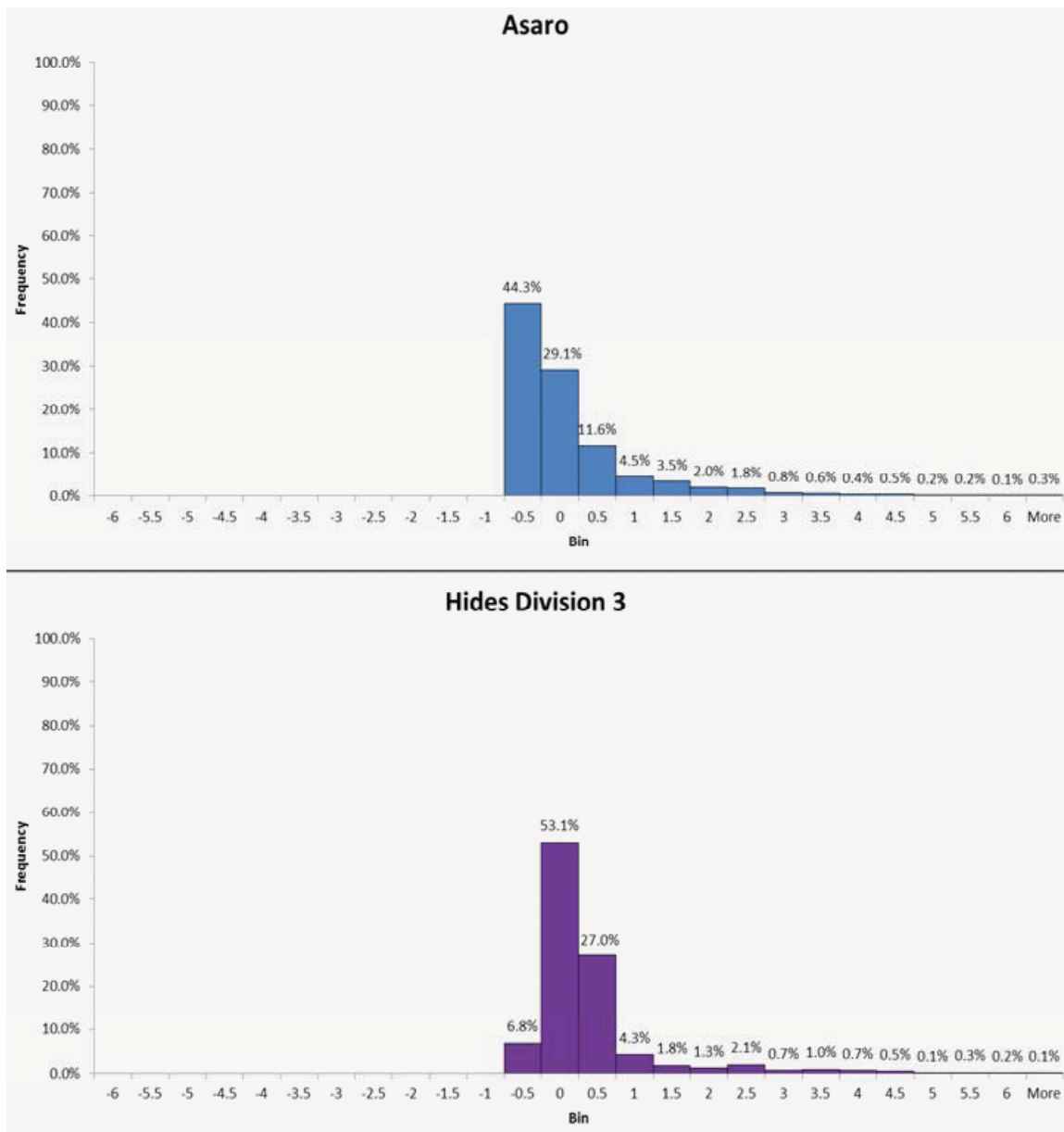


Figure 44 Histogram of First Principle Component, Asaro vs. Hides, Division 2, iHDSS, 2013

Hides versus Asaro

Figures 39-44 indicate that Hides is 'wealthier' than Asaro. Because of the lack of electricity throughout most of the Hides and Asaro areas, the distribution tails are similar. The big difference in wealth scores occurs at the low end, where Asaro has more people in the -0.5 bin. In contrast, there are more people in the 0 and 0.5 wealth score bins in Hides. The PNG LNG Project has had a noticeable effect at a household level on the wealth pattern in Hides. The lack of electricity impacts both sites; however, Hides households are much more likely to purchase basic goods like mattresses and bed nets than the households in Asaro. Poverty reductions are present; however, the pattern is much more consistent with consumables rather than durables. While there is a clear positive impact, the sustainability of these household level changes is uncertain as the PNG LNG moves from large-scale construction, (with associated large workforces) to operations where labour force levels will be much lower. The durability of household items is another factor. Buying cheap Asian products that do not last may right now illustrate some level of high income/wealth but in a few years' time when they no longer work or are discarded the picture will be different. Extent of sustainability is contingent on durability of household items as well.

Conclusion

The October 2013 wealth analysis evaluated Hiri and Hides in detail. This analysis has been further extended and now includes a comparison between the impact Hiri and Hides iHDSS locations and the comparison sites at Karkar Island and Asaro. Hiri wealth status is consistent with an urbanized, wage economy development pattern. This is in marked contrast to Karkar that is far more typical of a coastal subsistence pattern. Hides and Asaro are more similar although there appear to be significant gains in wealth across Hides that have occurred since the original baseline social impact assessment surveys. The Hides changes are driven by an increase in consumables spending which could rapidly decline as peak PNG LNG construction is over and rapid demobilization is occurring. Future follow-up surveys will be able to clarify whether the observed changes are transient or permanent.

Chapter 8

PROJECT INDUCED IN-MIGRATION (PIIM)

Abstract

Project induced in-migration (PIIM) is a critical concern for any large development project. Given the size and magnitude of the PNG LNG Project, there is a natural focus on problems such as pressure on land, health and education infrastructure, housing and food inflation and disturbances in community social cohesion. PIIM is monitored using both iHDSS survey data and sequential remote sensing satellite imagery.

Overall Hiri in-migration is noted; however, levels are relatively stable. Nevertheless, there are marked individual village differences. A significant birth boom has occurred particularly in Boera village. Hiri in-migration does not appear driven by immediate PNG LNG employment. Family, marriage and availability of education opportunities are significant factors. The potential role of establishing future LNG royalty/benefit streams is unknown. Hides in-migration was noted in the October 2013 and this has continued and is further documented by the substantial “building boom” that has occurred within three kilometres of major PNG LNG construction sites. Whether the observed new construction will be permanent is uncertain.

Introduction

Project induced in-migration (PIIM) is a critical concern for any large development project. Given the size and magnitude of the PNG LNG Project, there is a natural focus on problems such as pressure on land, health and education infrastructure, housing and food inflation and disturbances in community social cohesion.

The iHDSS has an important, but not exclusive, role in providing objective analysis of PIIM. The iHDSS systematically and regularly collects important demographic and socio-economic data at a household level. In a developing country setting, the iHDSS is the internationally recognized system for gathering and reporting vital statistics.

In conjunction with other PNG LNG activities, the iHDSS data can be utilized to understand whether in-migration is occurring and at what level. The iHDSS data is an important information source that can be utilized to confirm or dispute other information streams such as individual community member interviews and observations made by third party observers.

Within the iHDSS system, in and out migration data is obtained by household surveys. Typically the in-migration data has greater reliability and salience than the out-migration data. This situation occurs because there is often an extremely high rate of “non-response” to the question of why an individual left a household, i.e., marriage, education, illness, personal reasons, etc. The non-response rate for in-migration tends to be far lower and the information is significantly easier to obtain. Household in and out-migration can be cross checked by sequential comparisons to overall community population. In addition, the iHDSS also collects mortality and birth data. Hence, there is an ability to triangulate the in/out migration data with other objective sources of information. No survey system is perfect and there will always be a level of uncertainty with the data. Therefore, it is important to look at longitudinal trends not just a snapshot in time.

Materials and Methods

The PNGIMR March 2014 report has utilized several data streams for PIIM analysis:

- Core demographic data collected at the household level, including age and sex, births and deaths
- Formal in/out migration questions including reason(s) for entering or leaving a household/ community, e.g., education, employment, marriage, etc.
- Sequential high resolution satellite imagery- structural counts and changes in land use

PNGIMR has established formal iHDSS activities in Hiri, Hides and two matched control sites, Karkar Island and Asaro Valley. This report update is focused on the LNG villages (Hiri) and Hides areas. Data for the control sites will be available in subsequent PNGIMR reports.

Hiri (LNG Villages)

The four LNG villages, Boera, Papa, Lealea and Porebada, have had population census surveys performed in 2011 and 2012 by IMR. In addition, a large socio-economic census style survey was completed in 2013. Local reporters follow up households in the iHDSS every three months. During these visits the reporters record any in or out migrations, pregnancies, births and deaths. The current analysis includes data obtained from the end of November 2013 survey update. The survey data are a snapshot and provide information since the last household survey and do not represent cumulative trend information.

Findings

According to the November 2013 survey, there were 106 out migrations and 46 in migrations recorded. The out migration data are shown below in Table 46.

Table 46 Out-migration Hiri villages, iHDSS, 2013

	Number of Males	Number of Females	Out-Migrants as Percent of total 2013 Population	Percent of Eligible population working for LNG
Porebada	8	13	0.4%	9.7%
Boera	0	1	0.1%	33.5%
Papa	15	14	1.7%	24.3%
Lealea	30	25	1.8%	11.8%
Total	53	53	0.9%	15.8%

As illustrated by these data, Lealea and Papa saw the most out-migration both in absolute terms and as a percent of their 2013 population. Boera saw the least out-migration. Boera has the highest percentage of its eligible population employed by the PNG LNG project

Villagers with a non-response in gender are excluded in Table 47 and 48, but included in Table 49. The other/ unknown category is derived from summing up the “don’t know”, “not relevant” and “no response” categories and subtracting the total number of births. Surprisingly, in-migration triggered by “work” accounted for very few of the overall recorded responses.

Table 47 In-migration among males, Hiri villages, iHDSS, 2013

Reason for migrating in/return	Porebada	Boera	Papa	Lealea	All
Work	1	2	1	2	6
Education	1	0	3	0	4
Marriage	5	18	0	4	27
Divorce/Separation	1	1	0	0	2
Moving with parents	20	42	14	22	98
Moving with husband/wife	0	4	2	2	8
Travel to Give Birth	13	38	3	18	72
Other/Unknown	53	24	53	99	118
Total	94	129	76	147	335

Table 48 In-migration among females by villages, Hiri, iHDSS, 2013

Reason for migrating in/return	Porebada	Boera	Papa	Lealea	All
Work	2	0	0	1	3
Education	2	1	3	1	7
Marriage	23	31	4	8	66
Divorce/Separation	2	2	0	1	5
Moving with parents	31	44	22	21	118
Moving with husband/wife	6	4	2	12	24
Travel to Give Birth	11	31	3	12	57
Other/Unknown	61	23	8	32	124
Total	138	136	42	88	404

Table 49 In-migration among population (both sexes) by village, Hiri, iHDSS, 2013

Reason for migrating in/return	Porebada	Boera	Papa	Lealea	All
Work	3	2	1	3	9
Education	3	1	6	1	11
Marriage	28	49	4	12	93
Divorce/Separation	3	3	0	1	7
Moving with parents	51	86	36	43	216
Moving with husband/wife	6	8	4	14	32
Travel to give birth	24	69	6	30	129
Other/Unknown	131	63	27	55	276
Total	249	281	84	159	773
Percent Increase from 2012 Population	4.5%	15.8%	4.9%	5.1%	6.4%

Overall the November 2013 survey data demonstrate that significant PNG LNG Project induced in-migration is not a major factor. This does not mean that in-migration has not occurred; rather, in-migration tends to be driven by family considerations, i.e., moving with parents and educational opportunities. Within the Hiri LNG villages, there are functional schools including secondary educational opportunities.

Yearly population data are also considered when evaluating longitudinal trends. Table 50 presents the 2011 to 2012 Hiri village census data and 2012 to 2013. Census data were collected in 2011, one year later (2012) and again in 2013 as part of the standard iHDSS protocol. Hiri villages appear to be undergoing another growth spurt. While Papa and Lealea had a decline in their 2012-2013 growth rate, this trend is reversed when looking at the 2012-2013 rate. Boera has seen a substantial increase in its growth rate from 2012-2013; however, this is likely an artefact of its low population size. Much of this growth can be attributed

to an increase in the number of births in each village. The additional revenue families are receiving through project employment or remittance payments may be responsible for causing a “baby-boom.”

Table 50 Population data series, Hiri, iHDSS, 2011-2013¹⁴

Village	2011 Pop	2012 Pop	2012 Rate	2000-2011 Rate	2012-2013 Net change	2013 Pop	2012-2013 % change	2012-2013 Net change
Porebada	5109	5530	8.2%	1.3%	421	5984	8.2%	454
Boera	1733	1781	2.7%	2.7%	43	2141	20.2%	360
Papa	1675	1728	3.2%	5.7%	53	1865	7.9%	137
Lealea	3014	3109	3.2%	4.3%	94	3320	6.8%	211

Table 51 shows the number new entrants to each village, either through birth or in-migration. As can be seen, births represent around 40% of the total new entrants into villages. When one considers that nearly 30% of the non-birth in-migration came from the ‘moving with parents’ category (Table 49), it becomes clear that a significant portion of the in-migrants are children. Again, the presence of a functioning school system is likely an important driver of household behaviour.

Table 51 New entrants to villages by type, Hiri, iHDSS, 2013

Village	Births	In-Migrants	Total Entrants	% Births
Porebada	169	249	418	40.4%
Boera	73	281	354	26.0%
Papa	53	84	137	38.7%
Lealea	99	159	258	38.4%

Table 52 shows the natural rate of increase for the Hiri Villages (i.e., the growth rate without in-migration and out-migration), defined as “births per thousand people less deaths per thousand people.” Boera has the highest natural rate of increase among the four villages due to its high birth rate.

Table 52 Natural Rate of Increased Population, Hiri, iHDSS, 2013¹⁵

	Porebada	Boera	Papa	Lealea	All
Births	169	73	53	99	394
Deaths	60	15	10	35	120
2013 Population	5884	1858	1808	3286	12836
Crude birth rate (per1000 population)	28.72	39.29	29.31	30.13	30.69
Crude death rate (per1000 population)	10.20	8.07	5.4	12.3	9.3
Rate of natural increase in 2013 (per 1000 population)	18.52	31.22	23.91	17.83	21.39

Discussion

The in-migration and population data paint a complex picture that is best analysed at an individual village level rather than combining data across all villages. The overall Hiri natural rate of increase per thousand populations is generally as expected; however, this masks significant individual village differences. The different lines of data, e.g., surveys and satellite imagery, indicate that the four iHDSS villages are likely stabilizing in terms of population growth and land use trends. There is an obvious impact from the PNG LNG project in Boera, Papa and Lealea. These impacts are confirmed by the wealth analysis data. The situation in Porebada is more complex. Structure and wealth analysis indicate relatively low PNG LNG impacts. Historic population data do not indicate significant in-migration in Porebada; however, the 2012 population data appear to indicate a likely adult population influx. Further Porebada evaluation may be appropriate; however, it seems unlikely that the PNG LNG is the main driver of change in Porebada based on other lines of accumulated evidence, e.g., wealth and structure analysis, distance from LNG Project and LNG-related employment trends.

¹⁴The population recorded in Hiri iHDSS as well as other PiHP sites is updated on regular basis. This figure is not necessarily consistent with data reported in other Chapters.

¹⁵The population recorded in Hiri iHDSS as well as other PiHP sites is updated on regular basis. This figure is not necessarily consistent with data reported in other Chapters.

In-migration: Structure analysis-Hiri Villages

Additional remote sensing imagery for the Hiri region of PNG was obtained in May 2013. With the addition of these data, the change in the number and location of structures in the Hiri LNG villages can be sequentially analysed over 5 years using imagery from three time periods: Q1 of 2008, Q1 2012 and Q2 2013. Figures 34-38 show the structures and their creation date for Kido, Lealea, Papa, Boera and Porebada. Kido is considered to be an “LNG village” for this analysis as it falls within 5 kilometres of the offshore pipeline. However, Kido is not part of the iHDSS and is not connected by a land route to the other villages.

