PACIFIC JOURNAL OF MEDICAL SCIENCES

VOLUME 10, No. 2, NOVEMBER 2012

PACIFIC JOURNAL OF MEDICAL SCIENCES

(Formerly Medical Sciences Bulletin)

ISSN: 2072 - 1625

Volume 10, No. 2, November 2012

A multidisciplinary journal for publication of medical and biomedical research findings on issues pertinent to improving family health and related issues of public health

INFORMATION

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November 2012: **ISSN: 2072 – 1625** **VOLUME 10, No. 2**

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CASE REPORTS

LETTER TO THE EDITOR

THE ROLE OF TRADITIONAL MEDICINE PRACTITIONERS IN MANAGING HIV AND AIDS RELATED-SICKNESSES IN TWO PROVINCES OF PAPUA NEW GUINEA

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ABSTRACT:

The HIV/AIDS epidemic requires mobilization of existing and potential resources of health systems for coordinated effort from the grassroots to national level. In this context, the role of traditional medicine practitioners in the management of HIV/AIDS-related illnesses was investigated. The experiences, perceptions and beliefs of People Living with HIV/AIDS (PLHIV) who access traditional medicine practitioners (TMPs), and the existing linkages between herbalists and other agencies working with PLHIV were also investigated. Specifically designed separate sets of questionnaires containing both closed and open ended questions were administered to herbalists, PLHIV, health workers and members of the community in the Provincial towns of Alotau and Popondetta and clusters of villages beside them. The findings indicate that conditions such as weight loss, diarrhoea, and opportunistic infections in general were believed to respond better to herbal medicines than hospital medicine and many herbalists were able to effectively treat these conditions in PLHIV. TMPs also provided other services such as counseling, advice on diet and healthy lifestyle. The existing linkage between TMPs and other sectors was weak as 80.3% indicated there was little or no collaboration. While 49% of the PLHIV responded better to herbal than hospital medicine, 15% did not, and 21% were not sure. The most common suggestions made were to include TMPs in the health care management for PLHIV and to provide them training in primary health care and HIV management. One general conclusion from many of the specific findings indicates that herbalists are providing positive support in alleviating suffering from HIV/AIDS patients, and may be a potential key to scaling up comprehensive care for HIV/AIDS in PNG as in other parts of the world.

Key words: HIV/AIDS, PLHIV, Herbal-medicine, Traditional medicine practitioners, Health care management

(Submitted May 2012; Accepted August 2012)

INTRODUCTION:

Papua New Guinea (PNG) has the highest incidence of HIV in the Pacific region [1]. The HIV-AIDS epidemic in PNG continued to escalate dramatically in the last decade, entering a new and more critical phase in 2004, when PNG became the 4th country in the Asia Pacific region to declare a generalized HIV/AIDS epidemic. By the end of 2006, a total of 18,484 people had been diagnosed with HIV, although the estimated number could be about 46,275 [2]. Although no hard data exists, it is estimated that 2% of the adult population, approximately 64,000 people, are now HIV positive [3], however the recent report put the estimated number much lower at 34,100 [4]. There is also a significant shift in the trend; the rural areas now show a strong increase in the HIV incidence. It is expected that with passage of time HIV epidemic will increasingly become more rural, adding to the difficulties of addressing the epidemic [3]. By the end of 2012 HIV prevalence among the rural population will be considerably higher, 5.74% compared to 1.44% in urban areas [2]. As majority of the population (85%) live in the rural areas, the growing HIV/AIDS epidemic will impact on the future of PNG, including reduced life expectancy, workforce depletion, increased health expenditure and reduced economic growth. The situation calls for a comprehensive and multilateral approach to deal with the HIV/AIDS scourge.

The World Health Organization (WHO) has recommended that traditional medicine be included in national responses to HIV [5, 6, 7]. To handle the HIV/AIDS epidemic requires mobilization of existing and potential resources of health systems for coordinated effort from the grassroots to national level. The need for collaboration of two health care systems (official health care system and indigenous traditional medicine) is now more important than ever before to address the ever increasing burden of HIV/AIDS. For example, strategic collaboration between traditional healers and biomedical healing on HIV and AIDS has been established through series of projects in South Africa [8]. Literature reviewed show traditional healers are doing a commendable job in alleviating suffering from HIV/AIDS patients in resource poor countries in Africa through innovative programs such as THETA (Traditional and Modern Health Practitioners Together), TAWG (The Tanga AIDS Working Group), and others [9, 10, 11]. Can a similar approach be adopted in PNG?

In a timely and very significant move, the PNG government approved a national policy on traditional medicine in 2007 with a view to develop, promote and incorporate safe and effective traditional medicine and practices in the National Health System [12]. The policy also recognizes the role of traditional medicine practitioners in provision of health care. Preliminary reports indicate that many

herbalists are already providing valuable support to people living with HIV and AIDS (PLHIV) in various parts of PNG [13].

Traditional medicine practitioners are mostly based in rural communities in PNG [14, 15] and with a shift in trend of HIV/AIDS to rural areas they provide a ready resource. In an effective national response to HIV-AIDS all sectors of society, including TMPs will need to give their support to HIV/AIDS prevention and care initiatives. Only through a collective effort can the fight against HIV-AIDS be a success. There is also need to explore ways in which the authorities in PNG can assist TMPs play a more positive role in prevention, care and support to PLHIV. Besides, given the high cost and scarcity of antiretroviral (ART) drugs, there is need for a complementary measure to check the spread of HIV and manage PLHIV. It is believed that traditional medicine practitioners may be a key to scaling up comprehensive care for HIV/AIDS in PNG as in other parts of the world. In this context, contribution of indigenous traditional medicine and corresponding role of TMPs need to be examined.

The aims and objectives of the study were 1) to investigate the roles of TMPs in the management and prevention of HIV/AIDS-related illnesses in PNG and examine how such approaches could be integrated in the wider national programme to fight HIV/AIDS, 2) perceptions, beliefs and attitudes of PLHIV who access traditional healers, and 3) to determine existing linkages if any between herbalists, official health care system and other agencies working on HIV/AIDS and how these linkages could be strengthened.

METHODS:

Two study sites in PNG were selected for this study, Milne Bay and Oro province. In each of these provinces clusters of adjoining villages were selected from rural setting and besides the urban areas of Alotau and Popondetta towns. In Milne Bay Province Alotau town and 13 Tawala speaking villages along the Eastern Tawala coast were picked which included Ahioma, Nigila, Watunou, Daduwe, Bubulata, Divinai, Halowiye, Bubu, Bo, Lelehudi, Lelegwagwa, Gadudu and Kehelala. Similarly in Oro Province Popondetta town and 10 villages along the Oro Bay where Ewage (Notu dialect) is the common language of the community were selected for the study. The villages were Eroro, Beama, Dombada, Embi, Kopure, Embogo, Banderi, Waiwa, Emo, and Pongani.

Data collection, management, processing and analysis

Data was collected over a number of visits in each province during 2009, 2010 and 2011. There were four categories of study participants (see Table 1) with whom four separate data collection tools were used. Each

tool was a semi-structured questionnaire with both closed and open ended questions. Three local interviewers in each of the two provinces who spoke the local language and who resided in the area were trained on the use of the data collection tools a week prior to beginning of data collection. The data forms were collected and checked for errors and ensured that all questions were answered by the interviewers. All error checks were done by the principal investigators on site prior to submitting to the PNG Institute of Medical Research HQ in Goroka where the database was established and kept for analysis. Quantitative data was entered on Fox pro and then imported into STATA and analysed.

Traditional medicine practitioners providing care and herbal medicine to PLHIV were identified mainly by their respective provincial healers' associations in Oro and Milne Bay, whilst NGOs such as Anglicare Stop AIDS and Igat Hope, and TMPs assisted in recruiting PLHIV for this study. Some TMPs known to have provided services to PLHIV were also indentified by community members and PLHIV themselves, and included in this study. Only those PLHIV who were symptomatic were selected for this study irrespective of the form of treatment or care they had received earlier or were receiving at the time of this study. These included those who were on ART or herbal treatment or both. PLHIV who did not experience any symptoms of HIV/AIDS were excluded. Participating health workers (doctors, health extension officers, nurses and community health workers) were drawn from provincial general hospitals in Alotau and Popondetta as well as health centres and aid posts located in the study area. Questionnaires were provided to all cadres of health workers in HIV clinics and general hospitals in both the provinces. Community members (ward counsellors, teachers, village leaders, and senior members) who commanded respect and position in the community and believed to be responsible citizens were approached to participate in this study. Invariably willingness to participate in the study was one of the guiding factors in recruiting study participants.

In order to achieve the research objectives, the following research questions were posed among others: What are the services offered by the traditional medicine practitioners to HIV/AIDS patients? What is the experience and perception of PLHIV of services provided by TMPs? What is the level of interaction that exists between traditional herbalists, the government and other agencies working on HIV/AIDS? What is the level of knowledge and expertise that exists among individual practitioners in management of HIV/AIDS-related sicknesses such as skin-related infections, persistent fever, cough, headache, chronic diarrhea, sores and wound? And finally what assistance do traditional healers expect from the authorities in order for them to provide health care to PLHIV more positively?

Since HIV/AIDS is a highly sensitive matter appropriate precautions were taken to safeguard the trust of patients and their families whilst ensuring accuracy of the information gathered. Ethical clearance and permission for this study was obtained from the School of Medicine & Health Sciences Research and Ethics Committee, the PNG National AIDS Council (NACS), and Provincial AIDS Councils (PACs) of the Milne Bay and Oro provinces. Informed written consent from each respondent was obtained prior to conducting interview and/or administering questionnaires. Collected data were coded, collated, classified, and matched with key research questions and analyzed.

RESULTS:

This was a cross-sectional study conducted in selected sites in two provinces, Oro and Milne Bay Provinces in Papua New Guinea. The sites were selected based on their geographical location that provided both urban and rural settings. A total of 250 questionnaires were administered to respondents, and from these, 217 questionnaires complete in all aspects were selected for data analysis. Thus the response rate was 86.8%. The questionnaires which were either incomplete or lacking in relevant information were excluded from the study. Of the 217 respondents 61 were TMPs, 39 PLHIV, 59 health workers, and 58 community members.

Number of respondents in each category was higher in Oro compared to Milne Bay province [Table 1]. Of the 51 PLHIV approached only 39 responded (response rate being 71.4%). The relatively low number was due partly to reluctance on part of the subjects to come forward owing to stigma attached to this sickness.

The response rate among TMPs, health workers and community members was high (>90%). The study findings showed various interesting perceptions and practices amongst the study participants.

Table 1: Study Participants by Category and Province

Respondents	Milne Bay n (%)	Oro n (%)	Total N
Traditional Medicine Practitioners (TMPs)	22 (36.1)	39 (63.9)	61
People Living With HIV/AIDS (PLHIV)	10 (25.6)	29 (74.4)	39
Health Workers	24 (40.7)	35 (59.3)	59
Community Members	22 (37.9)	36 (62.1)	58

The Role of Traditional Medicine Practitioners

The experiences and perceptions of the traditional medicine practitioners were explored. They were asked about how they practice, if on full-time basis, their length of service as a traditional herbal practitioner and what do they advice people living with HIV and AIDS and whether they know if their clients are on traditional and modern medicine at the same time. These findings are summarised in Table 2. The practitioners were asked about their experiences and perceptions with respect to the conditions they provided herbal medicines for which alleviated the particular condition. In results presented in Table 2 indicates the responses from the traditional practitioners as to the conditions which they treated in the PLHIV and was seen to have been alleviated.

As the traditional practitioners' assistance was sought by the people living with HIV and AIDS and as they attended to them it became more and more apparent of the common conditions they thought the PLHIVs were coming to them for as shown in Table 2 but the top three turned out to be weight loss, chronic diarrhoea, persistent opportunistic infections particularly skin infections and equal third, loss of appetite and nausea. Besides these common services provided which they saw to alleviate the conditions shown in Table 2 TMPs also perceived themselves providing other services such as counselling, advices on diet and healthy lifestyle for the PLHIV because the PLHIV would return to them for feedback as they ate better, gained weight and improved, etc. as shown in Table 2.

Traditional Medicine Practitioners were also asked about their experiences and perceptions about linkages and collaborations with practitioners, be they health care providers in the government system or the NGO besides other traditional practitioners.

As shown in Table 2 most (55.7%) of their interaction is with other traditional practitioners followed by interactions with NGOs (52.5%) who provide care and support to PLHIV. There was some level of interaction (31.1%) with the health care providers of different categories ranging from the community health workers to the doctors but apart from that most respondents indicated that there was little or no existence of collaboration and linkage with all sectors. It was also observed that some TMPs interacted with more than one category of health workers. Though most TMPs (80.3%) indicated there was little or no collaboration 16.4% said there was adequate collaboration.

