

School of Medicine and Health Sciences
Discipline of Biochemistry and Molecular Biology
Micronutrient Laboratory
Research Report 2006 to 2008

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Academic position: Associate Professor
Discipline: Biochemistry and Molecular Biology
Division: Basic Medical Sciences
School: School of Medicine and Health Sciences

Research Interest:

- ❑ Maternal and child malnutrition with emphasis on micronutrient deficiencies (Iodine, Iron, Zinc, and Vitamin A) in infants and mothers;
- ❑ Metabolic disorders (diabetes mellitus, gestational diabetes, thyroid dysfunction, anemia, oxidative stress, and hypertension) with special interest in diagnosis and clinical biochemical assessment at the subclinical stages;
- ❑ Disease trends in PNG, with emphasis on retrospective assessment of laboratory data obtained in Clinical Biochemical department in Port Moresby General Hospital.
- ❑ Food Security and its implication for maternal and child health

RESEARCH PROJECTS COMPLETED: 2006 to 2008

PROJECT TITLE: Salt iodization and iodine status among infants and lactating mothers in Papua New Guinea

Principle Investigator: Victor J. Temple

Researcher students: Robin Oge and Ian Daphne

Co-investigators: Prof. John Vince, Dr. Paulus Ripa, Prof. Francois Delange (Brussels, Belgium), Prof. Creswell J Eastman (ICPMR, Westmead Hospital, Sydney Australia)

Background:

Iodine deficiency disorders (IDD) are the adverse health effects associated with inadequate intake of iodine. Universal salt iodization (USI) is the most effective and sustainable intervention strategy for the prevention, control, and elimination of iodine deficiency. USI has proved to be remarkably effective in many countries, with documented evidence of sustained success of IDD control programs. However, successful programs of USI do not necessarily cover the needs of lactating mothers and children younger than two years of age. Thus, infants may remain exposed to iodine deficiency, which can limit the production of thyroid hormones during the period of rapid growth and development. For infants under six months of age, breast milk is the major source of iodine for thyroid hormone biosynthesis, followed by infant formula fortified with iodine. Subclinical (mild to moderate) iodine deficiency in lactating mothers may result in impaired cognitive and psychomotor functions of their infants, making it a public health concern. This underscores the need for continuous evaluation of salt iodization programs and their impact on the vulnerable groups such as lactating

mothers and infants in target populations, in the developing countries such as Papua New Guinea.

The aim of this cross-sectional study was to determine the per capita consumption and availability of adequately iodised salt in households, and the iodine status of infants 7 - 120 days old and their lactating mothers, resident in National Capital District, Papua New Guinea.

Achievements:

Salt samples were obtained from households selected by simple random sampling. The mean daily per capita consumption of salt was 5.6 ± 1.5 g. The mean iodine content in salt from households and trade-stores was 33.38 ± 18.04 ppm and 44.20 ± 12.10 ppm, respectively. Adequately iodised salt was available in 94.48% of households and in 100% of trade-stores. The calculated mean daily per capita discretionary intake of iodine was 186.93ug, which is below the 250ug recommended for lactating mothers.

Casual urine samples selected by simple random sampling were used to determine the iodine status of infants and mothers. Urinary iodine concentration (UIC) was estimated by Sandell-Kolthoff reaction. Mean age of infants was 46.9 ± 28.2 days (95% confidence-interval 41.3 – 52.5 days). Median UIC of infants and of their lactating mothers was 253.5ug/L (interquartile-range 165.3 – 363.0ug/L) and 124.5ug/L (interquartile-range 93.0 – 161.0ug/L), respectively, indicating that iodine deficiency is not of public health significance among infants and lactating mothers. Eighty percent of the infants were exclusively breast-fed and 20% were mixed-fed. The median UIC for the exclusively breast-fed and mixed-fed infants was 251.0ug/L (interquartile-range 177.0 – 338.6ug/L), and 290.0ug/L (interquartile-range 147.1 – 425.5ug/L), respectively, indicating optimal status of iodine nutrition. The UIC of exclusively breast-fed infants was significantly ($P < 0.001$) higher than the UIC of their mothers. The Spearman's correlation test showed weak non-significant linear relationship ($r = 0.118$, $P = 0.297$) between UIC of the exclusively breastfed-infants and their mothers. Despite success in the implementation of the universal salt iodization strategy in the National Capital District, mild to moderate status of iodine nutrition was prevalent in 33.8% of the exclusively breastfeeding-mothers, although their exclusively breastfed-infants were nourished with iodine. There is therefore a need to advocate strongly for increased dietary intake of iodine by lactating mothers.

Our findings strongly indicate the urgent need for an efficient, sustainable, and functional monitoring system to strengthen and improve on the achievements of the universal salt iodization strategy in National Capital District.

PROJECT TITLE: Nutritional Status of Infants in the National Capital District of Papua New Guinea

Principle Investigator: Victor J. Temple

Researcher students: Robin Oge and Ian Daphne

Co-investigators: Prof. John Vince, Dr. Paulus Ripa, Prof. Francois Delange (Brussels, Belgium), Prof. Creswell J Eastman (ICPMR, Westmead Hospital, Sydney Australia)

Background:

Anthropometry is an acceptable method that is used to assess the growth and development of infants and young children. It is the conventional practical tool for evaluating the nutritional status of infants and young children, especially in developing countries. According to WHO expert committee, the overall nutritional status of infants and young children can be assessed by comparing their growth or attained weight or recumbent length (height) for their age with that of the appropriate gender in a reference population of healthy infants and children. This comparison is calculated in terms of standard deviation (SD) scores, or Z-scores, in which the placement of a measure, like the weight of the child within a distribution of the reference weights of healthy children, is characterised by its distance from the median in SD units. WHO recommends this classification system for its ability to describe nutritional status including, at the extreme ends, of the distribution, and to allow for derivation of summary statistics of the data. The Z-Scores are now widely used in most developing countries, especially in community-based studies.

In Papua New Guinea (PNG), the Z-scores were used in the classification of the nutritional status of children 6 – 59 months during the PNG National Nutrition Survey, conducted in 2005. There is, however, paucity of published data that use the Z-scores to assess the nutritional status of infants in the National Capital District (NCD) of PNG.

The aims of this study were to conduct anthropometric measurements of infants, resident in NCD, and to use the data obtained for assessing the nutritional status of these infants, using Z-scores. The main objective of the project was to compare the Z-scores obtained, using the NCHS reference and the WHO 2005 standards.

Achievements:

The sample size of 226 infants was based on a design effect of one, a relative precision of 10%, assumed prevalence rate of 20%, predicted non-response rate of 10% and confidence level of 95%. Simple random sampling was used to select infants attending the well-baby clinics in Port Moresby General Hospital (PMGH). There were 121 (53.5%) male and 105 (46.5%) female infants, age group 0 to 24 months.

Weights and lengths were measured using standard recommended techniques. The age of each infant was obtained from the baby book. The weights and lengths of the infants were converted into Z-scores using the new WHO Anthro 2005 software, which also gives the summary statistics of the data.

Using the WHO 2005 standard, prevalence of stunting, wasting and underweight among the infants was 28.6%, 5.3% and 8.9% respectively. Stunting was higher among infants in the 6 to 11 months age group. The percent prevalence of stunting, wasting and underweight in the male infants was 33.1%, 4.6% and 7.4%, respectively, compared to 23.3%, 6.1% and 10.6%, respectively, in the female infants.

Coefficient of correlation between length and weight was high for both male (0.87) and female (0.78) infants. Males were significantly heavier ($p < 0.05$) and shorter, than the females. Stunting was higher in males, compared to the females.

Although the percent prevalence of stunting among all the infants (28.6%) and among the male (33.1%) and female (23.3%) infants was not of public health significance, yet these figures indicate that the rate of stunting in NCD should be classified as moderate, not low, prevalence rate. This should be of concern to program planners, because of the

complex sub-clinical problems that have been related to stunting. The stunting syndrome has been related to cumulative deficient growth and features that may include developmental delay, impaired immune function, reduced cognitive development, metabolic disturbances leading to accumulation of body fat, loss of lean mass and risk of developing hypertension. This underscores the urgent need for advocacy for improving the current nutritional status of infants and young children in NCD.

The nutritional status of infants in NCD needs urgent attention. There should be greater focus on nutritional education to reduce malnutrition among infants. Emphasis should be placed on educating the community, individuals and families. Nutrition education messages should be simple and easy to understand by the community. Important information, such as when to start solid foods, how often to feed solid food, what to buy in the store for infants, as well as family planning, must be taught over and over again at the community level. Data obtained in future anthropometric studies of under-five children in PNG should be analysed using the WHO 2005 standards.

PROJECT TITLE: Nutrient and Energy Intake of People Living with HIV/AIDS in Port Moresby, Papua New Guinea: A 24-Hour Recall Study

Principal Investigator: Victor J. Temple

Researcher student: Sandra Ilaisa

Co-Investigators: Wila Saweri (National Department of Health) and Dr. Agatha Lloyd (WHO Consultant, Heduru Clinic, Port Moresby General Hospital)

Background:

Antiretroviral therapy (ART) and adequate dietary intake are essential components in the management of people living with HIV/AIDS (PLWHA). Poor nutrition status and HIV/AIDS are interrelated and exacerbate one another creating a vicious cycle that progressively damage the immune system, enhances risk of developing opportunistic infections, increase fatigue, decrease physical activity and productivity of PLWHA. HIV/AIDS specifically affects nutritional status by increasing energy requirements, reducing food intake and adversely affecting nutrient absorption and metabolism. People living with HIV/AIDS have greater energy needs than uninfected persons. Extent of increase energy needs depends on progression and stage of HIV infection.

The National AIDS Council Secretariat (NACS), Provincial AIDS Committees (PAC), several International, Non-governmental (NGO), Private Institutions, Organizations and Agencies are intensively involved in the fight against HIV/AIDS in Papua New Guinea (PNG). However, information on periodic screening and assessment of nutritional status of PLWHA is scanty. There are not published data on the dietary intake and nutritional status of PLWHA in PNG. This study was prompted by the apparent lack of published data needed to advocate for increased resource allocation and support for improved nutrition, and other nutritional needs of PLWHA in PNG.

The aim of this study was to assess the nutrient and energy intake of PLWHA in Port Moresby. The objectives were to obtain baseline data on the average per capita intake of nutrients and energy by PLWHA in Port Moresby. To provide baseline data for use as an advocacy tool to strengthening the need for decision-makers to include nutrition as an integral part of all on-going ART of PLWHA in PNG.

Achievements:

A prospective cross-sectional study carried out in the Heduru Clinic in Port Moresby General Hospital in PNG. Study population was selected by simple random sampling of PLWHA attending Heduru clinic from May to July 2006. Fifty eight participants were recruited on a consecutive basis. Self-designed pre-tested 24-hour food-recall questionnaire was used to obtain data from consented participants. Standard and modified food-recall kits were used to obtain estimated quantities of all foods and drinks consumed the previous day (24-hours). Food-Works Professional edition 2005, version 4.00.1179: Xyris Software (Pacific Food Tables) was used to convert estimated food intakes into nutrient and energy values. Data analysis was carried out by Microsoft Excel data pack 2006 and SPSS software version 11 for Windows.