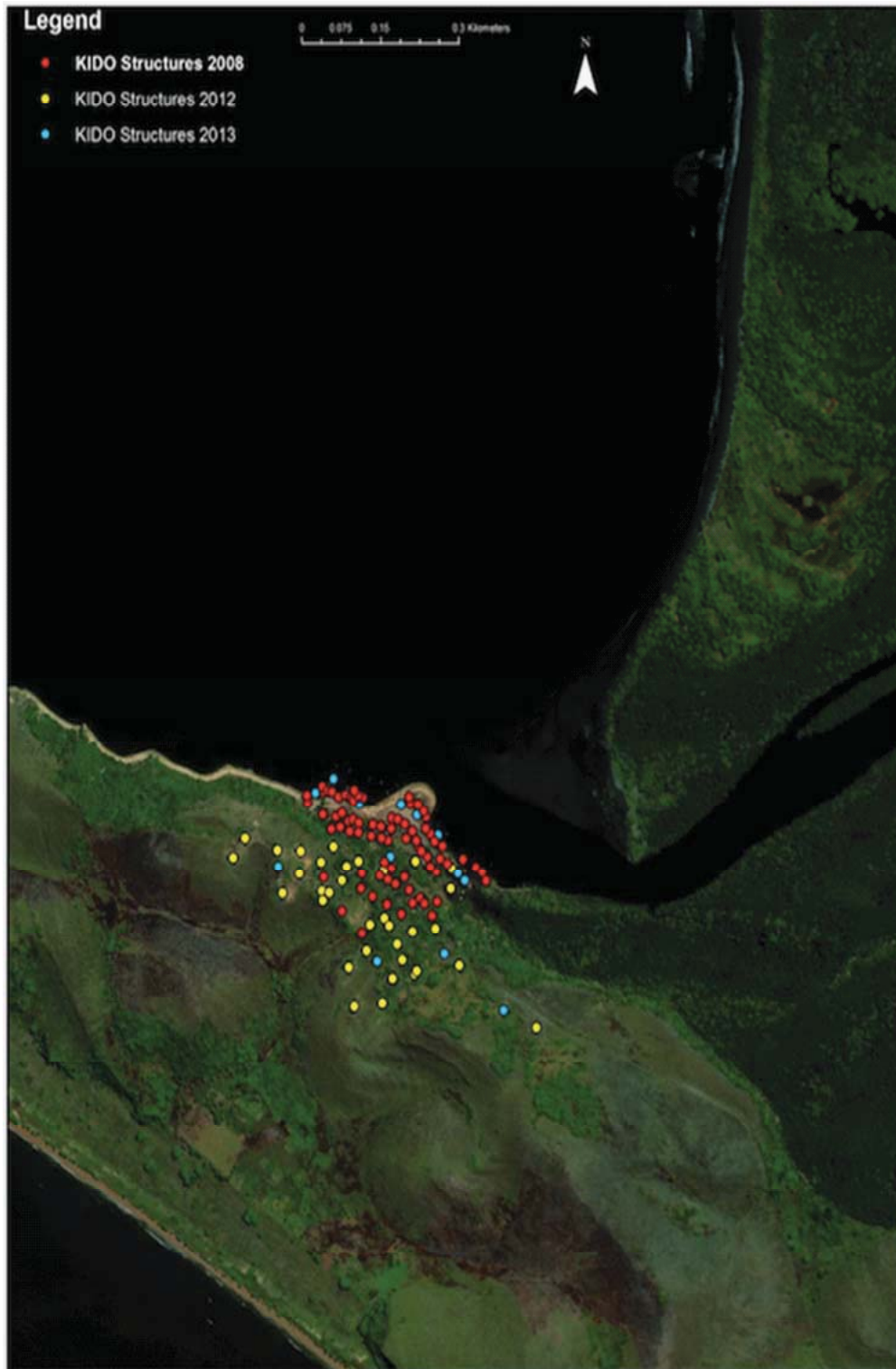


Figure 45 Kido Structures over Time, 2008, 2012, 2013, iHDSS, 2013

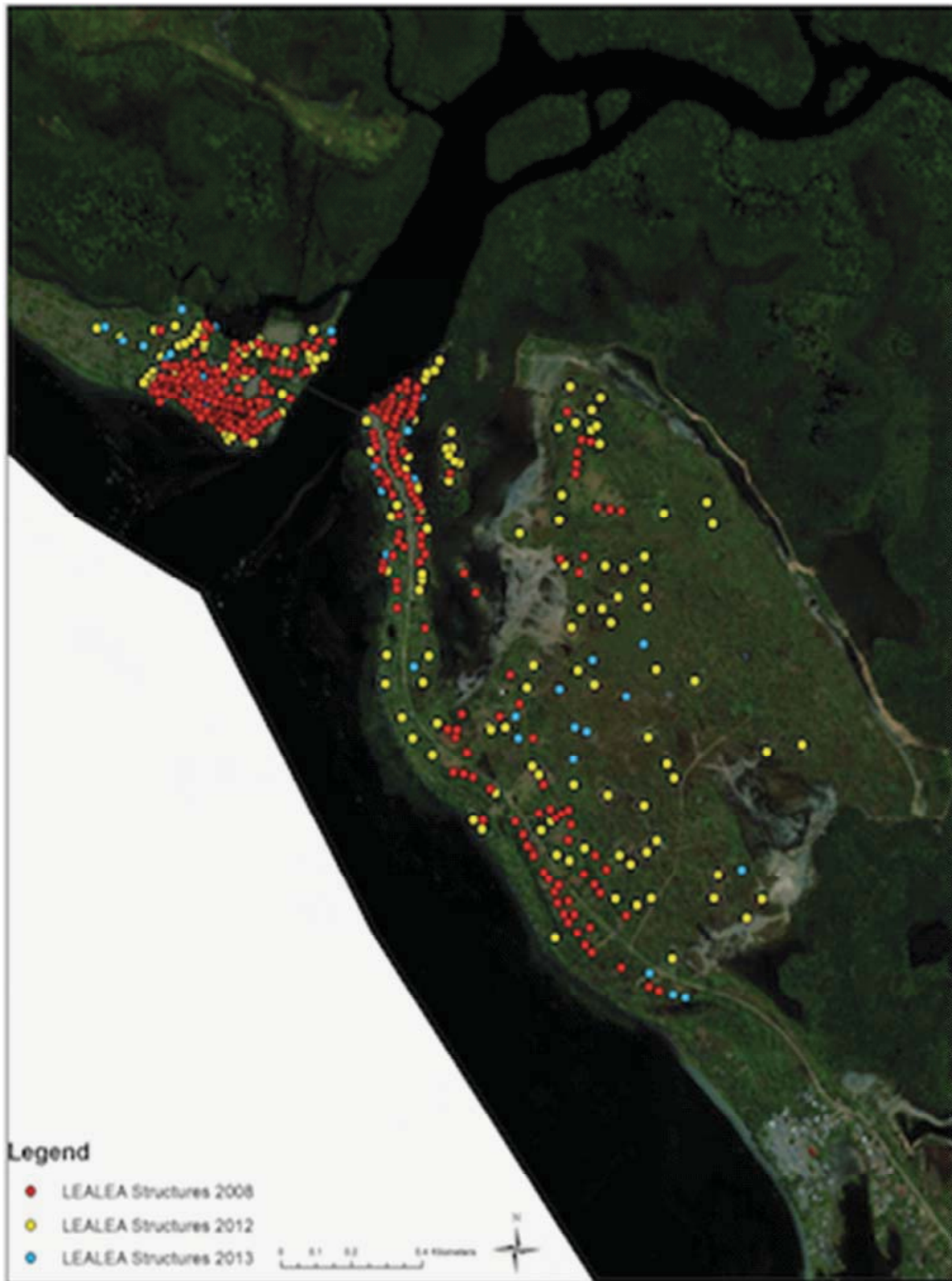


Figure 46 Lealea Structures over Time, 2008, 2012, 2013, iHDSS, 2013

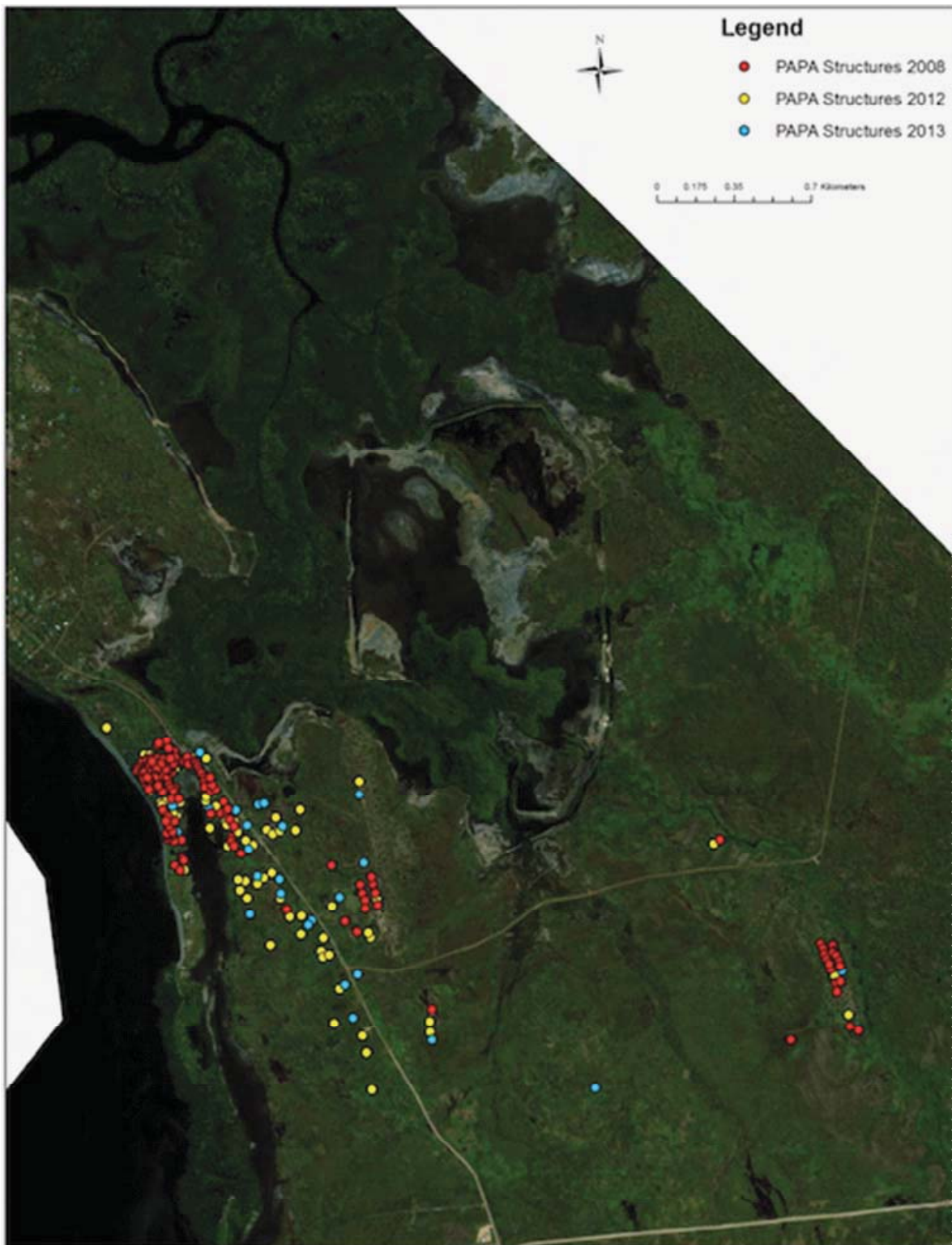


Figure 47 Papa Structures over Time, 2008, 2012, 2013, iHDSS, 2013

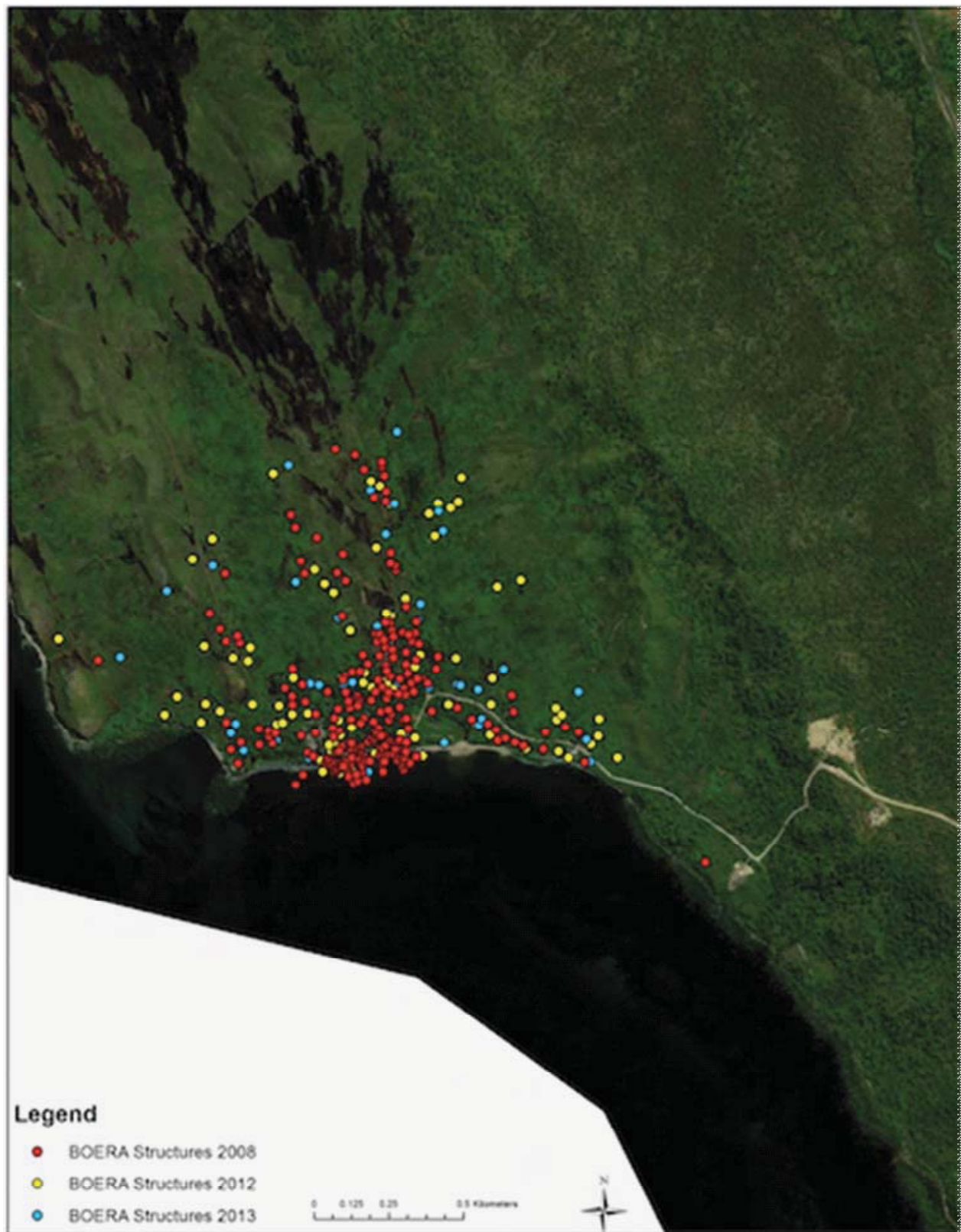


Figure 48 Boera Structures over Time, 2008 – 2013, iHDSS, 2013



Figure 49 Porebada Structures over Time, 2008-2013, iHDSS, 2013

As the maps in Figures 45-49 illustrate, there is increasing number of structures from 2008 to 2012 and from 2012 to 2013. The counts and “percent change of structure by year” identified are summarized in Table 53. Because these images were collected at different period of the year, the average quarterly change in structures is also included. Percent change is used to normalize the data across villages. Based upon the absolute change of structures from 2012 to 2013 and the absolute change from 2012-2013 in population seen in Table 53, it would appear that the majority of new structures are households. However, without detailed ground truthing, “structures” cannot be further identified as habitable (households), small businesses,

sheds, etc. A standard or “typical” housing growth rate for PNG is extremely difficult to define. Rural housing is typically constructed using “bush materials” while in an urban setting more complex construction using purchased materials would be anticipated. Housing growth rates over 2% exceed typical urban/peri-urban growth rates and potentially imply an accelerating organic expansion of population (increased fertility rate) and/or influx of new households.

Table 53 Count of Structures in villages, iHDSS, 2013

Village	Q1 2008	Q1 2012	Q2 2013	2008-2012 Pct. Change	2012-2013 Pct. Change	2008-2012 Quarterly change	2012-2013 Quarterly change
Kido	75	101	114	34.7%	12.9%	1.8%	2.0%
Lealea	279	411	443	47.3%	7.8%	2.3%	1.3%
Papa	135	204	231	51.1%	13.2%	2.5%	2.1%
Boera	222	289	327	30.2%	13.1%	1.6%	2.1%
Porebada	561	675	730	20.3%	8.1%	1.1%	1.3%

Table 53 demonstrates that structure growth has been uneven across the 5 villages. While Papa and Lealea experienced strong growth from 2008 to 2012, these rates have declined when comparing sequential 2012 to 2013 data. These data are consistent with the overall population growth rate observed from 2011 to 2012 and the in/out migration data. Porebada's growth rate remains largely unchanged and is inconsistent with the apparent population jump observed from 2011 to 2012, implying undercounting as a potential explanation rather than a true growth surge. Interestingly, the growth rate of Boera has increased, while those of Papa and Kido have stayed at or above 2%. These relatively high growth rates may in part be explained by the fact that the initial counts of structures were low, i.e., the starting base denominator is small. For instance, Kido had an increase of nearly 35% from 2008 to 2012 in structures, yet this only amounts to a total increase of 26 structures. Boera has also clearly experienced a birth boom as previously shown in Table 52.

