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AWARENESS ABOUT IONIZING RADIATION AND HISTONE MODIFICATION AMONG ALLIED HEALTH SCIENCE STUDENTS

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Abstract

Introduction: The observation of radiation-induced epigenetic effects (changes in gene expression without altering the DNA sequence) and of non-linear responses, such as non-targeted and adaptive responses, that in turn can be controlled by gene expression networks. The aspects of the biological response to ionizing radiation in which epigenetic mechanisms are, or could be, involved, focusing on the possible implications to the low dose issue in radiation protection. The present system of radiation protection assumes that exposure at low doses and/or low dose-rates leads to health risks linearly related to the dose. They are evaluated by a combination of epidemiological data and radiobiological models. The latter imply that radiation induces deleterious effects via genetic mutation caused by DNA damage with a linear dose-dependence. Aim: To assess the knowledge level and create awareness about ionizing radiation and histone modification among allied health sciences students. Material and Methods: A cross-section research was conducted with a self-administered questionnaire containing ten questions distributed amongst 100 Allied Health Science students. The questionnaire assessed Ionizing radiation and Histone Modification among Allied Health Science Students. The responses were recorded and analysed. Result: 88.9% of respondents are aware of ionizing radiation. 86% of students aware about histone modification. 86% of students aware about the types of ionizing radiation. 72% of students are aware that histone is a part of DNA. 83% of students are aware that ionizing radiation causes mutation. Conclusion: There is a good awareness amongst Allied Health Science students about Ionizing Radiation and Histone modification. Enhanced awareness initiatives and educational programmes together with increased importance for curriculum improvements that further promote knowledge and awareness of Ionizing Radiation and Histone modification among Allied Health Science Students.

Keywords: Ionizing Radiation, Radiation Biology, Radiation Protection, Health Effects, Epigenetics, Low Dose Radiation, DNA Methylation, Non-Targeted Effects.

INTRODUCTION

The observation of radiation-induced epigenetic effects (changes in gene expression without altering the DNA sequence) and of non-linear responses, such as non-targeted and adaptive responses, that in turn can be controlled by gene expression networks. The aspects of the biological response to ionizing radiation in which epigenetic mechanisms are, or could be, involved, focusing on the possible implications to the low dose issue in radiation protection[1].

The present system of radiation protection assumes that exposure at low doses and/or low dose-rates leads to health risks linearly related to the dose. They are evaluated by a combination of epidemiological data and radiobiological models. The latter imply that radiation induces deleterious effects via genetic mutation caused by DNA damage with a linear dose-dependence[2].

Quantitative evaluation of health risks at these levels of exposure is currently obtained by a combination of epidemiological and radiobiological data and models. Even though no comprehensive and “universal” model of radiation action on living systems, i.e., a model capable of describing all aspects at the different scale involved (molecular, cellular, tissue, organ, organisms), has been developed yet, nevertheless, radiobiology research, after just over a century of existence, has provided a wealth of information on biological response to ionizing radiation. Some important general notions are currently used by international bodies, such as the United Nations Scientific Committee on the Effects of Atomic Radiation and the International Commission on Radiological Protection, to extrapolate to low doses and low dose rates the health risk derived from epidemiological data at higher acute doses[3].

These notions are essentially the harmful mutagenic potential of ionizing radiation and its linear dose-dependence at low levels of exposure. In particular, the fundamental role of radiation-induced DNA damage in the induction of mutations and chromosome aberrations is currently assumed to provide a framework for the analysis of risks at low radiation doses and low dose-rate exposures. Additionally, for the induction of cancer and heritable disease at low doses/low dose-rates, the use of a linear relationship between increments of dose and increased risk is considered a scientifically plausible assumption, even if uncertainties regarding this judgement are recognized[4].

Non-linear radiobiological responses that can be relevant at low level exposures have been observed for many years, such as the so-called “non-targeted effects” (NTEs), and the (radio) adaptive response (AR). Moreover, it is now well established that ionizing radiation, besides genetic mutations, may also cause epigenetic alterations. In effect, epigenetic events are known to regulate gene activity and expression not only during development and differentiation, but also in response to environmental stimuli, such as ionizing radiation. Interestingly, there is evidence that NTEs and AR are interrelated and even more interesting is the possibility that epigenetic mechanisms may have a role in them[5].