Table 2: Experiences and Perceptions of Traditional Medicine Practitioners (n = 61)

Practices of Providing Herbal Medicine	**Yes**	**No**	**Not disclosed**
Full time herbal practitioner	32 (52.5)	27 (44.3)	2 (3.2)
Length of service			
< 10 years	17 (27.9)		1 (1.6)
> 10 years	43 (70.5)		
Advised patient to stop hospital medicine and switch to herbal*	16 (26.2)	33 (54.1)	12 (19.7)
Patient taken ART and herbal medicine simultaneously	23 (37.7)	20 (32.8)**	18 (29.5)
Experiences of Health Conditions Better Treated and Commonly Seen by TMPs in PLHIV	**Frequency of responses**	**Percent**	
Weight loss	23	37.7	
Chronic diarrhoea	18	29.5	
Persistent opportunistic infection like skin infection, rashes, painful blisters, wounds, etc	16	26.2	
Loss of appetite & nausea	14	23.0	
Persistent fever & cough	14	23.0	
General body weakness	13	21.3	
Joints pain & arthritic pain	10	16.4	
Sores, wounds & hair loss	7	11.5	
Interaction and Collaboration of TMPs With Other Health Care Providers	**Yes**	**%**	
Other TMPs	34	55.7	
Health care providers for PLHIV	19	31.1	
- HIV Clinic Staff	18	29.5	
- Other doctors	15	24.6	
- Other Nurses & HEOs	17	27.9	
- CHWs at Health Centres and Aid Posts	11	18.0	
- Others	6	9.8	
Involved in work with NGOs providing care and support	32	52.5	
Existence of collaboration and linkages			
Does not exist	22	36.0	
Little	27	44.3	
Adequate	10	16.4	

[Figures in parenthesis are percentages]

*Reason for switching was because patient did not improve and had more faith in traditional medicine

**Patients not on ART and herbal medicine simultaneously

A total of 39 people living with HIV were interviewed in the two sites on their experiences of herbal medicine. The number of PLHIV who were on ART numbered 33; 10 of these had stopped ART on their own accord for varied reasons. All PLHIV had accessed TMPs and used herbal medicine one time or the other to treat HIV/AIDS-related illnesses. There were good as well as bad experiences of herbal medicine expressed by these people. Three main questions asked were in relation to (1) if HIV/AIDS related conditions responded better to herbal medicine than hospital medicine, (2) if they ever took ART and herbal medicine simultaneously, and (3) if they ever experienced complications from combining ART with herbal medicine. They were also asked if the traditional medicine practitioner had advised them to stop taking their ART. These results are shown in Table 3. The third category of study participants were health workers whom the study involved. They were asked about their opinions on what they saw to be the role of the traditional medicine practitioners. A total of 59 health workers ranging from community health workers to medical officers responded stating various roles more to do with primary health care as shown in Table 3. Of these various roles the top three that were more favourable were helping to treat or prevent skin infection and participating in home-based care including counselling for positive living. On the other hand 10 (16.9%) of the 59 health workers did not see any role the traditional medicine practitioners have in treating or managing PLHIV. Thirteen (22 %) health workers had made referrals to TMPs because hospital could not provide the alternative care, and that the TMP was readily available to patients.

All respondents or study participants were asked about how they thought linkages could be strengthened and the most common suggestions made by the participants were to include traditional herbalists in the health care management and to provide training for traditional herbal practitioners in primary health care and HIV management as shown in Table 4. These perceptions were highly supported by community members, particularly about including the TMPs in the health care management of PLHIV and almost half the health workers went along with this too. Traditional medicine practitioners above all the other expressed the idea of strengthening linkages and collaboration by giving training to TMPs on primary health care and HIV management because this was one of the best ways of getting to overcome misunderstanding of ART and herbal medicine and what they do which can be harmful as well as being damaging.

Table 3: Experiences and Perceptions of PLHIV, Health Workers and Community Members

Experiences and Perceptions of PLHIV (n=39) (PLHIV on ART #33)				
Experiences of the use of herbal medicine	**Yes n (%)**	**No n (%)**	**Not sure n (%)**	**NA/NR n (%)**
HIV/AIDS-related conditions responded better with herbal medicines than hospital medicine	19 (48.7)	6 (15.4)	8 (20.5)	6 (15.4)
Taken ART and herbal medicine simultaneously	13 (39.4)	18(54.5)	3(7.7)	5 (12.8)
Experienced problems or complications from combining ART with herbal medicine	2 (15.4)	11(84.6)	Nil	26 (66.7)
TMP advised to stop ART	11 (33.0)	19(57.6)	3 (9.0)	6 (15.4)
Stopped ART on own accord	10 (30. 3)			
Experiences and Perceptions of Health Workers (n=59)				
Role of traditional Medicine Practitioners	**Number (%) of Respondents**			
Prevent and treat opportunistic infections like skin infections, etc.	22 (37.3)			
Help in primary health and home based care	9 (15.3)			
Counselling for positive living	9 (15.3)			
Available for alternative health care and advice on diet and nutrition	6 (10.2)			
No role	10 (16.9)			
Not sure	2 (03.4)			
22.4% (13) Health workers had made referrals to TMP because the hospital could not provide the alternative care; and that the TMP was readily available to patient				
Experiences and Perceptions of Community Members (n=58)				
Role of Traditional Medicine Practitioners	**Number (%) of Respondents**			
Are aware of TMPs treating PLHIV	29 (50)			
Kind of role TMPs play				
- Attend to opportunistic infections	29 (50)			
- Attend to other HIV/AID-related health conditions	21 (36.2)			
- Provide physical as well as psychological support	10 (17.2)			

NA= Not applicable; NR= Non-responders

Table 4: Ways to Strengthen Linkages between TMPs and Health System

Ways to Strengthen Linkages	TMPs (n=61)	Health Workers (n=59)	Community Members (n=58)
Include TMPs in health care management for PLHIV			
- Yes (all TMPs)	36 (59.0%)	28 (45.9%)	48 (82.8%)
- No	2 (03.3%)	2 (03.4%)	3 (05.2%)
- Only a selected few	18 (29.5%)	25 (42.4%)	7 (12.0%)
- Not sure	5 (08.2%)	4 (06.8%)	0 (00.0%)
Training in Primary Health Care & HIV	47 (77.0%)	39 (66.1%)	42 (72.4%)

DISCUSSION:

The role of traditional healers in HIV/AIDS prevention, treatment and care has been widely explored in developing countries, and it is concluded that the conventional biomedical system alone has not and will not be in position to fulfil the national HIV/AIDS strategic plans without engaging the help of all relevant stakeholders, including traditional healers [5,6,16]. This study has demonstrated the positive role played by TMPs in providing treatment for HIV/AIDS-related sicknesses to PLHIV in the provinces of Milne Bay and Oro in Papua New Guinea. Their main contribution is in alleviating suffering from opportunistic infections, and providing advice on diet and healthy life style [Tables 2 & 3]. TMPs as well as health workers and community members have suggested training of TMPs in primary health care and HIV as one of the ways to strengthen linkages between TMPs and health system [Table 4]. It is believed that given the necessary training and support traditional healers can be integrated in the management and prevention of HIV/AIDS as a complementary measure as is currently done in some countries in Africa [17].

In this study more than one third (13 out of 33) of the PLHIV reported taking ART and herbal medicine concurrently [Table 3], majority (84.6%) of them did not experience any problems whilst 30% of them stopped ART by their own choice. There is no conclusive scientific study to suggest that combining ART with herbal medicine was harmful. Recent studies in South Africa however shows that there is a complex intersection of beliefs towards the concurrent use of traditional African medicine and ART amongst PLHIV and that both were perceived to serve distinct purposes and were complementary in nature [18]. Patients with AIDS in the Tanga region of Tanzania stated that they felt less pain from AIDS-related symptoms after local treatment

from healers as compared to treatments received in the hospitals [9]. This study has also demonstrated that nearly half of PLHIV interviewed said they responded better to herbal medicine than hospital medicine [see Table 3].

In this study the results demonstrated the existence of other sectors of health care in the two geographical locations studied. As Kleinmen [19] suggests, in any complex societies one can identify three sectors of health care that overlap and interconnect. These are the popular sector, the folk sector and the professional sector. This study has shown the overlapping and inter-connecting of these sectors in the study sites [Tables 2 and 3] as elsewhere [19]. Most health workers view a positive role for TMPs, however some have negative view of traditional healers as expressed by 17% of the health workers in this study who said the traditional healers had no role to play in the care and management of people living with HIV [Table 3]. Though a minority view, it agrees with the findings of a study carried out in Botswana which indicated that the contribution of traditional healers as healers and caregivers to PLHIV was waning fast due to strong advocacy against the use of two medical systems by the biomedical practitioners [20]. At the same time a study supported by UNDP in Bangladesh has concluded that the role of traditional healers in the fight against HIV/AIDS was of great importance, and that there was a strong desire by traditional healers to access legitimacy and resources that can be achieved through collaboration with modern medicine [21]. Similar sentiments were expressed by majority of TMPs interviewed in this study who expressed strong desire for training in primary health care and HIV as well as strengthening of linkages with modern health system [Table 4]. Although demographic data of TMPs and PLHIV who participated in this study has not been reported in this paper, several earlier reports have indicated that TMPs are mainly based in rural communities in PNG [14,15], and with the HIV/AIDS incidence set to increase significantly in rural areas TMPs have a definite role to play in providing care and support to PLHIV. Herbal medicine is widely used in treatment of variety of ailments throughout PNG [13]. Diarrhoea, skin infections, weight loss, loss of appetite, sores and wounds are some of the common sicknesses seen in PLHIV. Reports of TMPs treating these conditions effectively are well documented in literature [22,23]. Given the health workforce shortage and inadequate health infrastructure in PNG, there is need for bolder thinking – how can services of this group of informal providers be appropriately used as healers and caregivers to PLHIV in PNG. Policy implications of including traditional healers for HIV and AIDS Policy are currently the subject of debate in many developing countries [24], and PNG should also be looking at this issue.

CONCLUSIONS:

The study showed that traditional medicine practitioners are playing an important role in providing medical care and in alleviating suffering of PLHIV in Oro and Milne Bay provinces. Their main contribution is in improving the quality of life by effectively treating many of the symptoms of this disease. The study also shows that linkage between TMPs and the health care system exists but is weak and needs strengthening. It is concluded that TMPs are potential key to scaling up comprehensive care for PLHIV in PNG as in many countries in Africa and Asia. More research is however needed to further understand the practices and efficacy of the herbs used in the management of specific opportunistic infections.

There is also need to conduct further studies in other provinces to determine if TMPs were playing equally an important role in providing treatment, care and support to PLHIV as their counterparts in Milne Bay and Oro. If findings are supportive services of TMPs may be incorporated into regular service delivery system for PLHIV along with provisions in the PNG National HIV and AIDS Strategy 2011-2015 under Strategic Priority 2, Cluster 2.1.10 (re: Treatment and Management of Opportunistic Infections), and Priority 2, Cluster 2.4 in home based care for PLHIV. Further, incorporation of TMPs' services needs to be monitored and supported by research for evidence based best practice.

ACKNOWLEDGEMENT:

The authors wish to sincerely acknowledge and thank the participating communities and individuals who participated in this study from the respective communities. The support extended by the Provincial authorities, the personnel of the Non-government organizations and Health facilities in the two provinces is gratefully acknowledged. Special thanks to traditional medicine practitioners' Provincial associations of Oro and Milne Bay led by Mr John Max Gadebo and Mr. Moses Babakuva respectively. The study was supported by a research grant (RES08 0007) from the PNG National AIDS Council Secretariat (NACS).

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FACTORS AFFECTING THE AVAILABILITY AND COST OF FOODSTUFFS IN THE REPUBLIC OF THE MARSHALL ISLANDS

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(Funding provided by the Washington University School of Medicine FIHTM summer fellowship grant, the Arnold P. Gold Foundation Humanism in Medicine student summer fellowship, and the Washington University Social Change Grant provided by Procter & Gamble.)

ABSTRACT:

The objective of this study was to quantify the cost and availability barriers to obtaining healthy foodstuffs in the Republic of the Marshall Islands (RMI).

A validated food environment survey procedure was adopted to assess the cost and availability of healthy foods in the larger, but more difficult to access grocery stores, compared to smaller, but more easily accessible, convenience stores in the RMI. Stores were scored based on food availability, price, and quality. Availability score of healthy foods in grocery stores was much higher than in convenience stores (15.6 vs 2.9). Grocery stores also tended to have fresher produce (quality score = 6.7 vs 1.2), but they generally had a higher cost score (price score = -1.1 vs -0.2). Furthermore, healthy alternatives to commonly purchased staples of the RMI diet were limited and trended towards being more costly in all stores surveyed. Grocery stores in the RMI scored substantially lower than stores in economically disadvantages areas of the United States. In the RMI, there are significant barriers of access and cost to healthy diets. This makes it difficult for average Marshallese families to make alterations to their eating habits, even with educational and community outreach efforts.

KEYWORDS: Diabetes Mellitus Type 2, Marshall Islands, Environment and Public Health

(Submitted August 2012, Accepted October 2012)

INTRODUCTION:

The Republic of the Marshall Islands (RMI) is a series of atolls located in the western Pacific Ocean. Though spread out over an area larger than the state of Alaska, the actual land mass of the RMI is approximately the size of Washington DC [1]. Since its formal independence from the United States in 1986, rates of obesity and diabetes in the RMI have been on the rise. In 1998, adult obesity rates (BMI ≥ 30) were over 25% [2]. By 2002, rates of obesity had risen to 45%, with total overweight incidence (BMI ≥ 25) of more than 80% [3]. These increases in BMI have driven up the rates of many chronic illnesses, including type 2 diabetes mellitus. Though a widely distributed population with poor medical access makes the exact rates hard to quantify, a 2010 study estimates that 41% of the adult population (age 25-64) has diabetes [4]. Because of the chronic nature of the disease, this represents a significant and ongoing cost to the government. Additionally, it is the leading cause of death in this population, and the death rate due to diabetes is the highest in the entire Pacific region [4]. From 1958 to 1999, the RMI population has grown from 14,163 to 50,848 [5, 6]. Fish has historically been the staple of the Marshallese diet, supplemented by fruits and vegetables like coconut and pandanus. However, rapid population growth in the face of limited land, a desire for Western lifestyles, and readily available imports has resulted in a shift away from this diet. Today, most of the food consumed by the Marshallese people is imported [7]. At the same time, the RMI's remote location means that fresh fruits and vegetables must be air-freighted in, driving up their cost [8]. This is further compounded by high rates of poverty and unemployment [9]; the average wage in the RMI is $2.57 in the private sector (92% of the workforce), and on average 1.8 wage earners support 9.5 members per household [10]. As a result, household foods are limited and canned or dried goods are the staples of today's high fat, low fiber Pacific Islander diet [11]. One 2002 study determined that 91% of the RMI population did not meet the suggested five fruits and vegetables per day [4], compared to 53% in the US [12]. In the more urban areas of Majuro and Ebeye, where most Marshallese people live, this lifestyle is especially prevalent [9]. To date, there has been little effort to quantify the nutritional environment in the RMI capitol of Majuro. This study aims to examine intrinsic barriers to eating a more nutritious diet by systematically surveying the availability and cost of the most commonly purchased Marshallese foods, as well as some available healthy alternatives.

