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Research paper

Radiation Awareness among Secondary School Students in Perak, Malaysia

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Abstract

Currently, the number of student enrolment for Radiography programme in Universiti Kuala Lumpur – Royal College of Medicine Perak is the lowest compared to other programmes. Hence, this study is done to determine students' tendency to further their study in radiography or related programme and determine the radiation awareness among the secondary school students. A survey was conducted on n=429 form four secondary school students under national standard curriculum. 75.5% of the data were collected from seven government secondary schools in Perak, while the remaining were collected from visitors of our institution. The result shows the average score of basic knowledge regarding radiation with mean score of 59.53% and standard deviation of 18.89%. Meanwhile, printed reading materials is the highest type of information source and video game is the lowest with 25.9% and 0.2% respectively. 46.2% claimed that they are fear to radiation and all of them agreed that the radiation disaster incidences was their main reason. 92.3% claimed that they will seek for their parents' opinion and 17.5% claimed to follow their parents' choice with regard to the choice of future career while 50.8% claimed that they may continue their higher education in radiography or related programme. Result also showed that fear to radiation effects the students' tendency to choose radiography or related programme as their choice [$p<0.05$]. It can be concluded that the radiation awareness among secondary school students in this study is assumed as average and the tendency to further study in radiography or related programme is quite low mainly due to their fear to radiation disaster incidence.

Keywords: *Radiation Awareness; Student's awareness; Radiation Fear; Radiation Perception*

1. Introduction

University Kuala Lumpur Royal College of Medicine Perak is a higher institution situated in Ipoh, Perak. It offers allied health sciences programme for diploma and degree level such as Diploma in Radiography, Diploma in Nursing, Diploma in Pharmacy and other several programmes. However, the number of students' enrolment for Diploma in Radiography programme in UniKL RCMP is the lowest compared to other programmes with similar level of study. From 2014 to 2016, only 24% to 30% were enrolled to the programme each year. The small number of students' admission and the reason of not choosing this programme are our concern.

The prospective future students are among the form four and form five school students who undertake any science subject. However, our focus respondents group was those who undertake Science subject, which is offered for Art stream students; or Physics subjects, which is offered for Science stream students. This condition is important as it is a standard requirement for entry qualification based on Malaysian Qualification Agency [MQA] programme standards for medical and health sciences [1].

Since this institution is located in Perak, we scoped the focus areas of the study in Ipoh and other two nearby districts which are Batu Gajah and Kuala Kangsar.

The aims of this study are to determine the radiation awareness among the secondary school students and to determine their tendency to continue their higher education level in this programme.

2. Literature Review

2.1. The Overview of Radiation

Radiation is energy transmitted through a medium as either electromagnetic [EM] waves or subatomic particles [2, 3]. It can be categorized generally into three different ways which are ionizing and non-ionising, particle and wave and hazardous and non-hazardous [4, 5]. The sources of radiation are categorized into two namely natural radiation and artificial radiation.

The natural radiation which is also known as background radiation are radiation that is exist around us. Despite of the fear and concern about the effects of radiation to mankind, the exposure to background radiation is unavoidable [6, 7]. It is reported that 84% of average radiation exposure in European country is contributed by the background radiation [8], while in United States, the background radiation contribution is 50% [9]. A study done in Selangor state, Kuala Lumpur and Putrajaya of Malaysia revealed that the mean terrestrial gamma radiation dose rate was two times higher than the world average value [10]. The natural radiation is also has become our daily consumption. This is proven by a study on the uptake of naturally occurring radionuclides by rice, tapioca, sweet potato and water [11-13].

2.2. The Usage of Radiation

The radiation actually is widely used in numerous areas such as industries, military and medical. However, it is normal situation where people always relate the radiation with nuclear power plant and military used. This is based on effects of atomic bombing in Japan during the World War II and the incident in Chernobyl [6, 7]. The phobia grew more by the accident at Fukushima Daiichi Reactors in Japan in 2011 and the report by media that used the term of 'deadly radiation' [7]. These scenarios indirectly created the negative perception of radiation.