Just as important as *how many* structures are being erected is *where* these structures are being built. An analysis of the location of the new structures may provide insight on the need for a local managed growth plan. For instance, an increase that occurs primarily in the already densely populated areas of the village of concern could mean that the burden on fragile water and sanitation services and supplies is critical. An increase in structures outside of the dense population areas may simply indicate an accelerating growth in areas where land is actually available. Land tenure in PNG is overwhelming based on customary rights; hence, land acquisition and housing expansion requires agreement by existing landowners, a prerogative that is zealously guarded and enforced. The development of uncontrolled squatter housing is virtually impossible. The imagery demonstrates *no evidence* of squatter settlement development.

Figures 32-39 show each village with red polygons delineating areas with a high density of structures. These polygons were based on the distribution of structures as detected by the 2008. While the polygons are arbitrarily defined, it represents an important first step in looking at the growth rate of developable land. A more focused study based on the work of Faith Karanja and Peter Lohmann's paper entitled “Using Developable Land Units as an Indicator of Rate of Growth of an Urban Area,” would allow for a more accurate and refined estimate regarding the effects of an increasing growth rate on the village environment.



Figure 50 Kido Structures and Density Delineation in 2008



Figure 51 Lealea Structures and Density Delineation in 2008



Figure 52 Papa Structures and Density Delineation in 2008



Figure 53 Boera Structures and Density Delineation in 2008



Figure 54 Porebada Structures and Density Delineation in 2008

Using the delineations provided by the above figures, it is possible to determine whether a given structure is located within or outside a densely built area. Table 54 shows the results of this analysis.

Table 54 Structure Count by Density Delineation by villages, 2008-2013, iHDSS, 2013

	2008		2012		2013	
	Total Structures	Pct. of Structures Not in Dense Region	Total Structures	Pct. of Structures Not in Dense Region	Total Structures	Pct. of Structures Not in Dense Region
Kido	75	6.7%	101	31.7%	114	31.6%
Lealea	279	5.0%	411	23.4%	443	26.0%
Papa	135	11.1%	204	27.9%	231	33.8%
Boera	222	13.5%	289	20.4%	327	22.9%
Porebada	561	2.1%	675	4.1%	730	5.5%

With the exception of Porebada, the number of structures outside of the density polygons has dramatically increased since 2008. Both Kido and Papa have roughly one-third of their structures occurring outside of the developed zone, while Lealea and Boera have approximately one quarter of their structures outside the developed zones. While these numbers demonstrate a significant increase, Figures 41-44 illustrate that they still represent a small amount of the available land for each village. Additional research would be needed to determine what percent of developable land is being used and how it has changed over time.

Porebada's lack of structures outside of the density delineators is striking, that will this be subject of a more detailed evaluation. Only a small fraction of the 169 new structures erected over the past 5 years have occurred outside of this zone. The density of housing coupled with the apparent population "surge" seen in 2012 is an important observation. Continued monitoring could be considered in order to document whether a growing population living in an increasingly dense area adversely impacts water, sanitation, and transmission of communicable diseases like TB. Additional survey work in Porebada may be considered by the iHDSS in order to clarify population dynamics.

Discussion

Overall, the different lines of data, e.g., surveys and satellite imagery, indicate that the four iHDSS villages are still experiencing strong increases in terms of population growth and land use trends. Given that most of the in-migration is seemingly not work-related, growth is likely driven by numerous factors rather than purely by an increased availability of work. Establishing a household in order to "claim" future royalty streams may be a potential household level driver. Historic population data also indicate significant in-migration in Porebada compared to the 2000-2011 period. The 2012 and 2013 population data indicate a recent population influx into an already densely populated area. Further Porebada evaluation may be appropriate to ensure that there is no degradation in water, sanitation, or health.

HIDES/KOMO HDSS

The three divisions of Hides each have different make-ups regarding population size and structure. Figure 55 shows the population distribution by division of Hides/Komo over two years: the 2012 initial data and the 2013 census update. There has been a substantial increase in the population count for each division, particularly for Division 3. This population increase from 2012 to May 2013 is potentially related to the significant economic activity associated with the PNG LNG Project, while the decrease in Divisions 1 and 2 in from May to November 2013 may be related to Project demobilization, as construction of the HGCP was largely complete by the end of 2013. The change in populations in Divisions 1 and 2 is likely due to interdivision movement. Between May to November 2013, 372 residents of Division 1 moved to Division 2, though it is unclear why. The data shows that there was no other movement between divisions. Huli typically have multiple "residences" an observation well made in the baseline Social Impact Assessment.

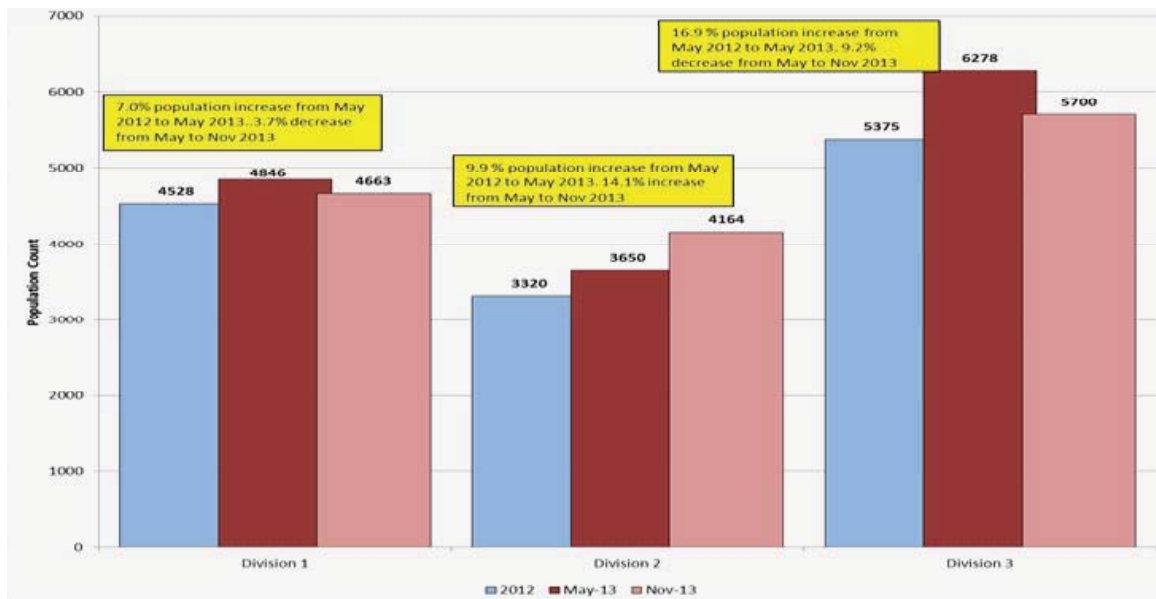


Figure 55 Hides /Komo Population Count by Division over Time, 2012-2013, iHDSS, 2013

Figures 56-58 show the population pyramids for each of the divisions the May 2013 census. The large percentage of males age 25-29 in Division 3 may be an indicator of employment-induced in-migration, as work on the HGCP is likely the largest and obvious source of employment in the area. Komo airfield work has been completed and significant demobilization has occurred in 2013. The change in population from May to November of 2013 showed no surprising characteristics. As such the population pyramids remained stable between updates, with only fractional changes in each age groups percentage.

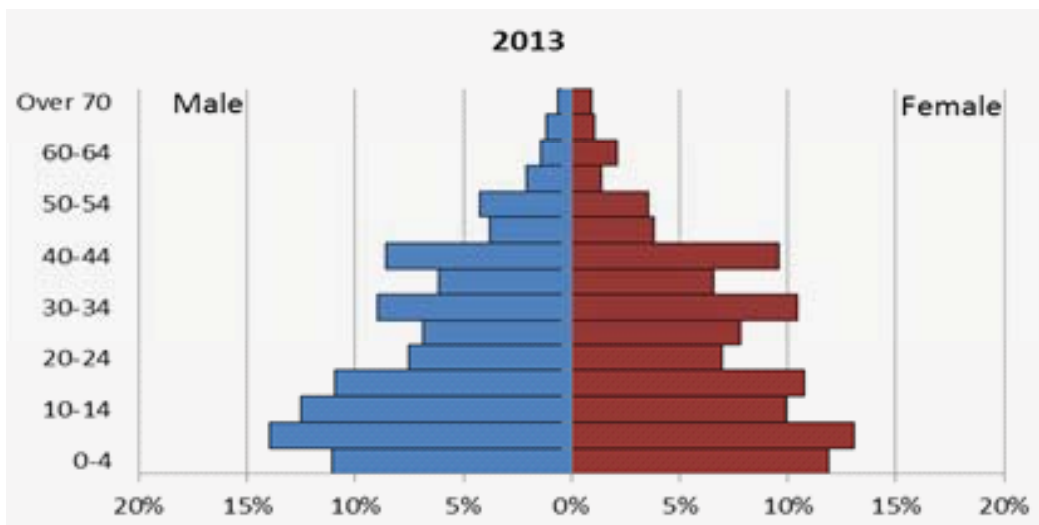


Figure 56 Hides Division 1 Population Pyramid, iHDSS, 2013

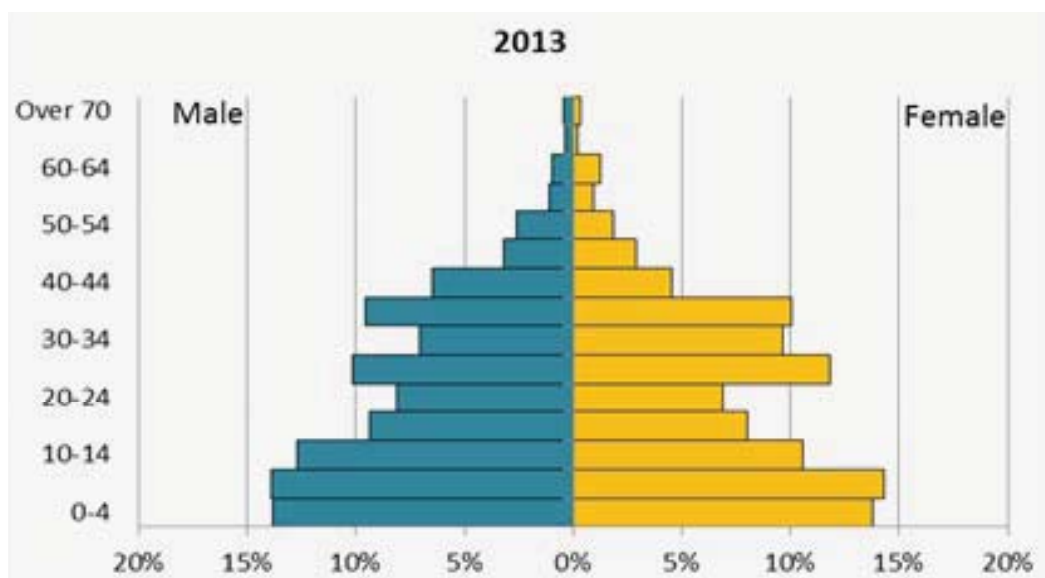


Figure 57 Hides Division 2 Population Pyramid, iHDSS, 2013

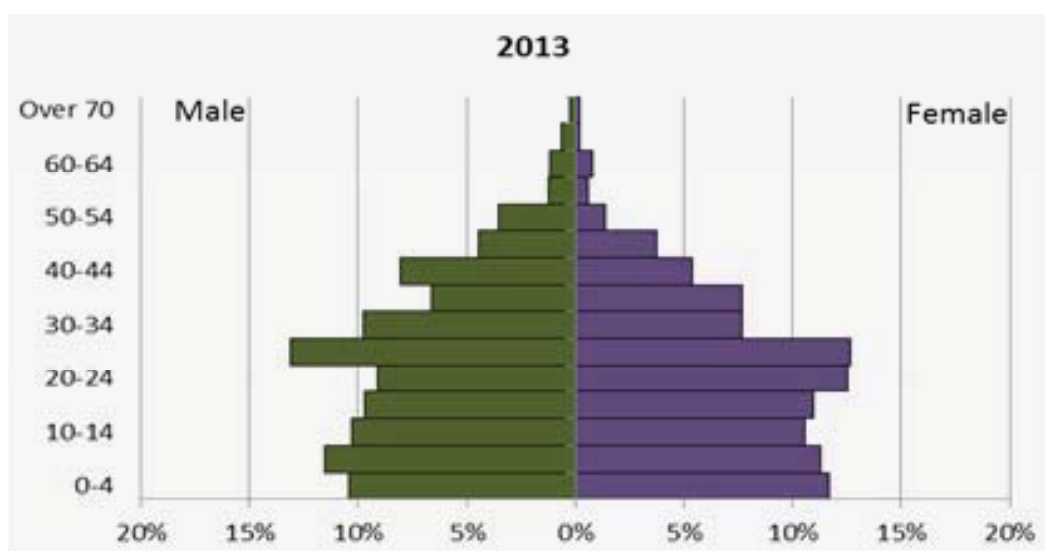


Figure 58 Hides Division 3 Population Pyramid, iHDSS, 2013

Each of the Hides Divisions has more males than females, a pattern also observed by the Hiri iHDSS. Table 55 shows the counts and sex ratios for all three divisions. Divisions 2 and 3 have high proportions of males. The differences in sex ratios may reflect some level of PIIM. Division 1, which is not as close to the Komo Airfield or HGCP, has a sex ratio that is much closer to being even. The November 2013 update shows that Division 1 and 3 have remained about the same, while Division 2 saw slightly more new female entrants (42 more females than males).

Table 55 Hides/Komo Population and Sex Ratio by Division*, iHDSS, 2013

	Male		Female		Sex Ratio (Male/Female)	
	May 2013	Nov 013	May 2013	Nov 2013	May 2013	Nov 2013
Division 1	2440	2351	2368	2275	103.0	103.3
Division 2	1890	2123	1735	2010	108.9	105.6
Division 3	3290	2984	2964	2698	111.0	110.6

* Those records where gender has been omitted have been excluded from table

The distribution of marital status by time period is shown in Figure 59. All three divisions show similar rates of marriage. Marriage rates have increased substantially from 2007 to 2013; although the trend has appeared to slow significantly from 2012 to 2013. Many Huli practice polygamy and take on more wives as their wealth increases. Anecdotal, this observation has been frequently reported to 3rd party observers. Further survey work is needed to better evaluate this issue. There has been no appreciable difference in marriage rates from May to the November 2013 update.

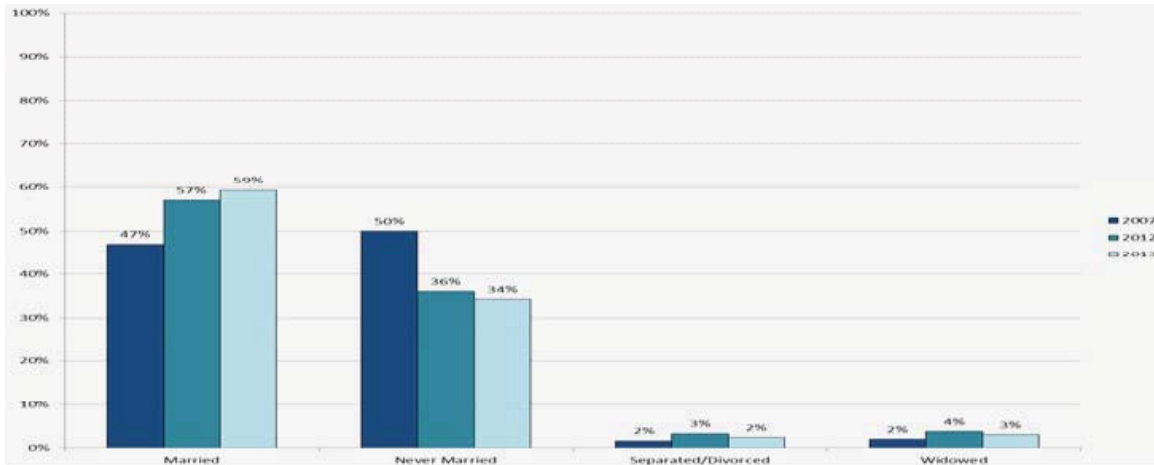


Figure 59 Hides/Komo Marital Status over time, 2007-2013, iHDSS, 2013

Employment

Employment status by sex is examined in Figure 60. Those people in the cohort with these responses were considered unemployed: (i) unemployed, (ii) subsistence farming, and (iii) home duties. Responses of either “Don’t Know” or “Not Relevant” have been removed from the totals. There was a nearly 40-percentage point drop in the male unemployment rate from the SIA conducted in 2007 to May Census in 2013. Over the same time period, there was over a 7-percentage point decrease among females. In Huli culture, employment is much more likely to be concentrated among men with women focused on domestic affairs and gardening. Despite demobilization of the HGCP construction, there has been little change in the unemployment level with the November update; however, this may quickly change in 2014, with “unemployment” going back up to typical historical levels, i.e., a largely rural subsistence, non-wage economy.