MATERIALS AND METHODS:

Availability, price and quality of food choices were assessed using The University of Pennsylvania's Nutrition Environment

Measures Survey (NEMS), a validated standardized observational study originally based in Atlanta, GA. It rates convenience and grocery stores on availability, price, and quality, which can then give a general score. The original compiled score had a possible range of -8 to 50, with surveyed Atlanta grocery stores scoring a mean of 22.58 (52.3% of total possible points) and convenience stores scoring a mean of 5.85 (23.8%). For this study, the NEMS survey was adapted to the RMI using guidelines provided in NEMS training modules [13]. Fruits and vegetables used in the original NEMS which were unlikely to be available in the RMI, such as grapes, pears, and cucumbers, were substituted for locally available produce, such as papaya, coconut, and breadfruit, as suggested by the NEMS module. Unavailable packaged foods were removed from the survey and replaced with local items.

All data was gathered from downtown Majuro, the capital city of the RMI, which has the most access to food options in the country with 136 convenience stores and 7 grocery stores. All grocery stores, defined as large walk-in stores with a hired staff selling primarily foodstuffs organized into aisles, were surveyed by a trained rater. The convenience stores were divided into two types: walk-up and walk-in. The walk-in stores were typically larger than the walk-up stores and sold a wider variety of foods but were still much smaller than grocery stores. The walk-up stores had no place for customers to enter, with only a window through which to order. This distinction between walk-up and walk-in stores was made to avoid sampling bias when randomly selecting convenience stores to analyze. These convenience stores were counted, mapped, and numbered. Two walk-up convenience stores and two walk-in convenience stores from each neighborhood were randomly selected and surveyed. Three raters underwent a 20-hour online training course for NEMS provided by the University of Pennsylvania. Inter-rater reliability was tested using a randomly selected grocery store, a walk-in convenience store, and a walk-up convenience store, each evaluated by all three raters. Inter-rater reliability was calculated by dividing the points assigned to a store by each rater by the total possible points and comparing the results of each rater. These are reported as the range of inter-rater reliability across the three stores analyzed.

Analysis was performed using the NEMS scoring system, which scores stores based on availability and quality of fresh produce as well as cost of healthy versus unhealthy items. A separate price analysis was also done on the healthy versus unhealthy options found at grocery stores. The comparisons made were: chicken legs versus boneless skinless chicken breast; regular canned luncheon meat versus light canned luncheon meat; tuna canned in oil versus tuna canned in water; white versus wheat bakery bread and sliced bread; white rice versus brown rice; white flour versus wheat

flour; full-fat mayonnaise versus light or fat-free mayonnaise; regular soy sauce versus low sodium soy sauce; solid shortening versus vegetable oil; regular soda versus diet soda; artificial juice drink versus 100% juice; regular chips versus lower fat chips; and donuts compared to oatmeal. The average price differences between these foods were calculated, and discrepancies in healthy food availability were identified. Because the original NEMS-S scoring scale had been changed to reflect Marshallese diets, scores of stores in Atlanta were converted to the RMI scale for comparison; the percentage scored by each store in Atlanta was multiplied by the maximum of 89 points possible in the Marshallese scoring system. This converted score was then used to compare the overall food environment of Atlanta stores to the RMI scores. To analyze the compiled mean scores of grocery stores versus convenience stores, IBM's Statistical Package for the Social Sciences (SPSS) was used to calculate independent sample T-tests for the scores.

RESULTS:

Inter-rater reliability was 95-98% when analyzing the NEMS scores for each store, indicating low overall variability. Our inter-rater reliability scores were within the 92-100% range that the original published NEMS research stated [13]. Grocery stores had a mean score of 27.3± 6.5 while convenience stores scored a mean of 5.15 ± 1.4. The grocery stores had a mean difference of 22.1±3.40 more points than convenience stores, scoring significantly higher than convenience stores ($p < 0.001$). In general, all grocery stores scored higher than convenience stores (Figure 1). The stores were scored based on availability and quality of produce and healthy items like beans and fresh fish, and the availability and cost of healthy alternatives, such as wheat flour and brown rice. When scores were broken down by price, availability and quality, convenience stores underperformed in both availability and quality (Table 1); though they were nearly equivalent with grocery stores in price. Availability of fresh fruits and vegetables in grocery and convenience stores was low. Only 40.7% of stores sold oranges, the most commonly available fruit, and only 29.6% of stores had cabbage, the most commonly available vegetable; 22.2% of stores had dried beans and 25.9% of stores had fresh fish available. For healthy alternatives, 11.1% of stores had a healthier version of canned luncheon meat, such as Turkey canned luncheon meat, while 96.3% had regular canned luncheon meat; 18.5% of stores had tuna canned in water, while 92.6% had tuna canned in oil; 14.8% of stores had brown rice compared to 77.8% with white rice; and 29.6% of stores had a low-fat version of mayonnaise compared to 85.2% with regular mayonnaise (Table 2).

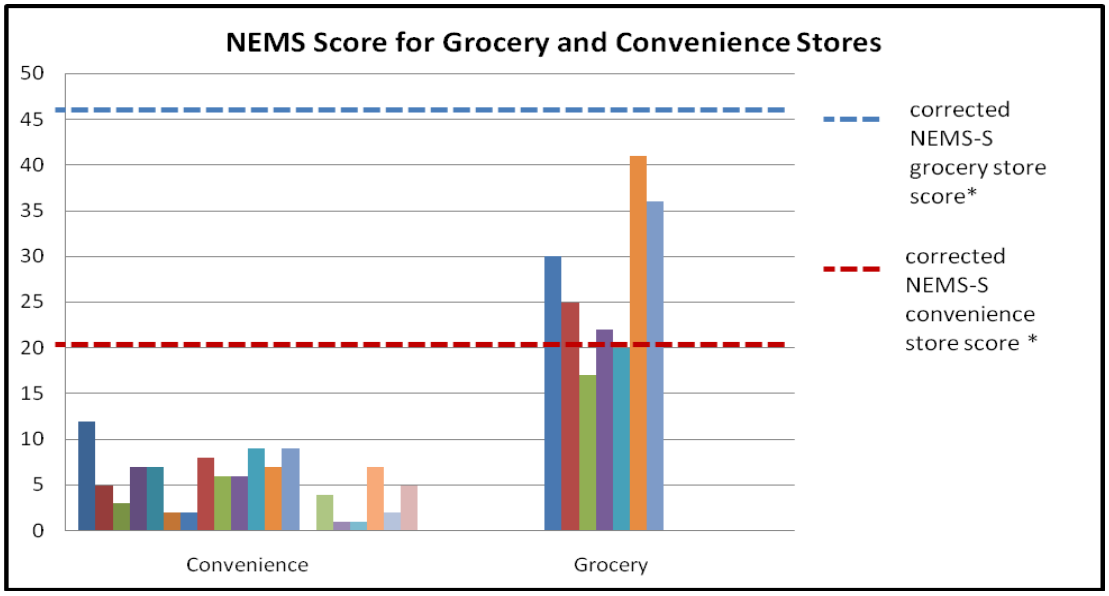

Fig 1: NEMS Score for Grocery and Convenience Stores. Scores are out of a total 89 possible points. The scoring system awards points based on availability and quality of produce and healthy packaged options, as well as whether healthy alternatives are less expensive then unhealthy alternatives. An ideal store would score close to 89 points, signifying the availability and affordability of high quality healthy foods. Stores that earn few points have little healthy food available and the foods that are present are either more expensive than an unhealthy alternative or of poor quality, as defined by >50% of the foods spoiled. All of the grocery stores scored higher than the convenience stores.
*NEMS-S scores were converted to reflect a change in total points available by multiplying the percentage scored with the maximum of 89 points possible

Table 1: Scores of grocery versus convenience stores by category

Average points earned by grocery stores and convenience stores			
	Point Range	**Grocery Stores (n = 7)**	**Convenience stores (n = 20)**
Availability	0 to 30	15.6 (52.0%)	2.9 (9.7%)
Price	-16 to 32	-1.1 (31.0%)	-0.2 (32.9%)
Quality	0 to 9	6.7 (74.4%)	1.2 (13.3%)
Scores of grocery versus convenience stores by category; Price scores can be negative because stores lose a point when healthy alternatives are more expensive. To calculate a percentage scored on price, we added 16 to the score and divided it by a total of 48 so as to assess the price out of total theoretical points possible. However, because stores gain a point for stocking a healthy option, total number of points can never be negative.			

Table 2: Percentage of the 27 stores analyzed

Type of Foodstuffs	Stores with Healthy Choice (n = 27)	Stores with Unhealthy Choice (n = 27)
1) Milk	5 (18.5%)	8 (39.6%)
2) Fruit		
• Apples	10 (37.0%)	
• Oranges	11 (40.7%)	
• Banana	6 (22.2%)	
• Papaya	2 (7.4%)	
• Marshallese Apple	0 (0.0%)	
• Ni	3 (11.1%)	
• Watermelon	1 (3.7%)	
3) Vegetables		
• Sweet Potatoes	1 (3.7%)	
• Cabbage	8 (29.6%)	
• Squash	0 (0.0%)	
• Breadfruit	1 (3.7%)	
• Eggplant	0 (0.0%)	
• Taro	1 (3.7%)	
• Corn	3 (11.1%)	
• Tomatoes	5 (18.5%)	
• Carrots	6 (22.2%)	
• Fresh Beans	0 (0.0%)	
4) Dried Beans	6 (22.2%)	
5) Fresh Fish	7 (25.9%)	
6) Chicken	3 (11.1%)	13 (48.1%)
7) Spam	3 (11.1%)	26 (96.3%)
8) Tuna	5 (18.5%)	25 (92.6%)
9) Baked Bread	2 (7.4%)	11 (40.7%)
10) Starches		
• Rice	4 (14.8%)	21 (77.8%)
• Flour	2 (7.4%)	16 (59.3%)
11) Condiments		
• Ketchup	0 (0.0%)	27 (100.0%)
• Mayo	8 (29.6%)	23 (85.2%)
• Soy Sauce	5 (18.5%)	26 (96.3%)
• Oil/Shortening	26 (96.3%)	21 (77.8%)
12) Beverages		
• Soda	21 (77.8%)	27 (100.0%)
• Juice	8 (29.6%)	20 (74.1%)
13) Bread	1 (3.7%)	4 (14.8%)
14) Chips	3 (11.1%)	22 (81.5%)
15) Donuts/Oatmeal	6 (22.2%)	8 (29.6%)
16) Take Out Meal	1 (3.7%)	8 (29.6%)

Percentage represents the number of stores that carried the food item out of the 27 stores analyzed. For example, 5 out of 27 stores (19%) had a low fat milk option, while 8 out 27 stores (30%) carried full-fat milk.

Table 3: Price difference between healthy and unhealthy alternatives at each grocery store

Food types:	Store 1	Store 2	Store 3	Store 4	Store 5	Store 6	Store 7	Mean Difference	Confidence Interval
Chicken	n/a	0.95	n/a	n/a	n/a	2.44	2.8	2.06*	0.95 to 3.17
Spam	n/a	-0.2	n/a	n/a	n/a	0.06	0.04	-0.03	-0.20 to 0.13
Tuna	0.1	0.02	0.17	n/a	n/a	0.12	0.03	0.09	0.03 to 0.14
Rice	n/a	n/a	1.89	n/a	n/a	0.14	-0.12	0.64	-0.60 to 1.87
Flour	n/a	n/a	n/a	n/a	n/a	0.4	0.5	0.45*	0.35 to 0.55
Mayo	-0.09	n/a	-0.1	n/a	-0.1	0.02	0.02	-0.05	-0.11 to 0.01
Soy Sauce	0.02	0	n/a	0.06	n/a	0.26	0.28	0.12*	0.01 to 0.24
Shortening/ Oil	0	0.01	0.02	-0.01	0	0.04	-0.04	0.00	-0.02 to 0.02
Juice	-0.01	-0.1	0.08	-0.04	-0.03	-0.11	0.03	-0.03	-0.08 to 0.02
Chips	n/a	n/a	n/a	n/a	n/a	-0.01	-0.31	-0.16	-0.45 to 0.13
Oatmeal / donuts	n/a	n/a	n/a	n/a	n/a	0.12	-0.53	-0.21	-0.84 to 0.43

N/A indicates that a healthy alternative to the item was not available. Chicken is priced per pound. Bread is priced per loaf. Oatmeal, donuts are priced per serving. The other measures are priced per ounce. *Healthy item significantly more expensive than less healthy alternative

Because convenience stores had such limited availability of healthy alternatives, only grocery stores were subjected to additional price analysis of healthy vs. unhealthy products. Four healthy food items showed statistically significant higher prices when compared to their unhealthy counterparts: boneless/skinless chicken breast ($2.06 more expensive per ounce; 95% CI: $0.95-3.17), tuna in water ($0.09 more expensive per ounce; 95% CI: $0.03-0.14), whole wheat flour ($0.45 more expensive per ounce; 95% CI: $0.35-0.55), and low sodium soy sauce ($0.12 more expensive per ounce; 95% CI: $0.01 to 0.24). No healthy options were significantly less expensive than their unhealthy counterparts (Table 3).

