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Editor

Dr. R.K. Sharma
Institute of Medico-legal Publications
501, Manisha Building, 75-76, Nehru Place,
New Delhi-110019

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Factors Related to Personal Absorbed Dose in Health Workers at Hospital's Radiology Unit

Yunita Kemala Sari[1], Tri Martiana[2], Linda Dewanti[3]

[1]Bachelor of Public Health, Airlangga University, Indonesia, [2]Professor, Doctor, Magister of Science, Department of Occupational Health and Safety, Airlangga University, Indonesia, [3]Doctor, Magister of Health, Master of Health Science, Doctor of Philosophy, Department of Occupational Health and Safety, Airlangga University, Indonesia

ABSTRACT

Diagnostic radiology services are an integral part of medical services that need special attention because they are useful in diagnosing, but also very dangerous for patients, officers and the environment. The purpose of this study was to analyze factors related to the personal absorbed dose of health workers

This study was an observational study with cross sectional approach. This study conducted at private hospitals in Surabaya (Hospital A, B and C) and the population was 36 workers. Dependent variable in this study was personal absorbed dose while independent variable was gender, knowledge, attitude, age, education, study program, length of working, type of work, obedience in using personal protective equipment, presence of workers when rest time, average of treated patient by workers, dose limitation, x-ray, facility building, record and report, policy, and supervision.

Result of linear regression test showed that there is five variable that its standardization coefficients are related to personal absorbed dose, such as length of work, age, policy and obedience in using radiation Personal Protective Equipment (PPE) completely (β 0,206, β 0,579, β - 0,716, β -0, 161 respecively)

It is recommended for hospitals to make a supportive policy to reduce dose of exposure to health workers. It is necessary to supervise the completeness of using radiation Personal Protective Equipment (PPE).

Keywords: *Health Workers, Radiation, Personal Absorbed Dose, Policy*

INTRODUCTION

Hospital is a workplace that has many risk factors such as physical, biological, ergonomic, psychological and chemical. Potential hazards in hospitals due to physical, biological, chemical, ergonomic, and psychosocial factors can cause illness and accidents for workers, patients, visitors and communities arround. Hospital workers have a higher risk than other workers for work-related disease and work-related accident[1]

The radiology installation, which is part of the hospital, as a medical supporter, use ionizing radiation sources to diagnose the presence of a disease in the form of anatomical features displayed in radiographic films. The negative effects of exposure to X-ray radiation in the human body can be acute and chronic effects, acute effects can usually be seen immediately after exposure, whereas chronic exposure begins to develop if accumulated several years after exposure. The effects of radiation can affect almost all parts of the human body, ranging from the skin, eyes, thyroid, lung, reproductive organs, blood clotting system, digestive system and fetus

According to the Department of Manpower in Indonesia, in 2011 there were about 61 cases of accidents caused by radiation exposure. Research at company X Surabaya, as many as 7 people (46,7%) from 15 respondent radiographer, leukocyte count is not normal and this can be caused by X-ray exposure and radiographer condition itself [2].

A preliminary study at the radiology unit of RS A Surabaya and an interview with the head of the Radiological Unit showed that the implementation of radiation safety has not gone well. There is still

no medical physician officer, measuring instrument of radiation dosage of TLD badge is only given to radiographer who have permanent employees status, medical check up is done every 2 years, and facilities of radiology room is not enough. In addition, radiation accidents have occurred in workers. Measurement results in May 2016 show that 50% of health workers have a personal absorption dose exceeding the Dose Limit Score set by the Nuclear Power Control Agency 20 mSv / year.

Based on the background above, the purpose of this study was to analyze factors related to the personal absorbed dose of health workers at Hospital A, Hospital B and Hospital C in Surabaya. RS A, RS B and RS C in Surabaya.

MATERIAL AND METHOD

This study was an observational study with cross sectional approach. This study conducted at private hospitals in Surabaya (Hospital A, B and C) and the population was 36 workers. The data were collected by questionnaire, observation and interview. The data analysis is done by linear regression test to see how big the relation of independent variable to dependent variable.

FINDINGS

Characteristics of Health Workers

Based on table 1, it showed that mostly man are at Hospital C with percentage (50%) as many as 8 respondents while woman are more dominant in Hospital B with 60% percentage as many as 9 respondents. The average age of Hospital B employee is relatively young which is 28 years old while Hospital C 48 years old. The length of work in each hospital an average of 7 hours per day. The highest education level of respondent is D3 (93,3%) at Hospital B and dominant of Radiology Study Program (100%) while in Hospital C there are 31,3% health workers that have equal education of SMU and not radiology program. Radiology health workers in Hospital B mostly have radiation protection training (86,7%), while Hospital C only 56,3%.

