

## Health Status and Physical Condition of Community Living in Takandeang Village, an Area With High Natural Radiation in Mamuju

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**Abstract.** Mamuju in West Sulawesi was well known has a highest level of natural radiation due to radon exposure compared to other areas in Indonesia. Therefore it is interested to study on the negative impact that may found in the local community members mainly to their health and physical conditions that may lead to cancer induction. Aim of the study is to assess the impact of natural radiation to the health condition (eye, skin, ENT (ear-nose-throat) and teeth) of community members in Takandeang Village, Mamuju. Sixty male and female respondents in Takandeang and 30 respondents in Keang Village as control were participated in this research with the range of age of 16 and 75 years old by filling out informed consent. The examination was also done through anamneses i.e. interviewing the health history covering daily life style and consumption as well as cigarette. Cataract examination was done by anamneses and shadow test. Results of study showed that there is no health impact was found in general, including cancer incidence caused by radiation among community members who were participated in the study and there is no correlation with their age. Incidence of cataract as a marker of high radiation exposure was found in very low cases. It noted that in general the blood pressure in control group was higher than that in study group that need further assessment. Based on palpation on the neck area, there is no enlargement of thyroid glands and neck lymph nodes among residents and control group. It can be concluded that there is no impact of natural radiation to the health and physical conditions of residents living in Takandeang Village.

**Keywords :** effects of high background radiation, health and physical status, cataract, Mamuju

### Introduction

Natural radiation is the major source of human exposure to ionising radiation and the health effects of these chronic low-level radiation exposures are still poorly understood. Therefore, understanding the health impacts of low-level chronic exposure is critical to providing a rational basis for regulating public radiation exposure in current society (Hendry, 2009; Eisenbud, 1997; Ghiassi-Nejad, 2002). The primary radioactive elements in the earth's crust that lead to chronic human exposure are potassium, uranium, thorium, and their radioactive decay products (e.g., radium, radon, etc) (Robert, 2003). Of these, radon and its decay daughter products are the most wide spread source of low doses of ionising radiation exposure in humans and contribute more than 50% of natural radiation sources (Sinitsky, 2014).

There are some areas in the world which has abnormal or high natural radiation exposure. A high natural background radiation (HNBR) area is defined as an area or a complex of dwellings where the sum of cosmic radiation and natural radioactivity in soil, indoor and outdoor air, water, food, etc leads to chronic exposure situations from external and internal exposures that result in an annual effective dose to the public above a defined level (Hendry, 2009). This area of the world is of great interest, because they provide unique opportunity to study the health effects of chronic low level radiation exposure directly on humans [6]. It is important to note that current models for estimating the risk of

radiation-related hazards are based upon analysis of data collected from irradiated miners (Sinitsky, 2014). Data from Japanese atomic bomb survivors, who have now been followed for more than 50 years, are also widely used to the similar study (Gilbert, 2009; Preston, 2004). Currently, it is not clear how transferrable these risk models are to studies involving inhabitants of areas with high-natural radiation conditions (Sinitsky, 2014).

Indonesia has a region with high dose natural ionizing radiation. Based on Gamma Dose Rate Map of Indonesia that was done by Iskandar *et al.* (2007), Mamuju, a village in the suburb of West Sulawesi Province has a background radiation around 13 times higher than normal. This place has a highest average dose rate compared to other regions in Sulawesi island and even Indonesia area, which can achieved up to 2.800 nSv/hour, as measured by carborne-radiometric using portable Exploranium GR-130 (Syaeful, 2014). For example, the dose rate of gamma rays in Bangka Island was noted between 39.00 to 291,52 nSv/h (Setiawan, 2013). This radiation in Mamuju is the result of natural uranium content (<sup>226</sup>Ra and radon gas, both of which are highly water soluble) in rock and soil. Major concern is due to its location which is near inhabitant settlement area.

Thus studies of the health of populations living in areas of high levels of natural radiation such as in Mamuju, West Sulawesi are a potential source of information on the effects of chronic low dose-rate exposures. Previous study conducted in Botteng village in Mamuju showed no any detrimental

effects found in community member of that adjacent area (Rahajeng, 2015). This finding is also supported by study on the cytogenetics and deoxyribonucleic acid damage in that area (Syaifudin, in press). This paper aims to assess the health and physical status of populations which may provide important information and to obtain baseline information about individuals that may be useful in the future.

## Materials and Methods

### Research Procedures

This research was done after anethical approval was obtained from Ethical Committee on Health Research, National Institute of Health Research and Development, Indonesian Ministry of Health with number of LB.02.01/5.2/KE.051/2015. All procedures were already validated and taken from various literatures published in reputed international journal and also following Standard Procedures.