DISCUSSION:

Despite recognition that type 2 diabetes is the leading cause of death in the RMI, no objective studies measuring food availability and price in the capital island of Majuro were found on literature search. By clarifying which healthy foods are available and comparable in price to traditional foods, this information could prove valuable in guiding educational programs and lifestyle intervention efforts. Furthermore, an understanding of the state and limitations of the current food environment could help elucidate the factors impacting high obesity and diabetes rates in the RMI.

Diets high in saturated and trans-fats, sugars, and refined grains but low in fiber have been linked to the development of obesity, which is a

major risk factor in type 2 diabetes [14, 15]. Unfortunately, much of the current Marshallese diet is made up of these foods. White rice, white flour, canned luncheon meat, and ramen noodles are now among the most commonly purchased foods [10], largely replacing fresh fish, coconuts, breadfruit, and bananas. There are several reasons for this shift, including the convenience of packaged food, population growth causing decreased land area for agriculture, and a taste preference for salt and sugar without knowledge of the dangers of overconsumption. In recent years there has been an effort to increase awareness of food choices and obesity as causes of type 2 diabetes [16]. However, there are still many barriers to accessing healthier foods in the food environment.

This study shows these barriers include availability, quality, and price of healthy foods at both grocery stores and convenience stores. Convenience stores, the most numerous type of store available, performed significantly worse than their more expensive, less accessible counterparts. While grocery stores had significantly higher NEMS scores than convenience stores, even these venues compared poorly to American cities. Their overall NEMS score of 27.3 points or 31%, as well as the percentages of healthy foods available shown in Table 2, reflects an overall nutritionally poor food environment. In comparison, urban Atlanta stores selected because of "evidence of socioeconomic disparities in nutrition environments" scored at an average of 53% [13]. Also, a NEMS survey of grocery stores in Little Rock, Arkansas and Burlington, Vermont, had average availability score of 93% (27.9/30), average quality score of 100% (6/6), and average price score of 13% (2.4/18) [17]. In comparison, grocery stores in the RMI scored 52% (15.6/30), 74% (6.7/9) and 31% (14.9/48) for availability, quality and price respectively, scoring lower in both availability and quality. Though the price score was higher in the RMI, this is likely an artifact of how stores are scored. Stores which have more expensive healthy alternatives lose a point for price, but stores which lack the healthy alternative simply do not gain a point. As a result, stores that have limited healthy alternatives, as in the RMI, can have comparatively better price scores. The lower availability of healthy food alternatives in convenience stores compared to grocery stores is a major barrier to healthy food choices. Grocery stores are also farther away than neighborhood convenience stores and usually necessitate a taxi ride. In addition, many outer islands only have convenience stores available.

Even at grocery stores, where availability of food tends to be better, price can be a limiting factor. Chicken legs, tuna canned in oil, white flour, and soy sauce, were shown to be cheaper than their healthy alternative. Two of these, chicken legs and white flour, are known to be in the top five most commonly purchased

foods in the modern Marshallese diet [10]. These staples are high in fat and sugar, respectively, and low in nutritional value. Many other commonly eaten Marshallese foods, such as white rice and canned luncheon meat, were not shown to have a significant difference when compared to healthy alternatives, potentially because low availability of healthy alternatives creates a small sample size.

One possible limitation to this study is that the compiled data came from a randomly selected cross section of small stores on one island in the RMI. Due to the large number of convenience-type stores, and only three trained raters, it was not feasible to rate them all. The sample stores were selected randomly to avoid sampling bias but some bias could still exist given the small sample size. There was also no objective data collected on the alternative food suppliers on island, such as community gardens. However, it has been documented that the majority of foods bought by the average Marshallese citizen are imported packaged foods [10] therefore the contribution to food purchases from a garden is likely minimal at the time of this study.

It is well established that changes in community-wide behavior follow changes to the environment that support this new behavior [18]. The need for these efforts is beginning to be recognized in the RMI as well, and there are several initiatives taking steps to achieve this. The Diabetes Wellness Center, funded through a grant by the US Department of Defense, enrolls groups of Marshallese adults for three-month long intensive educational, exercise, and nutritional workshops with impressive results. The center also serves a high fiber vegetarian breakfast and lunch daily, has a gym open for membership, and offers free clippings from their garden to members of the community to start their own plots; however, most of the Center's services are too expensive for the average Marshallese citizen, which limits its use. The government-run Ministry of Health has started programs targeting churches as venues for raising awareness about diabetes risk factors and encouraging healthy choices. A moderate-scale Taiwan-sponsored garden in a more remote part of the island has had success growing crops once thought to be unsustainable in the salty climate. Gardening efforts have also begun on less settled outer islands. Unfortunately, these efforts are often limited by grant funding, or are in developmental stages. Gardening is especially difficult because fertile land is scarce and there are few trained gardeners.

Some independent business owners have recognized the need for healthier foods in the RMI and have begun importing inexpensive dried goods such as beans and lentils. However, the purchase of these foods is low, especially among the native Marshallese. This could be attributed to the fact that the Marshallese people are unfamiliar with the foods and are unsure how to prepare them, indicating the need for food education. To this

end, school-based initiatives are underway to improve the nutrition of school lunches and make diabetes education a component of the curriculum for all grades, a method proven to be effective in other high-risk communities, but not yet in effect in the RMI [19, 20]. With education about diabetes, nutrition, and exercise starting at younger ages, there is hope that the development of diabetes as a lifelong illness can be prevented in future generations. However, education and access to healthy, affordable foods must increase in tandem in order for the population to be able to put these lessons into action.

While these initiatives are each having an impact on the sub-populations that they serve, there is still a lack of government supported, nation-wide efforts to make healthy foods more accessible to the Marshallese people. Prevention efforts are challenging for any government, especially one with scarce resources and a high active disease burden to address. The identification of specific barriers to access in this survey could help support the design and implementation of targeted interventions by the government, such as subsidizing costs of healthy food alternatives, encouraging importation and sale of these alternatives in all stores, and expanding gardening efforts. This will take an initial investment, but focused interventions directed at these major barriers to health would result in dramatic savings in healthcare costs.

The impact of preventing, or even delaying, the onset of diabetes in the next generation would be momentous in decreasing morbidity and mortality and decreasing the economic cost to the RMI. Since the rapid shift in lifestyle post-WWII, the RMI has been struggling to improve education, develop industry, and become a self-sustaining country capable of participating in the global economy [16]. These goals have yet to be met, and economic prospects remain bleak as long as so much of their budget must be spent on the increasing numbers of Marshallese people chronically ill with diabetes, while the workforce is depleted by the same disease. Until this epidemic is controlled, the RMI's economy, which is primarily supported by the US, will continue to be dramatically impacted by the disease burden of diabetes.

In the meantime, many Marshallese exercise their right to free immigration to the US, with as much as 10% of the Marshallese population living in the US [10] and many having come specifically for healthcare [21]. In addition, Marshallese people living in the US are four to seven times more likely to develop diabetes [21]. Both of these factors increase the burden of care that must be assumed by the US, as a fulfillment of their obligations outlined in the nuclear claims treaty. The US is currently intimately involved both financially and politically in the development of the Marshall Islands and must take an interest in the health status of the population. It is becoming increasingly clear that the Marshallese and US

governments need to act now to address the draining but ultimately preventable disease epidemic of type 2 diabetes in the RMI. Not doing so will result in the slow devastation of an entire nation, and an economic burden on the US with no end in sight.

The results of our study show a food environment that has low availability of healthy alternatives and significant barriers to healthy food in terms of accessibility, price, and quality. Healthy foods were generally more expensive than less healthy alternatives and were not as accessible through the numerous convenience stores throughout the RMI. While the five grocery stores did have a larger selection of healthy foods than convenience stores, these grocery stores had a worse food environment, as defined by selection, quality, and price, than grocery stores located in impoverished urban Atlanta neighborhoods.

ACKNOWLEDGEMENTS:

We would like to thank the Ministry of Education and Ministry of Health of the Republic of the Marshall Islands, and specifically Biram Stegge, Justina Langidrik, Gideon Gideon, Godfrey Waidubu, Ione DeBrum, and the members of the curriculum development department, for their invaluable insight, input, and cooperation throughout this project. Our greatest thanks also to Denis Yates, director of the Diabetes Wellness Center, for his guidance, knowledge, and assistance; thank you to Dr. Deborah Haire-Joshu for her help with the initial planning phases of this project; finally thank you to our sources of funding: the Washington University School of Medicine FIHTM summer fellowship grant, the Arnold P. Gold Foundation Humanism in Medicine student summer fellowship, and the Washington University Social Change Grant provided by Procter & Gamble.

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ASSESSMENT OF DOWN SYNDROME PATIENTS IN WEST BENGAL, INDIA

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ABSTRACT:

The study was designed to assess the frequency of different phenotypic features and congenital or systematic clinical complicacy of the Down syndrome patients in West Bengal. Karyotype pattern was also studied for confirmation. Eighty five cases diagnosed as Down syndrome patients in the Genetics Department and 30 healthy individuals as control were taken from the pediatric department of Ramakrishna Mission Seva Pratishthan, Kolkata, India. Clinical features observed in more than 90.0% of the Down syndromepatients were flat facial profile, simian crease in palm, low set years, dysmorphic facial features and abnormal distance of eyes. Congenital heart disease was present in 56.5% of the patients, 41.2 % had jaundice at birth.These characteristics were significantly different from the healthy controls.Efforts to establish early diagnosis and a proper screening for high association with clinical features should be undertaken among the Down syndrome patients.

Key Words: Down syndrome, karyotype, physical examination, clinical complicacy, genetic counselling.

(Submitted August 2012; Accepted October 2012)

INTRODUCTION:

Down syndrome (DS) is recognizable at birth. It is a relatively common congenital malformation having physical abnormalities of the face, eyelids, tongue and other parts of the body with retarded physical and mental growth [1]. It has been estimated to occur in approximately 1 in 732 infants [2].The affected individual has either a somatic cell of 46 chromosomes involving translocation of chromosome 21or 47 chromosomes with trisomy 21.As reported by Nussbaum et al. [3] over 95% of DS individuals

possess free trisomy 21 resulting from non-disjunctional error of chromosome 21 during gametogenesis in one of the parents. While about 2-4% result showed a translocation, in the rest of 1-2% of persons with the DS showed mosaicism [3]. These individuals may be phenotypically less severely affected than those in the first two types, but their conditions are generally indistinguishable in all other aspects. Dr Langdon Down (1828-1896) was the first to describe the clinical features of DS children precisely [4,5,1]. The knowledge of clinical manifestations of DS by physicians and other health professionals is important for an early diagnosis in order to reduce morbidity and mortality of these children (e.g. early operation of heart defects). Furthermore, proper clinical diagnosis of DS children is important to avoid normal children being investigated for DS based on only few clinical features [6].Apart from the Karyotype, the most common characteristic features of DS are facial features, development delay, hearing and visual abnormalities, gastrointestinal anomalies, congenital heart defects, and leukemia particularly acute mega-karyoblastic leukemia [7]. As DS is associated with many congenital abnormalities and health problems molecular mapping of the Down-critical region (DCR), of chromosome 21 has been carried out [7, 8]. The mapping provided evidence that the DCR which spans 0.4 to 3 million bases on 21q22.2 is involved in the pathogenesis of DS [7, 8]. Earlier clinical diagnosis allows parents to begin to accept the diagnosis at an earlier stage, and in some instances, make medical decisions about life threatening events [9].

This study on referral cases of DS was undertaken to correlate the cytogenetic profile with the clinical features in the patients. The objectives of this study were to identify problems in reaching clinical diagnosis and provide some recommendations for improvement.

PATIENTS AND METHODS:

Study groups

The study group comprised of 115 individuals, which include both DS patients (n=85) and healthy control (n=30). The age range was from 2 days to 30 years. Gender distribution of the DS patients indicates 55 (64.7%) males and 30 (35.3%) females. Among the control group, 17 (56.7%) were males and 13 (43.3%) were females.The studied population came from mainly the lower socioeconomic strata of the society. Thus, most of the parents of the patients were illiterate and the family incomes were very low. They had limited knowledge, and were not properly aware about genetic abnormality. The distribution of the DS patients according to age groups and gender is presented in Table 1.

Table 1: Distribution of Down syndrome patients (n = 85) according to age groups and gender

Age groups	Males n (%)	Females n (%)	Total n (%)
< 12 months	32 (37.7)	12 (14.1)	44 (51.8)
1-4 yrs	13 (15.3)	11 (12.9)	24 (28.2)
5 – 9yrs	2 (2.4)	4 (4.7)	6 (7.1)
10 – 14 yrs	2 (2.4)	0	2 (2.4)
15 – 19yrs	4 (4.7)	1 (1.2)	5 (5.9)
>20 yrs	2 (2.4)	2 (2.4)	4 (4.7)
Total	55 (64.7)	30 (35.3)	85 (100)

The studies involving human subjects were reviewed and approved by the ethical Committee of the Vivekananda Institute of Medical Sciences. All individuals were included in this study only after the Informed Consent of their parents.

Physical examination

Examinations of nose, eyes, mouth, tongue and palate were performed and recorded either as apparently normal or abnormal as observed from the clinical examination [7]. Abnormalities were recorded in specially prepared examination forms. Established clinically as an abnormally enlarged tongue this was protruding maximum time, when the ears were small, low set with an over folded helix, as a dysmorphic faces, instead of two creases across their palms, people with Down syndrome frequently have a single crease and abnormal distance present between two eyes [7,8]. The examination also included, if the individuals have any clinical complication like congenital heart disease at present and jaundice at birth time.