In India [14], it was found that the cements used in constructing building contained with gamma activity. Therefore, staying in a concrete building will also expose us to the radiation. X-ray also has been used to control insect pests in cut flower export industry by inhibit the sterility of the pests [15]. According to IAEA [16], more than 60 countries are using radiation to sterilize food products. A study [17] found out that, there was an increase of food irradiation in Malaysia in the year of 2010 by 1.6 times compared to 2005, which includes the spices and herbs. The radiation is used in the food industry as a method to control the food from spoilage due to bacterial contamination without affecting the taste and quality of the food.

Radiation also is used as an alternative of power source. IAEA in its Power Reactor Information System [PRIS] [18] reported that, in the world, there are thirty countries that have nuclear power reactor with 449 in operation, sixty are under construction and two in long term shut down. Among the countries, United States of America has the highest number of nuclear power reactor followed by France and Japan with a ninety nine, fifty eight and forty two respectively. Countries with only one power reactors are Armenia, Iran, Netherlands and Slovenia. The nuclear power is proven to produce less greenhouse effects by emitting less carbon dioxide [CO_2] to the environment [19, 20]. It is also a solution to countries with less raw supply of power producing sources [20]. However, despite of its benefits to a country and to the future generation, the perception and acceptance of the people must also be a consideration [21, 22].

In medical, x-ray has been used for many years after it was discovered by Wilhelm Conrad Roentgen in 1895. Since then, the development of medical equipment that produced x-rays for diagnostic and therapeutic purposes has grew up. The diagnostic information given by the x-rays helped the physician to give better diagnosis from the bones to the soft tissues. The invention of fluoroscopy and ultrasound unit provides the real time imaging that enables the physician to examine the functionality of the human body systems and also act as image guidance [23, 24]. Three dimensional, slice by slice images and non-invasive assessment can also be produced by computed tomography unit and magnetic resonance imaging unit [25, 26]. Certain radionuclides also play their roles in tracing tumor and cancer site in patients' body and also in recent technology of hybrid imaging technique which are single-photon emission computed tomography/computed tomography [SPECT/CT] and positron emission tomography/computed tomography [PET/CT] [27, 28]. Other than diagnostic purposes, radiation is also being used for teletherapy, which is treating the tumor and cancer cells. This includes the usage of cobalt-60 machine, linear accelerator machine and brachytherapy [29, 30].

In concern of the radiation protection, there are numbers of international bodies and agencies that play roles for the said issue. International Commission on Radiological Protection [ICRP] for examples provides the common basis for radiological protection standards, legislation, guidelines, programmes, and practice [31]. Another international body that concern in non-ionizing application in example the sun, microwave, Wi-fi and mobile phone is International Commission on Non-Ionizing Radiation Protection [ICNIRP] [32]. Reports regarding the effects and risks of ionizing radiation exposure based on scientific measures and evidence are the responsibility of United Nations Scientific Committee on the Effects of Atomic Radiation [33]. In Malaysia, the regulation regarding the radiation activities is stated in Atomic Energy Licensing Act [Act 304]. The implementation of the act is enforced by Atomic Energy Licensing Board in terms of the production, application, radiation dose and any matter pertaining to radiation [34].

2.2. The Media and Reports Regarding Radiation

Mass media has become a powerful communication medium to convey information and knowledge. The history of printed media in the form of book started in mid of fiftieth century in Western Europe [35]. The media was first introduced in printed materials and later followed by broadcasting method. There are many types of media for examples printed media [newspaper, magazine and books], television, video and computer games, internet, social media and many more. Today, the new media has become prominence and information can be found at any time almost immediately [36]. Television is one of the easiest and the closest type of media to be assessed. The information provided also is easily understood and digested by the users as it does not require any reading afford. The colorful and appealing interface, less wording and persuasive sounds may shape the viewers perception regarding any issue in mass [37]. Therefore, articles reported by media may easily influence the readers and hence the public.