Table 1. Characteristics of Responden at Hospital A, Hospital B and Hospital C

Variable	Hospital A		Hospital B		Hospital C	
	N	%	N	%	N	%
Gender						
Man	4	80	6	40	8	50
Woman	1	20	9	60	8	50
Age (X± SD	5	39±14	15	28±9	16	48±9
Length of Work (hour/da	5	6±2	15	7,5±0,2	16	7±1
Type of Work						
Doctor (S2)	1	20,0	1	6,7	4	25,0
Radiographer(D3)	4	80,0	14	93,3	7	43,8
Asistant (SMU)					5	31,3
Study Program						
Radiology	5	100	15	100	11	68,8
Non Radiology					5	31,3
Radiation Protection Training						
Ever	4	80,0	13	86,7	9	56,3
Never	1	20,0	2	13,3	7	43,8
Knowledge about Radiation Safety						
Good	4	80	8	53,5	12	75,0
Fair	1	20	7	46,7	4	25,0
Attitude to Occupational Health and Safety						
Good	3	60	14	93,3	12	75,0
Fair	2	40	1	6,7	4	25,0

Cont... **Table 1. Characteristics of Responden at Hospital A, Hospital B and Hospital C**

Obedience in using PPE completely						
Good	2	40	4	26,7	10	62,5
Fair	3	60	11	73,3	6	37,5
Presence of workers when rest time						
In the Room	4	80	11	73,3	13	81,3
Outside the Room	1	20	4	26,7	3	18,7
Average of treated patient by workers	5	10±2,6	15	10,8±2,6	16	9,8±1,7

Hospital C have 12 responden that have good knowledge about radiation safety (75%). Hospital B have 14 responden that have a good attitude of occupational health and safety (93,3%). Obedience in using PPE completely with good category (62,5%) is at Hospital C while in Hospital B is fair (73,3%). When the health workers are at rest, they dominantly rest in the room (81,3%) at Hospital C and 26,7% of health workers at Hospital B are outside the room. Approximately, health workers treat 11 patient a day.

Tabel 2. Result of Multiple Linear Regression of Independent variable to Dependent Variable at Hospital A, Hospital B, and Hospital C

Variable	**Standarized Coefficients Beta**	**Sig**
Length of work	0,206	0,343
Age	0,579	0.058
Presence of workers when rest time	0,103	0,69
Dose Limitation	0,066	0,812
Policy	-0,716	0,001
Training	-0,102	0,505
Obedience in using PPE completely	-0,161	0,555
Average of treated patient by workers	0,127	0,468
Attitude to Occupational Health and Safety	-0,021	0,902
Knowledge about Radiation Safety	0,158	0,436
Gender	-0,013	0,941
Constant : 0,950		
R Square : 0,574		
Anova : 0,013		

Notes: Education and Study Program have multicolinearity, X-ray, facility building and gender are excluded variable.

Based on table 2, independent variable such as length of work, age, training, presence of workers when rest time, obedience in using PPE completely, average of treated patient by workers, knowledge, attitude, type of work, gender, policy ang dose limitation have effect on personal absorbed dose simultaneously. It can be seen on *Pvalue Anova* 0,013>α=0,05.

a) Relation of gender with personal absorbed dose

Gender is the difference between men and women biologically from birth. The difference between men and

women is not only biologically but also physically and psychologically.

The value of man regression coefficient equal to -0.013. It can be interpreted that man regression variable has a negative effect on the absorption of radiation. This shows that the man regression will increase by 1 unit, the absorption of radiation will decrease by 0,013.

The effects of radiation on men and women are almost the same. Every body tissue also has its own sensitivity to radiation (organ weight factor), for example, the sex cells have higher organ-weight factors than bone marrow, kidney, lung, and others. But for women, the effect is increasingly complex. Not only damage the cells and tissues but also the fetus (if in a condition of pregnancy). In addition to pregnancy, according to BATAN female workers in the breastfeeding period are not allowed to work in radiation areas with high risk of contamination[3]

b) Relation of age with personal absorbed dose

The results showed that age had positive effect on the absorption dose of radiation that is 0,579. The higher the age, the absorbed dose of radiation will increase by 0.579.

Based on the results of the study, workers over the age of 40 years are radiology specialists and radiographers who have had a long working period, experienced in the field both in the field of diagnostic and interventional radiology and more interventional action. Radiation received by interventional radiologists has a potentially high risk of radiation and may exceed the[4]

c) Relation of length of work with personal absorbed dose

The result of analysis showed that the duration of work had positive effect on the absorption dose of radiation equal to 0,206. When the duration of work increases by 1 unit, the absorption dose of radiation will increase also by 0.206.

The longer the working hours, meaning the more the number of patients performed radiological examiner and many complex procedures / actions performed per day for example the action of fluoroscopy where the radiation beam emitted directly and continuously with the duration of the old work the exposure to radiation received greater

d) Relation of Presence of workers when rest time with personal absorbed dose

The result of the analysis showed that rest in the room had positive effect on the absorption dose of radiation that is 0,103. In indoor workers, radiation absorption doses will increase by 0.103.