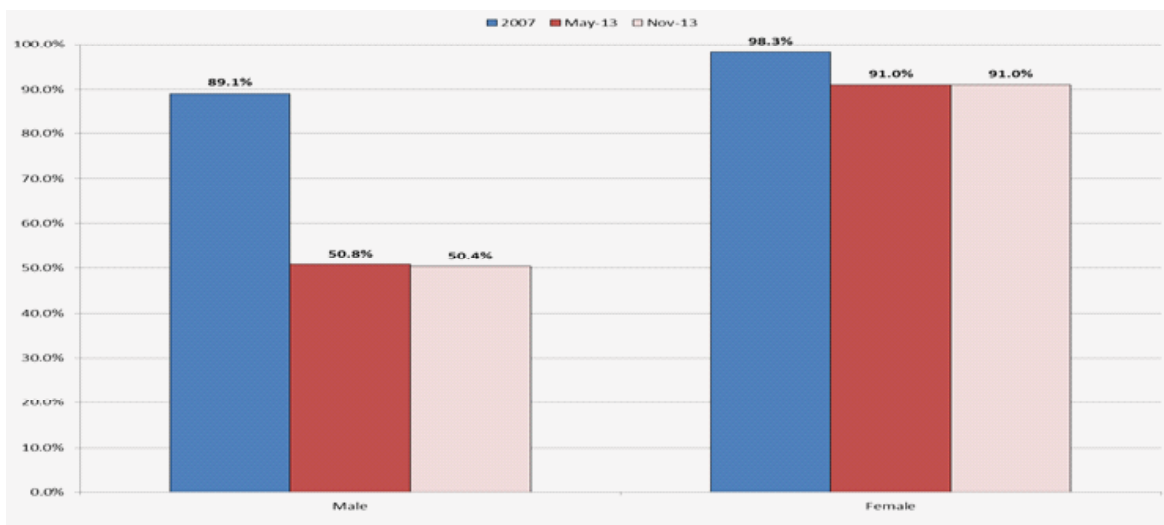


Figure 60 Unemployment Status among adult population sex, Hides, 2007-2013, iHDSS, 2013

Given the substantial decrease in male unemployment, Figure 61 compares the percentage of males by employment type (as asked by the census) and Division. The high percentage of workers that fall into “Labourer in mining, construction, and transport” category in Division 3 is likely because of its proximity to the HGCP construction activity. Similarly, the higher count of plant and machine operators and assemblers is likely due to the proximity of the Komo Airfield.

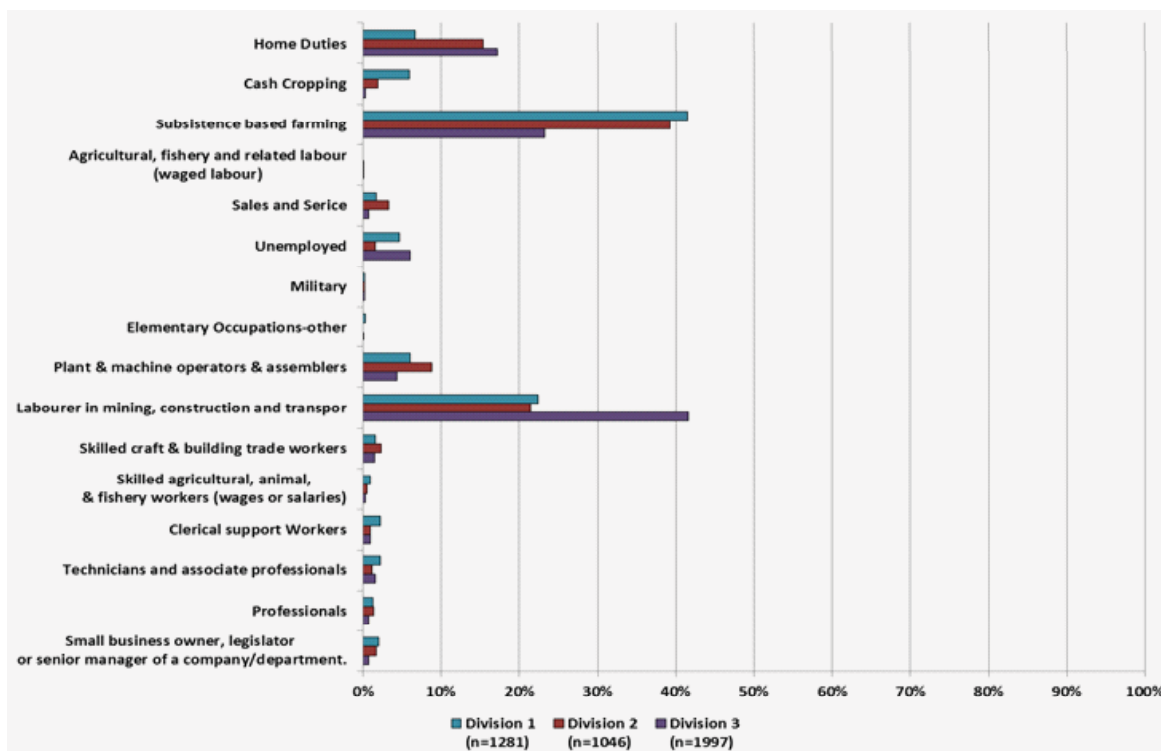


Figure 61 Male Employment by type, Hides, 2012-2013 Comparison, iHDSS, 2013

Figure 62 shows the percentages of residents employed by division and sex. Residents who responded either as student, not relevant, or don't know to the question regarding their occupation were excluded from the equation, as these residents are likely to be children under the age of 15. The two divisions closest to the LNG project (Divisions 2 and 3) have the highest percentage of workers employed by the project. Over 50% of males in Division 3, and 40% of males in Division 2, are employed by the LNG Project. Most women do not work for the LNG project; however, the largest female working cohort is in Division 3, and likely a result of its close proximity to HGCP construction.

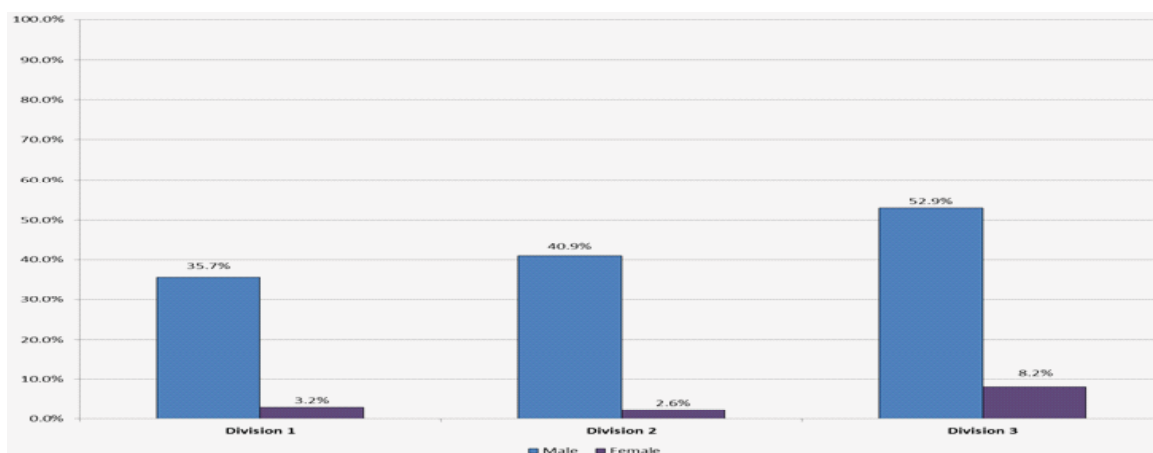


Figure 62 Percentage of Residents Employed by LNG Project by sex and division, Hides, iHDSS, 2013

In-Migration

Three surveys, the initial 2012 census data, a May 2013 update, and a November 2013 update were reviewed and compared. Within the surveys, each person is given a unique ID that is the same in both files. Using this ID, it is possible to determine who from the 2013 file is also in the 2012 file. It is assumed that if a person is in the 2013 file but not in the 2012 file, that they are a “new resident” of a specific surveyed Hides division. A new entrant can be through birth or via in-migration. This section will first look at the difference between the 2012 census and the May 2013 update and then proceed by comparing the May 2013 data to the updated November 2013 data.

There were 1834 in-migrants in May 2013. This represents 13.9 percent of the overall all combined 2012 divisional population which was 13,220. Division 3 dominates the percent distribution with slightly over 50% of the total. The absolute numbers by division are shown below Figure 63. Absolute numbers are more meaningful than percentages as the local communities and households absorb a true number not a relative percent. Division 3 increase 972 people; Division 2 increase 385 people; Division 1 increase 457 people.

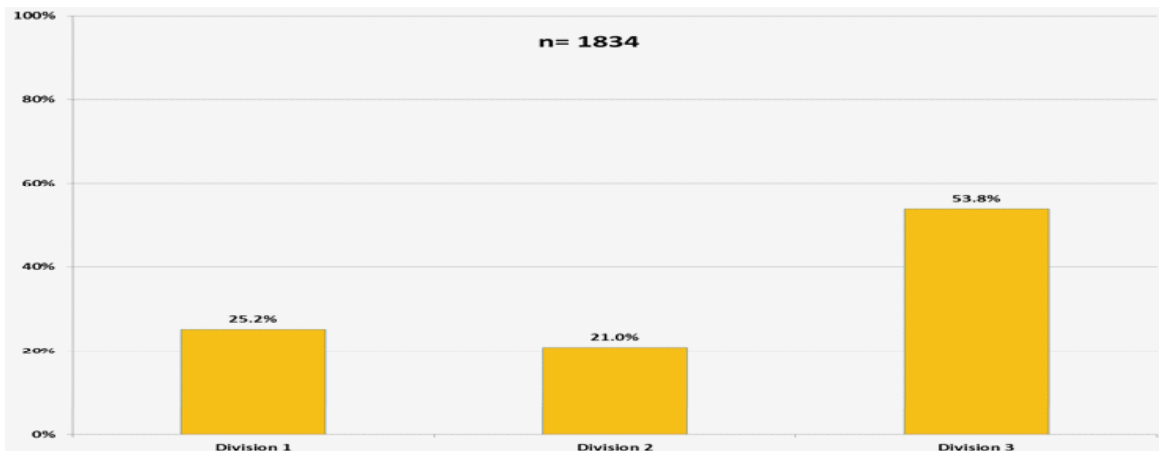


Figure 63 Distribution of new entrants by division, Hides, iHDSS, 2013

The age and sex breakdown of “entrants” is presented in Figures 64-65. As illustrated in these figures, greater than age 16 year olds account for a significant percentage of the total, particularly for Division 2 and 3. However, as shown in Figure 65 new entrants are not simply young males as the percentages of males and females are extremely close.

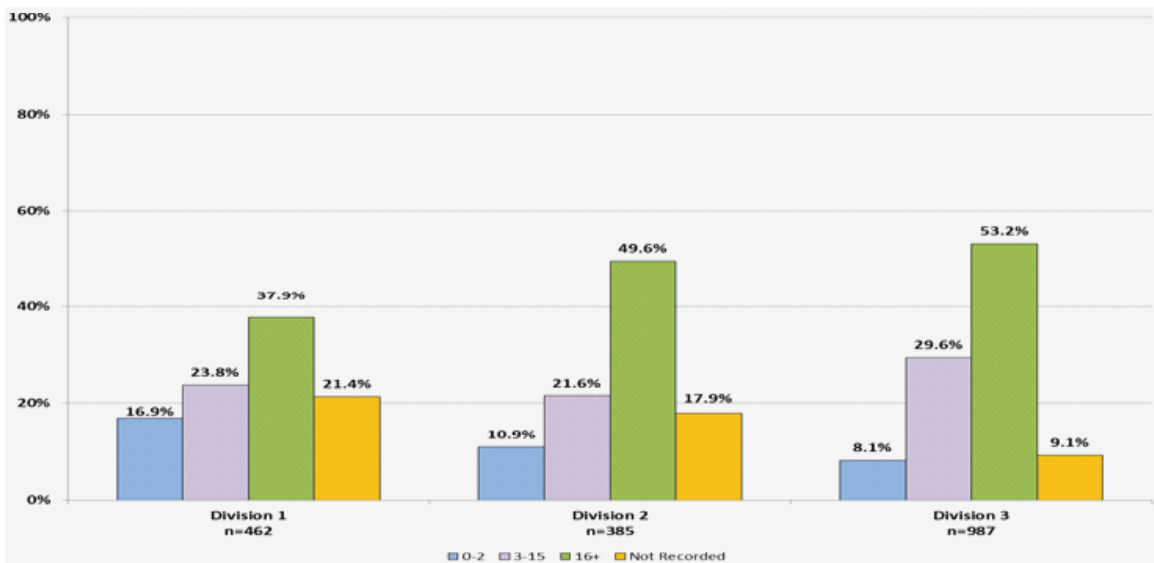


Figure 64 New Entrants by age group and division, Hides, 2012- 2013, iHDSS, 2013

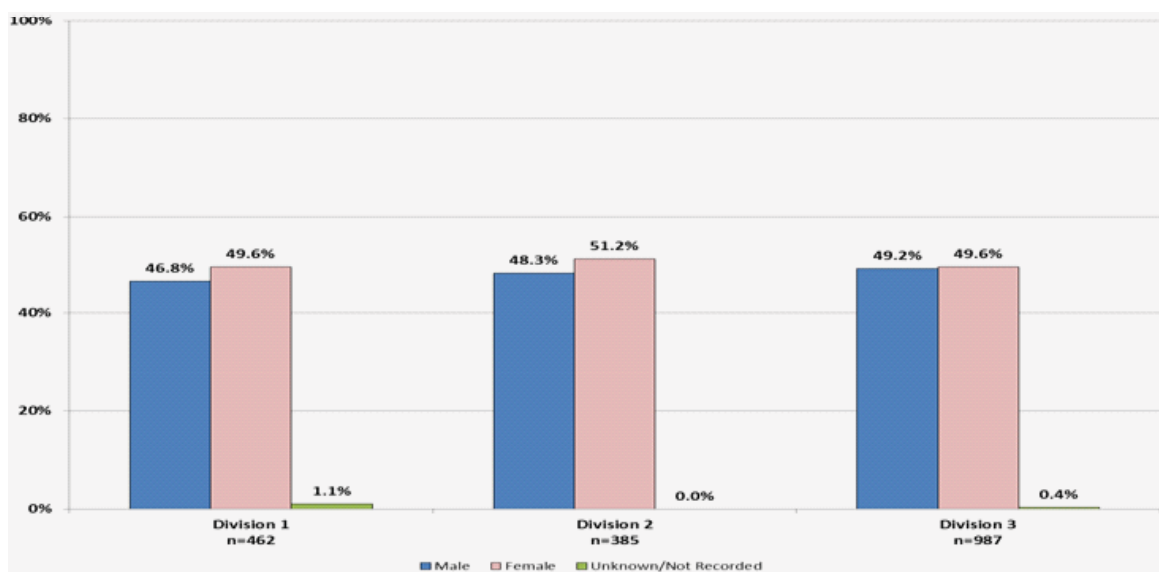


Figure 65 New Entrants by Sex and Division, Hides, 2012-2013, iHDSS, 2013

Figure 66 presents the entrants data sorted by LNG employment and per division. The LNG employment varied by division: Division 3 had the highest LNG employment for new entrants at 53%. Not surprisingly, Divisions 2 and 3 had much lower levels of LNG employment. Out-migration data are not shown as the non-response rate was 97%; therefore, these data are not meaningful.