Fifty (86%) PLWHA consented to participate. 21 (42%) were males and 29 (58%) females. Mean per capita intake of proteins, fat and carbohydrates were for males 62 ± 11 g, 67 ± 6 g and 258 ± 32 g respectively, for females the values were 66 ± 12 g, 61 ± 6 g, 226 ± 28 g respectively. Mean per capita intake of energy for males and females was 1892 ± 198 kcal (95% CI was 1576 – 2208 kcal) and 1725 ± 214 kcal (95% CI was 1385 - 2065 kcal) respectively. The mean energy intake of male and female PLWHA was 33.6% and 14% below the recommended daily allowance (RDA) for healthy non-HIV infected PNG males and females respectively. Significant differences were obtained when the energy intakes are compared to the WHO recommended energy intake for male and female PLWHA.

Although there is no clear recommendation for increase intake of micronutrients by PLWHA, the amount consumed per day should not be less than the RDA for non-HIV infective individuals. There is an urgent need to increase the intake of Iron by female PLWHA. In the short term this can be achieved by giving them Iron tablets, which is the current practise for women attending Anti-natal clinics in PMGH. In addition, multivitamin supplementation can be included as part of the on-going HAART management in Heduru Clinic, PMGH. In the long term, a comprehensive nutrition education program tailored towards using appropriate locally available foodstuffs to provide adequate amounts of energy and micronutrients to meet the required RDA should be advocated.

The growing epidemic of HIV/AIDS and food and nutrition insecurity is a potent combination that can negatively impact severely on the educational, socio-economic and political development of PNG. In order to avert this “perfect storm” more effective and strategic planning on the use of the limited resources available to combat the spread of HIV/AIDS and to improve food security is urgently needed.

WHO request for the integration of nutrition into the essential package of care, treatment and support for PLWHA should be urgently implemented in PNG. PLWHA should be encouraged to eat more locally available nutrient dense foods regularly, frequently snacking on variety of foods throughout the day and to eat small, frequent meals especially if their appetite is poor. Nutrition screening, assessment and counselling should be an integral part of all HIV/ AIDS treatment programs. Incorporate nutrition screening, assessment and counselling into the National Policy and Guidelines for care and treatment of PLWHA in PNG. More elaborate and detailed study is required to fully assess the nutritional status, adequacy of diets and food habits of PLWHA in various parts of PNG.

PROJECT TITLE: Retrospective Assessment of Thyroid Function Tests Results obtained in Port Moresby General Hospital from January 2004 to December 2005

Principal Investigator: Victor J. Temple

Research student: Gwen H. Pamu

Background:

Thyroid hormones are Thyroxine (T4, also called 3,5,3',5'-Tetra-Iodothyronine) and Tri-Iodothyronine (T3 also called 3,5,3'-Tri-Iodothyronine). Tri-Iodothyronine is the biologically active form, because it is the hormone that binds to receptors and trigger end-organ effects.

Thyroid Function Tests (TFT) are used to establish if there is Thyroid dysfunction. Current recommended parameters used for the TFT are Plasma TSH and Free Thyroid hormones (FT4 & FT3). However, the choice of TFT used usually depends on local arrangements and laboratory protocols. Thus, Thyroid function tests can be ordered as TSH alone by entering "TSH", as FT4 alone by entering "FT4" or as FT3 alone by entering "FT3" or as a combination (TSH, FT4 and or FT3) by requesting "TFT". The combined results can occur in either of six defined patterns that need appropriate interpretation. TFT results can be classified as either Concordant if both TSH and FT4 indicated the same findings (as Euthyroid, Hypothyroid or Hyperthyroid) or Discordant if TSH and FT4 did not indicate the same findings.

The aim of this project was to retrospectively assess Thyroid Function Tests carried out in Port Moresby General Hospital (PMGH) in 2004 and 2005. The objective was to classify the TFT for the purpose of providing base line information that can be used to assess the possible types of thyroid dysfunctions that are prevalence in NCD. To use the information obtained to provide data on disease trend in relation to thyroid dysfunction in NCD.

Achievements:

All TFT carried out in the Central Pathology Hospital Laboratory (CPHL) in PMGH during the period January 2004 to December 2005 were obtained from records available in the Clinical Biochemistry laboratory. The data collected were registration number of the patient, gender, age, tests ordered (TSH, FT4 or both), date of the test and results of the tests. The registration number was used to identify patients with more than one test per year; only the first result was used for such patients. TFT results were classified as either Concordant or Discordant. Discordant results were further separated into various groups as recommended for standard clinical analysis of data.

Ranges for TSH and FT4 used were obtained from the CPHL in PMGH:

TSH: Normal range: 0.32 – 5.0 μ IU/mL; Low < 0.32 μ IU/mL; High > 5.0 μ IU/mL

FT4: Normal range: 9.14 – 23.08 pmol/L; Low < 9.14 pmol/L; High > 23.08 pmol/L

Table 1: Distribution of male and female patients according to levels of TSH and FT4 in 2004 and 2005

Levels	2004				2005			
	TSH		FT4		TSH		FT4	
	Male	Female	Male	Female	Male	Female	Male	Female
Low	24 (24%)	114 (35%)	13 (12%)	46 (14%)	39 (31%)	131 (35%)	67 (45%)	190 (43%)
Normal	65 (64%)	177 (55%)	77 (71%)	210 (63%)	71 (57%)	211 (56%)	54 (36%)	187 (42%)
Raised	12 (12%)	34 (11%)	19 (17%)	78 (24%)	15 (12%)	36 (10%)	28 (19%)	69 (16%)

Table 2: Classification of TFT results for male and female patients in 2004 and 2005

	2004		2005	
	Male	Female	Male	Female
Concordant	85 (78%)	237 (71%)	61 (41%)	175 (39%)
Discordant	16 (15%)	87 (26%)	61 (41%)	191 (43%)
Not classified	8 (7%)	10 (3%)	27 (18%)	80 (18%)

Table 1 shows distribution of male and female patients according to levels of TSH and FT4 obtained in 2004 and 2005. Further analysis of the data in Table 1 indicates that in 2004, most of the male (54%) and female (44%) patients had normal TSH and FT4 levels. A similar trend was obtained in 2005 with most of the male (25%) and female (25%) patients having normal TSH and FT4 levels.

The classification of TFT results for 2004 and 2005 as concordant or discordant is presented in Table 2. In 2004, 85 (78%) of male patients had concordant results compared to 16 (15%) with discordant results. 237 (71%) of the female patients were concordant and 87 (26%) were discordant. Of the 85 concordant males, 59 (69%) were euthyroid, 9 (11%) hypothyroid and 17 (20%) hyperthyroid. 146 (62%) of the 237 concordant females were euthyroid, 22 (9%) were hypothyroid and 69 (29%) were hyperthyroid.

In 2005, results indicate 61 (41%) concordant and 61 (41%) discordant male patients. Of the 61 concordant males, 37 (61%) were euthyroid, 10 (16%) were hypothyroid and 14 (23%) were hyperthyroid. For the females, 175 (39.2%) were concordant and 191 (43%) discordant. 112 (64%) of the 175 concordant females were euthyroid, 21 (12%) hypothyroid and 42 (24%) hyperthyroid.

In 2004, the discordant results show that subclinical hyperthyroidism (low TSH with normal FT4) was highest in male (50%) and female (44%) patients. Non-thyroidal illness (normal TSH with low FT4) was next in both male and female patients. In 2005, the discordant results indicate prevalence of two types of non-thyroidal illnesses (normal TSH with low FT4, low TSH with low FT4) among the male and female patients. 31 (51%) of male and 91 (48%) of female patients had the first type and 21 (34%) males and 69 (36%) female had the second type of non-thyroid illness. One of

the major limitations in this study is the retrospective design that prevents analysis of the reasons for which the thyroid function tests were ordered.

PROJECT TITLE: Self-Medication among Students in the University of Papua New Guinea

Principal Investigator: Victor J. Temple

Research student: Gillian Meaurio

Co-investigator: Jackson A K Lauwo

Background:

The use of drugs to treat self-diagnosed disorders or symptoms, or the intermittent or continued use of a prescribed drug, without consultation, for chronic or recurrent disease or symptoms is considered as self-medication. In most developed countries self-medication is a major component of the primary health care system. Rational use of over the counter (OTC) drugs can be achieved by appropriate labelling, information leaflets and also by ensuring that Pharmacists or Physicians give all necessary additional information or professional advice to consumers. The use of prescription drugs for self-medication is common practice in some developing countries. Some of the reasons for such common practice include non-licensed providers of drugs, availability of prescription drugs in open markets, actions of unregistered practitioners, use of leftovers, drugs obtained from family members or friends with previous similar symptoms. There are also reports of increased and sometimes irrational use of OTC drugs in some developing countries.

The Medicines and Cosmetic Act 1999 of PNG lists 1070 Prescription Only Medicines, 334 Pharmacy Only Medicines and 493 OTC drugs. There are no published data indicating awareness of the groups of medicines that are available for self-medication in PNG. In addition there are no data to indicate the prevalence and factors associated with self-medication among the various communities in PNG. This calls for appropriate research to establish the extent and pattern of self-medication in PNG, so as to develop appropriate strategy to address the problems. This cross-sectional descriptive study assesses prevalence and factors associated with self-medication among students in the University of Papua New Guinea during the 2005 academic year.

The aim of this study was to assess the prevalence and factors associated with self-medication among students in the University of Papua New Guinea (UPNG). The objective was to ascertain the types of drugs used; the sources of drugs and drug information, and also the common symptoms for which the drugs were used for self-medication.

Achievements:

Data from randomly selected consented students on the Taurama and Waigani campuses of the UPNG were obtained by self-administered, structured, pre-tested questionnaires. The sample size for the two campuses was calculated using the “proportionate to population size” (PPS) cluster sampling technique. A total of 583 questionnaires were distributed as follows, 124 (21.3%) among students on Taurama campus and 459 (78.7%) among students on Waigani campus. However, only 309 (53%) of the questionnaires received from all the students were suitable for analysis. Of these, 253 (82%) students, mean age 22.7 ± 3.4 years, used self-medication during the

academic year. Gender distribution was 117 (46%) males, mean age 23.6 ± 4.1 years, and 136 (54%) females, mean age 22.0 ± 2.2 years. Highest prevalence of self-medication was among students in 20 – 24 years age group. No significant difference ($p > 0.05$) was observed in self-medication practice between male (79.1%) and female (84.5%) students.

Further analysis of the questionnaires from all the 309 students indicates that 85 (27.5%), mean age 22.4 ± 2.4 years were from Taurama campus and 224 (72.5%), mean age 22.8 ± 3.6 years, were from Waigani campus.

Data for all the 309 students indicate that OTC and Prescription drugs were used in 710 instances (63.8%) and 402 instances (36.2%) respectively. Paracetamol was the most frequently (59.6%) used OTC drug. Antibiotics (54.5%) and Antimalarials (45.5%) were the prescription drugs used. For antibiotics, Amoxicillin (89.5%) was the most frequently used. For antimalarial drugs, Chloroquine (47.5%) and Artemether (38.3%) were the most frequently used.

Headache and malaria were the most common symptoms for self-medication, whereas the most common reasons were previous experience of treatment in relation to symptoms and mild illness. Sources of drugs for self-medication were friends (53.8%), pharmacy (52.6%) and supermarkets (43.1%).

The prevalence of self-medication is high (82%) among students in the UPNG, with no significant difference between male and female students. There was no significant difference observed in the self-medication practices among the students on the Taurama and Waigani campuses.

Paracetamol and other NSAID were the most frequently used OTC drugs for self-medication. Amoxicillin was the most frequently used antibiotic, while Chloroquine was the most frequently used antimalarial drug. Inappropriate use of drugs was higher among the male students (53.6%) compared to the female students (46.4%) in UPNG. Headache and malaria were the two major reasons for self-medication. Friends, relatives and drug retail shops are responsible for promoting self-medication among the students. The presence of pharmacists in all drug retail outlets can play a significant role in controlling some of the factors that promote self-medication among the students.