Short time leucocyte culture

About 5ml of peripheral blood samples were taken from each subject in heparinized vials by venipuncture. The blood samples were coded and used to carry out lymphocyte culture for chromosomal aberrations (CA) analysis by the method of Sharma and Talukder [10]. For each subjects duplicate cultures were maintained. Leucocyte rich plasma (0.5ml) was added to 5 ml culture media supplemented with 20% fetal bovine serum and Phytohaemagglutinin M (0.04ml/ml of culture media). The cultures were incubated at 37º C. The harvesting was done at 72 hrs after initiation of the culture. At 70 h of culture colchicine was added. Two hours later cells were centrifuged at 1000rpm for 10 min, treated with pre-warmed KCl (0.075M) for 15 min, centrifuged at 1000rpm for 10 min and

fixed in methanol: acetic acid (3:1).Fixatives were removed by centrifugation and two more changes of fixative were performed. Fixed cell suspension was laid on clean grease-free glass slide and air-dried. The preparation was stained with aqueous Giemsa. All slides were coded and 100 metaphase plates were scored randomly for chromosomal aberrations per individual. In all cases, the data was analyzed statistically following the chi-square test. Genetic counseling was carried out with the help of counselors of Ramakrishna Mission Seva Partishthan Hospital.

RESULTS:

Chromosomal study

Of the 85 patients with Down syndrome 68 (80.0%) were below five years of age. A total of 44 (51.8%) of the 85 cases were in the less than 12 months age group. The age and gender distribution are presented in Table 1. The mean age at referral did not differ for the different categories of karyotypic abnormalities. A small number of patients were referred from neonatal ward while the remaining was referred for delayed development and mental retardation. Cytogenetic testing results of all the DS patients revealed that 78 (91.8 %) had pure trisomy 21; two (2.4 %) had translocation, one of which was a denovo 21, 21 translocation, and 5 (5.9 %) showed mosaic pattern. All the individuals in the control group showed normal karyotype.

Clinical complications of the studied population

Clinical complications like congenital heart defect, jaundice at birth time of the DS patients and control were compared. The result shows 56.5% of DS patients had different types of congenital heart disease like inter-atrial communication, patent ductusarteriosus, atrioventricular septum, tetralogy of Fallot and valve insufficiency. Among them two cases are not properly specified about the type of the heart disease; more than 30.0% DS patients had more than one type of congenital heart defect. In the control group, only 3.3% had congenital heart defect ($p \leq 0.001$).Among them, two had atrioventricular septum and one had non specified artery defect. Jaundice occurred at the birth time of 41.2% DS patients compared to 16.7% in the control group ($p \leq 0.05$).Thus, the incidence of jaundice at birth time is significantly higher among DS patients compared to the control. Table 2 shows the distribution of the DS patients with clinical complication according to age groups. No statistically significant differences were found when the age groups were compared. Some kids with Down syndrome need a lot of medical attention, others lead healthy lives.

Table 2: Distribution of Down syndrome cases according to their clinical complications

Age	DS patients (n = 85)	Heart Problem (n = 48)	Jaundice at birth time (n = 34)
		N (%)	N (%)
< 12 months	44	30 (35.3)	21 (24.7)
1-4 yrs	24	10 (11.8)	8 (9.4)
5 – 9yrs	6	4 (4.7)	2 (2.3)
10 – 14 yrs	2	2 (2.3)	1 (1.2)
15 – 19yrs	5	1 (1.2)	1 (1.2)
>20 yrs	4	2 (2.3)	1 (1.2)

Table 3: Phenotypic features of the study groups

	Tongue protruded	Ear (low set)	Mongoloid Face	Palm (simian crease)	Distance of eye
	N (%)	N (%)	N (%)	N (%)	N (%)
Control (n = 30)	1 (3.3)	2 (6.7)	2 (6.7)	1 (3.3)	3 (10.0)
DS Patient (n = 85)	56 (65.9)*	61 (71.8)*	62 (72.9)*	39 (45.9)*	77 (90.6)*

*Statistically significant at P ≤ 0.001

Table 4: Phenotypic features of the Down syndrome patients

Age	DS patients (n = 85)	Tongue protruded	Ear (low set)	Mongoloid Face	Palm (simian crease)	Distance of eye
		N (%)	N (%)	N (%)	N (%)	N (%)
< 12 months	44	34 (40.0)	39 (45.9)	35 (41.2	23 (27.1)	42 (49.4)
1-4 yrs	24	14 (16.5)	13 (15.3)	18 (21.2)	11 (12.9)	22 (25.9)
5 – 9yrs	6	4 (4.7)	3 (3.5)	2 (2.3)	4 (4.7)	5 (5.9)
10 – 14 yrs	2	0	0	1 (1.2)	0	1 (1.2)
15 – 19yrs	5	2 (2.3)	4 (4.7)	4 (4.7)	0	3 (3.5)
>20 yrs	4	2 (2.3)	2 (2.3)	2 (2.3)	1 (1.2)	4 (4.7)

Physical features of the studied population

In our study, Physical features like protruding tongue, small and low set ears, dysmorphic (mongoloid) faces, simian crease in the palm in hand or toe or both and abnormal distance between two eyes of the DS patients and control were compared (Table. 3). Among the control group, none had protruding tongue and mongoloid faces ($p \leq 0.001$), only 6.7% had low set ears, one had simian crease in left hand, and three had flat nasal bridge with upward slanting eyes. 94.6% Down syndrome patients had three or more defective physical features. Prevalence of the defective physical features was significantly higher among the DS patients compared to the control. Age wise Physical features of the DS patients were also observed (Table 4).The physical features associated with Down syndrome can vary widely from child to child, but can't vary among different age group of patients. At birth, infants with DS appear maximum physical features.

DISCUSSION:

The genetic diseases are divided into two categories: chromosomal abnormalities and gene abnormalities. Chromosomal abnormalities are caused by cells that have extra or missing chromosomes or parts of chromosomes. Gene abnormalities (gene mutations) occur when the genetic instructions stored in the DNA are altered so that the protein product coded for by the gene is less functional or nonfunctional [11]. Cells that have extra chromosomes or chromosomes missing are aneuploid. DS is one of the most common chromosomal anuoploidy. Free trisomy 21, translocation and mosaicisim are the three types of this disease. Nondisjunction (free trisomy 21) is the most common genetic defect found in Down syndrome [12]. In this present study, it was observed 91.8% of the children with DS have free trisomy 21, 5.9% had mosaicism, and while 2.4% have a translocation, where one had de novo 21, 21 translocation. High frequency of carriers of balanced Robertsonian translocations in a population could result in a higher frequency of cases with translocation trisomies since the risk of having a live born child with a translocation trisomy 21 is increased for the carriers. In the present study, the percentage of children having a translocation trisomy is even lower compared to a study from Kuwait [13]. All DS cases were cytogenetically confirmed. In our study 51.8% of DS children were diagnosed cytogenetically at the age of less than twelve month and 28.2% were diagnosed at the age between 1-4 years. Thus, more than 80.0% of DS cases were diagnosed below 5 years of age, which indicates that pediatricians and other medical professionals are aware of the clinical phenotype of DS and prompt the cytogenetic confirmation. Similar results were reported from Lebanon [14] and Estonia [15] where 47.3% and 48.0% of DS diagnosis were

confirmed cytogenetically during the child's first year of life. In contrast, registries from England and Wales showed that 90.0% of the DS were confirmed cytogenetically within 10 days after birth [16]. Comparison of the clinical complicacy and phenotypic features of the DS patients with those in the control group indicated significant statistical differences for most of the characteristics. In 1966, Hall described ten cardinal features of trisomy 21 in the newborn [17]. Hall looked at trisomy 21 only, without including mosaic or translocation DS. Our study includes translocation and mosaic DS and this may have accounted for the difference in the results. Abbag [18] reported that the incidence of congenital heart diseases in DS was about 60.0%. In our present study, 56.5% of the children presented with congenital heart diseases, similar frequency as in Brazilian studies, which ranges from 51.0 to 62.2% [19]. The most common characteristic features of DS are gastrointestinal anomalies [8] which may be congenital or non-congenital. Our result shows that 41.17% DS patients had jaundice in the time of their birth. This suggests that many DS children may have different types of congenital and non-congenital complicacy from the birth time, which may impact their physical and psychological development. The children in the control group were selected from among the low socioeconomic area where ground water is the only source of drinking water. Thus water pollution, other environmental factors and unhealthy lifestyles may affect the mothers of these children. Several other factors may contribute to the phenotype variability in DS, such as allelic heterogeneity for chromosome 21 genes present in three copies, the individual's genetic constitution and environmental factors like metallic contamination, excessive pollution [20]. India is one of the countries with the different ethnic heterogeneity, thus, mixed gene population may affect the phenotypic features. The frequency of the phenotypic features observed in the present study are different from those reported by Kava et al and Ahmed et al for DS children in India [21, 22]. The observation of simian crease, distance of eyes, abnormality of ears and mongoloid faces in more than 30% of the total DS cases in the present study are consistent with the values reported by Jones [23] and Fryns [24].

The early diagnosis of children with DS is important, because appropriate treatments for certain common diseases, such as, hypothyroidism and cardiac defects may commence. In addition, it will enable the parents to have access to supporting groups and make use of early intervention programmers for special education and training that aims to improve the quality of life for the children.

ACKNOWLEDGEMENTS

This study was financially supported by the grants from Vivekananda Institute of Medical

Sciences, Kolkata. We are grateful to the Secretary, Ramakrishna Mission Seva Pratisthan, Vivekananda Institute of Medical Sciences, Kolkata for the necessary permission to carry out this study. We are also thankful to Mr. Monoj Bera for technical assistance.

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PREVALENCE OF AFLATOXIN B-1 IN SOME FOODSTUFFS IN PAPUA NEW GUINEA

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ABSTRACT:

Aflatoxins are secondary metabolites produced by the fungi Aspergillus flavus and A. parasiticus that grow on a variety of agricultural commodities and other foodstuffs. Aflatoxin B1 (AFB1), which is a highly toxic, hepatotoxic, mutagenic, teratogenic, carcinogenic and immunosuppressive compound, is the most toxic of all the aflatoxins produced by these fungi. Contamination of foodstuffs by AFB1 is a major food safety concern in developing countries in the tropics, because of its adverse effect on human and animal health; it can also negatively affect the exportation of foodstuffs, such as peanuts and grains to most developed countries. The levels of AFB1 in 204 food samples purchased from markets in Papua New Guinea (PNG) were determined using solid phase direct competitive enzyme immune-assay (EIA) kits. The results were analyzed according to the legal permissible limits for AFB1 in foods, recommended for PNG, Australia, Food & Drug Administration (FDA), European Union and the Codex Alimentarius. The mean AFB1 level in the 204 food samples was 2.80ppb and the Range was 0.0 – 29.30ppb. AFB1 was not detected in 21.6% of all the food samples. The AFB1 levels in 90.7% and 94.1% of the food samples were below the 10.0ppb and 15.0ppb legal permissible limits for PNG and Australia respectively. The dried roasted peanut group had the highest mean AFB1 level (6.1ppb), followed by the peanut butter (3.8ppb) and maize (3.3ppb) groups. There is need to advocate for continuous monitoring of AFB1 levels in foodstuffs in PNG.

Key words: Aflatoxin B1, food contaminants, Papua New Guinea

(Submitted: August 2012, Accepted October 2012)

INTRODUCTION:

Mycotoxins are secondary toxic metabolites produced by various fungi [1]. Aflatoxins are the most widely occurring mycotoxins produced by the fungi Aspergillus species [1 – 3]. Under favourable conditions of relative humidity, temperature and moisture content, Aspergillus flavus and A. Parasiticus can grow on a variety of agricultural crops, other foodstuffs and animal feeds [1 – 6]. This can occur before harvest, during post-harvest drying and storage or during food preparation [1, 3 – 8]. Aflatoxin B1 (AFB1), which is a highly toxic, hepatotoxic, mutagenic, teratogenic, carcinogenic and immunosuppressive compound, is the most toxic of all the aflatoxins produced by these fungi [1 – 8]. AFB1 contamination of peanuts, maize, cottonseeds, variety of grains, rice, cereals, dried fruits, wheat, chillies, cassava, and other foodstuffs have been reported in some tropical and subtropical regions of the world [6 – 12].

The Food and Agricultural Organization (FAO) and the Codex Alimentarius Commission proposed the legal permissible limit of 15.0ppb for AFB1 in foods for human consumption worldwide [13, 14]. However, a number of countries and organizations have set their own legal permissible limits [14]. Consumption of AFB1 contaminated foodstuffs is more common in developing countries with poorly implemented food safety regulations and limited consumer awareness of food safety [6, 9 – 12]. This is in contrast to the strict implementation of regulatory standards aimed at reducing the importation of AFB1 contaminated foods into the developed countries [6 – 8].

The limited published data on the prevalence of AFB1 contamination of food samples in Papua New Guinea (PNG) has been contradictory [9 – 12]. In 1972 AFB1 contamination was reported in 80% of food samples from East New Britain (ENB) and Markham Valley [9]. In 1975 AFB1 contamination was not detected in food samples purchased in Koki market in the National Capital District (NCD) of PNG [9, 10]. In 1991 four brands of peanut butter from the Markham Valley in PNG were highly contaminated with AFB1 ranging from 31.0 – 135.0ppb [11]. In surveys carried out in 1996, 2002 the PNG National Agricultural Research Institute (NARI) tested food samples, especially peanuts, purchased from markets in Sepik, Western Highlands, Morobe, ENB and NCD [9, 10]. According to these authors, AFB1 contamination ranging from 5.0 to 20.0ppb was reported in 35.0% of the food samples. The National Agricultural Research Institute (NARI) in PNG conducted a three years (2003 to 2005) bimonthly assessment of AFB1 levels in peanuts sold in markets and other outlets in NCD, Eastern Highlands, Morobe, and ENB provinces [15]. According to the authors the yearly mean results indicated that the AFB1 level in about 12.0% of peanut samples were

greater than 10.0ppb, with a small percentage of highly contaminated samples [15].