Most health workers resting indoors feel secure because there is a Pb shield on the wall of the X-ray room with a room directly adjacent to the workspace. The radiology unit served 24 hours, when an officer rested, the other officers were still working

When resting, it should be outside the radiation area, to avoid possible exposure to radiation scattering radiation rays.

e) Relation of dose limitation with personal absorbed dose

The results showed that the dose limitation had positive effect on the absorption dose of radiation that is 0,066. When the dose limitation is increased by 1 unit, the absorption dose of radiation will also increase by 0.066 or vice versa.

If the dose limitation aspect in the form of providing radiation protection equipment should be able to reduce the absorbent dose of health workers, but the fact that there are non-adherent health workers use PPE radiation completely so that the acceptable personal absorption dosage increases. One of the main factors to minimize exposure is adequate protection equipment and proper use in the procedure / action space

f) Relation of policy with personal absorbed dose

The results of the analysis showed that the policy had a negative effect on the absorbed dose of radiation -0.716. When the policy increases by 1 unit, the absorbed dose of radiation will decrease by 0.716, or vice versa.

If the policy related to service standards in the radiology unit is well implemented and there is supervision from risk management of radiation exposure may decrease. Management must strive to reduce and control hazards and risks, prevent accidents and injuries, and maintain safe conditions [5]

g) Relation of radiation protection training with personal absorbed dose

The results showed that the training had a negative effect on the absorption dose of radiation that is 0.102. As the training increases by 1 unit, the absorption of radiation will decrease by 0.102.

Training is an activity designed to help increase the access of workers to gain or increase the knowledge, skills, attitudes and behaviors required to perform the job well [6] Most health workers have attended radiation protection training, with training, they gain knowledge on how to prevent and minimize exposure to radiation in the body

h) Relation of Obedience in using PPE completely with personal absorbed dose

In conducting the activities of radiation workers are sometimes required to use personal protective equipment, because exposure to radiation generated X-ray plane is high enough. For this purpose, the radiology unit is obliged to provide complete personal protective equipment for its workers, as a means of minimizing the impact and effects of radiation received by workers.

The result of the analysis showed that PPE compliance had negative effect on the absorption dose of radiation that is 0,161. When PPE compliance increases by 1 unit, the absorption of radiation decreases by 0.161.

Compliance with nest in the use of radiation APD completely can reduce radiation exposure so as to avoid the health hazards of both stochastic, non stochastic and nasokimia infections in carrying out their duties. There are abnormalities experienced by 4 respondents who, due to not wear Personal Protective Equipment (PPE). The abnormality is characterized by reduced levels of leukocytes (white blood cells), which serves to defend the body from disease. This is in accordance with the results of research indicating that adherence to the use of PPE affect the absorption of radiation

i) Relation of Average of treated patient by workers with personal absorbed dose

The results showed that the number of patients per day had a positive effect on the absorption of radiation dose of 0.127. The more the number of patients per day treated, the absorbent dose of radiation will increase by 0.127.

The more patients treated, the more likely it is to get radiation exposure and increase the personal dose. This is because Radiation received by radiation workers is mostly radiation scattering from patients.

The level of radiation exposure around the patient can be higher in normal working conditions. If protective devices and radiation measurements are not used and if many complex procedures / actions are performed per day, there is a possibility of interference. In many cases, the relationship between the dose of the worker and the patient is largely dependent on the equipment, the doctors/interventional procedures.

j) Relation of attitude with personal absorbed dose

The result of the analysis shows that the negative effect on absorption of radiation is -0,021. When the attitude increases by 1 unit, the absorption of radiation will decrease by 0.021.

Attitude is a state of being affected by a person, an idea, or an object. Attitude can indicate a person's readiness to behave. The highest level of attitude is when a person is responsible for the risks to be faced due to his choice of a problem[7]

Health workers who have a positive attitude to work safely can reduce the risk of radiation because nakes work with caution and use the radiation APD to minimize the absorbed dose of radiation received.

k) Relation of knowledge with Personal Absorbed Dose

Workers with good practice categories are widely owned by workers with a good level of knowledge[8]. Knowledge related to occupational safety and health in this case radiation safety need to be explored, maintained and developed and well utilized to improve the competence and safety of the officer. This is because knowledge is one of the internal factors that can affect one's behavior [9]

The result of the analysis showed that the knowledge had positive effect on the absorption dose of radiation that is 0,158. When knowledge increases by 1 unit, the absorption dose of radiation will also increase by 0.158, or vice versa.

This happens because the well-informed workers are able to perform various work-related actions in

the radiation field, such as: guiding the percutaneous procedure in the operating room, performing fluoroscopy, despite full radiation APD to minimize exposure dose, the job has a high radiation risk because the radiation beam is continuous and in the long duration until the surgical / surgical action is completed.

CONCLUSION

It can be concluded that there are five variables of standardization coefficient related to the personal absorption dosage that is the variable of work, age, policy and compliance of Personal Protective Equipment (PPE).

Conflict of Interest: None

Source of Funding : None

Ethical Clearance: The study was approved by the ethical committee of Universitas Airlangga. All subjects were fully informed about the procedures and objectives of this study and each subject prior to the study signed an informed consent form.

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