There is need to carry out intensive education and comprehensive awareness campaign to advocate for reduction in the prevalence of self-medication among students on the Taurama and Waigani campuses in the UPNG.

PROJECT TITLE: Assessment of the Iodine Nutritional Status of School Children (6–12 years) in Honiara, Solomon Islands

Principal Investigator: Victor J. Temple
Research student: Richard Zesapa Hapa,
Co-investigator: James Auto

Background:

Normal metabolism of the thyroid hormones (Thyroxin and Triiodothyronine) requires adequate dietary intake of Iodine, which is one of the essential trace elements that are

required for normal growth and development. Deficiency or low intake of iodine can impair thyroid hormone biosynthesis leading to a wide range of conditions known as iodine deficiency disorders (IDD). The spectrum of IDD includes goitre, impaired thyroid function, retarded growth, and abnormalities in mental development that ranges from the mild forms in apparently normal schoolchildren to extreme forms of endemic cretinism, decreased fertility and increased prenatal mortality. Iodine deficiency is regarded, as the single most common cause of preventable mental retardation and brain damage in communities where the intake of iodine is low.

According to WHO/UNICEF/ICCIDD, Universal salt iodization (USI) is the most effective intervention strategy for eliminating IDD. In order for USI strategy to be successful and sustainable, it is vital to monitor the iodine content of salt regularly, beginning at the point of production or importation and continuing through the distribution channels to final consumption in the household. In addition, the effectiveness of the USI strategy in eliminating IDD in a community requires systematic monitoring of urinary iodine concentration, which is the key biochemical indicator recommended for assessing the impact of iodine deficiency control programs.

There are no published data available to indicate the status of iodine nutrition in the Solomon Islands. Published information on the salt iodization programme for control of IDD in the Solomon Islands is scanty. In addition, there are no data to indicate systematic monitoring of the iodine content of salt in the Solomon Islands. Furthermore, no data is available on the median urinary iodine concentration in school children in Solomon Islands.

In view of the lack of scientific data on the USI strategy for control of IDD in Solomon Islands, the aim of the present project was to determine the availability of iodised salt in households, the iodine content of salt, and the median urinary iodine concentration among schoolchildren age 6 – 12 yrs in Honiara Solomon Islands.

The objectives of the project include using the data obtained to provide information on the availability, coverage and use of iodised salt in the households in Honiara, the status of iodine nutrition among schoolchildren in Honiara, and also to determine the current prevalence of IDD among schoolchildren in Honiara.

Achievements:

This was a prospective school-based study. The study population consisted of School children in the age group 6 – 12 years. Multistage cluster sampling method was used for selecting the study population. Simple random sampling technique was used to select 19 of the 28 primary schools in Honiara used in the present study.

The sample size of 500 schoolchildren was based on a design effect of three, a relative precision of 10%, confidence interval (CI) of 95%, assumed prevalence rate of 25%, with a predicted non-response rate of 20%.

All analyses were carried out in the Micronutrient laboratory (MNL) in the School of Medicine and Health Sciences (SMHS), University of Papua New Guinea (UPNG). The iodine content in salt samples was measured using the single wavelength semi-automated WYD Iodine Checker Photometer. Urinary iodine concentration was

estimated using the sensitive colorimetric method of Sandell-Kolthoff reaction after digesting the urine with Ammonium Persulfate in water-bath at 100^{0C}.

The Internal QC monitoring was carried out by application of the “Westgard” Rules on QC Pool Tracking Levy-Jennings Charts prepared for salt and urine samples.

External QC assessments for assay of iodine content in salt using the WYD Iodine Checker in the MNL SMHS UPNG was carried out by: The National China Reference Laboratory and the INCAP Laboratory in Guatemala, South America

External QC for assay of urinary iodine was by the Ensuring the Quality of Iodine Procedures (EQUIP) and the External Quality Assurance (QAP) Program of the Centres for Disease Control and Prevention (CDC), Atlanta, Georgia, USA and also by the external quality assurance program of the Institute of Clinical Pathology and Medical Research (ICPMR), Westmead Hospital, Sydney, NSW, Australia.

The MS Excel Data Pack 2000 and SPSS-PC software (version 11) were used for the statistical analyses of the data.

Salt was available and used in 99.5% of the households. The mean \pm SD and median values for the iodine content in household salt samples were 55.2 ± 17.7 ppm and 54.6ppm respectively. The 95% confidence interval was 52.9 – 56.3ppm. The iodine concentration was ≥ 15.0 ppm in salt samples from 99.1% of the households. This indicates effective implementation of the USI policy.

Despite the effective coverage and use of iodised salt there is need to enhance the advocacy and awareness on the importance and appropriate use of iodised salt which is already available and accessible to communities in Honiara. This is of significance because 52% of the respondents in the households do not know the use of iodised salt and 15.5% indicates that they do not use iodised salt at home. Since 99% of households are using adequately iodised salt, there is the likelihood that people in these households, especially the elderly, may be consuming relatively large amount of salt per day, putting them at risk of developing adverse health consequences in the long term.

The median UI concentration obtained for all the children was 328.0ug/L, Inter-quartile range 226.6ug/L, with a mean of 353.7 ± 189.6 ug/L. The 95% confidence interval of the UI concentration was 310.7 – 345.3ug/L. A total of 97.2% of all the children had UI concentration ≥ 100 ug/L and 0.7% had UI concentration < 50 ug/L. 55.6% of all the children had UI concentrations ≥ 300 ug/L. There were no significant differences in the UI concentration among the children in the various age groups.

The median UI concentrations for the male and female children were 337ug/L and 325ug/L respectively. The inter-quartile range for male children was 214.63ug/L and for female children was 230.0ug/L. 97.1% of male and 97.4% of female children had UI concentrations ≥ 100 ug/L. 56.8% of the male and 54.4% of the female children had UI concentrations ≥ 300 ug/L. The median UI concentrations obtained for all the children and the various sub-groups of children indicate that the status of iodine nutrition can be classified as “more than adequate” (range 200 – 299ug/L). The data indicate that iodine deficiency was not of public health significant in the various age groups of schoolchildren in Honiara at the time of this study. A similar trend in the

interpretation of the data was observed for UI values obtained when the children were separated according to gender.

To sustain the current achievement of the iodine status among schoolchildren in Honiara, greater attention must be given to development of an efficient, sustainable and operating monitoring system. It is therefore necessary to further emphasize the notion that sustainable optimal iodine nutrition and consolidation of the current achievement of elimination of iodine deficiency, as a public health problem, among schoolchildren requires continuing effective monitoring and regular evaluation of the implementation of Universal salt iodization strategy in Honiara.

PROJECT TITLE: Thiamin Status of Students Attending Boarding Schools in the National Capital District and Central Province, Papua New Guinea

Principal Investigator: Victor J. Temple

Research student: Poruan Temu

Co-investigators: Adolf Saweri and Wila Saweri

Background:

Overt or subclinical thiamine deficiency can severely alter metabolic functions in the nervous, cardiac, respiratory and endocrine systems. Signs of thiamine deficiency have been identified in some patients in Port Moresby General Hospital (PMGH). Current nutrition legislation, stipulating that all rice sold in Papua New Guinea (PNG) must be fortified with thiamine, is under review, despite the lack of published data on thiamine status of the population. It is thus paramount that appropriate studies be done to determine the Thiamine Status, particularly among high-risk groups, which include boarding school students, for whom rice and other cereals are staple foods. Selection of boarding school students for this study was also based on their high vulnerability to low thiamine intake, easy accessibility and representativeness of their age group in the community.

Achievements:

This study was carried out in five boarding schools in two adjacent provinces of the Southern Region of PNG: The Central Province and the National Capital District (NCD).

The three boarding high schools in rural Central Province are Kupiano Secondary, Kwikila Secondary, and Mount Diamond Secondary.

The two boarding high schools in the National Capital District (NCD) are Marianville Secondary and De La Salle High School.

The five boarding schools were selected based on easy accessibility by road, as blood samples must be kept at required temperature (approx. + 4°C) in the field and during transportation from the site of collection to the Micronutrient Laboratory (MNL) in the School of Medicine and Health Sciences (SMHS), University of Papua New Guinea (UPNG), for proper storage.

The total sample size of 500 students was based on a design effect of three, a relative precision of 10%, confidence level (CL) of 95% and predicted non-response rate of 20%. As there was no available information on likely prevalence rate of Thiamin deficiency in PNG, an assumed prevalence rate of 25% was used. Multistage cluster

sampling method was used for selecting the study population. The sample size for each school was calculated using the “proportionate to population size” (PPS) cluster sampling technique.

About 0.5mls of blood was collected from each student, by finger-stick, using contact activated single-use lancet, into properly labeled EDTA-coated microtainer. Each blood sample was then kept in a cool box, protected from light and kept between 4 -10°C in the field and during transport from the field to the laboratory. Blood samples were frozen at -70°C, until required for analysis.

A self-designed pre-tested food frequency questionnaire was used to obtain required data from each consented student. Parameters were calculated using the Food Works 2005 data suite, and the Pacific Islands Standard. Anthropometric data of the students were obtained on the day of sample collection.

Assessment of Thiamin status was carried out using the “ClinRep HPLC Complete Kit for Clinical-Chemical Analysis” to assay Vitamin B1 as Thiamine Pyrophosphate (TPP) in whole blood. Assay of Vitamin B1 as total Thiamine in whole blood was also carried out in a subset of blood samples. Reverse Phase High Performance Liquid Chromatography (HPLC) with post-column derivatization was used to assay TPP in whole blood. The same procedure was used to assay total Thiamine in whole blood. Internal quality control (QC) samples for both low and high concentrations of TPP were used for assessing the performance characteristics of the chromatographic system and for daily monitoring of the HPLC throughout the period of analysis. The “Levy-Jennings” charts and the “Westgard” rules were used for daily monitoring of the HPLC output data throughout the period of analysis.

Thiamine status of the students was assessed using the recommended cut-off points for assessing the TPP concentration in erythrocytes by HPLC. Over 93% of all the students have normal Thiamine status. However, severe to marginal status of Thiamine deficiency was prevalent in 6.5% (30) of all the students. Unlike the clinical criteria, there are no proposed WHO criteria that can be used to define the public health significance of Thiamine deficiency, using the modern HPLC assay of TPP concentration in erythrocytes or whole blood.

Students with whole blood TPP concentration below the 10th percentile (69.4ug/L) are very close to the lower limit of normal (63.53ug/L) and are at risk of developing marginal thiamine deficiency in the event of stress, increased physical activity, increased energy output during exercise, or increased caloric intake without a corresponding increase in the intake of Thiamine. The mean whole blood TPP concentration for male students (104.67ug/L) was significantly higher ($p < 0.05$) than the mean for the female students (90.5ug/L), with the females averaging 14.1ug/L less than males with a 95% confidence interval of 9.85 - 18.5ug/L.

Normal Thiamine status was indicated among 96% of the male and 90.2% of the female students. Severe to marginal status of Thiamine deficiency was higher among the female students (9.9%), compared to the male students (4.0%). The 10th percentile whole blood TPP concentration for the male students was 73.16ug/L, compared to 63.9ug/L for the female students. This indicates that more female students are at risk of developing marginal Thiamine deficiency, because the 10th percentile value (63.9ug/L)

is only slightly higher than the 63.53ug/L for the lower limit, indicating normal Thiamine status.

