

# AWARENESS ABOUT ROS MEDIATED DNA METHYLATION CHANGES AMONG ALLIED HEALTH SCIENCE STUDENTS

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## Abstract

**Introduction:** Reactive oxygen species (ROS), including free radicals, play important roles in cellular signaling, being an important element of organismal homeostasis. ROS are implicated in the pathogenesis of many human diseases, and, in fact, it is not easy to find a disorder without ROS in its pathogenesis. **Aim:** This survey was conducted to assess the knowledge level and create awareness about Ros mediated DNA methylation changes among Allied Health Science students. **Materials and Method:** A cross-section research was conducted with a self-administered questionnaire containing ten questions distributed amongst 100 Allied Health Science Students. The questionnaire assessed the awareness about Ros mediated DNA methylation changes. The responses were recorded and analysed. **Result:** 48.5% respondents were aware of ROS mediated DNA methylation changes .50% were aware of mechanisms involves direct chemical modification of DNA. 50% were aware that it is a new invention. 37% of respondents have knowledge about the method. 31% were aware of the uses of mechanism. **Conclusion:** There is a limited awareness among allied health sciences about Ros mediated DNA methylation and changes. Enhanced awareness initiatives and educational programmes together with increased importance for curriculum improvements that further promote knowledge and awareness of Ros mediated DNA methylation and changes among Allied Health Science Students.

**Keywords:** Awareness, Health, ROS, DNA Methylation.

## INTRODUCTION

Reactive oxygen species (ROS), including free radicals, play important roles in cellular signaling, being an important element of organismal homeostasis]. On the other hand, ROS are implicated in the pathogenesis of many human diseases, and, in fact, it is not easy to find a disorder without ROS in its pathogenesis. Moreover, ROS are directly or indirectly implicated in both normal (physiological) and accelerated aging. Therefore, it is not surprising that ROS are reported to play an important role in the etiology of several age-related diseases[1].

Reactive oxygen species (ROS) comprise of a family of short-lived molecules like O<sub>2</sub>, H<sub>2</sub>O<sub>2</sub> and •OH, first described in skeletal muscle as free radicals. ROS are produced endogenously by (i) mitochondria where O<sub>2</sub> acts as a terminal electron acceptor for electron transport chain (ii) NADPH oxidase, a cell membrane bound enzyme, (iii)

Peroxisomes which contain enzymes that produce H<sub>2</sub>O<sub>2</sub> e.g. polyamine oxidase, (iv) Endoplasmic reticulum produce H<sub>2</sub>O<sub>2</sub> as a by product during protein folding[2].

DNA methylation analysis is the study of chromosomal patterns of DNA or histone modification by methyl groups. Methylation constitutes an epigenetic mark because its location can affect the regulation of gene expression in a heritable fashion[3].

DNA methylation regulates gene expression by recruiting proteins involved in gene repression or by inhibiting the binding of transcription factors to DNA. During development, the pattern of DNA methylation in the genome changes as a result of a dynamic process involving both de novo DNA methylation and demethylation[4].

DNA methylation is essential for silencing retroviral elements, regulating tissue-specific gene expression, genomic imprinting, and X chromosome inactivation. Importantly, DNA methylation in different genomic regions may exert different influences on gene activities based on the underlying genetic sequence[5]. This survey was conducted to assess the knowledge level and create awareness about ROS mediated DNA methylation changes among Allied Health Science students.

## MATERIAL AND METHODS

This cross-sectional research was conducted with a self-administered questionnaire containing ten questions distributed amongst 100 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 ROS mediated DNA methylation changes 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 salient questions in the study are :

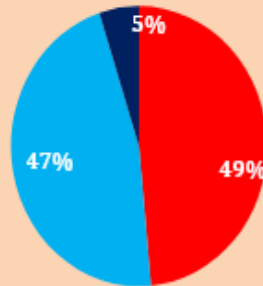
- 1) Do you know about ROS mediated DNA methylation changes?
- 2) Do you know mechanism involves direct chemical modification to the DNA?
- 3) Do you know about DNA damage?
- 4) Do you have any knowledge about the methods?
- 5) Do you know the use of mechanism?