### Location and Respondence Criteria

Location of sampling was Takandeang, Pala'da, Rantedunia, Salumati subvillages, Takandeang Village, Tappalang District, Mamuju Municipal, West Sulawesi and was done under coordination with Local Health Office. *Informed consent* was filled out by all respondences whose were locally born and living in the study area with the range of age of 16-75 years old. Inclusion criterias were healthy respondences and no medical treatment with radiation in last 5 year. Exclusion criterias were had no chronical sickness, and no blood disorder such as haemophily.

### Data Earnment

Survey and data sampling were done on March and May-June 2016. Data were obtained from interviewed to 90 respondences with providing aquestionaire (Attachmant 1). Cataract observation was done with anamnesa on sight seeing disorder and with *shadow test* by lightening the eye at angle of 45°, and then the appeared shadow of iris on the lens was seen and this observation was conducted in the dark or dim (minimal lighting) room. The examination of ear, nose and throat (ENT) and teeth was done according to the standard procedure. For anamnesa, any sickness or uncomfortable condition were asked to the respondences, any lesion on the skin that difficult to heal, any abnormal in sightseeing, sprue (*sariawan*) or repeated diarrhea, history of asthma (disorder in breath), history of serious sickness/malignancies, and the history of any

sickness in their family. The photographs of the examination activities are presnted in Figure 1.

For general physical examination, blood pressure, frequency of pulse and breath, any abnormalities in mucosa and hygiene in the mouth. Neck examination was done to determine any enlargement on thyroid gland and lymph node by palpation on these glands of the neck. Auscultation on the lung was also done to determine any disorder in the breathness. Beside that, a complete health assessment also includes gathering information about a person's medical history and lifestyle, and screening for disease (Bickley, 2002). Information on lifestyle, socio-demographic features, occupation, housing, residence history, and tobacco and alcohol use was obtained by enumeration of every resident individual.

## Results and Discussion

In this study, sixty male and female respondences in Takandeang and 30 respondences in Keang Village as control were participated with the range of age of 16 and 75 years old by filling out the informed consent provided to every respondence. The complete data of the examination is presented in Table 1. Some abnormalities such as hypertension, artralgia and refractive disorder of the eyes were found higher in control population. In general there were no difference found between data on health status in the current study area with previously village studied of Botteng village (Rahajeng, 2015).

Based on physical observation and interview by using a questionnaire it was known that there was no any abnormalities in the health found among community member in Takandeang village as study area and Keang as control area, including radiation related cancer among respondences and no relationship with their age that means that health condition can be found in all age group.

Results of study on cataract that was done by anamneses and shadow test showed that there is no health impact on eyes was found in general (extremely low cases), including cancer incidence caused by radiation among community members who were participated in the study. However it was noted that in general the blood pressure in control group was higher than that in study group that need further assessment. Based on palpation on the neck area, there is no enlargement of thyroid glands and neck lymph nodes among residents and control group.



Figure 1. Physical examination of community members living in study area of Takandeang and Keang (control) by a physician (medical doctor) including cataract (upper-left), throat (upper-right), blood pressure (lower-left) and mouth (lower-right).

Table 1. Number/percentage of cases found per number of residence.

No.	Types of abnormalities/ Results of observation	No. of cases (Takandeang) N=60 (percentage)	No. of cases (Keang) N=30 (percentage)
1.	Hypertension	5 (8%)	14 (46.7%)
2.	Headache	10 (16.7%)	4 (13.3%)
3.	Fatigue	2 (3.3%)	2 (6.7%)
4.	Heartburn	4 (6.7%)	5 (16.7%)
5.	Chest pain	0	2 (6.7%)
6.	Artralgia	3 (5%)	8 (26.7%)
7.	Tooth ache	3 (5%)	0 (0%)
8.	Condition of skin and hair :		
	- Infection (t.korporis, t.versicolor, onichomycosis)	6 (10%)	0 (0%)
	- Non-infection (neuro-dermatitis, psoriasis, pigmentation, lipoma)	5 (0.8%)	4 (13.3%)
	- Normal	49 (89.2%)	28 (93.3%)
9.	Eyes :		
	- Lens opacity	11 (18.3%)	8 (26.7%)
	- refractive disorders	2 (3.3%)	8 (26.7%)
	- Pterigium	3 (5%)	1 (3.3%)
	- Afakia	0 (0%)	1 (3.3%)
	- Normal	44 (73.3%)	12 (40%)
10.	Mucosa (oral) :		
	- Mucositis	1 (1.6%)	0 (0%)
	- poor oral hygiene	32 (53.3%)	6 (20%)
	- Normal	27 (45%)	24 (80%)
11.	Thyroid glands :		
	- Enlarge	1 (1.6%)	0 (0%)
	- Not palpable	59 (98.3%)	30 (100%)
12.	Lung auscultation :		
	- Ronkhi	0 (0%)	1 (3.3%)
	- Normal	60 (100%)	29 (96.7%)

According to interview with local health center there is no population cancer registry system that has been established to obtain cancer incidence rates. In this preliminary analysis, there is no evidence that cancer occurrence is consistently higher because of the higher levels of external gamma-radiation exposure in the area. Our results obtained from this study are also in agreement with the physical data and health status from other HNBR area in other research.