Media has reported numerous articles regarding radiation especially regarding the radiation disaster involving mass population in Hiroshima, Nagasaki, Three Mile Island, Chernobyl and Fukushima [38-44]. The effect of the tragedy is still existing especially to the survivors physically, emotionally and economically [44-47]. Previous studies and reports [45, 47-49] revealed that survivors suffers from leukemia, solid cancer [for examples cancer at reproductive organs, lung, thyroid, bladder, digestive tract, brain and nervous system], cataracts, thyroid and parathyroid disease, heart disease and stroke, mental retardation, and immunological changes. Survivors of the atomic bombing especially those who were in the city during the incidence were found to have more anxiety and somatization symptoms compared to those who were not there [50].

Despite of the negative impact that the nuclear radiation can harm the world, we still cannot deny the benefits of radiation especially in medical use. Better diagnosis of diseases and possibility of cancer patients to survive were documented in many studies [51-53]. These indicate that the overall human quality of life also has increase with the advancement of medical imaging and radiation therapy technology.

The post irradiation effects and history found in previous usage of radiation in medical, industries and military had led to the study of radiation protection and safety [54]. International bodies and local bodies that focused on enforcement of regulations were then established to promote the safety usage of x-rays and particulate radiation. Radiation protective equipment and technique and radiation personnel monitoring are also available. This includes the 'as low as reasonably achievable [ALARA]' concepts, basic principles of radiation protection [Justification, Optimization and Limitation], lead gown and apron, lead goggle, leaded face shield, thyroid shield, breast shield, gonad shield, lead glove and lead syringe vial [55, 56]. These made the radiation especially x-ray is safe to be used nowadays with regards to medical purposes.

In overall, media is agreed to become a medium conveying information and messages to the global community [57] even though there were also some people who have less trust upon the news reported by the media [58]. Therefore, any misleading in the terms used to highlight the danger of radiation may create fear or phobia among the community with less understanding about radiation [7]. This is due to the fact that perception by a person is built through his sensory stimuli interpretation [59]. This negative perception is believe has become a factor for the higher learning education candidates in their choice of courses.

2.3. The Perception of Radiation

According to the Oxford dictionary [60], perception is defined as the ability to notice or understand something and also a particular

way of looking at or understanding something. Plethora of studies regarding perception of radiation has been carried out previously. Finding by Ricketts et al., 2013[61] showed that among 121 patients underwent medical imaging examination, 72% of them were unaware of the radiation risk and 6.6% of patients associated with ionizing radiation related examination claimed that it can cause cancer to them. The study also found that 91% of patients were not being explained by the medical personnel regarding the radiation risks.

Study by Hollada et al., 2015 [62] on 1725 mammography patients found out that 60% of them claimed that mammography yield high dose. The misunderstanding may lead the patients to avoid mammogram. Many of them also claimed that x-ray and computed tomography [CT] do not use ionizing radiation, while magnetic resonance imaging [MRI] does use ionizing radiation, which are of course a misunderstanding too.

A study done in Japan in 2004 [63] which was conducted to determine students' perception of radiation has found that the knowledge regarding radiation had been introduced to the students at the elementary school. However, the content was prone towards the dangerous and the negative impact of radiation per se. The study also found out that the contents regarding the benefits of radiation was described in high school physics. Unfortunately, it was reported that only 30% of the high school students take the physics subjects.

The negative perception regarding radiation can be agreed due to lack of knowledge which then create the fear to radiation [64, 65]. Therefore, more programmes to educate the public especially the school age students should be held in order to make sure that the community have a great understanding regarding radiation.

3. Methodology/Materials

3.1. Data Sampling

This study was a descriptive cross sectional study and was conducted to only Form Four secondary school students who undertake the national education curriculum structure under the Ministry of Education of Malaysia. In Malaysia, the diploma entry requirement for local students must base on the Sijil Pelajaran Malaysia [SPM], which the students will sit in the end of their form five year. However, Ministry policy in Malaysia only allow the research to be conducted among non-examination candidates in the year of the survey period. Hence, we decided to conduct the survey only among form four students.