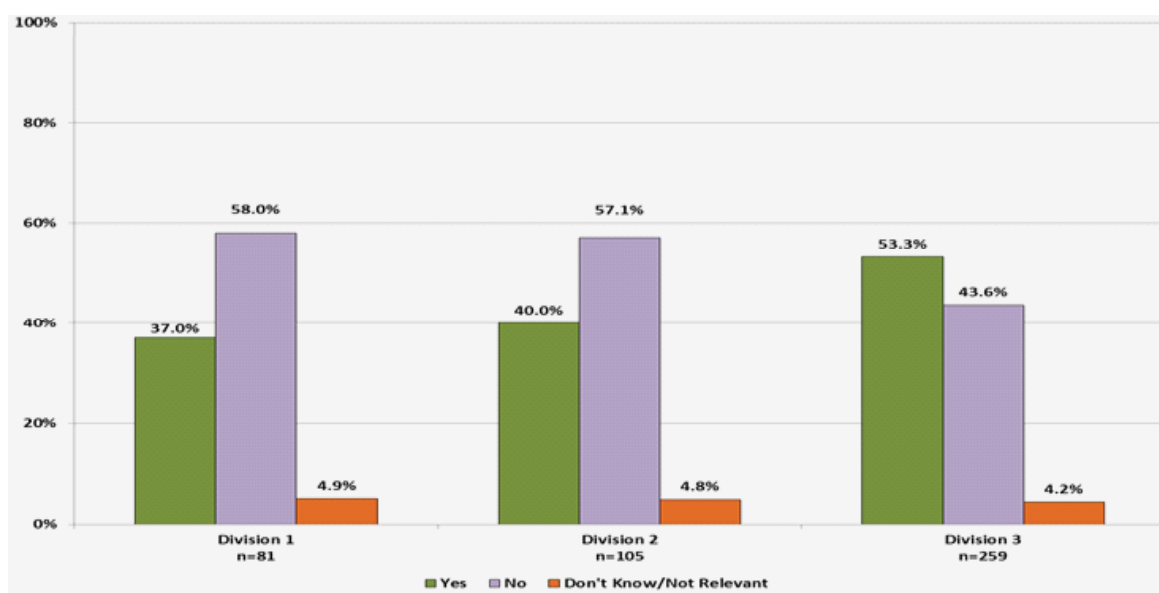


Figure 66 In-migrants by LNG employment among males aged 16+, Hides, 2012-2013, iHDSS, 2013

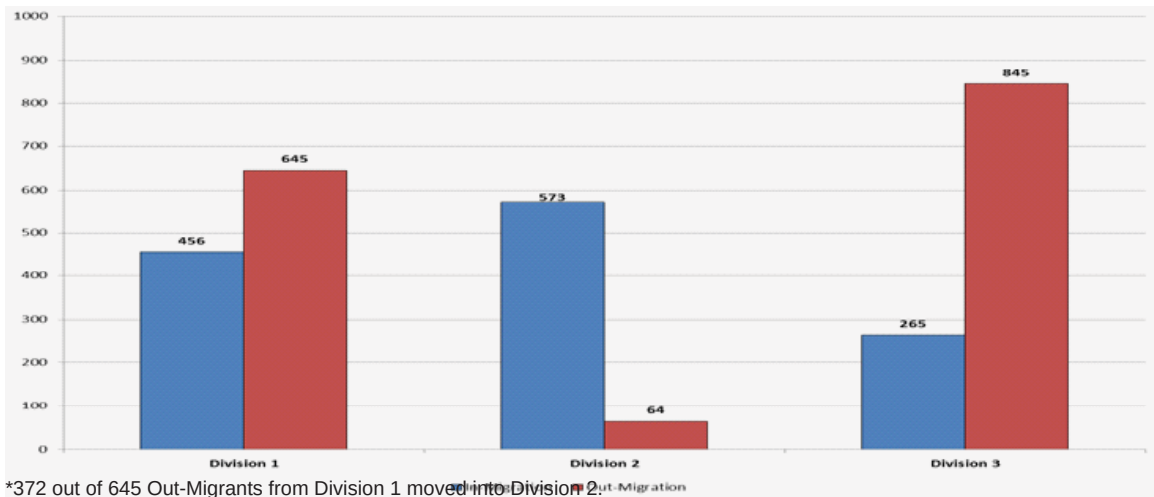
Summary 2012 to May 2013 In-Migration

Overall, the in-migration (new entrant) data are consistent with the observations made in the March 2013 PIIMs Report. As noted in this report, IFC estimates extractive industry in-migration often adds 10–15% over the annual national average 2–3%. Moreover, PIIMS survey/analysis per Dr. L Goldman suggested that the pre-project rate of 'movement' was in the range 7–14%. As also noted by Dr. Goldman, in-migrants (or entrants) in Hides are often multi-local residents, i.e., they come and go as they have alternative residences outside the immediate survey area. In Hides, there is a constant shifting between locales in Huli geography but with greater 'velocity' of movement because of the project attractions.

May 2013 to November 2013 In-Migration

As has been previously seen, there has been a decrease in the population of Division 1 and 3, and an increase in the population of Division 2. Though the population changes numbers for Divisions 1 and 3 indicate a decrease in overall population, it does not mean that there was no in-migration. This section will examine the in and out migration patterns of the Divisions from May to November of 2013.

Figure 67 shows the comparison of In-migration vs. Out Migration for the May to November 2013 period. The total out-migrants from Division 1 include those residents who moved into Division 2 (372 villagers) and hence the Division 2 In-migration number includes these villagers as well.



*372 out of 645 Out-Migrants from Division 1 moved into Division 2.

Figure 67 In and Out-migration comparison by division, Hides, May-November 2013, iHDSS, 2013

Figure 68 shows the breakdown of May to November In-Migrants by Age. The proportions are similar to the previous in-migration figures, though Division 3 does have a higher percentage of age 1 plus. The numbers indicate that in-migrants are likely to be families rather than childless adults looking for work.

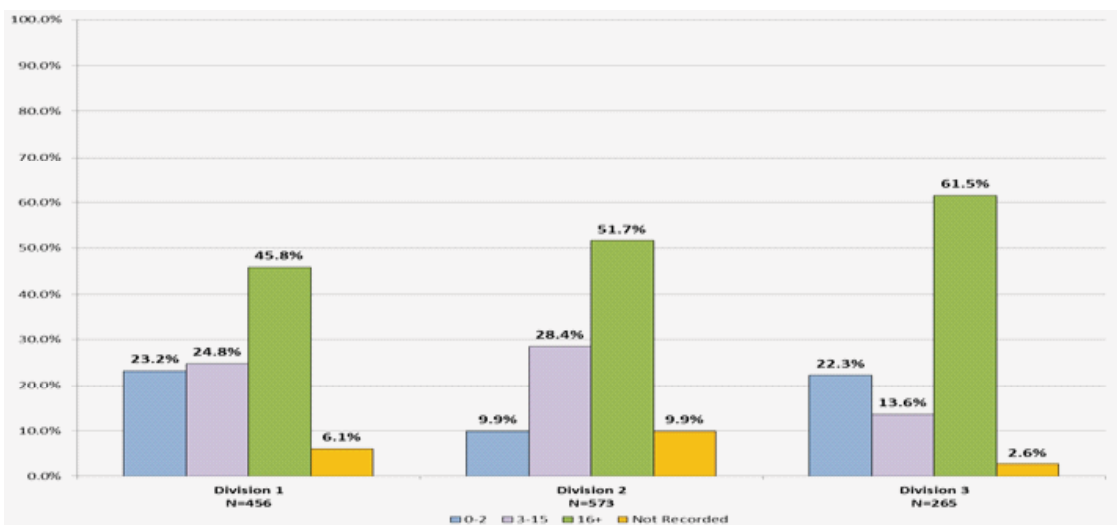


Figure 68 In-Migration by division and age group, Hides, May-November 2013, iHDSS, 2013

Figure 69 shows comparisons the in-migrants by sex and division. The data are similar to that seen in Figure 65. While there appears to be some disparity in Division 3, this is an artefact of a small total number. The 4.2 percentage point difference represents 11 more males than females and hence should not be construed to be anything meaningful.

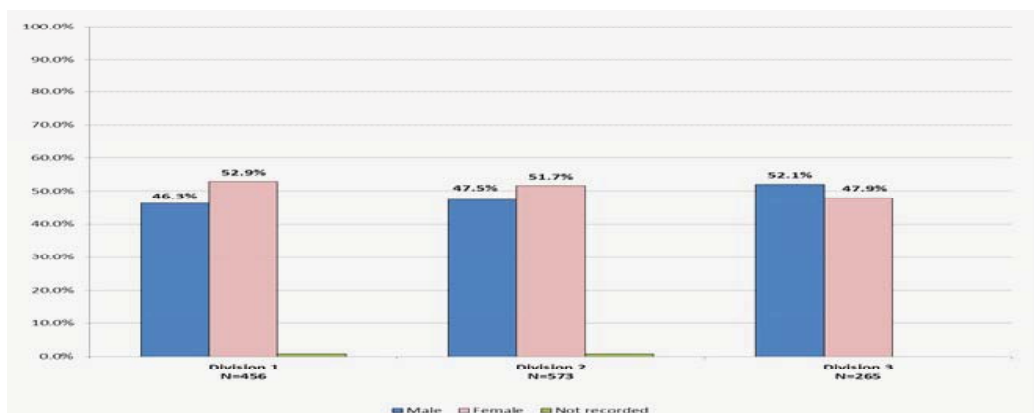


Figure 69 In-Migration by Division and Sex, Hides, May-November 2013, iHDSS, 2013

The number of work eligible males that in-migrated from May to November 2013 is shown by their LNG employment status in Figure 70. There is a substantial decrease in the in-migrants that are employed by the LNG project that the previous in migrants shown in Figure 44. This can likely be explained by the demobilization of the LNG project as fewer additional labourers are needed and any new hiring of workers is done to replace old labourers that have prematurely left.

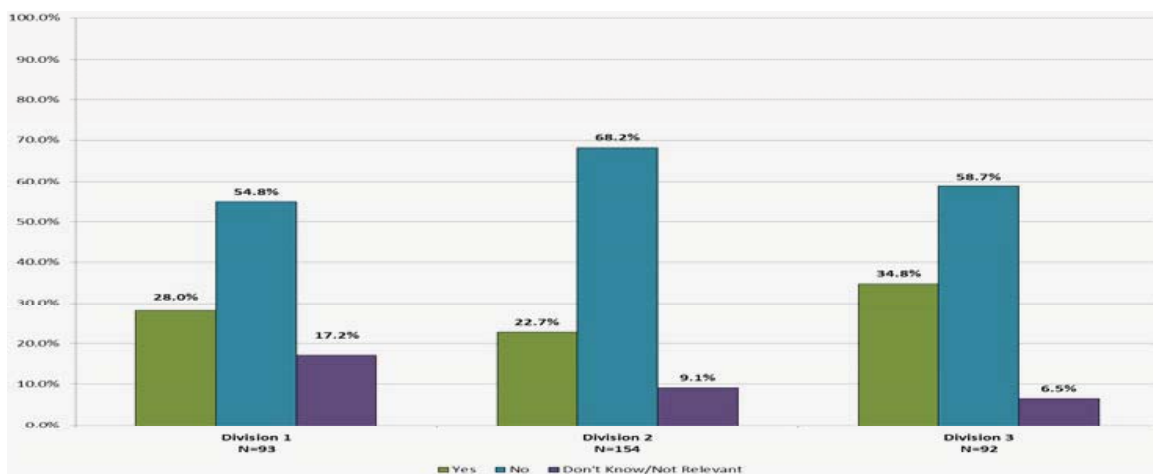


Figure 70 In-migrants by LNG employment among males of working age 15+, May-November 2013, Hides, iHDSS, 2013

Out-Migration

As Figure 71 illustrates there has been significant out-migration in Divisions 1 and 3 of the Hides and relatively little in Division 2. This section will explore the age, sex, marital status and previous LNG employment status of the out-migrants from the May to November 2013 period to determine whether or not LNG project demobilization was a primary contributor to the out-migration.

Figure 71 shows the out-migrants by Division and Age range. Those residents who left Division 1 for Division 2 are included. An overwhelming number of out-migrants are over age 16. This finding suggests that the conclusion of the HGCP construction phase may be causing working age adults to leave the Hides area.

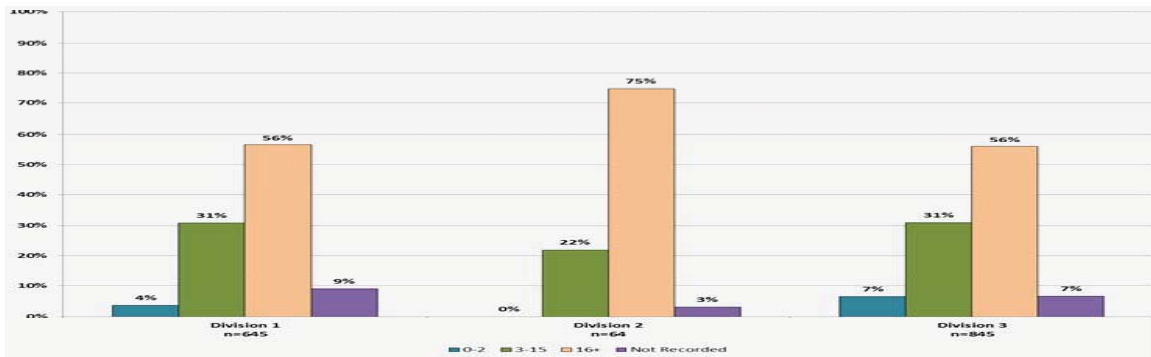


Figure 71 Out-migration by division and age group, Hides, May-November 2013, iHDSS, 2013

Looking further into the makeup of out-migrants, Figure 72 looks at the sex of work age-eligible residents. Divisions 2 and 3, those divisions that had the most direct benefit in employment by the LNG project, lost more males than females. This is yet another indication that out-migration may be being influenced by the demobilization of the project. This trend remains the same when children are excluded from totals. Figure 73 removes children under 15 and adults over 65 to look only at the work eligible population. The trend of more males leaving than females is apparent here as well; however, one must be cautious in interpreting the data from Division 2 due to a reduced sample size.

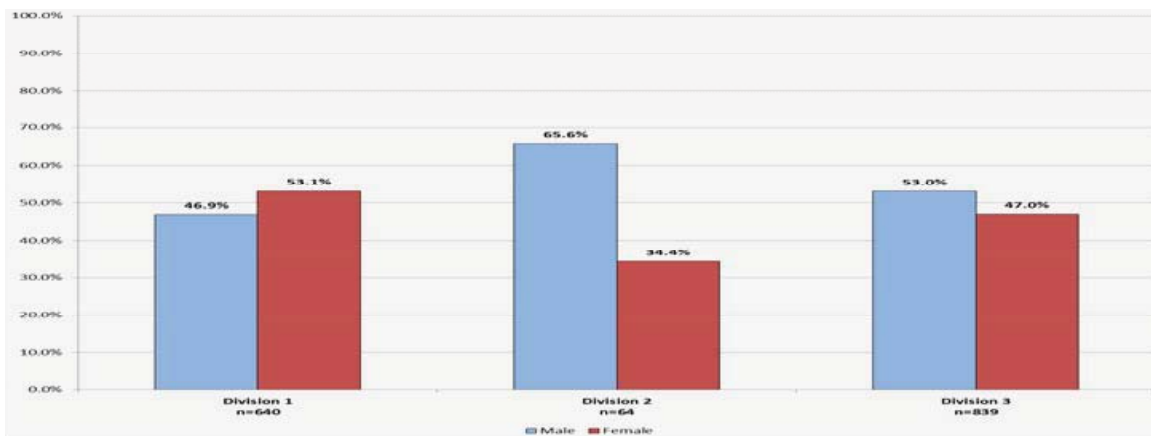


Figure 72 Out-migration by division and sex among the entire population, May-November 2013, Hides, 2013

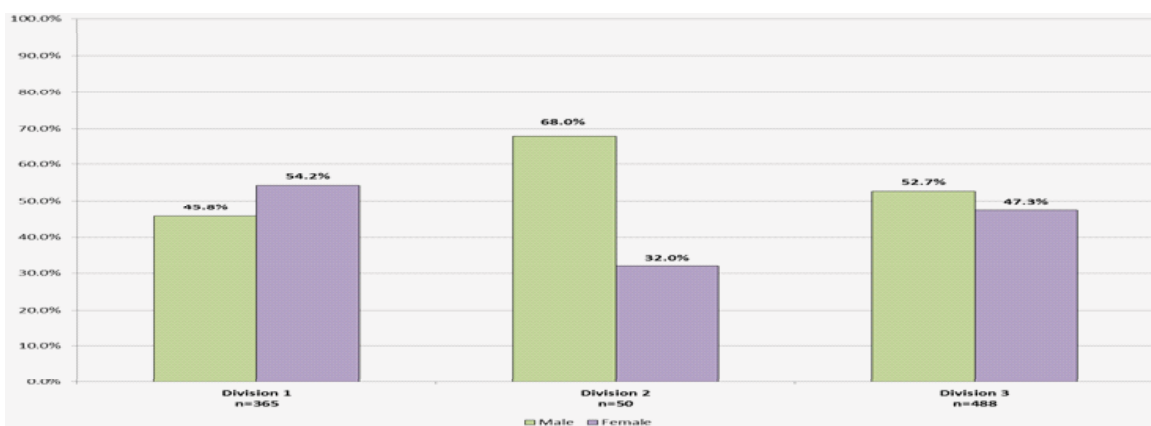


Figure 73 Out-migration by division and sex among population aged 10+, May-November 2013, Hides, iHDSS, 2013

The number of out-migrants who were previously employed by the LNG project is shown in Figure 73. Only age-eligible males (age 10 and over) are shown. Of the three divisions, Division 3 has the highest percentage of out-migrants who had previously worked for the project. This should not be surprising as Division 3 also had the highest proportion of residents who had worked for the LNG project. Conversely, Division 1 had the lowest percentage of workers involved in the LNG project and also has the lowest percentage of out-migrants who had worked for the project. The sample size for Division 2 is too low to draw any significant conclusions, though shows a similar trend as the other two divisions.