The calculated 95% reference interval (Mean \pm 2 SD) of the whole blood TPP concentration for all the students in De La Salle and Marianville was 51.45 – 141.21ug/L and 46.9 – 109.82ug/L, respectively. For students in Mount Diamond, Kupiano and Kwikila the calculated 95% reference intervals were 57.96 – 135.48ug/L, 35.29 – 141.57ug/L and 56.53 – 158.25ug/L, respectively.

The 5th percentile cut-off values for both Marianville and Kupiano are within the range, indicating marginal status of Thiamine deficiency. The 25th percentile cut-off value for Marianville (67.1ug/L) and Kupiano (69.8ug/L) are both lower than the 5th percentile (72.0ug/L) cut-off value for Kwikila, and, unlike the other three boarding schools in which over 90% of the students have normal Thiamine status, in Marianville and Kupiano less than 85% of the students have normal Thiamine status.

There is an urgent need to advocate for an increased intake of Thiamine by boarding students in both Marianville and Kupiano. The apparently low Thiamine status among the students in the two schools may be due to different reasons, as Marianville is a female boarding school located in the NCD, while Kupiano is a coeducational boarding school, located close to Kupiano town.

The calculated 95% reference interval of the TPP concentrations for the two NCD boarding schools together was 46.5 – 134.9ug/L, while for the three Central Province boarding schools it was 49.9 – 152.3ug/L. The mean whole blood TPP concentration of the students in NCD boarding schools was 10.5ug/L lower ($p < 0.05$) than the mean whole blood TPP concentration of the students in boarding schools in the Central Province. Severe to marginal deficiency status was indicated in 9.6% of students in the NCD schools and in 5.5% of the students in the Central Province Schools.

Comparative analysis of whole blood TPP concentrations (ug/L) in betel nut chewers compared to non-betel nut chewers indicated a difference in means of 2.8ug/L with betel nut chewers having a mean of 98.3ug/L and non-chewers a mean of 101.1ug/L. Independent sample T-tests, however indicated that this difference was not of statistical significance ($p > 0.05$). The mean whole blood TPP concentration for smokers (mean = 101.3ug/L) was only 3.0ug/L higher than the mean for non-smokers. This difference in means was not statistically significant ($p > 0.05$).

The mean whole blood Total Thiamine concentration for all the students was 81.3ug/L. The minimum whole blood Total Thiamine (WBTT) concentration for all the students was 48.1ug/L; this value is higher than the cut-off point (< 20 ug/L) for indicating deficiency status in a population. This indicates that all the students have normal Thiamine status.

The CDC percentile growth charts (age groups 2 to 20yrs) were used to assess the nutritional status of the students, because no other criterion for interpreting anthropometric data of students in the age groups 14 to 20 years in PNG is available. Underweight was prevalent in 10.7% of all students. The prevalence of underweight was higher in the males with 15.1% below the 5th percentile, compared to the females, with only 4.6% below the 5th percentile.

The prevalence of stunting was relatively higher among the male students (23%), compared to the female students (12.1%). It is, however, of great concern that male students in the boarding schools are lighter and shorter than their female counterparts

Thiamine deficiency exists among students in each of the five boarding schools. Kupiano and Marianville Secondary schools appear to have the highest prevalence and are at greater risk of having more students develop thiamine deficiency. Female students are at greater risk, compared to their male counterparts.

Whole blood TPP concentration (ug/L) is lower among students with low daily intake of thiamine, compared to those with high daily intake of thiamine. It is likely that for these groups the thiamine intake is lower, due to the fact that less rice and more processed foods are consumed, as is the case in Marianville.

Marianville and Kupiano served one rice meal a day compared to the other schools, where two rice meals were made available to the students. In addition, Mt Diamond, which recorded the highest thiamine intakes, served only brown rice for school meals.

The results indicate the need for similar studies to be carried out in other boarding schools in the various provinces in PNG. The observed levels of thiamine deficiency indicate the need for regular monitoring of thiamine status in other high-risk groups, such as children resident in settlements and inmates in correctional establishments, detention centers, and half-way houses to prevent significant public health problems in the future. Continued fortification of rice and other cereals with thiamine is strongly recommended. Any changes to the current nutrition legislation, that would lower the levels of Thiamine fortification, may cause a drastic increase in the prevalence of thiamine deficiency in high-risk communities. Rice products and other foodstuffs that are required by law to be fortified with thiamine should be analyzed for thiamine content, to ensure that adequate fortification is taking place.

The moderate prevalence of thiamine deficiency among students in boarding schools in the NCD and Central province should be of concern to program planners. Thus, it is recommended that a standardized meal ration be developed for institutions such as boarding schools, to ensure that students consume the recommended daily intake (RDI) for macro- and micronutrients. Such diets should include a wide variety of foods rich in thiamine, such as legumes and vegetables, in addition to thiamine fortified foodstuffs.

In the wider community, awareness programs, outlining the benefits of consuming foods rich in thiamine, may prove effective in ensuring that thiamine intake is adequate; this, in turn, will further reduce the prevalence of the deficiency.

PROJECT TITLE: Prevalence of Microalbuminuria in Diabetic and Hypertensive Patients Attending Clinics in Port Moresby General Hospital

Principal Investigator: Victor J. Temple

Research student: Vineanna Fabila,

Co-investigators: David Linge, Isi Kevau and L. Ipai

Background:

Estimation of urinary protein is part of the initial clinical evaluation of patients with suspected renal or cardiac dysfunction. Microalbuminuria (MAU) is an increase in urinary albumin concentration that cannot be detected with the conventional urinalysis albstick, clinistick, dipstick or multistick. In vulnerable individuals MAU is usually followed by progressive increase in proteinuria leading to clinical albuminuria (Macroalbuminuria) and declining glomerular filtration rate. Macroalbuminuria is associated with progressive renal damage and subsequent development of end stage renal disease and increased coronary mortality among diabetic and hypertensive patients. The early detection of MAU can serve as a vital subclinical parameter in preventing complications in patients with either diabetes mellitus or hypertension. In addition, it is easier to prevent diabetic nephropathy by clinical intervention at the MAU stage. The need for implementation of effective screening protocol of diabetic and hypertensive patients for MAU and timely therapeutic intervention cannot be overemphasized. Published data on the prevalence of MAU among diabetic and hypertensive patients in PNG is scanty. This apparent lack of published data prompted this study.

The aim of this project therefore, was to assess the prevalence of MAU among patients attending the diabetic and hypertensive clinics in Port Moresby General Hospital (PMGH). The major objective was to use the data obtained to advocate for setting up a protocol for screening of patients attending the diabetic and hypertensive clinics in PMGH.

Achievements:

The study population for this cross-sectional study consisted of randomly selected subjects attending the diabetic and hypertensive clinics in PMGH and apparently healthy subjects in the general population outside PMGH.

The sample size of 140 subjects was based on a design effect of one a relative precision of 10%, a confidence level (CL) of 95% and predicted non-response rate of 10%. As there was no available information on the likely prevalence rate of MAU in PNG, an assumed prevalence rate of 10% was used. Selected subjects were informed about the study before requesting their informed consent. Patients with end-stage renal failure, high fever, hematuria, leukocyturia, or cardiac failure were excluded from the study.

About 3.0ml of random upright spot urine sample was collected from each consented subject after completing and signing a pre-tested questionnaire that requested information on gender, age, smoking history, family history of diabetes and hypertension. Clinical information, such as diabetic status, blood pressure, weight and height of each subject were appropriately determined and recorded in the questionnaire. Appropriate precautions were taken to ensure that only one urine sample was collected per individual throughout the duration of the study.

Urinalysis using Multistix G-10 was carried out on each urine sample on the day of urine collection. MAU was estimated with the Quik-Read 101 U-ALB protocol using the Orion Quik-Read 101 equipment and reagent kit.

MAU was defined as urinary albumin concentration in the range 20 to 200mg/L in patients with less than 50.0mmol/L of glucose in urine. Data obtained were analysed

using Excel 2003 data pack and SPSS Version 11 for Windows. Student's T-test and ANOVA were used to assess the statistical significance of the data.

Urine samples with albumin concentration in the range 20.0 – 200.0mg/L were positive for MAU and classified as “MAU Present”. Urine samples with albumin level below 20.0mg/L were negative for MAU and classified as “Normal”.

Of the 121 urine samples that were suitable for analysis 42 (34.7%) tested positive for albuminuria indicating clinical albuminuria and 79 (65.3%) tested negative for albuminuria.

The mean age of the male subjects with clinical albuminuria was 54.6 ± 9.1 yrs, and their mean BMI was 27.0 ± 4.5 kg/m². The mean age of female subjects with clinical albuminuria was 54.1 ± 11.5 yrs and their mean BMI was 27.3 ± 4.8 kg/m².

The mean age of male subjects that tested negative for albuminuria was 50.1 ± 16.7 yrs and their mean BMI was 26.6 ± 3.8 kg/m². The mean age of the female subjects that tested negative for albuminuria was 54.6 ± 9.1 yrs and their mean BMI was 27.0 ± 4.5 kg/m².

All the 79 urine samples that tested negative for albumin were then assayed quantitatively for MAU. A total of 44 (55.7%) of the 79 urine samples were positive for MAU and 35 (44.3%) were Normal. Gender distribution of the 79 urine samples indicates that 20 (25.3%) males and 24 (30.4%) females were “MAU Present”, compared to 13 (16.5%) males and 22 (27.8%) females that were “Normal”. The results indicate that the prevalence of MAU was higher among females (30.4%) compared to males (25.3%), but this difference was not statistically significant ($p > 0.05$).

Prevalence of MAU was higher among male and female diabetic subjects compared to non-diabetic subjects.

The blood pressure was separated into three categories to indicate Normal, High Normal and Hypertension using the recommended cut-off points for the Diastolic and Systolic blood pressures. The blood pressure was in the Normal BP category for 39.4% of male and 30.4% of female subjects with MAU. The High Normal BP category shows 18.2% male and 2.2% female subjects with MAU. In the category indicating Hypertension, there were more female (19.6%) than male (3.0%) subjects with MAU.

Screening diabetic and hypertensive patients for MAU should be an integral part of the comprehensive management strategy for male and female patients and for those at risk of developing these conditions.

PROJECT TITLE: Prevalence and Determinants of Non-Adherence to Highly Active Antiretroviral Therapy among HIV/AIDS Patients in Heduru Clinic, Port Moresby General Hospital

Principal Investigator: Victor J. Temple

Research student: Lisa Ijape

Background:

Current evidence indicates that, when used properly, the highly active antiretroviral therapy (HAART) significantly improve the clinical status of people living with the

Human Immunodeficiency Virus (HIV) / Acquired Immuno-Deficiency Syndrome (AIDS). Adherence to HAART treatment protocol is vital for it to be effective, to prevent resistance and other complications. Adherence rate below 95% is an independent predictor of increased viral resistance, cross-resistance, opportunistic infections, development of drug resistance, clinical failure, treatment failure, which may result in immunological failure and prolonged hospital admissions. Poor adherence or non-adherence includes failure to follow drug schedules for whatever reasons, taking incorrect doses, and stopping consumption of the drugs partially or completely. One of the major concerns with scaling up of HAART in resource-limited countries is the emergence of drug resistance HIV strains caused by non-adherence to medication, resulting from suboptimal drug levels. Very high levels of adherence to medication by people with HIV/AIDS using HAART must be maintained at all times, in order to ensure long-term efficacy of the drugs.