MATERIAL AND METHODS

This cross-sectional research was conducted with a self-administered questionnaire containing ten questions distributed amongst 102 Allied Health science students. The students were randomly selected across various disciplines of Allied Health Sciences. The study setting was designated in the university campus. The survey instrument was a questionnaire pre tested and evaluated for validity and reliability concerns.

The questionnaire included ten questions eliciting the demographic data through open ended responses and multiple choice questions for the other responses. The study was approved by the Institutional Ethical Committee and informed consent was obtained from the participants. The questionnaire was posted on an online platform and the identity of the respondents were kept confidential.

The questionnaire assessed the Awareness about ionizing radiation among Allied Health Science Students. The responses were recorded and analyzed. There were no incomplete responses and no dropouts from the study. The final data obtained was organized, tabulated and subjected to statistical analysis.

The Salıent Questıons:

1. Are you aware about ionizing radiation?
2. Are you aware about histone modification?
3. Are you know about the type of ionizing radiation?
4. Histone is a part of _____.
5. Does ionizing radiation cause mutation?

RESULTS

88.9% of respondents are aware of ionizing radiation (Figure 1). 86% of students aware about histone modification(Figure 2). 86% of students aware about the types of ionizing radiation(Figure 3). 72% of students are aware that histone is a part of DNA(Figure 4). 83% of students are aware that ionizing radiation causes mutation(Figure 5).