Malaysia education system offers several education stream option with a number of core subjects that must be taken by students across the all education streams. This includes the Science subject. However, it is excluded in Science stream curriculum structure as the students will take Physics; Chemistry; Biology or Engineering Drawing. Based on the programme standards for medical and health sciences by Malaysian Qualification Agency [MQA] [1], one of the entry requirements for Diploma in Radiography or related programmes in any recognized local higher education institutes is to have credit in one of the science subjects, which is Biology, Physics, Chemistry, General Science or Applied Science. Therefore, the survey was only conducted among Science subject students or the Science stream subjects [Biology, Physics and Chemistry] students.

Convenience sampling was used as method of data collection. 80.7% sample were collected in seven government secondary schools while 19.3% sample were collected among the form four secondary school students who had visited our institution. An approval letter to conduct the study in government school premises has been received from Ministry of Education of Malaysia and Perak State of Education Department prior the data collection process.

3.2. The Questionnaire

The questionnaire has been validated prior the real data collection was conducted. It comprised of three main sections. The first section was design in order to collect the demographic data of the students, such as their gender and their level of study. Meanwhile, second section was mainly constructed to focus on the respondents' basic knowledge regarding radiation. This section also collected information regarding their sources of information regarding radiation and more than one answer were allowed for this particular section. Other than that, respondents were asked about their fear to radiation and their reasons of being fear. Finally, the third section concerned about their tendency to choose Radiography or related programme as their field of choice to further their higher education. Respondents who answered not to choose this programme were directed to the options of their reasons. Other than that, the parents' opinion factor was also being asked. Their answer were rated and their score were recorded.

3.3. Statistical Analyses

All collected data were tabulated and analysed by using IBM SPSS Statistics version 23. Meanwhile, descriptive and inferential statistical tests were used for data analyses.

4. Results and Findings

The total number of respondents is 429. Table shows the overall distribution of gender among the respondents and distribution of gender per school or group is shown in Table. The overall female to male ratio is almost balance and their age were sixteen years old. Table shows that there were seven government secondary schools involved in the survey which are labeled with B – H which gave the total of 324 respondents [75.5%] out of 429 respondents. The remaining 105 respondents [24.5%] came from the Form Four students who visited Universiti Kuala Lumpur – Royal College of Medicine Perak during the period of data collection [indicates as A in Table]. All respondents from group A were also those who studying in Science stream or at least taking the Science subject.

This study found that all [100%] of the respondents have knowledge regarding radiation. Table shows the sources of information regarding radiation claimed by the respondents. In this question, respondents were allowed to choose more than one response. A total of 896 responses were collected with printed reading materials shows the highest type of sources with 25.9% [n=232] followed by internet with 20.3% [182]. However, it is a concerned that n=119 respondents, which is almost one third of the respondents, claimed that fiction film and television drama were also one of their source of information. It is also a concerned that there were n=2 respondents claimed video game as a source of information.

Information provided by printed material and electronic media such as news, documentary and internet is proved to give influence to the students' perception regarding radiation [7, 66, 67]. Therefore, reports or news that they found especially via social media may create their perception and may give them a big idea regarding radiation regardless of right, wrong or biased information. This is also shown by the reasons of fear claimed by respondents in this study which will be discussed later.

Table and Fig show the distribution and tabulation of score marks among the respondents. This study found that all [100%] of the respondents have knowledge regarding radiation with mean score and standard deviation of 59.53% and 18.89% respectively. The minimum and maximum score were 12.50% and 100% respectively.

The results of this study shows that the knowledge regarding radiation among the respondents is considered as average. This could be due to some of the respondents who were not yet learned about the radiation related topic in Form Four if they were students undertaking science stream subject. Physics subject for this group of students will cover the said topics in Form Five [68, 69]. However,

Science subject for the art stream students has already covered the said topic in form four [70-72]. Therefore, it is expected that all the science stream form five students would have better knowledge regarding radiation.

Concerning the topics related to radiation that were covered in the Science and Physics textbook [68, 70], overall contents were quite good. However, we believe that there are rooms for improvement in order to enhance the students' understanding regarding the basic of radiation science as well as the benefits of radiation to the mankind. The knowledge regarding the radiation energy can be added in the early part of the topic. This includes the types of radiation and source of radiation. We would also like to suggest that the usage of radiation energy to be included in medical field for example the ionizing and non-ionising radiation usage for diagnostic and treatment purposes [53, 73-77].