The Heduru clinic in Port Moresby General Hospital (PMGH) started prescribing and dispensing HAART to people living with HIV/AIDS (PLWHA) in 2005. No published scientific data is available to indicate the prevalence rate of adherence by PLWHA receiving HAART in Heduru Clinic. In addition, no scientific data indicating the determinants or predictors of non-adherence to medication by PLWHA receiving HAART in Heduru clinic PMGH has been published.

The major aim of this study was to assess the prevalence and determinants of non-adherence to HAART regimen among HIV-positive male and female patients attending the Heduru clinic in PMGH.

Achievements:

This was a non-intervention, prospective, cross-sectional study carried out in Heduru Clinic in PMGH. The total sample size of 140 was based on a design effect of one, a relative precision of 10%, confidence level (CL) of 95%, predicted non-response rate of 10% and an assumed non-adherence prevalence rate of 15%. The study population was selected by simple random sampling of HIV/AIDS patients receiving HAART. No patient was selected twice during the period of the study. Patients of all age groups using HAART for more than three months were eligible to participate in the study.

A structured pre-tested questionnaire was used for data collection. The questionnaire consisted of two sections. The first section, consisting of six questions, was the Simplified Medication Adherence Questionnaire (SMAQ), which is the modified version of the Morisky Scale. This section was used to determine non-adherence. The potential non-adherence determinants were based on the criteria proposed by Morisky as modified by Knobel et al. The SMAQ was considered positive when a non-adherence patient was detected. That is, when there was a positive response to any of the four qualitative questions, and when more than two doses of medications were missed over the past week or when there was over two days of total non-medication during the past three months. The second section of the questionnaire, consisting of thirteen questions, was used to obtain socio-demographic data of the respondent. To avoid bias and distortion only one interviewer administered the questionnaire throughout the study.

The SPSS version 11 and Excel MS data pack softwares were used for statistical analysis of data. Chi-square test (Fisher's exact test), ANOVA, Kruskal-Wallis tests,

and Logistic regression analysis were performed. To evaluate variables associated with non-adherence, multivariate analysis was performed using logistic regression.

Over the four months duration of this study, signed consent were obtained from 135 of the 140 selected patients on HAART (response rate of 96.4%). The mean age (\pm SD) of the 135 patients was 33.2 ± 9.6 years, the 95% confidence interval (95% CI) was 31.6 – 34.8 years, and the age range was 18 – 57 years. Distribution of the 135 patients according to age groups indicates that 55 (40.7%) were in the 20 – 29 years age group, followed by 45 (33.3%) in the 30 – 39 years age group, 19 (14.1%) in the 40 – 49 years age group, and 13 (9.6%) in the 50 – 59 years age group.

All the patients have been using HAART for over six months. However, 77.8% (105) of them were not aware of the type of medication that they were using. This indicates inadequate patients understanding and awareness of their medication and dosing. According to WHO adherence rate is usually higher among patients who are able to identify their medications in their own words and describe their proper dosing and administration.

The 135 patients were separated according to gender: 59 (43.7%) were males and 76 (56.3%) were females. Twenty-three (39.0%) males met the criteria for non-adherence, which gives an adherence rate of 61.0%. For the females 24 (31.6%) met the criteria for non-adherence, which gives an adherence rate of 68.4%.

The 61.0% and 68.4% adherence rate among the males and females respectively was significantly lower than the recommended 95% adherence required for optimal clinical management and complete suppression of the HIV. Thus, the very high prevalence of non-adherence among the male (39.0%) and female (31.6%) patients should be of concern to program planners, because this may cause decline in health of the patients, increased frequency of opportunistic infections, possible development of resistance and cross-resistance, and faster progression of the disease. In addition, it could seriously limit future use of the HAART for treatment of other infected individuals in the NCD.

To attain the over 95% adherence to treatment regimen, intensive advocacy, education and awareness campaign should be carried out among PLWHA using HAART. Every individual should be made aware that for HAART to be effective long-term and to prevent the emergence of resistant strains of HIV in the NCD, very high levels ($\geq 95\%$) of adherence to medication must be maintained at all times.

Demographic characteristics of the male and female patients in the non-adherence groups indicate that 65.2% of males and 37.5% of females were married. 56.5% of males were employed compared to 12.5% of females. In both cases the difference were significant statistically ($p = 0.001$).

The risk assessment of non-adherence among the male and female patients was identified by the multivariate logistic regression of the six independent variables used in the Simplified Medication Adherence Questionnaire (SMAQ).

Males who forgot to take their medications had a 2.35 fold risk ($p = 0.005$; 95% CI = 1.28 – 4.3) of not adhering to their medication compared to females with a 1.75 fold

risk ($p = 0.046$; 95% CI = 1.02 – 3.05). Our data supports the widely reported findings that forgetfulness is one of the most commonly cited reasons for non-adherence.

Males who are careless at times about taking their medication had a 1.8 fold risk ($p = 0.029$; 95% CI = 1.07 – 3.06) of not adhering to their medication. Unlike the males, careless was not a risk factor for non-adherence among the females ($p = 0.32$) in our present study.

Females who missed their last weekend dose of medication had a 3.8 fold risk ($p = 0.013$; 95% CI = 1.23 – 11.7) of not adhering to their medication. Missed weekend dose was not a risk factor for the males ($p = 0.064$). Missing over two doses of medication in the last two weeks was a significant determinant of non-adherence for both males ($p = 0.001$) and females ($p = 0.02$). In addition, missing over two days of medication in the past three months was also a significant determinant of non-adherence for both male ($p = 0.001$) and female ($p = 0.001$) patients.

The prevalence of non-adherence to HAART is very high among male and female HIV-positive patients attending the Heduru clinic in PMGH. The major determinants of non-adherence include forgetfulness, carelessness, and high frequency of missed doses. The need to address these and other problems in order to significantly reduce the risks of non-adherence to HAART among PLWHA attending Heduru clinic in PMGH cannot be overemphasized. There is an urgent need to advocate for full implementation of the “guidelines for the use of antiretroviral therapy in PNG” together with the WHO document “Scaling-up antiretroviral therapy in resource-limited settings”.

PROJECT TITLES:

- Assessment of Vitamin A and Nutritional status of children (age 6 to 59 months) attending Well-Baby Clinic in Port Moresby General Hospital.
- Assessment of Vitamin A and Nutritional status of non-pregnant women in NCD

Principal Investigator: Victor J. Temple

Research Students: Cecily Kaira and Cathy Kupe

Co-Investigators: Prof. J. Vince, Prof. Sir, Isi Kevau, and Dr. D. Mokela

Background:

Vitamin A deficiency is a major nutritional determinant of severe infection, poor growth and mortality among children in most developing countries. Vitamin A is involved in iron metabolism and erythropoiesis, thus its deficiency can lead to anemia in children and women. Scientific data on vitamin A status of infants and women in Papua New Guinea (PNG) is scanty. The lack of published data on the vitamin A status of children and women of childbearing age in PNG partly prompted the PNG national micronutrient survey. In 2005, the UNICEF in consultation with the National Department of Health (NDOH) and School of Medicine and Health Sciences (SMHS), University of Papua New Guinea (UPNG) decided to carry out a National Micronutrient Survey as the first step towards assessing the status of Vitamin and Mineral Deficiency (VMD) in PNG.

Preliminary reports indicate severe status of vitamin A deficiency among infants less than 5yrs of age in most of the regions in PNG. At the end of 2005, the UNICEF introduced systematic supplementation of vitamin A to infants in some regions of PNG.

The protocol for supplementation includes monitoring of the Vitamin A status in areas already covered by the supplementation program. To date no assessment of the Vitamin A status of infants and women have been carried out.

The main aim of this project was to evaluate the vitamin A status of infants and women resident in National Capital District (NCD).

Achievements:

The study sites for Vitamin A included the “Well-baby clinic” in PMGH and the UPNG Staff clinic at Waigani campus. The sample sizes of 140 infants and 130 non-pregnant women were each based on a design effect of one, a relative precision of 10%, confidence level (CL) of 95%, predicted non-response rate of 20% and an assumed prevalence rate of 25%. The subjects for these cross-sectional studies included infants (age 6 to 59 months) and non-pregnant women for the Vitamin A studies,

About 0.1 to 0.25ml of venous blood was obtained from the blood samples that the Pediatric Registrar collected from infants for routine blood analysis. Blood sample of infant was collected only after obtaining consent from the parent accompanying the infant. About 0.25ml of capillary blood was collected from consented non-pregnant women by finger-stick using contact activated single-use lance. Each blood sample was kept in appropriately labeled EDTA-coated Microtainer.

Assay of Vitamin A as Plasma Retinol was carried out by HPLC after extraction using the “ClinRep” Complete Kit for determination of Vitamin A in plasma. C-reactive protein (CRP) in plasma was assayed using the Quik-Read Orion–101 point of care reagent kit.

Self-designed pre-tested questionnaire and food frequency chart were used to obtain required information, such as, age, sex, residential status, types and amounts of vegetables consumed. Anthropometric data, in the form of height and weight were obtained on the day of sample collection.

Hemoglobin level in blood was assessed using the HemoCue. The Z-scores obtained using the WHO Anthro 2005 software was used to assess the nutritional status of the infants. Weights and lengths were measured using standard recommended techniques.

The SPSS version 11 and Excel MS data pack software were used for statistical analysis of the data. ANOVA, Mann-Whitney test, Chi-square test (Fisher’s exact test) and Logistic regression analysis were performed as required.

Vitamin A and nutritional status of Infants:

The total number of infants (age 6 – 59 months) recruited for this study was 181. Consent was obtained from 140 parents but only 132 blood samples were enough and suitable for analysis. This gives a response rate of 73.0%. The very high (27%) non-response rate is an indication of the problem usually encountered in projects that required collection of blood samples from infants for research.

The mean (\pm SD) Plasma Retinol concentration for all the infants regardless of infection was 1.087 ± 0.61 $\mu\text{mol/L}$, the median was $0.981 \mu\text{mol/L}$ and the range was 0.09 to $4.27 \mu\text{mol/L}$. The plasma retinol data regardless of infection was further

analyzed according to the recommended cut-off points indicating Vitamin A status in infants. The plasma retinol concentration was lower than 0.35umol/L in 3.8% of all the infants, 22.7% of all infants had plasma retinol concentration in the 0.35 to 0.69umol/L range, 28.0% had plasma retinol concentration in the 0.7 – 1.049umol/L range and 45.5% of infants had plasma retinol concentration greater than or equals to 1.05umol/L.

According to our data 26.5% (35) infants have plasma retinol concentration lower than 0.7umol/L, which is the recommended cut-off point that indicates deficiency status for infants in the 6 – 59 months age group. This according to WHO recommendation indicates that Vitamin A deficiency among the infants in NCD should be categorized as severe.

The concentration of C-reactive protein (CRP) in plasma was used to assess the extent of sub-clinical and clinical infections in the infants. Elevated CRP concentration in plasma is an indication of the presence of sub-clinical or clinical infection. The data for all the infants indicates that the plasma CRP concentration was normal in 56.8% (75) of infants compared to 43.2% (57) with elevated plasma CRP concentration.

The mean plasma retinol concentration for infants with normal plasma CRP concentration was 1.29 ± 0.64 umol/L, the median was 1.194umol/L and the range was 0.092 – 4.27umol/L.

For infants with elevated plasma CRP the mean plasma retinol concentration was 0.816 ± 0.43 umol/L, the median was 0.707umol/L and the range was 0.244 – 2.178umol/L. There was no statistically significant different ($p = 0.487$) between the mean plasma retinol concentrations of the infants with normal and elevated plasma CRP concentrations.