## RESULT

48.5% respondents were aware of ROS mediated DNA methylation changes (Figure 1). 50% were aware of mechanisms involves direct chemical modification of DNA (Figure 2). 50% were aware about DNA damage (Figure 3). 37% of respondents have knowledge about the method (Figure 4). 31% were aware of the uses of mechanism (Figure 5).

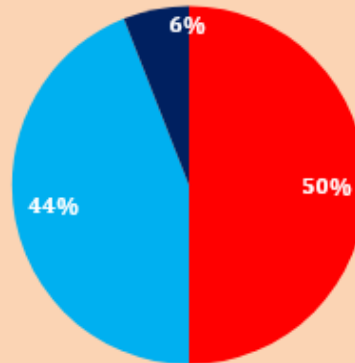
### Do you know about ROS mediated DNA methylation changes

■ Yes ■ No ■ May be

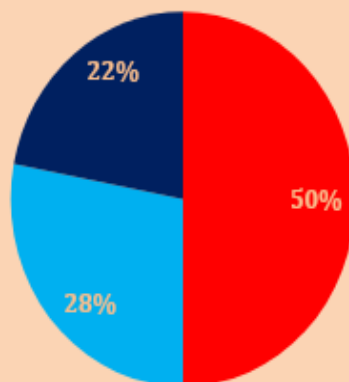


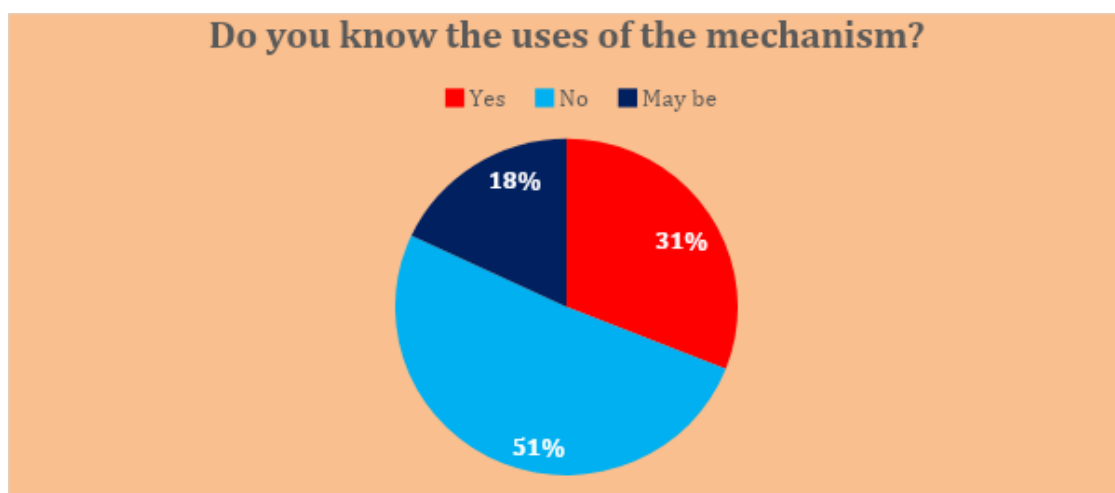
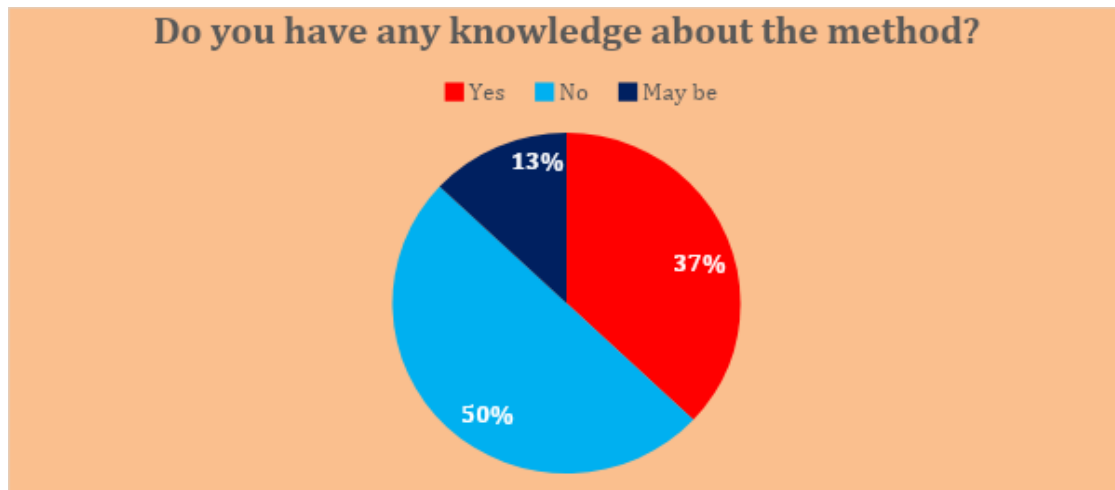
### Do you know mechanism involves direct chemical modification to the DNA?