Table summarised the distribution of fear to radiation among the respondents. 46.2% [n=198] claimed to have fear and only 21.2% [n=91] claimed to have no fear. Table shows the reasons of fear choose by the respondent who claimed to have fear to radiation. For this question, respondents were allowed to choose more than one response and n=261 responses were collected. Among the listed factors, all of the respective respondents claimed that radiation disaster was their fear factor and almost one third of the respective respondents fear was claimed due to the fiction film. Other fear factors claimed by the respondents are that radiation can cause infertility, birth defects, cancer and cell death.

As a country that never had any experience involving radiation disaster, 198 respondents claimed that their fear was assumed due to the news or article that they have read or heard. Even though only 57 respondents claimed fiction film were their fear factor, it has also become one of our interests and attention. Misleading of radiation terms and effects in the story may give impact to their perception [7]. However, to look at the positive side, printed materials and fiction film or television drama can be used to promote the benefit of radiation. Highlighting the job of a Radiographer in medical related field in the screenplay is also a suggestion rather than too focusing on the doctors, laboratory specialists and nurses [78-80].

Concerning the respondents' planning of their future higher education, respondents were asked about general opinion about their dream course. Table shows that 94.2% claimed that they have their dream course to be chosen. 92.3% will seek for their parents' opinion but only 17.5% claimed to follow their parents' choice. This indicates that the respondents have control in their decision of choice without ignoring their parents. As the number of respondents' to seek parents' opinion is very high, promoting and educating the Radiography or related programme towards the parents is also important. This situation has also been discussed in previous study [81]. This result also agree that the respondents were still practicing the traditional belief of respecting their parents [82]. However, this finding is contrary with a previous finding [83] regarding decision making of choosing future course or career. Our study found out that most of the respondents have their own decision making authority in choosing their future programme as only a small number of respondents claimed to follow their parents' choice. Nevertheless, study regarding the parents' perception of radiation and the programme; and also parents' expectation on their children's' future career should be carried out in the future. It is vital to look at wider spectrum regarding this issue.

Respondents' tendency to further their study in Radiography or related field were also assessed in this study and is also shown in Table. In this assessment part, respondents were allowed to choose more than one response for reason of not choosing the field of study. It is found that only 50.8% showed positive tendency. Tabl showed the reasons of not choosing Radiography or related field with 'not interested' became the top in the list [29.6%] and closely followed by 'think radiation is dangerous' [28.2%]. It has become a concern that a total of 40.8% of the respondents claimed the reasons were related to the programme and the job prospect. Other reasons claimed by the respondents are phobia to hospital environment, still looking for suitable study field and think the salary payment is low.

A statistical analysis regarding the radiation fear and the tendency of the respondents to choose the programme had been done. It is found out that, statistically, the fear affects the respondent's tendency to choose the programme in the future [$p < 0.05$].

The belief of radiation is dangerous shows that the current syllabus in their formal school are not able to change their individual perception. We believe that more promotion and education at school level regarding the true fact of radiation, the Radiography or related programme offered in higher learning institutions and also the job prospect can be the eye opener amongst the students and able to change their current perception.

Table 1: The gender distribution

Gender	n [%]
Female	217 [50.6]
Male	212 [49.4]
Total	429

Table 2: The gender distribution and the total number of respondents across all schools or groups

Schools / Groups	Male	Female	Total [n]
	n [%]	n [%]	
A	50 [47.6]	55 [52.4]	105
B	27 [73.0]	10 [27.0]	37
C	21 [42.0]	29 [58.0]	50
D	29 [58.0]	21 [42.0]	50
E	23 [46.0]	27 [54.0]	50
F	23 [53.5]	20 [46.5]	43
G	21 [46.7]	24 [53.3]	45
H	18 [36.7]	31 [63.3]	49
Total	212 [49.4]	217 [50.6]	429

Note:
A: Students who visited our institution. B – G: Government secondary schools.