For infants with normal plasma CRP concentration, 1.3% had plasma retinol concentration lower than 0.35umol/L, 9.3% had plasma retinol in the 0.35 to 0.69umol/L range, 26.7% had plasma retinol in the 0.7 to 1.049umol/L range and 62.7% had plasma retinol greater than or equals to 1.05umol/L. The result indicates that 10.7% of infants with normal plasma CRP concentration had plasma retinol concentration below 0.7umol/L, which indicates moderate status of Vitamin A deficiency. The plasma retinol concentration was below 0.7umol/L in 47.4% of infants with elevated plasma CRP concentration, indicating severe status of Vitamin A deficiency. This should be of concern to program planners involved in the supplementation of Vitamin A to infants in NCD. The relatively very high percentage of infants with plasma retinol concentration below 0.7umol/L in the group with elevated CRP tends to indirectly indicate reduced liver store of retinol.

The mean Hb level of all the infants was 11.23 ± 1.94 g/dl, the median was 11.1g/dl and the range was 6.6 – 18.4g/dl. Infant with Hb below 11.0g/dl was considered anemic. A total of 41.7% of all the infants in the present study had Hb level below 11.0g/dl. This according to the WHO recommendation indicates severe status of anemia among the infants in NCD at the time of this study.

Further analysis of the data indicates that the Hb level was below 11.0g/dl in 38.7% of infants with normal plasma concentration of CRP compared to 45.6% of infants with elevated plasma concentration of CRP. The prevalence of anemia among infants with

normal CRP is of moderate public health significance. The prevalence of anemia among infants with elevated CRP is of severe public health significance. The need to advocate for improved nutrition among infants in NCD cannot be overemphasized.

The weights and lengths of the infants were converted into Z-scores using the WHO Anthro 2005 software, which also gives the summary statistics of the data. The Z-score data obtained for each infant were interpreted, using the WHO recommended criteria and cut-off points. Stunting was defined as Length-for-Age (LAZ) Z-score < -2 , Underweight was defined as Weight-for-Age (WAZ) Z-score < -2 , and Wasting was defined as Weight-for-Length (WLZ) Z-score < -2 .

Stunting (LAZ) was prevalent in 38.1% of the infants, Underweight (WAZ) was prevalent in 45.8% of the infants, and Wasting was prevalent in 28.7% of the infants.

Vitamin A and nutritional status of non-pregnant women:

A total of 128 apparently healthy non-pregnant women resident in NCD were recruited for this project. Consent was obtained from only 101 of these women, given a response rate of 78.9%. The mean plasma retinol concentration for the women was 2.21 ± 0.63 $\mu\text{mol/L}$. The median was $2.25 \mu\text{mol/L}$ and the range was 0.66 to $4.17 \mu\text{mol/L}$. The result shows that 98.0% of the women had Plasma Retinol $> 1.05 \mu\text{mol/L}$. This indicates that Vitamin A deficiency is not of public health significance among non-pregnant women resident in NCD at the time of this study. However, analysis of the data according to age groups indicates that Plasma Retinol concentration was lower than $0.7 \mu\text{mol/L}$ in 9.1% of women in the 25 – 29 yrs age group. In addition, 2.0% of women in the 20 – 24 yrs age group have plasma retinol concentration in the 0.7 – $1.05 \mu\text{mol/L}$ range. The C-reactive protein concentration for all the women was within the normal range.

The mean Hb level (g/dl) for all the women was 12.63 ± 1.8 g/dl, the 95% CI was 12.28 – 12.98 g/dl, the median was 12.7g/dl and the range was 6.8 – 16.1 g/dl.

The prevalence of anemia (Hb < 12.0 g/dl) among the women in this study was 30.6%. This indicates moderate public health problem, which is significant and thus, requires urgent attention from the appropriate authorities. This level of anemia is slightly higher than the 30.2% reported for the global prevalence among non-pregnant women (Sight and Life 2007). The prevalence of Anemia (Hb < 12.0 g/dl) was greatest (63.7%) among women in the 25 – 29 yrs age group, followed by women (42.9%) in the 35 – 39 yrs age group. The prevalence of anemia among women in the various age groups indicate the complete spectrum of public health significance according to the classification recommended by WHO, and used for classification of anemia in the PNG National Micronutrient Survey (NDOH 2005).

Our data indicates that in general undernutrition (low BMI) is not of public health significance among non-pregnant women in NCD at the time of this study. However, detailed assessment of the nutritional status (low BMI) of women in the various age groups indicates medium to low prevalence of undernutrition among women in the 15 – 19 yrs and 20 – 24 yrs age groups respectively.

Vitamin A deficiency is not of public health significant among non-pregnant women in NCD at the time of this study. However, attention should be given to women in the 25 – 29 yrs age group that shows about 9.0% of sub-clinical vitamin A deficiency.

Severe to mild status of anemia is prevalent among non-pregnant women in NCD. The severity of anemia is greatest among women in the 25 – 29yrs age group, followed by 35 – 39 yrs age group.

PROJECT TITLE: Assessment of Thyroid Stimulating Hormone (TSH) and Free Thyroxine (FT4) in Cord Blood

Principal Investigator: Victor J. Temple

Research student: Jamblyne Pamu

Co-Investigators: A. B. Amoa and Nigani Willie

Background:

The World Health Assembly recognized that iodine deficiency (IDD) is the world's greatest single cause of preventable mental retardation. Neonatal TSH level is one of the indicators recommended for assessing IDD control programs in a population as increase in the TSH level in neonates indicates sub-optimal supply of thyroid hormones to the developing brain.

Iodine deficiency in a population is indicated, if the frequency of neonatal TSH level is above 5m U/L in whole blood or above 10m U/L in serum in more than 3% of the blood samples obtained from Cord Blood or 3 days old neonates. The cut-off points for mild, moderate and severe IDD are indicated by neonatal TSH frequencies of 3 – 19.9%, 20 – 39.9% and greater than 40%, respectively.

Clinical diagnosis of congenital hypothyroidism is difficult at birth and measurements of TSH are essential for this diagnosis. Screening for congenital hypothyroidism is widespread in most countries for the last two decades. However, it has not been implemented in PNG. This is most probably due to non-availability of data in our population. Other factors like cost, and lack of laboratory facilities is a important for its non-implementation.

According to recent reports by the WHO/UNICEF/ICCIDD expert committee (4), there is growing evidence that iodine deficiency may be reappearing in some countries, where it was previously under control. This statement further underscores the need for continued monitoring and evaluation of the iodine status of populations that have been at risk in the past

There are no published data on iodine status of neonates in the NCD. No published data is available on screening for Permanent Sporadic Congenital Hypothyroidism among Neonates. Furthermore, there are no data on prevalence of Compensated or Transient Primary Hypothyroidism, which can be cause by Iodine Deficiency, and whose incidence can be as high as 1 in 10 Neonates.

The aim of this research project was: To assess the thyroid status of neonates by carrying out thyroid function tests on cord blood

The objectives were, to obtain data that can be used to assess the frequency of permanent sporadic congenital hypothyroidism among neonates, to assess the prevalence of compensated or transient primary hypothyroidism among neonates, and

to make recommendations for the assessment of thyroid function in neonates to be a routine screening procedure in the Port Moresby General Hospital.

Achievements:

This was a prospective cross-sectional study carried out in the Obstetrics and Gynecology Unit at the Port Moresby General Hospital (PMGH).

The subjects included pregnant mothers in their 36 to 40 weeks Gestation who come to deliver at the Labour ward in PMGH. A self-designed pre-tested questionnaire was given to each selected pregnant mother or their spouse. After delivery about 5.0mls of mixed cord blood was collected into plain vacutainer from the placenta of those mothers that returned the signed questionnaire and consent forms. All mothers with thyroid disease, or previous history of thyroid disease, and those on medications that affect thyroid status including those with systematic illness were excluded from the study.

Analyses of TSH and FT4 were carried out using the appropriate 96 wells Enzyme Immunoassay (EIA) Kits from Linear Chemicals. S. L, Barcelona, Spain. Settings for the Microplate washer and Reader and also for the internal quality control (QC) were as indicated in the protocols obtained from Linear Chemicals. S. L, Barcelona Spain.

Total number of pregnant mothers that were randomly selected for participation in this project was 172. Selection and enrolment occurred just before the mothers were prepared for delivery. Signed informed consent was obtained from 150 of the 172 mothers enrolled, given a response rate of 87.2%. Analyses of TSH and FT4 were carried out in the 150 sera obtained from the 150 blood samples collected.

Mean (\pm SD) age of the 150 mothers was 25.2 ± 5.3 years, median age was 25.0 years, age range was 16.0 – 39.0 years and 95% confidence interval (95% CI) was 23.4 – 26.1 years. Diabetic status and thyroid status of all the mothers were normal. Diastolic (60 to less than 90mmHg) and Systolic (100 to less than 160mmHg) blood pressures of all the mothers were within the normal ranges before delivery. All the mothers in this study had normal vaginal delivery (NVD).

The mean and median birth weights for all the 150 neonates were 3.1 ± 0.46 kg, and 3.1kg respectively. The range of the birth weights was 2.0 – 4.2kg, and the 95% CI was 3.0 – 3.2kg. Birth weights of 139 (92.7%) neonates were normal (≥ 2.5 kg).

The Median TSH concentration was 2.17m IU/L, the interquartile range (IQR) was 1.53 – 3.48m IU/L and the Range was 0.19 – 15.3m IU/L. The TSH concentration in only two cord serum samples was greater than 10.0m IU/L. The TSH concentration in all the cord samples was below 20m IU/L. This indicates absence of permanent sporadic congenital hypothyroidism among the neonates. The data also excludes clinical significant prevalence of compensated or transient primary hypothyroidism.

The lower limit (2.5th) and upper limit (97.5th) of the TSH percentile cut-offs in the cord serum samples for all the neonates were 0.76m IU/L and 7.77m IU/L.

The Median FT4 concentration in the cord serum samples for all the neonates was 1.51pmol/L and the IQR was 1.29 – 1.73pmol/L.

The results indicate normal status of thyroid function in the neonates. Prevalence of congenital hypothyroidism and transient hypothyroidism among neonates in the present study is very low 1.3%, which is below the clinical significant level of > 3.0%. Data obtained in the present study indicates absence of permanent sporadic congenital hypothyroidism among the neonates. The data also excludes clinically significant prevalence of compensated or transient primary hypothyroidism.

A major outcome of this research project is the setting up of a functional analytical laboratory with state-of-the-art equipment for assay of all hormones and proteins using the Enzyme Immunoassay (EIA) technique. The Microplate Enzyme Immunoassay methodology provides optimum sensitivity while requiring very limited technical manipulations. The Microplate Reader and Microplate Washer can be used for Enzyme Linked Immunosorbent Assay (ELISA) and Enzyme Immunoassay (EIA) procedures.

PROJECT TITLE: Assessment of Iodine Nutrition Status among School-age Children (6 – 12years) in Aseki- Menyamya District, Morobe Province

Principal Investigator: Victor J. Temple

Research student: Christopher AQUAME

Co-investigator: Nigani Willie

Background:

In 1990, the World Health Assembly recognized that iodine deficiency disorder (IDD) is the world's greatest single cause of preventable mental retardation, and established the goal of eliminating this public health problem. Universal salt iodization (USI), a policy of iodizing all salt used in households, catering, food processing and agriculture, is the agreed strategy for achieving this goal. WHO, in collaboration with UNICEF, the International Council for the Control of Iodine Deficiency Disorders (ICCIDD) and other international organizations has played crucial role in supporting national governments in their efforts to achieve this goal.