Since 2005 no published data is available on the level of AFB1 in foodstuffs sold in PNG. The major aim of the present study was to assess the prevalence of AFB1 contamination in some foodstuffs sold in Papua New Guinea.

METHODOLOGY:

A total of 204 food samples were purchased from markets, trade-stores, supermarkets, street vendors and other food outlets in Port Moresby & NCD (Port Moresby-NCD), Lae in Morobe Province and Wewak in East Sepik Province. All the food samples were collected between June 2011 and March 2012. A high speed electronic food processor was used to ground each food sample into fine powder, which was then passed through a sieve to obtain the finely grounded particles. The fine powder was then collected and stored in a plastic zip-lock bag in the refrigerator at 4°C until required for extraction.

The extraction was carried out in a fume cupboard in dim light. Two grams of the fine powder was extracted with 10ml of 70.0% methanol; the extract was filtered through Whatman # 1 filter paper. The filtrate obtained was used for analysis of AFB1 [16]. The commercial Helica Aflatoxin B1 solid phase direct competitive enzyme immune-assay (EIA 96 Microwell plates) kit was used to determine the AFB1 level in each filtrate [16]. All reagents used were of analytical grade. Assay procedures for AFB1 in filtrate, standards and quality control samples were carried out as indicated in the instructional protocol of the manufacturer [16]. Analysis was carried out in the Micronutrient Laboratory, Division of Basic Medical Sciences, School of Medicine and Health Sciences, University of Papua New Guinea.

The results obtained in this study were analyzed using the various legal lower permissible limits of AFB1 in foods recommended in various countries as follows: Papua New Guinea AFB1 below 10.0ppb [15]; European Union (EU) AFB1 below 2.0ppb; Australia AFB1 below 15.0ppb; Food and Drug Administration (FDA) Unites States of America AFB1 below 20.0ppb; foodstuffs with AFB1 greater than or equals to 20.0ppb are considered as highly contaminated [14].

RESULTS:

The 204 food samples were assayed in duplicate for AFB1 levels and the mean value for each sample was calculated. Of the 204 food samples 184 (90.2%) samples were from Port Moresby-NCD, 14 (6.9%) were from Lae in Morobe province and 6 (2.9%) were from Wewak in East Sepik province. All the samples from Lae and Wewak were peanuts. The mean and range AFB1 levels for the 184 samples from Port Moresby-NCD were 2.7ppb and 0.0 to 29.3ppb respectively. The mean AFB1 for the 14 peanut samples from Lae city was

3.2ppb and range was 0.3 – 22.6ppb. For the 6 samples from Wewak the mean AFB1 was 0.5ppb and range was 0.2 to 0.6ppb. There was no statistically significant difference between the AFB1 levels in the Port Moresby-NCD samples and the Lae samples. The levels of AFB1 in 166 (90.2%), 13 (92.9%) and 6 (100%) of the food samples from Port Moresby-NCD, Lae and Wewak were below 10.0ppb. The three sets of data from Port Moresby-NCD, Lae and Wewak were pooled together for further analysis.

The mean and median AFB1 levels for the 204 food samples were 2.80ppb and 0.84ppb respectively. The Range was 0.0 – 29.30ppb and the Interquartile Range was 0.18 – 2.06ppb.

Table 1 shows the percent distribution of all the food samples according to the legal lower permissible limits for AFB1 levels in foods by country.

Table 1: Percent distribution of all the food samples (n = 204) according to the legal lower permissible limits for AFB1 levels in foods by country

Legal lower permissible limits for AFB1 in foods		**Percent (n) of foodstuffs**
Not detected (ND)	0.0ppb	21.6 (44)
European Union (EU)	< 2.0ppb	74.0 (151)
Papua New Guinea (PNG)	< 10.0ppb	90.7 (185)
Australia (AU)	< 15.0ppb	94.1 (192)
Food & Drug Administration (FDA) USA	< 20.0ppb	96.6 (197)
Highly Contaminated (HC)	≥20.0ppb	3.4 (7)

(NB: ppb = part per billion; 1.0ppb = 1.0pg/mg, or 1.0ug/kg)

AFB1 was not detected in 21.6% of all the food samples. The AFB1 levels in 90.7% (185) of all the food samples were below the 10.0ppb legal lower permissible limits for PNG. A total of 94.1% (192) of all the food samples were below the 15.0ppb legal lower permissible limit for Australia. According to the FDA legal lower permissible limits 3.4% (7) of all the food samples were highly contaminate with AFB1.

For further interpretation of the results the food samples were separated into ten food groups

shown in Table 2. The mean, range and median values of AFB1 in the various food groups are presented in Table 2. The dried roasted peanut group has the highest mean AFB1 level (6.1ppb), followed by the mean AFB1 levels in the peanut butter (3.8ppb) and maize (3.3ppb) groups.

The range for AFB1 was highest in the dried roasted peanut group (0.0 – 29.3ppb), followed by the maize group (0.0 – 19.7ppb) and the peanut butter group (0.0 – 16.7ppb).

The percent distribution of the AFB1 levels, in food samples in the ten food groups, according to the legal lower permissible limits for AFB1 in foods is presented in Table 3. In the dried roasted peanut group the AFB1 levels in 67.4% of the peanuts were below 2.0ppb, 76.1% were below 10.0ppb and 80.4% were below 15.0ppb. A total of 15.2% of the peanut samples were highly contaminated. For the peanut butter group, the AFB1 levels in 53.8% of the samples were below 2.0ppb and 92.3% were below 10.0ppb and 15.0ppb. None of the peanut butter samples were highly contaminated with AFB1. In the maize group the AFB1 levels in 45.8% of the samples were below 2.0ppb and 91.7% were below 10.0ppb and 15.0ppb.

Table. 2: Mean, range and median values of AFB1 levels in the ten food groups

Food Groups	Mean (ppb)	Range (ppb)	Median (ppb)
Peanut butter (n = 13)	3.8	0.0 – 16.7	1.9
Dried roasted Peanuts (n = 46)	6.1	0.0 – 29.3	1.5
Seeds & Beans (n = 18)	2.0	0.0 – 10.6	0.7
Maize (n = 24)	3.3	0.0 – 19.7	2.0
Flours (n = 10)	0.4	0.0 – 0.9	0.3
Rice (n = 12)	0.5	0.0 – 1.7	0.5
Bread & Biscuits (n = 24)	0.8	0.0 – 8.6	0.1
Cereals & Oats (n = 16)	1.1	0.1 – 4.1	1.0
Sago & Starches (n = 13)	0.5	0.0 – 1.6	0.3
Other foodstuffs (n = 28)	3.0	0.0 – 12.8	1.2

Table 3: Percent (n) distribution of the AFB1 levels in the ten food groups according to the legal lower permissible limits for AFB1 in foods by country

		Food Groups**									
Legal lower permissible limits for AFB1 in foods		Peanut butters (n =13)	Dried roasted peanuts (n = 46)	Seeds & Beans (n=18)	Maize (n=24)	Flours (n=10)	Rice (n=12)	Bread & Biscuits (n=24)	Cereals & Oats (n=16)	Sago & Starches (n=13)	Other foodstuffs (n=28)
Not detected	0.0ppb	38.5% (5)	6.5% (3)	16.7% (3)	12.5% (3)	50.0% (5)	41.7% (5)	50.0% (12)	0.0	30.8% (4)	13.3% (4)
European Union	<2.0ppb	53.8% (7)	67.4% (31)	72.2% (13)	45.8% (11)	100% (10)	100% (12)	95.8% (23)	93.8% (15)	100% (13)	57.1% (16)
PNG	<10.0ppb	92.3% (12)	76.1% (35)	88.9% (16)	91.7% (22)	100% (10)	100% (12)	100% (24)	100% (16)	100% (13)	89.3% (25)
Australia	<15.0ppb	92.3% (12)	80.4% (37)	100% (18)	91.7% (22)	100% (10)	100% (12)	100% (24)	100% (16)	100% (13)	100% (28)
FDA USA	<20.0ppb	100% (13)	84.8% (39)	100% (18)	100% (24)	100% (10)	100% (12)	100% (24)	100% (16)	100% (13)	100% (28)
HC*	≥20.0ppb	0	15.2% (7)	0	0	0	0	0	0	0	0

*HC = highly contaminated; **All values are cumulative, thus do not add up to 100%

DISCUSSION:

In the present study the solid phase direct competitive enzyme immune-assay (EIA 96 Microwell plates) technique was used to determine the AFB1 level in the filtrates. This technique is more specific for AFB1 and has a higher sensitivity and precision compared to the Thin Layer Chromatography (TLC) and the High Performance Liquid Chromatography (HPLC) [14, 16].

The mean AFB1 levels in food samples from Port Moresby-NCD, Lae and Wewak were below the 10.0ppb legal lower permissible limits for PNG. These values were lower than the mean AFB1 levels reported for foodstuffs in Nigeria [8], Ghana [8, 17] and Turkey [18]. The 9.8% and 7.1% of foodstuffs from Port Moresby-NCD and Lae respectively with AFB1 levels greater than 10.0ppb were lower than the 12.0% AFB1 contaminated foodstuffs reported for PNG [15].

Although AFB1 was not detected in 21.6% of the 204 food samples, a total of 26.0% had AFB1 levels greater than the 2.0ppb legal lower permissible limit for the European Union. This should be of concern to program planners wising to establish trade relationship with countries in the European Union.

The 6.1ppb mean AFB1 level obtained for the dried roasted peanut group in the present study was higher than the mean AFB1 values reported for peanuts in NCD [11], but lower than the values reported for peanuts sold in most cities in Nigeria, Ghana and Cameroon [8, 12, 17]. The AFB1 range (0.0 – 29.3ppb) obtained for the dried peanut group was also lower than the range reported for AFB1 in peanuts sold in Nigeria [8, 17], Botswana, India and Argentina [8]. For the peanut butter group the mean AFB1 level (3.8ppb) was similar to values reported peanut butter samples in NCD [15]. The range (0.0 – 16.7ppb) for the peanut butter group was lower than the values reported for Bangladesh [8], Nigeria [8, 17] and India [8]. In the present study AFB1 was detected in all the food groups in PNG, which contradicts sections of the reports by others [10, 11]. One of the reasons for this discrepancy might be due to the difference in methodology. The EIA method for assay of AFB1 is a faster and more advanced technique than the TLC and HPLC methods.

The 23.9% of peanut samples with AFB1 levels greater than 10.0ppb in the dried roasted peanut group obtained in this study was higher than the 11.0% and slightly higher than the 22.0% peanut samples reported in the NARI survey in 2005 [15]. This high level of AFB1 contamination of peanuts should be of concern to program planners in the health and agricultural sectors in PNG. Peanut is one of five major cash crops cultivated by small and

medium scale farmers in PNG. It is also a major component of the diet consumed in both rural and urban households. Regular consumption of small amounts of AFB1 contaminated foodstuffs can lead to liver disease and other Aflatoxin related disorders [4, 5]. Thus, the urgent need for intensive nutrition education, food safety information and awareness campaigns to advocate for proper implementation of recommended guidelines to reduce the infestation of peanuts by fungi.

In order to effectively address these issues, between 2003 and 2005, the NARI in collaboration with stakeholders implemented the "Aflatoxin Contamination and Public Awareness Program on Better Handling Practices", a project that was funded by PNG Agricultural Innovations Grant Facility (AIGF) [15]. The outcome of this project (AIGF 1035) apart from the bimonthly collection of peanut samples for analysis of AFB1, included production of advocacy materials and newsletters in the local PNG language [19, 20]. The long term impact of this project on the small scale peanut farmers has not been fully assessed because the project was not accompanied by effective monitoring [15].

CONCLUSION:

In summary, our data indicates that the AFB1 level was greater than 10.0ppb in 23.9% of the peanuts in the dried roasted peanut group. All the highly contaminated food samples were in the dried roasted peanut group. These findings strongly suggest the urgent need for implementation of well structured projects similar to AIGF-1035 across PNG. The projects should also include nutrition education for farmers and consumers, and efficient, sustainable, monitoring systems.

ACKNOWLEDGEMENTS:

We acknowledge the PNG Office of Higher Education Science and Technology for funding this project. We thank Dr. Peter Corbett and colleagues in the National Agricultural Research Institute (NARI) for their collaboration and support.

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CASE REPORTS

UNUSUAL OCCURRENCE OF EPIDERMOLYSIS BULLOSA WITH AMELOGENESIS IMPERFECTA – A RARE CASE

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Running title: Epidermolysis bullosa with Amelogenesis imperfecta

ABSTRACT:

Epidermolysis bullosa is an inherited disorder which is characteristically presented as skin blisters developing in response to minor injury. Junctional variety of Epidermolysis bullosa is associated with enamel hypoplasia. Amelogenesis imperfecta presents with abnormal formation of the enamel both in deciduous and permanent dentition. This is a case report of amelogenesis imperfecta with complete loss of enamel in a young female patient with epidermolysis bullosa.

Keyword: Epidermolysis Bullosa, Amelogenesis Imperfecta, Vesicles and Bullae.
(Submitted August 2012; Accepted October 2012)

INTRODUCTION:

Epidermolysis Bullosa (EB) is a group of genetically determined rare disorder, where mutations coding for targeted proteins involved with keratin filament assembly promote architectural alterations in the epithelial basement membrane complex [1, 2]. Epidermolysis bullosa occurs at the time of birth or in early infancy [3]. This is commonly observed in children; it can be minor or severe and is very different from case to case. It has an incidence rate of approximately 400,000-500,000 peoples who are affected worldwide and no definitive treatment have yet been developed [1].