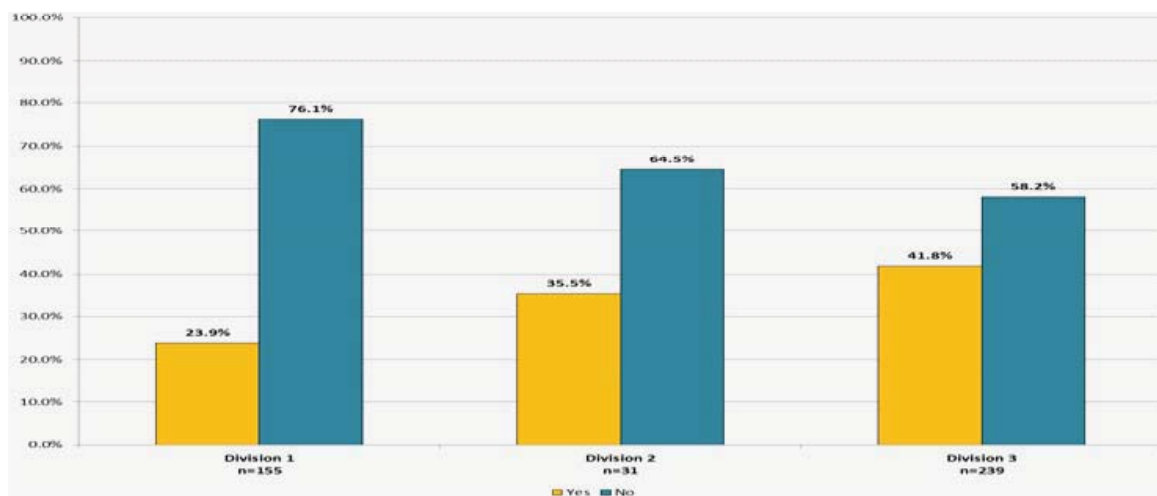


Figure 74 Out-Migrants by LNG Employment among males of working age 15+, May-November 2013, Hides, iHDSS, 2013

Discussion: Out Migration between May and November 2013

Division 3 experienced significant out-migration from May to November 2013. Based on the above data, it would appear the demobilization of the HGCP construction made a significant contribution to the overall out-migration. Division 2 has yet to see any significant out-migration, an observation that should be further monitored. Division 1 saw significant out-migration; however, nearly half of this was movement into Division 2. It is unclear as to whether this represents work-induced movement due to proximity of the Komo Airfield, or typical Huli movement between divisions.

In-migration: Structure Analysis

Remote sensing imagery for the Hides region was obtained for October 2012 and November 2013. These images permitted the number and location of structures in parts of Hides to be analysed over a 13-month period. Unfortunately, the coarse spatial resolution of the 2012 imagery available for this analysis prevented structures constructed from “bush material” to be accurately counted as they were often indistinguishable from exposed soil. In addition, the imagery does not capture all three iHDSS divisions. Hence, the imagery represents a useful but inherently “incomplete” picture of the iHDSS listing frame. The analysis counted buildings constructed from metal or concrete that are unlikely to be part of the LNG development; however, ground truthing is not available. Figures 75-76 show the satellite imagery used in this analysis and the location of structures existing in 2012 and 2013 within the areas surrounding the Hides Gas Conditioning Plant (HGCP) and the Komo Airfield.

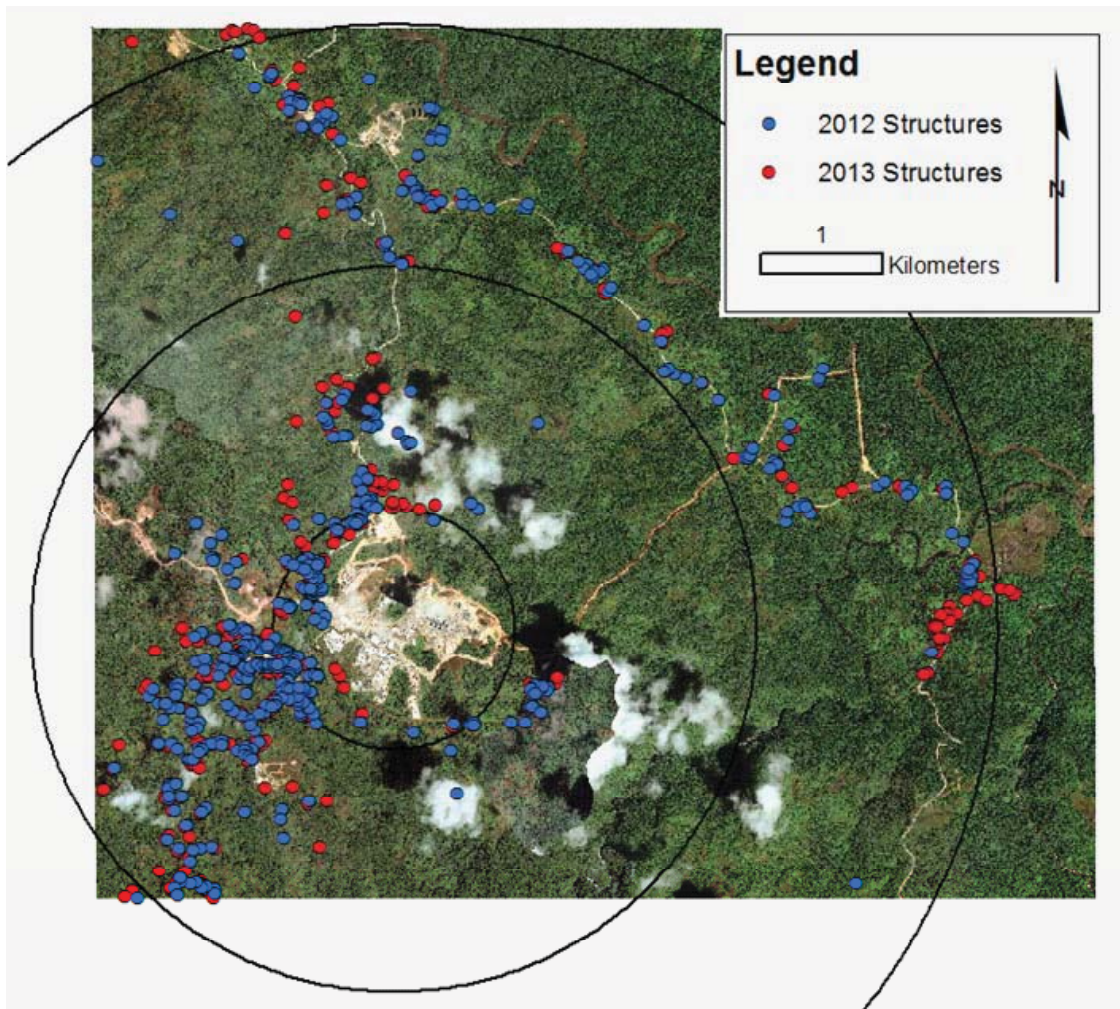


Figure 75 HGCP Count of Structures by Year

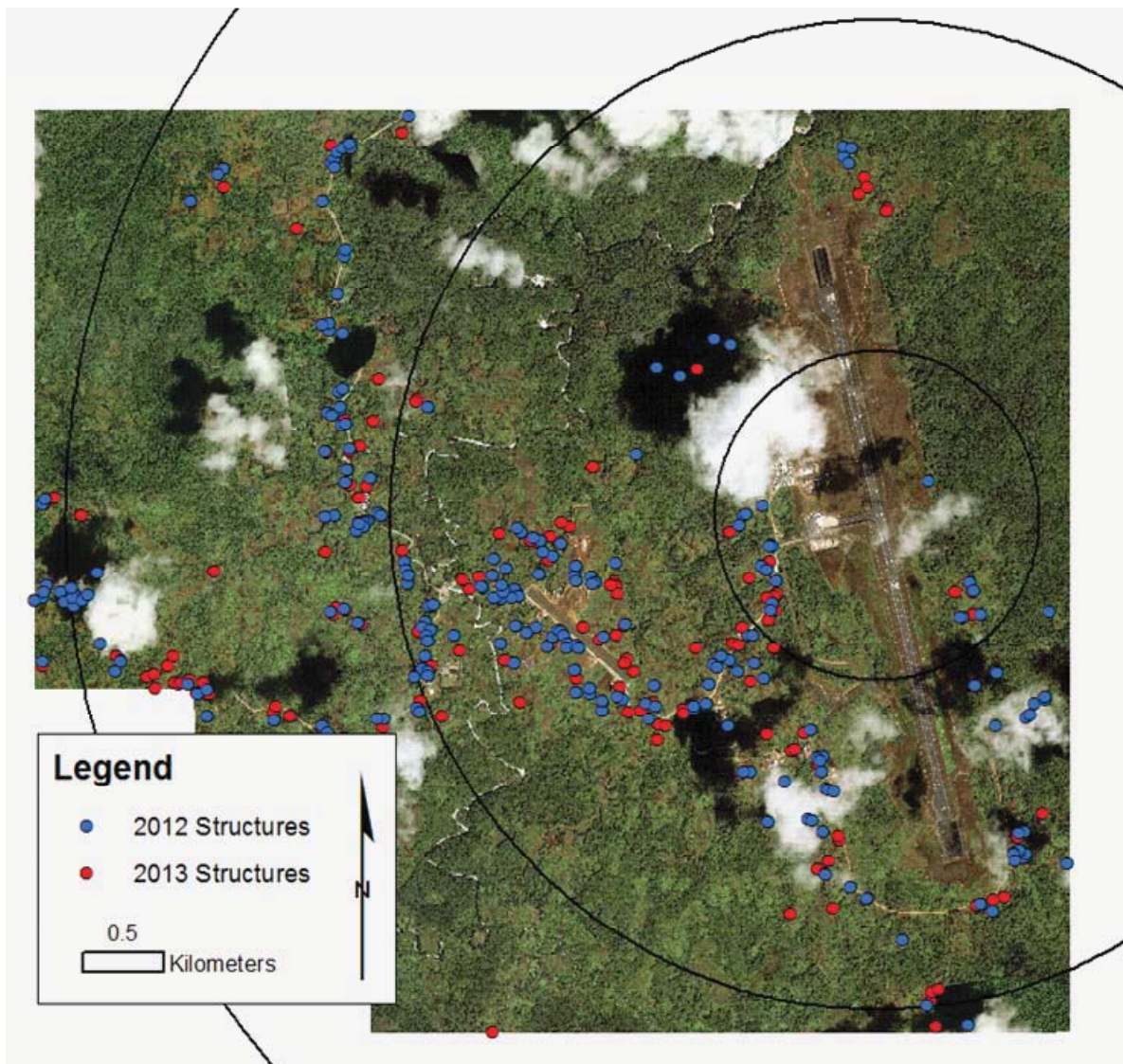


Figure 76 Komo Airfield Count of Structures by Year

As the maps in Figures 75-76 show, the number of structures in the areas surrounding the HGCP and Komo Airfield increased between 2012 and 2013. These counts and the percent change in the number of structures for each region are summarized in Table 56 and displayed as a chart in Figure 77. Without detailed ground truthing, “structures” cannot be further identified as habitable (households), small businesses, sheds, etc.

Table 56 Hides Overall Count of Structures by Year

	2012	2013	% Change
HGCP	482	673	39.6
Komo Airfield	243	334	37.4

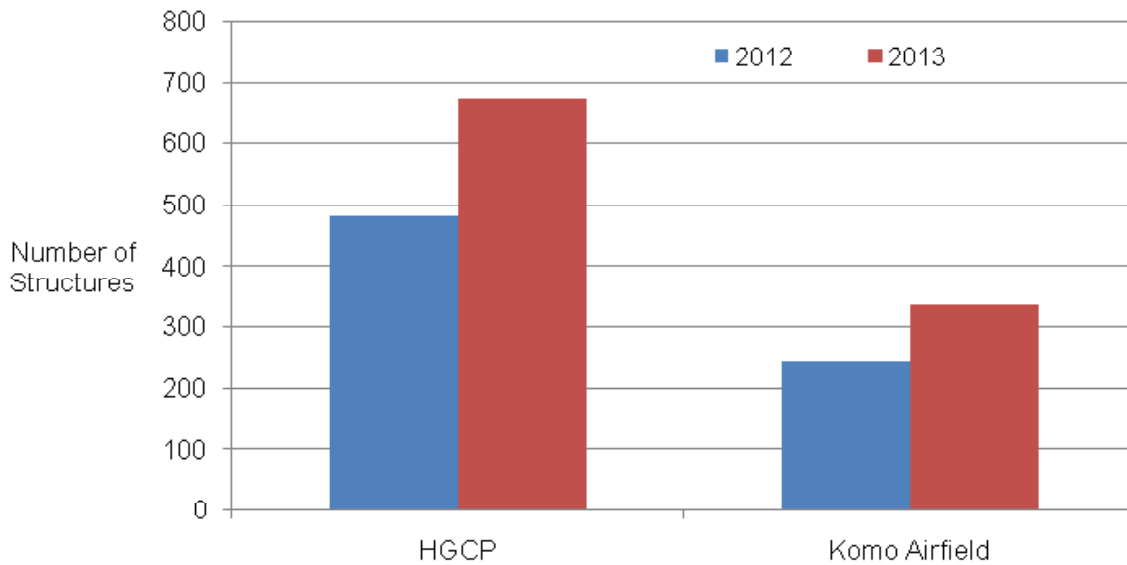


Figure 77 Count of Structures by Year, Hides, iHDSS, 2013

Tables 58 demonstrates that despite the HGCP area having approximately twice as many structures as the Komo Airfield area, the percent change in the number of structures between dates is relatively even across both areas.

Tables 57-58 show how the change and the percent change in the number of structure are distributed in relation to the distance from the HGCP and the Komo Airfield. Each of the three distances for each area is depicted in Figures 52-54 as black concentric circles. It should be noted that the entire area within each distance was not included in the counts due to the irregular shape of the satellite imagery used for this analysis.

Table 57 Komo Airfield count of structures by year, 2012-2013, iHDSS, 2013

	2012	2013	% Change	Net Change
1 km	18	28	55.5	10
3 km	160	224	40.0	64
5 km	233	325	39.4	92

Table 58 HGCP count of structures by year, 2012-2013, iHDSS, 2013

	2012	2013	% Change	Net Change
1 km	99	129	30.3	30
3 km	349	483	38.3	134
5 km	492	661	34.3	169

The number of structures within each of the six areas increased at a rate between 30% and 56%. The fastest percentage rate of growth occurred within 1 km of the Komo Airfield; however, only ten structures were added in this area over the period of time examined. Thus, one must also look at absolute change, i.e. the growth occurred between 1 and 3 km (54 structures). Table 58 shows a similar trend regarding the HGCP, wherein the large percentage change within 1km is in partly due to a low initial count with the majority of growth happening between 1 and 3 km. Figures 78-79 show charts depicting the numbers from Tables 57-58.

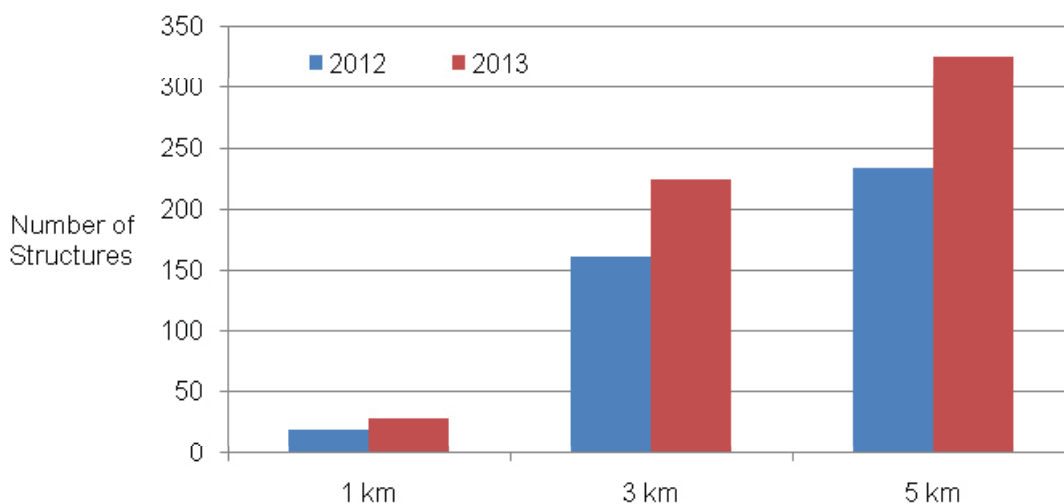


Figure 78 Airfield Count of Structures, 2012-2013, Komo, iHDSS, 2013

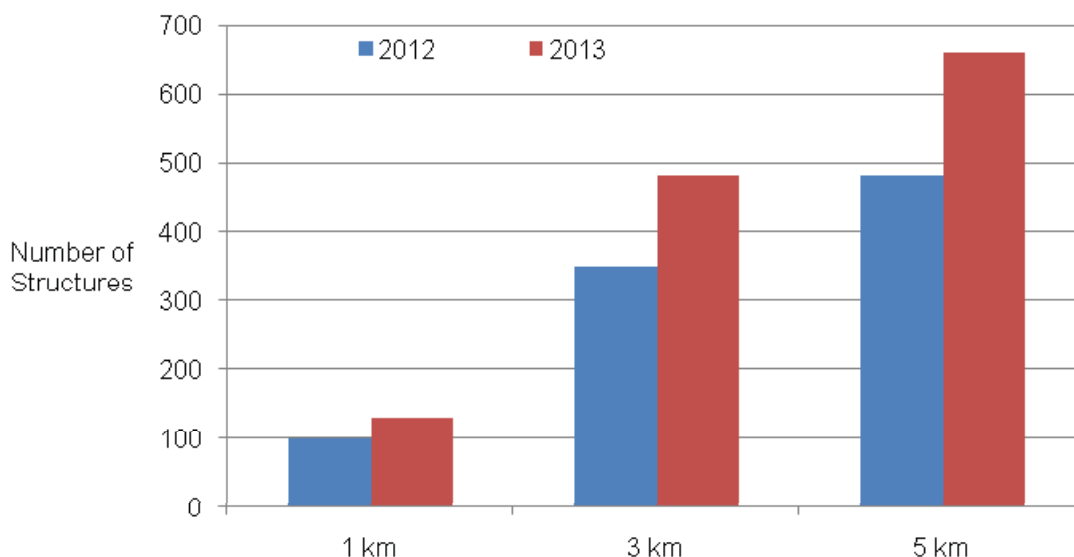


Figure 79 HGCP Count of Structures, 2012-2013, iHDSS, 2013

Discussion Hides

Overall, this analysis of satellite imagery of the HGCP and the Komo Airfield indicates that the number of structures grew at a rate of almost 40% between October 2012 and November 2013. There was significant growth in the number of structures between 1-3 km from both the Komo Airfield and the HGCP. The high percentage growth for structures within 1km is largely due to a low initial count. Given the previously discussed growth rates, without extensive ground trusting, it is difficult to determine whether or not these structures are (i) project related or, more likely, (ii) were constructed by the LNG villagers for residential and/or commercial (petty trading/entertainment) use.