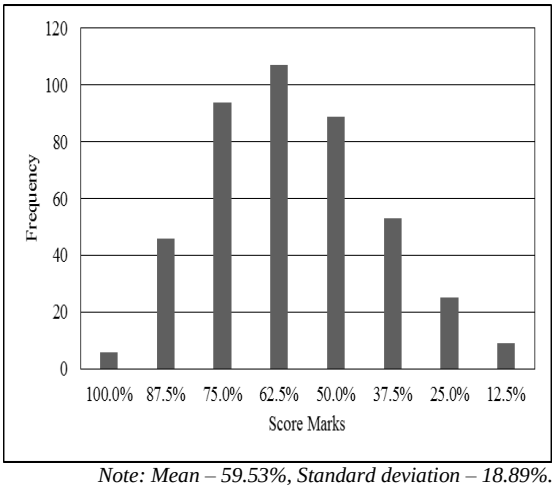
Table 3: The sources of information regarding radiation

Sources	n [%]
Printed reading material	232 [25.9]
Internet	182 [20.3]
Documentary	149 [16.6]
Conversation / formal class	128 [14.3]
Fiction film / television drama	119 [13.3]
Radiographic examination	84 [9.4]
Video game	2 [0.2]
Total	896 [100]

Note: The respondents were allowed to choose more than one response.

Table 4: The distribution of score marks among the respondents

Score Marks	n [%]
100.0%	6 [1.4]
87.5%	46 [10.7]
75.0%	94 [21.9]
62.5%	107 [24.9]
50.0%	89 [20.7]
37.5%	53 [20.7]
25.0%	25 [5.8]
12.5%	9 [2.1]
Total	429 [100]



Note: Mean – 59.53%, Standard deviation – 18.89%.
Fig. 1: The tabulation number of respondents to the score marks

Table 5: The summary regarding fear to radiation

Fear to Radiation	n [%]
Yes	198 [46.2]
No	91 [21.2]
Not sure	140 [32.6]
Total	429 [100]

Table 6: The distribution of radiation fear reasons claimed by respondents who select 'Yes' as tabulated in Table

Reasons	n [%]
Radiation disaster	198 [75.9]
Fiction film / television drama	57 [21.8]
Others	6 [2.3]
Total	261 [100]

Note: The respondents were allowed to choose more than one response.

Table 7: Parents' opinion factor in choosing higher education programmes in the future and tendency to further study in Radiography or related programmes

Item	Yes	No	Total [n]
	n [%]	n [%]	
Asking for parents' opinion	396 [92.3]	33 [7.7]	429
Follow parents' choice	75 [17.5]	354 [82.5]	429
Tendency	218 [50.8]	211 [49.2]	429

Table 8: Reasons by respondents who claimed of not choosing Radiography or related field programme in their future higher education

Reasons	n [%]
Not interested	83 [29.6]
Think radiation is dangerous	79 [28.2]
Less popular programme	56 [20]
Think the job scope is limited	49 [17.5]
Less info regarding the course	8 [2.9]
Others	4 [1.4]
Less info regarding the job scope	1 [0.4]
Total	280 [100]

Note: The respondents were allowed to choose more than one response.

5. Conclusion

The study found that radiation awareness among the respondents is in average level as part of respondents have yet learnt about radiation related topic in Physics subject during the study was conducted. Therefore by their Form Five year, the respondent's knowledge regarding radiation is expected to increase. We would also like to suggest to enhance the content of current Science subject for Form Four and Physics subject for Form Five regarding the basic of radiation. However, other than formal class syllabus, we believe that there are rooms to improve the students understanding regarding radiation. Institution or professional bodies like Malaysian Nuclear Agency, Malaysian Society of Radiographers and perhaps higher learning institutions which can help promoting the radiation awareness among the school students and at the same time highlighting the job prospect related to the programme. Understanding of the nature and benefit of radiation to the mankind and also the radiation protection may decrease their fear towards radiation and at the same time increase their tendency to further study in Radiography or related programmes.

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