It can affect both sexes equally and in any racial or ethnic group [3]. The development of blisters following minor or insignificant trauma

to skin or mucosal surfaces leading to formation of large non healing ulcer is the characteristic of this disorder [4]. Disruptions to cellular adhesion will facilitate increased fragility of the skin and mucosal surfaces. Lesions may arise spontaneously, often with compromised wound healing with scarring in various EB subpopulations. Oral features seen with EB include mucosal vesicles and bullae that are frequently painful, exuberant granulation, tissue proliferation, and abnormal teeth usually affecting enamel complete or partial [5]. The dentition may be affected severely by enamel hypoplasia and/or dental caries depending on the EB type. Gedde-Dahl indicated that all patients with junctional EB suffered from enamel hypoplasia [6]. It has since been confirmed in a large prospective study that generalized enamel hypoplasia is limited to junctional EB types [6]. Amelogenesis Imperfecta (AI) may present as hypoplastic, hypomineralised or both and the teeth affected may be discoloured, sensitive or prone to disintegration. AI is due to the malfunction of the proteins in the enamel, ameloblastin, enamelin, tuftelin and amelogenin [7]. The exact incidence of AI is still uncertain but the prevalence can vary from 1:700 to 1:14,000 [8]. A rare case of a female patient suffering from junctional epidermolysis bullosa with Amelogenesis imperfecta is reported. The ethical clearance for the publication of the case report was obtained from the Yenepoya University Ethics Committee.

A CASE REPORT:

An 18 year old female patient reported to department of Oral Medicine and Radiology, with a complaint of discolored teeth since childhood. Her past dental history revealed similar type with early loss of tooth structure in deciduous dentition. Her medical history revealed presence of multiple dermal lesions which started appearing immediately after birth which was later diagnosed as Epidermolysis bullosa. She is the second child from a consangious marriage and her sister is also affected with similar dermal lesions since childhood. Her gait was abnormal due to nonhealing ulcer in both right and left feet. Blisters were seen on the lower part of both right and left feet with irregular borders and yellowish slough present at the base of the lesions. Scarring of healed lesions on knees was also noticed.

On examination diffuse reddish pseudo membranous area was seen extending from external occipital protuberance and spreading bilaterally till ear and extends till scapula. Loss of hair was seen with respect to that area. There was presence of itching and burning sensation in the affected area. The surface was erythematous with yellowish slough (Fig 1). On intra oral soft tissue examination a vesicle was seen on the right rugae area on the hard palate (Fig 2). However there was no abnormal eruption pattern noticed. From a functional point of view, she had been avoiding hard food

substances and carious lesion was noticed affecting enamel and dentin on few teeths.

On detailed hard tissue examination, it was found that she had a normal complement of teeth. Height of teeth was reduced because of complete chipping of enamel and exposing dentin. Underlying dentin appears to be normal. The surfaces of the teeth were rough. The teeth, in general, exhibited a yellowish brown discoloration, with diffuse pitting present on the exposed tooth surfaces, more prominent on the labial and buccal aspects. The emergence pattern and timing of teeth seemed to be within the normal range. No occlusal disharmony was present (Fig 3).

Panoramic radiograph revealed a normal pulp chamber and root canal spaces. The enamel was completely lost, radiopaque dentin is clearly appreciated. Based on history, clinical and radiographic features the diagnosis of hypoplastic; rough, autosomal recessive AI was made. The patient was referred for dermatological treatment and restorative rehabilitation.

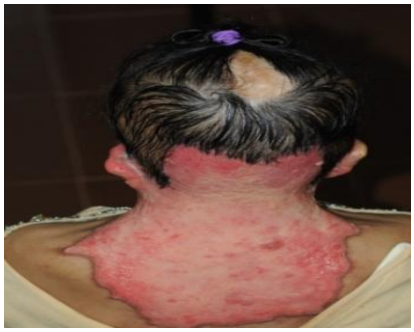

Figure 1: Dermal lesion in occipital region

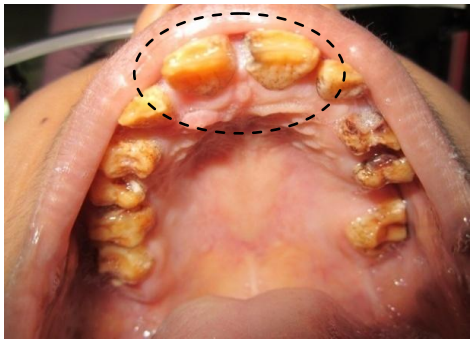

Figure 2- Vesicle in the anterior palate

Figure 3: Clinical appearance of teeth

DISCUSSION:

Epidermolysis bullosa is a diverse, heterogeneous group of conditions characterised by fragility of the skin that results in blisters caused by little or no trauma. Epidermolysis bullosa is of 3 major categories which includes- EB simplex (EBS; intraepidermal skin separation); junctional EB (JEB; skin separation in lamina lucida); and dystrophic EB (DEB; sublamina densa separation) [9].

Ten genes are known to harbor mutations in the major types of EB, and the level of expression of these genes within the cutaneous basement membrane zone and in extracutaneous tissues, as well as the types and combinations of the mutations, explain in general terms the phenotypic variability [3].

Molecular genetic studies revealed that Junctional form of Epidermolysis Bullosa is caused by mutations in the genes encoding COL17 or laminin 332 [3]. Enamel hypoplasia has also been reported in junctional form of epidermolysis bullosa. This is because deficiency of epithelial-mesenchymal junction molecules, such as COL17 can lead to the pathological mechanisms that can result in enamel hypoplasia [3].

Disruption of the COL17 gene leads to abnormal interaction between enamel epithelium and the underlying mesenchyme via the epithelial-mesenchyme junction, resulting in defective ameloblast differentiation. Epithelial-mesenchymal interactions via the epithelial-mesenchymal junction are important for tooth morphogenesis, and hemidesmosome components are thought to regulate the proliferation and differentiation of tooth forming cells including ameloblast [10]. Since there is presence of enamel hypoplasia which occurs only in association with junctional epidermolysis bullosa this case goes in favor of junctional enamel hypoplasia.

Enamel hypoplasia in the form of Amelogenesis imperfecta is seen in this present case. Amelogenesis imperfecta can have different inheritance patterns depending on the gene that is altered. Based on phenotype, Amelogenesis imperfecta is divided into four major categories- hypoplastic, hypomaturation, hypocalcified and hypoplastic with taurodontism. Hypoplastic with taurodontism which are again subdivided into 15 subtypes by phenotype and secondarily by mode of inheritance [8].

Clinically, a skeletal anterior open bite is seen in approximately 50% of patients with Amelogenesis Imperfecta of either X-linked or autosomal inheritance however in the present case it was not evident. Such an association might be regarded as a syndrome but this does not appear as such in any classification. The significance of this common association has yet

to be elucidated. Diagnosis involves exclusion of extrinsic environmental or other factors, establishment of a likely inheritance pattern, and recognition of phenotype and correlation with the dates of tooth formation to exclude a chronological developmental disturbance [10]. Radiographically the enamel may appear totally absent. When present may appear as a thin layer, chiefly over the tips of the cusps & on the interproximal surfaces. In some cases calcification is so much affected that enamel & dentin seem to have the same radio density, making differentiation between the two difficult [11]. In the present case, complete absence of enamel was seen in radiograph.

The management of EB is primarily preventive and supportive, consisting of prevention of trauma, careful wound care, nutritional support and infection control. Surgical procedures are indicated when deformities are caused by the blistering and scarring. Steroid therapy is controversial for EB. Since EB are genetic disorders, no drug is capable of correcting the molecular defect.

Gene therapy is potentially, a future therapy. Recently, researchers have reported sustainable genetic correction of Junctional Epidermolysis Bullosa, patient skin tissue with laminin gene delivery. Clinical physicians should provide genetic counseling for families at risk for EB. The prognosis of EB depends on the severity of the illness. [10]

There is also a need for diet supplements, such as vitamins, proteins and iron in order to avoid anemia. The use of vitamin E and immunosuppressive drugs have also been suggested for the treatment of EB. [12].

Dental treatment is aimed at avoiding the formation of new bullae during perioperative management, and the choice of anesthetic method is one of the main issues for dentists and anesthesiologists. Special dental concerns involve the use of soft toothbrushes and irrigation techniques.

CONCLUSION:

To the best of our knowledge the present case is the first case report of Epidermolysis bullosa along with amelogenesis imperfecta.

Dermal lesion and its association with dental anomalies have made management difficult. Palliative care was given for dermal lesions and aesthetic rehabilitation as part of dental management.

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HEREDITARY ECTODERMAL DYSPLASIA – A REPORT OF TWO CASES

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ABSTRACT:

Hereditary Ectodermal dysplasias are a group of X-linked recessive inherited disorders characterised by primary defects in the development of two or more tissues derived from embryonic ectoderm. The tissues which are affected include skin, hair, nails, eccrine glands and teeth. Here, we report two cases of hypohidrotic ectodermal dysplasia in male siblings.

Key words: hereditary ectodermal dysplasia, partial anodotia
(Submitted September 2012, Accepted October 2012)

INTRODUCTION:

Hereditary ectodermal dysplasias (HEDs) are characterised by defective formation of one or more structures derived from ectoderm. It was first described by Thurman in 1848 [1] and was coined by Weech in 1929[2]. Freire-Maia redefined it as a developmental defect which at embryonic level affects the ectoderm and therefore the tissues and structures derived from it [3]. Thus it affects the development of keratinocytes and cause aberrations in the hair, sebaceous glands, eccrine and apocrine glands, nails, teeth, lenses and conjunctiva of the eyes, anterior pituitary gland, nipples and the ears [3].

CASE REPORT:

A 19 year old male and his male sibling of 17 years of age, both born of non-consanguineous marriage presented with complaint of missing teeth since childhood. Physical examination revealed recession of hair line all along with

sparse, thin light brown brittle scalp hair. On extra oral examination, prominent forehead, sunken cheeks with prominent supra orbital ridges, thin eyebrows, hyper pigmentation around eyes and saddled nose were noted. Lips were everted and prominent in both of them. Eye lashes appeared normal. Both of them gave the same clinical history of almost complete absence of sweating from birth. Their maternal grandfather had similar complaints. Dental examination revealed partial anodontia and maxillary incisors were conical in shape [Figure-1, Figure-2 and Figure-3]. They both complained of xerostomia. The combined clinical and dental findings pointed towards diagnosis of hypohidrotic ectodermal dysplasia.

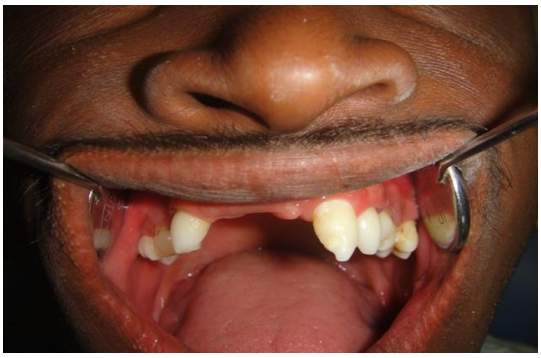

Figure 1: Partial anodontia and conical shaped anterior teeth in the elder brother

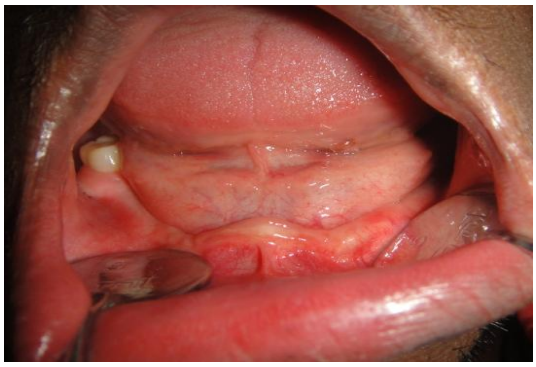

Figure 2: Only lower right second molar tooth present in the mandibular arch in the elder sibling

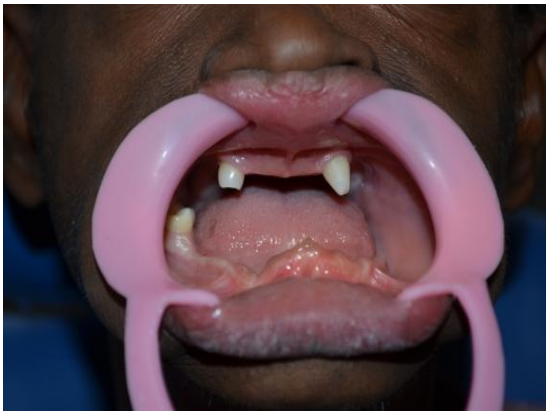

Figure 3: Partial anodontia. Only maxillary canines and right lower mandibular second molar tooth are present in the younger sibling

DISCUSSION:

The ectodermal dysplasias (EDs) are congenital, diffuse and non progressive disorders. More than 192 distinct disorders have been described till date [4]. It is typically inherited as a cross-linked recessive trait so that frequency and severity of the condition is more pronounced in males than in females.

The disorder might occur during the first trimester of pregnancy. If it is severe, it appears before the sixth week of embryonic life and consequently the dentition will be affected. After eighth week other ectodermal structure may be affected [5]. Genetic studies of more than 300 cases have revealed X linked mode of inheritance with its gene locus being Xq11-21.1; the gene is carried by the female but manifested in male [3].

However, there are reports of multiple siblings being affected and of females suffering with this condition [3]. The gene that causes hidrotic ectodermal dysplasia (Clouston's syndrome) has been identified to be the GJB6, which encodes for connexin-30. GBJ-6 has been mapped to the pericentromeric region of chromosome 13q. Mutations of the gene PVRL1, encoding a cell-to-cell adhesion molecule/herpes virus receptor, have been reported in those with cleft lip/palate ectodermal dysplasia [6].

A definite classification of ectodermal dysplasia is difficult to formulate since many of the syndrome that involve ED have overlapping features. A simple attempt made by Nelson included five categories, namely Hypohidrotic (anhidrotic), Hidrotic (Clouston's syndrome), Ectodactyly ectodermal dysplasia (EEC) syndrome, Rapp-Hodgkin syndrome and Robinson's disease [7].