Conclusion

There has been an observed objective change in both population and structures, particularly in close proximity to major PNG LNG construction sites. This finding is not surprising and was clearly predicted by the pre-project baseline social impact assessment. Further longitudinal studies can determine whether the observed changes are permanent or transient.

Chapter 9

HEALTHY PREGNANCY

Abstract

This Chapter presents the epidemiology of sexually transmitted infections, including human papillomavirus, among pregnant women attending antenatal clinics at four sites in Papua New Guinea.

Preliminary findings from this study indicate that pregnant women experience an unacceptably high burden of sexually transmitted infections (STI) in Papua New Guinea. The burden of curable STIs (chlamydia, gonorrhoea and trichomonas) was particularly high. Overall, 44% of women attending antenatal clinics in Hiri, Hides and Asaro had one or more of these infections, with the highest burden observed in Hides (53% prevalence). More than 80% of these infections were asymptomatic and therefore would not have been identified and treated based on current national syndromic management guidelines. Prevalences of syphilis and HIV infection were also high (2.2% and 1.3% respectively for the three sites combined), and confirm the country's place among the highest burden nations worldwide for maternal syphilis infection. This study is also providing the country's first general population level estimates of human papillomavirus (HPV) type prevalence, and is expected to inform national policy on HPV vaccination and cervical cancer prevention.

Introduction

Papua New Guinea (PNG) has among the highest prevalences of HIV, syphilis and other sexually transmitted infections (STIs) in the Asia-Pacific region [1-8]. The HIV epidemic in PNG is primarily linked to heterosexual transmission, with over half of reported HIV diagnoses coming from three of its 22 provinces [5, 9]. Adult HIV prevalence is currently estimated at 0.9% [5], however prevalences of 12-17% have been reported among women and men who sell and/or exchange sex [10, 11], and antenatal HIV prevalences around 2.0% have been reported from several Highland provinces [9]. PNG is among 12 high-burden countries selected by the World Health Organization (WHO) for intensified support for the elimination of mother to child transmission of syphilis [2]. PNG also has one of the highest estimated burdens of cervical cancer globally, with an age-standardized incidence of 23.7/100,000, compared to 5.0/100,000 in Australia [12].

Sexually transmitted infections (STIs) are associated with significant adverse reproductive health outcomes, particularly among women [13-15]. In pregnant women with untreated early syphilis, 25% of pregnancies result in stillbirth and 14% in neonatal death [15, 16]. Up to 35% of pregnancies among women with untreated gonorrhoea are estimated to result in spontaneous abortion and premature deliveries, and up to 10% in perinatal death [15, 16]. In the absence of prophylaxis, 30 - 50% of infants born to mothers with untreated gonorrhoea and up to 30% of infants born to mothers with untreated Chlamydia will develop ophthalmia neonatorum, which can lead to blindness if not diagnosed and treated promptly [15]. Untreated Chlamydia or Gonorrhoea can result in chronic salpingitis leading to infertility or ectopic pregnancy.

In addition to their direct effects on reproductive health, many STIs have been shown to biologically enhance the transmission and acquisition of HIV [17-24], so that their effective management may play an important role in HIV prevention, particularly in resource-limited settings [25-29].

As is the case with many developing countries, PNG could benefit from better information on the extent of STIs to inform national prevention and control strategies. This study will provide the first robust estimates of

STI prevalences among pregnant women, including the first estimates of HPV and HSV-2 infection.

Sexually transmitted infections in the Asia-Pacific region

In a recent six country study among 1678 pregnant women attending urban and rural antenatal clinics in Fiji, Kiribati, Samoa, Solomon Islands, Tonga and Vanuatu, the prevalence of Chlamydia was 6.4-29.0% (mean 18.0%); gonorrhoea, 0.0-2.5% (mean 1.7%); and syphilis, 0.0–10.0% (mean 3.0%) in the period 2004-2005[30]. None of the 1618/1678 clinic attenders who underwent voluntary counselling and confidential HIV testing (VCT) were HIV sero-positive [30, 31]. Chlamydia was the most prevalent STI, particularly in Fiji (29.0%) and Samoa (26.8%). Chlamydia was more prevalent in younger women in all locations [11]. For example, in Tonga, prevalence among women <25y was 27.5%, compared to 8.3% among women >25y; in Samoa prevalences of 40.7% and 17.5% were observed in these age-groups respectively [31]. Only 1.5% of the 1678 antenatal clinic attenders reported transactional or commercial sex in the previous 12-months, but these women were six times more likely to have Chlamydia infection [31]. High rates of STIs among pregnant women, including chlamydia (21.5%), gonorrhoea (5.9%), HSV-2 (30.0%), syphilis (2.4%) and trichomonas (27.5%), have also been reported previously in Vanuatu[32-34] and similar rates observed in Fiji [35] and Samoa[36]. Among 451 antenatal clinic attenders in Cambodia, the prevalence of Chlamydia was 2.8%; gonorrhoea, 0.0%; syphilis, 1.3%; and trichomonas 2.7% [37]. In a general population survey among 2550 women and 1350 men in the Philippines, the prevalence of Chlamydia was 5.7%, gonorrhoea 0.8%, and syphilis 0.2% among women; and 4.4%, 1.1% and 0.2% among men, respectively [38].

Sexually transmitted infections in Papua New Guinea

High prevalences of HIV, STIs and genital infections have been reported among men and women in PNG in comparison to other countries in the Asia-Pacific region [39-65]. A recent systematic review and meta-analysis of HIV/STI prevalences in community and clinic-based settings in PNG [11] however, identified only 3 epidemiological studies conducted to date among pregnant women; a combined total of 206 antenatal clinic attenders[47] and 736 women presenting in labour[50, 57] (Table 59).

Table 59 Summary of published data on antenatal HIV/STI prevalences in PNG

Author	Klufio et al., 1995[47]	Mgone et al., 1997[50]	Suarkia et al., 1999[57]
<i>Study population</i>	206 pregnant women attending first antenatal clinic visit at Port Moresby General Hospital	155 women presenting in labour to Goroka Base Hospital	581 women presenting in labour to Goroka Base Hospital
Bacterial vaginosis	23.3 (17.7, 29.7)	-	-
<i>C. trachomatis</i>	17.7 (12.4, 24.0)	36.8 (29.2, 44.9)	34.1 (30.2, 38.1)
<i>N. gonorrhoea</i>	-	-	-
Syphilis	-	-	-
<i>T. vaginalis</i>	18.9 (13.8, 25.0)	-	-
HIV	-	-	-
HSV-2	-	-	-

Periodic syphilis and HIV sero-surveys are conducted by the National Department of Health (NDoH) in PNG to support routine antenatal surveillance. In 2010, estimated antenatal syphilis prevalence was 6.9%, and HIV prevalence 0.7% in urban areas (N=4623) and 4.2% and 0.5% respectively in rural areas (N=3180) (NDoH, personal communication). No prevalence estimates of HSV-2 or HPV have previously been reported among pregnant women in PNG [11].

The reasons for the differences in the epidemiology of HIV and STIs in PNG compared to other countries in the Asia-Pacific region are unclear, but felt likely to be the result of locally-specific interactions between the behavioural determinants, socio-cultural dimensions and structural contexts that frame sexual agency, sexuality and sexual health in PNG compared to other settings[66-75]. These include gender power disparities, sexual violence and the societal roles of men and women [66-69, 72, 74-76]; low levels of male and female

condom use[53, 61, 77], and of male circumcision [67, 76, 78, 79]; limited access to STI treatment services due to poor transport and health systems infrastructure [80, 81]; and limited success in the design and implementation of culturally-relevant behaviour change interventions among both general population and at-risk groups, such as truck drivers, male and female sex workers and their clients[67, 79, 82]. These factors may also explain the high HIV/STI prevalences observed in Tanah Papua Province in Eastern Indonesia, which is experiencing a generalised HIV epidemic that has many parallels to that of neighbouring PNG [83].

HPV and cervical cancer in PNG

Cervical cancer is the most common cancer among women in PNG and a leading cause of premature death [8, 84]. An estimated 1500 women die every year in PNG due to cervical cancer. Despite this burden of disease, no large-scale surveys have been conducted to establish the prevalence of HPV among general or at-risk populations of women. The only survey published to date was conducted among 114 women in Eastern Highlands Province, which reported a 33% prevalence of HPV-16/18[85]. More recently, cervical biopsies obtained over the period 2006-09 from 70 women in PNG with cervical cancer were analysed for HPV infection [4]. HPV-DNA was found in all cases with HPV-16, 18, 33 and 31 the most prevalent HR types (57%, 26%, 10% and 4% respectively). These findings suggest that the currently available and highly effective vaccines against HPV types 16 and 18 have the potential to significantly reduce the burden of HPV-related cervical cancer in PNG, if distribution and cost issues can be resolved.

PNGIMR collaborative research program in sexual and reproductive health

The PiHP Healthy Pregnancy Study is part of a broader program of research being undertaken by the PNGIMR collaborative research group in sexual and reproductive health that has been led by A/Prof Valley (PNGIMR/UNSW) since 2007. This program includes research on the epidemiology, prevention and control of HIV, HPV and other STIs, and interventions research in cervical cancer and maternal and neonatal health.

Complimentary research among 1000 women attending well woman and sexual health clinics in Eastern and Western Highlands Provinces is also being conducted by our group under a separate funding mechanism, and will provide data on HPV genotype prevalence among women at different levels of sexual risk. These studies will together provide the necessary policy-relevant evidence required to inform locally-appropriate and effective interventions for the prevention of cervical cancer in PNG.

Study Aims and Objectives

The overall Aim of this study is to investigate the epidemiology of HIV, human papilloma virus (HPV) and other sexually transmitted infections (STIs) among pregnant women attending antenatal clinics at four sites in Papua New Guinea. The study has the following Research Objectives:

1. To provide the first robust estimates of *C. trachomatis*, *N. gonorrhoea*, *T. vaginalis* and *Herpes simplex* type-2 (HSV-2) prevalence among pregnant women in PNG;
2. To provide the first general population estimates of human papilloma virus (HPV) prevalence among women in PNG in order to inform national policy on HPV vaccination;
3. To validate estimates of antenatal HIV and syphilis prevalence obtained through national antenatal surveillance;
4. To investigate the demographic and sexual behavioural correlates of HIV, HPV and STI risk among women attending antenatal clinics at these sites.

Materials and methods

The PiHP Healthy Pregnancy Study is a cross-sectional bio-behavioural survey among 1000 women attending antenatal clinics in Central, Madang, Eastern Highlands and Hela Provinces. A total of 250 women per site will be recruited in order to enable the study to estimate STI prevalences with adequate precision at site-level in addition to providing robust estimates of prevalence across all sites. For example, this sample size will enable a Chlamydia prevalence of 18% across all sites combined to be estimated with around 2.4% precision (i.e. 95% CI: 15.6, 20.4), and a prevalence of 18% at a single site to be estimated with around 4.8% precision (i.e. 95% CI: 13.2, 22.8).

The study was approved by the Medical Research Advisory Committee (MRAC) of the National Department of Health (NDoH) in Papua New Guinea; and the Health Research Ethics Committees of the University of New South Wales (UNSW) and the Alfred Hospital in Australia.

Findings

Recruitment and sites

At end-February 2014, the study had been completed at two sites (Hiri, n=255; Asaro, n=258) and was close to completion in a third (Hides, n=189), with a total of 702 participants recruited. As a result of funding constraints, a decision was made in early 2014 not to go ahead with recruitment at a final site in Karkar.

Prevalences of HIV and sexually transmitted infections

Preliminary findings based on laboratory data from 664 study participants from 3 sites indicate that high prevalences of HIV, syphilis, chlamydia, gonorrhoea and trichomonas in this setting (Figure 80). The prevalences of syphilis and HIV infection were 2.2% and 1.3% respectively for the three sites combined. Overall, 44% of women attending antenatal clinics in Hiri, Hides and Asaro had one or more of chlamydia, gonorrhoea and trichomonas infections, with the highest burden observed in Hides (53% prevalence). More than 80% of these infections were asymptomatic and therefore would not have been identified and treated based on current national syndromic management guidelines.

HIV and syphilis prevalence data are broadly consistent with routine National Department of Health antenatal surveillance data. HIV estimates from the Healthy Pregnancy study need to be interpreted with caution particularly at the level of individual sites, due to the modest sample size per site and the low prevalence of HIV in the general population, which mean that the confidence intervals around these estimates will be relatively broad compared to estimates of more prevalent infections such as chlamydia or trichomonas.

95% CI for summary estimates across all sites (n=664) are in range of +/- 2.9-3.5% for CT, NG, TV but much wider for less common infections such as HIV and syphilis, as follows:

Chlamydia 23.6% (95% CI: 20.3, 26.9); Gonorrhoea 14.0% (95% CI: 11.2, 17.0); Trichomonas 24.1% (95% CI: 20.8, 27.5); HSV-2 28.8% (95% CI: 25.3, 32.3); HIV 1.3% (95% CI: 0.1, 2.5) ; Syphilis 2.2% (95% CI: 1.0, 3.4). For relatively rare events such as HIV the CI are wide as we would expect, especially at site level e.g. Hiri estimate is 1.6% (95% CI: 0.0, 3.5).