■ Yes ■ No ■ May be



■ Yes ■ No ■ May be





## DISCUSSION

ROS are well recognized as mediators of DNA damage. For example, Ionizing Radiation induces DSBs through direct high-energy damage to the sugar backbone of DNA, but also through free radicals generated in cells- mostly  $\cdot\text{OH}$  from water. Chemotherapeutics like doxorubicin and cisplatin increase ROS levels, which contributes to their genotoxicity. ROS have also been reported to directly induce other forms of DNA damage through oxidizing nucleoside bases (e.g. formation of 8-oxo guanine), which can lead to G-T or G-A transversions if unrepaired[6]. 48.5% respondents were aware of ROS mediated DNA methylation changes

An important source of endogenous DNA damage and DSB generation in cancer is oncogene induced replication stress. Proto-oncogenes aid in cell growth and proliferation, but mutations or overexpression can transform them into oncogenes that drive continuous cell growth and carcinogenesis. Oncogenic cell cycles are typically associated with replication stress, which is defined as aberrant replication fork progression and DNA synthesis[7]. 50% were aware about DNA damage.

Replication stress ultimately results in genomic instability and paves the way for tumor development through the accumulation of additional pro-carcinogenic changes. The DDR acts as a barrier which limits the expansion of abnormally replicating cells, and this leads to a selective pressure for DDR defects in carcinogenesis[8]. 50% were aware of mechanisms involves direct chemical modification of DNA.

Replication stress arises from a variety of sources including aberrant origin firing, decoupling of DNA polymerase-helicase activity, and physical obstacles to the replication fork. Oncogene activation leads to an increase in ROS, which in turn influences the occurrence of replication stress. ROS oxidize dNTPs to affect polymerase activity and thereby reduce replication fork velocity in vitro[9]. 37% of respondents have knowledge about the method

Intrinsic oxidative stress through increased production of reactive oxygen species (ROS) is associated with carcinogenic transformation, cell toxicity, and DNA damage. Mitochondrial DNA (mtDNA) is a natural surrogate to oxidative DNA damage. MtDNA damage results in the loss of its supercoiled structure and is readily detectable using a novel, supercoiling-sensitive real-time PCR method[10]. 31% were aware of the uses of mechanism.

## CONCLUSION

There is a limited awareness among allied health sciences about Ros mediated DNA methylation and changes. Enhanced awareness initiatives and educational programmes together with increased importance for curriculum improvements that further promote knowledge and awareness of Ros mediated DNA methylation and changes among Allied Health Science Students.

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