From the clinical point of view two main forms have been distinguished: Hypohidrotic form / Christ-Seimens-Tourian syndrome and Hidrotic form / Clouston syndrome.

The hypohidrotic form exhibits the classic triad-hypohidrosis, hypotrichosis and hypodontia. Usually X-linked recessive inheritance is seen. Males are affected severely, while females show only minor defects [6]. In the hidrotic form teeth, hair and nails are affected. The sweat glands are usually spared. It is usually inherited as an autosomal dominant trait. Other inheritance modalities like autosomal recessive have also been reported [6, 8].

Table 1 - Difference between the hidrotic and hypohidrotic forms of ectodermal dysplasia [9]

	Hidrotic	Hypohidrotic
Mode of inheritance	Most often autosomal dominant	Most often autosomal recessive
Scalp hair	Soft, dawny ,colour is darker	Fine in texture, fair and short
Teeth	Anodontia to hypodontia	Anodontia to hypodontia
Lips	No abnormality	Protruding
Sweat glands	Active	Reduced to absent
Nasal bridge	No flattening	Underdeveloped
Nails	Dystrophic nails	No abnormality
Eyebrows	Frequently absent	Absent
Eyelashes /pubic/axillary hairs	Scanty /absent	Variably affected

The typical facies is characterized by frontal bossing, sunken cheeks, saddle nose, thick everted lips, wrinkled hyper pigmented periorbital skin and large low set ears. Dental manifestations include conical or pegged teeth, hypodontia or complete anodontia and delayed eruption of permanent teeth. Fine, sparse, lustreless fair hair over scalp is seen in most of the patients. Onychodystrophy may be seen but is not common. Extensive scaling of the skin and unexplained pyrexia and heat intolerance due to anhidrosis occurs. Intelligence is normal [4]. Encourage frequent consumption of cool liquids to maintain adequate hydration and thermoregulation and advised cool clothing. The treatment usually comprises of complete restoration of function and aesthetics to normalise the vertical dimension and provide adequate support to the facial soft tissues. The options may include fixed, removable or implant prosthesis, singly or in combination.

The presentation of facial deformity, dry skin, and sparse hair in this report is similar to previous reports. These features are due to anomalies of the skin appendages which include the hair follicles, sweat glands and sebaceous glands [10, 11, 12, 13].

The intolerance of heat and hyperthermia observed in our patients is similar to the previous reports which are again due to absence of sweat glands [11, 12, 13].

In developed countries diagnosis pertains to laboratory identification of genes and mode of inheritance of mutated genes associated with recessively X chromosome or autosomal dominant or recessive. This may be difficult in developing countries like India where such facilities are insufficient and it requires further probing through genetic analysis.

In our case, the patients showed typical facies with dental manifestations, sparse scalp hair and heat intolerance. As both male siblings and their maternal grandfather were affected, we can ascertain the mode of inheritance to be X-linked recessive.

The most important aspect to be considered in these patients is the psychological impact on the child and parents due to absence of teeth. The principal aim of dental treatment is to restore missing teeth and bone, since it provides good esthetics, phonetics and masticatory comfort. It also helps patients develop good psychological self-image. Treatment plan generally include removable or fixed partial prosthesis. Dental implants may also be successfully employed to support and retain teeth.

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LETTER TO THE EDITOR

ACUTE DIARRHOEA OUTBREAK IN AMBUNTI DISTRICT IN EAST SEPIK PROVINCE, PAPUA NEW GUINEA: A CASE REPORT

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Summary

In late December 2010 ten people from the village of Iniok, in the Ambunti District of East Sepik Province, Papua New Guinea died from acute watery diarrhea within the space of two weeks. This outbreak was reported in the local newspaper as cholera although no laboratory confirmation was made. With logistical support from the Frieda River Project operating in the area, a concerted effort from the project and district health authorities contained the outbreak in two weeks. This case study reflects on the containment of the outbreak, and discusses lessons learnt with future implications.

Keywords: Diarrhoea, Outbreak, Frieda River Project, Ambunti, East Sepik Province.
(Submitted June 2012; Accepted August 2012)

INTRODUCTION:

The Frieda River Project is located on the border of East Sepik and Sandaun Provinces about 200.0 km from the coast and about 70.0 km from the Sepik River (Figure 1.0). Frieda River is a tributary of the Sepik River. The Project is a joint venture between Xstrata Frieda River Ltd and Highlands Pacific Ltd. The Frieda River Project is managed by Xstrata Copper [1].

The project is located in one of the most remote areas of Papua New Guinea (PNG). The project is made up of three separate camps with no road links. The Project is operated by helicopter, including the logistics for an extensive drilling campaign. Other logistical support into the Project site is provided by Twin Otter airplanes and barges that navigate the Sepik River from Lae. The barges dock at Iniok village (10 minutes by chopper) where supplies and machinery are airlifted by helicopter into the project site. During the drilling program, the project employed more than 400 people [1].

The communities affected by the project or will be affected by the project have been divided

into three (3) zones. Zone one being six 'project villages' (Paupe, Ok Isai, Wabia, Wamemin 1, Wamemin 2, and Amaromin [2]. Except for Paupe, all villages are in the Sandaun Province.

Figure 1: Map showing location of Frieda River Project site

Source: Frieda River Project Sustainability Report 2011 [2]

The Outbreak at Iniok Village:

Towards the end December 2010 an adult male from Iniok village returning from Madang developed acute watery diarrhea, and after one day of being ill was taken to Hauna Health Centre for treatment as he was severely dehydrated. Hauna Health Centre is reachable by motorized canoe and is more than 3 hours away from Iniok village. At the health centre, he was treated by a volunteer nursing officer who recognized the condition of the patient as a possible case of cholera. The patient died at Hauna Health Centre the same day. Within two weeks of the index case a total of 10 people died, all with acute onset of profuse watery diarrhea. The report of the outbreak quickly got the attention of the PNG media. Below is an article on the cholera outbreak reported in The National newspaper which is one of the major newspapers in PNG.

Cholera in East Sepik spread: By Duncan Willis
The National, Monday 3rd January 2011.

THE cholera outbreak in East Sepik has spread to Ambunti district's Iniok village and neighboring villages from the Tunap sub-district. At least 10 people have been confirmed dead since last Friday with unconfirmed reports of more casualties. Ambunti-Dreikikir district administrator Solomon Hopkos confirmed this last Friday after being alerted by community affairs officers of Xstrata Copper company which is developing the Frieda River copper-gold project in the district. Its helicopter flew health officials and necessary medical drugs from the Burui health centre to the affected communities.
"I have mobilised health officials from Maprik and Burui health centres and a medical team has already been sent to the villages by the company's helicopter," Hopkos said.
He said he had tried to contact the provincial health office in Wewak but was unsuccessful since everyone was out for the Christmas and New Year holidays.
"I have sent them a fax and I am still awaiting their response."
District health officer Dominica Wain, who is currently in the affected villagers to assess the situation, said: "As of last Wednesday and Thursday, more people are being affected and the death toll is increasing."Xstrata Copper Company has been assisting the district with logistics while waiting for the government to intervene and assist them to help fight the outbreak. Since cholera is waterborne, contaminated waste in the river will prove fatal because there are many villages along the banks of the Sepik River and it could spread to villages downstream. Hopkos and the district medical team are currently assessing the situation with very little funding and is appealing to the government and Health Department to take action and move in as soon as possible.
"I have a VHF radio operating 12 hours a day that we are monitoring constantly with Iniok, but we are requesting provincial and national health support," he said.
"Health officials from Ambunti, Burui and Maprik are on the ground and are currently dealing with the situation." [3].

Outbreak Response and Containment:

Initial Response

When the first death occurred at Iniok, Frieda River Project employees stationed there informed the site management and through the Community Affairs department established communication with the district health authorities to assemble and dispatch a government health team to Iniok. The Ambunti District Health Services assembled a Rapid Cholera Response (RCRT) Team, and with helicopter support from the Frieda River Project the team was dispatched to Iniok to start its initial investigation and control of the outbreak.

The RCRT was made up of a Health Extension Officer (HEO) who was the team leader, two Community Health Workers (CHW) and a Nursing Officer (NO). The team leader and the two CHW were part of the government team that responded to an earlier outbreak in Maprik so were experienced in recognizing cholera symptoms and administering preventative strategies. The project site doctor also worked with the RCRT and provided daily reports to the project management.

Outbreak containment

The outbreak was contained by implementing basic hygiene measures. Specifically, the

following activities were carried out in the affected and high risk villages:

- Encouraging and emphasizing boiling of drinking water.
- Washing of hands with soap before preparing meals and before eating. In addition families were instructed to have meals together with all members of the family present so as not to allow food to be stored away for other family members who were absent during the meal times.
- Covering of food from flies, rats and cockroaches.
- Instructing lactating mothers to wash themselves and their hands before breastfeeding their babies.
- Very strict guidelines to villagers on how to bury dead victims of the outbreak and any contaminated materials. Villagers were instructed to select about five members who were to transport the dead victim to the burial site for burial. The victim was to be buried with his or her contaminated clothes. The handlers' clothes were to be washed in very hot water at the burial site and the handlers were instructed to have a full bath with soap and return to the village in clean clothes.
- The affected villagers were also instructed not to stage a "house krait" (mourning house) for dead victims of the outbreak. Dead victims were to be buried on the same day. And the cultural practice of touching, kissing or throwing oneself on the dead person's body was strictly prohibited.
- Shaking of hands in the village was prohibited.
- All the villagers including children in Iniok, Paupe, Ok Esau and Wabia villages were given prophylactic treatment. Co-trimoxazole was given to children, lactating and pregnant women; Doxycilline was given to all other adults. The regimen was once only according to their weight. Infants under one year were not given these medications.
- Villagers who had diarrhoea with dehydration were treated with intravenous normal saline.

These very basic measures effectively stopped the outbreak. The Frieda River Project also assisted with other necessary logistic support throughout the Government response. Following the Project's outbreak guidelines, and with the recommendation of the project medical team, in-coming employees that were on leave and stayed in the villages during the outbreak were prevented from returning to work until the outbreak was contained and clearance given. This delay had a negative impact on

the project's drilling program schedule, but it was an important public health decision that prevented the possible introduction of the disease into the Project's camps. When the employees were allowed to commence work all of them were screened for symptoms of diarrheal illness and in addition given Doxycilline (100mg 12 hourly for 2 weeks) whether they had symptoms or not. None of the workers were quarantined or sent back home.

Ongoing preventative activities and diarrheal illness surveillance:

Cholera awareness and prevention of diarrheal illness in the Project camps is an integral part of induction procedures and weekly health talks. The Project also has a community health program and cholera prevention is an important component of health education in the villages. Community clinics are conducted once every month in the villages by the project medical team. There is also a daily VHF radio schedule that is managed by the community affairs team through which the medical team receives reports and updates of disease trends in the villages. Diarrheal illness in the Project camps is an illness that must be reported; all reports are made to the site medical doctor who notifies the operations manager daily.

DISCUSSION:

It is not known if the diarrheal illness outbreak was cholera. The symptoms were highly suggestive of cholera but no laboratory confirmation was done. The outbreak at Iniok was contained using basic hygiene messages. The quick response to the outbreak site was made possible with logistic support from the Project and is a good example of a private-public partnership to contain disease outbreaks in PNG. The main impact of the disease outbreak on the project schedule was a three weeks delay in crew change, which subsequently had a negative impact on the drilling program schedule. It was an important public health decision that the Frieda River Project site management made to prevent possible disease introduction and outbreak in the site camps. Operating exploration projects in remote locations in PNG presents unique challenges, one of which is the high risk of infectious diseases. Most companies also recruit unskilled labor from neighboring villages and a disease outbreak in the community has a high possibility of being introduced into project site camps. It is vital therefore to consider these factors and have a public health program to monitor disease trends in the community as well as preventing disease outbreaks in the camps. Monitoring disease trends in communities in the vicinity of a project site in PNG is a vital responsibility of the project medical team. Early signs of disease outbreaks can be detected by active disease monitoring and putting in place procedures for disease reporting. These reports can be used by the project management for timely decision

making, planning and allocating resources where needed. Further, having standard operating procedures for responding to disease outbreaks allows a coordinated approach in containing any outbreak. The Frieda River Project response to the Iniok outbreak was done using the site emergency response procedure which allowed proper logistical support for district health authorities as well as qualified health personnel to travel to the affected village and contain the outbreak.

Building good relationships with various stakeholders early in an exploration project is also an important aspect of any project in PNG. The community affairs department of the Frieda River Project had built a good working relationship with Ambunti District government which facilitated easier communication and response from the government.

CONCLUSIONS:

Lessons learnt from this case study can be summarized as follows:

- Infectious disease outbreaks are a threat to exploration project sites and remote locations in PNG and this risk can be managed with risk assessment planning.
- Having an emergency response or epidemic response plan at project will allow a well coordinated response to an outbreak.
- Building relationships with the community and the government is an important aspect to monitor disease trends and in responding to disease outbreaks.
- Ongoing public health education in project camps, but more importantly in project affected villages, prevents the introduction of diseases from the villages into the project site.
- Disease monitoring in the community near a project site will provide early warning signals of potential disease outbreak in the sites.

ACKNOWLEDGMENT:

Wish to acknowledge the management of Xstrata Frieda River Ltd for their consent for the publication of materials contained in this report, namely Paul Gow, General Manager, Justin Rogers, Community Affairs Manager and Melissa Bowerman. Thank you also to Ambunti District Health Authorities, Communities of Iniok, Paupe, Wabia and Ok Esai.

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The following should be acknowledged: Research or other financial grants; Material support, Contributions of Institutions, Colleagues, and other relevant participants.

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