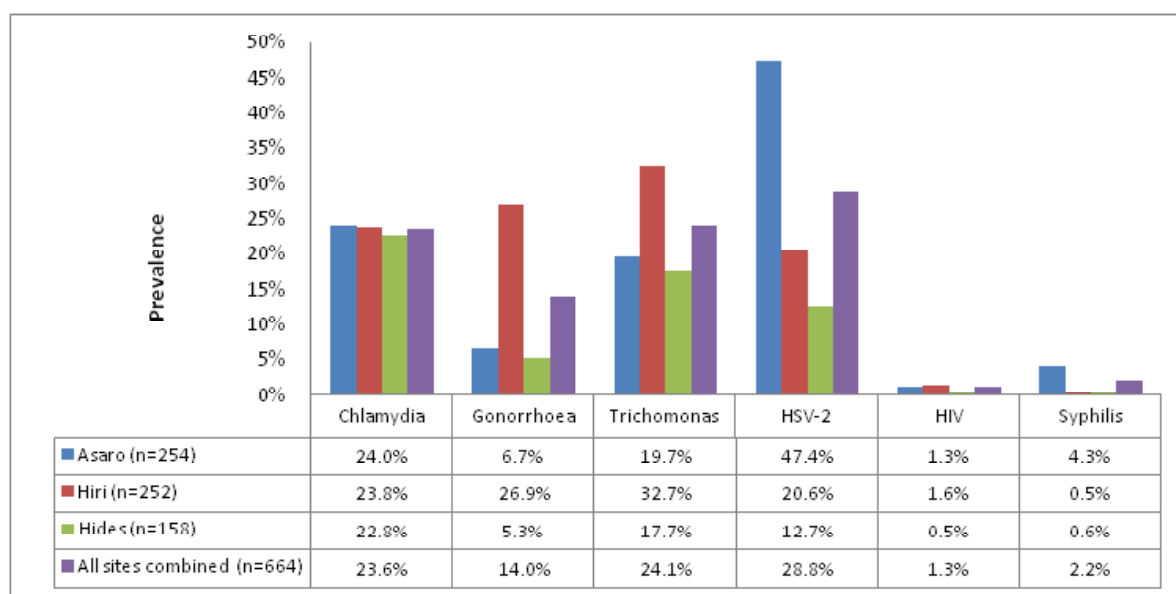
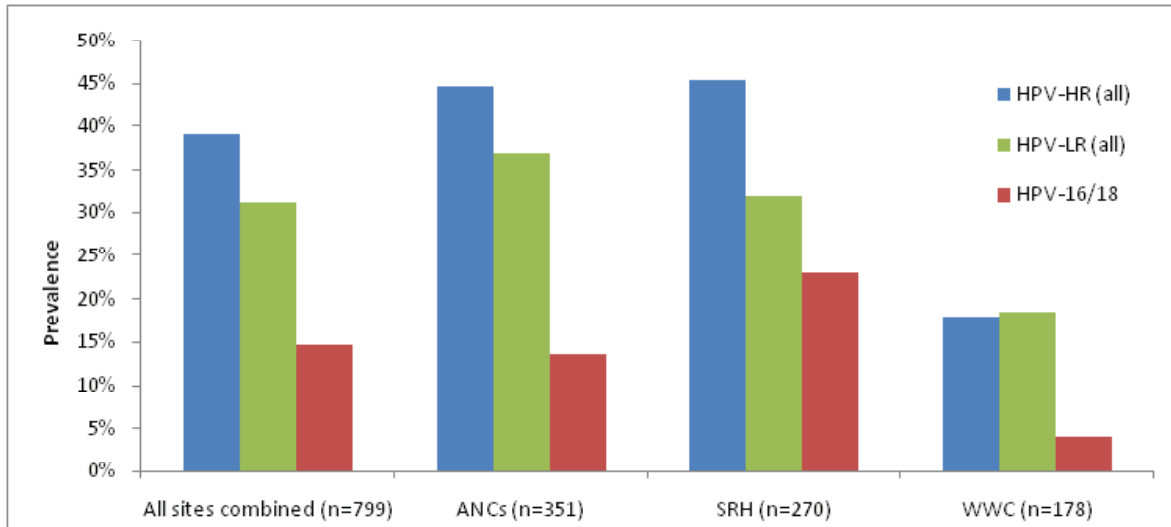


Figure 80 Prevalences of HIV and other STIs among 664 antenatal women, iHDSS, 2013

Prevalence of human papillomavirus (HPV) infection

The prevalence of HPV infection was high in this population compared to prevalences among women attending sexual health or well woman clinics in this setting, reflecting the younger median age of antenatal women compared to other clinic attendees (24 years, 33 years and 36 years respectively) (Figure 81).



ANC: antenatal clinic; SRH: sexual & reproductive health clinic; WWC: well woman clinic

Figure 81 Prevalences of HPV among 799 women attending antenatal, sexual health and well woman clinics in PNG, iHDSS, 2013

The prevalence of high risk HPV infection (all types combined) was 43% overall (Hides=26%; Hiri=44%; Asaro=49%) and that of HPV types 16 or 18 was 13% across all sites (Hides=3%; Hiri=10%; Asaro=18%). Among women with an HPV infection, the most prevalent high risk HPV types were HPV 16, 39, 52, 58 and 33 (Figure 82).

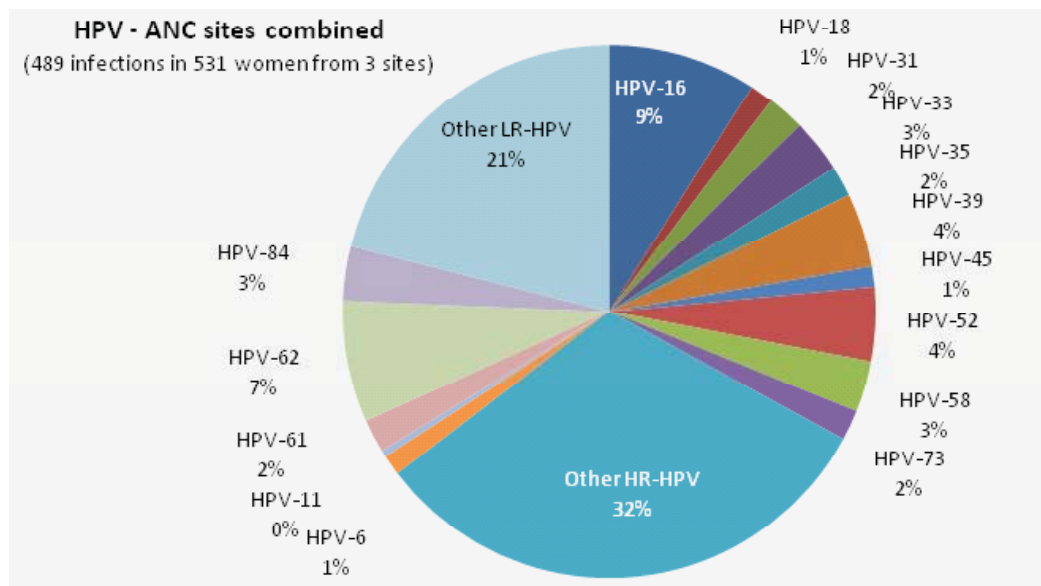


Figure 82 HPV types among HPV positive women attending antenatal clinics at three sites in PNG, iHDSS, 2013

Discussion

Preliminary findings from the PiHP Healthy Pregnancy Study indicate that pregnant women experience an unacceptably high burden of sexually transmitted infections (STI) in Papua New Guinea. The burden of curable STIs (chlamydia, gonorrhoea and trichomonas) appears to be particularly high and this health need is currently unmet through existing syndromic management approaches due to the majority of pregnant women having no clinical symptoms. These findings suggest that new strategies are needed to control STIs and their associated adverse maternal and neonatal health outcomes in this population. Arising from this research, the PNGIMR collaborative research group will be conducting a pilot intervention study among 500 antenatal women in PNG to test the operational feasibility and potential public health impact of newly available, robust and highly accurate point-of-care STI tests for the diagnosis and treatment of STIs in pregnancy. This study is expected to start in mid-2014 and will inform future field trials and public health interventions research being planned by our collaborative group.

Conclusion

The Healthy Pregnancy Study is providing the first geographical, age and type-specific prevalence data on HPV infection in PNG. Together with data from women attending sexual health and well woman clinics, these findings suggest that polyvalent HPV vaccines could have a significant impact in preventing cervical cancer in PNG, one of the highest burden settings globally. Discussions between the PNGIMR collaborative research group, the National Department of Health, and key development partners (including WHO, GAVI and Rotary International) regarding the conduct of robust district and provincial level HPV vaccine pilot intervention studies are on-going. The successful conduct of these studies will be critical to the successful wide-scale introduction of HPV vaccine in PNG.

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Chapter 10

VACCINATION COVERAGE

Abstract

This Chapter presents results of vaccination coverage adherence to vaccination schedules in Karkar iHDSS. Key findings are the vaccine coverage rate decreased for all vaccines from the first to later doses. The lowest coverage rate was with 2nd Measles at 44.9%. Vaccine dose completion rates of DTP/Hib/HepB, OPV and Measles were lower than Global vaccine coverage rates. Less than 20% of participants received the vaccines at right time even for vaccines given at birth (BCG and HepB). Conversely, up to 9% received vaccines prematurely. Delay of vaccination was seen with overall average delay of 145 days, or ~5 months.

Findings

The background and methods has been discussed in details in the previous PiHP report. There are 1243 children aged from 1 to 5 years old in the Karkar iHDSS census list (conducted in 1st Quarter of 2013). There was a slightly higher number of male than female children (51.5% vs. 48.5%). At the time of the survey, 198 children were not present, 9 were due to migration out of the area, and 189 were not available after twice visits. 1045 children were available to check for their health books. Of these, 769 children had health books (73.6%), and 276 children did not have health books (26.4%). Those who had no health book, 74.2% had lost their health books, and 14.9%, their health books were badly damaged.

Table 60 Distribution of study population by sex and status of health book ownership, iHDSS, Karkar, 2013

Total	1243
Male	640 (51.5%)
Female	603 (48.5%)
Migrated out	9 (0.7%)
Not available after twice visits	189 (15.2%)
Did not have health book	276 (26.4%*)
Had Health book	769 (73.6%*)

* % of 1045 (from total of 1243 -207 who were not available e.g., migrated out)

Table 61 Conditions of health books, Karkar, iHDSS, 2013

Condition of health books (N=769)		%
Good	319	41.5
Moderate	350	45.5
Bad	100	13.0

Of the 769 children who had health books, nearly half of health books were kept in good condition. Although 13% were in bad conditions, we were able to record the dates of vaccination.

Vaccination Coverage Rates

The vaccination coverage rates for first vaccines doses at birth were 71.1% for BCG, 50.0% for HepB, 93.8% for OPV, 94.4% for DTP/Hib and 67.6% for Measles. Lower coverage was found for the second and third doses of all vaccines.

Table 62 Vaccination coverage rates, Karkar, iHDSS, 2013

Vaccines	N=769	%
BCG	545	71.1
HepB1	381	50.0
DTP/Hib/HepB dose1	726	94.4
DTP/Hib/HepB dose2	600	78.0
DTP/Hib/HepB dose3	357	46.5
Measles1	520	67.6
Measles2	345	44.9
OPV1	721	93.8
OPV2	605	78.7
OPV3	396	51.6

The Figure 83 below shows decreasing coverage rates in the later vaccine doses. DTP/Hib/HepB coverage rates decreased from 94.4% at the first dose to 46.5% at the final dose ($p < 0.001$), Measles (Dose 1: 67.6% vs. Dose 2: 44.9%, $p < 0.001$) and OPV (OPV1 93.8%, OPV2 78.7%, OPV3 51.6%, $p < 0.001$) coverage rates decreased similarly.

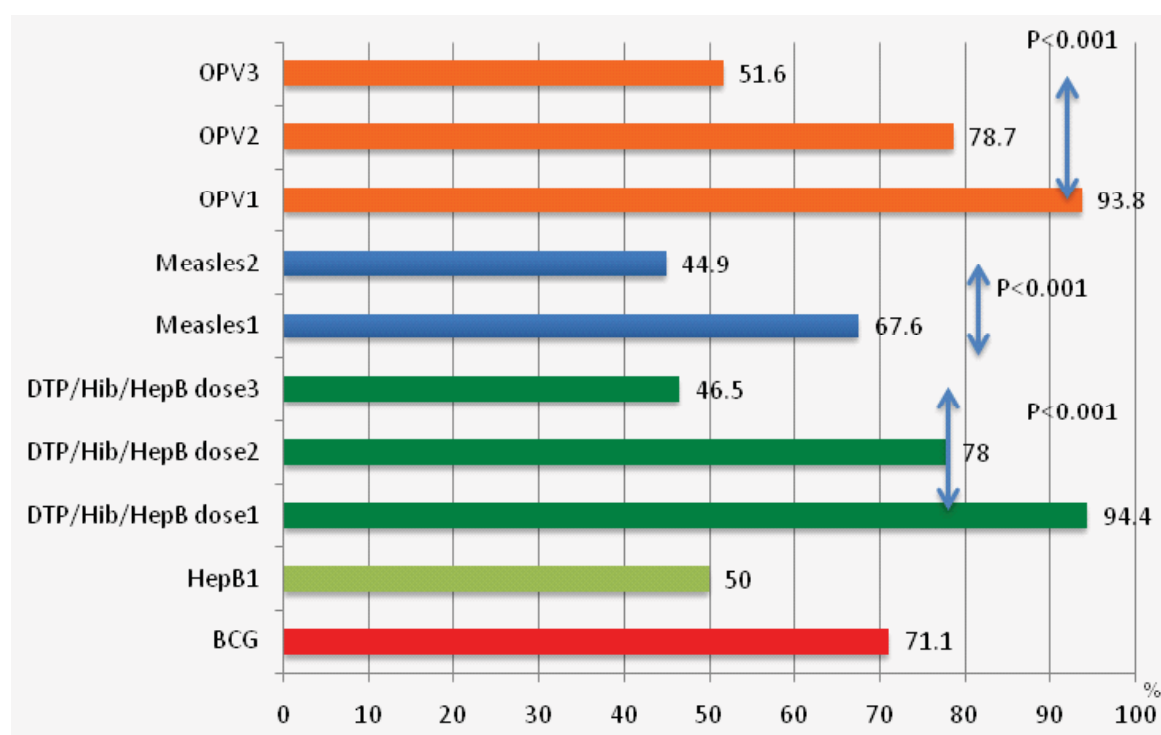


Figure 83 Coverage rates by vaccine type and dose, Karkar, iHDSS, 2013

Vaccine Dose Completion

The rates of completion of all vaccination doses were between 16-30% in the study areas. It is noted that 38.0% of children had not received any Measles vaccine.

Table 63 Completion of vaccination, Karkar, iHDSS, 2013

Vaccine	Coverage with Vaccine Doses (N=769)	%	Global Coverage with Vaccine Doses (%)*
DTP/Hib/HepB	358	46.6 %	83 %
OPV	397	51.6 %	84 %
Measles	346	45.0 %	N/A
Measles 1 dose at 2 years old	503	65.4 %	84%

* WHO & UNICEF, 2013

Table 63 above shows a comparison the vaccine dose completion rate with the Global Immunization coverage figures; dose completion rates of all three vaccine-types in this study were nearly 2 times lower than the Global rates (DTP/Hib/HepB was 46.6%; the Global coverage rate of this vaccine was 83%).

Vaccination at Correct Time Schedule

For vaccination to offer optimal protection against the respective diseases, vaccines should be given at the right time. Adherence to the EPI schedule is thus an important component of EPI. 16.8% of participants received BCG and HepB between at birth up to 2 weeks old. The vaccination rates at the correct time for the first doses of other vaccines were very low and ranged from 19.5% for DTP/Hib/HepB, 8.6% for Measles and 16.9% for OPV. The adherence to vaccination schedule was even lower for final doses of vaccines and only 2.3% of DTP/Hib/HepB, 5.7% of Measles and 0.5% of OPV doses were given at the correct time.

Table 64 Proportion of children receiving vaccination at correct schedule, Karkar, iHDSS, 2013

Vaccines	N=769	%
BCG	133	17.3
HepB1	129	16.8
DTP/Hib/HepB dose1	150	19.5
DTP/Hib/HepB dose2	59	7.7
DTP/Hib/HepB dose3	18	2.3
Measles1	66	8.6
Measles2	44	5.7
OPV1	130	16.9
OPV2	32	4.2
OPV3	4	0.5

Vaccination Delay

The mean of delay for the administration of each vaccine dose ranged from 62 (HepB) to 226 (3rd DTP/Hib/HepB). Except for Measles, the later doses of each vaccine showed a longer delay. Overall, the average delay for all vaccines was very pronounced at 226 days, or 6.5 months.

Table 65 Proportion of vaccination delay by type of vaccine, Karkar, iHDSS, 2013

Vaccines	N=769	%	Mean (days)
BCG	231	30.0	83
HepB1	106	13.8	62
DTP/Hib/HepB dose1	513	66.7	143
DTP/Hib/HepB dose2	507	65.9	164
DTP/Hib/HepB dose3	331	43.0	226
Measles1	387	50.3	156
Measles2	259	33.7	151
OPV1	591	76.9	112
OPV2	561	73.0	150
OPV3	57	7.4	212

Premature Vaccination

Between 1-9% of participants received at least one vaccine prematurely compared to PNG vaccine schedules. When DTP/Hib/HepB vaccine was given prematurely, the difference ranged from 5 day to 9 day. Of those who received Measles vaccine dose 1 prematurely, 10% received approximately 2 to 3 month prematurely (i.e. around 3-4 months instead of 6 months of age).

Table 66 Proportion of children receiving vaccination before the schedule time, Karkar, iHDSS, 2013

	N=769	%	Mean (days)
DTP/Hib/HepB dose1	63	8.2	9
DTP/Hib/HepB dose2	34	4.4	8
DTP/Hib/HepB dose3	9	1.2	5
Measles1	67	8.7	23
Measles2	42	5.5	15
OPV1	0	N/A	N/A
OPV2	12	1.6	3
OPV3	3	0.4	56
BCG	N/A		
HepB1	N/A		

Conclusion

The “Health Book” is the only means of health record keeping for individuals in PNG. This survey showed that 26% of children in the survey had no health books. However, among those with health books most kept their health books in good condition. The vaccine coverage rate varied and decreased for all vaccines from the first to later doses. The lowest coverage rate was with 2nd Measles at 44.9%. Vaccine dose completion rates of all three vaccine-types (DTP/Hib/HepB, OPV and Measles) were lower than Global vaccine coverage rates [2].

This survey showed that even for vaccines given at birth (BCG and HepB), less than 20% of participants received the vaccines at right time. Rates were even lower among later doses such as 2nd measles at 5.7% and or 3rd DTP/Hib/HepB at 2.3%. Conversely, up to 9% received vaccines prematurely compared to the EPI schedule. Delay of vaccination was seen with all vaccines with overall average delay of 145 days, or ~5 months. Again, the later doses of each vaccine showed a longer delay and the most delayed vaccine was 3rd STP/Hib/HepB at 226 days.

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