In an attempt to eliminate IDD, and to comply with the international goal of USI, the Government of PNG amended the Pure Food Act and the salt legislation was promulgated in June 1995, banning the importation and sale of non-iodized salt in PNG. Published data on the implementation of the USI and iodine nutrition status of the population in Morobe Province is scanty. This project was prompted by the apparent lack of data on the status of iodine nutrition among the community in Aseki-Menyamya District, Morobe Province PNG.

The major aim of this project was to determine the urinary iodine concentration of schoolchildren age 6 – 12yrs in Aseki – Menyamya District, Morobe Province.

The main objectives were to use the data obtained to assess the prevalence of IDD among the community in Aseki –Menyamya district of Morobe province, and to assess the level of sub-clinical iodine deficiency in the community.

Achievements:

Menyamya is one of the nine districts of Morobe Province, Papua New Guinea. It is remote and shares border with the Gulf and Eastern Highlands Provinces. According to the 2000 National census, it has a population of about 68, 546. The districts literacy rate

is about 64.5%. Most people are subsistence farmers and their main source of income is coffee. The district is made of four Local Level Government Councils. Kapao and Nanima Karipa in the Aseki sub- district whilst Wapi and Kome towards the Gulf Province. Two of the four LLGs; Kome and Nanima Karipa were randomly selected this research project.

Six schools were randomly selected from all the primary schools in the district. Children present during that day were chosen using simple random sampling method. Strictly children between the age group of 6-12 years were allowed to participate. Urine samples were collected and transported to the Micronutrient Laboratory (MNL) in the School of Medicine and Health Sciences (SMHS), University of Papua New Guinea (UPNG) for analysis of urinary iodine (UI), using the standard procedures already established in the MNL.

A total of 222 children age 6 – 12yrs were enrolled in this study. Informed consent was obtained from 207 of them, which gives a response rate of 93.2%. The mean age of the consented children was 8.5 ± 1.9 years (Mean \pm SD), the Median age was 8.0years. The median UI concentration for all the children was 149.5ug/L, and the Interquartile Range (IQR) was 69.8 – 300ug/L. The mean UI concentration was 207.7 ± 178.1 ug/L (Mean \pm SD) and the 95% confidence interval (95% CI) was 183.2 – 232.2ug/L. The data also indicated that 67.1% (139) of all the children had UI concentration ≥ 100 ug/L and 17.9% (37) had UI concentration < 50 ug/L.

Severe status of iodine nutrition was prevalent in 8.2% (17) of all the children, moderate status of iodine nutrition was prevalent in 9.7% (20) and mild status of iodine nutrition was prevalent in 15% (31) children.

The data indicates that mild to severe status of iodine deficiency is prevalent in 32.9% of school-age children. This should definitely be of great concern to program planners in the Province, the Region and the National Health Department.

Gender distribution of the children indicated 108 (52.2%) males and 99 (47.8%) females. The mean and median age of the male children was 8.8 ± 1.9 years and 8.0years respectively. For the female children the mean age was 8.7 ± 2.0 years and the median age was 8.0years.

The median UI concentrations for the male and female children were 145.8ug/L and 168.0ug/L respectively. The IQR for the male children was 65.8 – 261.0ug/L, and for the female children was 81.5 – 350.0ug/L. The mean UI values were 187.4 ± 156.0 ug/L for the male children and 229.7 ± 196.2 ug/L for the female children.

A total of 66.7% (72) male and 67.7% (67) female children had UI concentrations (ug/L) greater than or equals to 100ug/L. The UI concentration (ug/L) was below 50ug/L in 19.4% (21) male children and 16.2 (16) female children.

Among the male children 7.4% (8) were in severe status of iodine nutrition compared to 9.1% (9) female children. Moderate status of iodine nutrition was prevalent among 12% (13) male children compared to 7.1% (7) female children. Mild status was prevalent among 13.9% (15) male compared to 16.2% (16) female children.

The median UI concentrations obtained for the children in Kome LLG and in Nanima LLG indicated that the status of iodine nutrition should not be classified as deficiency status at the level of Public Health significance, because the Median UI concentrations in each case was above 100ug/L and the UI concentration in less the 20% of the children was below 50ug/L. However, significant number of children in both Kome LLG and Nanima LLG are in severe to mild status of iodine deficiency. The situation is more severe in the Nanima LLG compared to the Kome LLG. Greater emphasis must be put into the monitoring of the implementation of the USI strategy in the Morobe Province.

PROJECT TITLE: Assessment of Pseudocholinesterase activity and Dibucaine Number of Serum Pseudocholinesterase in Health subjects resident in the National Capital District PNG

Principal Investigator: Victor J. Temple

Research students: Rachael Rowe and Wesley Puri

Co-investigators: Harry Aigeeleng

Background:

A review of the literature indicates lack of published data on the prevailing Pseudocholinesterase activity (Phenotype) and the prevalence of Pseudocholinesterase variants (Genotypes) in the PNG population.

Some individuals may be Suxamethonium-sensitive or may have quantitatively low activity of Serum Pseudocholinesterase (SChE), which is usually a genetically determined trait. The clinical consequence of this is prolonged paralysis of the respiratory and other skeletal muscles after administration of a standard dose of Succinylcholine (an anesthetic) to susceptible individuals. It is therefore important to assess the SChE activity and Dibucaine number of individuals prior to the administration of Suxamethonium, to minimize the risk of prolonged muscular relaxation and Apnea in susceptible individuals.

These projects were prompted by the apparent lack of data to characterize SChE activity and variants among residents in the NCD and PNG as a whole. The projects are to determine the activity and the variant forms of SChE in health individuals. The projects also intend to set up simple but sensitive assay procedures that can be used for routine assay of SChE and the Dibucaine number of patients that are scheduled for surgical operations in PMGH. Knowledge of the variants of SChE that is prevalent among individuals can be used by appropriate authorities to make informed recommendations for screening of patients before using Succinylcholine (Scoline) as muscle relaxant in PMGH.

The aims of the projects were: To determine the activity of SChE in the serum of health individuals. To determine the Dibucaine number of SChE in the serum of individuals

The objectives included the following: To use the data obtained to assess the prevalence of normal and atypical SChE among health individuals. To use the data obtained to establish the normal range of SChE activity among health individuals. To use the data obtained to identify the variants of SChE in individuals.

Achievements:

This was a cross-sectional prospective study. The sampling sites included the University of Papua New Guinea (UPNG) Waigani and Taurama campuses and their immediate environs.

The sample size was calculated using a design effect of one, a relative precision of 7.0%, confidence level (CL) of 95%, and predicted non-response rate of 20%. As there was no available data on Serum Cholinesterase activity and Dibucaine number of individuals in PNG, an assumed prevalence rate of 25% was used. The sample size of about 250 was considered adequate for a base line study.

A total of 276 apparently healthy adults were selected by simple random sampling. All the selected participants were residing in the NCD at the time of the project.

Blood samples were collected from consented individuals who completed and returned their signed questionnaires. About 0.5mls of capillary blood was collected into plain Eppindoff tube by finger-stick using contact activated single-use sterilised retractable lancet. Each blood sample was kept in a cool box to prevent hemolysis in the field and during transport to the laboratory. Serum was separated into properly labelled sterile Eppindoff tube and stored frozen at -20°C till required for analysis.

Assay kits and protocols used for SChE activity and Dibucaine Number (DN) were obtained from Linear Chemicals, Barcelona, Spain. Assay of SChE was carried out using Butyrylthiocholine as substrate, which was hydrolysed to Butyrate and Thiocholine. The latter reduces DMNB to 5-mercapto-2-nitrobenzoate (5-MNBA), a coloured compound. The reaction was monitored kinetically at 405 nm by the rate of formation of the yellow colour produced which was proportional to the activity of SChE activity in the sample.

Dibucaine inhibition was estimated by assay of the enzyme activity in the presence of the inhibitor Dibucaine. The percent inhibition of the enzyme was calculated as follows: One minus the ratio of inhibited SChE activity to the un-inhibited SChE activity, multiplied by 100 to express as percentage. The percent inhibition obtained was the Dibucaine Number (DN) of SChE in the sample.

Statistical analysis of data was carried out using the SPSS version 11 for Windows and the MS Excel data pack.

A total of 276 apparently health subjects were selected randomly for participation in this project. Signed informed consent was obtained from 226 of these subjects, but blood samples were collected from 220 subjects. Data analysis was however, carried out for only 217 of the consented subjects. This gives a total response rate of 78.6%

The mean age for all the subjects was 24.8 yrs, median was 23.0yrs, age range was 14.0 – 56.0yrs and the Interquartile Range (IQR) was 22.0 to 26.0yrs. The Mean and Median SChE activities for all the subjects were 3.63 KU/L and 3.56 KU/L respectively. The range was 0.41 – 8.76 KU/L and the IQR was 2.94 – 4.24 KU/L.

Normal SChE activity status was indicated in 204 (94%) of all the subjects. Low status of SChE activity was indicated in 12 (5.5%) subjects, however the SChE activities in

these subjects were above the clinically significant level (0.425KU/L). One subject (0.5%) was classified as having clinically low SChE status, because the SChE activity (0.41 KU/L) was below the clinically significant level of 0.425KU/L. In addition, the SChE activity was less than 75% of the normal enzyme activity (1.7 KU/L). For the male subjects the Mean and Median SChE were 3.64KU/L and 3.74KU/L respectively. The range was 0.41 – 7.13KU/L, the 95% CI was 3.37 – 3.90KU/L and the IQR was 2.80 – 4.48KU/L. For the female subjects the Mean and Median SChE were 3.63KU/L and 3.51KU/L respectively. The range was 1.40 – 8.76KU/L, the 95% CI was 3.44 – 3.51KU/L and the IQR was 3.02 – 4.13KU/L. No statistically significant difference was obtained between the mean SChE of the male and female subjects. Normal SChE activity status was indicated in 90 (90.9%) males and 114 (96.6%) females. Low activity status was higher among the male (9.1%) compared to the female (2.5%) subjects. This difference was not statistically significant.

The mean Dibucaine number (DN) for all the subjects was 85.22 %, median was 85.82%, range was 61.9 - 96.27 %, and the Interquartile Range (IQR) was 82.55 – 88.05%. The Pearson coefficient of correlation ($r = 0.422$) indicated a linear statistically significant ($p = 0.01$) relationship between the DN and SChE activity for all the subjects.

A total of 194 (89.4%) subjects had DN in the 75 - 90 % range, which is classified as Normal DN. The greater than 90% DN range was prevalent in 21 (9.7%) subjects. Only 2 (1.0%) subjects had their DN in the 30 – 75% range.

No statistically significant differences were obtained between the mean DN of the male and female subjects.

The Percentile cut-offs and the calculated reference ranges obtained for the SChE and DN in the present study should be used as guidelines for assessing the SChE status of individuals in NCD. The assay of SChE should be included in the routine protocol for assessing all patients scheduled for administration of Scoline and other similar Acetylcholine esters anesthetics before surgical procedures. The methodology for routine assay of SChE and DN are now well established in our laboratory.

PROJECT TITLE: Using Glycosylated Haemoglobin (HbA1c) to assess Glycemic Control in Diabetic Patients in Port Moresby General Hospital

Principal Investigator: Victor J. Temple

Research Student: Lucy Toropo

Co-investigators: David Linge, and L. Ipai,

Background:

Available data on the prevalence of diabetes mellitus (DM) in Papua New Guinea indicates that DM has become a disease of major public health concern and is now included in the lifestyle diseases program in the PNG National Health Plan. Effective diagnosis and management of diabetes is an on-going process in the Port Moresby General Hospital (PMGH). The implementation of an efficient cost-effective program directed towards improving the Glycemic Control among patients attending the diabetic clinic in PMGH is one of the major factors required to decrease the high prevalence of diabetic complications in these patients.