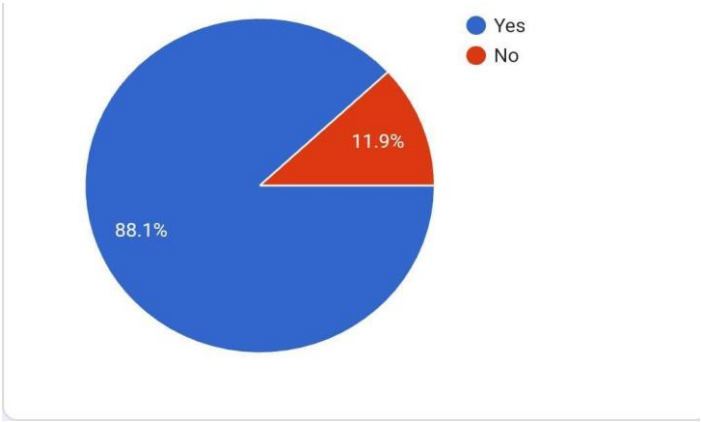

Figure 1: Awareness about Ionizing radiation

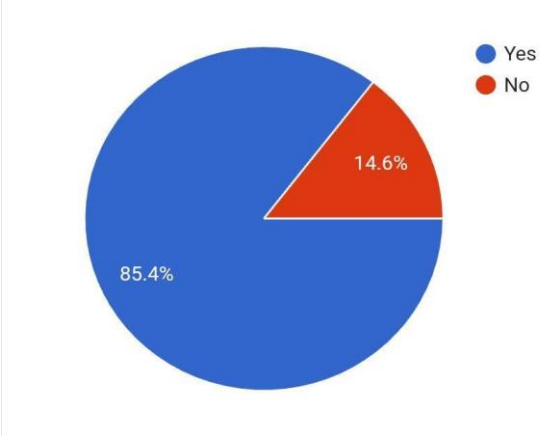

Figure 2: Awareness about Histone modification

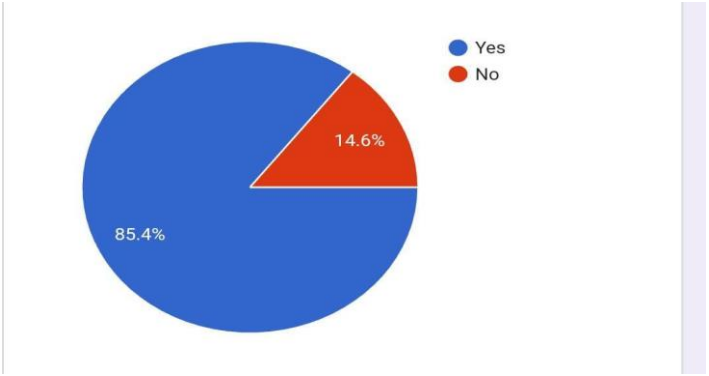

Figure 3: Awareness about types of Ionizing radiation

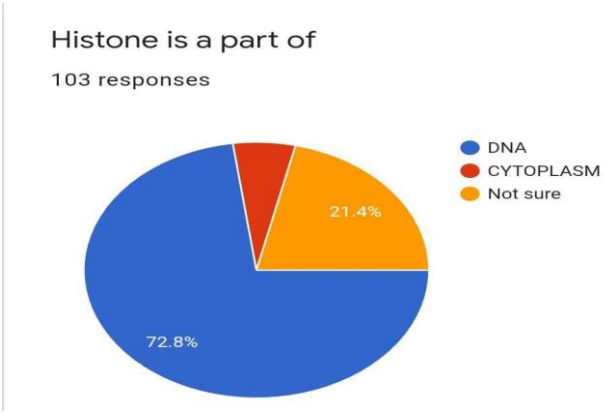

Figure 4: Awareness about location of Histone

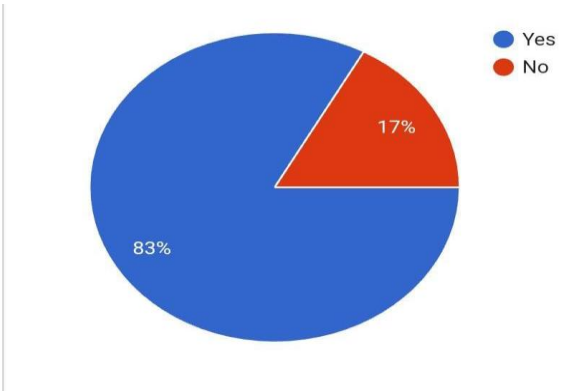

Figure 5: Awareness about Mutation due to ionizing Radiation

DISCUSSION

Ionizing radiation is capable of inducing a wide spectrum of DNA alterations, such as: base damage, sugar damage, single strand breaks (SSBs), double strand breaks (DSBs), DNA–DNA and DNA–protein cross-links. Clustered DNA lesions (defined as two or more lesions within one or two helical turns of DNA), such as complex DSBs and non-DSB clustered lesions are considered to be the most biologically relevant form of radiation-induced DNA damage [6].88.9% of respondents are aware of ionizing radiation

They are expected to be less readily repaired as compared to other radiation-induced damage and to endogenous or metabolism-related cellular damage. Indeed, ionizing

radiation is uniquely very efficient at inducing clustered DNA lesions . At low doses, even the passage of a single particle can produce clustered DNA lesions [7].86% of students aware about histone modification

The frequency and degree of clustering of DNA damage depend on radiation quality . There is evidence that clustered DNA damage, such as multiple DSB as well as non-DSB lesions close together is the most challenging to repair and that the proportion of clustered damage increases with Linear Energy Transfer (LET), reaching ~70% or more for high-LET radiation[8]. 86% of students aware about the types of ionizing radiation

High-LET charged particles typically induce complex chromosome aberrations defined as those aberrations involving three or more breaks in two or more chromosomes, although they can also be observed less frequently after exposure to γ-rays. In particular, high-LET heavy ions induce a high fraction of complex-type exchanges, and possibly unique chromosome rearrangements[9]. 72% of students are aware that histone is a part of DNA

Epigenetic events are known to regulate gene activity and expression during development and differentiation. In particular, epigenetic mechanisms regulate the gene expression in our body's cells to create all the different cell types, although they have the same genome. However, they also affect gene expression in response to environmental stimuli, including ionizing radiation[10]. 83% of students are aware that ionizing radiation causes mutation

CONCLUSION

There is a good awareness amongst Allied Health Science students about Ionizing Radiation and Histone modification. Enhanced awareness initiatives and educational programmes together with increased importance for curriculum improvements that further promote knowledge and awareness of Ionizing Radiation and Histone modification among Allied Health Science Students.

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