Even in area with much higher dose rate of natural radiation, it has been reported that no detrimental biological effects have ever been detected in the residences living in high natural background radiation areas in Ramsar, a city in northern Iran which has annual exposure levels in these areas are up to 260 mGy/y and the mean exposure rate is about 10 mGy/y for a population of about 2000 residents living in that area (Mortazavi & Mozdarani, 2013).

Radiation has always been all around us as a part of our natural environment, with the annual average dose per person from all sources is about 360 mrem (levels typically range from about 1.5 to 3.5 millisievert per year), but can be more than 50 mSv/y, of which higher than the current annual safe limit for nuclear workers (20 mSv/y). For example, Ramsar in Iran having the highest levels of natural background radiation on Earth: 250 mSv per year (Mortazavi & Mozdarani, 2013).

How radiation affects our health depends on the size of the radiation dose. Scientists have been studying the effects of ionizing radiation in humans and laboratory animals for many years. Studies so far have not shown that the low dose of ionizing radiation we are exposed to every day causes us any harm. We do know that exposure to massive amounts of ionizing radiation can cause great harm, so it is wise to not be exposed to any more ionizing radiation than necessary (ATSDR, 199).

Direct observations and studies of the radiobiological and epidemiological effects of ionizing radiation from naturally occurring radioactive materials (NORM) on man, in particular in areas with elevated NORM, are becoming of prime concern in radiation protection (Syaeiful, 2014). This simple semi-epidemiological studies with very limited number of responses have been conducted to evaluate the health effects of exposure to elevated natural background radiation in Mamuju. More over the sample size analysed from this research is also comparatively small.

Whereas a large-scale epidemiological studies have been conducted to analyse the frequency of health effects in HNBR areas, essentially in India and in China (Thampi, 2005; Hayata, 2004). Most of these studies were of ecological design. These studies mainly considered the risk of cancer, globally or for specific cancer sites, on the basis of mortality data or of incidence data. Some studies

also considered the risks of non-cancer diseases or of congenital malformation. Overall, these studies demonstrated no increased risks in the HNBR areas compared to control/reference populations. The recent study in Yangjiang, China, showed a significant excess of non-cancer mortality, including cerebro-vascular diseases, tuberculosis, viral infections and diseases of the digestive system, but these results should be considered with caution due to uncontrolled confounding factors. Another study in China observed a higher frequency of Down's syndrome in the HNBR area compared to the control area, but this result was based on a limited number of cases, and again some major confounding factors were not controlled for (Hayata, 2004; Zhou, 2005).

However, studies of human exposure to HBRA pose many problems, and several researchers have generally concluded that such studies are unlikely to provide definitive answers, even under the best of circumstances (Brenner, 2003). The limitations of studies of exposure to HNBR are several; for example, many countries that contain HNBR areas do not have well documented health statistics, in particular, organ-specific cancer rates.

Radioactivity is associated with an exposure dependent risk of some cancers such as leukaemia as most common case. Contrary to popular belief, however, most radiation to which the average person is exposed is natural in origin, and, of the man made sources, medical diagnosis and treatment is on average the largest source to the individual. A very important issue is the extent to which radon gas arising from certain rock types beneath dwellings can contribute to cancer risk (Hendry, 2009; Sinitsky, 2014; Gray, 2009). And a better understanding of the disease/health impacts of natural radiation exposure can help guide policymakers in designing preventive health measures that not only reduce disease, but also reduce costs to the health-care system.

## Conclusion

In conclusion, the elevated level of natural background radiation has no significant effect on health and physical condition among the population residing in HNBRA of Takandeang Village in Mamuju.

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### **Discussion**

Q : Gede Ngurah Sutapa, UNUD

What are the inclusion and exclusion criterias in this research?

A : Nastiti Rahajeng / M. Syaifudin

Inclusion criteria are willingness to participate in the research, healthy person, local born person or at least have been living in the study area for 20 years. Exclusion criterias are non healthy person mentally and person who just recently living (less than 5 years) in the area.