Glycosylated hemoglobin (HbA1c) is formed by spontaneous but irreversible condensation of glucose with the N-terminal residue of beta-chain of the adult hemoglobin (HbA). The amount of HbA1c in the blood is directly proportional to the blood glucose concentration of the preceding six to eight weeks. The level of HbA1c in the blood is usually affected by sustained increase in blood glucose level, not by the daily fluctuations of blood glucose level or by recent change in blood glucose concentrations. Thus, the measurement of HbA1c level in blood is one of the recommended parameters for the evaluation of glycemic control in diabetic patients. The HbA1c level in uncontrolled diabetes can be as much as two to three times higher than the level in non-diabetic individuals. Thus high HbA1c level indicates poor glycemic control.

There are no published data to indicate effective monitoring of the glycemic control of diabetic patients attending clinics in PMGH. No data are available on the status of glycemic control among these diabetic patients. This project intends to provide a base line data that can be used to assess the prevalence of glycemic control among patients attending the diabetic clinic in PMGH.

The aim of this project was to determine the HbA1c level in whole blood of diabetic patients attending the diabetic clinic in PMGH.

The objectives are: to use the data obtained for assessing the prevalence of glycemic control among patients attending the diabetic clinic in PMGH. To advocate for the implementation of routine protocol for the assessment of HbA1c that can be used as one of the components for monitoring glycemic control of diabetic patients. To set up an effective analytical procedure, with high quality assurance standards, for the assay of HbA1c in the Clinical Biochemistry laboratory in Basic Medical Sciences, SMHS UPNG

Achievements:

This was a prospective cross sectional study. The study subjects were patients from the Diabetic Clinic in PMGH. Subjects in the control group (Non-Diabetes) were selected from students in the SMHS UPNG. The sample size was calculated using a design effect of one, a relative precision of 10% confidence level (CL) of 95%, predicted non response rate of 15% and assumed prevalence rate of 25%. The sample size of 120 diabetic patients and 20 non-diabetic (control) subjects were considered adequate for a base study.

The study population included diabetic subjects, irrespective of age and gender, who reported at diabetic clinic for check up.

Whole blood collected was used for assay of HbA1c. About 0.5ml of blood was collected, in an EDTA- microtainer, from each consented participant by finger stick. Each blood sample was kept between 4 - 10°C in the field and during transport from PMGH to the laboratory in the Division of Basic Medical Sciences (BMS), SMHS UPNG.

Procedures for assay of HbA1c in whole blood was carried out as indicated in the protocol supplied with the HBA1c Turbidimetric Latex assay kit supplied by Linear Chemicals.

Of the 122 consented subjects 18 (14.8%) were non-diabetic and 104 (85.2) were diabetic patients. The mean \pm SD (standard deviation) age of the subjects in the non-diabetic control group was 25 ± 3.5 yrs, with age range of 20 – 30 yrs. For the 104 diabetic patients, the mean age was 53.4 ± 10.8 years and the age range was 19 to 89 years.

The mean HbA1c for all subjects in the control group was 3.13 with a range of 1.2 to 4.8%, and 95% Confidence Interval (95% CI) of 2.61 – 3.64%. All the subjects in the non-diabetic control group had HbA1c levels below the cut-off point of 6.5%, which indicates normal glycaemic control.

For the diabetic patients the mean HbA1c was $6.73 \pm 2.31\%$, the median was 6.50% and the Interquartile Range (IQR) was 5.0 – 8.5%. Further analysis of the data indicated that 52 (50%) of all the diabetic patients had HbA1c greater than 6.5%. The HbA1c was greater than 7.0% in 46 (44.2%) of all the diabetic patients. This indicates poor glycaemic control in over 40% of the diabetic patients. The mean HbA1c ($6.60 \pm 2.28\%$) for the male diabetic patients was not statistically different ($p = 0.606$) from the mean HbA1c ($6.84 \pm 2.35\%$) for the female diabetic patients.

The need to urgently commence effective monitoring of the glycaemic index of diabetic patients in PMGH cannot be over emphasized.

The methodology for routine assay of HbA1c, which is the recommended procedure for monitoring Glycaemic Control of diabetic patients, for screening for diabetes and also for confirmation of the diagnosis of diabetes mellitus is now well established in the Clinical Biochemistry Laboratory in the Division of Basic Medical Sciences, SMHS UPNG.

RESEARCH GRANTS:

PROJECT: “Thiamine Status of Students Attending Boarding Schools in the National Capital District and Central Province, Papua New Guinea”

Investigators: V. J. Temple, P. Tamu, A Saweri, and W. Saweri

Source of Funding: WHO Research Grant received in 2006: Project completed on schedule. Interim and Final reports submitted on schedule.

PROJECT: “Assessment of vitamin A status of infants and mothers in NCD”

Investigators: V. J. Temple, J. Vince, and D. Mokela, Isi H Kevau, Cecily Kaira and Cathy Kupe

Source of Funding: Office of Higher Education, Research, Science and Technology (OHE) Research Grant received in 2007 (UPNG SPA No. 1598 Vitamin A project): Project completed on schedule. Interim and Final reports submitted on schedule.

PROJECT: Does successful universal salt iodization guarantee optimal iodine nutrition in mother and infant?

Investigators: V. J. Temple, A. B. Amoa, J. Vince, Christopher Aquame, Jamblyne Pamu, and Nigani Willi,

Source of Funding: Office of Higher Education Research, Science and Technology (OHE) Research Grant received in 2008 (UPNG SPA No. 1609, Iodine Deficiency

Research Project). Project completed on schedule. Interim and Final reports submitted on schedule.

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Publications:

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Published Proceedings:

- Temple VJ. Universal salt iodization (USI): A control for iodine deficiency. In Proceedings: "Iodised salt monitoring workshop". UNICEF & NDOH Publication 2007.
- Temple VJ. Proposed strategy for monitoring USI implementation in PNG; "Iodised salt monitoring workshop". UNICEF & NDOH Publication 2007.
- Temple VJ. Salt iodization: Packaging and storage: situation analysis in PNG; "Iodised salt monitoring workshop". UNICEF & NDOH Publication 2007.
- Temple VJ. Consolidation of the monitoring system for salt iodization in PNG; "Iodised salt monitoring workshop". UNICEF & NDOH Publication 2007.
- Temple VJ. Salt iodization, monitoring and evaluation (SIME); "Iodised salt monitoring workshop". UNICEF & NDOH Publication 2007.

National and International Workshops/Meetings/Seminars/Conferences:

- ❑ Assessment of vitamin A and C-reactive protein in infants and their mothers attending paediatric clinics in Port Moresby; UPNG Science Conference, November 13 – 14, 2008 Gateway Hotel, Port Moresby
- ❑ Assessment of thiamine status of boarding school students in National Capital District and Central Province, Papua New Guinea UPNG Science Conference, November 13 – 14, 2008 Gateway Hotel Port Moresby
- ❑ Resource person: Technical meeting on Proposed Diethylcarbamazine (DEC) Fortified Salt as a Strategy for the Control and Elimination of

Lymphatic Filariasis (LF) in PNG. Sponsored by National Department of Health (NDOH): 13th Feb 2008, NDOH Conference Room, Level 2 – Aopi Centre.

- ❑ Participant: Videoconference and Workshop: “Nutrition in PNG – Present situation, challenges and solutions”. Organized by: PNG Association of Public Health, in association with NDOH, Global Development Learning Network (GDLN, World Bank), UNICEF, CDC USA, AusAID. 7th September 2007, GDLN, World Bank Conference centre, Deloitte Tower, Port Moresby.
- ❑ Resource person: National Research Agenda Workshop. Sponsored by National AIDS Council Secretariat (NACS). 2nd to 4th October 2007; Holiday Inn, Port Moresby.
- ❑ Resource person: Consultation workshop on HIV Food and Nutrition in PNG. Sponsored by NDOH and Albion Street Centre Sydney Australia: 26th to 28th Nov 2007. WHO Conference Room, NDOH PSA House Port Moresby.
- ❑ Resource person: Iodised salt monitoring workshop: A training for quarantine officers and food inspectors. Sponsored by NDOH and UNICEF: 22nd to 26th May 2006, Madang Resort Hotel, Madang Province, PNG.
- ❑ Resource person and Scientific Coordinator: Public Health Symposium: The National Micronutrient Survey 2005 (NMS 2005): Draft Report of NMS 2005. Sponsored by NDOH, UNICEF & Centres for Disease Control and Prevention (CDC) Atlanta, Georgia USA. 11th to 13th October 2006. Lamana Hotel, NCD, PNG.
- ❑ Resource person: National Micronutrient Survey Stakeholders workshop: Preliminary assessment of report. Sponsored by NDOH and UNICEF: 19th to 22nd June 2006. Lamana Hotel, NCD, PNG.

Published Abstracts/Seminar and Workshop Presentations/Research Reports:

- ❑ Shinoda N, Sullivan K, Tripp K, Erhardt J, Haynes B, **Temple VJ**. “Relationship between anemia and biomarkers of inflammation in children” 2nd International Meeting of the Micronutrient Forum. Micronutrients, Health and Development: Evidence-Based programs: Micronutrient Status Methodologies: Beijing China: Abstract TU 57, May 2009, pg 69
- ❑ Drammeh B, Schleicher R, Erhardt J, Haynes B, Tripp K, **Temple VJ**. “Assessment of vitamin A deficiency in women and children from Papua New Guinea using dried blood spot Retinol-Binding Protein” 2nd International Meeting of the Micronutrient Forum. Micronutrients, Health and Development: Evidence-Based programs: Micronutrient Status Methodologies: Beijing China: Abstract TU 63, May 2009, pg 70
- ❑ Tripp K, Woodruff B, **Temple VJ**., Saweri W, Haynes B, Codling K. “Iron and vitamin A status in Papua New Guinea: Results of A 2005 National Survey” 2nd International Meeting of the Micronutrient Forum. Micronutrients, Health and Development: Evidence-Based programs: Micronutrient Status Methodologies: Beijing China: Abstract TU 82, May 2009, pg 76.
- ❑ Temple VJ “Status of HIV related food and nutrition research in PNG” In Proceedings on Consultation workshop on HIV Food and Nutrition in PNG.

NDOH and Albion Street Centre Publication, 2008, Sydney and Port Moresby.

- Temple VJ “Assessment of dietary energy intake of PLWHA attending Heduru clinic in PMGH” In Proceedings of National Research Agenda Workshop. NACS Publications, 2008; Port Moresby.
- Oge R, Temple VJ, Vince J, Ripa P “Assessment of nutritional status of infants in NCD by Anthropometry”. 43rd Annual Medical Symposium, Sept 2007. Sir John Guise Stadium Indoor Complex, Port Moresby, NCD, pp 51.
- Ilaisa S, Temple VJ, Saweri W and Lloyd A. Assessment of dietary energy intake of PLWHA attending Heduru Clinic, Port Moresby General Hospital: 24-hour recall study. 43rd Annual Medical Symposium, 3rd – 7th Sept 2007. Sir John Guise Stadium Indoor Complex, Port Moresby, NCD, pp 55.
- Oge R, Temple VJ, Vince J, Ripa P. Status of Iodine Nutrition in Infants and Lactating Women Resident in NCD, PNG. Medical Society of PNG 42nd Annual Medical Society Symposium, Sept 2005, Divine Word Univ. Madang; pp. 48.

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